

# WELMEC Guide 11.1

## Common application for utility meters

(EU Measuring Instruments Directive 2014/32/EU)

**Version 2022**

For information:  
This Guide is made available for the Working Group Measuring Instruments  
(European Commission expert group E01349) for consideration for future  
referencing on the Europa Website.



WELMEC e.V. is a 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 e.V. 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 e.V as to the best practice to be followed.

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## 1. Foreword

This document is intended to provide guidance to all those concerned with the application of the Measuring Instruments Directive 2014/32/EU, 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 E 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 relates to the following subjects:

1. Scope and exclusions of the Directive.
2. Interpretation of the essential requirements in respect to utility meters MID Annex IV (MI 002) and Annex V (MI 003).
3. Interpretation of the special requirements on Annex IV (MI 002)
4. Interpretation of the special requirements on Annex V (MI 003)
5. Subassemblies.
6. Evaluation of assessment procedures.
7. Miscellaneous.
8. 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 002 to MI 003).

No.	Issue
2.2.1	Acceptance criteria for accuracy measurements during market surveillance and conformity assessment
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
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### 3. Interpretation of the special requirements on MI 002

No.	Issue
2.3.1	Calculation of compressibility factor in a volume conversion device
2.3.2	Clarification regarding the provision of an emergency power supply device
2.3.3	Indication of battery lifetime
2.3.4	Index resolution for testing and internal resolution of electronic gas meters
2.3.5	Testing of gas meters with $Q_{\min}$ during temperature tests
2.3.6	Connection of gas quality sensors like GC's with EVCD
2.3.7	Emergency device for rotary piston gas meter
2.3.8	Testing of mechanical gas meter and content of TEC or DEC in respect to lubrication oil
2.3.9	Internal update of gas composition in case of thermal gas meters
2.3.10	Testing of gas meters in respect to mechanical class M1, M2

### 4. Interpretation of the special requirements on MI 003

No.	Issue
2.4.1	Clarification regarding Annex I, Item 1.1, with respect to the matter that nothing else is stated concerning expression of MPE
2.4.2	Explanation regarding Annex I, item 10.5, concerning the meaning of the term „tools“
2.4.3	Treatment of meters with a voltage range
2.4.4	Treatment of meters with more than one rated frequency
2.4.5	Treatment of meters for usage under increased risk of over-voltage exposure
2.4.6	Mandatory content of the Type Examination Certificate
2.4.7	Tests to be performed as piece tests
2.4.8	Performance Monitoring Devices
2.4.9	Applied phase sequence for active electrical energy meters
2.4.10	Polyphase active electrical energy meters applied for the measurement of both import and export energy
2.4.11	Metering for charging of electric vehicles

2.4.12	Durability - testing of electricity meters
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## 5. Subassemblies.

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

## 6. Evaluation of assessment procedures.

No.	Issue
2.6.1	Adjustment of meters in order to avoid an exploitation of MPE
2.6.2	Unduly biasing of meters

## 7. Miscellaneous.

No.	Issue
2.7.1	MPEs applicable to a repaired meter that was originally conformity assessed against the MID
2.7.2	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
2.7.3	Documentation of Seals used for security measures

## 8. General/Horizontal issues.

No.	Issue
2.8.1	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 maximum size of meter that can be assessed under MID.

#### 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 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 with 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 EU type examination certificate or EU 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 (**Annex IV (MI002) and Annex V (MI003)**).

### 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

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

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

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

The observed errors  $e$  during a meter test meets the requirements if, for all repetitions the equation:  $e < \text{MPE}$  is fulfilled.

#### Conformity assessment according to module D and module F

For test equipment, it is recommended that the

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

The observed errors  $e$  during a meter test meets the requirements of 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) memorized 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 a billing period, weekend rates, etc.*).

If a meter is designed to count the quantities defined in MI 002 to MI 003 in different registers (a) the meter shall be able to 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 the 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 a 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 memorized values shall be available over a reasonable period of time in order to check the bill.

#### **Reasons:**

1. The price to pay for a measured quantity may depend mainly on the rates (price/quantity).
2. In order to control the consumption behavior 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 the distribution of the quantities in different rate registers will not be 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.*

### **Registration outside the measuring range.**

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.

### **Backflows in networks**

In order to fulfill the requirements of Annex I, clause 7.2, for static gas meters the following shall apply:

Under circumstances where there is a large contained volume behind the meter (trapped installation volume) and there is a sudden and significant variation of the pressure at the gas meter, then the inherent low resistance to flow may give rise to small negative gas quantities followed by positive gas quantities (as soon as the pressure has stabilized).

The registers should accommodate a temporary reduction and restoration of the recorded gas quantities, without changes to the index as viewed by the consumer.

This may be achieved by maintaining an internal register that records positive and negative temporary gas quantities, which may

- be either discarded or
- added to the forward register/index when either a suitable time or level of gas quantity has been exceeded.

In order to do the examination, the test “Registration of volumes due to flow oscillations” as listed in prEN 17526, has to be performed. From the point of view of WELMEC, this guideline is applicable to static meters, with a maximum flow rate not exceeding 40 m<sup>3</sup>/h

## 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 fulfill 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 the 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 an intermediate solution until there is a new improved version of the EN 50470.

### 2.3 Interpretation of the special requirements on Annex IV (MI 002)

#### 2.3.1 Calculation of compressibility factor in a volume conversion device

**Related to:** annex IV (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 harmonized 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 fulfills 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 with this standard.

#### **Reason:**

The MID allows using of technical solutions which are not described in any harmonized 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.

#### 2.3.2 Clarification regarding the provision of an emergency power supply device

**Related to:** annex IV (MI 002), Part I, gas meters, Part II, conversion devices

Annex IV (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 an emergency power supply according to EN 60654-2:1997.

The conformity assessment shall cover the appropriate test which shows 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 the type or design examination certificate.

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

### 2.3.3 Indication of battery lifetime

**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 the lifetime of the battery at the display or a separate sign on the meter. Additional warnings may be implemented also audible warnings.

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

### 2.3.4 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 fulfill the requirements of Annex I, paragraph 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 the 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 to 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 an electronic index, with a minimum flow rate of 40 dm<sup>3</sup>/h needs to have a test element of at least  $40/60 = 0,67$  dm<sup>3</sup>. Also, the resolution of the transfer of the rotation of the measuring part into electronic pulses needs to be at least 0,67 dm<sup>3</sup>/pulse.

**2.3.5 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.

**2.3.6 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 utilized 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 from 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 the 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.

**2.3.7 Emergency device for rotary piston gas meters**

Related to

Annex I, articles 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 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 defective 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 a 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 meter’s accuracy in any inadmissible way during the meter’s 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, 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.

### **2.3.8 Testing of mechanical gas meter and content of TEC or DEC in respect to lubrication oil**

Related to Annex 1, articles 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, and 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), temperature testing needs 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.

### **2.3.9 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 lifetime of the battery internal measurements for the gas composition may be carried out by the meter only periodically.

### **2.3.10 Testing of gas meters with 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 the testing of meters with 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 the case of M2 the meter shall work in an environment where severe vibration and shocks may occur. Under these conditions, a meter needs 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 is sufficient for mechanical class M2 but the test method does not investigate the meter behaviour during the application of the vibration and shocks.

The relevant harmonized standards usually do not investigate the meter behaviour during the application of mechanical disturbances. Hence the harmonized 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.

## 2.4 Interpretation of the special requirements on MI 003

### 2.4.1 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.

### 2.4.2 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.

### 2.4.3 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)

### 2.4.4 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. Harmonized standards are valid only for 50 Hz. The Notified Body can decide whether to apply it also for 60 Hz.

### 2.4.5 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.

### 2.4.6 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  $\delta$ -summands must be chosen:

The worst values<sup>1</sup> 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:

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

- 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, 2<sup>nd</sup> paragraph).

**2.4.7 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  $I_{min}$ ,  $I_{tr}$ ,  $10I_{tr}$ ,  $I_{max}$ .  
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.

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<sup>1</sup> These values may be different for different meter sizes of a meter family



### 2.4.8 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 2014/32/EU).

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 needs to be clarified how these meters should be treated in respect to MID.

### 2.4.9 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.

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

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

If the export energy is measured through a MID meter, then the 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 EU type-examination Certificate or EU 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 the 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.

#### **2.4.11 Metering for charging of electric vehicles**

Where electric energy needs 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 with respect to MID Annex V (MI-003) and for which an EU type-examination Certificate or EU design-examination Certificate was issued.

#### **2.4.12 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 a presumption of conformity.

This test applies to electronically and mechanically meters as well.

### **2.5 Subassemblies.**

#### **2.5.1 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 EU type examination certificate or the documentation referred to in the certificate which accompanies an instrument shall specify (in detail) information necessary to ensure

the 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 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 EU 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).

2.6 Evaluation of assessment procedures.

**2.6.1 Adjustment of meters in order to avoid exploitation of MPE**

**Related to:**

annex IV (MI 002), Part I gas meters, Part II conversion devices  
annex V (MI 003), electricity meters

Annexes IV and V include a requirement which restricts the MPE additionally in order to avoid an unduly 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 error curves that 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 chooses 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 with 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-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 MPE Remark: The reference conditions for testing shall be in the temperature range, where the 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.
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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 of 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 [2018] are fulfilled for the individual pressure and/or temperature sensor and the calculator.

**B Adjustment of each meter in order to minimize a Weighted Mean Error (WME) MI-002 part I gas meters**

Refer to harmonized standards; or use the 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, that different documents are harmonized 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 the case of the 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-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 to 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 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 with 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.

## 2.6.2 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%,  $Q_{\min}$  registration is not mandatory.

This rule applies to 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:**

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 the meter from 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.

## 2.7 Miscellaneous.

### 2.7.1 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.

### 2.7.2 Determination of “period of time estimated by the manufacturer” with respect to the meter durability (Annex 1 clause 5) and consequences for the 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 harmonized standard or normative document.

Taking into account the operating conditions existing in durability tests given in harmonized 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 harmonized 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 instruments 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:**

The 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 is 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.

**2.7.3 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 with 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 on the seals.

**Reasons:**

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

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

**2.8 General/Horizontal issues**

**2.8.1 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 simplest 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 into 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 harmonized 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)

#### Change history

Issue 2021

Version	change	added	removed
2021	Backflows in networks added. Numbering corrected in clause 1.2	Backflows in networks added In clause 2.2.4	
2020	Guideline updated to only include Gas meters (MI002) and Electrical energy meters (MI003)		All sections regarding MI-001 and MI-004