

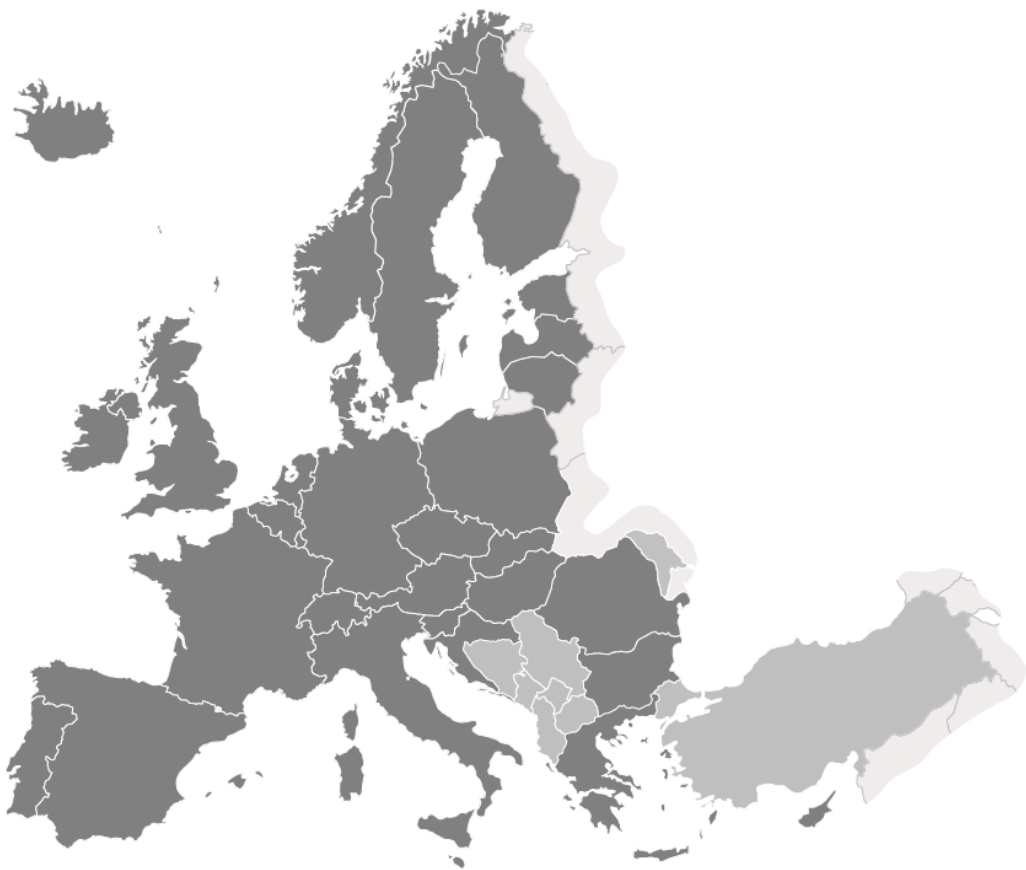
WELMEC 11.1

2017

WELMEC

European Cooperation in Legal Metrology

Measuring Instruments Directive 2014/32/EU Common application for utility meters



WELMEC

European Cooperation in Legal Metrology

WELMEC is cooperation 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 EU 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.

Published by:
WELMEC Secretariat

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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.

The guidance is applicable to Directive 2014/32/EU as well, the references in the Document are still linked to Directive 2004/22/EC.

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:

1. Scope and exclusions of the Directive.
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.
8. Evaluation of assessment procedures.
9. Miscellaneous.
10. General/Horizontal issues

1.2 Overview

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

1. Scope and exclusions of the Directive

No.	issue
2.1.1	Maximum size of a meter assessable under MID
2.1.2	Scope of MID concerning "additional/ associated functions" of measuring instruments

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

No.	Issue
2.2.1	Acceptance criteria for accuracy measurements during market surveillance, type approval and initial verification
2.2.2	Explanation regarding MID, Annex I, Introduction, concerning the term "suppliers"
2.2.3	Indication of results

2.2.4	Indication of low flows/currents
2.2.5	Influence of frequency disturbances (2-150 kHz) EN 61000-4-19
2.2.6	Unduly biasing

3. Interpretation of the special requirements on MI 001

No.	Issue
2.3.1	clean water as a subtype of potable water
2.3.2	Connection interface of axial or coaxial cartridge meters and its CE marking

4. Interpretation of the special requirements on MI 002

No.	Issue
2.4.1	Calculation of compressibility factor in a volume conversion device
2.4.2	Clarification regarding the provision of an emergency power supply device
2.4.3	Indication of battery life time
2.4.4	Index resolution for testing and internal resolution of electronic gas meters
2.4.5	Testing at Q_{min}
2.4.6	Connection of gas quality sensors like GC's with EVCD
2.4.7	Emergency device for rotary piston gas meter
2.4.8	Testing of mechanical gas meter and content of TEC or DEC in respect to lubrication oil
2.4.9	Internal update of gas composition in case of thermal gas meters
2.5.10	Testing of gas meters in respect to mechanical class M1, M2

5. Interpretation of the special requirements on MI 003

No.	Issue
2.5.1	Clarification regarding Annex I, Item 1.1, with respect to the matter that nothing else is stated concerning expression of MPE
2.5.2	Explanation regarding Annex I, item 10.5, concerning the meaning of the term „tools“
2.5.3	Treatment of meters with a voltage range
2.5.4	Treatment of meters with more than one rated frequency
2.5.5	Treatment of meters for usage under increased risk of over-voltage exposure
2.5.6	Mandatory content of the Type Examination Certificate
2.5.7	Tests to be performed as piece tests
2.5.8	Performance Monitoring Devices
2.5.9	Applied phase sequence for active electrical energy meters

2.5.10	Polyphase active electrical energy meters applied for the measurement of both import and export energy
2.5.11	Metering for charging of electric vehicles
2.5.12	Durability - testing of electricity meters

6. Interpretation of the special requirements to MI 004.

Note: Currently there are no guidelines available.

7. Subassemblies.

No.	Issue
2.7.1	Combining a volume conversion device and a gas meter during putting into use

8. Evaluation of assessment procedures.

No.	Issue
2.8.1	Requirements on the adjustment of meters (general rules and specific rules)

9. Miscellaneous.

No.	Issue
2.9.1	MPEs applicable to a repaired meter that was originally conformity assessed against the MID
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
2.9.3	Documentation of Seals used for security measures

10. General/Horizontal issues.

No.	Issue
2.10.1	Resetting of registers

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:

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 shall 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” referred to 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
 $BMC < 1/3 \text{ MPE}$.

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
 $BMC < 1/5 \text{ MPE}$.

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
 $BMC < 1/3 \text{ MPE}$.

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 metrological 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.*

The measurement results that serve as the basis for the price to pay may be:

A) the values of different registers, which are activated by remote control, a clock 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 MI 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 meter 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 needs the information, as to which rate is currently active.
3. If only the total quantity supplied is displayed on a legally controlled display, then distribution of the quantities in different rates registers will not obtainable for checking.

2.2.4 Indication of low flows/currents

Related to: annex 1, clause 7, suitability

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.

A meter shall allow checking whether there is registration also outside the measuring range or not.

It is up to the manufacturer to declare how this functionality is implemented.

An acceptable solution is for the meter to display a special sign.

In the case where the display is switched off (for saving energy) this sign may also be switched off.

A further acceptable solution for checking the registration outside the measuring range is that the design includes a sufficiently low value of the last digit of the display, or a special test mode.

2.2.5 Influence of frequency disturbances (2-150 kHz) EN 61000-4-19

Related to: Annex 1, clause 1. Allowable Errors

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.

The accuracy of an electricity meter may be considerably affected by low frequency disturbances in a frequency range up to 150 kHz generated by some electrical equipment, such as an electric energy inverter.

In order to fulfil the requirements of the MID the manufacturers shall state during the conformity assessment which measures/procedures they have taken into consideration and shall provide the results to the notified body.

This procedure shall be applied until the relevant harmonized standards or normative documents have been updated.

OIML D11 references EN 61000-4-19 standard in order to overcome the problem, that the normative documents and the harmonized standards do not include tests to ensure that meters work properly also in the case of presence of distortions in that frequency range.

This applies to OIML R46 and EN 50470.

The test has to be applied for current only.

This is considered as an intermediate solution until there is a new improved version of the EN 50470.

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 correct 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 co-axial 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 and M 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

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

A conversion device may use a calculation method for the determination of the compressibility factor 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

Related 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 declarations provided by the manufacturer, for the suitability in respect of the place of installation and in respect to a sufficient time of usability.

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

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

2.4.3 Indication of battery life time

Related to: MI-002, clause 5.2.

“A dedicated power source shall have a lifetime of at least five years. After 90% of its life an appropriate warning shall be shown”.

MI-002, Clause 5.2 has to be met by showing a warning at 90% of life time of battery at the display or a separate sign on the meter. Additional warnings may be implemented also audible warnings.

A warning is considered as appropriate in case of a visible warning like a message on the display or a warning indication. In addition an electronically interface may provide the warning to the grid operator. A hidden, “silent” warning (via the electronic interface) to the grid operator only is not a sufficient solution.”

2.4.4 Index resolution for testing and internal resolution of electronic gas meters

Related to: MI-002 paragraph 5.5:

“The gas meter shall have a test element, which shall enable tests to be carried out in a reasonable time.”

And Annex I, paragraph 7.6:

“A measuring instrument shall be designed so as to allow the control of 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.”

In order to fulfil the requirements of Annex I, paragraph 4, 7.6 and MI-002 paragraph 5.5, for gas meters the following shall apply:

For test purposes the increment of the test element or pulse shall occur at least every 60 seconds at Q_{\min} (see OIML R137-1 paragraph 6.4.5). This resolution is achieved without any special equipment or software and may be activated in a test mode, in which case it shall be described in the operation manual.

In case there is no specific test element available the least significant digit of the indicating device is considered as test element.

Furthermore, if a meter is constructed in such a way that the signal of the measuring part is produced in discrete steps this internal resolution shall be equivalent or more accurate than the increment of the test element.

Note 1:

The test element can be a continuously moving drum bearing a scale, where each subdivision on the drum is regarded as an increment of the test element.

Note 2:

As an example a G4 diaphragm gas meter with electronic index, with a minimum flow rate of 40 dm³/h needs to have a test element of at least $40/60 = 0,67$ dm³. Also the resolution of the transfer of the rotation of the measuring part into electronic pulses needs to be at least 0,67 dm³/pulse.

2.4.5 Testing of gas meters with Q_{\min} during temperature tests

Related to: Annex I clause 1.1:

“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”.

A gas meter shall be tested during conformity assessment in the whole flow rate range in order to show conformity with the requirements of MID. This concerns also the Q_{\min} test point at the maximum and minimum rated gas temperature specified by the manufacturer in accordance to MID MI 002 clause 1.2.

These tests shall be carried out in addition to the tests required by the relevant harmonized standards if not foreseen already.

2.4.6 Connection of gas quality sensors like GC's with EVCD

In case a gas chromatograph is connected as a live sensor to an EVCD, the GC influences the measuring result (base volume) of the EVCD and should therefore be a part of the Conformity Assessment Procedure.

For the gas chromatograph the modular evaluation can be utilised provided that the gas chromatograph meets the requirements as laid down in harmonized standards or normative documents, such as OIML R140.

The gas chromatograph can be connected as a sensor to the EVCD provided that the following conditions are fulfilled:

- The gas chromatograph has an Evaluation Certificate or Parts Certificate of a Test Institute that can act as a Notified Body under Annex B of the MID for MI-002.

- The EVCD is equipped with checking facilities able to detect if the gas chromatograph or the communication with the gas chromatograph is disturbed. In this case default values shall be activated and the EVCD shall count the volume in register for disturbed volumes.
- The EVCD needs to have an event logger to allow a check of the occurrence of metrological important events like errors or breaking of limits.
- All gas quality values used shall be measured or shall be negligible. A mixture of measured values and fixed values is not acceptable.

The gas chromatograph needs to have an event logger to log changes to the relevant parameters.

2.4.7 Emergency device for rotary piston gas meters

Related to

Annex I, article 6 and 7.1:

“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.”

“A measuring instrument shall have no feature likely to facilitate fraudulent use, whereas possibilities for unintentional misuse shall be minimal.”

Some designs of rotary gas meters have an internal bypass as an additional functionality, to guarantee the gas supply in case of an emergency when the rotors are jammed.

This bypass is automatically activated when the rotors in the meters are damaged such that movement is not possible.

If the meter stops working, the emergency device will open to allow gas to flow through it. This is comparable with what happens with e.g. a defect turbine meter or an ultrasonic gas meter, where also gas flows through the meter in case the meter is defective. The emergency device gives a guarantee for the end user that gas is still available in case the meter is damaged.

The emergency device cannot be activated by the user, but only when there is too high pressure drop which can occur when the meter is damaged. Activation of the emergency device is clearly indicated by the gas meter (audible or visible). A reset of the indication of the emergency device is only possible after breaking a metrological seal.

The emergency device shall not be activated under normal conditions of use, with a pressure loss of at least twice the normal pressure loss at Q_{\max} .

It is recommended that the device has an electrical output contact for recording function.

Where fitted, the internal emergency device shall be included in the complete conformity assessment procedure and is examined in combination with the meter. There shall be no influence to the meters accuracy in any inadmissible way during the meters declared lifetime.

The emergency device shall be described in the TEC, including the pressure difference at which the bypass is activated.

If an EVCD is connected to the gas meter, a logging of the event is recommended in case the emergency device is activated (as described in the OIML R 140 chapter 7.2.3).

Background: This functionality is especially intended for those applications where only a rotary gas meter is suitable and a continuous gas supply is essential.

2.4.8 Testing of mechanical gas meter and content of TEC or DEC in respect to lubrication oil

Related to Annex 1, article 9.3 (d) and (e):

“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:

....

(d) instructions for installation, maintenance, repairs, permissible adjustments;

(e) instructions for correct operation and any special conditions of use;

....”

For turbine and rotary gas meters all metrological tests shall be performed with the complete meter including oil if the oil is needed during the normal application.

The manufacturer shall declare which kind of oil(s) is necessary.

The type of oil(s) used shall be specified in the technical documentation provided by the manufacturer, especially its viscosity behaviour over its temperature range shall be described.

In case different types of oil are specified (for instance for different rated operating conditions), the temperature testing need to be carried out for every type of oil(s).

The TEC or DEC shall include a section covering the oil(s) specification.

Background:

The metrological characteristics of turbine and rotary gas meters will be affected by the oil used for lubrication. Especially at low temperatures the effect of the oil can be severe because of the changed viscosity of the oil.

2.4.9 Internal update of gas composition in case of thermal gas meters

Related to Annex I, 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.”

Thermal gas meters shall be constructed such that corrections for deviations in the gas composition are checked and updated at least once per 8 hours (3 times a day). In the TEC the refreshment rate shall be mentioned in order to check the suitability for the application.

Background:

Depending on the design of a thermal gas meter and in order to guarantee a sufficient life time of the battery internal measurements for the gas composition may be carried out by the meter only periodically.

2.4.10 Testing of gas meters in respect to mechanical class M1, M2

Related to: Annex 1 article 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.”

Annex 1 requires a testing of meters in respect to environmental classes. For mechanical class M1 no severe influences are to expect during the application. But the mechanical testing shall show that the meter works still correctly after influences typical during transportation.

In case of M2 the meter shall work in an environment where severe vibration and shocks may occur. Under these conditions a meter need to show that there is no change in the meter deviation during the application of mechanical disturbances.

The severity level for testing vibrations and shocks given in OIML R137 are sufficient for mechanical class M2 but the test method does not investigate the meter behaviour during application of the vibration and shocks.

The relevant harmonised standards usually do not investigate the meter behaviour during application of mechanical disturbances. Hence the harmonised standards and OIML R137 allow a specification of class M1 by the manufacturer.

Remark:

For a mechanical class M2 the mechanical safety of the meter has to be considered by the manufacturer in addition and this should be described in the meter manual.

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

Referring to point 1.1 Annex I of MID for electricity meters there is nothing stated in the instrument specific annex in respect to MPE. That means for electricity meters the 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). For example an optical sensor as a 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. $16\frac{2}{3}$ Hz meters shall be considered as not covered by MID. Harmonised standards are valid only for 50 Hz. The Notified Body can decide whether 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 as described in the 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 δ -summands must be chosen:

The worst values¹ determined during the type examination by measurements with a specimen representative for the type.

The δ 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:

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

- 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 a 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 the annex-F-assessment. Considering this within the annex-F-assessment it is sufficient to perform the following tests:

1. Visual check the sample regarding conformity with the type examination/design certificate
2. Test running with no load
3. Test Starting
4. Test relation between test output signal and displayed kWh-value, means: test of correctness of the (electronic) gear for the register
5. 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_{tr} , $10xI_{tr}$, I_{\max} .

¹ These values may be different for different meter sizes of a meter family

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 M 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.

2.5.9 Applied phase sequence for electrical energy meters

Related to: MI-003, Table 3, critical change values for disturbances of long duration, reversed phase sequence.

It shall be stated in the EC type-examination certificate or EC design-examination certificate whether the meter is sensitive to the applied phase sequence or not.

If the effect due to the reversed phase sequence is less than or equal to 1/3 of the percentage error limits as stated in table 4 of the EN 50470-2 or EN 50470-3 the meter is considered to be not sensitive to the applied phase sequence.

However, if the effect due to the reversed phase sequence is more than 1/3 of the percentage error limits as stated in table 4 of the EN 50470-2 or EN 50470-3, but within the requirements for reversed phase sequence as stated in table 9 of the EN 50470-2 or EN 50470-3, then the meter is considered to be sensitive. In that case it shall also bear information of the conditions of use with respect to the phase sequence of the applied voltage and current, conform article 9.1 of the MID.

Background information:

Some poly phase electrical energy meters are sensitive to the phase sequence of the applied voltage and current. This concerns especially electromechanical electrical energy meters, but also some static electrical energy meters. According to table 3 of MI-003 the critical change value for meters of class A, B or C is 1,5%; 1,5% or 0,3% respectively, independent of the applied measuring principle.

In some countries it happens that different areas use different phase sequences ('right rotating' or 'left rotating'). If the meter is verified at a certain phase sequence, but installed in a situation where the opposite phase sequence is applied, it may happen that the meter doesn't fulfill the essential requirements of the MID anymore. By giving extra information, via a statement in the EC type examination whether the meter is sensitive to a certain phase sequence and via a specific pictogram on the nameplate if the meter can be installed only with a certain phase sequence, installers, verifiers and market surveillance organizations can perform a better check on this item.

2.5.10 Polyphase electrical energy meters applied for the measurement of both import and export energy

Export energy is a matter which is of legal interest whether it falls under MID scope or not.

If the export energy is measured through a MID meter then following approach shall be done:

Poly phase electrical energy meters are only suitable to be used with 1 or 2 phases loaded with import energy and the remaining phase(s) loaded with export energy, if during the type examination it is determined explicitly that the essential requirements of the MID are fulfilled for imported energy under these conditions. The use of the poly phase electrical energy meter for import and export has to be stated in the EC type-examination Certificate or EC design-examination Certificate.

Furthermore also the calculation and registration methods of import and export energy in the different phases and the presentation of the measured energy have to be clearly described.

Background information:

Electrical energy meters can be used for the measurement of import and export energy. During the type approval process it is checked whether the meter functions within the tolerances at balanced load and also at single phase load in case of polyphase electrical energy meters. However, more and more poly phase meters are also used with 2 phases loaded with import energy and 1 phase loaded with export energy.

2.5.11 Metering for charging of electric vehicles

Where electric energy need to be paid by a customer wholly or partly by reference to a measured quantity supplied, this supply shall be determined by an appropriate meter. An appropriate meter is defined as a meter being of a pattern or construction under legal control. As such, this would comprise meters which were conformity assessed in respect to MID MI-003 and for which an EC type-examination Certificate or EC design-examination Certificate was issued.

2.5.12 Durability - testing of electricity meters

Related to annex I article 5, durability

For electricity meters the standard EN 62059-32-1 (Durability - Testing of the stability of metrological characteristics by applying elevated temperature) give presumption of conformity.

This test applies for electronically and mechanically meters as well.

2.6 Interpretation of the special requirements to MI 004.

Note: Currently there are no guidelines available.

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 such as 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 this 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 subassemblies 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.

2.8.1 Adjustment of meters in order to avoid an exploitation of MPE

Related to:

annex MI 001, water meters

annex MI 002, Part I gas meters, Part II conversion devices

annex MI 003, electricity meters

annex MI 004, heat meters

The Annexes MI 001 to MI 004 include a requirement which restrict the MPE additionally in order to avoid an undue biasing of meters during the production.

The meter shall not exploit the MPEs or systematically favour any party

This requirement (further called: Adjustment rule AR) shall be applied during the production step, where the adjustment of a meter takes place or during the final tests of the meter. It is not to apply during all other tests, listed in Annex 1.

The manufacturer is responsible for the correct adjustment and shall establish appropriate measures in his quality system or implement other means during production.

The adjustment shall lead to meter errors curves which are as close as possible near to zero, taking into account the technical opportunities of a meter/ or sub assembly design.

The quality system of the manufacturer (Module D, H1) shall refer to one of the following options and describe how a duly adjustment is implemented. If a manufacturer choose module (F) he shall inform the responsible notified body about the applied methods.

In order to allow a check of the correct application of the AR by the Notified Body, the manufacturer shall file the results of the relevant tests over an appropriate time.

Criteria in respect to the instrument specific annexes

A Same Sign Method

The meter errors above Q_t or a certain measurand (test point) shall be restricted, if all errors have the same sign.

MI-001 water meters, MI-004 heat meters

All Meters must be designed and adjusted as close as possible to the zero error limits.

Water meters and flow sensors with abilities for adjustment of the error curves, where the errors are aligned into the same sign (+/-) within the complete measuring range, shall only pass the assessment (verification) if all errors do not exceed a half of the MPE.

In cases where no adjustment is possible see C.

MI-002 Part I gas meters:

If above Q_t all errors have the same sign, then none of the errors above Q_t shall exceed the following MPE

class 1:	0,5 %	
class 1,5:	1 %	gas meter in accordance to clause 2.1. of MI-002
class 1,5:	1,3 %	gas meter with temperature conversion in accordance to clause 2.2. of Annex MI-002 at reference conditions

Remark: The reference conditions for testing shall be in the temperature range, where the MPE of a gas meter in accordance to clause 2.2 is increased by 0,5 % in comparison to a gas meter of class 1.5 in accordance to clause 2.1.

MI-002 Part II conversion devices:

The results for electronic volume conversion device EVCD's are dependent on pressure measurements, temperature measurements and the applied gas composition. Defining whether the errors favour some party is very difficult and dependent on different combinations. Also the errors of the EVCD are independent on the flow rate.

In case the conversion factor has the same sign for the whole operating range, the adjustment rule is considered to be fulfilled for each conversion device of type 1 or type 2, where the stricter requirements of table 3 of the EN 12405-1 [2005] +A1 [2006] are fulfilled for the individual pressure and/or temperature sensor and the calculator.

B Adjustment of each meter in order to minimise a Weighted Mean Error (WME)

MI-002 part I gas meters

Refer to harmonised standards; or use text of the normative document OIML R137-1.

Note:

There is a slight difference between the definitions in different documents. Especially the OIML R137-1 applies a factor of 0,4 for flow rates above $0,9 Q_{max}$. Due to the fact different documents are harmonised under the MID, it is allowed to use any of the definitions. In fact there is no real difference between the standards / documents.

C Statistical control

In a case of statistical method it is not permitted to select special meters from a batch to a customer. A batch is a deliverable of the same type and range. WELMEC guide 8.10 provides information about the acceptable size of a batch (lot size).

MI-001 water meters, MI-004 heat meters

In cases where no adjustment is possible, special measures have to be included into the quality system.

Note:

Measures mean e.g. to detect the batch of statistics coming from test results of water meters which shall show at Q_3 or Q_2 that the maximum of the error distribution are below half of the permitted errors.

MI-002 gas meters

If the mean values of the determined errors for the whole batch at flow rates equal to or above Q_t have different signs, the requirement is deemed to be met.

Otherwise the mean value at each of those flow rates shall be within $\frac{1}{3}$ of the MPE.

MI-003 electricity meters

It is not allowed that all meter errors due to varying-load current have the same sign. For each test point and each instrument the adjustment shall be made so that the error is as

close as possible to zero. Within in a batch the mean error for each test point should be within $\frac{1}{3}$ of the error limits at the test points.

Metrological surveillance

The metrological surveillance of meters in respect to the AR may be based on statistical methods applied on a sufficient number of meters.

Taking into account the typical values of uncertainties of the test rigs used by the manufacturer and surveillance authorities the uncertainties may be not negligible in respect to the MPE. The uncertainty of the used test rig shall be taken into account as described in W11.1 guidance 2.2.1

Note:

In the standard ISO 2859 it is described in general how to select a batch and sample.

Standards EN 62058-11, EN 62058-21, EN 62058-31 define batch acceptance for electricity meters.

2.8.2 Unduly biasing of meters

Related to: Annex I, paragraph 7.3: “The errors of a utility measuring instrument at flows or currents outside the controlled range shall not be unduly biased.”

The requirement of Annex I, clause 7.3 is covered by a gas meter, if for flow rates below Q_{\min} the error is between -100 % and 3 times the +MPE.

For flow rates below 20% of Q_{\min} registration is not mandatory.

This rule applies for the whole rated operated conditions relevant in this respect (like temperature, pressure, type of fluid etc.).

No specific requirements for flow rates above Q_{\max} apply, because installations are designed such that long overloads don't occur, an overload is only to be expected for a short period of time. Furthermore there is a requirement on overload in MI-002.”

Remarks:

The clause Annex I, 7.3 shall avoid a meter behavior, where the meter counts without any consumption or with a flow rate or current below the values where MPE's are applicable.

This is usually not a matter for mechanical meters because friction stops meter running below a fraction of Q_{\min} .

In several standards there are requirements for when a meter shall start or that the accuracy is not affected after running at overload. But that is no answer to the requirement of Annex I, paragraph 7.3.

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_{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 corruption of an instrument, it shall be easily possible to obtain drawings describing the design of the seal and its inscriptions.

A registration of the inscriptions of the seals as a trademark may be important in order to prosecute the illegitimate use of the seals.

2.10 General/Horizontal issues

2.10.1 Resetting of registers

Related to: Annex I paragraph 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.”

If tariff registers are used for billing purposes then they have to be treated as legally relevant parameters. The registers need to be protected against changes and resetting in the same way as legally relevant parameters (see WELMEC 7.2 requirement P5 and P7). That means for different tariff registers a software seal is allowed, as described in P7.

The overall cumulative register needs to be protected by means of a hardware seal. If no overall cumulative register is available, the displays from which the total quantity supplied can be derived, then that means all tariff registers need to be protected also by means of a hardware seal.

Background information:

Lots of utility meters have more than one tariff register. One of the most simple versions is a meter with a day and a night tariff register. The day or night tariff register may be reset under a software seal in case a total (overall cumulative) register is available which is protected by means of a hardware seal.

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, the following shall apply:

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_{\max}/I_{tr} , I_{\min}/I_{tr} and I_{st}/I_{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 (EN 50470-3-meters)
- the same printed boards and measuring principle (EN 50470-3-meters)
- the same software version (EN 50470-3-meters)
- the same voltage and current systems and the same internal geometry (EN 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_{max}/Q_{min} and Q_{max}/Q_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 $\Delta\theta$ range
- the same temperature pairs
- the same electronic devices for each meter size

Change history

Issue 2017

chapter	added	removed
1	Application note in respect to Directive 2014/32/EU	
2.2.5	Handling of influences of frequency disturbances (2-150 kHz) on power lines (electricity meters)	
2.4.7	Requirements for an emergency device for rotary piston gas meters	
2.4.8	Requirements on testing of mechanical gas meter and on the content of TEC or DEC in respect to lubrication oil	

2.4.9	Requirements on the internal update of gas composition in case of thermal gas meters	
2.5.10	Testing of gas meters in respect to mechanical class M1, M2	
2.5.12	Durability testing of electricity meters	
2.8.1	<p>Requirements on the adjustment of water and heat meters which have implemented a device/functionality for the error curve correction</p> <p>Requirements on the adjustment gas meters in accordance to MI 002 art. 2.2 (gas meters with built in temperature compensation)</p> <p>Requirements on statically control of water and heat meters in respect to meter errors observed</p>	