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World Metrology Day 2014:
Measurements and the global energy challenge

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Chris Pulham
Editor/Webmaster

World Metrology Day 2014 – a resounding success!

The 2014 theme, *Measurements and the global energy challenge* is of utmost importance as we face the challenge of diminishing energy resources and the urgent need to better manage our usage of supplies which are becoming increasingly scarce. As our energy consumption needs continue to grow, how can we better protect our environment and what technologies (measurement and other) will be required to do this; how can we build zero-energy houses, offices and factories, what smart-metering techniques can be developed to monitor and control our energy consumption, and what alternative sources can be developed? These questions and many others were raised during the World Metrology Day events worldwide, but will certainly continue to be topical for decades to come.

World Metrology Day 2014 was a huge success. Following in the wake of the very popular 2013 theme *Measurements in daily life*, this year's theme was again one that many people could not only relate to very closely, but also develop and expand to fit their national objectives. Different countries are at different stages of awareness and the abundant variety of events contributed significantly to this year's goal. Awareness-raising is key to the future direction that work on energy-related questions will take.

This success is reflected in the www.worldmetrologyday.org website statistics: on 20 May alone the WMD website received almost 50 000 hits, an all-time record. There were 180 000 hits for the whole month of May. There were about 2 500 distinct visitors to the site on 20 May (6 500 for the whole month).

25 variations of the poster were published and 30 countries submitted details of national or regional events to celebrate World Metrology Day. This led to a large number of exchanges between participants across the world and productive exchanges between the BIPM and the BIML who again jointly coordinated the production of the Press Release, Directors' messages, posters and website. The WMD Team would like to extend a very warm thank-you to our colleagues at KRISS, the Republic of Korea's national metrology institute, who designed the poster and who worked tirelessly to perfect it and respond to our (numerous!) suggestions and requests.

As we reflect on the success of the 2014 WMD we acknowledge and thank you all for your continued and growing interest and participation in the World Metrology Day event.

For more information, please see page 54 of this Bulletin and visit www.worldmetrologyday.org. ■

UTILITY METERS

The application of "In-Service Testing" of domestic type gas and electricity meters in the UK

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In-Service Testing (IST) is a statistical sampling scheme administered by the National Measurement Office (NMO) developed to enable energy suppliers, who have the legal responsibility to demonstrate that populations of gas and electricity meters approved under the European Measuring Instruments Directive continue to conform to legal requirements.

Introduction

In the United Kingdom, prior to October 2006, all gas and electricity meters were placed on the market in accordance with the requirements of national legislation. From October 2006, the *Measuring Instruments Directive* (MID) 2004/22/EC was implemented which allows for the free movement of weighing and measuring instruments (including gas and electricity meters) across the European Union. The MID is only applicable to meters up to the point at which they are first placed onto the market. Once in-service, national provisions apply and in the UK these are set out in the Gas and Electricity Acts.

There is no defined service period for MID gas and electricity meters and they can remain in-service for as long as they conform to the legal requirements, which correspond to the relevant parts of the Gas and Electricity Acts.

However, due to changes in the approval process and the in-service maximum permissible errors (MPE) allowed for MID approved meters, the UK Industry Metering Advisory Group (IMAG) was formed, consisting of key stakeholders from the government, meter manufacturers, energy suppliers and other interested parties.

Expert groups

The IMAG set up the IST and post-MID expert group (IST1), to develop proposals for the in-service accuracy monitoring of MID approved domestic type gas and electricity meters. A further expert group (IST2) was subsequently established to develop additional proposals to ensure the other legislative requirements aside from meter accuracy were also covered. The combined proposals of these groups were published in the IST1/2 report that was accepted by IMAG in 2008. These proposals set out a methodology based on sample testing whereby energy suppliers can demonstrate they are fulfilling their statutory obligation to keep meter populations in proper order for correctly registering the quantities of gas and electricity consumed.

A further expert group (IST3) was then established to consider the costs of the IST scheme and possible governance arrangements. The findings of this group were published in the IST3 report in 2009. IMAG and NMO then published a joint consultation on the governance options and it was agreed that NMO would assume responsibility for governance of the IST scheme.

This has developed into the current expert group (IST4) to implement the IST scheme, which is chaired by NMO. This group has approved the official IST handbook (current version as available on the NMO website is v2.2), which details the methodology, tests employed and any other information of use for the meter submitters and the IST test stations. This group is open to all interested parties including energy suppliers, trade organisations and meter manufacturers.

Scope of IST

With the testing methodology agreed upon, IST is a national sampling scheme for gas and electricity meters based on ISO 3951:1989 *Sampling procedures and charts for inspection by variables for percent nonconforming*. The IST scheme currently only covers domestic type meters approved under the MID. Domestic type meters are defined as those with a maximum capacity of 6 m^3/hour (gas) and whole current, single phase meters (electricity).

Sampling by attributes had been used for other similar national sampling schemes previously as the statistical method of determination, but sampling by variables captures more data during the testing process, thereby reducing the number of meters required for sampling. This results in a cost reduction to industry in removing meters and ultimately prevents those costs being passed onto the consumer and also reduces the possible inconvenience to consumers in having their

Table 1 Sample size in relation to population
Table based upon sample size tables I-A & I-B of ISO 3951:1989

Population by type and year	Sample size
1 201 to 3 200	50
3 201 to 10 000	75
10 001 to 35 000	100
35 001 to 150 000	150
>150 000	200

meters removed. Table 1 shows the sample size required compared to the population as a whole of the meter type/production year in general.

NMO contacts energy suppliers on an annual basis to request information about the meters in their portfolios, including manufacturer, model number, year of installation, and population size. NMO then collates this information to obtain a list of meter samples required for in-service testing. The sample sizes are allocated in proportion to the overall population size as detailed in the IST handbook (see Table 1). Energy suppliers are requested to submit the required number of samples to approved IST test stations for laboratory testing. Finally, NMO collates the test results and assesses the performance of individual meter populations using the agreed assessment criteria. IST will take place at regular intervals throughout the anticipated lifespan of a gas or electricity meter, with gas meters being sampled at three-year intervals and electricity meters first sampled after eight years and then at five-year intervals. Meters may continue in-service for as long as they conform to the regulations, while meters that no longer conform will need to be removed from service. IST therefore forms an important part of consumer protection by ensuring that only meters that operate within the prescribed MPEs are used for consumer billing.

Assessment of results

In determining the acceptability of the meters, the accuracy is checked at the following flow rates and load points for gas and electricity meters respectively, under the applicable MPEs, which are given in the tables below.

For gas meters, the limits of error for test purposes are shown in Table 2, where Q_{max} is the maximum rated flow rate of a gas meter.

Table 2 Gas meter MPEs
These values are taken from The Measuring Instruments (Gas Meters) Regulations (SI 2006/2647)

Flow rate	MPE Class 1.5	MPE Class 1.0 (no additional in-service tolerance)
0.2 Q_{max}	± 3.0 %	± 1.0 %
1.0 Q_{max}	± 3.0 %	± 1.0 %

Table 3 Electricity meter MPEs
These values are based on the test requirements in Table 4 of BS EN 50470-3:2006 for tests of accuracy at reference conditions, allowing for the additional errors due to variation of influence conditions to be taken into account

Load point	MPE for meters of Class A	MPE for meters of Class B	MPE for meters of Class C
1 amp	± 2.5 %	± 1.5 %	± 1.0 %
20 amps	± 2.0 %	± 1.0 %	± 0.5 %
I_{max}	± 2.0 %	± 1.0 %	± 0.5 %

For electricity meters, the limits of error for test purposes are shown in Table 3, where I_{max} is the maximum rated current of an electricity meter.

Populations may be assessed individually or as part of an overall population. To assess an individual population the sample average error ($\bar{x}$) and the sample standard deviation (s) are calculated.

Determine the value of the following two expressions:

$$\frac{\text{USL} - \bar{x}}{s} \quad \text{and} \quad \frac{\bar{x} - \text{LSL}}{s}$$

where:

USL (the upper specification limit) is the positive tolerance given in Tables 2 & 3, and
LSL (the lower specification limit) is the negative tolerance given in Tables 2 & 3.

If for any test point where:

$$\frac{\text{USL} - \bar{x}}{s} < k \text{ or } \frac{\bar{x} - \text{LSL}}{s} < k$$

the population shall be deemed unacceptable.

Table 4
Values of k corresponding to the sample size for an AQL of 2.5

	AQL	Sample size				
		50	75	100	150	200
		k				
Target	2.50	1.61	1.65	1.67	1.70	1.70

Where:

k is the acceptability constant for an AQL of 2.5 (See Table 4).

The value of k is dependent on the population size (and hence the sample size) and the defined acceptable quality level (AQL). Table II-A – Single sampling plans for normal inspection (master table): "s" method for ISO 3951:1989 has been utilised to derive the appropriate values of k.

When analysing results, it is assumed all samples will exhibit a normal distribution curve. If this is not the case and the samples are exhibiting anything which is not a normal distribution, other sampling methods should be considered such as sampling by attributes.

AQL: Acceptable Quality Level / Acceptance Quality Limit

A measure of the quality routinely accepted, AQL is defined as the percent defective that the sampling plan will accept 95 % of the time – i.e. lots at, or better than, the AQL will be accepted at least 95 % of the time and rejected at most 5 % of the time.

The decision of the IST4 group to use an AQL of 2.5 was governed by a number of factors, including employing statistical experts for input and advice but it is also a balance between the cost of replacing meter populations and the consequences of nonconforming meters remaining in service. NMO reserves the right to amend the AQL value in the future as the IST scheme evolves and historical data for various meter types becomes available.

Asset management

In detailing the IST assessment process the overall accuracy of the meters is the primary concern in the IST analysis, but as part of the overall asset management functions of IST, supplementary tests are also included. For gas meters these include testing of PUG (passing of unregistered gas), Gas Tightness (external leakage) and Advances under No Load (for ultrasonic E6 meters only). For electricity meters we include a Register Advance and No Load Condition test. Failure of these tests will result in the meter not undergoing the accuracy tests, but a record is made in the reporting details so potential manufacturing issues, etc. may be investigated. A further check involves assessing the state of any corrosion/rust on gas meter cases and recording the severity of this by following a scale within the IST handbook.

Annex 3 – Drawing of Samples & Test Requirements in the IST handbook v2.2 details potential issues affecting gas and electricity meters submitted for sample testing which should be recorded for possible further investigation, and those issues such as physical damage and fraud attempts that may be discarded as a one off issue.

Current situation

The IST scheme is still in its infancy and is subject to further development as the various stakeholders participate in the removal and testing of MID meters.

According to the agreed schedule and timetables, two of the largest energy suppliers operating within the UK submitted 50 domestic type gas meters manufactured in 2010 for sample testing last year. The results of this M10 testing have only just been received because of delays in the testing process although NMO shall shortly be commencing our analysis of this data and will be discussing the results with the main stakeholders affected.

The main focus of IST this year will be the testing of M11 marked domestic type gas meters. The "Big 6" energy suppliers, that cover the majority of consumers in the UK, have all agreed to participate and will be removing a selection of different meter types from their portfolios and submitting these for testing. The test results will be reviewed later this year and, again, NMO proposes a stakeholder review meeting to discuss the results and the testing processes, to ascertain whether improvements can be made.

Later this year NMO will also be asking the major energy suppliers to provide details of all M12 marked domestic type gas meters within their portfolios which they supply gas through. From this we will determine the number of samples required for testing in 2015. Electricity meters are first sampled eight years after manufacture and we will also begin to request information on MID electricity meters manufactured in 2006 and 2007. This will be more to evaluate the situation within the UK as we do not anticipate any meter types made available in large numbers in what were the early stages of the MID implementation.

Finally, as part of the governance procedures administered by NMO and to ensure we have confidence in all test results, we will continue with the auditing and approval of official IST test stations. As laid out in the IST handbook, only those meter test stations audited and appointed by us can test meters under the IST scheme. This will entail the annual audit of those already appointed as test stations and will hopefully include a number of other industry parties who have expressed an interest in being appointed, ensuring a busy year for those members of the Utilities Regulation team at NMO who have the responsibility for overseeing IST.

Future applications

NMO is now considering how the IST methodology may be extended to meters approved under UK national legislation.

Since the implementation of IST in 2010, NMO has been working with the Big 6 electricity suppliers to consider how the IST sampling process could be used as a mechanism to extend the certification life of electricity meters approved under UK national legislation. Certification is a legal requirement for the majority of electricity meters and used for domestic billing and it ensures meter populations are maintained in proper order for correctly registering the quantities of electricity consumed. Certification lives are listed in Schedule 4 of The Meters (Certification) Regulations (SI 1998/1566) which is published on the NMO website.

IST can assist suppliers to manage their meter portfolios during the transition to “smart meters”. With the UK Government mandated roll-out of smart meters to commence in 2015 and due to finish in 2020, many suppliers are reluctant to replace old meters with new “dumb” meters which may only have a few years of operating life. Extending IST to include legacy meters will enable suppliers to maximise asset life by avoiding unnecessary meter replacements, thereby reducing costs and any inconvenience to consumers.

In the future it may be possible to extend the IST methodology to cover non-domestic meters (i.e. larger meters installed in industrial and commercial premises). However, the statistical process detailed in the IST handbook will need to be modified to account for the much smaller populations of these meters.

With over 50 million gas and electricity meters within the UK, IST forms an essential part of consumer protection. The sampling scheme acts as one of numerous checks in regulating that only meters conforming to the legal requirements (including accuracy) are used for billing purposes. NMO will also continue to work with all industry stakeholders to promote IST as a valuable tool for asset management purposes. ■

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SOUND POWER

A new approach in sound power metrology

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Abstract

Despite the huge importance of the sound power level, shown e.g. by the fact that several European Directives directly refer to this quantity, its metrology is not well developed. There are no primary realizations of the acoustic watt in airborne sound and therefore no traceable measurement results at present. A joint research project coordinated by the PTB and funded by the European Metrology Research Programme (EMRP) aims to establish traceability for the measurand sound power level starting from the realization of the unit by a primary sound power source via the dissemination of the unit by appropriate transfer standards ending in applications in machinery noise. This contribution gives an overview of the basic concepts of this project.

Introduction

Sound power is the major descriptor for the total amount of sound radiated from a source. As opposed to acoustic field quantities such as sound pressure, it is independent of the distance to the source. It is furthermore considered that the acoustic environment does not influence the sound power output of a source. The acoustic properties of technical products, e.g. a sound emission or a sound insulation, are therefore described in terms of sound power or quantities derived thereof. Due to its outstanding importance in noise protection and other fields, several European Directives refer directly to the concept of sound power. These are the Outdoor Directive [1], the Machinery Directive [2] and the Energy Labelling Directive [3].

Outdoor Directive

The Outdoor Directive is related to the noise emission in the environment by equipment for use outdoors. Sound power levels from such equipment must be determined and declared. For some machines, e.g. lawnmowers and earth moving machinery, permissible sound power levels are defined and manufacturers are not allowed to market their products in Europe if they do not meet these requirements. Therefore, manufacturers as well as the notified bodies which carry out or supervise the conformity assessment procedures require traceable results with small uncertainties and a transparent uncertainty budget. At present, “Measurement uncertainties are not taken into account in the framework of conformity assessment procedures in the design phase.” (Annex III of the Outdoor Directive).

Machinery Directive

The Machinery Directive supports the free movement of goods in the European internal market. As a Directive under Article 114 of the Treaty on the Functioning of the European Union, drawn up to avoid trade barriers, it poses essential requirements on safety issues which have to be observed by all machinery manufacturers and machine importers in Europe. As noise is one of the important hazards addressed by the Machinery Directive, essential requirements on noise are included. Most important is the minimization requirement that postulates a noise control at the source by design with the aim of reaching the lowest possible noise emission levels. As a consequence it is necessary to assess whether the applied noise reduction measures are sufficient with regard to the state of the art of noise reduction. The emission values must be given in the instruction manual of the respective machine and in the sales literature describing the machinery. The intention is to allow potential purchasers of machines to compare machines of the same type but of different brands in order to choose the quietest machine on the market. As a result, the noise exposure of workers will be reduced by applying quieter machines at work places, thus leading to fewer people with a hearing impairment. Hearing impairment is one of the most prevalent occupational diseases today. The whole concept of the Machinery Directive is closely linked to the measurand sound power.

Energy Labelling Directive

The Energy Labelling Directive establishes a framework for the harmonization of national measures on end-user information, particularly by means of labelling and standard product information, on the consumption of energy and where relevant of other essential resources during use. This includes supplementary information concerning energy-related products, thereby allowing end-users to choose more efficient products. It is supplemented by Commission delegated regulations with regard to several household appliances. Such regulations exist e.g. for dishwashers, washing machines and refrigerators. The label on such household appliances must contain the "airborne acoustical noise emissions expressed in dB(A) re 1 pW and rounded to the nearest integer". It is expected that future regulations for further household appliances will also contain the noise emission criterion which is quantified by the sound power level.

Sound power determination – State of the art

Despite this importance, the metrological system for sound power is not well developed. There is no primary sound power standard, there is no system of traceability implemented, and uncertainty estimates are not well developed.

There are various standardized measurement procedures for the determination of sound power levels:

- a method that is used very often is the enveloping surface method in which the sound pressure level is measured and the sound power level is calculated from the mean sound pressure level under the assumption of a free field [4] or of an essentially free field [5], [6];
- in another approach, the sound pressure level is used to approximate the energy density in a diffuse field [7] or in a nearly diffuse field [8]. Integrating the energy density over the room volume then gives the sound power level;
- there are also substitution methods for diffuse fields [7] and essentially diffuse fields [9], [10]. For these methods, the source under test is substituted by a reference sound source which is "calibrated" according to [11]. The term calibration is misleading in this context since calibrations require traceability of the results to national standards which do not currently exist for the quantity sound power. The "calibration" according to [11] is simply a sound power determination in free or diffuse sound fields using sound pressure. The best estimate for the uncertainty of the sound power output of reference sound sources is at present the standard deviation of reproducibility derived from an interlaboratory test [12].

The sound field assumption is crucial for all methods using sound pressure. The best technical approximations for a free field are described in [4]. There, the decrease in sound pressure level measured over an increasing distance from a point source is used as a criterion for the sound field quality. For hemianechoic rooms, i.e. free fields over a reflecting surface, a

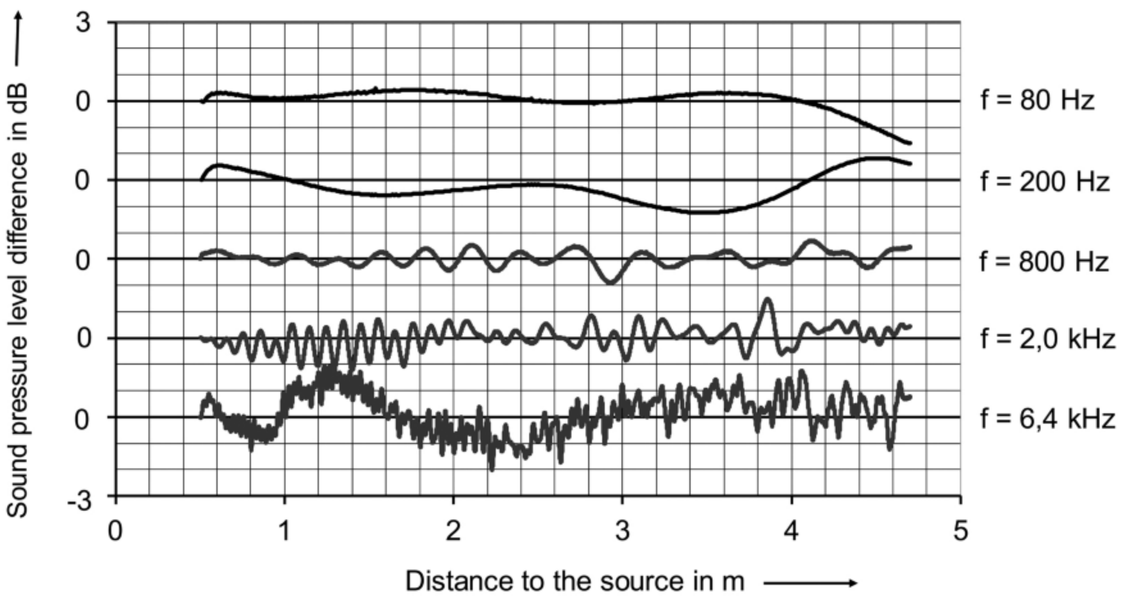

Figure 1: Difference between measured sound pressure levels and the ideal free field in a high quality hemianechoic room as a function of the distance to a point source. The standing wave pattern is clearly visible.

deviation to the ideal free field of ±2.0 dB is still considered to be a free field at medium frequencies. For high and low frequencies, even larger deviations are tolerated. An example for a high quality test room with such a free field is given in Figure 1. Deviations from the ideal free field behavior are in the range of a few dB in this room. It is clear that the remaining room reflections influence the sound power levels determined in these rooms, but it is not known to which extent. Similar arguments apply to diffuse-field methods where the required field quality can only be approximated in technical realizations.

Sound power determinations based on sound intensity measurements on an enveloping surface either at discrete positions [13] or by scanning [14], [15] are theoretically less dependent on the sound field quality, even though they currently also lack transparent uncertainty budgets. This is due to the fact that there is no primary standard for sound intensity which makes it impossible to derive an uncertainty budget for a sound intensity measurement until today. Furthermore, uncertainties of the sound intensity methods are currently estimated by standard deviations of reproducibility which are estimated and have never been checked under reproducibility conditions.

A good illustration of the current situation can be found in Figure 2. There, the A-weighted sound power level determined by one method (ISO 3747) is printed as a function of the sound power level determined by another method (ISO 9614-2) for the same machine. Both results were obtained by the same measurement team. It is obvious that there is an offset with respect to the mean of about 2 dB between both methods. But it cannot be decided today which of the methods is more appropriate. The results come from a European project [16], [17] where the sound power levels of five machines were each measured by about 8 different teams. It has to be noted here that the machines remained at the same place since they were quite large. So, the outer sound field remained constant during these measurements. This reduces possible deviations within the results obtained according to one method but also influences the offset between both methods.

Sound power determination – New approach

To improve the situation, a joint research project (JRP) funded by the European Metrology Research Programme (EMRP) was started in June 2013 with the aim of establishing traceability for the measurand sound power. The starting point is a primary standard for the realization of the unit watt in airborne sound and is based on a vibrating baffled solid body. The sound power output of this device can be determined from the vibration velocity of the body's surface and several additional quantities using Rayleigh's integral. If the surface of the radiating solid body is discretized, the following equation is obtained [18], [19] for the radiated sound power P:

$$P = \sum_{i=1}^{N} \frac{\rho\, c}{2\,\pi} k^2\, v_i^2\, S_i^2 + 2 \sum_{i=1}^{N} \sum_{l=i+1}^{N} \frac{\rho\, c}{2\,\pi} k^2 v_i\, v_l\, S_i\, S_l\, \frac{\sin(k\, d_{il})}{k\, d_{il}} \cos(\varphi_i - \varphi_l) \quad (1)$$

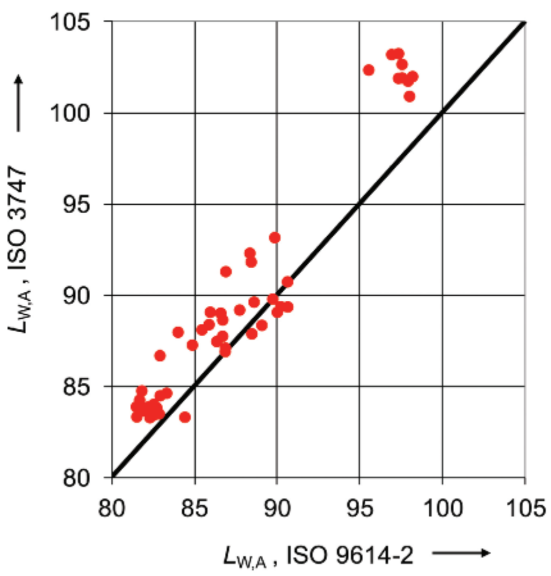

Figure 2: A-weighted sound power levels of five different machines measured each by 8 different teams with two different methods (ISO 3747 and ISO 9614-2), measurement results from [16], analysis from [17].

where:

v_i is the vibration velocity of the i-th radiating element,
φ_i is the phase of the vibration velocity of the i-th radiating element,
S_i is the element area,
k is the wave number,
d_{il} is the distance between the i-th and l-th radiating element,
ρ is the density of air, and
c the speed of sound in air.

So, eq. (1) provides a means to determine a sound power without any assumption on the outer sound field. In particular, measurements in the airborne sound field as well as restricting assumptions on the nature of the sound field are not required. This is a basic advantage to the state of the art.

The technical implementation will consist of an embedded piston which will be driven by an electrodynamic vibration exciter [20]. The vibration velocity of this device can traceably be measured by laser vibrometry including the phase. All the other quantities required for eq. (1) can be determined by other appropriate sensors which are traceable. It is furthermore to be pointed out that in theory there is no restriction to the distribution of velocities on the surface of the piston. There is also no linearity required between the input voltage to the vibration exciter and the vibration velocity. An uncertainty of 0.5 dB for the realization of the unit watt is thus targeted. Within the project, four different institutes will realize the unit watt in airborne sound by such a source. First realizations are already showing promising results [21].

A further main objective of this JRP is to develop a system for the dissemination of the unit watt. Therefore, the primary source will be installed in existing hemianechoic and reverberation rooms. The vibration velocity and its phase will be measured, which are used to determine the sound power level of the primary source $L_{\mathrm{W,PS}}$ by eq. (1). Then, the sound pressure level $L_{p,\mathrm{PS}}$ averaged over an enveloping surface (hemi free field) or over the room volume (diffuse field) will be measured. Finally, the primary source will be substituted by a transfer standard and the sound pressure level $L_{p,\mathrm{TS}}$ induced by this secondary source will be measured with the same measurement equipment and at the same positions as for the primary source. The sound power level of the transfer standard then simply is:

$$L_{\mathrm{W,TS}} = L_{\mathrm{W,PS}} + L_{p,\mathrm{TS}} - L_{p,\mathrm{PS}} \qquad (2)$$

Of course, aspects such as the radiation patterns and frequency content of the primary and secondary source must be considered in the process of dissemination. It will furthermore be investigated whether existing aerodynamic reference sound sources may serve as transfer standards. First results demonstrate that this should be possible [22]. In addition, a tonal transfer standard will be developed and tested since the whole system of realization and dissemination is not restricted to broad band sound sources.

A final goal of the JRP is the application of the transfer standards in machinery noise. One application to be developed is the qualification of complete measurement setups for sound power determinations. These setups are combinations of the acoustic field properties and the measurement equipment. The determination of the sound power of real sources by comparing them to a transfer standard is another application aimed at. Here, the determination of the uncertainty of the sound power is a major topic.

Summary

The sound power level as the main descriptor for the overall sound radiation from a source currently lacks traceability. This leads to non-transparent uncertainty budgets and large uncertainties. Establishing traceability for the quantity sound power level is therefore the major aim of a research project funded by EMRP. This project started in June 2013 and will have a duration of three years. Project partners are the national metrology institutes from Italy (INRIM), Sweden (SP), France (LNE), Turkey (TUBITAK), Germany (PTB) as well as Politecnico di Torino (POLITO) and the Federal institute for occupational safety and health in Germany (BAuA). The EMRP is jointly funded by the EMRP participating countries within Euramet and the European Union. ■

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SPEED MEASUREMENT

A complete and accurate system for the measurement of speed and acceleration based on piezoelectric wires and applied to road traffic

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Introduction

This article presents an accurate and reliable system for measuring the speed and acceleration of motor vehicles. Known as the PISYS system (from **pi**ezoelectric **sy**stem **s**peed), it calculates speed through the magnitudes that define it: distance and time.

Description

The PISYS reference system is based on piezoelectric wires which are embedded in the roadway and positioned perpendicularly to the direction of travel at perfectly known distances. It calculates the speed of motor vehicles through the signal received from the piezos, when they are pressured by the passage of vehicles. It consists of three modules:

i) a group of piezoelectric wires distributed in a particular provision,

ii) equipment to which the wires are connected for processing the signal responsible for making the necessary calculations, and

iii) a desktop application that connects to the equipment for processing the signal and that works as a user terminal, displaying the calculated data.

The group of piezoelectric elements is composed of two groups of piezoelectric sensors positioned on the highway consisting of two lanes in each direction of travel. Each group of sensors has eight wires; one group

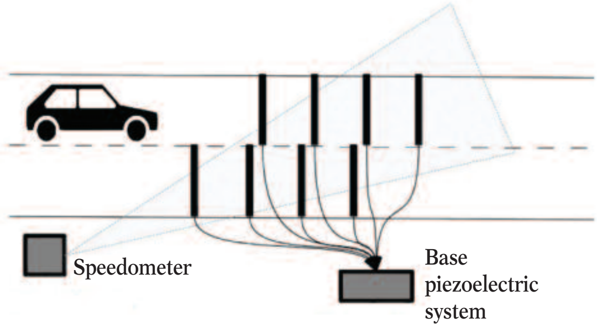

Fig. 1 Wires arrangement

applies to the measurement of speed and acceleration that we could consider instantaneous and the other applies to the measurement of average speed over a known section of around 300 m.

The first group of sensors is positioned on the highway with four wires per lane separated by different intervals and distanced from each other to facilitate the verification of the speedometer when the radiation beam is projected in the far lane (see Figure 1).

The second group of sensors is positioned on the highway in sets of four, separated from each other by a distance of around 300 m. This arrangement is used for the assessment and verification procedures of section speedometers or average speeds (see Figure 2a).

The data processing system is composed of a hardware device that allows the signal generated from the wires to be fed to a software control module which processes and presents the results and which applies primarily to the evaluation and verification of speedometers used to control the speed of vehicles in traffic and to calibrate other systems for the measurement of speed and acceleration used in the assessment of speedometers.

Operating principle

The system calculates the speed of a vehicle that crosses two lines situated at a known distance d_p. When the vehicle passes both barriers the system records the signals and measures the time between them (wire 1 signal vs. wire 2 signal) to obtain the measurement of the vehicle's speed (see Figure 2b).

Since there are four wires per lane we can obtain up to six partial speed readings, with the weighted geometric mean as a result of all of them - see Figure 3.

Although we can obtain a maximum of six speed readings per lane, the system allows the user to activate or deactivate the sensors whenever he chooses to, and a certain area, lane or both lanes can be measured simultaneously.

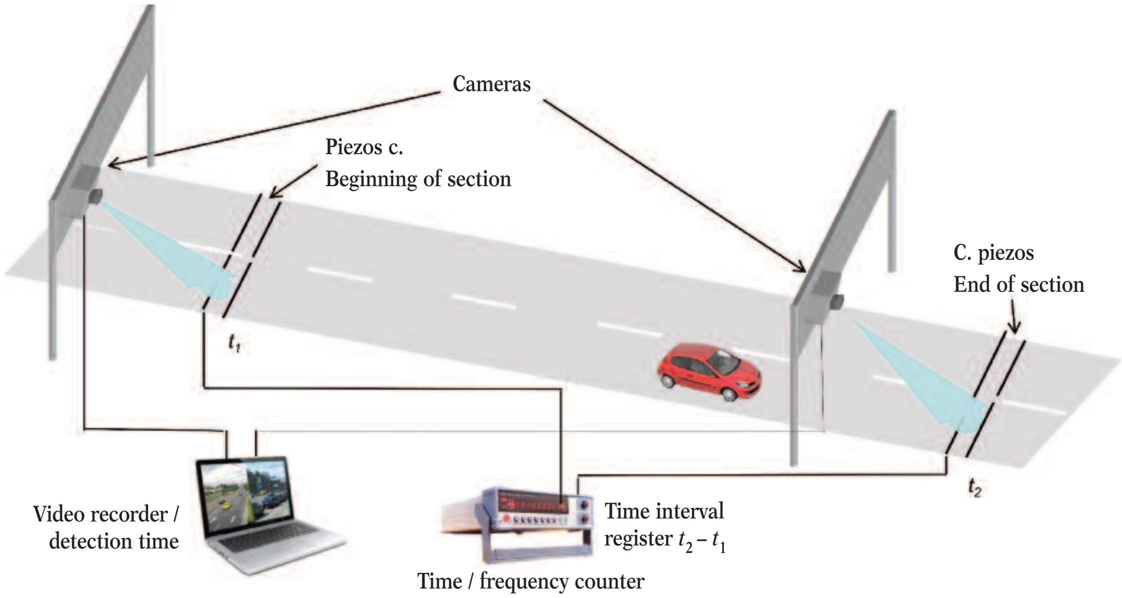

Fig. 2a Arrangement of the sensors for average speeds

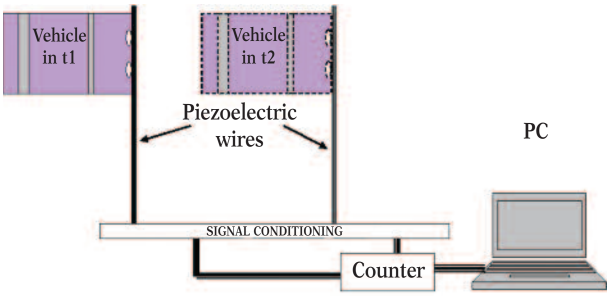

Fig. 2b The system records the signals and measures the time between them

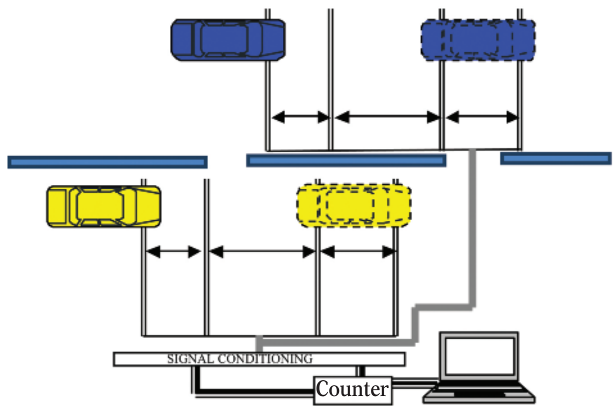

Fig. 3 Arrangement of the sensors for the measurement of the different speeds

$$v = \frac{d_p}{t_2 - t_1}$$

The system measures the speed in the slow lane or in the fast lane depending on the wires the user has selected for each lane. If the user wishes to carry out measurements in one lane, he should choose at least two barriers of that lane. The system considers all the selected barriers for determining the speed value, and it allows for certain measures to be dismissed in line with specific criteria.

If the user chooses wires in both lanes the system returns a speed in the slow lane and a speed in the fast lane, as long as a vehicle crosses at least two barriers of each lane.

After conditioning and processing the signals, the passing of the vehicle through the barriers is recorded to obtain the intermediate speeds depending of the combinations of the signals obtained and the distances between the wires. These intermediate speeds make it possible to obtain an accurate measurement of the vehicle's speed and to consider the situations of dismissal.

In this way the system will show, for the lane through which the vehicle has traveled, the following information:

- the partial speeds (speeds measured between the selected barriers) and the resultant speed displayed on the screen;
- the instant at which the measurement was recorded;
- the estimated acceleration of the vehicle (as long as there are more than two selected barriers per lane); and
- an indication or warning if there is a deviation greater than a programmed tolerance % between partial speeds.

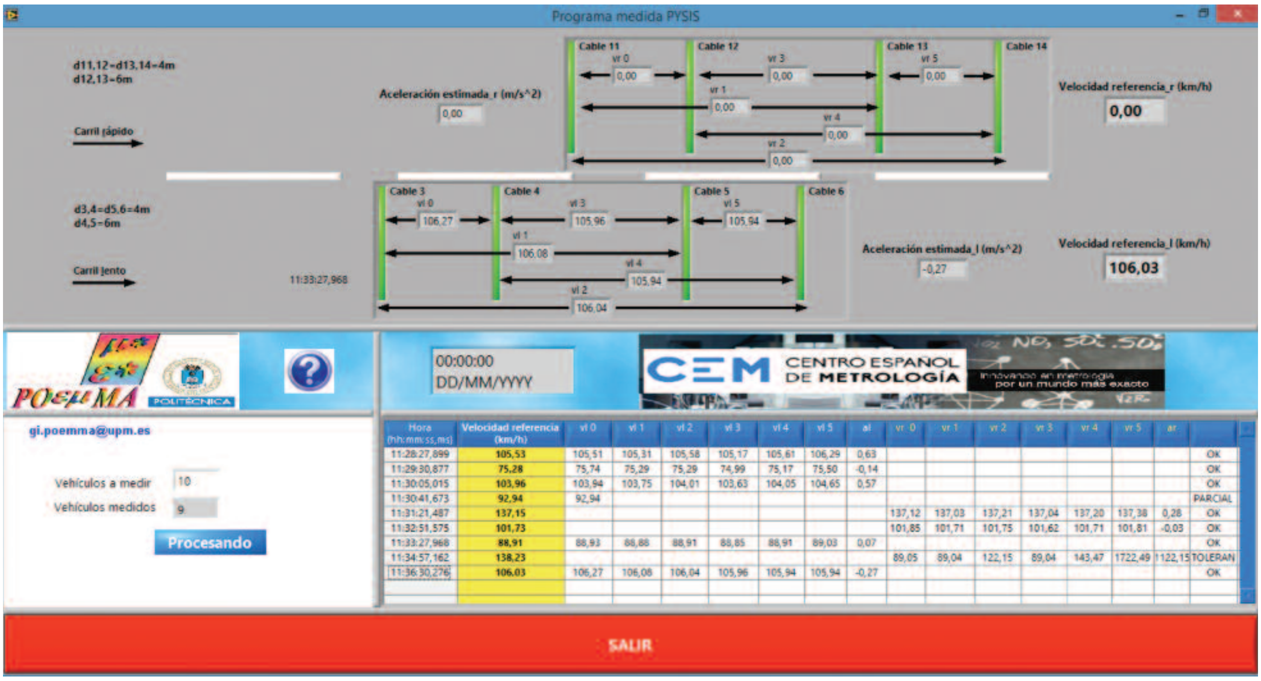

Fig. 4 Desktop application

Estimation of measurement uncertainty

It has been determined that the most significant sources of error come from the measurement of the distance between the wires, d_x; the different waveform in the signals received, and the error due to the sampling instant of the signal that may cause the peak of the cross correlation to be displaced by a time of $Ts = 1/f_s$, where f_s is the sampling frequency in the acquisition of the analogical signals from the wires.

Therefore, the sources that contribute to the uncertainty can be summarized as:

a) Uncertainties associated with the determination of the distance between sensors:

- component due to distance calibration;
- component due to the deviation between distance calibrations, considering a triangular distribution;
- component due to the variation in the distance due to temperature, considering a rectangular distribution.

b) Uncertainties associated with the time measurement:

- component due to the waveform considering a rectangular distribution;
- component due to the sampling instant, considering a rectangular distribution.

Therefore, two components of time measurement uncertainty have been considered: one due to the differences in the waveform of the signals received and another due to the sampling instant of the signal. The environmental influences are not considered since they affect both wires equally; the offset and non-linearity parameters are not considered either since they do not affect the signal form, they only slightly affect the response amplitude and this does not influence the time calculation.

c) Other uncertainties associated with the system resolution and calibration.

The following charts and figures show an estimation of the uncertainty considering the previous sources of error and assuming the following data:

- minimum distance between wires, d = 4 m
- calibration uncertainty = 0.003 m
- deviation between calibrations = 0.005 m
- error due to temperature variation = 0.01 m
- Sampling frequency of the signals fs = 100 kHz
- Error due to the signal waveform = 40 µs
- Error due to the sampling instant = 20 µs

When processing the previous data and applying the Guide to the Expression of Uncertainty in Measurement, GUM, we have an approximate representation of the measurement, which is indicated in Chart 1.

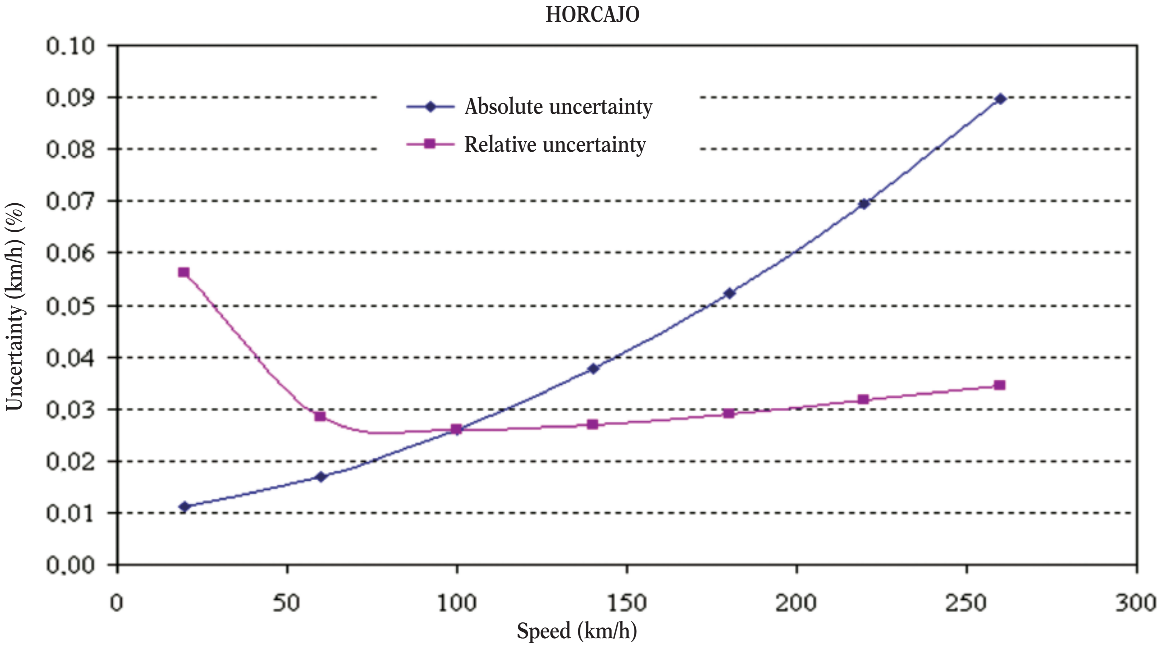

Chart 1 Approximate representation of the measurement

Validation tests and results

For the validation of the PISYS system presented here, several speed tests have been carried out and their readings compared with those obtained by our vehicle speed measuring system, equipped with two independent speed measuring systems:

- the Correvit LFII optical system is one of the systems installed in the vehicle which instantaneously measures the path and speed of the vehicle, as well as other parameters;
- the GPS system VBOX 3i by Racelogic Ltd., equipped with an inertial measurement unit, is the other system installed in the vehicle, which also instantaneously measures its path and speed.

Both the above systems, used by CEM, complement and validate each other. They are appropriately calibrated and synchronized and make up an effective tool for determining distances and speeds, contributing to conformity assessment of instruments subject to legal control, which require the determination of these magnitudes. The results obtained showed an excellent rate of compatibility.

Integration and automation

Considering that one of the aims of these installations is the assessment and verification of the speedometers used in traffic control, an application (CRONOS) has been developed with the aim of speeding up, automating and integrating the assessment controls between the different speedometers.

The CRONOS application collects time and speed data in real time, which is captured by the speedometer to be assessed. It compares them directly with our piezos reference system, automatically showing the assessment errors and issuing the corresponding report.

All the detections captured by the PISYS system are accompanied by a photographic record to analyze the road conditions at that time.

The recorded data is stored together with the picture and can be recovered at any time for repeatability, traceability and evidence of the test purposes.

All the equipment and infrastructure needed for this project is located at a service area of the DGT (Spanish

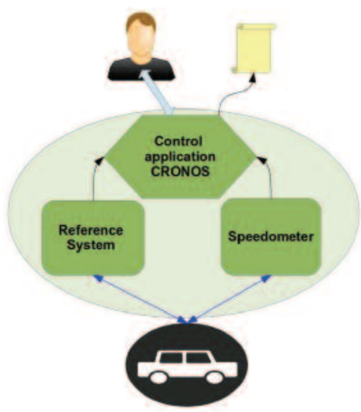

Fig. 5 Diagram of the CRONOS System

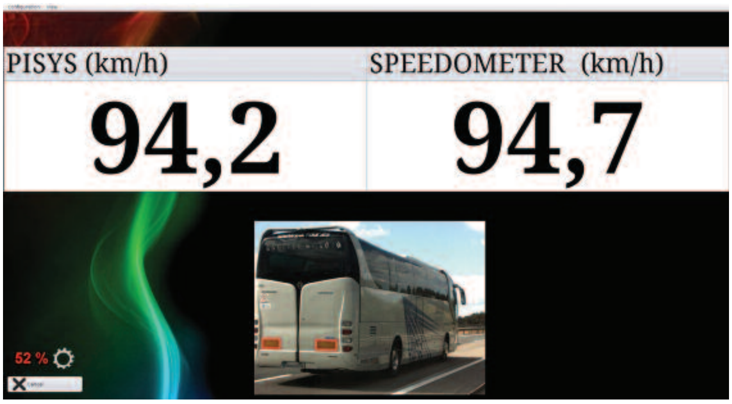

Fig. 6 Online recording

Traffic Department) next to a highway near Madrid. This area, offered by the DGT free of charge, was built for drivers to rest in a comfortable place. It has medical services, showers, bathrooms, etc. and was designed specially for North African citizens returning from long journeys through central Europe, especially France and Belgium.

In addition to these facilities, a building which comprises all the necessary equipment for the operation and control of the system was designed and built. It has a GPS receiver for measurement synchronization tasks, as well as surveillance and security services.

Fig. 7 Panoramic view, DGT Burgos-Madrid highway rest area

Fig. 8 View of the facilities building or control center

Fig. 9 Standard cabin for the assessment of speedometers

The speedometers to be verified are located in a standard cabin at the roadside, which includes the necessary security and surveillance devices. The cabin is equipped with all the necessary material for the correct operation of both the speedometers from different manufacturers, which will be operating inside it, and the control application CRONOS, which includes a gigabit-ethernet camera to collect photographic evidence of the PISYS system detections.

Summary

The Spanish Center of Metrology (CEM) has permanent and modern facilities with the following specifications:

- they are equipped with an automatic and accurate reference system for measuring speed and acceleration;
- they are suitable for carrying out all kinds of metrological control tests, validations and calibrations of other measurement systems in the field;
- they have tubes, supply and data preinstallations for the speedometers that shall be checked. This significantly reduces the time required for installation, preparation and adjustment, by limiting the operation to "connect and measure" (plug and play);
- they are prepared for the equipment and for reducing the risk to personnel;
- they have built-in surveillance and security systems.

Fig. 10 CEM's facilities in Horcajo de la Sierra (Madrid), for speed measurements

LNG

Results of the evaluation and preliminary validation of a primary LNG mass flow standard

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Keywords: LNG, calibration, flow, flowmeter, custody transfer, measurement, uncertainty, accuracy, transport fuel, standard

Abstract

Liquefied natural gas (LNG) custody transfer measurements at large terminals have been based on ship tank level gauging for more than 50 years. Flow meter application has mainly been limited to process control in spite of the promise of simplified operations, potentially smaller uncertainties and better control over the measurements for buyers. The reason for this has been the lack of LNG flow calibration standards as well as written standards. In the framework of the EMRP[1] "Metrology for LNG" project, Van Swinden Laboratory (VSL) has developed a primary LNG mass flow standard. This standard is so far the only one in the world except for a liquid nitrogen flow standard at the National Institute of Standards and Technology (NIST).

The VSL standard is based on weighing and holds a Calibration and Measurement Capability (CMC) of 0.12 % to 0.15 %. This paper discusses the measurement principle, results of the uncertainty validation with LNG and the differences between water and LNG calibration results of four Coriolis mass flow meters. Most of the calibrated meters do not comply with their respective accuracy claims. Recommendations for further improvement of the measurement uncertainty will also be discussed.

[1] European Metrology Research Programme, www.emrponline.eu

1 Introduction

The liquefied natural gas (LNG) industry is fast growing and accurate measurements for the trade of this product are therefore becoming increasingly important. The use of mass and volume flow meters for measuring LNG is beneficial in cases where it will lead to simplified measuring procedures and lower uncertainties. Furthermore, for the LNG (transport) fuel market no traceable measurements exist for flow metering. The problem is that no calibration standards for LNG flow meters are available in the world so far.

The development of traceability of LNG flow meters is therefore one of the elements to support the LNG custody transfer measurement processes. In Figure 1 a roadmap is shown which will lead to accurate measurements for small and large scale LNG applications. The first step in the development of traceability for LNG flow metering is the development of a primary mass flow standard.

In this paper, we present the results of validation of the primary standard with liquid nitrogen and liquefied natural gas. The second step will be the realization of a mid-scale mass flow standard, traceable to the primary standard, to disseminate the LNG flow rate unit to society. The need to develop large scale LNG flow standards (third step) will depend on whether the mid-scale standard can be used to derive and validate extrapolation models between low and higher flow rates and between water and LNG calibrations. The other elements of the roadmap are a calibration standard for volume flow measurement, an LNG composition standard and a primary LNG density standard.

2 Working principle and critical elements

2.1 Measurement principle

The purpose of the primary cryogenic mass flow calibration standard is to realize the unit of LNG mass flow. It is not designed for regular calibrations of flow meters but for the periodic recalibration of working standards or master meters. Those standard flow meters can then be used to calibrate other flow meters in a flow calibration loop using the master meter method.

A schematic picture of the measurement setup of the primary LNG flow standard is displayed in Figure 2. It consists of a 1 m^3 storage tank, a cryogenic pump, the flow meter under test and a 0.5 m^3 weighing (receiving) tank placed on a mass balance. The principle of operation is as follows: the pump generates a flow of cryogenic liquid that goes through the meter under test

(MuT) and is collected in the weighing tank. In order to obtain stable conditions at the position of the MuT (temperature, pressure), the flow is initially circulated through the MuT while bypassing the weighing tank. When the conditions are stable the flow is diverted to the weighing tank using a set of fast switching valves.

To remove any remaining gas (bubbles) inside the tubing between the MuT and the receiving tank, a purge cycle is carried out just before zeroing the balance. The calibration starts at the moment that the circulating flow is diverted towards the weighing tank. When the weighing tank is nearly full, the flow is diverted back, which defines the end of the calibration.

The indicated mass from the flow meter's totalizer collected during the period between the start and stop time stamps is compared with the increase of LNG mass collected in the balance tank. One of the main corrections made is for the weight of the vapor that is displaced and evaporated from the weighing tank during filling. This amount of vapor is measured using a specially designed gas flow meter in the vapor return line.

The cryogenic liquid is kept at subcooled conditions to prevent two-phase flows. This is accomplished by pressurizing the system up to 2~3 bar (gauge), which raises the boiling point. Due to imperfect insulation and heat produced by the pump, the temperature of the liquid will slowly reach the equilibrium temperature (boiling temperature). The system is therefore regularly depressurized to atmospheric pressure to cool down the liquid. This is then followed by re-pressurizing to re-establish subcooled conditions.

Figure 3 shows the interior and exterior of the primary LNG flow standard. The system is set up in a

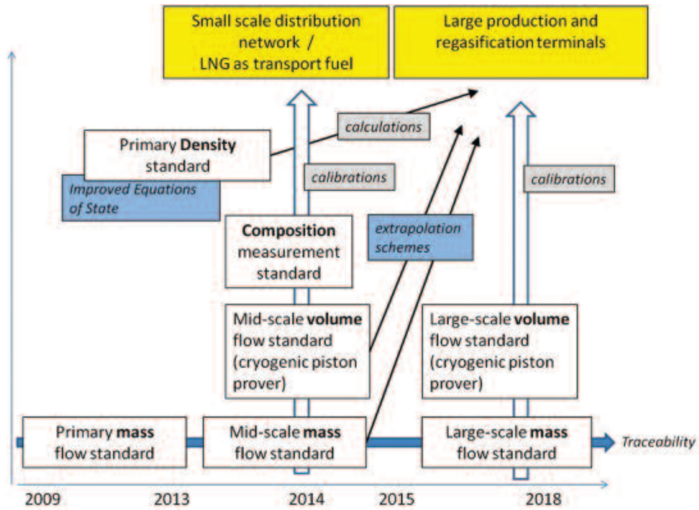

Figure 1 Roadmap towards an improved metrological infrastructure for LNG custody transfer

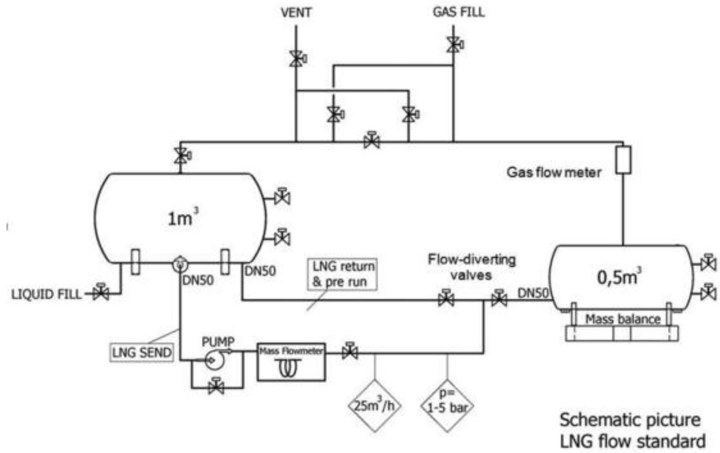

Figure 2 Schematic picture of the primary LNG flow standard

Figure 3 Interior and exterior of the primary LNG flow calibration standard

transportable container with the storage tank placed on top of the roof. The vacuum insulated weighing tank, inside the container, can be seen at the left side of the picture. The pump, piping and flow meters are inside a cold box filled with insulating perlite powder shown at the center of the picture.

2.2 Critical elements

There are a number of elements in the system which will influence the measurement result and uncertainty. The most critical elements are (unsteady) *parasitic forces acting on the balance system, displaced vapor correction, line pack volume corrections* and *time stamping*. A qualitative description and measures to minimize the influence of these effects are discussed below. The experimental results quantifying these effects are described in more detail in the results sections.

2.2.1 Parasitic forces acting on the mass balance system

As shown in Figure 2, the weighing tank has fixed connections to the external world through the filling line at the bottom and the vapor return line at the top. Since the balance plate and load cells are supported by rubber blocks, there will be a vertical deflection effect of a few tenths of a millimeter when loading the tank. Inherently this will cause forces and torques on the weighing system potentially leading to unpredictable and unsteady effects. These effects are minimized by using flexible tubing and an L-shaped piping configuration (not shown in the schematic picture).

Next, the pressure in the connected tubes acting on the cross-sectional area of the inlet and outlet of the tank also introduces a force. This sets requirements on the stability of the operating pressure throughout the calibration sequence. A pressure control system has been implemented for this purpose. The flexible hose and pressure control system do not, however, completely eliminate variations in the residual force applied to the weighing system. This leads to hysteresis effects in the balance response. A semi-automatic recalibration system has therefore been developed to facilitate frequent recalibration of the weighing system. This allows comparison of the linearity of the balance before and after the calibration.

In Figure 4 a set of balance calibration results related to the scale characteristics as a function of mass reading is depicted. The red colored curves represent deviations at ambient line pressure, the other curves are at p = 3 bar (absolute). The characteristic shapes of the calibration curves seem not to be dependent on the line pressure. The uncertainty bars of the averaged balance calibration cover a range of 70~110 g (2s) which is merely caused by the parasitic tube forces and inherent hysteresis. The balance reproducibility is about 20 times smaller.

2.2.2 Displaced vapor correction

If there is no evaporation and no pressure variations (e.g. due to condensation), the displaced gas volume is equal to the liquid volume that flowed into the weighing tank. (Note that there would be no displaced vapor if the weighing tank were to be closed). Experiments with closing the vapor return line however, showed that the pressure was not stable. This is due to the fact that the liquid is injected from the bottom of the tank instead of the top, resulting in pushing the liquid back to the storage tank due to vapor pressure in the weighing tank.

2.2.3 Line pack volume corrections

The line pack volume is defined as the volume between the MuT and the entrance of the weighing tank. Obviously, one must correct for any weight change of this volume occurring during the calibration interval. A decrease in density would for example imply that some mass moved into the weighing tank that is not measured by the MuT. Temperature sensors are installed at the position of the filling line and at the MuT to monitor any changes in density.

2.2.4 Time stamping

The calibration result is based on the comparison of the collected weight on the balance and the mass measured by the MuT. In the so-called dynamic or 'flying' start-stop method a constant flow passes through the MuT and is measured continuously. The measurement must be timed precisely between the moment that the flow is diverted to the weighing tank and back. This requires accurate time stamping.

3 Calibration results of four Coriolis mass flow meters

3.1 General approach

Several 2 inch mass flow meters were calibrated using different media in the period 2009–2013. An overview is given in Table 1. Tests were performed by VSL, National Engineering Laboratory (NEL) and Justervesenet (JV).

Table 1 Overview test program Coriolis meters

Meter ID	Meter flow range kg/s	Claimed accuracy Cryogenic application %	Claimed accuracy water %	Calibration range water kg/s	Calibration range LNG kg/s	Calibration range LIN kg/s
A	1-24	± 0.35	± 0.1	1-24	1-4.7 (2013)	1-5 (2012) 1-9 NIST (2009)
B	1-13	± 0.3	± 0.1	1-13	1-4.7 (2013)	---
C	1-24	± 0.35	± 0.1	1-24	4.3 JV[1] (2012) 1-4 (2013)	---
D	1-9	± 0.2	± 0.1	1-9	1-4 (2013)	---

[1] Justervesenet, National Metrology Institute of Norway

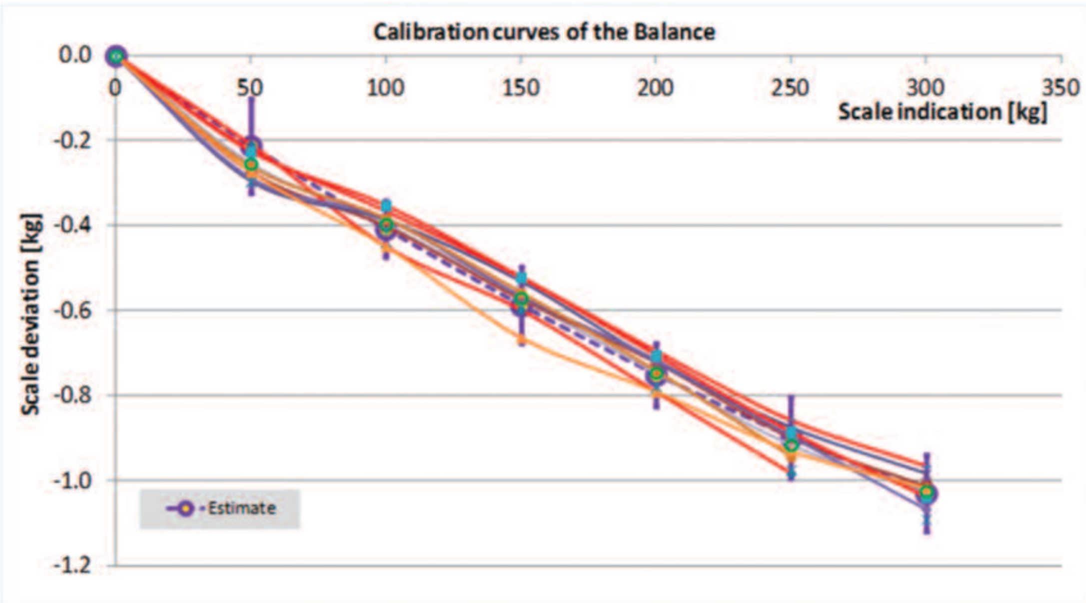

Figure 4 Balance calibration curves and uncertainty bars

The main objective of the test program is to evaluate the primary standard and to assess the transfer of a standard factory calibration with water at ambient conditions to operation at cryogenic conditions [2]. For confidentiality reasons, all meters are coded.

Although the calibrations were performed at various laboratories with different calibration procedures the following approach has typically been followed. The flow meter zero was set for the current testing conditions (ambient or cryogenic). This was achieved by closing the two valves upstream and downstream of the flow meter for a short time to avoid any liquid boiling. No further change was made to its value during subsequent tests. At cryogenic conditions, the zero value was monitored and recorded before and after each test in order to monitor its shift from the stored value. Note

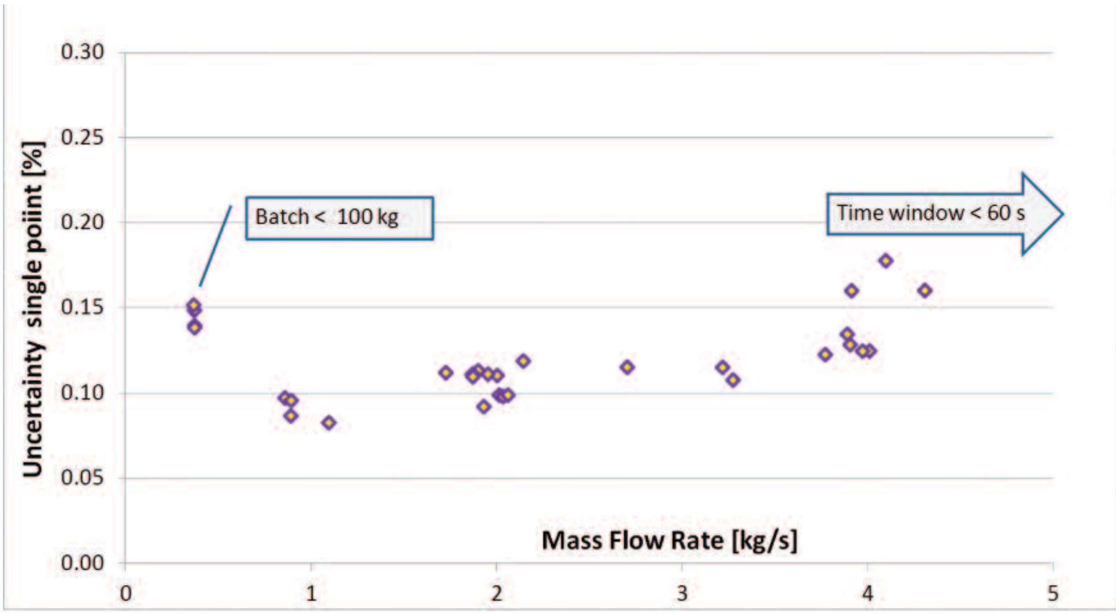

Figure 5 Typical uncertainties of reference mass flow rate

that the various procedures for zeroing the meter together with the zero stability may attribute to a small discrepancy for low flow rates (worst case scenario is 0.1 % at 1 kg/s).

Measurements were repeated at each flow rate to assess the repeatability. Tests were typically performed over multiple days.

The system is designed to run in dynamic or 'flying' start-stop method, although it is also suitable for static start-stop method. The static method is, however, not applicable for meters with a relatively long response time.

3.2 Calibration and measurement capability of the facility

Because the test parameters may vary (short or long time window, small or large batch, varying vapor mass, etc.) the impact of these parameters on the uncertainty budget is not fixed. Therefore the uncertainty is determined for each individual calibration. For most of the model equations the uncertainty propagation is linear.

The coverage factor for the calculated uncertainty of the single measurement points is $k = 2$.

In Figure 5 the single point uncertainties are plotted against flow rate. At high flow rates, the test time will be the largest attributor when it becomes less than 60 seconds. (Larger flow rates imply a shorter calibration time because the weighing tank will be filled more quickly) At low flow rates the 3 particular tests are based on small LNG batches (< 100 kg). It could have been possible to use larger batches, however the test time would increase and inherently the line pack effect, in most cases, would become larger.

3.3 Discussion of results with a liquid nitrogen and LNG calibration of meter A

As with all tested mass flow meters, flow meter A was adjusted to read 'zero deviation' when calibrated with water at ambient conditions. The results of the extensive liquefied nitrogen (LIN) calibration for flow meter A is depicted as a function of mass flow rate in Figure 6 with the claimed accuracies indicated as error bars.

In 2009 this meter was also tested at NIST, in Boulder, Colorado. At NIST, the meter was tested in open air (no extra thermal insulation), whereas at VSL, the meter was mounted inside a cold box filled with insulating perlite grit. Most of the tests are carried out using the 'flying start and stop' method (purple diamonds), were the MuT was stabilized in a pre-run at approximately the calibration flow rate set point. Data output collection is achieved with a fast counter and accumulated mass is related to the time window between the diverter switch trigger moments.

Some tests were done using the 'static start and stop method' (blue squares.) In this case, the MuT is ramped up from zero flow, kept a while at the set point flow and then ramped down to zero again. The results between measurements at VSL and NIST show differences in the order of 0.5 %. As of yet it is not clear what caused this deviation; probable causes are insulation effects, meter

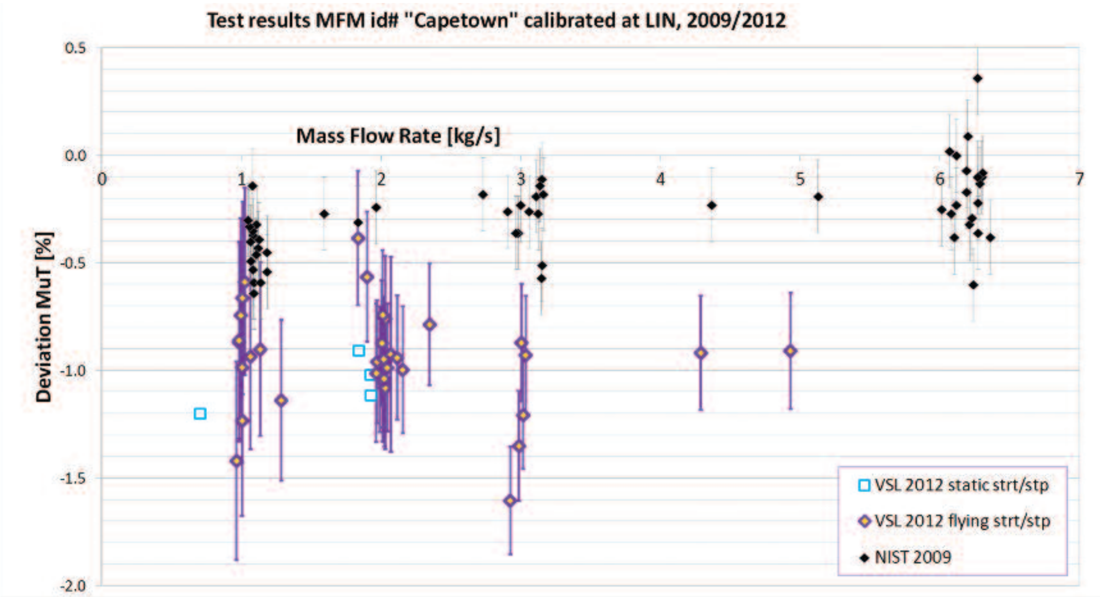

Figure 6 Results of LIN calibrations at different facilities

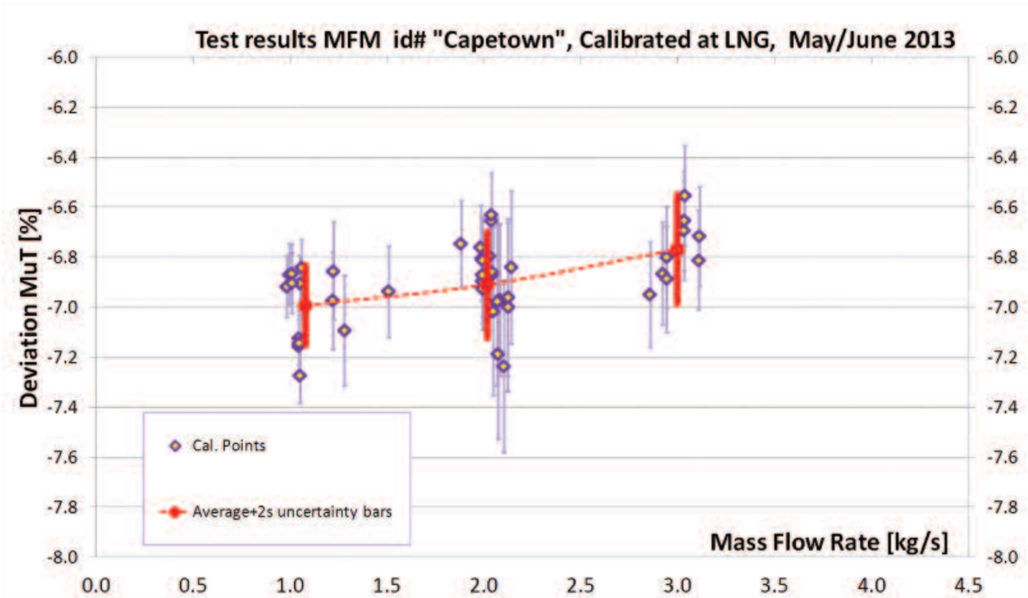

Figure 7 Results of LNG calibration of meter A

drift or electronic problems or drift of the standard (after the LIN calibrations the VSL standard received various important upgrades). On the other hand, as can be seen in Figure 7, this meter showed a rather large offset at LNG.

In Figure 7 the calibration results with LNG are shown. Although the meter shows a good repeatability, the deviation is more than minus 6.5 % related to the zero deviation line based on water. This could be an indication of a malfunctioning temperature compensation algorithm in the meter processor. The purple bars represent the uncertainty of one measurement point. The red bars represent the average uncertainty of the data population around a nominal flow rate (root sum square of standard deviation of average and the single point uncertainty of the test facility).

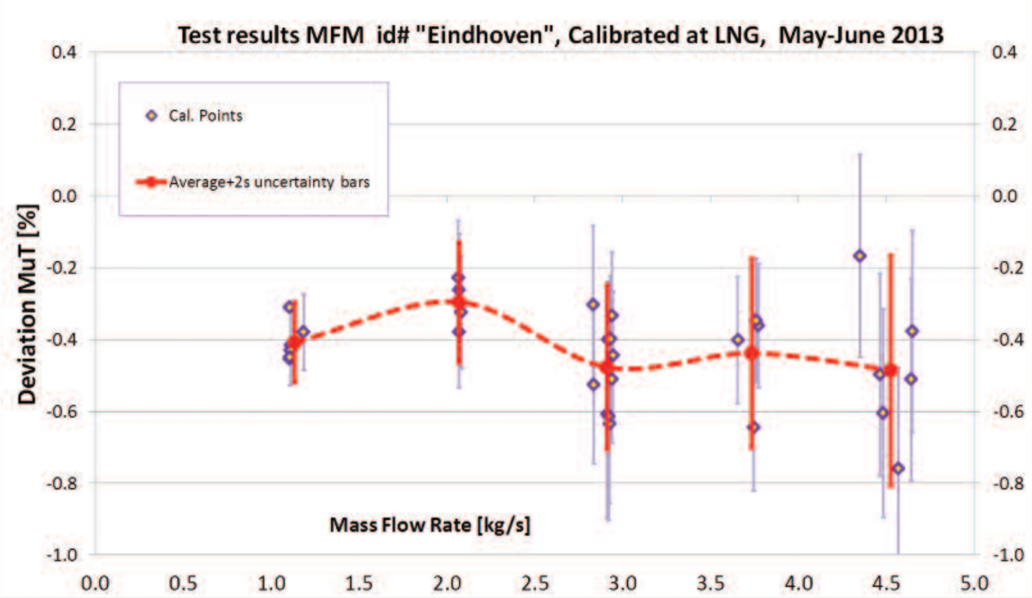

Figure 8 Results of LNG calibration of meter B

3.4 Discussion of results of the LNG calibration of meter B

In Figure 8 the results of flow meter B are depicted. The repeatability is comparable to the previous meter. The systematic deviation is found at around minus 0.4 %. The meter performance lies at the boundary of the claimed accuracy from the manufacturer.

3.5 Discussion of results of the LNG calibration of meter C, intercomparison tests with Justervesenet (Norway)

The results of the calibration of flow meter C are depicted in Figure 9. The meter is also calibrated a few times at 4.3 kg/s by filling a truck-trailer and using a weighing bridge [4] – see the black symbols at the right-most side of the figure. The claimed uncertainties of these tests are better than 0.2 %.

Given the claimed CMCs of the primary standard (0.12~0.15 %, see next chapter) and the reproducibility of the particular MuT, the level of equivalence is acceptable according to:

$$En = \frac{|\varphi_{JV} - \varphi_{VSL}|}{\sqrt{u_{JV}{}^2 + u_{VSL}{}^2}} = 0.7 \qquad (14)$$

given (see Figure 9) j_{JV} = –0.18 %, j_{VSL} = –0.38 % respectively u_{JV} = 0.2 %, u_{VSL} = 0.2 %.

So the weighing bridge and dynamic start/stop method results show comparable meter deviations.

The green dots in Figure 9 represent a test set at which the meter body was accidentally touching one of the cold-box inner walls. It was agreed to re-fix the meter to avoid this possible mechanical unbalance with respect to the desired ‘free vibration modes’ and to recalibrate it. From the different results, it cannot be concluded that the meter was influenced by this effect. Related to the accuracy claim, this meter also performs just on the edge of claimed accuracy. For custody transfer however, the use of this meter would not be acceptable assuming a required maximum permissible error (MPE) of 0.5 %. It appears that 95 % of all results are within ± 0.5 %, however given a CMC of 0.15 % the error limit is ± 0.38 % related to a 5 % accepted risk of false acceptance should be taken into account, see Figure 10.

Without further statistical proof one can determine this safety limit to be ± 0.38 % to ensure compliance with the hypothesis that the meter operates within 0.5 % MPE. The meter should therefore not show a deviation that exceeds ± 0.38 % at each single calibration point.

3.6 Discussion of results of the LNG calibration of meter D

Finally meter D was tested. Figure 11 shows that the maximum repeatability of the combined meter/facility is 0.1 % and the systematic deviation is very small. These test results will also be used to support the CMC claim of the VSL LNG flow calibration facility.

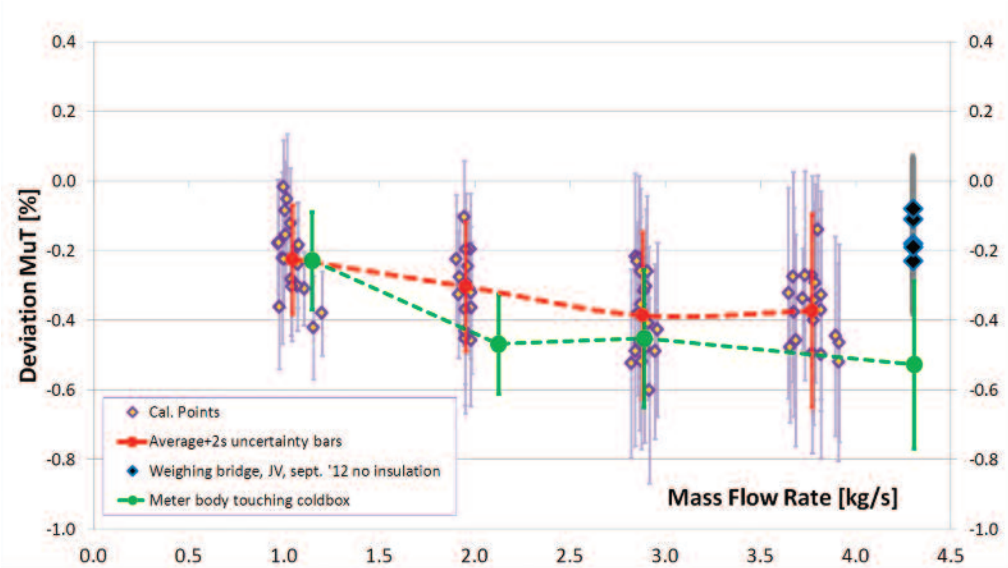

Figure 9 Results of LNG calibration of meter C

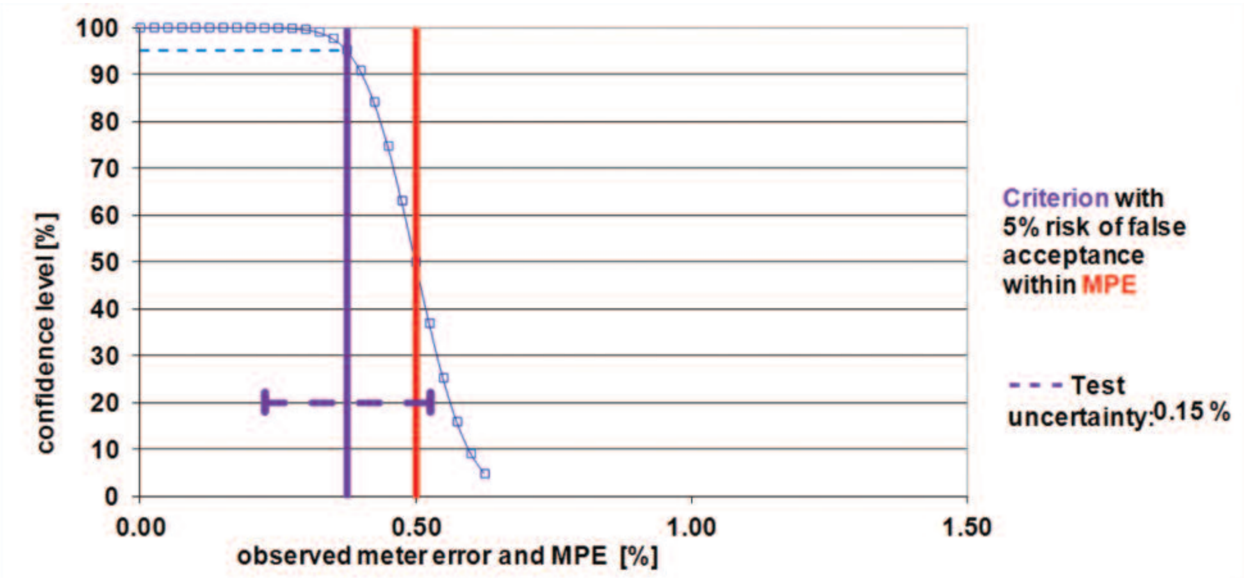

Figure 10 Pass criterion of meter under test at 5 % risk of false acceptance, MPE = 0.5 %, uncertainty = 0.15 %

4 Future plans

4.1 Primary standard

The primary standard for LNG mass flow calibrations shows reasonable uncertainties. However, when the standard is used for delivering traceability to facilities operating at higher flow rates (see next section) the following improvements can be considered to ensure CMCs below 0.1 % for the primary standard. This is required to keep enough margins to end up at CMCs smaller than 0.15 % at higher flow rates. The following improvements are currently under discussion:

- use of a smaller and more flexible LNG connection tube to the weighing tank in order to reduce parasitic forces;
- a fast coupling system to decouple the hose from the weighing tank to completely eliminate the parasitic forces;
- a more accurate model for the correction of the inclination effect;
- increase of the switching valve closing and opening speeds and better synchronization between the valves to reduce timing uncertainty;
- mounting a monitoring Coriolis mass flow meter (CMFM) for enabling Youden plots and to

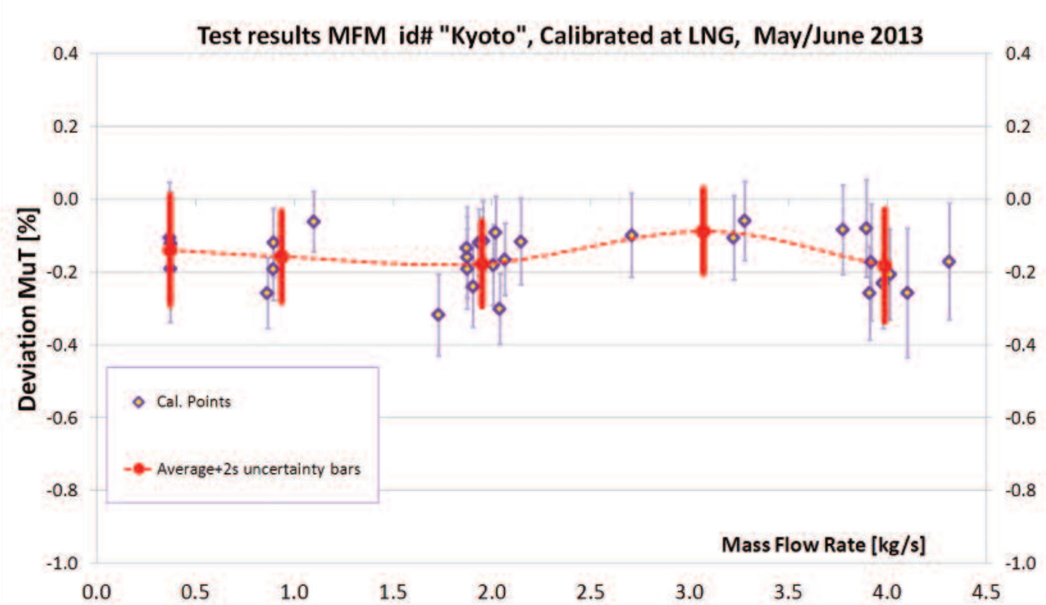

Figure 11 Results of LNG calibration of flow meter D

discriminate between reproducibility attributed to the standard and MuT respectively;

- a gas chromatograph and LNG sampler system for better estimates of LNG density during the day. There seemed to be a tendency for the LNG temperature of the system to rise during the day which could be an indication of aging of the LNG.

4.2 Mid-scale LNG mass and volume flow standard

With the development and validation of the primary standard, the unit of LNG mass flow has been realized. To disseminate the unit and to calibrate LNG flow meters in the range up to 200 m^3/h a mid-scale standard is being planned for 2016. This facility, with an option to increase the range up to 400 m^3/h, will cover the needs for LNG truck loading (small scale) and ship bunkering (mid-scale) applications. Whereas the primary standard is mass based, the mid-scale standard will be mass and volume based. To this end the system will be integrated with an LNG composition calibration system to measure the composition and to calculate the liquid density. The mid-scale facility will serve two purposes. It will provide direct traceability to the small and mid-scale applications of LNG flow meters. The second goal is to continue the experimental research to support and improve calibration models for LNG flow meters. Such models may allow flow meters to be calibrated with water instead of LNG depending on the required accuracy of the flow meter. Extrapolation of flow meter results in the range between 10 and 200 m^3/h (or 400 m^3/h) may also serve to predict the performance of large size LNG flow meters for the large scale LNG market.

5 Conclusions

This paper discussed the validation of the primary LNG mass flow standard. The claimed CMCs between 0.12 % and 0.15 % are supported by a bilateral comparison on LNG. This is a fundamental and first step on the roadmap towards sound metrological support for the new as well as the traditional LNG markets.

The validation results show good uncertainty figures for LNG calibrations. The main contributions to the irreproducibility are related to *balance hysteresis* (non-reversible parasitic forces from the flex-tubing connection), *switching valve timing* and *inclination effect*. The uncertainty of the gas vapor metering system is less than 3 % on vapor mass and the impact on reference LNG mass is negligible. The reproducibility of the meters under test and the primary standard itself are assumed to be comparable. This, however, has to be confirmed using e.g. Youden analyses. The potential improvements to reduce the CMC down to 0.1 % or below are realistic and will underpin a target projected CMC better than 0.15 % for a future small scale (10–400 m^3/h) test and calibration facility.

The facility in the first place is designed to be operated as a primary standard generating traceable reference values for the near future planned mid-scale calibration facility for LNG meters. However, the facility could also be used for type evaluation of custody transfer LNG meters in the flow range of 0.5 to 4.5 kg/s (4 to 40 m^3/h). Related to OIML R 117-1 (subclause 2.4), based on Class 1.5 meter validation, the claimed 0.15 % accuracy of this facility is by far within a 1/5 accuracy ratio requirement for test laboratories.

The calibration results of the four different Coriolis meters indicate that three out of four meters did not comply with the manufacturers' accuracy claim of 0.3 % when these meters were calibrated in advance with water at ambient conditions.

At present, the facility is disconnected and out of operation, in order to be connected to the planned small and mid scale facility at a later time.

VSL has, as a national standards institute, not only a responsibility to metrology as a science but also to the origin of metrology, viz. the need of society for reliable and traceable measurements as a basis for fair trade, quality control and process metering. Development, continuity and stability of reference values are an important element in the function and service of a national metrology institute (NMI) to society. Realization of reference values for LNG flow metering is one of VSL's focal points for the coming years.

6 Acknowledgements

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OIML D 11

2013 revision of OIML D 11

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Summary

In 2013 a revision of OIML D 11 *General requirements for measuring instruments - Environmental conditions* was published. The main changes in this revision, which actually started in 2010, were

- the extension of the scope from only electronic to all measuring instruments,
- the adaptation of D 11 to the revisions of many (28 out of 42) of the standards and documents referred to,
- the synchronization of the terminology with the VIML:2013 [1] and the VIM:2012 [2] and
- the provision of some additional instructions.

A cross reference table between the old and new versions is included in this article.

1 Introduction

OIML D 11 was first published in 1988. Its aim is to harmonize the prescribed requirements and tests concerning the environmental conditions that must be taken into account by OIML TCs, SCs and PGs when drafting Recommendations.

It provides support firstly by giving information about applicable test standards and requirements for testing the sensitivity (susceptibility) of instruments to permanent, variable and incidental environmental conditions, and secondly by defining acceptable responses.

It contains advice on how to integrate these tests into OIML Recommendations and explains how each test is intended to observe the measure of immunity of measuring instruments to the applicable environmental phenomenon. It also provides information on the reliability of the measurement results under various environmental circumstances.

OIML D 11 distinguishes between climatic, mechanical and electric/electromagnetic (EM) environmental phenomena and applies classifications concerning each of these parameters, taking into account existing international standardized methods and suggested test levels.

Keeping up with technology

While long-term changes may be observed in worldwide mechanical and climatic circumstances, changes in the electromagnetic environment (even in the shorter term) are far more noticeable. This therefore requires more frequent revision of those standards that concern electromagnetic environmental phenomena than those related to climate and mechanical influences.

Over time since the publication of the previous edition (2004) of OIML D 11, due to the rapid evolution of the international standards that deal with EM phenomena immunity, it appeared necessary to provide regular updates on the status of the revisions of the standards referred to in OIML D 11. To maintain D 11 completely updated would necessitate an annual revision.

However, D 11 also advises the TCs, SCs and Project Groups to review the status of the standards referred to and to quote the most recent edition in their Recommendations. Information on these latest versions of the standards is provided in Expert Report OIML E 5, which was first published in 2006. Updates have been published approximately every two years.

This option of quoting the most recent standards, however, can only cover those aspects that are not explicitly presented or recommended in the contents of OIML D 11 and does therefore not concern the adaptation of different test levels and frequency ranges, but solely aspects such as details of a test setup.

Since in the meantime new standards have been developed concerning EM phenomena and frequency ranges and test levels have been amended, regular revision of OIML D 11 itself is still required and this was agreed at the 2008 CIML meeting. It was also decided to extend the scope of OIML D 11 to apply to all instruments rather than just to electronic instruments.

2 Main changes

2.1 General application

OIML D 11 was initially published at a time when electronic measuring instruments were first being introduced on the market and performance

Cross reference table between the two versions of D 11

Old Clause	New Clause	Heading	Amended
1	1	Introduction	Update
2	2	Scope and field of application	General applicable; not only for electronic instruments
3	3	Terminology	Adapted to contents and VIM and VIML 2
4	4	Instructions for use of this Document in drafting OIML Recommendations	Minor
5	5	Requirements for measuring instruments with respect to their environment	Scope widened to apply to all measuring instruments
5.1	5.1	General requirements	No
5.2	5.2	Application	No
5.3	5.3	Measuring instruments equipped with checking facilities	Scope widened to apply to all measuring instruments
5.4	5.4	Measuring instruments equipped with durability protection facilities	Scope widened to apply to all measuring instruments
5.5	5.5	Requirements for battery powered instruments	Clause on Stand-alone batteries (chargeable or not)
6	6	Type evaluation	
–	6.1	Application for type evaluation	Clause generalized; details on required documentation shifted to new Annex A
6.2	6.2	General requirements	No
6.3	6.3	Instrument performance tests	Minor
6.4	6.4	Instrument durability tests	No
6.5	6.5	Test program	No
6.6	6.6	Test procedures	No
6.7	6.7	Number of specimens to be submitted to tests	Minor : "Specimen" is introduced instead of "unit"
6.8	6.8	Test arrangement (Equipment under test (EUT))	Minor
7	7	Initial verification	Amended; indicating to be out of scope of D11
8	8	Determination of test levels	Amended title while "Severity level" is dissuaded
8.1	8.1	Introduction	Language upgraded
8.2	8.2	Ambient classification and associated required severity of the climatic tests	Mainly terminology and language upgrading
	Table 1	Classification based on expected ambient humidity and water exposure	No
8.3	8.3	Ambient classification and associated required severity of mechanical tests	Mainly terminology and language upgrading
	Table 2	Classification based on expected mechanical environment	No
8.4	8.4	Classification of EM environment and the associated required severity of electromagnetic tests	Terminology and language upgrading; addition of class E3 (vehicle battery powered instruments) Guidance on provided EM phenomena updated and quite extended
	Table 3	Classification based on expected electro-magnetic environment	Class E3 implemented
	Table 4	Test method selection based on classification of electro-magnetic environment	Test levels added for class E3; amendment on level RF EM fields of general origin. Added low frequency mains disturbances and harmonics
8.5	8.5	Additional guidance for battery powered instruments	Mainly terminology and language upgraded
9	9	Instrument performance tests (general)	No
9.1	9.1	Preliminary remarks	Uncertainty sub clause quite extended and upgraded to better fit GUM a.o. approach
9.2	9.2	Test considerations	Included the applicability escape for instruments not employing electronics Added a better overview for suggested sequence for integrating instruments
	Table 5	Evaluation method in general applicable to the test	Implemented added test methods. Conditions adapted to the basic publication IEC/TR 61000-2-5
	Tables 6-41		Row "applicability" introduced; references updated Tables numbered. Sequence of EMC related tables changed. Language used upgraded
10	10	Climate related performance tests	No
10.1	10.1	Static temperatures	No
	Table 6	Dry heat	No
	Table 7	Cold	No
10.2	10.2	Damp heat	No
	Table 8	Damp heat, steady-state (non condensing)	Minor corrections like (% RH)
	Table 9	Damp heat, cyclic (condensing)	No
10.3	10.3	Water	No
	Table 10	Water	No
10.4	10.4	Atmospheric pressure	No
	Table 11	Static atmospheric pressure	No
	Table 12	Variation of atmospheric pressure	No

Cross reference table between the two versions of D 11 (cont'd)

Old Clause	New Clause	Heading	Amended
10.5	10.5	Sand and dust	No
	Table 13	Sand and dust	No
10.6	10.6	Salt mist	No
	Table 14	Salt mist	No
11	11	Mechanics related performance tests	No
11.1	11.1	Vibration	language upgraded
	Table 15	Vibration (random)	No
	Table 16	Vibration (sinusoidal)	No
11.2	11.2	Mechanical shock	
	Table 17	Mechanical shock	No
13	12	External wiring and mains power supply related performance tests	
13.1	12.1	DC mains variations (within network specification)	
	Table 18	DC mains voltage variation	No
	Table 19	Ripple on DC mains power	No
13.2	12.2	AC mains variations (within network specification)	
	Table 20	AC mains voltage variation	No
	Table 21	AC mains frequency variation	No
13.3-13.8	12.3	Mains power disturbances	
	Table 22	DC mains voltage dips, short interruptions and (short term) variations	Minor
	Table 23	AC mains voltage dips, short interruptions and reductions	Minor
	Table 24	AC mains harmonics	New implemented
	Table 25	VLF and LF disturbances on AC and DC mains	New implemented
	Table 26	Bursts (transients) on AC and DC mains	No
	Table 27	Surges on AC and DC mains power lines	Adapted to standard to exclude non applicable tests for DC mains
12.4-12.5	12.4	Other disturbances introduced through conduction by connected external wiring	
	Table 28	Bursts (transients) on signal, data and control lines	No
	Table 29	Surges on signal, data and control lines	Applied terminology adapted to standard
12	13	Electromagnetic environment related disturbances	
12.3	13.1	Mains power frequency electromagnetic field	
	Table 30	Mains power frequency (electro) magnetic field	No
12.1	13.2	Immunity to RF Electromagnetic fields	
	Table 31	Conducted (common mode) currents generated by RF EM fields	Title adjusted
	Table 32	Radiated RF electromagnetic fields	
	Table 33	Electromagnetic fields of general origin	Level E1 adjusted to actuality in domestic environment
	Table 34	Electromagnetic fields specifically caused by wireless communication networks	Frequency range adjusted to worldwide actuality
12.2	13.3	Immunity to electrostatic discharges	
	Table 35	Electrostatic discharge	No
14	14	Battery and non-mains power supply related performance tests	
14.1	14.1	Low voltage of internal battery	
	Table 36	Low voltage of internal battery (not connected to the mains power)	Described in more generic way and introduced the level 0.9 U_{bmin} in order to have a one fixed level check on low battery response
14.2	14.2	Power from external 12 V and 24 V road vehicle batteries	
	Table 37	Voltage variations	No
	Table 38	Electrical transient conduction along supply lines	Adapted to new version of standard. Pulse 4 deleted, while shifted to Table 40
	Table 39	Electrical transient conduction via lines other than supply lines	No
	Table 40	Battery voltage variations during cranking	ISO 16750-2 (Former test pulse 4; ISO 7637-2)
	Table 41	"Load dump" test	ISO 16750-2 (Former test pulse 5; ISO 7637-2)

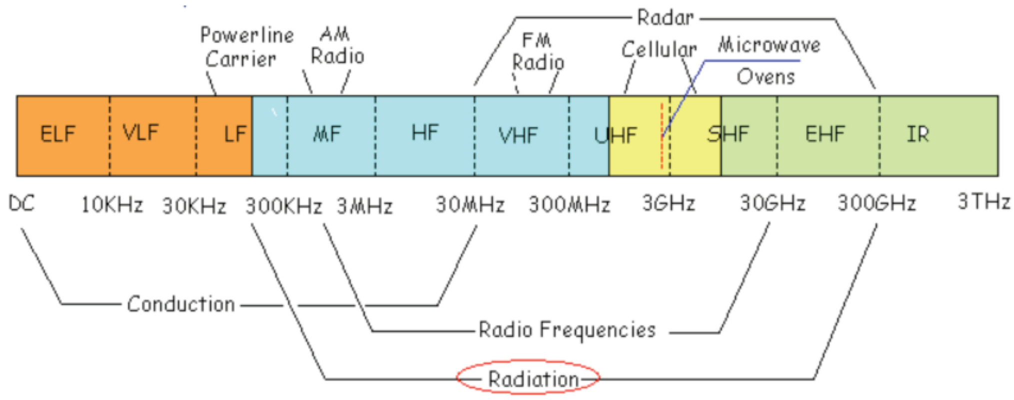

Figure 1 EM frequency spectrum

requirements and tests for the electronics were lacking in legislation. Requirements and tests on climatic and mechanical influences were already implemented.

In the meantime, OIML D 11 has grown to become a catalog of just about all generic environmental test methods. It can, therefore, in principle be applied when selecting tests for every kind of measuring instrument, including also purely mechanical instruments.

This extension of the scope, thus covering all measuring instruments, is not expected to have major implications, while test methods are only to be selected for influence quantities which are considered to be applicable to the specific type of measuring instrument concerned in the Recommendation.

2.2 Amending terminology

Some of the terms used in OIML D 11 are often referred to in Recommendations. OIML D 11, however, is not intended to be referred to as a vocabulary and therefore the latest edition (2013) of the VIML [1] took over a number of the general terms defined in the D 11 terminology section.

In a good cooperative exercise between the VIML [1] and D 11 conveners, some of the terms which appeared sometimes to be misinterpreted, were amended. As a consequence of this cooperation and thanks to the simultaneous publication of both revised publications, any discrepancies between the two have been eliminated. Also all the VIM [2] defined terms applied in OIML D 11 were reviewed and amended if necessary, to become exact copies of those in the VIM:2012 [2].

The main amendment to the OIML D 11 terminology section concerns the term “significant fault” which tended to be applied for both the occurrence of crossing a limit (“Yes” or “No”) as well as for the value of the applicable limit. In order to distinguish between the two different meanings a new term “fault limit” was introduced and defined.

A cross reference between the terminologies of OIML D 11, the VIM [2] and the VIML [1] was produced.

2.3 Extension of tests and test levels

When speaking about electromagnetic environment it will be evident that more and more line-bound and radiation-based transmission technologies become available and demands from both the public and private sectors for their application are increasing rapidly, if not exponentially.

This causes radio spectrum regulators to facilitate the extended use of the available radio frequency spectrum in both the higher and lower frequencies. As a result, emissions in both zones tend to increase. Moreover, the exponential increase of the use of mobile phones and their base stations and also of numerous other wireless connections (wifi, Bluetooth, etc.) causes an increasing risk of exposure to higher levels of field strength.

A fast increase can also be observed in the use of mains power line-bound communication; this concerns the (tele-) communications referred to as PLC/PLT. But the most problematic issue in these lower frequency ranges is the huge increase in disturbances caused by reactive loads and rapid switching converters which tend to generate residual steep slope surges on the mains. Examples are adapters, LEDs, dimmers, converters for photovoltaic cells, etc.

Many instruments powered by the mains require transformers or adaptors that often include rectifiers and stabilizers. This kind of converting devices will attenuate power line disturbances. However, such a reduction in the risk of interference is not applicable for those instruments which, because of their application, necessarily require a direct connection to the unfiltered mains (e.g. electrical energy meters).

The 2013 edition of OIML D 11 now offers test methods and advice on the selection of test levels concerning the testing of immunity to these additional lower frequency phenomena and is based on the latest standards. This includes immunity tests to mains harmonics and to line-to-line (= differential mode) pulses on voltage and current.

It is widely known that measuring instruments may be influenced by radiated radio frequency fields such as those mentioned above, generated for mobile communication purposes. The exponential growth in the use of mobile technology during the past decennia made it necessary to extend the applied bandwidth in the RF spectrum and to, more intensively, make use of free bands in the higher frequency range (e.g. Bluetooth). In the past decennium industry and other stakeholders have amended applicable standards to also cover these additional ranges and levels of exposure.

In order to comply with those most recent standards the frequency range for testing specified in D 11 therefore had to be extended This implies that in the published version the upper limit of the frequency range is shifted from 2 GHz to 6 GHz, with a note that the highest risk on interaction will be in the range below 3 GHz, thus covering the "unlimited" microwave and Bluetooth frequency (2.45 GHz).

2.4 Tests applicable to vehicle mounted instruments (mobile measuring instruments)

There will always be an incentive for more flexible/mobile application of measuring instruments. Today the options for designing measuring instruments dedicated to mobile applications are widely extended as a consequence of reductions in instruments' dimensions and in their energy consumption. The application of mobile instruments on vehicles, however, will cause these to become exposed to a wide variety of environments. And, because in general such mobile measuring instruments will be vehicle battery powered, their exposure to power supply influences and disturbances will be different from those instruments connected to the electrical mains power network.

For these reasons, and also in order to synchronize the approach with the MID [3], a specific new class (E3) was introduced which concerns the electromagnetic environment of vehicle battery powered instruments.

This class therefore includes tests related to battery powered instruments rather than tests for mains power influence quantities and generally speaking this class covers all the kinds of environments where mobile measuring instruments may be expected (excluded those considered hazardous for the general public).

3 Conclusion

The 2013 revision of OIML D 11 provides an updated catalogue of generic methods for testing measuring instruments in order to determine their conformity to the measure of immunity to environmental influences as required in OIML Recommendations.

This update includes the implementation of several new international (basic) standards and extension of test ranges in order to cope with the exponential growth in the use of the radio frequency spectrum.

Taking into account the increased use of mobile measuring instruments, the introduction of a new classification (E3) for vehicle battery powered measuring instruments provides help in fine-tuning the requirements and tests based on this mobility aspect.

And finally the definitions of the applied terminology have been synchronized with the most recent revisions of the VIML [1] and the VIM [2]. ■

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[1] OIML V 1:2013 *International vocabulary of terms in legal metrology* (VIML)

[2] OIML V 2:2012 *International Vocabulary of Metrology – Basic and General Concepts and Associated Terms* (VIM). 3rd Edition (Edition 2010 with minor corrections)

[3] MID Directive 2014/32/EU of the European parliament and of the council of 26 February 2014 on the harmonization of the laws of the Member States relating to the making available on the market of measuring instruments (recast)

TERMINOLOGY

Towards an electronic vocabulary for legal metrology

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1 The role of terminology in metrology

Wherever human activities require cooperation and communication between different parties, terminology plays an important role. This is also the case in metrology, where worldwide cooperation has reached such a level that we can speak about a worldwide measurement system.

Cooperation in metrology has many aspects. Scientific problems and legal issues have to be solved in order to provide uniform, accurate and reliable measurements all over the world. Practical applications of metrology cover a large variety of issues that are essential for industry and trade, as well as for health care, safety and many other fields. Metrology also supports conformity assessment, inspections, standardization and legislation in other technical areas.

International and regional (legal) metrology organizations (such as the OIML and the BIPM) study the needs arising in various areas from the viewpoint of (legal) metrology and try to reach consensus on measurement means and methods that can satisfy those needs.

The result of all this work is published in a variety of publications, such as OIML Recommendations and Documents. The use of uniform terminology in all these publications is a precondition for efficient communication, harmonized implementation of procedures and correct decisions in all fields where metrology plays a role; it may be considered as one of the measures to ensure uniformity of measurements.

2 Issues to be considered in terminology work

Experience over the last 50 years has shown that it is not practically possible to develop a truly comprehensive international vocabulary covering all aspects of metrology. What has been developed at the international level is a set of basic and general terms and definitions in metrology (the VIM) and a set of essential legal metrology terms and definitions (the VIML). These sets of terms and definitions are fundamental to metrology. Other terms and definitions relating to more specific metrological aspects, such as the measurement of different kinds of quantities or different measurement techniques, may vary between those specific areas, but should be coherent with the fundamental terms and definitions.

There are some issues in elaborating and maintaining the international metrological vocabularies. The links between metrology and other disciplines and the developments within those disciplines make it necessary to regularly update the sets of fundamental terns and definitions. But also developments within the more specific fields of metrology may necessitate changes to the fundamental sets of terms and definitions. Last but not least, developments in measurement theory may have a considerable impact on metrological terminology. The conclusion is that terminology work requires a permanent commitment and cannot be left aside for long.

Sometimes the need to update metrological terminology is created by the advent of new disciplines. For example, the development of conformity assessment required an adequate adaptation of the existing legal metrology terminology. New concepts and related terms in legal metrology are introduced in tandem with the employment of new procedures (e.g. statistical verification instead of verification of every single measuring instrument). Other causes which require metrological terminology to be updated are

- the development of mathematical and computational tools of metrology, and
- the development of technology and also changes in measurement techniques (as was the case during the development of electrical methods of measurement, and when computer science was introduced into the practice of measurement).

The wide range of application of metrological terminology – from simple measurement problems to complex scientific experiments – gives rise to an additional difficulty in compiling a vocabulary: those who make simple measurements generally wish the terminology to be simple, whereas those who perform subtle measurements requiring a high degree of accuracy often have a need for terminology that is more complex.

All these circumstances render the elaboration of universal metrological terminology rather complicated. A systematic approach is needed which would ensure permanent monitoring of emerging concepts and new procedures, as well as providing an efficient procedure for drafting new definitions. In the case of legal metrology terminology, cooperation between the OIML technical committees is necessary in order to arrive at a common position.

3 International work on terminology in metrology

The history of international work on metrological terminology demonstrates the mutual relationship between specific fields of metrology and the importance of harmonized terminology. The work was first started in the area of legal metrology and was initiated in 1961 by Professor Jan Obalski (from the Central Office of Measures, Poland; Prof. Obalski was an honorary CIML Member) who played a leading role in the preparation of the first edition of the *Vocabulary of legal metrology* (*VML*). It was sanctioned by the Third International Conference on Legal Metrology in 1968 and published in 1969. The first edition was later completed by two addenda sanctioned by the Fourth and Fifth Conferences in 1972 and 1976 respectively. The second edition of the VML, which included the first edition of 1969 and the two addenda, was published in 1978 as a bilingual French-English edition.

The need to harmonize metrological terminology worldwide, which then became clear, resulted in the identification of general concepts, which form the basic terminology common to various technical disciplines. Seven international organizations (BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and the OIML) thus jointly prepared the *International vocabulary of basic and general terms in metrology (VIM)* for which the VML, 1978 edition, was used as one of the basic sources. The first edition of the VIM was published in 1984 and the second edition in 1993.

Although the major part of the text of the 1978 edition of the VML had been transferred to the VIM, it was considered important to continue to work on terminology in legal metrology. That work was restarted in 1995 by OIML TC 1 *Terminology* and in 2000 the *International vocabulary of terms in legal metrology* (*VIML*) was published.

Meanwhile, work on the VIM continued within the newly formed *Joint Committee for Guides in Metrology* (JCGM) of which the OIML is a member organization. The aim of the JCGM was, among other things, to cover measurements in fields which had not been sufficiently considered in earlier editions of the VIM. Some important general concepts (e.g. metrological traceability, measurement uncertainty) also acquired new definitions. This work led to the publication of the third edition of the VIM in 2008 (referred to as VIM 3). Its title was changed to *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*, in order to emphasize the primary role of concepts in developing a vocabulary. In 2012 the 2008 edition with minor corrections was published.

The publication of the third edition of the VIM, as well as the period of eight years since the publication of the VIML, provided a stimulus to begin a revision of the latter. The developments in legal metrology which had occurred over that period included an increased role of conformity assessment and software tools, and also a change in views on the traditional forms of legal metrology. All this necessitated an adequate expression in the new edition. Moreover, in the course of the revision of the VIML, the BIML compiled a list of terms and their definitions as included in the “Terminology” sections of current OIML Recommendations and Documents. The list was published as OIML G 18:2010. This work revealed many differences in meaning and wording of terms and definitions used in OIML publications which did not always seem to be justified.

Furthermore, considering that OIML Recommendations and Documents are widely used and referred to, not only within the OIML, a risk was perceived that the existence – in the case of many concepts – of multiple terms and/or definitions could lead to equivocality and misunderstanding. This also required adequate preventive action and was the main reason why the BIML proposed resolution no. 24, adopted by the 46th CIML Meeting in 2011.

In this resolution, the CIML, referring among other things to “the requirements for the drafting and presentation of terms and definitions in OIML Recommendations and Documents” as laid down in Annex A of OIML B 6:2:2012, and in particular paragraph A.1.2 *Avoidance of duplications and contradictions*, resolved:

a) that new, and revisions of existing OIML Recommendations and Documents should apply the terminology and definitions of the VIM and the VIML without amendment,

b) that terms and definitions from international vocabularies from other fields (for instance statistics) may be adapted when the concept that they pertain to in legal metrology is different and that such conceptual differences should be explained in a note,

c) that when, in OIML publications other than Recommendations and Documents, terms and definitions are used that differ from those in the VIM and the VIML, these differences should be indicated in notes, as appropriate.

The BIML was also instructed to monitor the correct implementation of this resolution at all stages of the preparation of OIML publications.

At its 48th meeting in 2013, the CIML approved the revision of OIML V 1 *International vocabulary of terms in legal metrology* (*VIML*). Considering that the first edition of the VIML was published in 2000, the 2013 edition could be referred to as VIML 2. VIML 2 differs from VIML 1 in some important aspects. Its content is broader, and also new categories of terms were added which were not contained in the VIML 1. The entries are arranged in the following chapters:

0. Basic terms
1. Metrology and its legal aspects
2. Legal metrology activities
3. Documents and marks within legal metrology
4. Classification of measuring instruments
5. Construction and operation of measuring instruments
6. Software in legal metrology

Chapters 4 through 6 are new in that VIML 1 did not contain the matters they cover. Most of the terms from VIML 1 have been redefined. The new chapters contain not only terms that are typical for legal metrology, but also some terms relating to the structure of measuring instruments which are widely used in legal metrology documents and which users of measuring instruments (who are not necessarily specialists in the respective measurement techniques) must be familiar with. All the terms and definitions contained in the third edition of the VIM, published by the OIML as OIML V2-200:2012, are fully adopted by the OIML and are applicable in the field of legal metrology. However, it was found necessary to quote a number of those terms in the VIML. They are contained in Clause 0. *Basic terms*. Furthermore, considering the increasing use of conformity assessment it was acknowledged that selected terms pertaining to this field should also be included in the VIML. Those terms have been taken from ISO/IEC 17000:2004 *Conformity assessment – Vocabulary and general principles* and are contained in Annex A to the VIML.

4 Further work on assuring the uniformity of terminology in legal metrology

The third edition of the *International Vocabulary of Metrology* and the new edition of the *International Vocabulary of Terms in Legal metrology* are made available in PDF format on the OIML web site. However, as mentioned before, there is still a list of issues, actual and to come, that need a solution in order to avoid serious difficulties and ensure topicality and uniformity in terminology. Thus the secretariat of OIML TC 1 *Terminology* (Poland) and the BIML proposed a new OIML project with the objective of providing a procedure for updating terminology that would contribute to uniformity of terminology and that would make both vocabularies more accessible.

This idea was accepted and at its 48th meeting the CIML decided to start a new project in TC 1 to set up and maintain a bilingual (English/French) electronic vocabulary containing the entries from the VIM and the VIML and additional terms and definitions validated by the Project Group. In this way the permanent project will support the BIML in the implementation of resolution no 24 of the 46th CIML Meeting (2011). The following principles and objectives will be observed:

1 The purpose of the project is to set up and maintain a web based, electronic vocabulary containing all the entries in the VIM and the VIML and additional terms and definitions, validated by the Project Group (also named *Terminology Validation Team*, or TVT) for use in other OIML publications.

2 The Project Group / TVT is responsible for

   a) assessing whether new or revised terms and definitions proposed in draft OIML publications are compatible with those in the VIM and the VIML, and
   b) validating new and revised terms and definitions for inclusion in the electronic vocabulary.

3 The PG/TVT will include native English as well as native French speaking experts.

4 The convener of the PG/TVT and the BIML will jointly maintain the electronic vocabulary which will be hosted on the OIML web site.

5 The project is of a permanent nature, as the maintenance of the electronic vocabulary and the validation of new and revised terms and definitions are ongoing activities.

6 OIML Project Groups shall submit proposed new or revised terms and definitions for validation to the TVT. If, in the opinion of the TVT, a proposed term or definition does not meet the criteria for validation (see 7 below), the TVT convener shall consult with the convener of the Project Group concerned and with the BIML to resolve the issue. If no consensus can be reached, the issue will be referred to the CIML at the time of and together with the submission to the CIML preliminary ballot of the draft publication concerned.

7 The criteria for validation of terms and definitions are

   a) compatibility with terminology in the VIM and the VIML,
   b) terminological consistency with other terms and definitions in the electronic vocabulary,
   c) no contradiction with common understanding of the language.

8 The provisions of chapter 6 of OIML B 6 1:2013 (on the development of a publication) are not applicable.

9 Validated new or revised terms and definitions shall be included in the electronic vocabulary upon approval by the CIML of the publication in which they appear.

10 Entries in the electronic vocabulary that have been replaced, modified or withdrawn shall be clearly distinguished and labeled as "superseded", "withdrawn", or similar.

The proposed setup and maintenance by a validation team of an electronic vocabulary is similar to how the IEC's Electropedia (www.electropedia.org) is maintained.

It is then hoped that based on the results of the successful revision of the VIML and the methodological experience gained with it, future work on terminology in legal metrology will be productive and the expectations of the OIML members will be satisfied. Thus, the main objective of uniformity and coherence of legal metrology terminology will have been attained. ■

Jerzy Borzyminski
GUM, Poland

Willem Kool
BIML

WATER METERS

Harmonization of OIML R 49, ISO 4064 and CEN EN 14154 (Water meters) standards and its impacts

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OIML TC 8/SC 5 Secretariat

Dr. Michael Reader-Harris (NEL),
Convenor ISO/TC 30/SC 7, OIML TC 8/SC 5,
CEN/TC 92 Joint Working Group

The changing face of the global economy, international trade, health, safety, and environmental concerns have led to the requirement by national governments and manufacturers to have single, globally acceptable technical standards and conformance tests. Unharmonized national and regional standards increase the cost of doing business. In contrast, harmonized standards which cover the same product but which are approved by different standardizing bodies are increasingly becoming a means of promoting the free circulation of products, reducing repeated testing and ultimately eliminating regulatory barriers to trade.

A harmonized standardization infrastructure is also a basic condition for the success of legal metrology policy in developing countries, which is essential for improving productivity, international competitiveness, trade and consumer protection.

The ISO/TC 30/SC 7, OIML TC 8/SC 5, CEN/TC 92 Water Meters Joint Working Group

On 21 November 2006 at a meeting at the British Standards Institution (BSI) in London, it was agreed to establish a joint working group (JWG) for the purpose of preparatory work on a textual harmonization of the International Organization of Legal Metrology (OIML), International Organization for Standardization (ISO) and European Committee for Standardization (CEN) standards for *Water meters for cold potable and hot water*.

The main rationale for a joint OIML/ISO/CEN water meters working group was to finalize a harmonized standard for water meters to help reduce the costs to manufacturers of obtaining water meter certification across the world and to simplify the standardization process. Currently, water meters have various international standards including:

- EN 14154 *Water meters*;
- ISO 4064 *Measurement of water flow in fully charged closed conduits - Meters for cold potable water and hot water*; and
- OIML R 49 *Water meters intended for the metering of cold potable water and hot water.*

Differences in standards for water meters arose in the past because each standard was revised separately, therefore an improvement in one was not necessarily included in them all.

The harmonized water meter standard will enable all the components of a water meter system - measurement transducer, calculator, and indicating device - to interface efficiently, and in addition, enable the certification documents accompanying the water meters to identify the conformity of the measuring instruments' types and components with the requirements of international standards, and this makes international trade cheaper, safer and more efficient.

The JWG activity was undertaken by the appropriate technical committees of the standards bodies, OIML TC 8/SC 5 (*Water meters*), ISO/TC 30 (*Measurement of fluid flow in closed conduits*, Subcommittee SC 7, *Volume methods including water meters*) and CEN/TC 92 (*Water meters*), which met annually in various parts of the world to discuss the harmonization of the metrological and technical requirements and test procedures for the various water meter standards. The meetings of the JWG itself were chaired by the Joint Working Group Convenor, Dr. Michael Reader-Harris of NEL, assisted by the Secretary to ISO/TC 30/SC 7 Dr. David Michael of BSI and the Secretary to OIML TC 8/SC 5, Mr. Morayo Awosola of the National Measurement Office (NMO), with full participation from the members of the three standardization bodies. OIML TC 8/SC 5 had voted in favour of harmonizing the water meter standards by a majority of 10:0 (with one abstention).

During the harmonization activity several joint meetings were held:

- British Standards Institution, London, 20–21 November 2006;
- Swiss Association for Standardization, Switzerland, 18–21 February 2008;

Meeting of the OIML TC 8/SC 5 - ISO/TC 30/SC 7 Joint Working Group *Water meters for cold potable and hot water* at the BSI, Chiswick, London, on 22–23 October 2012

Meeting of the Joint ISO/CEN/OIML *Water meters* Joint Working Group at the National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland, USA on 8–10 November 2011

- Measurement Canada, Ottawa, Canada, 12–15 May 2009;
- AFNOR, Paris, 19–21 April 2010. A notable feature of this meeting was the lack of participation of most of the intercontinental members of the JWG because of cancellation of flights due to the recent eruptions from the Eyjafjallajökull volcano;
- National Institute of Standards and Technology, Gaithersburg, 8–9 November 2011;
- British Standards Institution, London, 22–23 October 2012.

Discussions covered a broad range of metrological and technical issues, including:

- testing of a family of meters and the problems associated with endurance testing of large meters within a family,
- developments in smart metering and the effect on the harmonized work,
- the "same-sign rule" requirement.

Several draft consultations and ballots were issued, culminating in the Draft Recommendation passing the 2013 online preliminary CIML ballot, and approval of the Final Draft Recommendation at the 48th CIML Meeting in Viet Nam in 2013. The harmonized drafts went through the ISO ballot process: ISO/FDIS 4064 was approved in 2013. The final texts will be published in 2014.

Benefits of the standardization harmonization activity

Harmonizing standards has many benefits:

- it reduces the necessity and cost of complying with multiple standards. A harmonized water meter standard means that users only need to comply with one standard instead of three separate standards for the same product;
- it provides a common international language about the requirements for water meters and how to test them. This improves user and customer confidence;
- it increases productivity and efficiency in manufacturing by reducing the cost of specifying parts, processes, and recurring technical requirements;
- it promotes the free circulation of water meters, since a harmonized standard testing certificate is recognized internationally, so it is not necessary to repeat the test in every country. This reduces costs for manufacturers;
- it reduces the administrative process in procurement, quality assurance, inventory control, etc.;
- it reduces the training requirements for users of the harmonized standards;
- it saves time and money for all users of the standards;
- it promotes collaboration between developing countries and international and regional standardization organizations.

Lessons learned

- It is complicated and difficult just to harmonize documents: many proposals were made to include new text that was not in any of the existing documents. It was not possible to address all the proposals highlighted during the work and some important suggestions were set aside, to be looked at again after publication of the standards.
- If a Member State wants an important change in a part of the document it is best to make the proposal at the beginning of the process, rather than after that part of the document has been discussed in detail.
- Joint maintenance of the documents after publication will require further commitments, possibly in the form of a dedicated working group.

Moving forward

Effective liaison and coordination between the editors of the standardization bodies during and in the final stages of the project work has helped to reduce the time taken to edit and finalize the documents. A considerable amount of editing work was required to ensure that the standards were ready for final publication. This process will be reviewed with a view to streamlining it even further during future reviews.

Setting and adhering to agreed clear targets and deadlines will help to avoid any potential misunderstandings, reduce project timeline, and instil an awareness of continuity and progress.

Conclusion

Achieving harmonized international standards for all technologies is an economically desirable objective because it helps to remove technical barriers to trade, reduces costs for all users of the standards and helps manufacturers access standards facilities all over the world. The customers in turn benefit from quality goods and services at lowest costs.

The harmonization of the OIML R 49, ISO 4064 and EN 14154 water meters standards has helped to collate and concentrate the various international methods for developing and administering these standards. Moreover, uniformity of water meters will benefit consumers.

Finally, harmonized standards reduce research, production and distribution costs for manufacturers, and promote competition, all for the benefit of consumers. ■

OIML Systems

Basic and MAA Certificates registered 2013.12–2014.05

Information: www.oiml.org section "OIML Systems"

The OIML Basic Certificate System

The *OIML Basic Certificate System for Measuring Instruments* was introduced in 1991 to facilitate administrative procedures and lower the costs associated with the international trade of measuring instruments subject to legal requirements. The System, which was initially called "OIML Certificate System", is now called the "OIML Basic Certificate System". The aim is for "OIML Basic Certificates of Conformity" to be clearly distinguished from "OIML MAA Certificates".

The System provides the possibility for manufacturers to obtain an OIML Basic Certificate and an OIML Basic Evaluation Report (called "Test Report" in the appropriate OIML Recommendations) indicating that a given instrument type complies with the requirements of the relevant OIML International Recommendation.

An OIML Recommendation can automatically be included within the System as soon as all the parts - including the Evaluation Report Format - have been published. Consequently, OIML Issuing Authorities may issue OIML Certificates for the relevant category from the date on which the Evaluation Report Format was published; this date is now given in the column entitled "Uploaded" on the Publications Page.

Other information on the System, particularly concerning the rules and conditions for the application, issue, and use of OIML Certificates, may be found in OIML Publication B 3 *OIML Basic Certificate System for OIML Type Evaluation of Measuring Instruments* (Edition 2011) which may be downloaded from the Publications page of the OIML web site. ■

The OIML MAA

In addition to the Basic System, the OIML has developed a *Mutual Acceptance Arrangement* (MAA) which is related to OIML Type Evaluations. This Arrangement - and its framework - are defined in OIML B 10 (Edition 2011) *Framework for a Mutual Acceptance Arrangement on OIML Type Evaluations*.

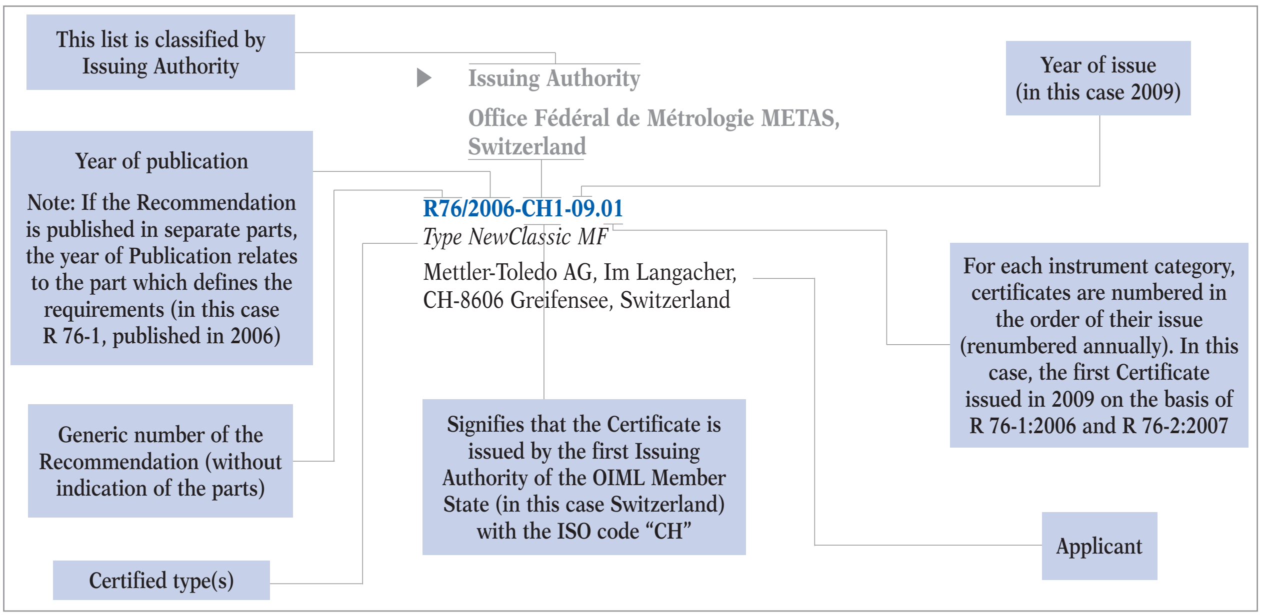
The OIML MAA is an additional tool to the OIML Basic Certificate System in particular to increase the existing mutual confidence through the System. It is still a voluntary system but with the following specific aspects:

- increase in confidence by setting up an evaluation of the Testing Laboratories involved in type testing,
- assistance to Member States who do not have their own test facilities,
- possibility to take into account (in a Declaration of Mutual Confidence, or DoMC) additional national requirements (to those of the relevant OIML Recommendation).

The aim of the MAA is for the participants to accept and utilize MAA Evaluation Reports validated by an OIML MAA Certificate of Conformity. To this end, participants in the MAA are either Issuing Participants or Utilizing Participants.

For manufacturers, it avoids duplication of tests for type approval in different countries.

Participants (Issuing and Utilizing) declare their participation by signing a Declaration of Mutual Confidence (Signed DoMCs). ■



INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Taximeters
Taximètres

R 21 (2007)

▶ Issuing Authority / *Autorité de délivrance*

NMi Certin B.V.,
The Netherlands

R021/2007-NL1-2014.01
Taximeter - Type: BCT|Focus
Quipment R&D B.V., Postbus 6859,
NL-6503 GJ Nijmegen, The Netherlands

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Diaphragm gas meters
Compteurs de gaz à parois déformables

R 31 (1995)

▶ Issuing Authority / *Autorité de délivrance*

Laboratoire National de Métrologie et d'Essais,
Certification Instruments de Mesure, France

R031/1995-FR2-2005.07 Rev. 1
Diaphragm gas meter ITRON type Gallus 2000 - G 4
Itron France, 1 rue Chretien de Troyes, FR-51061 Reims,
France

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Water meters intended for the metering of cold potable water and hot water
Compteurs d'eau destinés au mesurage de l'eau potable froide et de l'eau chaude

R 49 (2006)

▶ Issuing Authority / *Autorité de délivrance*

Czech Metrology Institute (CMI),
Czech Republic

R049/2006-CZ1-2014.01
Multijet water meter
Ningbo Water Meter Co., Ltd, N° 99, Lane 268,
Beihai Road, CN-315033 Ningbo, P.R. China

▶ Issuing Authority / *Autorité de délivrance*

Physikalisch-Technische Bundesanstalt (PTB),
Germany

R049/2006-DE1-2008.01 Rev. 1
Water meter intended for the metering of cold potable water - Type: MTK-AM, MTK-N, MTK-I, MTK-8R, MTK-CC, MTK-45, MTK-D - Based on multi jet principle with mechanical register - Viewing window (counter lens): plastic or mineral glass
Zenner International GmbH & Co. KG, Römerstadt 4,
DE-66121 Saarbrücken, Germany

R049/2006-DE1-2008.02 Rev. 7
Water meter intended for the metering of the cold potable water - Type: Q200 Q3=1.6 (E,P,M), Q200 Q3=2.5 (E,P,M), SM250 (E,P,M), SM 700 (E,P,M)
Elster Metering Ltd., 130 Camford Way, Sundon Park,
Luton, Bedfordshire LU3 3AN, United Kingdom

R049/2006-DE1-2010.01 Rev. 1
Water meter intended for the metering of cold potable water - Type: RNK-RP, RNK-RP-N, RNK-RP-L
Zenner International GmbH & Co. KG, Römerstadt 4,
DE-66121 Saarbrücken, Germany

R049/2006-DE1-2013.01 Rev. 1
Electromagnetic water meter intended for the metering of the cold potable water and hot water - Type: AFLOWT MF, AFLOWT MF Pro, AFLOWT MF Lite M
SEVLAND GmbH, Hauptstraße 27, DE-90547 Stain,
Germany

▶▶

R049/2006-DE1-2013.02
Water meter with mechanical indicating device or electronic indicating device - Type: WESAN WP, WESAN WP E
Hydrometer GmbH, Industriestrasse 13,
DE-91522 Ansbach, Germany

▶ Issuing Authority / *Autorité de délivrance*
Laboratoire National de Métrologie et d'Essais, Certification Instruments de Mesure, France

R049/2006-FR2-2009.01 Rev. 3
Water meters types 171 A and 171 B
Hydrometer GmbH, Industriestrasse 13,
DE-91522 Ansbach, Germany

R049/2006-FR2-2014.01
Compteur d'eau CONTAZARA - Type: CZHT
CONTAZARA S.A, Carretera Castellon km 5.5,
ES-50720 Sarragosse, Spain

R049/2006-FR2-2014.02
Compteur d'eau ITRON - Type: TD 88
ITRON FRANCE, 9 rue Ampere, FR-71031 Macon, France

▶ Issuing Authority / *Autorité de délivrance*
NMi Certin B.V.,
The Netherlands

R049/2006-NL1-2013.01 Rev. 2
Water meter intented intended for the metering of cold potable water- Type: Optiflux x200C; Optiflux x000F + IFC300y
Krohne Altometer, Kerkeplaat 12, NL-3313 LC Dordrecht, Netherlands

R049/2006-NL1-2014.01
Water meter - Type: WF11x / WF12x
Toshiba corporation Fuchu Complex, 1, Toshiba-Cho,
Fuchu-Shi, 183-8511 Tokyo, Japan

▶ Issuing Authority / *Autorité de délivrance*
Slovak Legal Metrology (Banska Bystrica),
Slovakia

R049/2006-SK1-2014.01
Mechanical multi-jet dry dial water meter for metering of cold water - Type MD-B
Ningbo Aimei Meter Manufacture Co., Ltd.,
68, West Town Road, Shangtian Town, Fenghua City,
CN-315511 Zhejiang, P.R. China

R049/2006-SK1-2014.02
Mechanical multi-jet dry dial water meter for metering of cold water - Type: MD-A; MD-AP
Ningbo Aimei Meter Manufacture Co., Ltd.,
68, West Town Road, Shangtian Town, Fenghua City,
CN-315511 Zhejiang, P.R. China

R049/2006-SK1-2014.03
Mechanical multi-jet dry dial water meter for metering of cold water - Type: ML-A; ML-AP
Ningbo Aimei Meter Manufacture Co., Ltd.,
68, West Town Road, Shangtian Town, Fenghua City,
CN-315511 Zhejiang, P.R. China

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Automatic catchweighing instruments
Instruments de pesage trieurs-étiqueteurs à fonctionnement automatique

R 51 (2006)

▶ Issuing Authority / *Autorité de délivrance*
National Measurement Office (NMO),
United Kingdom

R051/2006-GB1-2009.02
TS 310 checkweigher
Sparc Systems Ltd, Merebrook Industrial Estate,
Hanley Road, Malvern, Worcestershire WR13 6NP,
United Kingdom

R051/2006-GB1-2013.02
DACS-G-F015 Series
Ishida Europe Ltd, 11 Kettles Wood Drive, Woodgate Business Park, Birmingham B32 3DB, United Kingdom

R051/2006-GB1-2014.01
Selecta
Societa Cooperativa Bilanciai Campogalliano a.r.l, Via S. Ferrari, 16, IT-41011 Campogalliano (Modena), Italy

R051/2006-GB1-2014.02
MCheck2
Marel Ltd., Wyncolls Road, Severalls Industrial Park,
Colchester CO4 9HW, United Kingdom

R051/2006-GB1-2014.02 Rev. 1
MCheck2
Marel Ltd., Wyncolls Road, Severalls Industrial Park,
Colchester CO4 9HW, United Kingdom

▶ Issuing Authority / *Autorité de délivrance*

NMi Certin B.V.,
The Netherlands

R051/2006-NL1-2012.04 Rev. 1
Automatic catchweighing instrument - Type: AW-4600CPR-..., or AW-4600...
Teraoka Seiko Co., Ltd., 13-12 Kugahara, 5-Chome, Ohta-ku, JP-146-8580 Tokyo, Japan

R051/2006-NL1-2013.07
Automatic catchweighing instrument - Type: I-Series
Yamato Scale Co., Ltd., 5-22 Saenba-cho, JP-673-8688 Akashi, Hyogo, Japan

R051/2006-NL1-2014.01
Automatic Catchweighing Instrument - Type: Ventocheck
FLSmidth Ventomatic SpA, Via G. Marconi, IT-24030 Valbrembo (BG), Italy

R051/2006-NL1-2014.02
Automatic catchweighing instrument - Type: I-Series
Yamato Scale GmbH, Hanns-Martin-Schleyer Straße 13, DE-47877 Willich, Germany

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Metrological regulation for load cells (applicable to analog and/or digital load cells)
Réglementation métrologique des cellules de pesée (applicable aux cellules de pesée à affichage analogique et/ou numérique)

R 60 (2000)

▶ Issuing Authority / *Autorité de délivrance*

State General Administration for Quality Supervision and Inspection and Quarantine (AQSIQ), China

R060/2000-CN1-2013.01 (MAA)
Load Cell - Model designation: SLB615D
Mettler-Toledo (Changzhou) Precision Instruments Ltd., 5, Middle HuaShan Road, Xinbei District, CN-213022 ChangZhou, Jiangsu, P.R. China

▶ Issuing Authority / *Autorité de délivrance*

National Measurement Office (NMO), United Kingdom

R060/2000-GB1-2005.06 Rev. 2
Eurocell CPD & CPD-M, stainless steel, compression load cell with digital output
Societa Cooperativa Bilanciai Campogalliano a.r.l, Via S. Ferrari, 16, IT-41011 Campogalliano (Modena), Italy

R060/2000-GB1-2005.07 Rev. 3
Eurocell CPR & CPR-M, stainless steel, compression strain gauge load cell
Societa Cooperativa Bilanciai Campogalliano a.r.l, Via S. Ferrari, 16, IT-41011 Campogalliano (Modena), Italy

R060/2000-GB1-2009.10 Rev. 1 (MAA)
Strain Gauge Compression Load Cell Type T302X
Avery Weigh-Tronix, Foundry Lane, Smethwick B66 2LP, United Kingdom

R060/2000-GB1-2010.06 Rev. 1
Eurocell NTI, NTI, stainless steel, shear beam strain gauge load cell
Societa Cooperativa Bilanciai Campogalliano a.r.l, Via S. Ferrari, 16, IT-41011 Campogalliano (Modena), Italy

R060/2000-GB1-2011.02 (MAA)
MS-1 S-type stainless steel compression load cell
Zhejiang South-Ocean Sensor Manufacturing Co., Ltd, N° 58, Nanyang Road, Qianyuan Town, Deqing County, CN-313216 Huzhou City, Zhejiang Province, P.R. China

R060/2000-GB1-2011.06
ZSF-A-. ZSFY-A- and ZSFYB-A Alloy steel compression load cell
Olçsan Elektronik Sistemleri Iml.San Ve Tic Ltd, Bursa Karayolu 17 km, TR-Eskisehir, Turkey

R060/2000-GB1-2012.03 (MAA)
WMS aluminium Planar Beam load cell
Flintec GmbH, Bemannsbruch 9, DE-74909 Meckesheim, Germany

R060/2000-GB1-2012.04
DG-DWB Digital compression stainless steel load cell
Dinamica Generale s.r.l, Via Mondadori 15, IT-46025 Poggio Rusco, Italy

R060/2000-GB1-2012.05
CPTD-30000 Digital compression stainless steel load cell
Flexar SRL, (51) Santa Marta 1456, Villa Maipu (B1650LJD), Prov de Buenos Aires, Argentina

R060/2000-GB1-2012.07 (MAA)
SB6 Stainless steel load cell
Flintec GmbH, Bemannsbruch 9, DE-74909 Meckesheim, Germany

R060/2000-GB1-2014.01 (MAA)
GPB 75, 150 and 375 kg Planar beam load cell
Group Four Transducers Inc., 22 Deer Park Drive, MA 01028 East Longmeadow, United States

▶ **Issuing Authority / *Autorité de délivrance***

International Metrology Cooperation Office, National Metrology Institute of Japan (NMIJ) National Institute of Advanced Industrial Science and Technology (AIST), Japan

R060/2000-JP1-2011.01 Rev. 2 (MAA)
Compression load cell - Type: DCC1-20T, DCC1-24T, DCC1-36T, QDCC1-20T, QDCC1-24T,QDCC1-36T
Yamato Scale Co., Ltd., 5-22 Saenba-cho, JP-673-8688 Akashi, Hyogo, Japan

R060/2000-JP1-2012.05 Rev. 1 (MAA)
Beam (shear) load cell - Type: LCM17K200E, LCM17K300E, LCM17K500E, LCM17T001E, LCM17T002E
A&D Company Ltd., 3-23-14 Higashi-Ikebukuro, Toshima-Ku, JP-170-0013 Tokyo, Japan

▶ **Issuing Authority / *Autorité de délivrance***

NMi Certin B.V., The Netherlands

R060/2000-NL1-2011.21 Rev. 1 (MAA)
Compression Load Cell - Type: BM24R—xx-xxx-xxx-xx Series
Zhonghang Electronic Measuring Instruments Co. Ltd. (ZEMIC), Xinyuan Road, The North Zone of EDZ, Hanzhong, P.O. Box 2, CN-723000 Hanzhong-ShaanXi, P.R. China

R060/2000-NL1-2013.07 (MAA)
Bending beam load cell, with strain gauges - Type: PA10, PA12 and PA14L
Beijing True-Tec Co., Ltd, 4/F, Bldg. 2, N°. 8, Hong Da Bei Lu, BDA, CN-100176 Beijing, P.R. China

R060/2000-NL1-2013.17 Rev. 1 (MAA)
Single point load cell, with strain gauges, equipped with electronics - Type: SLP330D, SLP331D, SLP332D
Mettler-Toledo AG, Heuwinkelstrasse, CH-8606 Nanikon, Switzerland

R060/2000-NL1-2013.25 (MAA)
Compression load cell, with strain gauges, equipped with electronics - Type: ZSF-D & ZSW-D
Keli Sensing Technology (Ningbo) Co., Ltd., No. 199 of Changxing Rd, Jiangbei District, Ningbo, P.R. China

R060/2000-NL1-2013.25 Rev. 1 (MAA)
Compression load cell, with strain gauges, equipped with electronics. Type: ZSF-D, ZSF-DSS & ZSW-D, ZSW-DSS
Keli Sensing Technology (Ningbo) Co., Ltd., No. 199 of Changxing Rd, Jiangbei District, Ningbo, P.R. China

R060/2000-NL1-2013.26
A double bending beam load cell, with strain gauges - Type: TLC, HLC and THC
Hottinger Baldwin Messtechnik GmbH, Im Tiefen See 45, DE-64293 Darmstadt, Germany

R060/2000-NL1-2014.01 (MAA)
Tension load cell, with strain gauges - Type: 110xx
Anyload Transducer Co. Ltd., 6994 Greenwood Street, Unit 102, V5A 1X8 Burnaby, Canada

R060/2000-NL1-2014.02 (MAA)
Bending beam load cell, with strain gauges - Type Z6
Hottinger Baldwin Messtechnik GmbH, Im Tiefen See 45, DE-64293 Darmstadt, Germany

R060/2000-NL1-2014.02 Rev. 1
Bending beam load cell, with strain gauges - Type Z6
Hottinger Baldwin Messtechnik GmbH, Im Tiefen See 45, DE-64293 Darmstadt, Germany

R060/2000-NL1-2014.03 (MAA)
Single point load cell, with strain gauges - Type: 108JA
ALP Electric Technology (Changzhou) Co., Ltd., 158, Chuangxin Road, Longhutang, New North District, 213031 Changzhou, Jiangsu, P.R. China

R060/2000-NL1-2014.04 (MAA)
Shear beam load cell, with strain gauges - Type: 563YH
ALP Electric Technology (Changzhou) Co., Ltd., 158, Chuangxin Road, Longhutang, New North District, 213031 Changzhou, Jiangsu, P.R. China

R060/2000-NL1-2014.08 (MAA)
Bending beam load cell, with strain gauges - Type: PA08R,PA08G and PA08L
Beijing True-Tec Co., Ltd, 4/F, Bldg. 2, N°. 8, Hong Da Bei Lu, BDA, CN-100176 Beijing, P.R. China

R060/2000-NL1-2014.09 (MAA)
Single point load cell, with strain gauges - Type: PL001-xx-C3
Minebea Co., Ltd, 1-1-1 Katase Fujisawa-shi, JP-251-8531 Kanagawa-ken, Japan

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Automatic gravimetric filling instruments
Doseuses pondérales à fonctionnement automatique

R 61 (2004)

▶ Issuing Authority / *Autorité de délivrance*

National Measurement Office (NMO),
United Kingdom

R061/2004-GB1-2012.01 Rev. 1
SpeedAC NXT
Premier Tech, 1 avenue Premier, Rivière-du-Loup,
CA-G5R 6C1 Quebec, Canada

▶ Issuing Authority / *Autorité de délivrance*

NMi Certin B.V.,
The Netherlands

R061/2004-NL1-2014.01
Automatic gravimetric filling instrument - Type: DAP...
Immea Dosatrici S.R.L., Via Borsellino 27,
IT-25038 Rovato (BS), Italy

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Nonautomatic weighing instruments
Instruments de pesage à fonctionnement non automatique

R 76-1 (1992), R 76-2 (1993)

▶ Issuing Authority / *Autorité de délivrance*

National Measurement Office (NMO),
United Kingdom

R076/1992-GB1-2007.07
Huntleigh Healthcare Enterprise 9000, Enterprise 9100 and 9000X hospital bed with weighing facility
Huntleigh Healthcare Ltd, Unit 3 - Trident Drive,
Britannia Park, Wednesbury WS10 7XB, United Kingdom

R076/1992-GB1-2007.07 Rev. 2
Huntleigh Healthcare Enterprise 9000, Enterprise 9100 and 9000X hospital bed with weighing facility.
ArjoHuntleigh AB, Hans Michelsensgatan 10,
211 20 Malmö, Sweden

R076/1992-GB1-2009.04
Non-automatic weighing instruments comprising the GSE 60-Series electronic weight indicators connected to a compatible R 60 load cell and the 675 Bench Scale
Avery Berkel, Foundry Lane, Smethwick B66 2LP,
United Kingdom

R076/1992-GB1-2010.01
XM series, Models XM 100, XM 200 and XM 400 non-automatic weighing instruments
Avery Berkel, Foundry Lane, Smethwick B66 2LP,
United Kingdom

R076/1992-GB1-2010.04 Rev. 2 (MAA)
SW - Series
CAS Corporation, #19, Ganapri, Gwangjeok-Myeoun,
Yangju-Si, KR-482-841 Gyeonggi-Do, Korea (R.)

R076/1992-GB1-2010.05 (MAA)
PB series, PB Model, non-automatic weighing instrument
CAS Corporation, #19, Ganapri, Gwangjeok-Myeoun,
Yangju-Si, KR-482-841 Gyeonggi-Do, Korea (R.)

R076/1992-GB1-2010.07 (MAA)
Dolphin Series non-automatic weighing instruments
CAS Corporation, #19, Ganapri, Gwangjeok-Myeoun,
Yangju-Si, KR-482-841 Gyeonggi-Do, Korea (R.)

R076/1992-GB1-2013.01 Rev. 1
PR PLUS Series
CAS Corporation, #262, Geurugogae-ro, Gwangjeok-myeon, Yangju-si, Gyenonggi-do, Korea (R.)

R076/1992-GB1-2013.02 (MAA)
Maersden M-300 - Baby Scale
Marsden Weighing Machine Group Ltd, Unit 7, Centurion Business Park, Coggin Mill Way, Rotherham S60 1FB,
United Kingdom

R076/1992-GB1-2013.04 Rev. 1 (MAA)
Motorola MP62xx & MP65xx (where xx denotes alternative approved models)
Motorola Solutions, Inc., One Motorola Plaza,
11742-1300 Holtsville, NY, United States

▶ Issuing Authority / *Autorité de délivrance*

NMi Certin B.V.,
The Netherlands

R076/1992-NL1-2014.05 (MAA)
Non-automatic weighing instrument - Type: ABJ_NM
Kern & Sohn GmbH, Ziegelei 1, DE-72336 Balingen, Germany

R076/1992-NL1-2014.21
Non-automatic weighing instrument - Type: AW-5600, AW-5600..CP, AW-5600..CPR, AW-5600..EX, AW-5600..FX.
Teraoka Seiko Co., Ltd., 13-12 Kugahara, 5-Chome, Ohta-ku, JP-146-8580 Tokyo, Japan

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Non-automatic weighing instruments
Instruments de pesage à fonctionnement non automatique

R 76-1 (2006), R 76-2 (2007)

▶ Issuing Authority / *Autorité de délivrance*

Office Fédéral de Métrologie METAS,
Switzerland

R076/2006-CH1-2014.01 (MAA)
Non-automatic mechanical personal scale - Type: FLS02A
Seca GmbH & Co. kg., Hammer Steindamm 9-25, DE-22089 Hamburg, Germany

▶ Issuing Authority / *Autorité de délivrance*

State General Administration for Quality Supervision and Inspection and Quarantine (AQSIQ), China

R076/2006-CN1-2013.04 (MAA)
Price Computing Scale - Type: ACS-6-JJ(F902), ACS-15-JJ(F902), ACS-30-JJ(F902)
Jiangsu Honsta Electric Manufacturing Co., Ltd, Xihu Road 118, Wujin Hi-tech Industry Zone, Changzhou, 213161 Jiangsu, P.R. China

R076/2006-CN1-2013.05 Rev. 1 (MAA)
Weighing Indicator - Type: YH-T7, YH-T7+E
Shanghai Yaohua Weighing System Co., Ltd, No. 4059, Shangnan Road, Pudong District, CN-200124 Shanghai, P.R. China

▶ Issuing Authority / *Autorité de délivrance*

Dansk Elektronik, Lys & Akustik (DELTA),
Denmark

R076/2006-DK3-2014.01
Non-automatic weighing instrument - Type: V7-nn / B7-nn / C7-nn / NS7-nn / S7-nn / T7-nn / C8-nn / U8-nn, where nn is 20, 40 or 50
TScale Electronics Mfg (Kunshan) Co., Ltd, No. 99 Shunchang Road, Zhoushi Town, Kunshan City, CN-215300 Suzhou, Jiangsu Province, P.R. China

R076/2006-DK3-2014.02
Non-automatic weighing instrument - Type: J7-10/Q7-10/ J7-12/QT-12/A7-20/J7-20/Q7-20/X7-20/A7-40/J7-40/ Q7-40/X7-40
TScale Electronics Mfg (Kunshan) Co., Ltd, No. 99 Shunchang Road, Zhoushi Town, Kunshan City, CN-215300 Suzhou, Jiangsu Province, P.R. China

R076/2006-DK3-2014.03
Non-automatic weighing instrument - Type: B5/B6
Kaifeng Group Co., Ltd., No 6-8, Sifang Middle Road, Gushan Town, Yongkang City, 321307 Zhejiang, P.R. China

R076/2006-DK3-2014.04
Non-automatic weighing instrument - Type: TCS-B5 / TCS-B6
Kaifeng Group Co., Ltd., No 6-8, Sifang Middle Road, Gushan Town, Yongkang City, 321307 Zhejiang, P.R. China

R076/2006-DK3-2014.05
Non-automatic weighing instrument - Type: Aviator 3000 A31P
Ohaus Corporation, 7, Campus Drive, Suite 310, 07054 Parsippany - NJ, United States

▶ Issuing Authority / *Autorité de délivrance*

Laboratoire National de Métrologie et d'Essais, Certification Instruments de Mesure, France

R076/2006-FR2-2013.03 (MAA)
Module data processing type WT-12 for non-automatic weighing instruments
Arpege Master-K, 38 Avenue des Frères Montgolfier, BP 186, FR-69686 Chassieu Cedex, France

R076/2006-FR2-2014.01 Rev. 0 (MAA)
Indicator - Type: X112 B
Precia SA, BP 106, FR-07001 Privas Cedex, France

▶ **Issuing Authority / *Autorité de délivrance***

National Measurement Office (NMO), United Kingdom

R076/2006-GB1-2010.01 (MAA)
Weighing indicator, as part of a non-automatic weighing instrument, designated the E11xx / E12xx

Avery Weigh-Tronix, Foundry Lane, Smethwick B66 2LP, United Kingdom

R076/2006-GB1-2011.02 Rev. 2 (MAA)
3590E, CPWE, DFW and DGT Series

Dini Argeo Srl, Via Della Fisica, 20, IT-41042 Spezzano di Fiorano (MO), Italy

R076/2006-GB1-2012.02 Rev. 3 (MAA)
DD1050, DD1050i, DD2050

Societa Cooperativa Bilanciai Campogalliano a.r.l, Via S. Ferrari, 16, IT-41011 Campogalliano (Modena), Italy

R076/2006-GB1-2012.04 (MAA)
ZM301, ZM303, ZQ375 Series

Avery Weigh-Tronix, Foundry Lane, Smethwick B66 2LP, United Kingdom

R076/2006-GB1-2012.05 (MAA)
ZQ375 Checkweigher

Avery Weigh-Tronix, Foundry Lane, Smethwick B66 2LP, United Kingdom

R076/2006-GB1-2012.06 (MAA)
CL3500 Series

CAS Corporation, #19, Ganapri, Gwangjeok-Myeoun, Yangju-Si, KR-482-841 Gyeonggi-Do, Korea (R.)

R076/2006-GB1-2012.06 Rev. 2 (MAA)
CL3500 Series

CAS Corporation, #262, Geurugogae-ro, Gwangjeok-myeon, Yangju-si, Gyenonggi-do, Korea (R.)

R076/2006-GB1-2012.12 (MAA)
C510 Digital Indicator

Rinstrum Pty. Ltd, 41 Success Street, AU-QLD 4110 Acacia Ridge, Australia

R076/2006-GB1-2012.13 (MAA)
WE2111 Digital Indicator

Hottinger Baldwin Messtechnik GmbH, Im Tiefen See 45, DE-64293 Darmstadt, Germany

R076/2006-GB1-2012.14 Rev. 2 (MAA)
DD1010, DD1010IC, DD1010I, DD1010H, DD1010ICH, DD1010IH

Societa Cooperativa Bilanciai Campogalliano a.r.l, Via S. Ferrari, 16, IT-41011 Campogalliano (Modena), Italy

R076/2006-GB1-2014.01 (MAA)
DPS-800s

Digi Europe Ltd., Digi House, Rookwood Way, Haverhill CB9 8DG, United Kingdom

R076/2006-GB1-2014.02 (MAA)
Type: CDI-1600

Atrax Group (NZ) Ltd, 390 A Church Street, Penrose, Auckland, New Zealand

R076/1992-GB1-2004.04 (MAA)
Chronos Richardson GmbH SpeedAC NXT device

Chronos Richardson GmbH, Reutherstr. 3, DE-53773 Hennef, Germany

R076/2006-GB1-2014.04 (MAA)
Spirit Select

CHG Hospital Beds Inc., 1020 Adelaide Street South, N6E 1R6 London, Ontario, Canada

▶ **Issuing Authority / *Autorité de délivrance***

NMi Certin B.V., The Netherlands

R076/2006-NL1-2013.02
Indicator - Type: IND226x

Mettler-Toledo (Changzhou) Measurement Technology Ltd, N° 111, West TaiHu Road, ChangZhou XinBei District, CN-213125 Jiangsu, P.R. China

R076/2006-NL1-2013.14
Non-automatic weighing instrument - Type: PS15

Mettler-Toledo Inc., 1150 Dearborn Drive, Ohio 43085, Worthington, United States

R076/2006-NL1-2013.15
Non-automatic weighing instrument - Type: PS60

Mettler-Toledo Inc., 1150 Dearborn Drive, Ohio 43085, Worthington, United States

R076/2006-NL1-2013.33
Non automatic weighing instrument - Type: AW4600...

Teraoka Seiko Co., Ltd., 13-12 Kugahara, 5-Chome, Ohta-ku, JP-146-8580 Tokyo, Japan

R076/2006-NL1-2013.34 (MAA)
Non-automatic weighing instrument - Type: DPS-4600 / DPS-4600M

Teraoka Seiko Co., Ltd., 13-12 Kugahara, 5-Chome, Ohta-ku, JP-146-8580 Tokyo, Japan

R076/2006-NL1-2013.41
Non-automatic weighing instrument - Type: CUB II (RWXX..,XRWXX..,BPA224)
Mettler-Toledo (Changzhou) Measurement Technology Ltd, N° 111, West TaiHu Road, ChangZhou XinBei District, CN-213125 Jiangsu, P.R. China

R076/2006-NL1-2013.47 (MAA)
Indicator - Type: VT1000, VT800
Dibal S.A., Astintze Kalea, 24 Pol. Ind. Neinver, ES-48160 Derio - Vizcaya, Spain

R076/2006-NL1-2013.48 (MAA)
Non-automatic weighing instrument - Type: CS3X series
Xiamen Pinnacle Electrical Co. Ltd., 4F Chambridge Building, Torch High, Zone Xiamen, CN-361006 Fujian, P.R. China

R076/2006-NL1-2013.49 (MAA)
Indicator - Type: HF-L/s, GC-L/S, HC/E-200, PC/E-200
Shanghai Handfree Mechatronic Co., Ltd., 18th, No. 5018 Shangnan Road, CN-200124 Shanghai, P.R. China

R076/2006-NL1-2013.50 (MAA)
Indicator - Type: D2008
Keli Sensing Technology (Ningbo) Co., Ltd., No. 199 of Changxing RD, Jiangbei district, Ningbo, P.R. China

R076/2006-NL1-2014.01 (MAA)
Indicator - Type: XK315A1-2X
Shanghai Caisun Electronic Technology Co. Ltd., No. 25, 369 Datuanzhen Sandun Sanxuan Road, Nanhui, CN-201312 Shanghai, P.R. China

R076/2006-NL1-2014.04 (MAA)
Indicator - Type: T72XW
Ohaus Corporation, 7, Campus Drive, Suite 310, 07054 Parsippany - NJ, United States

R076/2006-NL1-2014.06 (MAA)
Non-automatic weighing instrument - Type: Serie LX/LS/LT
Precisa Gravimetrics A.G., Moosmattstrasse 32, CH-8953 Dietikon, Switzerland

R076/2006-NL1-2014.07 (MAA)
Indicator - Type: YH-T8 or YH-T8g2
Shanghai Yaohua Weighing System Co., Ltd, No. 4059, Shangnan Road, Pudong District, CN-200124 Shanghai, P.R. China

R076/2006-NL1-2014.08 (MAA)
Non-automatic weighing instrument - Type: Explorer EX…series
Ohaus Corporation, 7, Campus Drive, Suite 310, 07054 Parsippany - NJ, United States

R076/2006-NL1-2014.09 (MAA)
Indicator - Type: 500, 500-SW and D-900 Series
Dibal S.A., Astintze Kalea, 24 Pol. Ind. Neinver, ES-48160 Derio - Vizcaya, Spain

R076/2006-NL1-2014.10 (MAA)
Indicator - Type: DI-166, DI-166SS,DI-167
Shanghai Teraoka Electronic Co., Ltd., Tinglin Industry Developmental Zone, Jin Shan District, CN-201505 Shanghai, P.R. China

R076/2006-NL1-2014.12
Non-automatic weighing instrument - Type: RE series, Aviator 3000 A32P…series
Ohaus Corporation, 7, Campus Drive, Suite 310, 07054, Parsippany - NJ, United States

R076/2006-NL1-2014.13
Non-automatic weighing instrument - Type: MS-2xxx, MS-3xxx, MS-4xxx, MS-5xxx, MS-6xxx, MBF-5xxx, MBF-6xxx, MS21-NEOxx
Charder Electronic Co., Ltd, No. 103, Kuo Chung Road, Dah Li City, TW-Taichung Hsien 41262, Chinese Taipei

R076/2006-NL1-2014.14 (MAA)
Non-automatic weighing instrument - Type: TS2-series and TS5-series
Xiamen Pinnacle Electrical Co. Ltd., 4F Chambridge Building, Torch High, Zone Xiamen, CN-361006 Fujian, P.R. China

R076/2006-NL1-2014.15 (MAA)
Non-automatic weighing instrument - Type: BC series
Mettler-Toledo Inc., 1150 Dearborn Drive, Worthington, Ohio 43085, United States

R076/2006-NL1-2014.16 (MAA)
Non-automatic weighing instrument - Type: SM-120
Shanghai Teraoka Electronic Co., Ltd., Tinglin Industry Developmental Zone, Jin Shan District, CN-201505 Shanghai, P.R. China

R076/2006-NL1-2014.17
Non-automatic weighing instrument - Type: SM-100.., SM-5100..
Shanghai Teraoka Electronic Co., Ltd., Tinglin Industry Developmental Zone, Jin Shan District, CN-201505 Shanghai, P.R. China

R076/2006-NL1-2014.18 (MAA)
Indicator - Type: IND570
Mettler-Toledo (Changzhou) Measurement Technology Ltd, N° 111, West TaiHu Road, ChangZhou XinBei District, CN-213125 Jiangsu, P.R. China

R076/2006-NL1-2014.19 (MAA)
Non-automatic weighing instrument - Type: Ranger 7000 R71. . . Series
Ohaus Corporation, 7, Campus Drive, Suite 310, 07054 Parsippany - NJ, United States

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Automatic level gauges for fixed storage tanks
Jaugeurs automatiques pour les réservoirs de stockage fixes

R 85 (2008)

Issuing Authority / *Autorité de délivrance*
Czech Metrology Institute (CMI), Czech Republic

R085/2008-CZ1-2014.01
Magnetostrictive level gauge - Type: XMT-SI-485
Start Italiana srl., via Pola 6, IT-20030 Bovisio Masciago (MB), Italy

R085/2008-CZ1-2014.02
Magnetostrictive level gauge - Type: XMT
Start Italiana srl., via Pola 6, IT-20030 Bovisio Masciago (MB), Italy

Issuing Authority / *Autorité de délivrance*
Laboratoire National de Métrologie et d'Essais, Certification Instruments de Mesure, France

R085/2008-FR2-2013.01 Rev. 0
Level gauge SERAP - Type: First level 2
Serap Industries, Route de Fougeres, FR-53120 Gorron, France

Issuing Authority / *Autorité de délivrance*
SP Technical Research Institute of Sweden, Sweden

R085/2008-SE1-2011.01 Rev. 1
Automatic level gauges for measuring the level of liquid in stationary storage tanks
Emerson Process Management, Rosemount Tank Radar AB, Box 130 45, SE-402 51 Goteborg, Sweden

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Automatic rail-weighbridges
Ponts-bascules ferroviaires à fonctionnement automatique

R 106 (1997)

Issuing Authority / *Autorité de délivrance*
National Measurement Office (NMO), United Kingdom

R106/1997-GB1-2007.01 Rev. 1
Automatic rail-weighbridge, Railweight TSR4000
Avery Weigh-Tronix, Foundry Lane, Smethwick B66 2LP, United Kingdom

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Fuel dispensers for motor vehicles
Distributeurs de carburant pour véhicules à moteur

R 117 (1995) + R 118 (1995)

Issuing Authority / *Autorité de délivrance*
State General Administration for Quality Supervision and Inspection and Quarantine (AQSIQ), China

R117/1995-CN1-2013.01 Rev. 1
Fuel dispenser - Type ZC-11111, ZC-11122, ZC-22222
Zhejiang Genuine Machine Co., Ltd., Special Industrial Park Puqi Yueqing, 325609 Zhejiang, P.R. China

Issuing Authority / *Autorité de délivrance*
National Measurement Office (NMO), United Kingdom

R117/1995-GB1-2013.01
Liquids other than water dispenser, C series
Pumptronics Europe Ltd., Folgate Road, North Walsham NR28 0AJ, United Kingdom

R117/1995-GB1-2013.02
Liquids other that than water dispenser, SK700-II family including SK700-II,SK700-II/Horizon, SK700-II/IOD, SK700-II/Frontier and Endura models
Gilbarco Veeder Root, Crompton Close, Basildon SS14 3BA, United Kingdom

Issuing Authority / *Autorité de délivrance*

International Metrology Cooperation Office, National Metrology Institute of Japan (NMIJ) National Institute of Advanced Industrial Science and Technology (AIST), Japan

R117/1995-JP1-2013.01

Fuel dispenser for motor vehicles, HA / HI series

Tominaga Mfg. Co., 88 Nishinokyo-Minamiryomachi, Nakagyo-ku, JP-604-8493 Kyoto, Japan

R117/1995-JP1-2013.01 Rev. 1

Fuel dispenser for motor vehicles, HA / HI series

Tominaga Mfg. Co., 88 Nishinokyo-Minamiryomachi, Nakagyo-ku, JP-604-8493 Kyoto, Japan

Issuing Authority / *Autorité de délivrance*

Russian Research Institute for Metrological Service (VNIIMS)

R117/1995-RU1-2014.01

MIDCO Fuel Dispensing Units Sure Fill/AccueFill Series Suction type and Remote type

Midco Ltd., Metro Estate, Vidyanagari Marg, Kalina, IN-400098 Mumbai, India

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Multi-dimensional measuring instruments
Instruments de mesure multidimensionnels

R 129 (2000)

Issuing Authority / *Autorité de délivrance*

NMi Certin B.V., The Netherlands

R129/2000-NL1-2014.01

Multi-Dimensional Measuring Instrument - Type: DM3610-. . . .

Datalogic Automation Srl, Via Lavino no. 265, 40050 Monte San Pietro, Italy

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Automatic instruments for weighing road vehicles in motion and measuring axle loads
Instruments à fonctionnement automatique pour le pesage des véhicules routiers en mouvement...

R 134 (2006)

Issuing Authority / *Autorité de délivrance*

National Measurement Office (NMO), United Kingdom

R134/2006-GB1-2013.01

WheelRight Weight and Pressure in motion WR100 or WheelRight Weight in motion WR120

WheelRight Ltd., Begbroke CIE, Begbroke Science Park, Begbroke Hill, Woodstock Road, Begbroke OX5 1PF, United Kingdom

Issuing Authority / *Autorité de délivrance*

Dansk Elektronik, Lys & Akustik (DELTA), Denmark

R134/2006-DK3-2013.01

Automatic instrument for weighing road vehicles in motion - Type: LL2/AW

Tunaylar Baskül Sanayi ve Ticaret A.S., Akcaburgaz Mah. 88 Sok. N°7, Esenyurt, Istanbul, Turkey

R134/2006-DK3-2014.01

Automatic instrument for weighing road vehicles in motion - Type: GI511 BPR

Giropes SL., Pol. Emporda Internacional, C/Mollo 15-16, ES-17469 Vilamalla - Girona, Spain

R134/2006-DK3-2014.02

Automatic instrument for weighing road vehicles in motion - Type: GI511 PM

Giropes SL., Pol. Emporda Internacional, C/Mollo 15-16, ES-17469 Vilamalla - Girona, Spain

R134/2006-DK3-2014.03

Automatic instrument for weighing road vehicles in motion - Type: GesDyn GI308 BPPEM

Giropes SL., Pol. Emporda Internacional, C/Mollo 15-16, ES-17469 Vilamalla - Girona, Spain

R134/2006-DK3-2014.04

Automatic instrument for weighing road vehicles in motion - Type: GesDyn GI308 BPXL

Giropes SL., Pol. Emporda Internacional, C/Mollo 15-16, ES-17469 Vilamalla - Girona, Spain

OIML CERTIFICATE SYSTEM

List of OIML Issuing Authorities

The list of OIML Issuing Authorities is published in each issue of the OIML Bulletin. For more details, please refer to our web site: www.oiml.org/certificates. There are no changes since the last issue of the Bulletin.

		R 16	R 21	R 31	R 35	R 46	R 49	R 50	R 51	R 58	R 60	R 61	R 75	R 76	R 81	R 85	R 88	R 93	R 97	R 98	R 99	R 102	R 104	R 105	R 106	R 107	R 110	R 112	R 113	R 114	R 115	R 117/118	R 122	R 126	R 128	R 129	R 133	R 134	R 136
AT1	Bundesamt für Eich- und Vermessungswesen (BEV)							■	■	■		■		■		■	■		■	■		■	■		■	■	■			■	■	■							
AU1	National Measurement Institute (NMI)						■	■	■		■			■		■									■	■						■		■		■			
BE1	SPF Economie, PME, Classes Moyennes et Energie													■					■	■																			
BG1	State Agency for Metrology and Technical Surveillance (SAMTS)													■						■																			
BR1	Instituto Nacional de Metrologia, Normalização e Qualidade Industrial (INMETRO)													■																									
CH1	Institut fédéral de métrologie (METAS)	■		■			■	■	■		■	■		■					■	■				■	■	■						■						■	
CN1	General Administration of Quality Supervision, Inspection and Quarantine of P. R. China (AQSIQ)			■				■	■		■	■		■					■	■						■						■						■	
CZ1	Czech Metrology Institute (CMI)						■							■	■	■								■								■						■	
DE1	Physikalisch-Technische Bundesanstalt (PTB)	■		■	■		■	■	■	■	■	■		■		■	■		■	■	■	■	■	■	■	■	■			■	■	■		■	■	■	■		■
DK1	The Danish Accreditation and Metrology Fund (DANAK)							■	■		■	■		■						■				■	■	■						■				■		■	
DK2	FORCE Certification A/S						■																																
DK3	Dansk Elektronik, Lys & Akustik (DELTA)							■	■		■	■		■											■	■										■		■	
ES1	Centro Español de Metrología (CEM)						■		■		■	■		■					■	■														■					
FI1	Inspecta Oy							■	■		■	■		■		■									■	■						■							
FR1	Ministère de l'Economie, de l'Industrie et de l'Emploi (MEIE)	*All activities and responsibilities were transferred to FR2 in 2003*																																					
FR2	Laboratoire National de Métrologie et d'Essais (LNE)		■	■			■	■	■	■	■	■		■	■	■	■		■	■	■	■		■	■	■	■			■	■	■		■		■		■	
GB1	National Measurement Office (NMO) - Formerly NWML		■		■		■	■	■		■	■	■	■		■				■				■	■	■						■				■		■	
GB2	National Physical Laboratory (NPL)																		■																				
HU1	Hungarian Trade Licensing Office (MKEH)													■																									
IT1	Ministero dello sviluppo economico - Direzione generale mercato, concorrenza, consumatori, vigilanza e normativa tecnica						■																																
JP1	National Metrology Institute of Japan / National Institute of Advanced Industrial Science and Technology (NMIJ / AIST)										■			■																	■	■							
KR1	Metrology and Measurement Division (KATS)													■																									
NL1	NMi Certin B.V.		■	■		■	■	■	■		■	■		■	■	■			■		■			■	■	■						■		■	■	■		■	
NL2	KIWA Nederland B.V.						■																																
NO1	Norwegian Metrology Service (Justervesenet)							■	■			■		■										■	■	■						■				■			
NZ1	Measurement and Product Safety Service (MAPSS Wellington)													■																									
PL1	Central Office of Measures (GUM)													■						■		■																	
RO1	Bureau Roumain de Métrologie Légale (B.R.M.L.)																		■	■							■			■	■								
RU1	Russian Research Institute for Metrological Service (VNIIMS)			■			■	■	■	■	■	■		■		■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
SE1	Swedish National Testing and Research Institute AB (S.P.)							■	■		■	■		■		■				■					■	■						■							
SI1	Metrology Institute of the Republic of Slovenia (MIRS)													■																									
SK1	Slovak Legal Metrology						■							■																		■							
US1	NCWM, Inc.										■			■																									
VN1	Directorate for Standards and Quality (STAMEQ)													■																									

Press release

WORLD METROLOGY DAY 2014

Measurements and the global energy challenge

Release:

May 20 is World Metrology Day, commemorating the anniversary of the signing of the Metre Convention in 1875. This treaty provides the basis for a coherent measurement system worldwide.

The theme chosen for 2014 is ***Measurements and the global energy challenge***.

The world is facing a growing global energy challenge over the coming decades. The crux of the problem is the growing energy demand, particularly from the emerging nations, coupled with the need to limit or reduce greenhouse gases. Add in the desire to have diversity and security of supply and the increasing costs to extract fossil fuels, and we see the trend is for a greater mix of energy sources, including renewables. Diversification, combined with demands for improvements in efficiency of energy generation, transmission and use, mean that technology is constantly being pushed to the limit.

To meet the challenge we need to improve our ability to measure a whole series of parameters. For example, more accurate measurement of the manufacturing temperature or surface form of a turbine blade will enable efficiency improvements. Better power quality measurements will help improve the stability of transmission grids, which nowadays must also cope with variable inputs from wind turbines and photovoltaic cells, etc. More complex electrical power metering is needed to ensure the energy we buy, or even perhaps sell, is correct.

Across the world, national metrology institutes continually advance measurement science by developing and validating new measurement techniques at whatever level of sophistication is needed. They also participate in comparisons coordinated by the Bureau International des Poids et Mesures (BIPM) to ensure the reliability of measurement results worldwide.

Many measuring instruments are controlled by law or are subject to regulatory control, for example the scales used to weigh goods in a shop, instruments to measure environmental pollution, or meters used to bill energy. The International Organization of Legal Metrology (OIML) develops international Recommendations, the aim of which is to align and harmonize requirements for these types of instruments worldwide.

World Metrology Day recognizes and celebrates the contribution of all the people that work in intergovernmental and national organizations throughout the year on behalf of all.

Further information, including a message from the Directors,
posters, and a list of events, is available at
www.worldmetrologyday.org

Contact: wmd@worldmetrologyday.org

DEVELOPING COUNTRIES

ANNOUNCING THE

Sixth OIML Award for Excellent contributions from Developing Countries to legal metrology

Background

Many developing countries suffer from a lack of resources for the operation of a sound legal metrology system. Although these resources cannot be provided by the OIML, the Organization supports initiatives for the development of legal metrology. To highlight the importance of metrology activities in developing countries, and to provide an incentive for their improvement, in 2009 the OIML established an Award for *"Excellent contributions from developing countries to legal metrology"*.

This Award is intended to raise the awareness of, and create a more favorable environment for legal metrology and to promote the work of the OIML. The Award intends: *"to acknowledge and honor new and outstanding activities achieved by individuals, national services or regional legal metrology organizations contributing significantly to legal metrology objectives on national or regional levels."*

How can candidates be proposed?

Nominations may be made by any individuals or organizations concerned with legal metrology, including the individual or organization seeking the Award.

Nominations should be sent to Ian Dunmill at the BIML and must contain facts, documents and arguments explaining why the candidate deserves the Award. The closing date is 1 July 2014.

Selection procedure

The BIML will prepare a list of candidates highlighting the importance of the achievements, and will rank the applications. The Award winner will be selected by the CIML President and announced at the 49th CIML Meeting in October 2014.

Selection criteria

The criteria which will be used to assess the candidates' contribution or achievement will include:

- its significance and importance;
- its novelty;
- its attractiveness and adaptability for other legal metrology services.

The OIML Award

The Award will consist of:

- a Certificate of Appreciation signed by the CIML President;
- a token of appreciation, such as an invitation to make a presentation of the Award-winning achievement at the next CIML Meeting or OIML Conference at the OIML's expense;
- an engraved glass award trophy.

Further information

For more details, please contact:

Ian Dunmill
BIML Assistant Director
ian.dunmill@oiml.org

Past Awards

2013 - Weights and Measures Agency (Tanzania)

2012 - Loukoumanou Osséni (Benin)

2011 - José Antonio Dajes (Peru) and Juan Carlos Castillo (Bolivia)

2010 - Thai Legal Metrology Service

2009 - Mr. Osama Melhem (Jordan)

The OIML is pleased to welcome the following new

CIML Members

Republic of Croatia:
Mr. Bozidar Ljubic

Turkey:
Mr. Mehmet Karaoglu

Bulletin online:

Did you know that the OIML Bulletin is now available online free of charge?

oiml.org/en/publications/bulletin

OIML meetings

September 2014

TC 6/p 2: Revision of R 79
TC 6/ p 3: Revision of R 87
TC 6/p 5: New publication: Guidance for defining the system requirements for a certification system for prepackages
15-19 September - Seoul, Rep. Korea

TC 17/SC 7/p 3: Revision of R 126
24-25 September - Paris, France

November 2014

49th CIML Meeting and Associated Events
3-6 November - Auckland, New Zealand

December 2014

TC 8/SC 1/p 6: Revision of R 80
Date to be confirmed - Braunschweig, Germany

Committee Drafts

Received by the BIML, 2014.01 – 2014.05

New OIML publication: Conformity to type (CTT) - Pre-market conformity assessment of measuring instruments	E	1 CD	TC 3/SC 6/p 1	NZ
OIML R 139-3: Compressed gaseous fuel measuring systems for vehicles. Part 3: OIML Report format for type evaluation	E	1 CD	TC 8/SC 7/p 4	NL
Revision of OIML R 87: Quantity of product in prepackages	E	3 CD	TC 6/p 3	ZA
General requirements for the program of reference material certification	E	1 CD	TC 3/SC 3/p 7	RU
The role of measurement uncertainty in conformity assessment decisions in legal metrology	E	2 CD	TC 3/SC 5/p 2	US

Call for papers

OIML Members
RLMOs
Liaison Institutions
Manufacturers' Associations
Consumers' & Users' Groups, etc.

- Technical articles on legal metrology related subjects
- Features on metrology in your country
- Accounts of Seminars, Meetings, Conferences
- Announcements of forthcoming events, etc.

The **OIML Bulletin** is a forum for the publication of technical papers and diverse articles addressing metrological advances in trade, health, the environment and safety - fields in which the credibility of measurement remains a challenging priority. The Editors of the Bulletin encourage the submission of articles covering topics such as national, regional and international activities in legal metrology and related fields, evaluation procedures, accreditation and certification, and measuring techniques and instrumentation. Authors are requested to submit:

- a titled, typed manuscript in Word or WordPerfect either on disk or (preferably) by e-mail;
- the paper originals of any relevant photos, illustrations, diagrams, etc.;
- a photograph of the author(s) suitable for publication together with full contact details: name, position, institution, address, telephone, fax and e-mail.

Note: Electronic images should be minimum 150 dpi, preferably 300 dpi.

Technical articles selected for publication will be remunerated at the rate of 23 € per printed page, provided that they have not already been published in other journals. The Editors reserve the right to edit contributions for style, space and linguistic reasons and author approval is always obtained prior to publication. The Editors decline responsibility for any claims made in articles, which are the sole responsibility of the authors concerned. Please send submissions to:

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BIML, 11 Rue Turgot, F-75009 Paris, France
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