Measuring Instruments Directive 2004/22/EC
Common Application
for
utility meters

May 2010
WELMEC
European cooperation in legal metrology

WELMEC is a co-operation between the legal metrology authorities of the Member States of the European Union and EFTA. This document is one of a number of Guides published by WELMEC to provide guidance to manufacturers of measuring instruments and to Notified Bodies responsible for conformity assessment of their products. The Guides are purely advisory and do not themselves impose any restrictions or additional technical requirements beyond those contained in relevant EC Directives. Alternative approaches may be acceptable, but the guidance provided in this document represents the considered view of WELMEC as to the best practice to be followed.

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Measuring Instruments Directive 2004/22/EC
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Table of Contents

1 FOREWORD...........................................................................................................4
1.1 Classification of the decisions ....................................................................... .........4
1.2 Overview............................................................................................................4

2 Decisions...............................................................................................................6
2.1 Scope and exclusions of the Directive.................................................................6
2.1.1 Maximum size of a meter possible to be assed under MID.................................6
2.1.2 Scope of MID concerning “additional/ associated functions” of measuring instruments..6
2.2 Interpretation of the essential requirements in respect to utility meters (MI 001 to MI 004)............................................................................................................7
2.2.1 Acceptance criteria for accuracy measurements during market surveillance and conformity assessment..........................................................7
2.2.2 Explanation regarding MID, Annex I, Introduction, concerning the term “suppliers”......8
2.2.3 Indication of results.........................................................................................8
2.3 Interpretation of the special requirements on MI 001..............................................9
2.3.1 Clean water........................................................................................................9
2.3.2 Connection interface of axial or coaxial cartridge meters and its CE marking ............9
2.4 Interpretation of the special requirements on MI 002............................................10
2.4.1 Calculation of compressibility factor in a volume conversion device.............................. 10
2.4.2 Clarification regarding the provision of an emergency power supply device .................10
2.5 Interpretation of the special requirements on MI 003............................................11
2.5.1 Clarification regarding Annex I, Item 1.1, with respect to the matter that nothing else is stated concerning expression of MPE........................................................................11
2.5.2 Explanation regarding Annex I, item 10.5, concerning the meaning of the term “tools”. 11
2.5.3 Treatment of meters with a voltage range ..........................................................11
2.5.4 Treatment of meters with more than one rated frequency ........................................11
2.5.5 Treatment of meters for usage under increased risk of over-voltage exposure.............12
2.5.6 Mandatory content of the Type Examination Certificate............................................. 12
2.5.7 Tests to be performed as piece tests........................................................................13
2.5.8 Performance Monitoring Devices (PMD) ..............................................................13
2.6 Interpretation of the special requirements to MI 004.............................................14
2.7 Subassemblies....................................................................................................14
2.7.1 Combining a volume conversion device and a gas meter during putting into use ......14
2.8 Evaluation of assessment procedures..................................................................14
2.9 Miscellaneous....................................................................................................14
2.9.1 MPES applicable to a repaired meter that was originally conformity assessed against the MID 14
2.9.2 Determination of “period of time estimated by the manufacturer” in respect to the meter durability (Annex 1 clause 5) and consequences for manufacturer following from this statement15
2.9.3 Documentation of seals used for security measures..............................................16

3 Meter families in respect to conformity assessment..............................................16
3.1 Definition of a family of meters ....................................................................... ........16
3.1.1 Electricity meters............................................................................................16
3.1.2 Gas meters.....................................................................................................17
3.1.3 Water meters..................................................................................................17
3.1.4 Heat meters....................................................................................................17
1 FOREWORD
This document is intended to provide guidance to all those concerned with the application of Measuring Instruments Directive 2004/22/EC, on utility meters. This document provides a record of the continuing work of WELMEC Working Group 11 in the area of the common application of the Directive itself. This document is one of a number of Guides published by WELMEC to provide guidance to manufacturers of measuring instruments and to Notified Bodies responsible for conformity assessment of their products. The Guides are purely advisory and do not themselves impose any restrictions or additional technical requirements beyond those contained in relevant EC Directives. Alternative approaches may be acceptable, but the guidance provided in this document represents the considered view of WELMEC as to the best practice to be followed.

1.1 Classification of the decisions
The decisions listed in chapter 2 are ordered to subjects. The second number (x) relates to the subject, the third number is a sequential numbering. The numbers x relate to the following subjects:

2. Interpretation of the essential requirements in respect to utility meters (MI 001 to MI 004).
3. Interpretation of the special requirements on MI 001
4. Interpretation of the special requirements on MI 002
5. Interpretation of the special requirements on MI 003
6. Interpretation of the special requirements to MI 004.
7. Subassemblies.
10. General/Horizontal issues

1.2 Overview
The following is a list of decisions reached of common application of the Directive.

<table>
<thead>
<tr>
<th>No.</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1.1</td>
<td>Maximum size of a meter assessable under MID</td>
</tr>
<tr>
<td>2.1.2</td>
<td>Scope of MID concerning “additional/ associated functions”of measuring instruments</td>
</tr>
</tbody>
</table>
2 Interpretation of the essential requirements in respect to utility meters (MI 001 to MI 004).

<table>
<thead>
<tr>
<th>No.</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2.1</td>
<td>Acceptance criteria for accuracy measurements during market surveillance, type approval and initial verification</td>
</tr>
<tr>
<td>2.2.2</td>
<td>Explanation regarding MID, Annex I, Introduction, concerning the term “suppliers”</td>
</tr>
<tr>
<td>2.2.3</td>
<td>Indication of results</td>
</tr>
</tbody>
</table>

3 Interpretation of the special requirements on MI 001

<table>
<thead>
<tr>
<th>No.</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3.1</td>
<td>Clean water as a subtype of potable water</td>
</tr>
<tr>
<td>2.3.2</td>
<td>Connection interface of axial or coaxial cartridge meters and its CE marking</td>
</tr>
</tbody>
</table>

4 Interpretation of the special requirements on MI 002

<table>
<thead>
<tr>
<th>No.</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4.1</td>
<td>Calculation of compressibility factor in a volume conversion device</td>
</tr>
<tr>
<td>2.4.2</td>
<td>Clarification regarding the provision of an emergency power supply device</td>
</tr>
</tbody>
</table>

5 Interpretation of the special requirements on MI 003

<table>
<thead>
<tr>
<th>No.</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5.1</td>
<td>Clarification regarding Annex I, Item 1.1, with respect to the matter that nothing else is stated concerning expression of MPE</td>
</tr>
<tr>
<td>2.5.2</td>
<td>Explanation regarding Annex I, item 10.5, concerning the meaning of the term „tools“</td>
</tr>
<tr>
<td>2.5.3</td>
<td>Treatment of meters with a voltage range</td>
</tr>
<tr>
<td>2.5.4</td>
<td>Treatment of meters with more than one rated frequency</td>
</tr>
<tr>
<td>2.5.5</td>
<td>Treatment of meters for usage under increased risk of over-voltage exposure</td>
</tr>
<tr>
<td>2.5.6</td>
<td>Mandatory content of the Type Examination Certificate</td>
</tr>
<tr>
<td>2.5.7</td>
<td>Tests to be performed as piece tests</td>
</tr>
<tr>
<td>2.5.8</td>
<td>Performance Monitoring Devices</td>
</tr>
</tbody>
</table>
6 Interpretation of the special requirements to MI 004.
Currently no guidelines

7 Subassemblies.

<table>
<thead>
<tr>
<th>No.</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.7.1</td>
<td>Combining a volume conversion device and a gas meter during putting into use</td>
</tr>
</tbody>
</table>

8 Evaluation of assessment procedures.
Currently no guidelines

9 Miscellaneous.

<table>
<thead>
<tr>
<th>No.</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.9.1</td>
<td>MPEs applicable to a repaired meter that was originally conformity assessed against the MID</td>
</tr>
<tr>
<td>2.9.2</td>
<td>Determination of “period of time estimated by the manufacturer” in respect to the meter durability (Annex 1 clause 5) and consequences for manufacturer following from this statement</td>
</tr>
<tr>
<td>2.9.3</td>
<td>Documentation of Seals used for security measures</td>
</tr>
</tbody>
</table>

10 General/Horizontal issues.
Currently no guidelines

2 Decisions

2.1 Scope and exclusions of the Directive

2.1.1 Maximum size of a meter possible to be assessed under MID

There is no limit on what size of meter that can be assessed under MID.

Reason:
1. There are no limits in the MID, it is the choice of the manufacturer which meter sizes are in the scope of an assessment.

2.1.2 Scope of MID concerning “additional/associated functions” of measuring instruments

Functions of a measuring instrument which are not specified in an instrument specific annex MI-0XY shall be considered as “additional/associated functions”. They must be examined in order to ensure that they do not affect the conformity of the instrument to the essential requirements of MID.
The “additional/associated functions” including the concerned hardware and software respectively shall be examined in respect to the appropriate clauses of Annex I of MID, in particular the clauses 7.1, 7.6, 8.1, 10.2 and 10.5.

The EC type examination certificate or EC design examination certificate shall include a list of the “additional/associated functions” with a clear description of the functions and the additional information that these functions do not influence the metrological characteristics of the measuring instrument.

Note:
The guideline shall be applied to “additional /associated functions besides the measuring function” called as “additional /associated functions” in this guideline.

2.2 Interpretation of the essential requirements in respect to utility meters (MI 001 to MI 004).

2.2.1 Acceptance criteria for accuracy measurements during market surveillance and conformity assessment

In order to obtain reliable results, the traceability and the Best Measurement Capability (BMC) of the test equipment used during market surveillance and conformity assessments shall be known. The Best Measurement Capability is the uncertainty ($k=2$) of the measurand without the uncertainty contribution of the instrument under test.

Market surveillance
It is recommended that the

\[ \text{BMC} < \frac{1}{3} \text{MPE}. \]

Meters (or sub-assemblies) can be declared to be non-conforming if at any point of the operating range of the instrument, the average $\bar{e}$ (average of repetitions for one measuring value) of the observed errors exceeds the sum of MPE and $U$

\[ \bar{e} > \text{MPE} + U \]

in which $U$ is the uncertainty ($k=2$) of the measurement result.

If nothing else is stated in harmonised standards or normative documents, the following applies:

Conformity assessment according module B or module H1
For test equipment, it is recommended that the

\[ \text{BMC} < \frac{1}{5} \text{MPE}. \]

The observed errors $e$ during a meter test meet the requirements if, for all repetitions the equation:

\[ e < \text{MPE} \]

is fulfilled.

Conformity assessment according module D and module F
For test equipment, it is recommended that the

\[ \text{BMC} < \frac{1}{3} \text{MPE}. \]
The observed errors $e$ during a meter test meet the requirements if the equation:

$$ e < \text{MPE} $$

is fulfilled.

Note on the evaluation of test results:
The minimum measuring time or the minimum number of pulses taken into account during an accuracy test of a meter shall be specified by the manufacturer.
The results of repeatability tests in respect to Annex 1 clause 3 of MID shall be inside the MPE.

### 2.2.2 Explanation regarding MID, Annex I, Introduction, concerning the term “suppliers”

In Annex 1 the term supplier is used in the definition of ‘utility’. In this context the term Supplier means an entity which supplies electricity, gas, heat or water to the end users. Where electricity, gas, heat or water is resold, the reseller takes on the responsibility of the supplier.

### 2.2.3 Indication of results

**related to:** annex 1, clause 10.5, indication of result

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.

Measurement results that serves as the basis for the price to pay may be:

A) the values of different registers, which are activated by remote control, a watch or other means (*for instance a threshold of the current, a temperature threshold or a flow rate*).
Each register represents the total quantity, connected to one rate in the billing process.

B) memorised values, which represent the increase of the measured quantity during subsequent, fixed time intervals (*like 1/4 hour, 1 hour*). The values may be processed during the billing process in order to connect rates to one or a number of those values (*maximum demand in billing period, weekend rates etc*).

If a meter is designed to count the quantities defined in MI 001 to 004 in different registers (a) the meter shall be able display the total quantities of each register on the display by means of the user interface (see WELMEC guide 7.2, for instance buttons on the instrument) as well as the currently active rate register. It is possible to show the results on different displays, periodically or on request via user interface.

If a metes is designed to count the quantities consumed in time intervals (b) the display shall show the results on request via user interface (see WELMEC guide 7.2, for instance buttons on the instrument). In addition to the value itself, the corresponding date and time shall be identifiable. The memorised values shall be available over a reasonable period time in order to check of the bill.
Reasons:
1. the price to pay for a measured quantity may depend mainly from the rates (price/quantity).
2. in order to control the consumption behaviour individually the end user need the information, which rates is active currently
3. if only the total quantity supplied is displayed on a legally controlled display, then distribution of the quantities in different rates registers is not appropriate checkable (traceable)

2.3 Interpretation of the special requirements on MI 001

2.3.1 Clean water

related to: annex MI 001, Scope

"Clean water is potable water which may contain solid additives (particles) or additives in solution only, which will not affect the right functioning of the mechanical volume or flow rate sensor of a water meter. These influences do neither affect the flow rate range and the error of indication of the meter, nor stop or destroy the meter."

Reason:
1. In the field of liquid measurement, the differentiation of the various liquids is made between “cold potable water” (OIML R 49), hot water (OIML R72) and “liquids other than water” (OIML R 117). In spite of the fact that the corresponding EEC documents (75/33/EEC for water, 77/313/EEC and 71/319/EEC for liquids other than water) do not contain such clear definitions, the same differentiation was and is used.

2. On the other hand, there exists some mechanical water meters which can be affected by additives like solid particles (for instance sand) as described before. In order to avoid requirements concerning the kind of allowed additives, which a meter is able to work with, the application range was reduced to clean water.

2.3.2 Connection interface of axial or coaxial cartridge meters and its CE marking

A connection interface is not a sub-assembly of a meter in the sense of MID. It shall be considered as part of the installation piping, provided that it is described in the CEN standard EN 14154 and that the meter is assessed to fulfil the requirements of the Directive with one or more of the types of the defined connection interfaces. Axial and coaxial cartridge meters and the standardised connection interfaces are to be clearly marked for their intended combined fit for use under MID requirements.

The manufacturer has to specify which connection interface is to be used on application for the conformity assessment. Connection interface and cartridge meter have to carry the identical externally visible identification mark. Furthermore it is not allowed to use any adaptor devices, to make it possible to mount a meter into a connection interface -of a type where it is not intentionally designed for and approved for. This information must be part of the installation instructions.
The CE marking has to be applied to the measuring instrument only.

The above does not apply to concentric meters as defined in EN14154 part 1.

Reason:
According to article 4 sub-assemblies have to be mentioned in the instrument specific annexes. This is the reason for not considering the connection interface as a sub-assembly in view of the Directive.

It is the current experience of experts, that the metrological performance of a meter may be influenced if the meter is not used with the prescribed connection interface. In accordance with article 8 of the Directive the measuring instrument is to be put into use together with a connection interface of a type accepted under the conformity assessment of the cartridge meter. Attention should be given to the prohibition of use of adaptors in practice.

2.4 Interpretation of the special requirements on MI 002

2.4.1 Calculation of compressibility factor in a volume conversion device

detailed to: annex MI 002, Part II, conversion Devices

A conversion device may use a calculation method for the determination of the compressibility which is not described in the harmonised standards or normative documents. In this case the manufacturer has to demonstrate the conformity with the requirements of MID to the notified body. The manufacturer specifies the rated operation conditions and how the instrument fulfils the requirements for MPE considering the pressure and temperature sensors used. The rated operation conditions have to be specified for pressure, temperature and gas properties or gas composition respectively.

If the range of application is within EN ISO 12213, the reference value for the conformity assessment shall be determined in accordance to this standard.

Reason:
The MID allows to use technical solutions which are not described in any harmonised standard or normative document. The manufacturer is responsible for a correct technical solution and for the demonstration of conformity with the requirements of the MID.

2.4.2 Clarification regarding the provision of an emergency power supply device

detailed to: annex MI 002, Part I, gas meters, Part II, conversion devices

Annex MI-002, Part I, Item 5.1
A gas meter powered from the mains (AC or DC) shall be provided with an emergency power supply device or other means to ensure, during a failure of the principal power source, that all measuring functions are safeguarded.

A gas meter powered from the mains (AC or DC) shall be provided with an emergency power supply device. If an emergency power supply is not an integral part of the device to safeguard the measuring functions as required by MID, the manufacturer shall define:
- the class of power supply which is necessary for the gas meter according to the EN 60654-2:1997,
- the manufacturer shall also define the conditions of switching from main to emergency power supply according to the EN 60654-2:1997.

The conformity assessment shall cover the appropriate test which show that the functionality of the device is safeguarded within the conditions of power supply defined by the manufacturer.

The body which is responsible for putting the meter into use is responsible for the suitability of the power supply according to the definitions of the manufacturer, for the suitability in respect of the place of installation and in respect to an sufficient time of usability.

The conditions which shall be fulfilled by the emergency power supply shall be defined in type or design examination certificate respectively.

The guideline is also applicable to conversion devices powered from the mains (AC or DC).

2.5 Interpretation of the special requirements on MI 003

2.5.1 Clarification regarding Annex I, Item 1.1, with respect to the matter that nothing else is stated concerning expression of MPE

For electricity meters there is nothing stated otherwise in the sense of point 1.1 Annex I. That means for electricity meters MPE is expressed as a bilateral value of the deviation from the true measurement value.

2.5.2 Explanation regarding Annex I, item 10.5, concerning the meaning of the term “tools”

If a manufacturer applies for a construction which needs a tool to serve the display, this can be accepted if the tool is declared as a part of the instrument in the certificate and if it is ensured that the consumer has access to the tool (especially acceptable in case of meters which are used in light industry). Sample: Optical sensor as substitute for mechanical key. Necessary acceptable tool: torch

2.5.3 Treatment of meters with a voltage range

If the manufacturer claims a range of $U_n$ (for instance: 58...240 V) requirements shall be assessed for upper and lower value of voltage (58 V, 240 V)

2.5.4 Treatment of meters with more than one rated frequency

If the manufacturer claims more than one rated frequency $f_n$ (for instance: 50 Hz and 60 Hz) requirements shall be assessed for both frequencies. 16 2/3 Hz meters shall be
considered as not covered by MID. Harmonised standards are valid only for 50 Hz. The Notified Body can decide to apply it also for 60 Hz.

2.5.5 Treatment of meters for usage under increased risk of over-voltage exposure

The manufacturer shall specify whether the meter is intended also for increased risk of overvoltage exposure. The manufacturer shall in this case claim the amount of kV which his meter can withstand and by which means he achieves the protection. After assessment of the claimed voltage strength the Notified Body puts an appropriate comment into the type or design examination certificate.

2.5.6 Mandatory content of the Type Examination Certificate

In any case the EC type examination certificate should contain also the following information:

a) Additional /associated functions in the sense of guidance 2.1.2

b) the values concerning the effect of the influence quantities with respect to temperature, voltage and frequency

- \( \delta(T, I, \cos \varphi), \delta(U, I, \cos \varphi), \delta(f, I, \cos \varphi) \)

or the sum of their square values:

- \( \delta(T, U, f) = \sqrt{\delta^2(T, I, \cos \varphi) + \delta^2(U, I, \cos \varphi) + \delta^2(f, I, \cos \varphi)} \)

For the \( \delta \)-summands must be chosen:

The worst values determined during the type examination by measurements with a specimen representative for the type.

The \( \delta \) values should also be controlled from time to time during the manufacturing process.

Reason: During Assessment in respect to MID within
- the production stages “final product inspection and testing” (module D),
- within assessment regarding to module F, or
- within market surveillance tests
it is necessary to determine the MPE with the completed square root formula given in MI 003:

\[
e_c = \sqrt{e^2(I, \cos \varphi) + \delta^2(T, I, \cos \varphi) + \delta^2(U, I, \cos \varphi) + \delta^2(f, I, \cos \varphi)}
\]

1 These values may be different for different meter sizes of a meter family
c) Conditions of particular usage (for instance usage of a poly phase meter as a single phase meter)

d) Whether an individual instruction manual is mandatory and if yes what information inside the manual is needed.

e) If an certificate does not include the values asked for in b) then notified body shall amend the certificate (see Annex B 5.2, 2nd paragraph).

### 2.5.7 Tests to be performed as piece tests

Within assessment regarding to Annex F it is necessary to perform tests not as type tests but piece tests. Those tests can be performed to every piece of a production or under certain circumstances by using statistical methods. Because the requirements given in MI-003 are type requirements it is not necessary to perform all related tests within annex-F-assessment. Considering this within annex-F-assessment it is sufficient to perform the following tests:

- Visual check the sample regarding conformity with the type examination/design certificate
- Test running with no load
- Test Starting
- Test relation between test output signal and displayed kWh-value, means: test of correctness of the (electronic) gear for the register
- MPE determination:
  a) Determination of the error due to current variation at a temperature between +5 °C and +30 °C. Test at least at I_{min}, I_{rr}, 10xI_{rr}, I_{max}.

Calculation the MPE by using the value from a) and the values for influences concerning variation of temperature, frequency and voltage taken from the certificate.

### 2.5.8 Performance Monitoring Devices (PMD)

If PMDs are used for billing purposes which is under legal metrological control (refer to paragraphs 3, 4, 5 of MID preface), the PMDs shall comply with the requirements of the MID (Measuring Instrument Directive 2004/22/EC).

In this case the part of the PMDs which is covered by MID need to be conformity assessed and CE Marked.

**Reason:**
According to EN 61557-12, a PMD (Performance Monitoring Devices) is a combination of one or more devices of several functional modules dedicated for measuring and monitoring electrical parameters in energy distribution systems or electrical installations. It need to be clarified how these meters should be treated in respect to MID.
2.6 Interpretation of the special requirements to MI 004.

2.7 Subassemblies.

2.7.1 Combining a volume conversion device and a gas meter during putting into use

1. The national legislation has to provide regulations concerning the responsibility for a correct combination of a volume conversion device and a gas meter during putting into use. This includes the responsibilities concerning the correct programming of parameters like pulse factors, relative density, calorific value and gas composition in the conversion device. But inside the documentation of a meter and conversion device all information shall be easily available to set up the combination correctly. The notified body has to ensure that during the assessment the documentation is complete and comprehensive.

2. Before CE-marking the manufacturer has to set the parameters in such a way, that the conversion device works with default parameters.

3. The EC type examination certificate or the documentation referred to in the certificate which accompany an instrument shall specify (in detail) information necessary to ensure correct functioning of the combined meter + conversion device when built together and installed according to these information.

4. As regards the sealing of the connection of the subassemblies this shall be determined either by the distributor or by the person legally designated for the installing the meter, duly in conformity with the requirement 10c of Annex MI-002.

Reason:
According to article 5 of MID the gas meter and the conversion device can have separate EC type examination certificates.
According to article 10 clause 5 the manufacturer has to indicate all conditions necessary to combine sub-assemblies correctly.
The member states shall ensure that the distributor or the legally designated person cares about the correct combination of meter and conversion device (part III of the specific annexes of MID).

2.8 Evaluation of assessment procedures.

2.9 Miscellaneous.

2.9.1 MPEs applicable to a repaired meter that was originally conformity assessed against the MID

If an instrument was repaired before putting into use the MPEs stated in the corresponding specific annex apply.
For instruments that are in-service the national regulations apply.
**Reason:**
MID is applicable to new instruments only.

2.9.2 Determination of “period of time estimated by the manufacturer” in respect to the meter durability (Annex 1 clause 5) and consequences for manufacturer following from this statement

The period of time estimated by the manufacturer is the period of time over which the meter “maintains an adequate stability of its metrological characteristics”. (Annex 1/5).

a) The durability test is defined in a harmonised standard or normative document.

Taking into account the operating conditions existing in durability tests given in harmonised standards or normative documents, the period of time to be estimated by the manufacturer is the duration of the tests. The manufacturer shall state exactly the test used for this estimate.

An example of this declaration is “The meter x has a life estimated at 5000 hours at $Q_{\text{max}}$. This estimate was made using the test in EN 1359:1998 incl. amendment 1 clause xxx”

b) No durability test is defined in a harmonised standard or normative document.

The period of time to be estimated by the manufacturer will be supported by international standards providing guidance on Reliability Prediction, Accelerated Life and Reliability Testing (e.g. for electronic instrument a predictive model is described in IEC 62059-41 to indicate expected durability) and / or any methods to indicate if long-term stability is affected. The manufacturer shall state exactly the method used for this estimate.

An example of this declaration is “The meter x has a life estimated at YY years. This estimate was made by using the method in IEC 62059-41, clause xxx “

The manufacturer’s estimate of this period may be used as a guide, but it is not a specification of actual in-service life.

**Reasons:**
Actual in service life of a measuring instrument, working within its rated operating conditions, depends mainly on its use and / or the nature of the medium subjected to measurement. Neither the manufacturers nor the Notified Body which assesses the declaration are able to predict the use and conditions. Only the user has the knowledge of the application for the instrument and, being aware of the results of durability tests described in standards or normative documents elaborated by experts, can select the right instrument for a specific application.

Electronic measuring instruments (with experience to date) do not suffer deterioration of accuracy so long as the electronic components are functioning properly and the limiting factor of stability is deterioration or failure of such components. Predictive models give guidance on this.
Remarks:
The estimated time is not a product guarantee.

2.9.3 Documentation of seals used for security measures

The EC type examination certificate or EC design examination certificate respectively shall include a drawing or picture of the seals used for security measures in respect to Annex I, clause 8.2.
If different seals are in use, the certificate or amendments of the certificate shall include all kinds of inscriptions.
It is recommended to use registered trademarks as inscriptions of the seals.

Reasons:
In order to recognise a corruption of an instrument, it shall be easily possible to get information how the seals used by the manufacturer look like.
A registration of the inscriptions of the seals as a trademark may be important in order to prosecute the illegitimate use of the seals.

3 Meter families in respect to conformity assessment

The aim of defining meter families is to reduce the necessary tests and documents to a minimum.
The manufacturer should make suggestions for grouping instruments to a family.
The Notified Body assesses the suggestion and can accept, refuse or modify the proposal.

3.1 Definition of a family of meters

A family of meters is a group of meters of different sizes and/or different operating ranges, in which all the meters shall have the following characteristics:
• the same manufacturer
• the same measuring principle
• the same accuracy class
• a similar construction and component assembly
• the same materials for those components that are critical to the performance of the meter
• the same rated operating conditions
The meters within a family may have different display device versions as long as it is demonstrated by design argumentations or tests that they have the same influence on the metrological performances.

If nothing else is stated in normative documents or harmonised standards, following shall be used:

3.1.1 Electricity meters
In addition to the characteristics given in 3.1, a family of electricity meters shall have the following specific characteristics:
• roughly the same ratios $I_{\text{max}}/I_{\text{tr}}$, $I_{\text{min}}/I_{\text{tr}}$ and $I_{\text{st}}/I_{\text{tr}}$
• the same additional functionalities
• the same number of registers
In respect to EN 50470 they shall have
• the same meter housing inclusive terminal block
• the same current sensors (50470-3-meters)
• the same printed boards and measuring principle (50470-3-meters)
• the same software version (50470-3-meters)
• the same voltage and current systems and the same internal geometry (50470-2-meters)

3.1.2 Gas meters
In addition to the characteristics given in 3.1, a family of gas meters shall have the following specific characteristics:
• roughly the same ratios $Q_{\text{max}} / Q_{\text{min}}$ and $Q_{\text{max}} / Q_{\text{t}}$ or, if not, the tests will be carried out on the meter version which has the highest ratios
• for TC-meters the same temperature compensating construction
• the same versions of electronic devices for each meter size (these devices may be optional)

3.1.3 Water meters
In addition to the characteristics given in 3.1, a family of water meters shall have the following specific characteristics:
• geometric similarity of the wetted parts
• the same temperature class
• the same electronic devices for each meter size
• the same installation requirements related to the meter size

3.1.4 Heat meters
In addition to the characteristics given in 3.1 a family of heat meters shall have the following specific characteristics:
• geometric similarity of the wetted parts
• roughly the same ratios $q_s / q_p$ and $q_p / q_i$
• roughly the same range
• the same temperature pairs
• the same electronic devices for each meter size