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WELMEC

European Cooperation in Legal Metrology

Guide for common application of MID MI-005 and OIML R117-1, (R81, R80, R139)



WELMEC

European Cooperation in Legal Metrology

WELMEC is a co-operation between the legal metrology authorities of the Member States of the European Union and EFTA.

This document is one of a number of Guides published by WELMEC to provide guidance to manufacturers of measuring instruments and to Notified Bodies responsible for conformity assessment of their products.

The Guides are purely advisory and do not themselves impose any restrictions or additional technical requirements beyond those contained in relevant EU Directives.

Alternative approaches may be acceptable, but the guidance provided in this document represents the considered view of WELMEC as to the best practice to be followed.

Published by:
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E-mail: secretary@welmec.org
Website: www.welmec.org

Foreword

This document is intended to provide guidance to all those concerned with the application of MID Annex MI-005 and/or OIML International Recommendation R117-1 'Dynamic Measuring Systems for Liquids other than Water'.

This document provides a record of the continuing work of WELMEC Working Group 10 in the area of the common application of MID MI-005 and/or OIML R117-1 itself and in addition seeks to provide information, which is specific to individual member countries.

(Author's note 29/02/2012: Country specific information, once available, will be added in a separate Annex).

Some of the decisions made, were based on the R117 (1995). Where applicable, reference to the OIML R117 (1995) articles is presented in ~~strikethrough~~ font and reference to the R117-1 (2007) article has been added in regular font.

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1 Section 1, MID MI-005 related decisions, interpretations, etc.

1.1 MI-005 article 5.3 MPE's with air / gas intake

Introduction

During WG10 meetings and in the MID Amendment discussions it became apparent that article 5.3 of MI-005 and the corresponding OIML R117-1 articles were interpreted inconsistently by the various stakeholders. As a result of this undesirable situation the subject has been discussed at various occasions, ultimately resulting in below interpretation.

Argumentation

Milk measuring systems and their MPE during the entrance of air

This section describes the interpretation of the relevant articles of MID article 5.3 and R117-1, related to milk measuring systems and their MPE, when air is sucked in under normal operating conditions. It also applies to measuring systems fitted with gas elimination devices where air / gas intake occurs often during normal operation, or in other words, is part of the normal operating conditions.

Due to R117-1 2.10.1 measuring systems shall incorporate a gas elimination device for the proper elimination of any air or undissolved gases which may be contained in the liquid before it enters the meter. The suitability of the gas elimination device shall be such that the effect due to the influence of the air or gases on the measuring result does not exceed the values in 2.10.1.

For milk measuring systems, a gas/air elimination device is required according to R117-1 5.6. 5.6.3 first and second sentence describe two situations where air is entering the measuring system; 5.6.3 requires an adequate reaction of the air elimination device and makes a reference to the requirements in 2.10.1.

This statement might give the impression that 5.6.3 deals with an operational condition of the measuring system beyond the rated operating conditions, leading to the assumption that it is acceptable to exceed the MPE of the measuring system (see table 1 of 2.4 and table 2 of 2.5.1) by the values in 2.10.1.

Summary

But contrary to other measuring systems, where the entrance of air is beyond the normal operating conditions, the entrance of air described in 5.6.3 represents the normal working principle of a milk measuring system under rated operating conditions, for which the MPE applies.

Summarised, for measuring systems where air / gas intake occurs often and is therefore considered to be a part of the normal operating conditions, the MPE equals the MPE associated with that application in accordance with MI-005 table 2 only, and no additional shifts.

1.2 Mechanical class Fuel Dispensers M1 or M2

Introduction

In the past, under OIML R117 (1995), it was not customary to perform vibration tests on electronic components of fuel dispensers. In MID however, the definition of the mechanical classes differs somewhat from the then common classification.

Recent experience has shown this leads to questions, which can be settled by means of this decision.

Legal Background

MID

M1 This class applies to instruments used in locations with vibration and shocks of low significance, e.g. for instruments fastened to light supporting structures subject to negligible vibrations and shocks transmitted from local blasting or pile-driving activities, slamming doors, etc.

M2 This class applies to instruments used in locations with significant or high levels of vibration and shock, e.g. transmitted from machines and passing vehicles in the vicinity or adjacent to heavy machines, conveyor belts, etc.

OIML R117 (1995)

From Annex A.4.4 Vibration

This test should normally apply to mobile measuring systems only.

Cross-reference table MID / R117-1, June 2007

M1 is applicable to all measuring systems except those installed on trucks.

M2 is applicable to all measuring systems on trucks and to other types of measuring systems for specific applications.

Technical Background

Often Fuel Dispensers are installed on so-called islands, which are mechanically isolated from the surrounding road paving.

Decision

MID Mechanical Class M1 is applicable for Fuel Dispensers which are mechanically fixed on a dispenser island or solid platform, without performing vibration tests.

1.3 Harmonised EU Approach Self Service Devices

Still under discussion

1.4 On-site verification Yes / No

Introduction

MID doesn't specify the location of tests and/or examination performed during conformity assessment of product at the level of production (with or without quality assurance).

In the field of measuring systems for liquids other than water it is current practice that some tests and/or examination are performed on the instrument or a part of it at the manufacturers premises (by himself under quality assurance or by a notified body).

However there remain cases where due to the design of the system, it is necessary that some tests or part of the examination are performed when the instrument is installed at the place of use just before it is legally put into service.

The responsibility of the manufacturer goes "until and including "putting into use".

This Guide has the intension to help manufacturers in deciding when to perform tests in situ¹.

1. If there is a low risk that the metrological characteristics could be changed during handling, transportation or installation and the end user is considered capable to install the MI himself according to the manufacturer's instructions, the MI may be fully assessed at the manufacturers' premises by himself or by a notified body,
2. If there is a high risk that the metrological characteristics could be changed during handling, transportation or installation the MI should be assessed on site of installation (or at least the final part of the conformity assessment is performed in situ).

The following table is an attempt to reach common interpretation about what has to be in situ. It is also recalled that the content of the type examination certificate (module B) and design examination certificate (module H1) is defined in the relevant annexes of MID and in particular:

- In 5.2 second paragraph of annex B "The certificate and its annexes shall contain all relevant information for conformity evaluation and in service control. In particular"
- In 4.3.2 second paragraph of annex H1 "The certificate and its annexes shall contain all relevant information for conformity evaluation and in service control. It shall ..."

For this purpose for each case of different type of measuring systems of liquids other than water different risks have been evaluated

¹ It is recalled that concerning installation, even when under MID it is considered that the instrument does not need to be tested in situ , a Member State may have its own legislation concerning installation which could be distinguished from the instruments themselves provided that it does not interfere with the implementation of MID and the "fitness for installation" of the instrument. (Of course such a legislation has to be notified in advance to the Commission and other Member states)

Family of MS	Ref in R 117-1	In case of complete conformity assessment of MI in factory the risk that metrological characteristics or performances of the MI are changed before installation is completed is			High probability that examination on site of use, either under Module D or F is necessary*	High probability that testing on site of use, either under Module D or F (e.g. accuracy) F is necessary *	High probability that certification on site of use, either under Module D or F is necessary *	Necessity of demonstrating the competence for installers to be demonstrated to Manufacturer (or to national authority, depending on national legislation)
		due to packaging / handling	due to transportation	due to installation (conditions, need to break a seal...)				
Fuel Dispensers other than LPG and without self-service device with gas separator	5.1	Low	Low	Low	No 1)	No 2)	No 1) 2)	Yes
Fuel Dispensers other than LPG and without self-service device and without gas separator (submerged pumps in particular...)	5.1	Low	Low	High	Yes	No 2)	Yes	Not relevant
Measuring systems on road tankers for liquids of low viscosity	5.2			High	Yes	Yes	Yes	Not relevant
Measuring systems for the unloading of ship's tanks and rail and road tankers using an intermediate tank	5.3			High	Yes	Yes	Yes	Not relevant

Family of MS	Ref in R 117-1	In case of complete conformity assessment of MI in factory the risk that metrological characteristics or performances of the MI are changed before installation is completed is			High probability that examination on site of use, either under Module D or F is necessary*	High probability that testing on site of use, either under Module D or F (e.g. accuracy) F is necessary *	High probability that certification on site of use, either under Module D or F is necessary *	Necessity of demonstrating the competence for installers to be demonstrated to Manufacturer (or to national authority, depending on national legislation)
		due to packaging / handling	due to transportation	due to installation (conditions, need to break a seal...)				
Measuring systems (other than LPG dispensers) for liquefied gases under pressure measured	5.4			High	Yes	Yes	Yes	Not relevant
LPG fuel dispensers for motor vehicles without self-service	5.5	Low	Low	Low	No 1)	No 2)	No 1) 2)	Yes
Measuring systems for milk with a constant level tank	5.6			High	Yes	Yes	Yes	Not relevant
Measuring systems on pipeline and measuring systems for loading ships	5.7			High	Yes	Yes	Yes	Not relevant
Measuring systems for the refuelling of aircraft	5.8			High	Yes	Yes	Yes	Not relevant

Family of MS	Ref in R 117-1	In case of complete conformity assessment of MI in factory the risk that metrological characteristics or performances of the MI are changed before installation is completed is			High probability that examination on site of use, either under Module D or F is necessary*	High probability that testing on site of use, either under Module D or F (e.g. accuracy) F is necessary *	High probability that certification on site of use, either under Module D or F is necessary *	Necessity of demonstrating the competence for installers to be demonstrated to Manufacturer (or to national authority, depending on national legislation)
		due to packaging / handling	due to transportation	due to installation (conditions, need to break a seal...)				
Blend dispensers without self-service	5.9	Idem Fuel Dispensers other than LPG						
Fuel dispensers with self-service device	5.1, 5.5 or 5.9 + 5.10	Low	Low	High	Yes	4)	Yes	Not relevant
Other MS, in particular for loading trucks		Low 3)	Low 3)	Low 3)	No 1) 3)	No 2) 3)	No 1) 2) Yes	Yes Not relevant

* For a MS on truck, the site of uses is the truck

- 1) Provided there is no break of seal
- 2) Provided the MS in tested in laboratory with the intended liquid or with an appropriate substitution liquid
- 3) As soon as there is risk this line applies
- 4) The conditions for the fuel dispenser apply

1.5 Interpretation point 2.8

Introduction

Point 2.8 in Annex MI-005 of the MID (Directive 2014/32/EU) which had been added to the specific requirements of Directive 2004/22/EC by Directive 2009/137/EC reads as follows:

"2.8. The measuring system shall not exploit the MPEs or systematically favour any party".

This article shall transpose into a requirement for modules D, G, H1 and F to insure compliance with this article. The suggested method below gives only guidance for fuel dispensers placed on the market only under Module D of the MID since these are produced in high numbers which can be used in statistical analysis.

Note: For now, modules G, H1 and F are not covered in this Guide.

In the case of F, because the number of individual dispensers may be lower

Suggested method

General information

When manufacturing instruments under MI-005 (petrol stations) and using module D, calibration means and methods shall comply with A.2 of R117-1 (2007)

A.2 Uncertainties of measurement

When a test is conducted, the expanded uncertainty of the determination of errors on indications of volume or mass shall be less than one-fifth of the maximum permissible error applicable for that test on type approval and one-third of the maximum permissible error applicable for that test on other verifications. The estimation of expanded uncertainty is made according to the "Guide to the expression of uncertainty in measurement" (1995 edition) with $k = 2$.

Calibration process shall be such that the adjustment shall lead to measuring instrument error curves which are as much as possible near to zero with calibration tools, taking into account the technical opportunities of a measuring instrument.

As a consequence, when manufacturing instruments under MI-005 and using module D, statistical results (based on the final control recorded data, such data being the base for recalibration decisions at final control) of any given population(*) of instruments (minimum of 20 instruments) passed under module D shall comply with:

- Flow rate: tests used in the sample/population analysis shall be done at maximum flow rate for instruments (if possible, min 80% of approval maximum flowrate).
- Standard deviation calculation (over n-1)
- On complete dispenser

Sample size assessment can be established using WELMEC guide 8.10

Note: The population is determined at the discretion of the auditor.

Expected results

Expected results to comply with requirements of point 2.8, Annex MI-005.

- Mean value (M) : shall be very close to zero (fair limit : $\pm 0,05\%$) (note 1)
- Population in $\pm \frac{1}{3}$ of MPE with $k=2$ (note 2)

An example how to check:

- Collect population sample calibration data (always after any recalibration action)
- Calculate mean value and population standard deviation (n-1) for all collected data
- Check versus Note 2 approach

Note 1:

This is the average calibration value after any recalibration decision

- Instruments will show a standard bell curve distribution before any recalibration decision.
- The mean value and standard deviation of that population will depend on of the manufacturing quality of the sub-components involved upstream final metrology test (meter, etc..)
- After calibration check, decision should be taken to always pull back to the closest to zero any offset seen during final metrology test
- Statistical information (here, mean value and standard deviation) to be built from metrological calibration information AFTER any decision to recalibrate is applied

Note 2:

Population interval for $k=2$ is established as [(M - 2 x σ) ; (M + 2 x σ)]

- It is assumed that statistically, 95% of sampled population is compliant to requirement if population interval does not overlay outside of $\pm \frac{1}{3}$ of MPE from zero.
- Easy approach is to require that $-\frac{1}{3} \times 0,5\% \leq (M - 2 \times \sigma)$ and $(M + 2 \times \sigma) \leq + \frac{1}{3} \times 0,5\%$

2 Section 2, OIML R117-1 related decisions, interpretations, etc.

2.1 Sub-merged pumps

This section describes the interpretation of the relevant articles of R117-1, related to the omitting of the gas elimination device in fuel dispensers, other than LPG dispensers, intended for installation in a system with a submerge pump.

When the measuring system is intended for installation in a centrally pumped system, or for a remote pump, the general provisions in 2.10 shall be applied, e.g. the provisions in point 2.10.1. Because of the pumped flow, the provisions of point 2.10.2 are also applicable. As a general rule a gas elimination device is to be installed.

However the second paragraph of point 5.1.3 says:

“If it is not intended to install a gas elimination device, there shall be ~~the manufacturer or installer has to prove that there is~~ no risk of air intake or gas release. In this case, an automatic facility (such as a storage tank level detector) shall automatically prevent further deliveries when the storage tank minimum level is reached (see also 2.10.2) ~~the minimum level in the storage tank must be automatically secured and any leakage shall be checked.~~”

When no gas elimination device is installed, these prescriptions may be fulfilled by applying all of the following provisions 1 to 8.

1. Air intake / Minimum level.

To secure automatically the minimum level in the storage tank, a level detection system shall be installed. This system prevents using the submerge pump when the liquid level reaches a minimum level above the inlet of the pump, so that there is no risk of air intake. The minimum level that has to be respected is given by the following formula:

$$h \Rightarrow k \cdot v^2 / 2 \cdot g$$

where:

h: minimum level of the liquid above the suction inlet of the pump [m]

v: maximum velocity of the liquid at the pump inlet [m/s]

g: acceleration of gravity [m/s²]

k: security factor; k is at least equal to 6

with k=6 the formula becomes:

$$h \Rightarrow 3v^2 / g$$

2. Gas release

Gas can be generated during shut down periods as a result of temperature drop.

If it cannot be proven by calculation (see point 2.13.2) that the gaseous formation has a specific effect smaller than or equal to 1 % of the minimum measured quantity (see 2.10.2 ~~40.2.2~~) than at least one of the following provisions shall be applied to assure that no released gas will be in the system at the start and during the delivery:

- 2.1 A detection system based on a pressure control device holds the pressure of the liquid always well above the vapour pressure.
- 2.2 Each delivery shall be delayed until the submerge pump has been running for at least 3 seconds.

3. Leak detection

A leak detection system shall be installed.

Detection of any leakage in the line shall result in stopping or preventing of any delivery.

The detection system of 2.1 can fulfil the leak detection function.

4. Pipeline construction

The pipelines between the pump unit and the dispenser are installed with a positive slope of at least 1 %. There shall be no significant portion with no slope.

No high points are allowed upstream of each dispenser, except for the ones needed for the connection with other dispensers.

5. Non-return valve

At least one non-return valve shall be installed in the system. It is advisable to install a non-return valve upstream of every measurement transducer.

Note: this non-return valve shall not be likely to create gaseous formations.

6. Security of the devices

All the devices mentioned shall be in "positive" security so that no delivery is possible if one of these devices fail.

It shall be possible to check if the electronic devices (e.g. by simulation) are functioning correctly.

7. Type approval

The type approval certificate of the fuel dispenser shall clearly describe the above provisions 1 to 7 that have to be followed to allow the omitting of the gas elimination device.

8. Initial verification

The initial verification of the fuel dispenser shall include examination on site of use with respect to the above provisions:

- testing the positive security of all the devices,
- checking the correct functioning of the electronic devices by simulation,
- checking that the prescription for the minimum level is fulfilled,
- checking the presence of a leak detection system,
- if applicable, checking the delay time of delivery for each dispenser,
- checking the slope of the pipes on drawings.

2.2 Non-interruptible systems performance criteria

According to this definition, it is not logical to allow that a perturbation considered in A.11 A-4 imply the impossibility of performing any measurement for a non-interruptible measuring system, when no significant fault is allowed (4.1.1.2).

A high level of reliability is necessary for a non-interruptible measuring system. In any case, whatever the reason of the impossibility of performing a 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 R 117-1 is to have an accurate result without 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.f.1 ~~T-3-12~~ should be interpreted as following:

- a) The impossibility of performing any measurement is only acceptable for an interruptible measuring system.
- b) During tests considered in A.11 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.

(Authors note 29/02/2012: article 4.1.1.2 has not changed between the 1995 and 2007 edition of R117; only change made is replacement of "R117" by "R117-1").

2.3 Sealing of Associated measuring sensors and mandatory printing

- a) Associated measuring instruments sensors involved in the correction and/or conversion of volumes have to be sealed against unauthorized removal.
- b) According to 3.1.4.5 ~~the fifth paragraph of 2-20.1~~ it is not acceptable 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 participates in the **correction** of the volume.

This may be acceptable only in case of **selling between professionals** and only for the nature of the measured liquid or its viscosity. According to 3.1.4.5 ~~the last sentence of the fifth paragraph of 2-20.1~~ in this case it is necessary to provide the measuring system with a printing device. This device shall print this datum and a note explaining that this datum has been entered manually. According to 3.1.4.5 ~~2-2.2~~ this printing device shall be subject to control.

It is allowed to replace the printing device by a memory device or, when both parties have the possibility to be present to conclude the transaction, by any appropriate means to inform the two parties of the conditions of correction (for instance by displaying the nature of the liquid at the end of the transaction if the nature of the liquid participates in the correction). The pattern approval certificate may indicate how to gain access to the memorized data.

In case of **correction and direct selling to the public**, it is not authorized 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.

3 Section 3, ARCHIVE / REMINDERS

3.1 Pulser testing

According to this definition the pulser has to be considered as a part of the measurement transducer.

At the moment R 117-1 gives no possibility to issue a pattern approval for a pulser alone.

According to the current definition the pulser could be included in the pattern approval certificate of a meter or a measurement transducer but not in the pattern approval certificate of a calculator / indicating device.

Nevertheless, if the pulser is an electronic device, it has to be submitted to tests of Annex A.11 of R 117-1. It seems that the most convenient way to test a pulser according to Annex A.11 is to connect it to an electronic calculator / indicating device. These two devices could be tested at the same time. In that case the test report covers both devices.

Revision History

Version	Significant changes
2016	Addition section 1.5