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■ Editorial

CHRIS PULHAM
EDITOR/WEBMASTER

New OIML Website revealed!

We are very proud to inform you that the brand new OIML website is now live. It has a completely refreshed look, a new interface, the content has been expanded, and it is bilingual French-English. Latest news going back three months is published on the Home Page.

Those present at our Bucharest meetings last October will recall that the BIML Web Team (Jean-Christophe Esmiol, Jalil Adnani and myself) discussed the new site project with many CIML Members. We very much enjoyed these discussions and carefully documented and analyzed the information we gained, endeavoring to accommodate all the feedback. Over the past year, together with all the BIML Staff in a series of intense brainstorming and think-tank sessions, we have put together all of these ideas and come up with what we present to you today.

We have reviewed and updated all the texts, added images, redesigned the look and feel of the site and regrouped information in a more logical format. We have given considerable thought to our audiences both external to the OIML (the general public) and internal (our Members and TCs/SCs), and have expanded the content to encompass a global target audience, whilst always ensuring a minimum number of clicks to obtain the desired information.

All our publications are now fully indexed, which makes finding key information simpler, directly via the search box on the home page. We have been able to scan and upload the whole collection of OIML Bulletins, we have introduced search facilities for the Certificates and Technical Work, and streamlined our databases. We have updated all the TC/SC/PG information received following our inquiry to our CIML Members. We are currently preparing to distribute login details to our Members. The universal "members-riweb" will soon be a thing of the past!

To facilitate your use of the site, you can open up the dynamic site map via the link at the top right of your screen.

We invite you to explore the site fully. Please let us know what you think of it. We have already embarked upon Phase 2, during which we will be building the Members Voting Module and completing the pages needed by our TCs, SCs and Project Groups. In the meantime, the current Workgroups site remains accessible.

Thank you for your interest, and enjoy the site! ■

GAS MEASUREMENT

Calibration results of a new generation capillary type thermal mass flowmeter for natural gas

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Abstract

This paper presents two calibration results carried out by means of two different, independent, accredited metrology laboratories, on two samples of commercial CTTMFs (capillary type thermal mass flowmeter), for natural gas in domestic/residential (G4) applications.

The aim of this study is to evaluate the degree of metrological agreement between different calibration results, by means of the assessment of a suitable factor (compatibility index, also known as normalized error). This application study is quite interesting in the field of "legal metrology", where conformity assessment is required in order to ensure the adequate behaviour of a domestic gas meter.

The two tested gas meters were calibrated in two different laboratories, each of them characterized by different values of the calibration uncertainty, also called CMC (calibration and measurement capability), or BMC (best measurement capability), or minimum uncertainty.

The results reported here show a satisfactory agreement between the calibrations carried out by means of two different traceable test facilities: a volumetric primary standard (bell prover) and a secondary standard (sonic nozzles).

1 Introduction

In general, natural gas flow metering technologies are based on the following instrumentations:

1 gas flow sensor (gas meter):

- traditional, mechanic, *volumetric* gas meters: mainly positive-displacement types, such as diaphragm meters, rotary piston meters, etc.;
- traditional, mechanic, *non-volumetric* gas meters: turbine meters, differential pressure meters;
- new technology-based meters: ultrasonic meters, thermal mass flowmeters, Coriolis meters.

2 conversion device:

auxiliary instrument for the conversion of gas volume in function of its pressure, temperature and compressibility factor; such types of instruments are usually not required for domestic gas metering. A gas volume converter is usually composed of (i) a pressure probe (such as a piezo-resistive sensor), (ii) a temperature probe (such as a 4-wire platinum resistance detector), (iii) an electronic unit which converts the gas volume measured/registered by the meter (gas sensor) into "reference thermodynamic conditions" (or *reference conditions*: 1.013 bar and 15 °C) through the standard formula (compliant to AGA NX19, AGA8, S-GERG):

$$V_b = \frac{p_m}{p_b} \cdot \frac{T_b}{T_m} \cdot \frac{z_b}{z_m} \cdot V_m \tag{1}$$

where:

V_m = unconverted (measured) gas volume registered by the meter (m^3);
V_b = converted gas volume in reference (base) conditions (m^3);
T_m = gas temperature in operating conditions (K);
T_b = reference (base) temperature (15 °C = 288 K);
p_m = gas pressure in operating conditions (bar);
p_b = reference (base) pressure (1.013 bar= 1013 hPa);
z_m = compressibility factor in operating conditions (-);
z_b= compressibility factor in reference (base) conditions (-).

The gas volume converter typically also has a function of data storage (local data logger) and remote data transmission through several integrated communication media and protocols.

Traditional mechanical gas meters are analogue (dynamic), and are therefore influenced by the effects of wear (more sensitive to performance degradation pattern).

New technology-based gas meters are usually static, smart (fully electronic or digital meters) and therefore typically have a more stable metrological performance. In addition, mass flow metering technologies (Coriolis and thermal) do not require an external volume conversion unit, since they directly display the gas volume expressed in reference/standard thermodynamic conditions.

Accurate measurement of natural gas in commercial transactions is a crucial matter. A very significant application of gas metering is represented by the domestic (residential) volumetric meters, very popular and widespread for billing domestic consumers.

The accuracy of the measurement is also very important in custody transfer applications.

Respecting compliance with legal metrology error limits (known as maximum permissible error or MPE) guarantees the correctness of commercial transactions: legal metrology ensures the quality and credibility of measurements that are used directly in regulation and in areas of commerce.

2 Operation principle of capillary type thermal mass flowmeters

The new generation micro-thermal mass flow sensors, such as CMOS (complementary metal-oxide semi-conductor), or MEMS (micro-thermal calorimeters) are based on the cooling of a heated miniaturized object (micro heater) placed in the flow. The measurement arrangement is composed of three basic elements (see Figure 1): two temperature sensors and a central micro heater; both the temperature sensors and the micro heater are controlled by a suitable electronic module.

A bypass capillary type mass flowmeter is composed of four main elements (see Figure 1):

- a bypass circuit (in which flows the capillary mass flow rate m_c, in a conduit of cross-section area A_c),
- a flow sensor mounted in the bypass circuit, in which the basic elements are miniaturized, thus realizing a measurement "chip",
- an electronic circuit (microcontroller),
- a pressure dropper (laminar element), placed in the main pipe (in which flows the main mass flow rate m_m, in a conduit of cross-section area A_m).

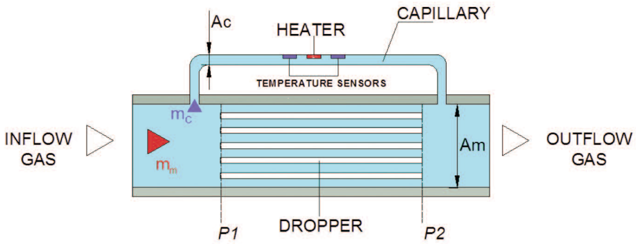

Figure 1 Basic elements of a by-pass capillary thermal mass flowmeter

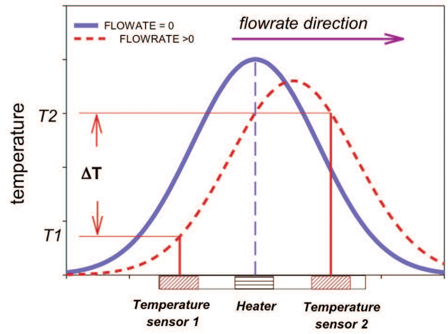

Figure 2 Temperature profiles in a by-pass capillary thermal mass flowmeter: with flow (dotted line) and without flow (continuous line)

Gas enters the meter and is divided into two flow paths; in both, laminar flow is ensured: in the bypass capillary tube by the very small diameter of the capillary, and in the main tube by the pressure dropper/laminar flow element. Most of the flow (m_m = main mass flow rate) goes through the main pipe with pressure dropper: the pressure drop ($p_1 - p_2$) forces a small fraction (m_c = capillary mass flow rate) of flow through the bypass capillary tube.

At the maximum flowrate, the pressure dropper placed in the main gas flow generates a pressure drop typically < 2 mbar. Less than 1 % (a very small amount) of the gas stream, i.e. the mass flow rate in the capillary circuit (m_c) is thereby forced to flow through the bypass capillary tube and over the sensor.

In the micro-thermal mass flow sensor, the temperature difference between two temperature sensors placed symmetrically upstream and down-stream of the micro heater (see Figure 2) detects the passage of gas flow. If no gas is flowing over the sensor, the two thermo-elements measure the same rise in temperature (see Figure 2). If a gas stream flows through the micro heater the temperature symmetry is disturbed, and the asymmetry can be expressed as a temperature difference between the two temperature sensors (see Figure 2). This temperature difference signal, which exists in the form of a voltage difference (thermopile), is processed in the analogue part of the sensor chip and then digitalized in the digital part. This measurement signal (voltage difference) is proportional to the mass flowrate of the gas flowed over the sensor-chip.

Basically, the micro-thermal mass flow sensor uses the thermal properties of the gas to directly measure the mass flow rate (considering the electric power supply, Q_{el}, provided to the micro heater as being equal to the thermal power, Q_{th}, generated by the Joule's effect (RI^2) and lost to the gas flow by means of forced convective heat transfer (see ISO 14511:2001):

$$Q_{el} = RI^2 = Q_{th} = m_c c_p \Delta T \quad (2)$$

where:

Q_{el}	is the heat power produced by the micro heater [W],
Q_{th}	is the heat power transferred to the gas flow [W],
R	is electrical resistance [Ω],
I	is current intensity [A],
m_c	is the mass flow rate in the capillary bypass [kg/s],
c_p	is specific heat of the gas at constant pressure [J/(kg K)],
$\Delta T = T_2 - T_1$	is the net difference in gas temperature [K],
T_1	is the temperature detected by the upstream sensor [K],
T_2	is the temperature detected by the downstream sensor [K].

The sensor chip detects the mass flow rate in the capillary tube (m_c): if the flow is laminar in both the circuits (the capillary one and the main one) the ratio m_c/m_m (mass flow rate in the capillary circuit/mass flow rate in the main pipe) is constant (typically equal to the ratio between the cross section areas A_c/A_m).

The sensor uses the basic principle that each gas molecule has the specific ability to pick up heat (forced convective heat transfer). This property, called the specific heat for a constant pressure (c_p), directly relates to the mass and physical structure of the molecule and can be determined experimentally. The physical structure of molecules varies widely from gas to gas, as does the specific heat, c_p, which varies depending on the gas composition and temperature (for a gas with a "real" behavior, not ideal gas). Changes in c_p also imply changes in the thermal conductivity λ of the gas, since the thermal diffusivity α of the gas is $\alpha = \lambda/(c_p \cdot \rho)$, where ρ is the gas density.

The gas sensitivity (or gas identification/recognition) represents a crucial feature for the measurement reliability. Nowadays, the new and improved generations of CTTMF are able to sense gas composition, providing possible corrections to all current gas families (compliant to EN 437:2009).

3 Calibration technologies

Gas metering in legal metrology utilizes the meters mainly as *volume counters* (meter reading expressed in m^3) rather than as volumetric flow meters (meter reading expressed in m^3/s).

In the case of a thermal mass flowmeter, the gas volume – expressed at stated thermodynamic conditions: i.e. volume at reference conditions (or base conditions or standard conditions) – is inferred from the measurement of the mass flow rate (by density conversion).

The percentage error *e* (%) (also called deviation) is defined as follows:

$$e(\%) = \frac{V_{meter} - V_{ref}}{V_{ref}} \cdot 100 \qquad (3)$$

where:

V_{meter} is the gas volume measured by the meter under test in m^3 (the difference between two meter readings at the beginning and at the end of the test), converted to reference conditions,

V_{ref} is the gas volume in m^3 at reference conditions provided by a traceable standard.

Calibration of gas meters can be of two types:

- *primary calibration*, in which the gas volume measured by the meter under test and the gas volume provided by a suitable (traceable) primary standard are compared;
- *secondary calibration* (also called "reference-calibration"), in which the gas volume measured by the meter under test and the gas volume provided by a reference (traceable) measurement system (secondary standard) are compared.

3.1 Primary calibration volume standard

The bell prover principle of operation consists in measuring the time interval required to collect a known volume of gas at a measured temperature and pressure. The bell prover typically is composed (see Figure 3) of a cylindrical tank which forms an annulus filled with sealing oil. Into this annulus is placed the bell, open at the bottom and having a dome-shaped top. Its weight is

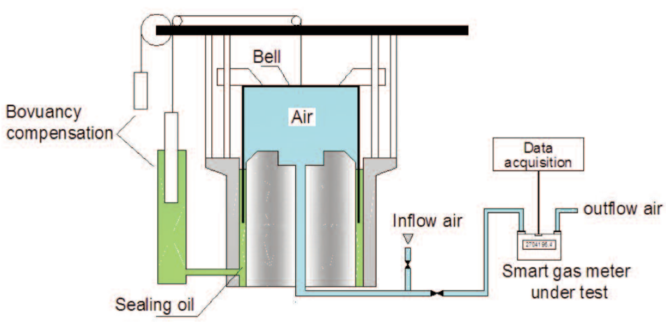

Figure 3 prover (primary calibration) measurement scheme nearly balanced by counterweights so that it can be raised or lowered by a small differential pressure (0.3 kPa) to collect and measure a volume of gas. A smaller counterweight is mounted on a cam so that it provides a correction for buoyancy effects as the bell immersion in the sealing liquid changes. Rollers and guide rods provide lateral stability in the bell position as it moves upwards. A control valve system provides firstly the filling of the bell by means of an air blower, and then (switching the position open/close of the valves) the gas contained in the bell flows through the meter under test for different fixed flow rate values. The accurate measurement of the gas volume depends on the bell position assessment (by index), measured either manually (by a graduated scale) or automatically (by an opto-electronic system).

Typical extended uncertainties of a primary standard bell prover range from ±0.10 to ±0.30 % (with a coverage factor k=2, i.e. 95 % coverage interval);

3.2 Secondary calibration volume standard

A sonic nozzle is typically used as a transfer standard during the flowmeter calibration.

The mass flow rate (in the case of sonic flow) of the gas passing through the nozzle is a function of the thermodynamic conditions upstream (inlet pressure, inlet temperature) and of the type of gas. The measurement principle of the sonic nozzle is based on a linear relationship between mass flow and the inlet pressure and temperature when the gas is flowing through the nozzle at sonic velocity. Normally, flow reaches sonic velocity when the downstream pressure is not greater than one half of the upstream pressure.

The geometry of a sonic nozzle (designed and manufactured in accordance with both ASME and ISO standards) is such that the gas is accelerated along the circular arc converging section and then is expanded in a conical diverging section, which is designed for pressure recovery (see Figure 4). In the throat, or minimum area point of the sonic nozzle, the gas velocity becomes equal to the speed of sound. At this point, the gas velocity and density are maximized, and the mass flow rate is a function of the inlet pressure, inlet temperature, and the type of gas.

The characteristic sonic nozzle equation is as follows:

$$m = A\,C_d\,C_c \cdot \frac{p}{\sqrt{r\,T}} = A\,C_d\,C_c \cdot \frac{p}{\sqrt{\left(\frac{R}{M}\right)T}} \tag{4}$$

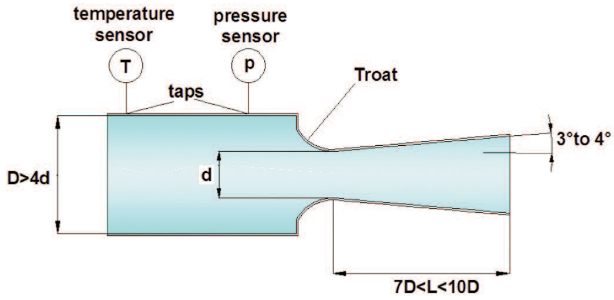

Figure 4 Typical design of an ASME/ISO sonic nozzle

where:

- A is the cross section of flow at nozzle throat (m²),
- M is the molar mass of the gas (kg/mol),
- m is the mass flow rate (kg/s),
- p is the upstream gas pressure, at the nozzle inlet (Pa),
- r is the ratio of the universal ideal gas constant to molar mass of the gas (J/kg K),
- R is the universal ideal gas constant (J mol^{-1}K^{-1}),
- T is the upstream gas temperature, at the nozzle inlet (K),
- C_d is the discharge coefficient,
- C_c is the critical flow factor.

Typical extended uncertainties of a secondary standard (flow nozzle) range from ±0.30 to ±0.60 % (with a coverage factor k=2, i.e. 95 % coverage interval);

4 Calibration and metrological compatibility

The metrological characterization of a gas meter, in legal metrology applications, is carried out by means of suitable calibration. The main aim of the gas meter calibration is to determine the measurement errors, and the comparison with the MPE.

For the two tested G4 capillary type thermal mass CTTMF gas meters (called "meter A" and "meter B" below) the maximum permissible errors are:

- ± 3 % for $Q_{min} \le Q \le Q_t$;
- ± 1.5 % for $Q_t \le Q \le Q_{max}$,

where Q_t is the transitional flow rate that divides the flowrate range into two fields (the upper and the lower zones).

The minimum uncertainty (or the BMC) of the test facilities during the test are the following (for k=2):

Bell prover - primary calibration rig:

$BMC_{Lab\ 1}$ = ± 0.30 % (for all the test flow rates).

Sonic nozzles – secondary calibration rig:

$BMC_{Lab\ 2}$ = ± 0.60 % (for the lower zone of the flowrate range);
$BMC_{Lab\ 2}$ = ± 0.30 % (for the higher zone of the flowrate range).

The comparison of the calibration results is usually carried out through the normalized error $E_{1,2}$ (or compatibility index), calculated between two involved laboratories (for example "Lab 1 – primary standard" and "Lab 2 – secondary standard"):

$$E_{1,2} = \frac{\left|\bar{e}_{Lab\,1} - \bar{e}_{Lab\,2}\right|}{\sqrt{U^2_{Lab\,1} + U^2_{Lab\,2}}} \qquad (5)$$

where:

$\bar{e}_{Lab1}$ is the average percentage error (%) evaluated in the Lab1 – primary standard, for each test gas flow rate,

$\bar{e}_{Lab2}$ is the average percentage error (%) evaluated in the Lab 2 – secondary standard, for each test gas flow rate,

U_{Lab1} is the extended uncertainty (%) of the Lab 1 – primary standard,

U_{Lab2} is the extended uncertainty (%) of the Lab 2 – secondary standard.

As concerns the average percentage error ($\bar{e}_{Lab}$) it is worth pointing out that each laboratory assumes six measurement repetitions (for each test flow rate).

The test flow rates are the following: Q_{min}, 0.1 Q_{max}, 0.2 Q_{max}, 0.4 Q_{max}, 0.7 Q_{max}, Q_{max}.

For each test flow rate, the extended uncertainty (U_{Lab}) of the calibration laboratory is defined as follows:

$$U_{Lab} = k \cdot u_{C_{Lab}}\ (\%) = k \cdot \left(\sqrt{u_A^2 + u_B^2}\right)_{Lab} \qquad (6)$$

where:

$u_A = \frac{s}{\sqrt{N}}$ is the type A uncertainty (i.e. the ratio between the experimental standard deviation "s" of a series of six measurement repetitions, and the square root of the number of repetitions N=6),

u_B is the type B uncertainty occurred during actual measurements (also called CMC o BMC),

U_{CLab} is the combined standard uncertainty,

k is the coverage factor, usually chosen to ensure a 95 % coverage interval.

$E_{n1,2} \leq 1$ indicates that the metrological agreement is good (full metrological compatibility between couples of calibration measurements).

$E_{ni,j} > 1$ means that the difference between the two error values determined by different calibrations cannot be covered by the uncertainty of the same difference; in other words, the two calibration results are not mutually compatible and therefore the calibration performances of the two laboratories must be improved and "aligned".

5 Discussion and conclusions

In Tables 1 and 2 the calibration results obtained respectively in the primary standard calibration laboratory (Lab 1) and in the secondary standard calibration laboratory (Lab 2) are reported.

In Figures 5 and 6 the calibration results plotted with respect to the MPE are shown.

In Table 3 the values of the compatibility index between the primary standard and the secondary standard calibration approaches are reported.

It should be noted that the method of determining the normalized errors is based on the hypothesis that no changes in status (or in performance) of the instrument under test occur. Possible, unavoidable, slight changes of the meter status (caused by transportation and storage condition) can affect the calibration results. In the case study presented here, the the time period in which the calibrations were performed is about 15 months. The good agreement of the calibration results is probably due to the static measurement principle of the CTTMF.

Finally, it is possible to summarize the following conclusions for the new generation of CTTMFs tested:

Table 3 Compatibility index of the two calibrations (Lab 1 vs. Lab 2)

	Compatibility Index	
	Meter A	**Meter B**
Flowrate		
Q_{max}	0.17	0.16
0.7 Q_{max}	0.51	0.00
0.4 Q_{max}	0.55	0.26
0.2 Q_{max}	0.28	0.07
0.1 Q_{max}	0.12	0.01
Q_{min}	1.41	0.02

	Lab 1-Primary Standard											
	Meter A						Meter B					
	E	u_A	u_C	u_B	k	U_{Lab1}	E	u_A	u_C	u_B	k	U_{Lab1}
Flowrate	%	%	%	%			%	%		%		
Q_{max}	0.41	0.06	0.16	0.15	2.02	0.33	0.45	0.13	0.20	0.15	2.23	0.44
0.7 Q_{max}	0.68	0.07	0.16	0.15	2.03	0.33	0.50	0.11	0.19	0.15	2.16	0.41
0.4 Q_{max}	1.06	0.12	0.19	0.15	2.20	0.43	0.70	0.10	0.18	0.15	2.11	0.38
0.2 Q_{max}	0.00	0.06	0.16	0.15	2.02	0.33	-0.17	0.02	0.15	0.15	2.01	0.30
0.1 Q_{max}	0.20	0.02	0.15	0.15	2.01	0.31	-0.09	0.03	0.15	0.15	2.01	0.31
Q_{min}	-0.42	0.07	0.16	0.15	2.06	0.34	0.32	0.05	0.16	0.15	2.03	0.32

Table 1

Results of the primary calibration

	Lab 2-Secondary Standard											
	Meter A						Meter B					
	E	u_A	u_C	u_B	k	U_{Lab2}	E	u_A	u_C	u_B	k	U_{Lab2}
Flowrate	%	%	%	%			%	%	%	%		
Q_{max}	0.33	0.05	0.16	0.15	2.02	0.32	0.36	0.05	0.16	0.15	2.01	0.32
0.7 Q_{max}	0.44	0.06	0.16	0.15	2.02	0.33	0.50	0.03	0.15	0.15	2.01	0.31
0.4 Q_{max}	0.77	0.03	0.15	0.15	2.01	0.31	0.57	0.02	0.15	0.15	2.01	0.31
0.2 Q_{max}	-0.12	0.00	0.15	0.15	2.01	0.30	-0.14	0.03	0.15	0.15	2.01	0.31
0.1 Q_{max}	0.15	0.02	0.15	0.15	2.01	0.30	-0.09	0.01	0.15	0.15	2.01	0.30
Q_{min}	0.56	0.02	0.30	0.30	2.01	0.60	0.31	0.01	0.30	0.30	2.01	0.60

Table 2

Results of the secondary calibration

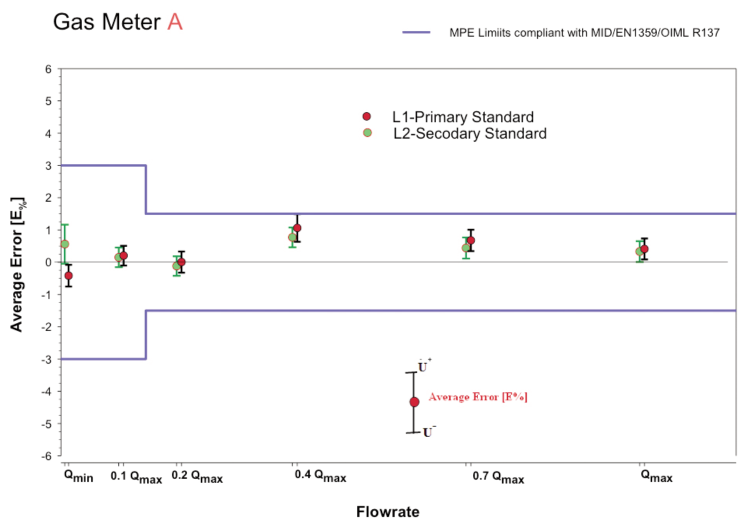

Figure 5

Comparison between the calibration results carried out in the two different laboratories on the same meter A

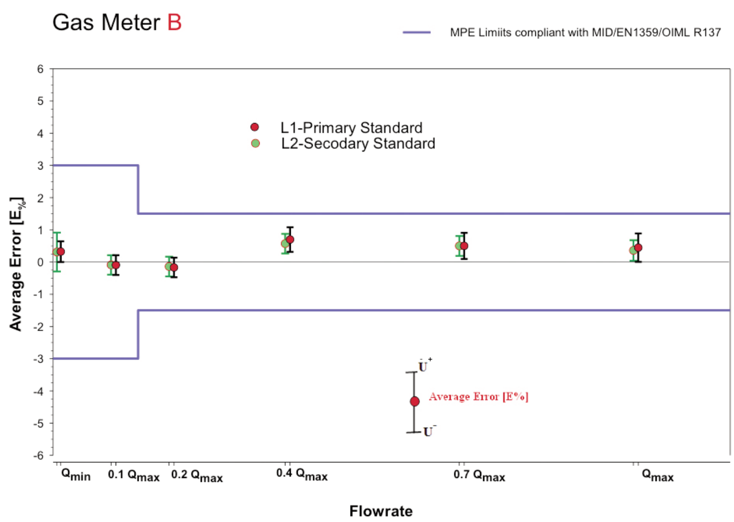

Figure 6

Comparison between the calibration results carried out in the two different laboratories on the same meter B

1) for both the tested meters the errors are within the MPE;
2) the two calibration results show a satisfactory compatibility index;
3) the calibration results obtained in the two different test laboratories are in good agreement: such a feature is particularly interesting and meaningful since the two calibration approaches are quite different: in the primary calibration rig (using the bell prover) the primary measured quantity is the gas volume and the flow rate is inferred from the test time measurement; instead in the secondary calibration rig (using critical nozzle) the primary measured quantity is the gas flow rate, and the gas volume is inferred also measuring the test time;
4) a slight misalignment occurred only for Meter A at the minimum flow rate (Q_{min}).

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BREATH ALCOHOL

Variation in the mass concentration of alcohol due to the temperature of exhaled breath

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Abstract

Breath alcohol analyzers are widely accepted as legal measuring instruments used for the determination of the mass concentration of alcohol in exhaled breath. Nowadays, the Road Traffic Department of the Romanian Ministry of the Interior uses over 1 000 electronic devices for testing breath alcohol concentration. Alcohol addiction is extremely costly to individuals and to society throughout the world, contributing to the mortality rate and to a host of economic, interpersonal and societal problems. Over one year, statistics have shown that in Romania in roughly 75 % of fatal road accidents a vehicle driven by an alcohol-impaired person was involved.

Medical research studies show that the temperature of exhaled breath of a human being varies between 33.3 °C and 34.4 °C. This is why the reference temperature of exhaled breath was chosen to be 34 °C. In this respect, OIML R 126 *Evidential breath analyzers* states that the exhaled breath temperature delivered by a simulator system shall be 34 °C. However, this exhaled breath temperature was chosen taking into consideration the fact that the people tested are healthy individuals whose body temperature is about 37 °C. The question is, what is the temperature of exhaled breath when the body temperature is 38 °C, 39 °C or 40 °C? Moreover, how does this temperature variation affect the mass concentration of alcohol in exhaled breath?

This paper describes the influence of temperature on exhaled breath alcohol measurements, using certified reference materials (CRMs) with documented traceability to the LNE France, the AlcoCal simulator system with traceability to the PTB, Germany, and the Alcotest 9510 breath analyzer with traceability to the LNE, France. The measurements were made for seven levels of mass concentration of alcohol at five different temperatures: 32 °C, 33 °C, 34 °C, 35 °C and 36 °C. The temperature values were controlled by a PC. Additionally, a prediction of the mass concentration of alcohol at 37 °C was calculated. This article aims to prove the dependency of the measured concentration on the temperature of the simulator system and the necessity to monitor and control it continuously in order to obtain accurate measurement results.

Introduction

Loved by some, cursed by others, but accepted by many as a means of stimulation and relaxation, alcohol (more accurately ethanol) due to its physico-chemical and physiological properties is the most ingested substance of the whole alcohol group. It passes into the blood extremely rapidly and is distributed throughout the body. Qualitative and quantitative methods for analysis of alcohol from biological samples are based on six analytical principles: chemical oxidation, enzymatic oxidation, gas chromatography, electrochemical oxidation, infrared spectrometry, and proton magnetic resonance spectroscopy proton (1H-MRS).

After drinking, the alcohol diffuses through the stomach and the small intestine wall, passing via the capillaries into the bloodstream. It is well known that on the one hand alcohol is a stimulant but on the other hand, from a medical point of view, it is a cellular toxin. Due to the volatile nature of ethanol, a certain quantity of alcohol, proportionate to the blood alcohol concentration, transfers from the blood to the lung alveoli (in the same way that CO_2 moves from the blood to the lung alveoli) in order to be eliminated, as illustrated in Figures 1 and 2. Based on this phenomenon, it is possible to measure the alcohol concentration from a deep exhaled breath sample with high accuracy.

According to Henry's law[1] and as illustrated in Figure 3, "The alcohol continues to diffuse into the blood until a stable state is reached". In this respect, when an aqueous mixture of a volatile substance reaches equilibrium with the air, there will be a fixed ratio between the mass concentration of the substance in the air and its mass concentration in the standard solution. This remains constant for a given temperature. In accordance with Henry's law, a fixed equilibrium is generated between the mass concentration of alcohol in the blood in the lungs (BAC) and the mass concentration of alcohol in the air in the lungs (BrAC), as a result of a diffusion compensation process, as illustrated in Figure 4.

[1] See: https://en.wikipedia.org/wiki/Henry's_law

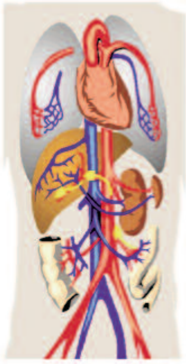

Figure 1 Alcohol diffusion in the human body

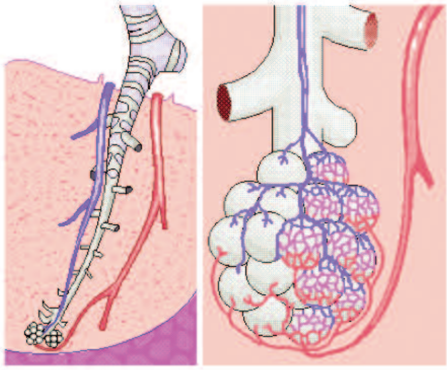

Figure 2 Alcohol exchange into the lung alveoli

Figure 3 Illustrated / experimental Henry's law

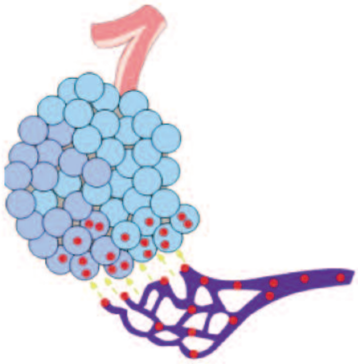

Figure 4 Illustrated exchange of alcohol within the lungs according to Henry's law

1 Experimental system

According to Dubowski's formula [11], the concentration of ethanol present in the vapor phase above the liquid-water mixture depends on just two factors: the temperature of the mixture and the alcohol concentration in the liquid.

$$\gamma_{air} = \gamma_{eth} \cdot A \cdot e^{B \cdot t} \quad (1)$$

where:

γ_{air} is the mass concentration of ethanol in the vapor phase above the liquid-water mixture, in mg/L;

γ_{eth} is the mass concentration of ethanol in the solution, in g/L.

The following experimental coefficients A and B were established, based on several studies on the partition coefficient of an air/ethanol solution: A = 0.04145 (mg/L / g/L) and B = 0.06583 (1 / °C).

The experimental system consists of LNE-CRMs, the AlcoCal simulator system and the Alcotest 9510 breath analyzer, as presented in Figure 5 [1]:

- The Alcotest 9510 breath analyzer, using dual IR & EC technology [3], manufactured by Dräger Safety AG & Co., Germany, uses a combination of two technologies [11]: infrared-sensor and electrochemical sensor. It has documented traceability to the LNE, France. In order to avoid interference by certain volatile substances, the alcohol mass concentration measurements were performed using this breath analyzer. The infrared sensor uses IR radiation absorption at a wavelength of 3.4 µm corresponding to the rotational movement of the CH bonds in the molecules of ethanol and IR radiation absorption at a wavelength of 9.4 – 9.5 µm corresponding to the O-H vibration movement of the OH bonds.
- The simulator system used was the AlcoCal, a new wet bath simulator system with depletion compensation [10], also manufactured by Dräger Safety AG & Co, with calibration certificate number 30089 dated 06.09.2011, issued by the PTB Germany. AlcoCal operates on the basis of enrichment of a carrier gas with ethanol vapor as the carrier gas passes through an ethanol-in-water solution. The carrier gas used is air. A mass flow controller regulates the air mass flow rate internally. To determine the current mass flow rate, the internal control circuit uses a sensor to measure the differential temperature at the heated part of a capillary tube, according to the heat transport principle. Due to this principle the mass

flow rate is independent of the air temperature and pressure. Air leaving the mass flow controller first passes through the outer then through the inner of two incident vessels containing ethanol-in-water solutions and is enriched with water and ethanol vapor according to the current fluid temperature and the associated vapor pressure. To improve the quality of measurement, a mass flow controller F-201AV-ABD-33-V was used, manufactured by Bronkhorst, with a calibration certificate dated 09.08.2011. Additionally, a calibrated thermometer DTM 3000, manufactured in Germany, was used. During the measurements, the thermometer's thermocouple was directly in contact with the inner cylinder of the coaxial simulator system [2].

- CRMs prepared by LNE, with calibration certificates with numbers M060126/01-07, were used as presented in Table 1.

2 Results and discussions

According to OIML R 126 *Evidential breath analyzers*, the temperature of exhaled breath is 34 °C. In order to understand how one or two degrees Celsius [7] influence the mass concentration of alcohol, a number of repeated measurement were made at 32 °C, 33 °C, 34 °C, 35 °C and 36 °C. The measurement data are presented in Table 2, for each LNE-CRM value presented in Table 1. 20 repeated measurements were made for each mass concentration of alcohol and for each temperature in the table. The averages of these data, γ_m, were calculated and are presented in Table 2.

From the results presented in Table 2, a synthesis of data is presented in Table 3. A temperature variation of 1 °C, for the 6 levels of mass concentration of alcohol in exhaled breath used in the experiments, leads to a variation of between 0.75 % and 6.75 % in the measured mass concentration of alcohol, while a temperature variation of 2 °C leads to a variation of between 0.53 % and 6.29 % in the measured mass concentration of alcohol.

Figure 6 presents the calibration curve of all six levels of mass concentration of alcohol in exhaled breath for 34 °C (the value stated in OIML R 126 as being the temperature of exhaled breath [11]).

The influence on all the mass concentrations of alcohol at each chosen temperature value is presented in Figures 7–12, taking into account all the data presented in Table 2. In each figure the best fit equations (linear, logarithmic and polynomial) [4], the correlation factor,

Table 1 CRMs prepared by LNE and used by INM

Mass concentration of alcohol in standard solution	γ_{eth}	(g/L)	0.2573	0.5146	0.9005	1.0292	1.8011	2.4444
	U_{eth}	(g/L)	0.0005	0.0006	0.0011	0.0012	0.0021	0.0028
Mass concentration of alcohol in simulated breath	γ_{air}	(mg/L)	0.1000	0.1995	0.3500	0.3990	0.6980	0.9500
	U_{air}	(mg/L)	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033

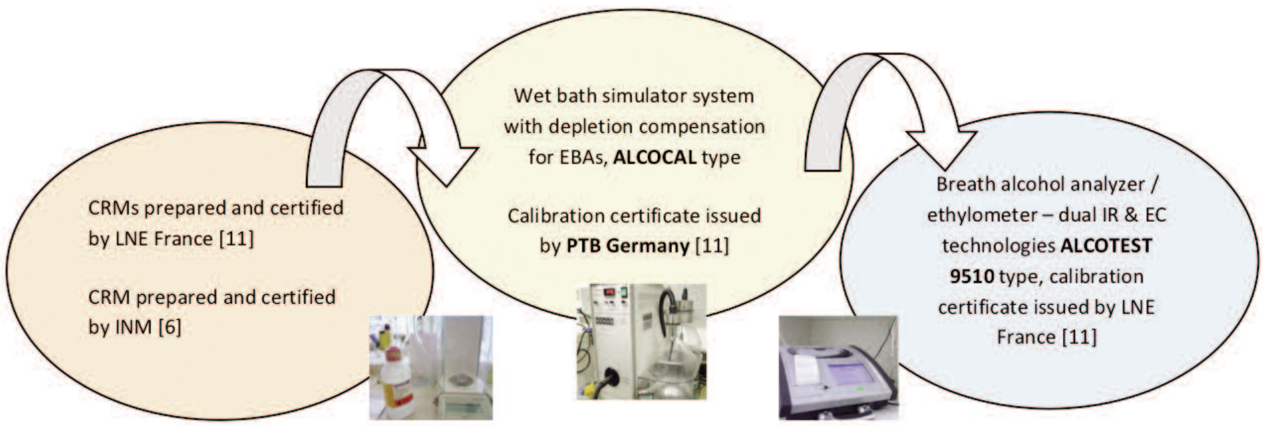

Figure 5 Measurement set-up for mass concentration of alcohol within simulated breath measurements

Table 2 Variation in the mass concentration of alcohol due to temperature using CRMs

	32 °C			33 °C			34 °C			35 °C			36 °C		
	T °C	Mass concentration		T °C	Mass concentration		T °C	Mass concentration		T °C	Mass concentration		T °C	Mass concentration	
		γ_0	γ_i		γ_0	γ_i		γ_0	γ_i		γ_0	γ_i		γ_0	γ_i
CRM	(0.257 3 ± 0.000 5) g / L - 0.100 mg / L (34 °C)														
γ_0		**0.088**			**0.094**			**0.100**			**0.107**			**0.114**	
γ_m(mg/L)	**32.06**	**0.088**	**0.076**	**32.98**	**0.094**	**0.081**	**33.94**	**0.100**	**0.086**	**34.98**	**0.107**	**0.094**	**36.46**	**0.823**	**0.829**
s (mg/L)	0.0128	0.0001	0.0011	0.0197	0.0001	0.0007	0.0257	0.0002	0.0018	0.0264	0.0002	0.0005	0.0119	0.0006	0.0025
$u_{AlcoCal}$			**0.00072**			**0.00078**			**0.00083**			**0.00089**			**0.00072**
u_c [5]			**0.00125**			**0.00117**			**0.00111**			**0.00123**			**0.00106**
U (k=2)			**0.0025**			**0.0023**			**0.0022**			**0.0025**			**0.0021**
CRM	(0.514 6 ± 0.000 6) g / L - 0.200 mg / L (34 °C)														
γ_0		**0.175**			**0.187**			**0.200**			**0.214**			**0.228**	
γ_m(mg/L)	**32.40**	**0.180**	**0.173**	**33.31**	**0.191**	**0.182**	**34.08**	**0.201**	**0.191**	**35.02**	**0.214**	**0.205**	**36.06**	**0.229**	**0.220**
s (mg/L)	0.0491	0.0006	0.0018	0.0271	0.0003	0.0012	0.0252	0.0003	0.0010	0.0338	0.0005	0.0009	0.0217	0.0003	0.0009
$u_{AlcoCal}$			**0.00051**			**0.00058**			**0.00061**			**0.00066**			**0.00071**
u_c [8]			**0.00081**			**0.00109**			**0.00087**			**0.00114**			**0.00107**
U (k=2)			**0.0016**			**0.0022**			**0.0017**			**0.0023**			**0.0021**
CRM	(0.900 5 ± 0.001 1) g / L - 0.350 mg / L (34 °C)														
γ_0		**0.307**			**0.328**			**0.350**			**0.374**			**0.399**	
γ_m(mg/L)	**32.37**	**0.314**	**0.305**	**33.05**	**0.329**	**0.321**	**34.04**	**0.351**	**0.344**	**35.30**	**0.381**	**0.375**	**36.06**	**0.401**	**0.395**
s (mg/L)	0.0291	0.0006	0.0015	0.0282	0.0006	0.0013	0.0217	0.0005	0.0018	0.0474	0.0012	0.0008	0.0175	0.0005	0.0009
$u_{AlcoCal}$			**0.00031**			**0.00033**			**0.00035**			**0.00037**			**0.00040**
u_c [9]			**0.00080**			**0.00082**			**0.00080**			**0.00104**			**0.00082**
U (k=2)			**0.0016**			**0.0016**			**0.0016**			**0.0021**			**0.0016**
CRM	(1.029 2 ± 0.001 2) g / L - 0.400 mg / L (34 °C)														
γ_0		**0.351**			**0.375**			**0.400**			**0.427**			**0.456**	
γ_m(mg/L)	**32.08**	**0.353**	**0.345**	**33.01**	**0.375**	**0.368**	**34.01**	**0.400**	**0.394**	**34.97**	**0.426**	**0.422**	**36.03**	**0.457**	**0.451**
s (mg/L)	0.0993	0.0023	0.0023	0.0338	0.0008	0.0023	0.0745	0.0020	0.0021	0.1133	0.0032	0.0036	0.0137	0.0004	0.0021
$u_{AlcoCal}$			**0.00028**			**0.00030**			**0.00032**			**0.00034**			**0.00036**
u_c			**0.00069**			**0.00068**			**0.00074**			**0.00066**			**0.00068**
U (k=2)			**0.0014**			**0.0014**			**0.0015**			**0.0013**			**0.0014**
CRM	(1.801 1 ± 0.002 1) g / L - 0.700 mg / L (34 °C)														
γ_0		**0.614**			**0.655**			**0.700**			**0.748**			**0.799**	
γ_m(mg/L)	**31.29**	**0.591**	**0.602**	**32.98**	**0.661**	**0.663**	**33.92**	**0.696**	**0.699**	**35.08**	**0.752**	**0.756**	**36.21**	**0.810**	**0.099**
s (mg/L)	2.1766	0.0635	0.0014	0.0942	0.0038	0.0034	0.0264	0.0012	0.0014	0.0415	0.0021	0.0034	0.0254	0.0014	0.0015
$u_{AlcoCal}$			**0.00016**			**0.000168**			**0.000177**			**0.000188**			**0.00020**
u_c			**0.00069**			**0.00063**			**0.00061**			**0.00060**			**0.00061**
U (k=2)			**0.0014**			**0.0013**			**0.0012**			**0.0012**			**0.0012**
CRM	(2.444 4 ± 0.002 8) g / L - 0.950 mg / L (34 °C)														
γ_0		**0.833**			**0.889**			**0.950**			**1.015**			**1.084**	
γ_m(mg/L)	**31.87**	**0.826**	**0.821**	**32.98**	**0.889**	**0.893**	**33.99**	**0.948**	**0.956**	**35.12**	**1.022**	**1.032**	**36.23**	**1.100**	**1.097**
s (mg/L)	0.0296	0.0016	0.0039	0.0175	0.0010	0.0031	0.1041	0.0064	0.0022	0.0318	0.0021	0.0029	0.0187	0.0014	0.0096
$u_{AlcoCal}$			**0.00010**			**0.00011**			**0.00012**			**0.00013**			**0.00014**
u_c			**0.00060**			**0.00057**			**0.00068**			**0.00057**			**0.00065**
U (k=2)			**0.0012**			**0.0011**			**0.0014**			**0.0011**			**0.0013**

and the predicted value of mass concentration for 37 °C are presented.

The best fit equations, presented in Figures 7–12, have been calculated for each set of measurements, using three methods: linear, logarithmic and polynomial, in order to check the tendency of the correlation factor to be as close as possible to 1. The value of the calculated correlation factor proves a positive correlation between the considered random variables: the temperature and the mass alcohol concentration, which in turn leads us to conclude that the mass alcohol concentration increases as the temperature rises.

3 Conclusions

Whilst alcohol is appreciated by many people as a means of stimulation and relaxation, and although when consumed in moderate quantities its influence on humans is not necessarily unpleasant, the consumption of alcohol does present many dangers.

According to Dubowski's formula, temperature is one of the key variables on which exhaled breath alcohol concentration depends. The aim of this article was to study the influence of this important parameter,

Table 3 Mass concentration of alcohol with 1 °C and 2 °C variation in breath temperature

CRM	(g/L)	**0.257 3**	**0.514 6**	**0.900 5**	**1.029 2**	**1.801 1**	**2.444 4**
T_{34}	(°C)	33.94	34.08	34.04	34.01	33.92	33.99
γ_{34}	(mg/L)	0.086 5	0.191 3	0.344 1	0.393 6	0.699 0	0.955 8
T_{35}	(°C)	34.98	35.02	35.30	34.97	35.08	35.12
γ_{35}	(mg/L)	0.094 3	0.205 4	0.374 9	0.422 2	0.756 3	1.031 8
T_{36}	(°C)	36.21	36.06	36.06	36.03	36.46	36.23
γ_{36}	(mg/L)	0.098 6	0.220 1	0.394 9	0.451 3	0.828 9	1.096 7
T_{35}-T_{34}	(°C)	1.04	0.95	1.26	0.96	1.16	1.13
γ_{35}-γ_{34}	(mg/L)	0.0078	0.014 1	0.030 8	0.028 6	0.055 3	0.076 1
Δγ, 1 °C more	(%)	**0.75**	**1.48**	**2.44**	**2.99**	**4.76**	**6.75**
T_{36}-T_{34}	(°C)	2,27	2.02	2.02	1.90	2.54	2.24
γ_{36}-γ_{34}	(mg/L)	0.012 1	0.028 8	0.050 8	0.057 8	0.129 9	0.141 0
Δγ, 2 °C more	(%)	**1.07**	**2.86**	**5.01**	**6.08**	**10.21**	**12.57**

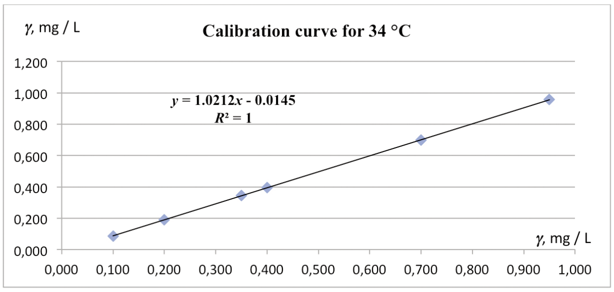

Figure 6 Calibration curve for 34 °C

temperature, on the concentration of alcohol using the AlcoCal simulator system.

For the purpose of this study the following experimental system was designed consisting of:

- an AlcoTest 9510 breath alcohol analyzer (ethylometer) based on dual infrared and electrochemical technology, with traceability to LNE France;
- an AlcoCal simulator system, which is a wet bath simulator system with depletion compensation, with traceability to PTB Germany; and
- LNE certified reference materials (CRMs).

OIML R 126 states that the temperature of exhaled breath is 34 °C. This temperature was chosen as a result of medical studies. These studies, conducted on healthy individuals reveal that the exhaled breath temperature varies between 33.3 °C and 34.4 °C. This article has focused on the influence of the exhaled breath temperature when the human body's temperature increases up to 38 °C, 39 °C or 40 °C. For a good understanding of the influence of the temperature on the mass alcohol concentration, 20 repeated measurements were performed at five fixed temperatures: 32 °C, 33 °C, 34 °C, 35 °C and 36 °C and for six levels of mass concentration of alcohol:

0.2573 g/L (equivalent to 0.1000 mg/L at 34 °C);
0.5146 g/L (equivalent to 0.1995 mg/L at 34 °C);
0.9005 g/L (equivalent to 0.3500 mg/L at 34 °C);
1.0292 g/L (equivalent to 0.399 0 mg/L at 34 °C);
1.8011 g/L (equivalent to 0.6980 mg/L at 34 °C); and
2.4444 g/L (equivalent to 0.9500 mg/L at 34 °C).

The measurement results show that a 1 °C temperature variation produces an alcohol mass concentration variation, corresponding to each CRM, with the following percentages: 0.75 %, 1.48 %, 2.44 %, 2.99 %, 4.76 % and 6.75 %, while a 2 °C temperature variation results in an alcohol mass concentration variation as follows: 1.07 %, 2.86 %, 5.01 %, 6.08 %, 10.21 % and 12.57 %.

The results were extended for 37 °C using prediction tools. The temperature of a healthy human being is about 37 °C while the exhaled breath temperature varies around 34 °C. That means that a difference of about 3 °C was found between the air temperature from alveoli and the breath exhaled temperature. Taking into consideration that the body's temperature can, in extreme conditions, be about 40 °C, the experiment was conducted for five different temperatures. Using the measurement results, the calibration curves were drawn for each of these five temperatures and a prediction for 37 °C was calculated. The measurement results are presented in Figures 7–12. The predictions of mass concentrations of alcohol for an exhaled breath temperature of about 37 °C were:

0.1049 mg/L (for 0.2573 g/L);
0.2293 mg/L (for 0.5146 g/L);
0.4182 mg/L (for 0.9005 g/L);
0.4758 mg/L (for 1.0292 g/L);
0.8739 mg/L (for 1.8011 g/L); and
1.1672 mg/L (for 2.4444 g/L).

For each CRM used, the predicted value clearly fitted into the corresponding calibration curve.

A variation in the exhaled breath temperature of 3 °C (from 34 °C to 37 °C) generates a significant variation in the mass concentration of alcohol with:

1.84 % (for 0.2573 g/L);
3.80 % (for 0.5146 g/L);
7.41 % (for 0.9005 g/L);
8.22 % (for 1.0292 g/L);
17.49 % (for 1.8011 g/L); and
21.14 % (for 2.4444 g/L).

The best fit equations (linear, logarithmic and polynomial) for the variation in the mass alcohol concentration with temperature were presented. The value of the correlation factor, close to 1 for all mass alcohol concentrations, proves that the mass alcohol concentration is dependent on the temperature of the subject tested with these modern, non-invasive analysis methods used by breath alcohol analyzers.

Acknowledgment

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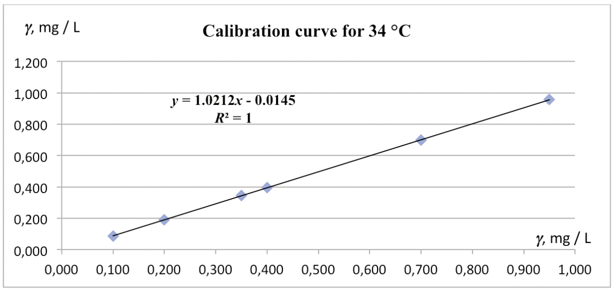

Figure 7 Prediction of 0.257 3 g/L for 37 °C

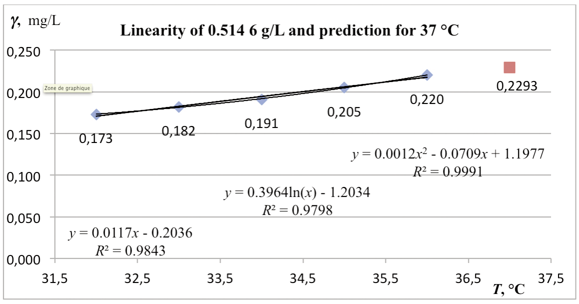

Figure 8 Prediction of 0.514 6 g/L for 37 °C

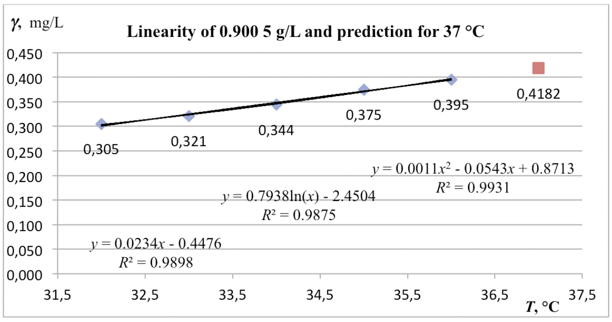

Figure 9 Prediction of 0.900 5 g/L for 37 °C

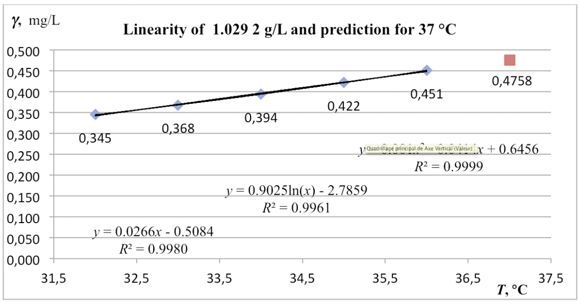

Figure 10 Prediction of 1.029 2 g/L for 37 °C

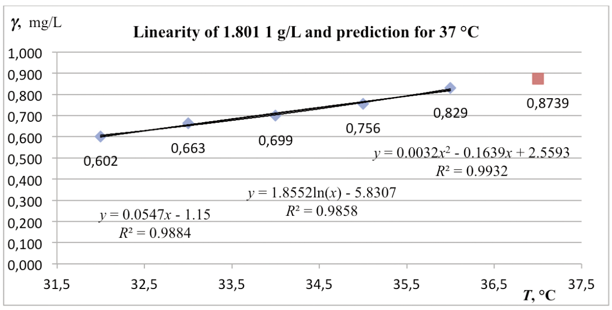

Figure 11 Prediction of 1.801 1 g/L for 37 °C

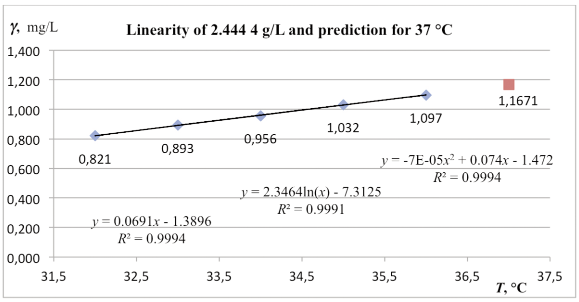

Figure 12 Prediction of 2.444 4 g/L for 37 °C

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FUEL DISPENSERS

Comparison on the verification of fuel dispensers

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Abstract

In order to check the concordance of results and procedures in the verification of fuel dispensers by the verification bodies designated by the Portuguese Institute for Quality (IPQ, the National Body for Legal Metrology) a national comparison between these entities was performed for the first time.

A correction for reference temperature was performed on the results presented by the participants (maximum flow at 20 L and minimum flow at 5 L) using petrol and diesel as the verification liquids.

The analysis of the results, using the normalized error statistics, evidenced satisfactory values for the majority of the national entities. The uncertainty components and values were very similar among the participants for the minimum flow at 5 L. For higher volume, the uncertainties were very much dependent on the type of volume standard used.

1 Introduction

The IPQ defines the general rules for legal metrology, draws up metrological regulations, co-ordinates metrological control activities, performs type approvals and verifications and designates notified bodies and verification bodies. Legal metrological control in Portugal is decentralized among 768 verification bodies which comprise governmental, regional and local authorities, public and private companies.

The verification body designation process is based on NP EN ISO/IEC 17020 and NP EN ISO/IEC 17025. The majority of the 54 national verification bodies are accredited laboratories and certified companies (NP EN ISO 9001) involved in the verification of 25 different categories of measuring instruments. One of these categories is fuel dispensers, commonly known as petrol pumps.

Like any kind of measuring instruments used for commercial transactions, fuel dispensers are submitted to metrological control in order to guarantee accurate measurements and therefore ensure consumer protection.

In Portugal fuel dispensers approved under the European measuring instruments directive (MID) [7] are subject to metrological control in service. Throughout their lifetime, fuel dispensers are subjected to annual verification by a verification body, following internal procedures, according to the specific national regulations [1].

There are currently 45 000 fuel dispenser hoses in Portugal, verified by several verification bodies evenly distributed throughout the country.

1.1 National comparisons in legal metrology

Accredited laboratories often perform comparisons in order to verify the concordance of results and procedures. In legal metrology, however, this is not common practice.

IPQ decided to implement the practice of organizing comparisons between designated verification bodies for legal metrological control. The first chosen metrological field was the verification of fuel dispensers and six verification bodies decided to participate, even though they use different equipment and experimental procedures.

The comparison was piloted by IPQ which prepared the protocol, including all the experimental details and a form for the results, which was sent to all the participants before the beginning of the comparison. As the pilot laboratory, IPQ performed measurements before and after those of the participating laboratories, providing the reference value and the associated uncertainty.

The comparison was performed over one week. Each participant used their own volume standards and had two hours to make the on-site measurements.

1.2 Fuel dispenser characteristics

The fuel dispenser (see Figure 1) used in the comparison was supplied by a national company and had the characteristics listed in Table 1.

2 Experimental procedure

The experimental procedure was included in the protocol sent to the participants. The main parts are briefly described below.

Table 1 Fuel dispenser characteristics

Brand	PETROTEC
Model	P5000
Class	0.5 according to National Regulation no. 19/2007, 5 January
Resolution	0.01 L
Engraving	MID CE M11 0866
Diesel hose	3
Petrol hose	5

Figure 1 Fuel dispenser used in the comparison

Each participant had to verify the delivered volume of the fuel at maximum flow using a 20 L volume standard and the delivered volume of the fuel at minimum flow using a 5 L volume standard. The verification liquids used were petrol and diesel, in that order due to residual volume increase. Five measurements were performed for each volume standard using the two different fuels.

The variation in the maximum allowable temperature for the liquid was 0.5 °C during the five measurements. The ambient conditions had to remain constant between the following intervals:

- temperature between 15 °C and 35 °C,
- relative humidity between 25 % and 75 %, and
- pressure between 840 hPa and 1060 hPa [2].

The volume standards were calibrated by recognized entities and the delivery time respected [3].

Each participant was asked to employ the normal work routine, including the operator, the procedure and the equipment (see Figure 2).

Figure 2 Measurements performed on-site by IPQ

Figure 3 Stainless steel volume standard

Figure 4 Carbon fiber volume standard

For the sake of confidentiality, the names of the participant entities are not presented and are replaced by codes, for example PE1.

The characteristics of the volume standards used by each participant are presented in Figures 3 and 4 and in Table 2.

Table 2 Characteristics of the volume standards used by the different participants

Participants	Type	Resolution
IPQ	Carbon fiber	0.01 % for the 20 L standard; 0.02 % for the 5 L standard
PE1	Carbon fiber	0.01 % for the 20 L standard; 0.02 % for the 5 L standard
PE2	Stainless steel	0.05 %
PE3	Stainless steel	0.10 %
PE4	Stainless steel	0.5 %
PE5	Stainless steel	0.10 %
PE6	Stainless steel	0.10 % for the 5 L standard; 0.05 % for the 20 L standard

3 Statistical analysis

3.1 Results analysis

The results analysis was performed according to the E_n number [4, 5]:

$$E_n = \frac{(V_{PE} - V_{Ref})}{\sqrt{U_{PE}^2 + U_{Ref}^2}} \qquad (1)$$

where:

V_{PE} and U_{PE} are the volume and the corresponding expanded uncertainty obtained by participant entity,

V_{Ref} and U_{Ref} are the volume and the corresponding expanded uncertainty obtained by the reference laboratory (IPQ).

According to normative documents, absolute values of E_n smaller than or equal to 1 represent a satisfactory performance of the participant entity.

3.2 Reference value determination

The reference value used was the mean value of the two measurements performed by IPQ: the first at the beginning and the other at the end of the comparison. The uncertainty of the reference value considered was the largest value of both measurements.

4 Measurement results

In order to obtain comparable measurement results, they were corrected to a reference temperature of 20 ºC using the standard model [6]:

$$V_{20} = V_t[1 + \gamma(20 - t)] \qquad (2)$$

where γ is the cubic thermal expansion coefficient of the volume standard material and t the liquid temperature.

4.1 Volume determination of the fuel dispenser

The volume delivered by the fuel dispenser determined by the participants using diesel and petrol at a maximum flow (20 L) and minimum flow (5 L) are presented in Figures 5 to 8.

The majority of the results are very similar and the variation between participants is smaller than 0.2 % which is less than the maximum permissible error (MPE) for these instruments. Indeed and according to the Portuguese national regulation [1] and the MID the MPE for fuel dispensers is 0.5 %. The worst cases are for petrol using the 5 L volume standard, which was expected, due to the volatility of the fuel and the small quantity of fluid delivered.

4.2 Normalized error

The normalized errors, E_n numbers as defined previously, obtained for the measurement results of each participant entity, are displayed in Figures 9 to 12.

Inconsistent results are only found for petrol and mainly for 5 L, but very close to 1. A possible explanation is that the participants did not respect the order of the liquids described in the protocol, first petrol and then diesel. This behavior leads to a higher volume than the reference value due to the extra residual volume.

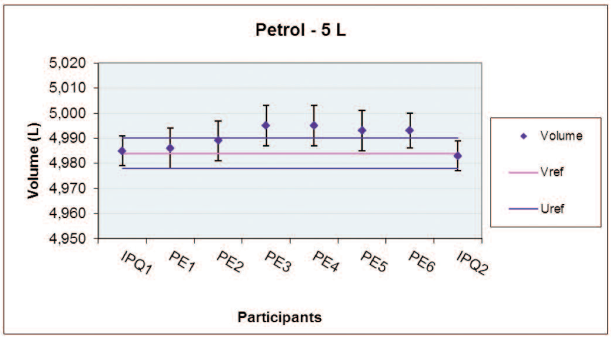

Figure 5 Delivered volume for petrol at minimum flow

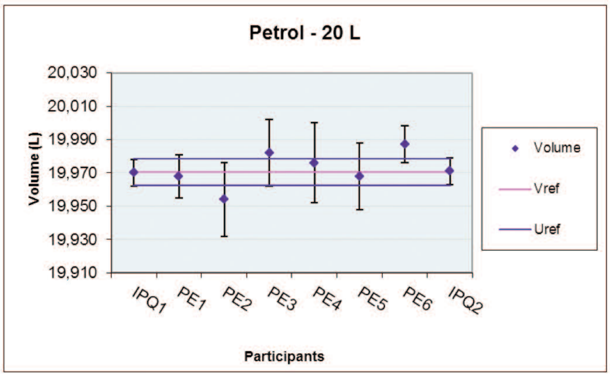

Figure 6 Delivered volume for petrol at maximum flow

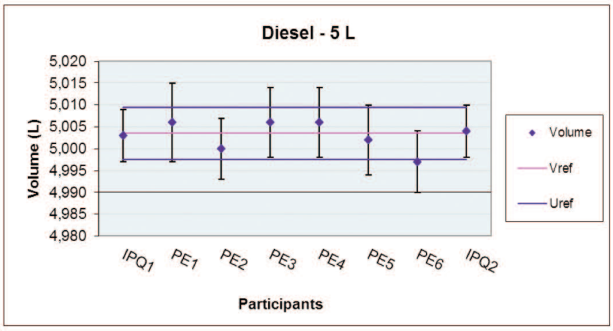

Figure 7 Delivered volume for diesel at minimum flow

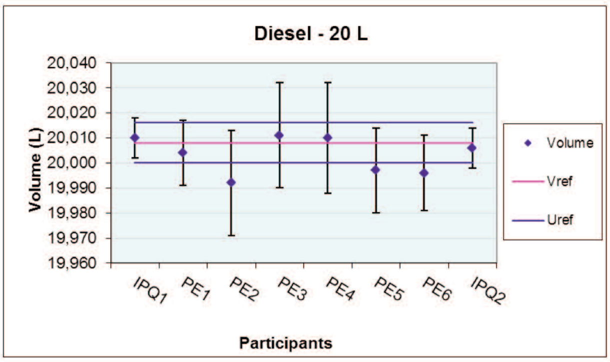

Figure 8 Delivered volume for diesel at maximum flow

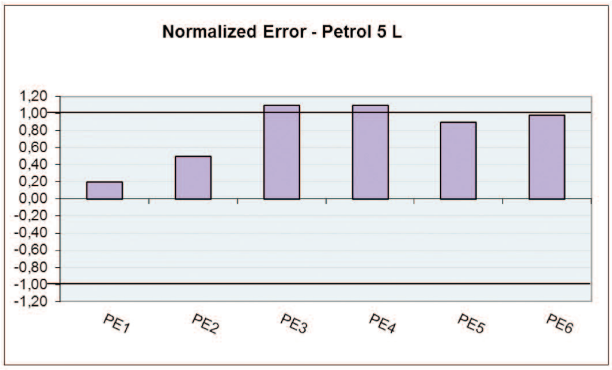

Figure 9 Normalized error for petrol at minimum flow

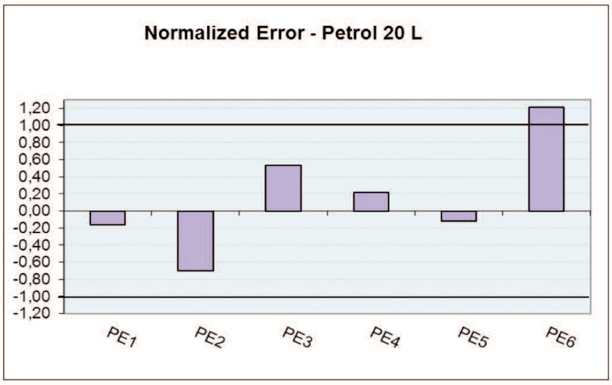

Figure 10 Normalized error for petrol at maximum flow

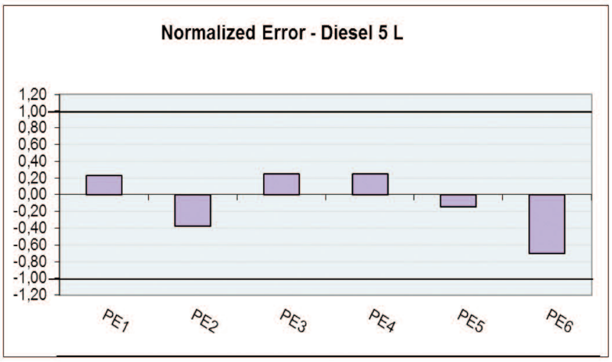

Figure 11 Normalized error for diesel at minimum flow

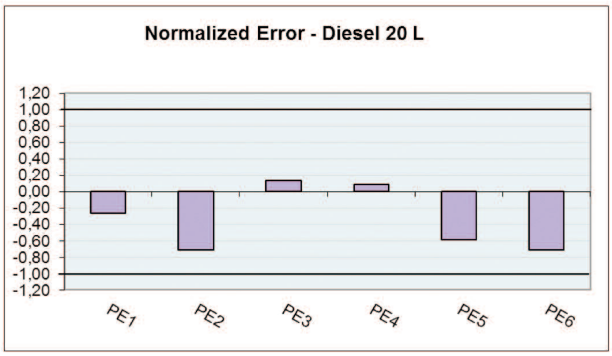

Figure 12 Normalized error for diesel at maximum flow

5 Uncertainty analysis

When starting the comparison, a spreadsheet was supplied for presenting the results and the uncertainty budget according to the GUM [8].

In order that each participant's results could be compared on the same grounds, some common uncertainty components to be included in the uncertainty budget were suggested by the pilot laboratory. These uncertainty components were:

- the repeatability of the measurements (u_{rep}),
- the calibration of the volume standard ($u_{cal\ vs}$),
- the expansion coefficient of the volume standard ($u_{exp\ coef}$),
- the resolution of the volume standard ($u_{res\ vs}$),
- the meniscus reading (u_{men}),
- the resolution of the fuel dispenser ($u_{res\ fd}$), and
- the liquid temperature (u_{temp}).

Almost all the participants evidenced uncertainty budgets according to the pilot laboratory's suggestions. The results for 5 L and 20 L using petrol are displayed in Figures 13 and 14. As the results for diesel are very similar, they are not presented.

For 5 L, the largest source of uncertainty is the resolution of the fuel dispenser. The expanded uncertainties are very similar for all the participants.

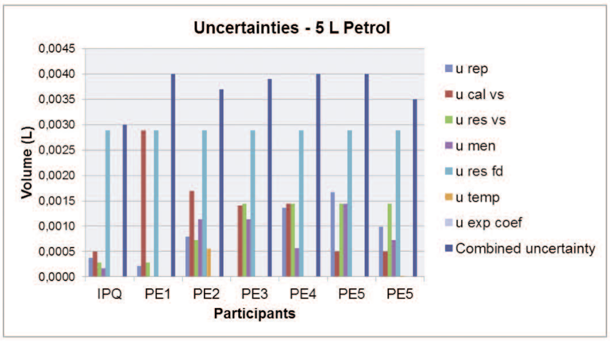

Figure 13 Uncertainty for petrol at minimum flow

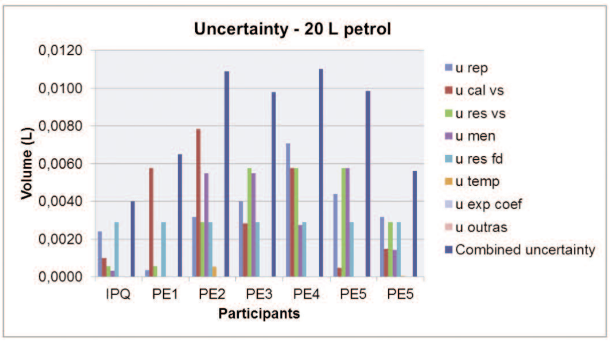

Figure 14 Uncertainty for petrol at maximum flow

For 20 L, it is not possible to make the same conclusion regarding the largest uncertainty component contribution. The value of the combined uncertainty is different between the participants. The reference laboratory and one of the participants used a volume standard with a better scale resolution and consequently better uncertainty – it was a carbon fiber volume standard.

6 Comparison of results at different temperatures

The volume results from all the participants were corrected for a reference temperature of 20 °C but this correction was not applied in the field measurements. Indeed, the usual procedure is to verify the fuel pumps at working liquid temperature without corrections.

During the entire comparison, the liquid temperature changed from 22 °C up to 26 °C. So, in order to check the possible volume differences, the volume measurement results of the participants with and without temperature corrections were compared. The variation results (%) are presented in Table 3.

The maximum observed variation is 0.04 % which is much less than the MPE.

There is no variation in the carbon fiber volume standards used by IPQ and PE1 as the expansion coefficient of the material is much smaller than the stainless steel one.

Table 3 Relative volume variation with temperature

Participants	Relative volume variation for 4 °C, %			
	Petrol 5 L	Petrol 20 L	Diesel 5 L	Diesel 20 L
IPQ	0.00	0.00	0.00	0.00
PE1	0.00	0.00	0.00	0.00
PE2	0.02	0.03	0.04	0.02
PE3	0.04	0.03	0.02	0.02
PE4	0.03	0.02	0.01	0.02
PE5	0.02	0.02	0.02	0.02
PE6	0.02	0.02	0.02	0.01

7 Concluding remarks

For the first time, a national comparison in field of verification of fuel dispensers was organized between six qualified entities for metrological control. The IPQ-NMI piloted this comparison, providing the reference value.

Considering that the measurements were performed on-site, on different days and at different times by different entities using volume standards with different characteristics, the results of the comparison can be seen as positive.

Although three participants had unsatisfactory results in the petrol measurements, their E_n values were very close to 1. Such situations occurred because the participants did not comply with the order of the liquids as described in the protocol, which stated that petrol should be used before diesel. Indeed, a higher volume than the reference value was always obtained if the protocol was not followed.

Interestingly, the volume values measured by the participants had a maximum variation between each other of 0.2 %. This value is smaller than the MPE of the fuel dispensers and indicates a good reproducibility of the whole of the measurements.

The corrected values of the participants for the reference temperature are very similar to the results obtained at the working temperature, for the maximum temperature variation of 4 ºC, during the measurement time.

Concerning the evaluation of the measurement uncertainty, we can verify that, for 5 L with both kinds of fuels, the largest source of uncertainty of all participants was the resolution of the device under test. For 20 L, there was no evidence regarding the largest source of uncertainty and correspondingly the value of the expanded uncertainty was very different among the participants.

8 References

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Acknowledgments

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METROLOGY IN CUBA

Metrology and the various forms of non-state employment

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Introduction

In many countries, small and medium sized enterprises (SMEs) in the private sector play an important role in economic, technological and social development. Countries in our region such as the Dominican Republic, Argentina, Mexico and Uruguay report that 90–95 % of their businesses are SMEs.

Governments often support SMEs by providing subsidies or loans, in some cases under programs of international (donor) organizations.

The policy in our country is to develop SMEs in the form of cooperatives, small farms, etc. with the objective of reducing imports and providing a greater diversity of products to the population.

This policy is laid down in the "Economic and Social Guidelines of the Party and the Revolution", adopted by the 6th Congress of the Communist Party of Cuba. The policy has led to an increase in self employment in high demand fields such as the preparation and sale of food, transportation, manufacture and sale of household goods, hairdressing, etc.

This article focusses on the role of metrology in the development of Cuba's private sector and, more specifically, on the outcomes related to metrology of a survey on the knowledge about the quality, standardization and metrology issues of the self employed economic actors in Cuba. The survey was part of the project "Tools to facilitate quality management in self-employment in Cuba".

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Development

In October 2012, Havana hosted a workshop on the importance of standardization and metrology for the quality of products and services, to ensure consumer protection and customer satisfaction and to be competitive in domestic and foreign markets. The workshop was sponsored by the Pan American Standards Commission (COPANT) and Cuba's National Bureau of Standards (NC) and was attended by representatives from 17 countries.

Some of the presentations concerned national experiences in the field of metrology. Bolivia's SNMAC (Standardization, Metrology, Accreditation and Certification System) reported on its involvement in measurement quality assurance through a chemical and food laboratory, as well as measuring and verification equipment, to provide the SMEs with quality control related technical assistance.

Through a representative from the Dirección General de Normas (DGN), Mexico presented its experiences on conformity assessment in industry and stressed the role of the national Federal Law on metrology and standardization in providing verification offices and calibration and testing laboratories to evaluate SME products.

Working jointly with the Instituto Argentino de Normalización y Certificación (IRAM), the Instituto Nacional de Tecnología Industrial (INTI) – responsible for that country's metrological activity – establishes laboratories, provides certification and develops instruments for testing laboratories.

The Instituto Uruguayo de Normas Técnicas (UNIT) qualifies measurement and sampling supervisors.

As can be seen, each country's involvement is different. In the case of metrology, the focus of this article, some use the state or private infrastructure in place while others receive various government bonds (no cash is involved) so that the SMEs can receive and pay for the services offered by the metrological entities.

One of COPANT's metrology-related recommendations was to increase the attention paid by SMEs to measurements as the basis for standardization and quality.

This is very important in Cuba, given the legalization of the private sector, which uses a different language from the state sector regarding metrological assurance and control. Cuba's private sector is an emerging sector with little previous training or knowledge of standardization, metrology and quality work.

For practical purposes, priority must be given to compliance, though still with a flexible approach to our performance, in such a way that we prove our competence and capability to contribute to the quality of the final outcome.

The state sector is still faced with difficulties to correctly manage the quality of measurements of its products and services, so it is hardly surprising that even more problems arise in this field regarding awareness and comprehension of the role of metrology and particularly measurements, in their everyday work.

With a view to supporting this important goal, the CGDC (Quality Management and Development Center) spearheads the project "Tools to facilitate quality management in self-employment in Cuba" together with other institutions such as INIMET (Metrology Research Center) – in charge of metrology and measurements – ONN (National Bureau of Standards) –the provider of standards officers and inspectors linked to this new scenario – and MINCIN (Ministry of Domestic Trade) – with experts from its Consumer Protection Division – and the local government with its Labor and Social Security and Hygiene departments. All of these are key actors who strengthen research in a municipality with one of the country's highest rates of self-employment. The aim of this project is to develop useful and sustainable tools that can be used as a function of a culture of nonstate employment and integrate into the usual practice of stakeholders such as the relevant regulatory and public administration entities. Most importantly, the aim is to create a general culture of quality, standardization and metrology in this field in order to make a positive impact on the local population's economic growth and quality of life.

In the early stages of this project a survey was conducted into the level of knowledge of quality, standardization and metrology topics among self employed economic actors. The municipality of Centro Habana was chosen for this study because it is among those with the highest number of licenses granted (357,663 self-employed workers at the end of 2011).

Materials and methods

The conceptual and statistical design of this study included:

1 Sample size (n), in general and according to the type of license;
2 Selection of individual values (x_i);
3 Organization of groups and subgroups to carry out interviews;
4 Establishment of the best route to follow;
5 Design and application of the data collection guide;
6 Processing and analysis of the gathered data.

1 Sample size (n), in general and according to the type of license

The following types of license were selected:

- Retail home or street vendor of foods and non-alcoholic beverages;
- Retail outlet seller of foods and non-alcoholic beverages;
- Barber;
- Hairdresser;
- Seller of foods and beverages at a private restaurant;
- Home delivery of foods and non-alcoholic beverages.

The license database included 1,647 types and we only had 6 interviewers, so it was impossible to talk with all of the selected self-employed workers. Then we decided to establish the proper sample size.

A *probabilistic study* was chosen, since all elements of the population are equally likely to be selected when a probabilistic sample is used. The values of the sampling elements will be very similar to those of the population, so the measurements in this subset will give accurate estimates of the greater set.

The assumptions are for a 0.95 probability and a typical error (S_e) of 0.01; 0.03; 0.04 and 0.05, and a 0.90 probability and a typical error (S_e) of 0.05. Given that a 0.95 probability and a margin of error of 0.05 produces acceptable results, our sample size was 90, itemized by type of license (see Table 1). Each member interviewed 15 self-employed workers.

2 Selection of individual values (x_i)

Once the sample size was established, we selected self-employment license holders from the database for the interviews (full name, ID number and address), made through ***random sampling*** without replacement.

Table 1 Sample selected for the interviews of selected license holders

Type of license	N	p=0.95				p=0.90
		S_e 0.01	S_e 0.03	S_e 0.04	S_e 0.05	S_e 0.05
Retail home or street seller of foods and non-alcoholic beverages	1185	339	51	29	19	35
Retail outlet seller of foods and non-alcoholic beverages	182	132	41	26	17	50
Barber	132	104	51	25	17	29
Hairdresser	100	100	35	23	16	27
Seller of foods and beverages at a private restaurant	26	25	18	14	11	26
Home delivery of foods and non-alcoholic beverages	22	21	16	13	10	14
TOTAL	1647	721	212	130	90	161

3 Organization of groups and subgroups to be interviewed and

4 Establishment of the best route to follow

To do this we took into account the fact that the self-employed workers to be interviewed were relatively close to one another within the municipality in order to make the most of our time frame and route plan. We chose the following groups and zones:

Group 1 Streets: from Zanja to Laguna and from Industria to Zulueta,
Group 2 Area around the Museum of the Revolution,
Group 3 Area around Hermanos Ameijeiras Hospital up to Galiano St.,
Group 4 Area around the CGDC,
Group 5 Area around the Market Square,
Group 6 Area around Hermanos Ameijeiras Hospital up to Infanta St.

This distribution stems from the technique known as an *Affinity diagram*. A total of 83 self-employed workers (92 %) were interviewed (one hairdresser, one private restaurant owner and five coffee-shop owners were not available). See results in Table 2.

Table 2 Location-based distribution of the interviewed self-employed workers

Type of lisence	Group						Total
	1	2	3	4	5	6	
Retail home or street seller of foods and non-alcoholic beverages	3	3	3	3	3	4	19
Retail outlet seller of foods and non-alcoholic beverages	2	1	1	5	3	5	17
Barber	5	4	4	3	-	1	17
Hairdresser	1	1	3	3	6	2	16
Seller of foods and beverages at a private restaurant	3	3	1	-	2	2	11
Home delivery of foods and non-alcoholic beverages	1	3	3	1	1	1	10
TOTAL	15	15	15	15	15	15	90

5 Data collection

A questionnaire covering standardization, metrology and quality activities was designed for the interviews. See the metrology-related questions in Table 3.

Table 3 Metrology-related questions for the interviews

No.	Intention	Yes	No	Remarks
1	I make some measurements or use some kind of container to quantify amounts			
2	If you answered YES, describe such measurements or containers and the unit of measurement used.			
3	I assure my measurements or the containers I use to quantify in order to achieve the right results.			
4	If you answered YES, explain why you know that your results were the right ones.			

6 Processing and analysis of the data gathered

Once the scheduled interviews are conducted and the information collected, the data gathered are processed in terms of the number of positive answers per type of license (in numbers and percentage).

Results

Table 4 shows the positive answers to the questions on metrology.

Table 4 Number of positive answers per type of license

Type of license	Positive answers	
	Number	%
Barbers / hairdressers	28	47
Private restaurants	25	62
Coffee-shops	21	44
Peddlers	23	30
Beverages	13	32
Total	110	42

The questions were worded as simply as possible for the sake of understanding and to avoid frightening the interviewees by the use of academic terms or expressions about metrology. However, despite our efforts, the questions were not always properly understood, nor were the actions to guarantee a correct measurement intended to achieve quality products and services.

The figures reveal that while some self-employed workers identify with the need to carry out on-the-job measurements, they are not totally sure about the kind of measurement that needs to be made, let alone the need to assure them or how to do it.

Annex A provides information about what we learned from the interviews regarding their perception of measurements and the assurance of their quality. Their views are valid scientific evidence of their lack of information and knowledge about metrology.

Table 5 shows general information about the prevailing trend of the answers per type of license and question.

An important finding was the identification of training needs in standardization, metrology and quality topics, and especially metrology, since the previous tables show that, generally speaking, the license holders that we interviewed had no knowledge about the existence of metrological assurance and its relationship with the services that they provide, nor did they know the relevant legislation, all of which makes it impossible for them to assess the impact of their activities or meet their obligations. Add to this the infrastructure's failure to have access to certain measuring instruments or to the calibration and verification services established for them.

Table 5 Positive answers per type of license and question

INTENTION	Hairdresser's shop	Barbershop	Private restaurant	Cafeteria	Street vendor	Drinks	Total
Do you make measurements or use some kind of container to quantify amounts?	12	0	10	10	11	8	51
If you answered YES, mention the measurements you make, the containers you use, and the units of measurement in which you express your results	3	0	4	1	2	1	11
Do you assure your measurements or your containers to quantify amounts and get proper results?	12	0	7	9	8	4	40
If you answered YES, explain why you know that your results were the right ones.	1	0	4	1	2	0	8
TOTAL NUMBER OF POSITIVE ANSWERS	28	0	25	21	23	13	110
TOTAL NUMBER OF NEGATIVE ANSWERS	32	0	15	27	53	27	154
TOTAL NUMBER OF ANSWERS	60	0	40	48	76	40	264
% OF POSITIVE ANSWERS	47	0	62	44	30	32	42

Conclusions

- At international level, the small and medium-sized enterprises are a powerful driving force for a national economy, despite the existence of problems and weaknesses caused mainly by the absence of a strategic vision and poor training of business owners.
- The current legislation on self-employment clearly establishes the kind of activity allowed for this sector (181 different jobs to date) as well as the amount of their contribution to social security and other taxes, but a clear definition is yet to be developed of the quality management criteria applicable to the products and services provided by these self-employed individuals.
- A study of the situation in the Centro Habana municipality using social qualitative methods based on techniques designed to encourage engagement as well as consultations with members of the community taking into account the interviews of the self-employed workers reveals those issues that received the highest number of positive answers, namely:
    - implementation of quality techniques in the relevant field;
    - awareness of customer needs and expectations;
    - measurement of customer satisfaction.

The main weakness is related to the lack of knowledge about the importance of measurements and their assurance.

Recommendations

- Define metrology-related requirements to be gradually met by the non-state sector engaged in the activities covered by this study.
- Develop a communication strategy to make the said sector aware of the existing ways to check the measuring instruments that they use in their jobs.
- Organize short workshops and design teaching materials, specifically aimed at those involved in food preparation and sale and to hairdressers and barbers, which include good practices related to the knowledge about and the use of reliable measuring instruments. This is, among others, one of the best ways to fulfill the expected goal of guaranteeing service quality in nonstate forms of employment.

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Annex A

Perception of measurement and its relationship with the relevant activity that prevails among self-employed workers

Facts learned from self-employed workers who claim to make measurements

Street vendor of sweets, ice creams, etc.

They make measurements with a 5 L pitcher and an 8 ounce glass and use a scale to weigh their flour and cooking oil. They measure in pounds. They claim to always obtain the same value; their scale is very good and has never been broken. An ice cream vendor uses a bottle to measure the correct amount. The product he serves is the result of mixing a bottle of water and a bottle and a half of flavored syrup. He measures the regulatory amount of ice cream with an 8-ounce glass (he says it holds 40 grams) filled to the brim. He does not know whether his measurements are correct.

Hairdresser

She uses the original jars on which the amount of product is printed. For instance, number of milligrams of hair dye, which can also be expressed in milliliters. After 22 years in this trade, she believes in measuring quantities at a guess.

Private restaurant owner

They hardly have any electronic or mechanic weighing instrument. They all have apportioning devices, cups and spoons, but none use any unit of measurement. Some use the pound as a unit of measurement; very few use the kilogram. Some said that they were not sure whether their weighing instrument was working correctly. Asked whether they assure the measurement result and whether they know if the result is correct, some replied that they level their weighing instruments by themselves and send them to the workshop if they think they are not working correctly. None could name a supplier of this kind of service. They estimate the weight by making comparisons with another product of known value.

Home delivery of foods and beverages

They use the pots of goods sold in the market and fill them to the brim. They use a digital weighing instrument to weigh sliced ham and cheese (by the gram). The owner of the weighing instrument claims that it works correctly but cannot explain how she knows this to be true.

Snack preparation

They use a small jar or a can to measure the sugar, flour and water they use. They rely on experience to establish the right amount they serve. For instance, if they do not use a can and a half (approximately half a pound, after they weighed the product in a nearby grocery) then they have to reduce the amount of product.

Coffee-shop owner

He uses a weighing instrument (up to 30 pounds) to check by himself the products that he buys, which are always sliced. He believes that he assures his measurements and they are right because the weighing instrument is new and there is no need to have it checked (it is adjusted by leveling).

Barber

No measurements made. ■

TC/SC NEWS

Meetings of TC 17/SC 1 and TC 17/SC 8

Diane Lee, NIST (USA), TC 17/SC 1 Secretariat

Grahame Harvey, National Measurement Institute (Australia), TC 17/SC 8 Secretariat

Consecutive meetings of TC 17/SC 1 and TC 17/SC 8 were hosted by the National Institute of Standards and Technology (NIST) on 23–25 July 2013 in Gaithersburg. OIML TC 17/SC 1 is responsible for the revision of OIML R 59 *Moisture meters for cereal grains and oilseeds* and TC 17/SC 8 is responsible for the development of a new OIML Recommendation on protein measuring instruments. Fourteen delegates from Australia, China, Germany, Japan and the USA attended, in addition to Mr. Luis Mussio, BIML contact for both Project Groups.

TC 17/ SC 1: Revision of R 59 *Moisture meters for cereal grains and oilseeds*

The TC 17/SC 1 project conveners, USA and China, received 163 comments to the 6CD of OIML R 59. At the TC 17/SC 1 project group meeting, members identified and reviewed critical comments, many of which concerned harmonizing the test procedures in the 6CD of OIML R 59 and the 4CD of the Recommendation on protein measuring instruments for cereal grain and oil seeds. Harmonization is necessary because some instruments measure both grain moisture and protein. As such, the type evaluation test procedures should be the same, to avoid the need for additional testing on devices that measure both moisture and protein. The 6CD will be revised in line with the comments received and discussions held during the meeting.

TC 17/SC 8: Development of a Recommendation on protein measuring instruments

Since the last meeting of TC 17/SC 8/p1 in 2010, two Committee Drafts (3CD and 4CD) of an International Recommendation for *Grain protein measuring for cereal grains and oilseeds* have been developed and circulated to Member States. The purpose of the 2013 meeting was to resolve any remaining issues highlighted by P- and O-members during April to July 2013. The latest consultation specifically concerned the 4CD which comprised:

- Part 1: Metrological and technical requirements;
- Part 2: Metrological controls and performance tests;
- Part 3: Report format for type evaluation.

Most of the feedback was positive and the key issues drawn from stakeholder comments were limited to:

- ranges for selected influence quantities and the test sample temperature;
- security requirements and software assessment scheme for instruments that can be used in an open network;
- further alignment of the test procedures with R 59 tests (i.e. number of units subjected to test program, number of replicate measurements, temperature and humidity setpoints for climatic tests).

Some issues were already resolved following the meeting on the 6CD revision of R 59. For example, the test sample temperature range discussed in the earlier meeting was also adopted for protein measuring instruments. All the relevant test procedures in OIML D 11 *General requirements for electronic measuring instruments* were implemented in the 4CD for grain protein measuring instruments. With exception of the damp heat humidity test, harmonization with the type evaluation test procedures for grain moisture meters was achieved (i.e. calibration accuracy, tests for influence factors and disturbances).

The remaining comments were reviewed in detail. In almost all cases, TC 17/SC 8 agreed on a solution for implementation. Following the meeting, the convener will prepare a 5CD revision for circulation in late 2013. It is anticipated that TC 17/SC 8 will allow it to progress to CIML preliminary online ballot, enabling the project to be completed in the coming year.

Software security – severity level

OIML D 31 *General requirements for software controlled measuring instruments* promotes requirements corresponding to an elevated risk level for instruments used in an open network. Issues identified were:

- some types of protein measuring instruments that are available are very simple and cannot be connected to any network;
- in some countries, the use of instruments with 'networking' facilities in open networks such as the internet remains a relatively novel concept that should not be inhibited; and
- in a number of countries, either likelihood or consequence of fraud or misuse involving transmitted or stored data is low.

Consequently, national responsible bodies will be able to specify security provisions at a reduced severity level if they deem it appropriate, including for instrument types that can be used in an open network. ■

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. The changes since the last issue of the Bulletin are marked in red.

		R 16	R 21	R 31	R 35	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)												■																									

OIML Systems

Basic and MAA Certificates registered 2013.06–2013.08

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*.

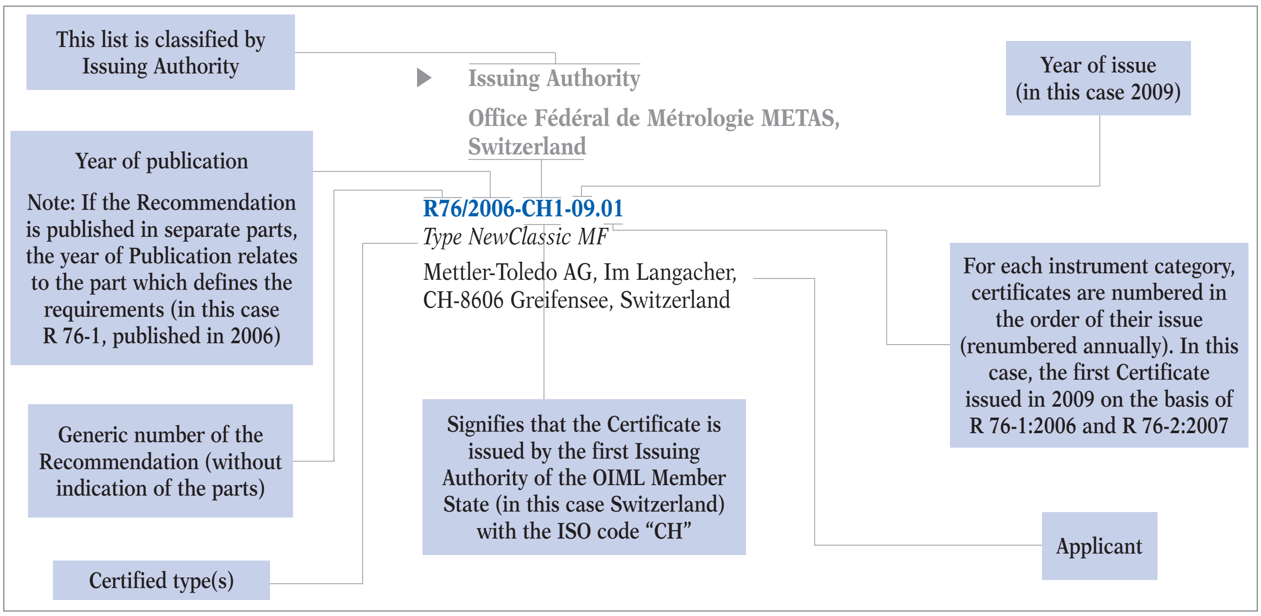
The OIML MAA is an additional tool to the OIML Basic Certificate System in particular to increase the existing mutual confidence through the System. It is still a voluntary system but with the following specific aspects:

- 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

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*

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

R049/2006-FR2-2013.02
Compteur d'eau - Type: TD 88
ITRON France, 9 rue Ampère, FR-71031 Macon, France

▶ Issuing Authority / *Autorité de délivrance*

NMi Certin B.V., The Netherlands

R049/2006-NL1-2011.02 Rev. 1
Water meter intended for the metering of cold potable water and hot water - Type: model "Sharpflow SWB7 + CWB7", class 1 and 2
Itron France, 11, Boulevard Pasteur, FR-67500 Haguenau, France

▶ Issuing Authority / *Autorité de délivrance*

Physikalisch-Technische Bundesanstalt (PTB), Germany

R049/2006-DE1-2008.02 Rev. 6
Water meter intended for the metering of cold potable water - Types: Q200 Q3=1.6 (E,P,M), Q200 Q3=2.5 (E,P,M), SM250 (E,P,M), SM700 (E,P,M)
Elster Metering Ltd, 130 Camford Way, Sundon Park, Luton, Bedfordshire LU3 3AN, United Kingdom

R049/2006-DE1-2010.03 Rev. 3
Water meter intended for the metering of cold potable water Combination meter with mechanical register - Type: C4000
Elster Messtechnik GmbH, Otto-Hahn Strasse 25, DE-68623 Lampertheim, Germany

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

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

R 51 (1996)

▶ Issuing Authority / *Autorité de délivrance*

NMi Certin B.V., The Netherlands

R051/1996-NL1-2013.06
Automatic catchweighing instrument - Type: LI-4600
Teraoka Seiko Co., Ltd., 13-12 Kugahara, 5-Chome, Ohta-ku, JP-146-8580 Tokyo, Japan

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

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

R 51 (2006)

▶ Issuing Authority / *Autorité de délivrance*

NMi Certin B.V., The Netherlands

R051/2006-NL1-2013.03
Automatic catchweighing instrument - Type: SSV series checkweigher (TWS5xxxBxxx)
Anritsu Industrial Solutions Co., Ltd, 5-1-1 Onna, JP 243-0032 Atsugi, Kanagawa-Prefecture, Japan

R051/2006-NL1-2013.04
Automatic catchweighing instrument - Type: Helper X / Millenium5
Veigroup srl, Piazza G. Zanella 1/A, 36066 Sandrigo (VI), Italy

R051/2006-NL1-2013.05
Automatic catchweighing instrument - Type: SSV series checkweigher (KWS6xxBxx)
Anritsu Industrial Solutions Co., Ltd, 5-1-1 Onna, JP 243-0032 Atsugi, Kanagawa-Prefecture, Japan

▶ Issuing Authority / *Autorité de délivrance*

National Measurement Office (NMO), United Kingdom

R051/2006-GB1-2008.01 Rev. 8

CW3 Checkweigher

Loma Systems Group and ITW Group, Southwood, Farnborough, Hampshire GU14 0NY, United Kingdom

▶ Issuing Authority / *Autorité de délivrance*

Physikalisch-Technische Bundesanstalt (PTB), Germany

R051/2006-DE1-2013.01

Checkweigher - Type: KWE6xxx / KWI6xxx / KPI3xxx

Robert BOSCH GmbH, Stuttgarter Straße 130, DE-71332 Waiblingen, 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*

Centro Español de Metrologia, Spain

R060/2000-ES1-2013.03

Compression load cell - Model designation CCI

Ascell Sensor, S.L, Avda. Congost, 56, nave 3., Poligono Industrial Congost, 08760 Martorel, Spain

▶ Issuing Authority / *Autorité de délivrance*

Dansk Elektronik, Lys & Akustik (DELTA), Denmark

R060/2000-DK3-2013.01

Compression, strain gauge load cell - Type: CA

ESIT Electronik Sistemler Imalat ve Ticaret Ltd Sirketi, Nisantepe Mahallesi Handegul, Sokak N° 8, Cekmekoy, TR-34794 Istanbul, Turkey

▶ 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-JP1-2013.02 (MAA)

Compression load cell - Type: CS008A-200K, CS008A-500K, CS008A-1T, CS008A-2T, CS008A-3T, CS008A-5T

Minebea Co., Ltd, 1-1-1 Katase Fujisawa-shi, JP-251-8531 Kanagawa-ken, Japan

▶ Issuing Authority / *Autorité de délivrance*

NMi Certin B.V., The Netherlands

R060/2000-NL1-2013.11 (MAA)

Single point load cell, with strain gauges - Type: XSB

Keli Sensing Technology (Ningbo) Co., Ltd., No. 199 of Changxing RD, Jiangbei district, Ningbo, P.R. China

R060/2000-NL1-2013.12 (MAA)

Compression load cell, with strain gauges - Type: NH-SS, NHSY-SS

Keli Sensing Technology (Ningbo) Co., Ltd., No. 199 of Changxing RD, Jiangbei district, Ningbo, P.R. China

R060/2000-NL1-2013.12 Rev. 1 (MAA)

Compression load cell, with strain gauges - Type: NHS-SS, NHSY-SS

Keli Sensing Technology (Ningbo) Co., Ltd., No. 199 of Changxing RD, Jiangbei district, Ningbo, P.R. China

R060/2000-NL1-2013.13 (MAA)

Shear beam load cell, with strain gauges - Type: SQB

Keli Sensing Technology (Ningbo) Co., Ltd., No. 199 of Changxing RD, Jiangbei district, Ningbo, P.R. China

R060/2000-NL1-2013.14 (MAA)

Bending beam or shear beam cell - Type: H210-xx-xx-xxx-xx Series

Jay Instruments & Systems pvt. Ltd., E-16, Everest, Tardeo Road, IN-400 034 Mumbai, India

R060/2000-NL1-2013.14 Rev. 1 (MAA)

Bending beam or shear beam cell - Type: H210-xx-xx-xxx-xx Series

Jay Instruments & Systems pvt. Ltd., E-16, Everest, Tardeo Road, IN-400 034 Mumbai, India

R060/2000-NL1-2013.15 (MAA)
Compression load cell, with strain gauges - Type: OBL-01-CX-XX-XX-XX series
Ozkanlar Baskul San.Tic.Ltd.Sti., Ozgur Mah. 2399 Sok. No:8/A, Yuregir-Adana, Turkey

R060/2000-NL1-2013.16 (MAA)
Single point load cell, with strain gauges, tested as a part of a weighing instrument - Type: LAB-XXXX-BX-XX-XX series
Xiamen Loadcell Technology Co., Ltd, 5FL, No 20, Huli Park, Tongan Industry Central Zone, CN-361100 Xiamen, P.R. China

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

R060/2000-NL1-2013.18 (MAA)
Tension load cell, with strain gauges - Type: UU-Kxxx
Dacell Co., Ltd., 681-1 Cheoksan - Ri, Nami - Myeon, Korea, Cheongwon - Gun, Korea, Korea(R.)

R060/2000-NL1-2013.19 (MAA)
Bending beam load cell, with strain gauges - Type: SLB215, SLB415
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-GB1-2013.02
LTC stainless steel compression load cell
LOADTECH, S.L., Portal Nou, 46, Terrasa, Barcelona, Spain

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-GB1-2013.01
Automatic gravimetric filling instruments - Type: CCW-R, CCW-RS and CCW-RV
Ishida Europe Ltd, 11 Kettles Wood Drive, Woodgate Business Park, Birmingham B32 3DB, United Kingdom

▶ **Issuing Authority / *Autorité de délivrance***
Physikalisch-Technische Bundesanstalt (PTB), Germany

R061/2004-DE1-2013.01
Automatic gravimetric filling instrument - Type: MEC4
Haver & Boecker, Carl-Haver-Platz 3, DE-59302 Oelde, Germany

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***
NMi Certin B.V., The Netherlands

R076/1992-NL1-2013.16 (MAA)
Non-automatic weighing instrument - Type: TW-V/TX/V Series
Shimadzu Corporation, 1, Nishinokyo-Kuwabara-cho, Nakagyo-ku, JP-604-8511 Kyoto, Japan

Issuing Authority / *Autorité de délivrance*

National Measurement Office (NMO), United Kingdom

R076/1992-GB1-2013.04 (MAA)
Type: Motorola MP62xx & MP65xx, where xx denotes alternative approved models

Motorola Solutions, Inc., One Motorola Plaza, 11742-1300 Holtsville, NY, United States

R076/1992-GB1-2013.05 (MAA)
Non-automatic weighing instruments - Type: FW500 Series

CAS Corporation, #19, Ganap-Ri, Gwangjuk-Myoun, Yangju-Si, KR-482-841 Kyunggi-Do, Korea (R.)

Issuing Authority / *Autorité de délivrance*

Physikalisch-Technische Bundesanstalt (PTB), Germany

R076/1992-DE1-1995.02 Rev. 4
Non-automatic electromechanical weighing instrument - Type: BC BC 100, KA BC 100, MB BC 100, BA BC 200, BD BC 200, MA BC 200 and MD BC 200
Sartorius Industrial Scales GmbH & Co. KG, Leinetal 2, DE-37120 Bovenden, Germany

R076/1992-DE1-1998.04 Rev. 4
Non-automatic electromechanical weighing instrument - Type BD BH 110, DS BH 310, DT BH 210, DT BH 310

Sartorius Lab Instruments GmbH & Co. KG, Weender Landstr. 94-108, DE-37075 Gottingen, Germany

R076/1992-DE1-2000.09 Rev. 8
Non-automatic electromechanical weighing instrument - Type: iso-TEST:

Indicating and operator terminals: Types YAC01..., YAC02..., TN, TN-X and isi...

Weighing modules: Types BD BF, BC BF, BF BF, BE BK, HC BF, HA BD, KC BN and YCO02IS-0CE

Sartorius Industrial Scales GmbH & Co. KG, Leinetal 2, DE-37120 Bovenden, Germany

R076/1992-DE1-2001.08 Rev. 4
Non-automatic electromechanical weighing instrument

Type: BC BL 100, BD BL 100, BD BL 200, BF BL 500

Sartorius Lab Instruments GmbH & Co. KG, Weender Landstr. 94-108, DE-37075 Gottingen, Germany

R076/1992-DE1-2006.01 Rev. 3
Non-automatic electromechanical weighing instrument with or without lever system - Type: BD ED 100, DB ED 200

Sartorius Lab Instruments GmbH & Co. KG, Weender Landstr. 94-108, DE-37075 Gottingen, Germany

R076/1992-DE1-2007.08 Rev. 3
Non-automatic electromechanical price-computing weighing instrument for direct sales to the public - Type: BC II.

Bizerba GmbH & Co. KG, Wilhelm-Kraut-Strasse 65, DE-72336 Balingen, Germany

R076/1992-DE1-2008.03 Rev. 2
Non-automatic electromechanical weighing instrument with or without lever system Type: BD SI 200, BG SI 200, DG SI 300, DX SI 300

Sartorius Industrial Scales GmbH & Co. KG, Leinetal 2, DE-37120 Bovenden, Germany

R076/1992-DE1-2012.03 Rev. 1
Non automatic electromechanical weighing instrument - Type: SQP-A, SQP-B, SQP-C, SQP-D, SQP-E

Sartorius Lab Instruments GmbH & Co. KG, Weender Landstr. 94-108, DE-37075 Gottingen, Germany

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*
Dansk Elektronik, Lys & Akustik (DELTA), Denmark

R076/2006-DK3-2013.02
Non-automatic weighing instrument - Type: CWB7/CWBR7/CWB22/CWBR22/CPB9

Changzhou Newton Force Weighing System Co., Ltd., Wujin Minghuang Southern Industrial Area, Changzhou, Jiangsu, P.R. China

R076/2006-DK3-2013.03
Non-automatic weighing instrument - Type: CWT7/CWT22/CPT10/CPT20

Changzhou Newton Force Weighing System Co., Ltd., Wujin Minghuang Southern Industrial Area, Changzhou, Jiangsu, P.R. China

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
Weighing Indicator - Type: XK3190-A12, XK3190-A12E
Shanghai Yaohua Weighing System Co., Ltd, No. 4059, Shangnan Road, Pudong District, CN-200124 Shanghai, P.R. China

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

R076/2006-NL1-2013.11 (MAA)
Non-automatic weighing instrument - Type: Magellan 980x
Datalogic Scanning, Inc., 959 Terry Street, US-Oregon 97402-9150 Eugene, United States

R076/2006-NL1-2013.11 Rev. 1 (MAA)
Non-automatic weighing instrument - Type: Magellan 980x
Datalogic Scanning, Inc., 959 Terry Street, US-Oregon 97402-9150 Eugene, United States

R076/2006-NL1-2013.18 (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-NL1-2013.23 (MAA)
Non-automatic weighing instrument - Type: DS-785
Shanghai Teraoka Electronic Co., Ltd., Tinglin Industry Developmental Zone, Jin Shan District, CN-201505 Shanghai, P.R. China

R076/2006-NL1-2013.25 (MAA)
Non-automatic weighing instrument - Type: ICS 241
Mettler-Toledo (Changzhou) Measurement Technology Ltd, N° 111, West TaiHu Road, ChangZhou XinBei District, CN-213125 Jiangsu, P.R. China

R076/2006-NL1-2013.28 (MAA)
Non-automatic weighing instrument - Type: InBody 770
Biospace Co., Ltd, 15, Heugam-gil, Ipjang-myeon, Seobuk-gu, Cheonan-si, Chungcheongnam-do, 331-824 Korea (R.)

R076/2006-NL1-2013.29 (MAA)
Non-automatic weighing instrument - Type: PS-160
Shanghai Teraoka Electronic Co., Ltd., Tinglin Industry Developmental Zone, Jin Shan District, CN-201505 Shanghai, P.R. China

R076/2006-NL1-2013.30 (MAA)
Non-automatic weighing instrument - Type: Progressa, 8 series hospital bed.
Hill-Rom, 1069 State Route 46 East, US-47006 Indiana, Batesville, United States

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

R076/2006-GB1-2013.01
XK3190-A12 or XK3190-A12E
Eurobil S.r.l., Via Olona 183/C, 21013, Gallarate (VA), Italy

R076/2006-GB1-2013.03 (MAA)
C510 Digital Indicator
Rinstrum Pty. Ltd, 41 Success Street, QLD 4110 Acacia Ridge, Australia

R076/2006-GB1-2013.04 (MAA)
WE2111 Digital Indicator
Hottinger Baldwin Messtechnik GmbH, Im Tiefen See 45, DE-64293 Darmstadt, Germany

Issuing Authority / *Autorité de délivrance*
Physikalisch-Technische Bundesanstalt (PTB), Germany

R076/2006-DE1-2008.04 Rev. 1
Nonautomatic electromechanical weighing instrument with or without lever system also as a multi-interval or as a multiple range instrument - Type: SARTICS
Sartorius Industrial Scales GmbH & Co. KG, Leinetal 2, DE-37120 Bovenden, Germany

R076/2006-DE1-2010.01 Rev. 3
Non-automatic weighing instrument for direct sales to the public - Type: SCII...
Bizerba GmbH & Co. KG, Wilhelm-Kraut-Strasse 65, DE-72336 Balingen, Germany

R076/2006-DE1-2012.05
Non-automatic electromechanical weighing instrument - Type: DISOBOX plus
Schenk Process GmbH, Pallaswiesenstrasse 100, DE-64293 Darmstadt, Germany

R076/2006-DE1-2013.03
Non-automatic electromechanical weighing instrument for persons - Type: CHS01DE-I:M
Seca GmbH & Co. kg., Hammer Steindamm 9-25, DE-22089 Hamburg, Germany

R076/2006-DE1-2013.04
Non-automatic weighing instrument - Type: ITx000 (M, E, ET)
SysTec Systemtechnik und Industrieautomation GmbH, Ludwig-Erhard-Str. 6, DE-50129 Bergheim, Germany

R076/2006-DE1-2013.05
Non automatic electromechanical weighing instrument - Type: eS
Bizerba GmbH & Co. KG, Wilhelm-Kraut-Strasse 65, DE-72336 Balingen, Germany

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-CZ1-2013.01
Automatic level gauge - Type: LABKO 3000 (probe) / LPS-1 (Power supply and interface unit)
Labkotec Oy, Myllyhaantie 6, FI-33960 Pirkkala, Finland

R085/2008-CZ1-2013.02
Magnetostrictive level gauge - Type: XMT-SI-485 (probe) / Tank manager (power and communication unit + software)
Bois Bros Company, Peraios & Glanidi 18, GR-18346 Moschato, Greece

R085/2008-CZ1-2013.03
Magnetostrictive level gauge - Type: MR-7 (probe) / Tank manager (power and communication unit + software)
Bois Bros Company, Peraios & Glanidi 18, GR-18346 Moschato, Greece

R085/2008-CZ1-2013.04
Magnetostrictive level gauge - Type: XMT (probe) / Tank manager (power and communication unit + software)
Bois Bros Company, Peraios & Glanidi 18, GR-18346 Moschato, Greece

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***

Russian Research Institute for Metrological Service (VNIIMS)

R117/1995-RU1-2013.01
Tatsuno Fuel Dispensing Unit Sunny XE Series Suction type and Remote type
Tatsuno India Private Ltd, Plot N°. B-31 & B-32 MIDC, Taloja Industrial Area Village - Pendhar, Taluka - Panvel, Dist - Kolabra, Navi Mumbai, Maharashtra, India

R117/1995-RU1-2013.02
Tatsuno Fuel Dispensing Unit Sunny GII Series Suction type and Remote type
Tatsuno India Private Ltd, Plot N°. B-31 & B-32 MIDC, Taloja Industrial Area Village - Pendhar, Taluka - Panvel, Dist - Kolabra, Navi Mumbai, Maharashtra, INDIA

▶ **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

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

NMi Certin B.V., The Netherlands

R117/1995-NL1-2009.02 Rev. 3
Fuel dispenser for motor vehicles - Type: Quantium XXXX
Tokheim Group S.A.S., Paris-Nord 2, 5 rue des Chardonnerets, BP 67040 Tremblay en France, FR-95971 Roissy Ch de Gaulle Cedex, France

R117/1995-NL1-2009.02 Rev. 4
Fuel dispenser for motor vehicles - Type: Quantium XXXX
Tokheim Group S.A.S., Paris-Nord 2, 5 rue des Chardonnerets, BP 67040 Tremblay en France, FR-95971 Roissy Ch de Gaulle Cedex, France

Issuing Authority / *Autorité de délivrance*

SP Technical Research Institute of Sweden, Sweden

R117/1995-SE1-2013.01
One or two sided fuel pumps/dispensers for motor vehicles type. Wayne Helix 2000, 4000, 5000, 6000

Dresser Wayne Pignone, Limhamnsvägen 109,
Box 300 49, 200 61 Malmö, Sweden

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Evidential breath analyzers
Éthylomètres

R 126 (1998)

Issuing Authority / *Autorité de délivrance*

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

R126/1998-FR2-2013.01
Evidential Breath Analyzer - Type: INTOX EC/IR II.t
Evidential Breath Analyzer - Type INTOX EC/IR II.t

Intoximeters, Inc, 2081 Craig Road, St-Louis MO 63146,
United States

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 et le mesurage des charges à l'essieu

R 134 (2006)

Issuing Authority / *Autorité de délivrance*

National Measurement Office (NMO),
United Kingdom

R134/2006-GB1-2012.02
Type: 3590E-AF09

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

The OIML is pleased to welcome the following new

Member State

- Zambia

CIML Members

- Algeria: Mr. Samir Drissi
- Belgium: Mr. Philippe Degavre
- Egypt: Eng. Medhat Fawzy Bekhit
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- Korea (Rep.): Mr. Choi, Mi-Ae

Corresponding Members

- Iraq
- Korea (DPR)

OIML Meetings

1–3 October 2013

TC 8/SC 3/p2 (R 117-2)
NMO, Teddington, UK

7–11 October 2013

48th CIML Meeting and Associated Events
Ho Chi Minh City, Viet Nam

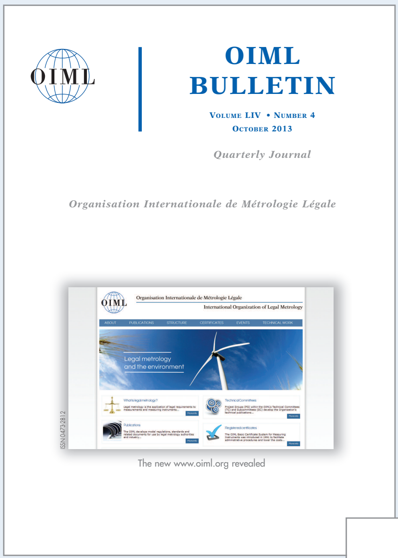
22–23 October 2013

TC 17/SC 7 (Breath testers)
PTB, Berlin

Committee Drafts

Received by the BIML, 2013.07 – 2013.09

OIML R 50-3 Continuous totalizing weighing instruments - Part 3 Test report format	E	2CD	TC 9/SC 2	UK



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