guide

Nederlands Meetinstituut

Physikalisch-Technische Bundesanstalt

Ministère de l'Economie,
des Finances et de l'Industrie
Secrétariat
d'Etat à l'Industrie

Sous-direction de la Métrologie

COMMON INTERPRETATION FOR APPLICATION OF OIML R117

BY NMi, PTB and SDM

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0 - INTRODUCTION

After having implemented the International Recommendation R117 on Measuring systems for liquids other than water for two years, the Nederlands Meetinstituut (NMi), the Physikalisch-Technische Bundensanstalt (PTB) and the Sous-direction de la métrologie (SDM) felt the need for interpreting some provisions of the R117 and for developping common solutions in order to complete some provisions.

The present document is the result of this exchange of views. Set of numbers in brackets in this document refers to the corresponding point of R117.

It contains three main parts :

- a first part on provisions that can be considered as simple interpretation of R117,
- a second part on provisions that can be considered as acceptable solutions in order to fulfill the corresponding requirements in R117,
- a third part on additional provisions or specifications on points not covered by the current text and which should be considered in the future applications. This points can be considered necessary for a good application of R117 and can also be considered as acceptable solutions.

These three metrological bodies have identified other questions whose solutions should consist in restarting the work at the OIML level, and which are not developped in this document. Some of them are just mentionned in the fourth part.

This document reflects only the common views of the NMi, the PTB and the SDM. However, it may be circulated among any body involved in legal metrology or any manufacturer. The NMi, the PTB and the SDM would be very satisfied if it could help some of them for application of R117 and are expecting reactions if any. They also hope that this document could be used as a working paper for the first revision of R117.

I - INTERPRETATION OF R117

1) Question : Can it be allowed that an electronic device stops working under conditions of varying alternative currect mains power supply between V_{nom} - 15 % and V_{nom} + 10 % ?

   Answer : No. All functions shall operate as designed, and all errors shall be within the maximum permissible errors when alternative currect mains power supply is between V_{nom} - 15 % and V_{nom} + 10 %. The measuring system shall be designed to continue operating in this range.

2) Question : Is it allowable in case of direct selling to the public to enter manually into the calculator at the beginning of the measurement operation the nature of the measured liquid or its viscosity when this datum partipates in the **correction** of the volume ?

Answer : No. This is acceptable only in case of selling between professionals (and only for the nature of the measured liquid or its viscosity), and in this case it is necessary to provide the measuring system with a printing device subject to legal metrological control. This device shall print this datum and a note explaining that this quantity has been entered manually.

In case of correction and direct selling to the public, it is not authorised to enter manually the nature of the liquid or any other datum at the beginning of the measurement operation when this datum participates in the result. That means it is allowed to measure different liquids only if the different correction factors relating to the different liquids are equal.

In other cases, characteristics of the measured liquid which participes in the correction shall be measured by associated measuring instruments subject to legal control.

3) Question : Is it allowable to enter manually into the calculator at the beginning of the measurement operation the nature of the measured liquid or any other datum when this datum participates in the **conversion** of the volume ?

Answer : As a rule, the parameters which characterize the measured liquid and which intervene in the conversion formula shall be measured using associated measuring instruments subject to control (3.7.3).

However, if the influence of some of these parameters is less than one-tenth of the MPE given in the table 2.5.1 of R117, they may not be measured or associated instruments may not be subject to control.

Moreover, it may be allowable to enter manually into the calculator at the beginning of the measurement operation in the case of direct selling to the public the nature of the liquid, or in the case of selling between professionals the nature of the liquid or any other datum, when this datum participates in the conversion of the volume, under the following conditions :

a) A printing device subject to legal metrological control is mandatory.

b) This datum and a note explaining that this datum has been entered manually shall the be printed at the same time as the measurement results.

c) The nature of the liquid printed shall be without any ambiguity, particulary in case of direct selling to the public. For example, it may be allowable to print "product 3" in case of selling between professionals, if this indication refers directly and without any ambiguity to a standard, but this indication is not sufficient in case of direct selling to the public.

In case of direct selling to the public, it is prohibited to print for example only the indication "LPG 1" or "LPG 2". It may be acceptable for example to print "LPG X % butane" (respectively propane) if the butane (respectively propane) is the main component of the blend.
The indication "LPG" is not allowed in case its composition intervenes in the conversion.

d) In case of transaction between professionals the other allowed data are those which characterise the nature of the measured liquid without any ambiguity.

For example, other allowed data may be : viscosity in base conditions, density in base conditions, ...

For example, non-allowed data may be : viscosity or density at measuring conditions, temperature, ...

4) Question : As far as a presetting device is concerned, is it possible to issue a pattern approval for an electronic calculating-indicating device alone provided with a presetting functionality, whereas it may not possible to perform an accuracy test on the presetting without a transducer measurement and without the valves of the measuring system associated to the calculator ?

Answer : It seems not possible to perform an accuracy test on the presetting device of an electronic calculating-indicating device alone. Nevertheless, the pattern approval certificate of the calculator may include this functionality, under the condition it clearly indicates that an accuracy test of the meter or the measuring system including the valves, in which the calculator is associated, has to be performed during initial and subsequent verifications.

5) Question : Is it logical that, according to the definition of non-significant fault in T.3.12 of R117, it be allowed that a perturbation considered in A.4 of R117 could imply the impossibility of performing any measurement for a non-interruptible measuring system, when no significant fault is allowed (4.1.1.2) ?

Answer : No, it is not logical. A high level of reliability is necessary for a non-interruptible measuring system.

In any case, whatever the reason of the impossibility of performing any measurement, the concrete effect can only be one of the two following aspects :

- stopping the flow, or
- blocking or blanking the display.

In the case of a non-interruptible measuring system, the first hyphen is not applicable.

The spirit of 4.1.1.2 of R117 is to have an accurate result whithout any alarm, since no alarm with significant fault is allowed. The logical conclusion is that the instrument has to continue working and displaying correctly.

The corresponding provision in T.3.12 should be interpreted as following :

1) The impossibility of performing any measurement is only acceptable for an interruptible measuring system.

2) During tests considered in A.4, a non-interruptible measuring system shall continue to operate as designed and accurately according to 4.1.1.2. However there is no need that checking facilities ensure and control that it continues operating. When it operates, checking facilities shall only control it operates as designed and accurately.

6) Question : Is the checking facility for the indicating device as described in 4.3.4.2 a) the only possibility to check the display ?

Answer : No. What is indicated in brackets has to be considered as the solution for a seven-element display and not as the only possibility to fulfill the requirement.

For application to other displays (matrix, ...) :

* the first hyphen "displaying all the elements" has to be interpretated as "displaying all the elements used to display the measurement results",
* the second hyphen has to be modified in the same way,
* "example" should be added in both brackets,

The following sentence could be added :

"For application of the first and second hyphens and for matrix displaying, white and black is an acceptable solution".

7) Question : Is it mandatory that associated measuring instruments involved in the correction and/or the conversion of volume be sealed ?

Answer : Yes. All the associated measuring instruments involved in the correction and/or the conversion of volumes have to be sealed on site.

II - EXAMPLE OF ACCEPTABLE SOLUTIONS

1) Question : What can be the consequence of the notion of significant fault on the checking facility for the measurement transducer ?

Answer : An interpretation can be given by the following Annex 1.

2) Question : How to know if the pre-setting device included in a measuring system will be used for prepaid or pre-ordered delivery (3.6.6) ?

Answer : The applicant of the pattern approval has to declare if he wants to use the pre-setting device in the case of pre-ordered or pre-paid transaction. If he wish to do that, it is necessary to perform accuracy tests at the level of pattern approval. Then the user of the measuring system has to declare if he wants to use this possibility on site. If he wish to do that, it is necessary to perform accuracy tests at the level of verifications.

If the accuracy has not been verified :

- at the level of pattern approval, the pattern approval certificate shall bear a provision indicating that prepayment is not allowed and that the instrument shall bear the corresponding restriction.

- at the level of a verification, the measuring system shall bear : "prepayment or pre-ordered not allowed".

If the accuracy has been verified at pattern approval, the certificate may contain such a provision : "If the accuracy is not verified at verifications the measuring system shall bear : "prepayment or pre-ordering not allowed".

If the pattern approval certifcate does not contain such a restriction, the accuracy has been verified at pattern approval and is intended to be verified at initial and subsequent verifications.

III - COMPLEMENTARY PROVISIONS OR SPECIFICATIONS

1) Question : The significant fault is currently defined only for the volume. Does it mean that, in case of an electronic calculating-indicating device provided with a conversion device connected to associated measuring instruments, no significant fault for the quantities measured by these instruments has to be defined for the performance tests of Annex A.4 of R117 ?

Answer : It is necessary to define a significant fault for the quantities measured by associated measuring instruments. All requirements to be applied for the volume during the performance tests of Annex A.4 of R117 have to be applied for the quantities measured by associated measuring instruments.

The value of significant fault for the quantities measured by associated measuring instruments retained by NMi, PTB and SDM is two fifth of the MPE given in the Table 4 of R117.

2) Question : What can be the frequency of sampling of the parameters measured by the associated measuring and transmitted to the electronic calculating indicating device for the conversion ?

Answer : The parameter which characterize the measured liquid and which are measured by associated measuring instrument shall be transmitted either at quantities of liquid not exceeding one fifth of the minimum mesured quantity of the meter, or at time intervals not exceeding the duration of the measurement of one fifth of the minimum measured quantity of the meter at the maximum flowrate of the meter.

3) Question : Has the pulser to be considered as a part of the measurement transducer or of the electronic calculating-indicating device ? .

Answer : According to the definitions it has to be considered as a part of the measurement transducer. Moreover, at the moment there is no possibilty to issue a pattern approval for a pulser alone.

Nevertheless, if the pulser is an electronic device, it has to be submitted to tests of Annex A.4 of R117. It seems that the most convenient way to test a pulser according Annex A.4 is to connect it to an electronic calculating-indicating device. These two devices could be tested at the same time.

However as the text is the pulser could be included in the pattern certificate of a meter or a measurement transducer but not in the pattern certificate of a calculator.

For NMi	For PTB	For SDM
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ANNEX 1

Consequence of the notion of significant fault

on the checking facility for the measurement transducer

Application of the notion of significant fault to the maximum permissible deviation of pulses Δn_0 allowable between the two lines of counting or absolute deviation of counting.

Note : The present annex leads to the determination of the maximum permissible deviation of the number of pulses Δn_0 between the two lines of pulses sent by the pulse sensor. This value can be used to calculate the absolute maximum permissible number of parasite pulses, on both lines of counting.

The notion of significant fault is very usefull for the electronic calculating devices because it intervenes at different levels in the study of the instrument, and more particularly during design examination specified in 6.1.2 during the performance tests specified in Annex A.4 of R117. Then, it's necessary and very important to determine in a right way the value of the significant fault for each study.

According to point T.3.12 of R117, it's a fault the magnitude of which is greater than the larger of these two values :

- one fifth of the magnitude of the maximum permissible error for the measured volume,
- the minimum specified volume deviation.

Thus, with :

- ds : significant fault,
- V : measured volume,
- V_{min} : minimum measured quantity,
- E_{min} : minimum specified volume deviation,
- A : numerical value of maximum permissible error applied to measuring system, whose value in per cent (%) is laid down in point 2.5.1 of R117,

we have the relation :

$$|ds| \geq \max \left(\frac{1}{5} \times \frac{A}{100} \times V \; ; \; E_{min}\right)$$

In case of minimum measured quantities greater than or equal to 2 L, we have the following relation (point 2.5.3 of R117) :

$$E_{min} = 2 \times V_{min} \times \frac{A}{100}$$

Thus, the definition of significant fault is becoming in this case, and only in this case :

$$|ds| \geq \max \left(\frac{1}{5} \times \frac{A}{100} \times V \; ; \; 2 \times V_{min} \times \frac{A}{100}\right) \qquad (1)$$

The value of significant fault appears under many aspects in the technical study of a measuring system of liquids other than water. One of these aspects is the determination of maximum permissible deviation of the number of pulses Δn_0 between the two lines of pulses sent by the pulse sensor as shown below.

From the relation (1), we have :

$$|ds| \geq 2 \times V_{min} \times \frac{A}{100} \qquad \text{if } 0 \leq V < 10 \times V_{min} \qquad (2)$$

$$|ds| \geq \frac{1}{5} \times \frac{A}{100} \times V \qquad \text{if } V \geq 10 \times V_{min} \qquad (3)$$

At this step, it's necessary that the manufacturer (or the applicant) indicates clearly which value of significant fault he considered. This value is a metrological one and has to be considered as all metrological parameter (the access to this value has to be protected by sealing devices).

There are two possibilities :

1) The manufacturer takes into account only a constant value of significant fault whatever the measured volume. This value, called ds_{min}, is given by the relation (2) for $V = V_{min}$, by the following relation :

$$ds_{min} = 2 \times V_{min} \times \frac{A}{100} \qquad (4)$$

2) The manufacturer takes into account two values of significant fault according to the measured volume :

   a) the first one, which is constant, is given by the relation :

$$ds_{min} = 2 \times V_{min} \times \frac{A}{100} \qquad \text{for} \quad 0 \leq V < 10 \times V_{min} \qquad (4')$$

   b) the second one, which varies with the measured volume, is given by the relation :

$$ds_{var} = \frac{1}{5} \times \frac{A}{100} \times V \qquad \text{for} \quad V \geq 10 \times V_{min} \qquad (5)$$

If we call p the "weight of a pulse" of the meter, i. e. the volume of a pulse, and n_1 and n_2 the number of accounted pulses on each lines of the pulse sensor, it's necessary to have then :

$$p \times |n_1 - n_2| = p \times \Delta n \leq p \times \Delta n_0 = ds \qquad (6)$$

If we apply this last relation to the two previous possibilities we obtain then :

1) with a constant value of significant fault whatever the measured volume :

$$\Delta n_0 = 2 \times V_{min} \times \frac{A}{100} \times \frac{1}{p} \qquad (7)$$

2) with a value of significant fault which may be constant in a first step and varaiable in a second step :

a) the first one, which is constant, is given by the relation :

$$\Delta n_0 = 2 \times V_{min} \times \frac{A}{100} \times \frac{1}{p} \qquad for \qquad 0 \le V < 10 \times V_{min} \qquad (8)$$

b) the second one, which varies with the measured volume, is given by the relation :

$$\Delta n_0 = \frac{1}{5} \times \frac{A}{100} \times V \times \frac{1}{p} \qquad for \qquad V \ge 10 \times V_{min} \qquad (9)$$

The manufacturer may be allowed to reset the counter of parasite pulses after the delivery of each measurement equal to V_{reset} in the course of a greater delivery. The volume V_{reset} is defined by :

$V_{reset} \ge 20 \times V_{min}$ (10) for selling to the professionals

$V_{reset} \ge 40 \times V_{min}$ (11) for direct selling to the public

In practical case this possibility should be met only in case 1) (equation (7)).

Note : in case of direct selling to the public R117 requires an interruptible measuring system.

According to point 4.3.2.1 of R117, this last relation must be checked by the checking facility for the measurement transducer at time intervals not exceeding the duration of the measurement of the amount of liquid equal to E_{min}.

It is then possible,

(i) either to determine the value of Δn_0, knowing the value of V_{min},
(ii) or, from a known value of Δn_0, to determine the value of V_{min}.