GUIDE

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Surveillance of utility meters in service on the basis of sampling inspections

Surveillance des compteurs utilitaires en service sur la base d'inspections d'échantillonnage

OIML G 20 Edition 2017 (E)

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INTERNATIONAL ORGANIZATION OF LEGAL METROLOGY

Contents

Foreword

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Surveillance of utility meters in service based on sampling inspections

1 Introduction

Two of the key elements of metrological control for establishing and maintaining the quality and performance of utility meters used for billing purposes are

- their initial verification (before use), and
- their subsequent verification at periodic intervals while in use.

Mandatory verification of electrical energy meters, gas meters, water meters, and heat meters – generally referred to as utility meters in this Guide – and the period of validity of such verifications are governed by national regulations. When the period of validity of the utility meter's verification expires, it must normally be submitted for subsequent verification.

The period of the validity of the verification is normally set at a fixed number of years corresponding to the national regulatory body's confidence with respect to the utility meter type's reliability (i.e. its ability to remain accurate while in use). As utility meter reliability is affected by numerous factors including those pertaining to design, production, usage, time, and the environment, the effects of such factors are difficult to assess. Therefore, the period of validity initially established for the verification of a utility meter may be either longer or shorter than it should be.

One generally accepted aim of legal metrology is that a high percentage of the utility meters installed in the utility service networks respect the maximum permissible errors (MPE) in service during use. The national regulatory body usually defines the level of consumer protection to be applied by determining the precise percentage of utility meters that have to remain within the MPE.

This Guide provides an objective means to address the above issue, using statistical methods to make an assessment regarding the appropriateness of initially established periods of validity with respect to specified utility meter performance and conformance standards. It permits the lot quality at the time near the expiration of the period of validity to be re-assessed on the basis of sampling inspection.

Usually the period of validity is fixed based on long experience and observation (statistical follow-up) of the metrological behavior of the utility meters installed in the utility service networks. The quality of a utility meter type may allow the period of validity to be extended (or shortened).

Representative random samples are selected from lots formed from utility meters which are homogeneous with respect to the factors which affect utility meter reliability. The sample utility meters are inspected, and the results of the inspections are compared with criteria based on probability theory to determine whether or not an extension to the period of validity of the verification should be granted to the utility meters in the lot.

The replacement of in-service utility meters when their periods of validity expire is costly. The results of successful sampling inspection may suggest that such replacement is premature and helps to reduce the utility meter owner's operating costs.

As experience is gained over time, national regulatory bodies will also be able to use the results of the implementation of this Guide to make sound decisions regarding the increase or reduction in the initial periods of validity for the verification of various utility meter types.

The sampling plans as given in Annex 2 are not suitable for testing the performance of measuring instruments on a production line, because the control of a sequence of product batches requires so-called "switching rules" with repercussions on inherent changes of the production process. For the same reason the sampling plans in Annex 2 are not applicable for the purpose of initial verification[1]. The national regulatory body or the "supervising authority" might use the outcome of the statistical results within their obligations for the metrological control within their surveillance activities of utility meters in service.

It should be clearly stated that the selection of the kind of sampling plans is a purely political decision on the level of consumer protection as defined by the limiting quality values (LQ).

Very small LQ values would increase the size of the sample to such an extent that the workload would come close to an (almost complete) re-verification procedure, thus jeopardizing the objective of this Guide.

An example of a sampling plan (based on an LQ = 8 %) is given in Annex 2.

This Guide is primarily intended for use in countries that do not have existing regulations concerning sampling procedures. Existing national regulations have to be observed.

This Guide does not describe sampling procedures for measuring instruments aiming at the compliance of the maximum permissible errors during the extension of the period of the validity of the verification at any time.

2 Scope

2.1 The present Guide relates to the method and procedure according to which the period of validity of the verification of utility meters forming part of a defined lot is extended if the correctness of the utility meters has been proved by sampling inspections prior to the expiry of the period of validity of the verification. This is basically for utility meters used at private homes but with a sufficient number of instruments forming the size of a lot.

2.2 It is the responsibility of the national regulatory body to define the maximum permissible error (MPE) in service as a criterion of acceptance as well as the validity period of verification.

2.3 Only those types of utility meters that are subject to legal metrology requirements for the purpose of consumer protection are to be taken into account.

2.4 The sampling instructions applied have been compiled in the sampling plans (see Annex 2). They are valid for a limiting quality (LQ) of 8 % in compliance with ISO 2859-2 [1], thus corresponding to a consumer's risk of 10 %.

[1] The same non-applicability holds true for the procedure of "putting into use" in accordance with the EU Measuring Instruments Directive (MID), 2014/32/EU.

3 Terminology

3.1 The statistical terms used in this Guide are defined in International Standards ISO 3534-1 [2], ISO 2859-1 [3] and ISO 3534-4 [4].

3.2 The metrological terms used in this Guide are defined in the relevant OIML Recommendations:

- OIML R 46:2012 [5] Active electrical energy meters;
- OIML R 137-1 & R 137-2:2012 [6] Gas meters;
- OIML R 49:2013 [7] Water meters for cold potable water and hot water;
- OIML R 75:2002 [8] Heat meters

3.3 For the purposes of this Guide, the following terms apply.

3.3.1
national regulatory body

official body responsible for determining legislative requirements

3.3.2
body responsible for subsequent verification

body officially appointed at national or some other level of government to be responsible for ensuring that requirements for subsequent verification are adhered to. It may carry out the verification function itself or, according to legislative requirements, appoint other verification bodies to carry out the verification function on its behalf

3.3.3
legally responsible entity

body/organization which is in charge of performing the reading out, collection and/or processing of the measurement data according to the national legislation

3.3.4
supervising authority

agency which is in charge of safeguarding the legally prescribed performance of the "bodies responsible for subsequent verification" or "legally responsible entities", depending on the state of privatization of the legal metrology system. The supervising authorities are also often in charge of market surveillance activities

3.4 The most important statistical terms have been compiled in Annex 1.

4 Carrying out the sampling inspection – General

4.1 If a sampling inspection is to be carried out in order to extend the period of validity of the verification of utility meters, the legally responsible entity of the utility meters (usually public utility companies) must file an application with the body responsible for subsequent verification.

4.2 The sampling inspection is to be carried out in good time before the expiry of the period of validity of verification so that in the case of non-compliance with the requirements, all utility meters forming part of the lot can be removed from the network prior to the expiry of the period of validity of verification and be replaced by verified utility meters.

4.3 The selection of random sample utility meters and the inspection thereof may only be carried out by the body responsible for subsequent verification or under the direct supervision of this body.

4.4 If a check is made, and if so requested by the body responsible for subsequent verification, the legally responsible entity of the utility meters must prove (by indicating the utility meter number, the place of installation and supplying the necessary data) for which utility meters and up to which date the period of validity of verification has been extended.

5 Criteria for the assembly and delimitation of a lot

5.1 Only such utility meters that fulfil the following minimum requirements may be assembled into a lot:

- same manufacturer (including other manufacturers that are licensed to make exactly the same utility meters);
- same type or model of the utility meter;
- same year of production;
- same accuracy class;
- same type approval number or mark;
- same date of initial or subsequent verification.

The year of production or the year of the last verification shall not vary by more than one year. In any case the fixed period for statistical control as defined by the national regulatory body must not be surpassed. These utility meters usually have an identical approval number or mark. The rated operating conditions of all utility meters shall be the same.

Additional requirements may be necessary and these shall be set by the national regulatory body, e.g.:

- requirements for transportation and storage of utility meters after being dismantled from their place of utilization and before their inspection in laboratories; or
- parameters of operating and ambient conditions.

Moreover, the following characteristics must be identical in all utility meters:

(a) electrical energy meters

- nominal voltage;
- transitional current;
- maximum current;
- current-carrying capacity (maximum current/basic current proportion) up to 4 times or more than 4 times;
- rated current (for transformer operated meters) – all values mentioned in electrical energy standards;
- single tariff or multi tariffs (electro-mechanical meters only);
- nominal frequency.

(b) gas meters

- maximum flow rate;
- temperature compensation (y/n);
- membrane material (if applicable);
- physical technique used (mechanical or electronic).

(c) water meters

- permanent flow rate (Q_3);
- ratio of the permanent flow rate to the minimum flow rate (Q_3/Q_1);
- nominal diameter.

(d) heat meters

- permanent flow rate (of the flow sensors);
- limiting flow rate values;
- same components (subassemblies) – For further reference see also EN 1434-1:2016 *Heat meters*, No. 9.2.1 [9].

For water meters and flow sensors of heat meters, only those meters that were operated with water of identical or comparable quality may be assembled into a lot.

5.2 With the approval of the national regulatory body, and subject to the conditions stated below, combined lots may be formed of utility meters:

- that are of a different type, provided that appropriate conditions for the assembly into such a lot have been clearly stipulated by the national regulatory body concerned;
- that are the property of different public utility companies, provided that responsibility for the individual undertakings has been made quite clear.

5.3 Once determined, the sample should be kept for all subsequent verifications based on sampling inspections. The same utility meter can be selected for one lot only.

6 Application for sampling inspection

The application for sampling inspection must provide the following information with reference to 5.1:

(a) for electrical energy meters:

- accuracy class;
- nominal voltage;
- transitional current;
- maximum current.

(b) for gas meters:

- accuracy class;
- maximum flowrate;
- membrane material and whether temperature correctors have been provided.

(c) for water meters:

- accuracy class;
- permanent flow rate (Q_3);
- ratio of the permanent flow rate to the minimum flow rate (Q_3/Q_1);
- nominal diameter (DN).

(d) for heat meters:

- permanent flow rate (of the flow sensor) and limiting flow rate values.

(e) type, manufacturer, approval mark, date or dates of the last verification (year);

(f) lot size;

(g) public utility entities which are the owners of the utility meters;

(h) statement by the public utility undertaking or entity as to whether the lot for which sampling inspection is applied was previously subjected to sampling inspections;

(i) date on which the utility meters selected for sampling inspection will presumably be removed from the network and made available for inspection;

(j) sampling instruction chosen.

7 Selection and treatment of the sample utility meters

7.1 Reference shall be made to the specific OIML Recommendation which might contain further updated criteria.

7.2 The following shall be agreed between the body responsible for subsequent national verification and the applicant:

(a) Procedure and characteristics for random sampling of the utility meters (for example: by manufacturer's serial number, owner's or customer's number; table of random numbers or program for the computer-aided generation of random numbers), in order to ensure that the samples are representatives of the lot;

(b) Sampling instruction to be applied (see Annex 2);

(c) Date or period of removal of sample utility meters from the network, date of their delivery to the inspection place or period between the two operations and date of the inspection for utility meters tested on the field; and

(d) Procedure reducing the possibility of inadmissible interventions in the sample utility meters during the period between their removal from the network and the inspection.

7.3 Depending on the lot size and the sampling instruction chosen, the sample utility meters and the spare utility meters are selected from the defined lot. The selection must be made in compliance with the rules of mathematical statistics, i.e. the probability to be selected as a sample utility meter or spare utility meter must be the same for each utility meter forming part of the lot. See Annex 2 for sample size and number of spare utility meters.

7.4 The inlet and outlet sockets of gas meters, water meters and flow sensors of heat meters must be sealed immediately after the devices have been removed from the supply network.

Gas meters may be rinsed with air or inert gas for a short time.

Water meters and flow sensors of heat meters have to be protected against drying out. They shall be removed from the network in such a way that as much water as possible remains in the meters.

7.5 The period between the removal of gas meters, water meters and heat meters (all properly sealed) from the supply network and their inspection should be as short as possible, but in any event this period should not exceed one month.

7.6 During transport, the utility meters shall not be subject to extreme mechanical stress.

7.7 Any interventions such as repair, adjustment, exchange of the counter, etc. are inadmissible, except the purging of gas meters and the rinsing of water meters or of the flow sensors of heat meters.

8 Sampling inspection

8.1 Non-conforming utility meters

8.1.1 Type approval certificate

A utility meter forming part of the sample shall be considered as non-conforming if it does not comply with the specifications of the applicable type approval certificate and if it does not meet the regulations for mandatory verification.

8.1.2 Display test

The display shall be tested for legibility and correct operation according to the relevant OIML Recommendation, if applicable.

8.2 Test points

The metrological characteristics of the sample utility meters are generally tested at the test points required by national legislation for the extension of the validity period. Annex 3 provides proposals of test points for gas meters for possible use.

8.2.1 Electrical energy meters

8.2.1.1 Running with no load

When the voltage is applied with no current flowing through the current circuit (the current circuit shall be an open circuit), the electrical energy meter shall not register energy at any voltage between 0.8 U_{nom} and 1.1 U_{nom}.

The term I_{tr} (transitional current) is the declared value of current at and above which the electrical energy meter purports to lie within the smallest maximum permissible error corresponding to the accuracy class of the electrical energy meter. The ratio $\frac{I_{max}}{I_{tr}}$ must be equal to or higher than 50 for direct connected electrical energy meters.

8.2.1.2 Accuracy tests

0.5 I_{tr}; 1.0 I_{tr}; 10 I_{tr} and 1.0 I_{max}

8.2.1.3 Starting current: An electrical energy meter is deemed to be non-conforming if it does not start to register energy at 1.5 times the starting current.

8.2.2 Gas meters

8.2.2.1 Test points for gas meters

Test points at Q_{max}, Q_t and Q_{min}. The national regulatory body may decide whether the test point Q_{min} may be applied for sample testing.

The flow rate characteristics of a gas meter shall be defined by the values of Q_{max}, Q_t and Q_{min}.

Table 1 Flow rate characteristics

Q_{max} / Q_{min}	Q_{max} / Q_t
≥ 5 and < 50	≥ 5
≥ 50	≥ 10

Q_t is the transitional flow rate that occurs between the maximum flow rate Q_{max} and the minimum flow rate Q_{min} that divides the flow rate range into two zones, the "upper zone" and the "lower zone", each characterized by its own maximum permissible error (See also Annex 3).

If the examination is conducted at different flow rates, the accuracy of the results shall be at least equivalent to those obtained by the tests mentioned above.

Q_t is also required to be marked on the identification plate of the meter.

Q_t and Q_{max} are preferred test points.

8.2.3 Water meters

The following scheme relates to 7.3.4 of OIML R 49-1:2013 [7], which prescribes test points for the initial verification of water meters.

The errors (of indication) of the water meters in the measurement of actual volume shall be determined for at least the following flow rates:

(a) between Q_1 and 1.1 Q_1;

(b) between Q_2 and 1.1 Q_2; and

(c) between 0.9 Q_3 and Q_3

(d) for combination water meters, between 1.05 Q_{x2} and 1.15 Q_{x2}

However, depending on the shape of the error curve, additional flow rates may be specified in the type approval certificate.

8.2.4 Heat meters or sub-assemblies of heat meters

Flow sensors: 0.1 q_p, q_i, q_p (in the order stated).

Calculators: $\Delta\Theta_{min}$; $\Delta\Theta_{max}$; $\Delta\Theta$ = 10 K or $\Delta\Theta$ = 20 K.

Temperature sensor pairs: $\Delta\Theta_{min}$; $\Delta\Theta_{max}$ and another value, preferably $(\Delta\Theta_{min} + \Delta\Theta_{max}) / 2$.

8.3 Spare utility meters

If the sample utility meters selected comprise utility meters:

(a) which are damaged on the outside,

(b) whose protective mark is damaged,

(c) which can no longer be localized or which have been incorrectly filed, or

(d) which are not accessible;

replacement of such utility meters by spare utility meters is permissible before the inspection process is started.

In cases (a), (b) and (c) only 6 % (in total) of the sample selected may be replaced by spare utility meters. The actual number of utility meters to be replaced by spare utility meters depends on the size of the lot and is provided in Tables 1–4 in Annex 2.

- Replacement shall only be done once, just after visual examination;
- Spare utility meters used for replacement shall be chosen from the spare lots at random.

If it is impossible to complete the whole sample according to the rules mentioned above, the application to extend the period of validity of the verification on the basis of sampling inspection shall be rejected.

Remark: Limiting the number of spare utility meters used for replacing sample utility meters in cases (a), (b) and (c) results from the assumption that if the limit is exceeded, this means that the lot contains too many utility meters meeting those three criteria.

8.4 Test methods

The test methods shall be the same as during initial verification. Special attention shall be paid to the fact that the uncertainty requirements for the test facilities and reference conditions should be the same as those specified in the relevant OIML Recommendation.

The test facilities shall use calibrated equipment traceable to national and international standards as agreed with the supervising authority.

8.4.1 Electrical energy meters

(a) The individual electrical energy meters shall be tested at nominal voltage at unity power factor; poly-phase electrical energy meters shall be submitted to an additional test at single-phase load but with balanced poly-phase voltages applied to the voltage circuits.

(b) The test may be carried out by a short-time test method or by a method with the electrical energy meter energized continuously. The test performed with the electrical energy meter energized continuously shall be carried out for a period to reach a resolution of 0.1 %.

8.4.2 Gas meters

Before starting the tests, the volume passed through the gas meter shall be at least 50 times the cyclic volume of the gas meter, or a volume equivalent to the amount passing through the gas meter for 1 minute at Q_{max}.

8.4.3 Water meters and heat meters

Water meters and flow sensors for heat meters shall be removed from the network in such a way that as much water as possible remains in the meters.

The same conditions shall be observed for mounting the meters into the test rig.

Having inserted the meters, the meters and the complete measuring section shall be filled slowly in order to remove all air before beginning the testing.

After the test, the inlet and outlet sockets shall be sealed again to keep the inside of the meters moist for possible re-testing. The temperature shall be stabilized at the desired test value.

8.5 Retention periods

The body responsible for subsequent verification or the supervising authority may fix a deadline up to which the sample utility meters are to be retained unchanged. This period should not exceed one

month (for water meters) or two months (for heat meters and flow sensors of heat meters) from the day of the sampling inspection up to the day of reverification in order to prevent the utility meters from drying out.

The supervising authority may determine the period up to which the re-verified utility meters shall be maintained in storage for reasons of control.

9 Sampling plans

9.1 The sampling instructions applicable to sampling inspection are given in Annex 2. From a statistical point of view, the sampling instructions in Tables 1 and 3 are equivalent and are binding for the body carrying out the inspections. They must not be deviated from without the prior approval of the body responsible for subsequent verification. For lot sizes larger than 35 000 meters, the tables in Annex 2 can be extended in compliance with ISO 2859-2 [1].

9.2 In order to achieve a higher acceptance probability for lot sizes, a sampling instruction applicable to larger lot sizes with a correspondingly larger sample size may be chosen.

9.3 It is not permitted to switch from the sampling instruction originally chosen to another one after the sampling process has been started, unless the national regulatory body has agreed otherwise.

10 Test results

10.1 All test results are to be recorded and stored in such a way that they can be re-evaluated by the national regulatory body. Re-testing of the sample by the body responsible for subsequent verification must be possible within a certain period of time.

The lot is accepted if the requirements of the sampling instruction have been met and a possible re-test by the body responsible for subsequent verification has not led to any objection.

If the lot is rejected, all units of the lot must be put out of service before the period of validity of the verification has expired.

10.2 If the lot is accepted after the inspection has been carried out according to one of the sampling instructions given in Annex 2, the period of validity of the verification of all the utility meters forming part of the lot is extended to 50 % of the period valid for initial verification or to a period specified by the national regulatory body. The initial verification period has to be fixed by the national regulatory body according to the level of performance (i.e. durability test) of the utility meters prevailing in the country.

10.3 The extension of the period of validity of the verification begins with the month following the month in which the sampling inspection was carried out.

10.4 The supervising authority is to be informed about the result of the sampling inspection. The individual test results are to be submitted upon request.

10.5 The disposal of the sample utility meters is left to the discretion of the owner of the instruments according to national legislation.

Annex 1
Terminology

Statistical terms

1
inspection lot

quantity of items (measuring instruments, parts of measuring instruments) submitted for testing or inspection

2
inspection lot size (N)

number of items in the inspection lot

3
sample

number of items taken from an inspection lot for inspection

3.1
sample size (n)

number of items in the sample

3.2
cumulative sample size (n_K)

cumulative sample sizes in double sampling; for the first sample, the cumulative sample size corresponds to the sample size of the first sample; for the second sample, it corresponds to the sum of the sample sizes of the first and the second samples

4
sampling inspection

inspection based on a sampling instruction in the case of which the inspection lot is assessed in accordance with the result obtained for a single sample or, if necessary, for various samples

4.1
single sampling inspection

the decision whether or not the criteria defined in the sampling instruction are complied with is taken on the basis of a single sample

4.2
double sampling inspection

the decision whether or not the criteria defined in the sampling instruction are complied with is taken on the basis of the first sample or, depending on the result of the first sample, on the basis of the combined first and second sample

4.3
sampling instruction

instruction for taking one or, if necessary, several samples, and for evaluating the result with regard to acceptance or rejection of an inspection lot

4.4
sampling plan

compilation of sampling instructions according to general aspects in order to limit the risk of non-conforming items being tested

5
acceptance

conclusion that an inspection lot satisfies the requirement criteria defined in the sampling instruction

5.1
acceptance number (c)

highest number of non-conforming items specified in the sampling instructions, or the specified highest number of non-conformities in the individual samples that permits acceptance of the inspection lot

6
rejection

conclusion that the inspection lot does not satisfy the requirement criteria stated in the sampling instruction

7
rejection number (d)

lowest number of non-conforming items or lowest number of non-conformities in the individual samples specified in the sampling instructions in the case of which the inspection lot is rejected

8
inspection by attributes

inspection of attributes or variable characteristics classified accordingly, in which a distinction is made only between conforming and non-conforming items

9
non-conforming item

item, one or more characteristics of which do not meet the requirements criteria stated in the sampling instruction

Annex 2
Sampling plans
with a Limiting Quality level (LQ) of 8 % at a consumer risk of 10 %
according to ISO 2859-2 [1]

Table 1 Single sampling inspection for electrical energy meters, gas meters and water meters

No.	Lot size	Sample size	Number of non-conforming meters		Spare utility meters according to 8.3
			Criterion for acceptance of lot (c)	Criterion for rejection of lot (d)	
1.1	up to 1 200	50	1	2	10
1.2	1 201 to 3 200	80	3	4	16
1.3	3 201 to 10 000	125	5	6	25
1.4	10 001 to 35 000	200	10	11	40

Table 2 Single sampling inspection for complete heat meters

No.	Lot size			Sample size	Number of non-conforming meters		Spare heat meters according to 8.3
					Criterion for acceptance of lot (c)	Criterion for rejection of lot (d)	
2.1	up	to	90	24	0	1	5
2.2	91	to	150	26	0	1	8
2.3	151	to	280	28	0	1	10
2.4	281	to	500	32	0	1	10
2.5	501	to	1 200	50	1	2	10
2.6	1 201	to	3 200	80	3	4	16
2.7	3 201	to	10 000	125	5	6	25
2.8	10 001	to	35 000	200	10	11	40

Table 3 Single sampling inspection for components of heat meters

No.	Lot size			Sample size	Number of non-conforming meters		Spare heat meters according to 8.3
					Criterion for acceptance of lot (c)	Criterion for rejection of lot (d)	
3.1	up	to	90	24	0	1	5
3.2	91	to	150	26	0	1	8
3.3	151	to	280	28	0	1	10
3.4	281	to	500	32	0	1	10
3.5	501	to	1 200	50	0	1	10
3.6	1 201	to	3 200	80	1	2	16
3.7	3 201	to	10 000	125	2	3	25

Table 4 Double sampling inspection for electricity meters, gas meters, water meters and complete heat meters

No.	Lot size	Sample	Sample size	Cumulative sample size	Number of non-conforming utility meters**)			Spare utility meters according to 8.3
					Criteria for acceptance of lot (c)	Criteria for rejection of lot (d)	Criteria for required 2nd sample*)	
4.1	up to 1 200	first	32	32	0	2	1	6
		second	32	64	1	2		6
4.2	1 201 to 3 200	first	50	50	1	4	2 to 3	10
		second	50	100	4	5		10
4.3	3 201 to 10 000	first	80	80	2	5	3 to 4	16
		second	80	160	6	7		16
4.4	10 001 to 35 000	first	125	125	5	9	6 to 8	25
		second	125	250	12	13		25

Explanations:

*) A second sample of the same size as the first sample is to be randomly drawn from the lot if the number of non-conforming utility meters stated in this column are part of the first sample.

**) In each of the lines corresponding to a second sample, the number of non-conforming utility meters relates to the cumulative sample size.

Annex 3
Proposals for sampling testing of gas meters

Maximum permissible errors (MPE) of gas meters in ±.

Table 1 Criteria of acceptance for sample testing

Flow rate Q	**Criteria of acceptance for Sample testing [MPE] Class**			**MPE In-service Class**		
	0.5	1	1.5	0.5	1	1.5
$Q_{min} \leq Q < Q_t$	-	3.5 %	5.5 %	2 %	4 %	6 %
$Q_t \leq Q \leq Q_{max}$	-	1.5 %	2.75 %	1 %	2 %	3 %

Table 2 Test points for sample testing

Q_{max} / Q_{min}	**Class 1**	**Class 1.5**
≥ 50	Q_{max}, Q_t, Q_{min}	Q_{max}, Q_t, Q_{min}
≥ 5 and < 50	Q_{max}, 0.1 Q_{max}, Q_{min}	Q_{max}, 0.1 Q_{max}, Q_{min}

At the Q_{min} test point, mechanical gas meters may have negative errors outside the MPEs, which is typically due to locally different influences (dust, temperature, mechanical shocks, etc.). In the upper flow rate range, however, they usually work reliably within the established MPEs because the main consumption occurs in the flow rate range between Q_{max} and Q_t.

Given this fact, and in view of the undue increase in costs that would arise if gas meters were replaced which, under normal conditions of consumption, work satisfactorily, it might – from an economic point of view – be justified to apply only the test points between Q_{max} and Q_t.

Therefore, the national regulatory body may decide not to apply the test point Q_{min}.

Annex 4
References

[1] ISO 2859-2:1985, Sampling Procedures for Inspection by Attributes – Part 2: Sampling Plans Indexed by Limiting Quality (LQ) for Isolated Lot Inspection

[2] ISO 3534-1:1993, Statistics – Vocabulary and Symbols – Part 1: Probability and General Statistical Terms

[3] ISO 2859-1:2001, Sampling Procedures for Inspection by Attributes, – Part 1: Sampling Schemes Indexed by Acceptance Quality Limit (AQL) for Lot-By-Lot Inspection

[4] ISO 3534-4:2014, Statistics - Vocabulary and symbols - Part 4: Survey sampling

[5] Active electrical energy meters
OIML R 46-1-2:2012
OIML R 46-3:2013

[6] Gas meters
OIML R 137-1-2:2012

[7] Water meters
OIML R 49-1-2-3:2013

[8] Heat meters
OIML R 75-1:2002
OIML R 75-2:2002
OIML R 75-3:2006

[9] EN 1434-1:2016 Heat meters