Towards the 21st century . . .

OIML approaches the future with new long-term policy orientations
MEMBER STATES

ALGERIA  DEM. P. REP. OF KOREA
AUSTRALIA  REP. OF KOREA
AUSTRIA  MONACO
BELARUS  MOROCCO
BELGIUM  NETHERLANDS
BRAZIL  NORWAY
BULGARIA  PAKISTAN
CAMEROON  POLAND
CANADA  PORTUGAL
P. REP. OF CHINA  ROMANIA
CUBA  RUSSIAN FEDERATION
CYPRUS  SAUDI ARABIA
CZECH REPUBLIC  SLOVAKIA
DENMARK  SLOVENIA
EGYPT  SPAIN
ETHIOPIA  SRI LANKA
FINLAND  SWEDEN
FRANCE  SWITZERLAND
GERMANY  TANZANIA
GREECE  THE FORMER YUGOSLAVE REPUBLIC OF MACEDONIA
Greece  TUNISIA
HUNGARY  UNITED KINGDOM
INDIA  UNITED STATES OF AMERICA
INDONESIA  YUGOSLAVIA
IRELAND  ZAMBIA
ISRAEL  
ITALY  
JAPAN  
KAZAKHSTAN  
KENYA  

CORRESPONDING MEMBERS

ALBANIA  MALAYSIA
BAHRAIN  MAURITIUS
BANGLADESH  MEXICO
BARBADOS  MONGOLIA
BENIN  NEPAL
BOTSWANA  NEW ZEALAND
BURKINA FASO  OMAN
COLOMBIA  PANAMA
COSTA RICA  PERU
CROATIA  PHILIPPINES
ECUADOR  SEYCHELLES
FUJI  SINGAPORE
GHANA  SYRIA
HONG KONG  THAILAND
ICELAND  TRINIDAD AND TOBAGO
JORDAN  TURKEY
KUWAIT  UGANDA
LITHUANIA  URUGUAY
MALAWI  VENEZUELA
~

130, RUE GÉNÉRAL DE GAULLE
10000 TROYES
technique

5 Fabry-Perot: Correlation photometer for gas analysis
M. Zöchbauer

15 KRISS high pressure gas flow standard system
D. Chi, K. Park, J. S. Paik

21 Mobile mass comparator for verification and calibration of weights
T. Myklebust

evolutions

Since the beginning of the 1990's, the definition of new policy directions for OIML has been one of the Organization's most important activities. This issue of the Bulletin features two parts of a long-term policy document with three modules addressing metrology and its various aspects, OIML as it appears today, and the strategies to be followed by OIML for accomplishing its goals. In the Editorial, B. Athané, Director of BIML, explains the context in which the Long-term policy of OIML was developed.

24 OIML long-term policy: Part 1 Metrology

26 OIML long-term policy: Part 3 OIML strategy

36 Asia Pacific Legal Metrology Forum
J. Birch

update

38 OIML Annual Reports for 1994

45 BIML report on 1994 activities

46 OIML meetings

49 OIML Certificate System

52 Liaison activities

56 Calendar
Technique

5 Photomètre de Fabry-Perot à corrélation pour l’analyse des gaz
M. Zöchbauer

15 Le système de référence pour la mesure des débits de gaz à haute pression
développé par le KRISS
D. Chi, K. Park et J.S. Paik

21 Comparateur de masse déplaçable pour la vérification et l’étalonnage des poids
T. Myklebust

Évolutions

Dès le début des années quatre-vingt-dix, l’une des plus importantes activités de l’OIML a été de définir
les nouvelles directions de sa politique. Le présent numéro du Bulletin présente deux des trois parties
d’un document qui traite de la métrologie sous ses divers aspects, de l’OIML telle qu’elle apparaît aujourd’hui,
et de la stratégie que l’OIML doit appliquer pour atteindre ses objectifs. Dans son éditorial, B. Athané,
Directeur du BIML, explique le contexte dans lequel la Politique à long terme de l’OIML a été développée.

30 Politique à long terme de l’OIML: Partie 1 Métrologie

32 Politique à long terme de l’OIML: Partie 3 Stratégie de l’OIML

36 Forum Asie-Pacifique de métrologie légale

D’un bulletin à l’autre

38 Rapports annuels OIML pour 1994

45 Rapport du BIML sur ses activités en 1994

46 Réunions OIML

49 Système de Certificats OIML

52 Liaisons

56 Calendrier
In the January 1995 issue of the OIML Bulletin, our newly-elected President, Gerard J. Faber, introduced a new strategy concept for the future of OIML.

Several years of thoughts and discussions within the OIML Conference and Committee were concluded in a recent two-day meeting of the Presidential Council, during which the text of the OIML long-term policy and strategy paper was finalized.

In fact, what do we mean by "new"?

Obviously, the basic aims of OIML, as defined by the statutory Convention, have not been questioned, but just reaffirmed. Obviously, the raison d’être of legal metrology and its international harmonization appear as they did when OIML was established, although strengthened by the evolutions of our world.

In this sense, the OIML long-term policy paper will perhaps disappoint those who were expecting revolutionary views on legal metrology: after years of discussions, it was concluded that international legal metrology deserved sound evolutions, not an abrupt revolution.

What is new is the spirit in which OIML Members have considered the situation, and decided to express, in written form, a consensual result of what they had on their minds.

What is new is the effort to maintain transparency in OIML activities so that all those interested in participating in our work or in implementing our output know exactly what we do and how we do it.

What is new is the clear list of actions that will be pursued for reaching OIML’s goals.

What is new is the assessment procedure that will permit CIOM to monitor progress and redirect strategy actions whenever necessary.

What is new is OIML’s reinforced willingness to participate actively and in close cooperation with numerous international and regional bodies to promote metrology, in all its aspects, as an essential tool for progress and welfare.

The OIML long-term policy paper includes three parts. Parts 1 and 3 are given in this issue of the Bulletin; Part 2 is a current description of OIML and is not reproduced since such information has already been published in previous issues of the Bulletin.

I invite all those interested in metrology, and especially in legal metrology, to share their reactions with us after having read these two essential parts of OIML’s policy (pp. 24–29 for the English version and pp. 30–35 for the French version). All comments, favorable or critical, will no doubt encourage us and assist us in choosing the best orientations for our activity.

B. Athané
ENVIRONMENTAL MEASUREMENT TECHNOLOGY

Fabry-Perot correlation photometer for gas analysis

M. ZÖCHBAUER
Hartmann und Braun AG, Germany

Abstract
The spectral correlation methods have obtained great importance in industrial gas analysis. A Fabry-Perot correlation photometer using a newly developed, thermally-tunable silicon etalon is introduced. After a short presentation of the fundamentals, the paper describes the concept, construction and application possibilities of the photometer. Based on the exemplary measured components CO and NO, the features of the photometer are examined with emphasis on the selectivity. Finally, the relevant properties are compared with those of the NDIR correlation method.

1 Introduction

In process and environmental measurement technology, the concentration of certain gases must be monitored or regulated. For example, an important field of application is the flue gas monitoring of the components CO, NO, NO₂, SO₂, CO₂, and HCl. Such applications presuppose that the component of interest is determined in the gaseous mixture with the necessary degree of selectivity and sensitivity, without other components falsifying the measurement. Here, special correlation methods have attained significant importance for practical applications.

Correlation methods operate on the principle that the absorption spectra of low molecular organic gases possess a pronounced, fine structure in the IR and UV spectral region, this feature being a characteristic of the respective gas [1–3]. The basic idea is to compare the absorption spectra of the examined gaseous mixture with that of the gas component to be detected (measured component) and then to determine a quantitative measure for the “similarity” of both spectra. Well-known procedures are the gas-filter correlation [4], the non-dispersive infrared method [5], and two different interferometric correlation methods based either on the multiple-beam interference [6–8] or on the two-beam interference [9–11]. The multiple-beam interference method uses a Fabry-Perot interferometer [12] which simulates the absorption spectrum of the measured component and saves it in the measuring instrument. To date, very little has been published on the practical application of the Fabry-Perot correlation method [6–8], most likely due to the complex design and operation of the Fabry-Perot interferometer known up to now.

The following article focuses on a Fabry-Perot correlation photometer featuring a newly designed, electrically conductive silicon etalon [13, 14]. The fundamentals and concept of a laboratory prototype as well as the possible applications of the photometer will be outlined.

2 Fabry-Perot correlation method

Figure 1 illustrates the design and operating method of the classical Fabry-Perot interferometer. A plane-parallel layer of air is confined by two glass plates (P1 and P2). Both plates are provided with semitransparent mirrors on their inner sides; at present, dielectric mirrors permitting low-loss transmission of light are generally used [15]. An optical beam emitted from the light source is frequently reflected to and fro once it has penetrated the mirror layer of the first plate. A fraction of the energy is emitted towards the back during each reflection. To prevent interfering reflections on both external surfaces of the glass plates, the latter are slightly wedge-shaped. The optical beams coming from

(*) Translated from the original German version published in tm - Technisches Messen 5/1994.
the second plate interfere with each other and are combined in the focal plane of a lens L. Using an adjustment device, the distance between P1 and P2 (hence the optical layer thickness) is set to a certain value. The illustrated arrangement can be simplified if the adjustment tasks for the distance between the plates can be dispensed with. In this case, only one plate, which is plane-parallel and coated with semitransparent mirrors on both sides, is used. This shape of the Fabry-Perot interferometer is generally designated as an etalon and is used here (see section 4). Maximum light amplification is observed when the optical layer thickness (twice the distance between the mirrors) is equal to an integer multiplied by the light wavelength.

The transmission of a Fabry-Perot interferometer as a function of the wavelength is calculated from the Airy function (Fig. 2). Two essential features of the Airy function can be observed: the transmission peaks are equidistant with respect to δ, the curve shape is dependent on the reflectance r. The distance between the transmission peaks is designated as the free spectral range. Another vital characteristic of the Fabry-Perot interferometer is its narrowness, which is defined as the ratio of the free spectral range to the half-intensity width of the Airy profile.

The principle of the Fabry-Perot correlation method can be demonstrated on the basis of a special correlation function, which gives a measure of the similarity between the Fabry-Perot spectrum and the sample gas spectrum. The correlation function [14] is expressed as

\[ \Gamma(\sigma) = \frac{1}{K_N} \int F(v)[1 - T(v)]P(\sigma, v)dv \]  

where \( \sigma \) is the free spectral range of the Fabry-Perot, \( v \) is the wave number (reciprocal value of the wavelength), \( F(v) \) is a filter function, \( T(v) \) is the transmission spectrum of the gaseous mixture and \( P(v, \sigma) \) is the Airy function.

The function

\[ K_N(\sigma) = \int F(v)P(\sigma, v)dv \]  

is used for normalization. In the simplest case, the gaseous mixture (sample gas) comprises only the measured component. As an example, Fig. 3 shows a transmission spectrum of CO. The free spectral range, i.e. the optical layer thickness, is set such that the distance between the interference lines is equal to that between the rotational lines of the CO spectrum. The correlation function shown in Fig. 4 is obtained by changing the free spectral range.

The correlation function indicates an oscillating course with relatively sharp maximum values for CO. The left maximum value with the highest amplitude
Fig. 3 Numerically calculated transmission spectrum of CO as a function of the wavenumber [16-18]. The line calculation is based on the Lorentz function. Concentration $c = 10^{-3}$ bar, cell length $l = 13$ cm.

corresponds to the resonance position, i.e. the state where interference lines and rotational lines coincide. However, the coincidence is not strict since the interference lines are equidistant, whereas the rotational lines are not. The correlation minimum value which follows can be viewed as the antiresonance position, i.e. where the interference lines and rotational lines are mutually phase-shifted by a distance of half a line. The degree of correlation is practically zero in this state. The next correlation maximum value is observed if the Airy function is displaced by exactly one interference order. The slowly declining amplitude of the correlation maximum values results from the decreasing coincidence between interference and gas lines.

Completely different conditions arise depending on whether one observes the correlation function of individual interfering components, e.g. nitrous oxide (N$_2$O), whose pronounced rotation-vibrational spectrum partially intersects the CO spectrum, or whether one studies a wideband, non-structured interfering component. The correlation functions calculated can be seen in Fig. 4.

Unlike the measured component CO, a significantly reduced correlation contrast can be observed for both interfering components, with this being practically zero in the case of the wideband interfering component. The correlation method's ability to suppress interfering components can be easily demonstrated by calculating the difference between the degree of correlation of the resonance and antiresonance positions for the respective components (broken lines in Fig. 4). The sensitivity is zero for the wideband interfering component. The degree of correlation for nitrous oxide in the resonance and antiresonance position is of practically the same magnitude, thus resulting in fairly satisfactory compensation. However, such favorable circumstances do not always exist for practical applications; more difficult cases will be discussed in section 5.

3 Concept of the tuneable Fabry-Perot interferometer

The fundamental aim is to simplify the complicated mirror adjustment for the classical Fabry-Perot interferometer. The solution is obvious: if the Fabry-Perot interferometer is designed as an etalon consisting of a single plate with semitransparent mirrors on the boundary surfaces, the mirror adjustment is fully omitted. Of course, we have to obtain the same degree of parallelism of the mirror surfaces for the etalon; however, adjustment for this is already made at the time of manufacture, e.g. by means of smoothing and polishing. Once the etalon surfaces have been mutually aligned, they remain in this position and need not be permanently checked during operation.

From the Airy function (Fig. 2), one can deduce that tuning can only be performed via the refractive index $n$, thickness $s$ or the angle of refraction $\alpha$. As regards the angle of refraction $\alpha$, attention is called to the change...
that must be made in order to displace the interference lines by one order. The calculation [14] shows that the desired tuning can be performed by making a relatively small change in the angle of incidence. A conceivable approach would be to obtain an arrangement using a step motor which would tilt the etalon in a defined manner. A more thorough view, however, shows that tuning the etalon by means of tilting results in very stringent demands on the optical setup in order to maintain the narrowness during tuning.

The next possibility for Fabry-Perot tuning would be to change the refractive index n. Here, one could use electro-optical crystal materials. For lithium niobate \((n = 2.2, \lambda = 624 \mu m, \lambda = 4.6 \mu m)\), one needs a control voltage of 14.4 kV for displacing the interference lines by one order \((\Delta n = 3.7 \cdot 10^{-3})\) [14, 19]. The high voltage needed results in relatively complicated electronic circuits which make the use of the etalon difficult, if not impossible. Acousto-optical crystals also permit tuning by changing the refractive index. For example, TeO2, features the highest acousto-optical effect which is based on the photoelastic effect. Using the relatively high, but technically feasible acoustic power of 100 W/cm22, the refractive index variation \(\Delta n = 6.2 \cdot 10^{-4}\) [19] is obtained, hence only approximately 1/6 of the desired value. Therefore, acousto-optical crystals are not suitable.

Finally, thermal tuning can be considered as a “trivial” possibility, with both the thickness s as well as the refractive index n being changed. In this case, the optical layer thickness s \(\cdot n\) is the variable to be tuned. The temperature difference of the displacement by one interference order is

\[
\Delta T = \frac{\lambda \cdot n \cdot n}{d(s \cdot n)},
\]

where \(d(s \cdot n)/dT\) denotes the temperature coefficient of the optical layer thickness. Table 1 shows that the temperature difference, e.g. for silicon and germanium, is relatively small. Therefore, in principle there are no objections to experimental implementation.

This gives rise to the question as to whether it is possible to construct a simple thermally-tuneable etalon with a small mass, capable of operating without an external thermostat of slow response and suitable for quick measurements. It would have to be possible to heat the etalon “directly” in order to keep the total mass to a minimum. The etalon concept implemented here is therefore based on the use of an electrically conductive etalon material which can be heated in a defined manner by direct application of a relatively low electrical voltage [25]. The fact that the two materials with the lowest temperature difference (silicon and germanium – see Table 1) are also semiconductive materials must be viewed as a favorable circumstance. Both materials can be easily doped and set to the desired electrical conductivity. Silicon was ultimately chosen because it can be well-processed by using thin-film technology.

4 Design and principle of operation of the correlation photometer

Figure 5 illustrates the design of the thermally tuneable silicon etalon. It consists of a silicon plate \(P\) with the dimensions \(11 \times 11\) mm\(^2\). The silicon material used has the crystal orientation <100> and is p-doped with a surface resistance of approximately 1–10 \(\Omega \cdot \text{cm}\). Depending on the measurement task, the plate thickness is chosen such that the distance between the interference lines is equal to the distance between the rotational lines. For example, a thickness of approximately 400 \(\mu m\) is obtained for the CO measurement.

The thermally-tuneable silicon etalon is designed using thin-film technology (sputtering technology) in the following manner. The gold-electrodes E1 and E2 are arranged on two opposite edges, and are connected electrically with the silicon via a bonding layer H (e.g. nickel). The electrodes are used for applying an electrical voltage (approximately 40–50 V) which drives a current through the plate and warms it. A nickel resistor T, which is electrically isolated from the silicon by means of the thin silicon nitride insulation layer I, is situated on plate P for precise temperature measurement. The gold surfaces K have been provided

<table>
<thead>
<tr>
<th>Material</th>
<th>(d(sm)/(dT)) [1/K]</th>
<th>(\Delta T_p) for CO [1/K]</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaF&lt;sub&gt;2&lt;/sub&gt;</td>
<td>27.8 (10^{-4})</td>
<td>198.6</td>
</tr>
<tr>
<td>ZnS</td>
<td>53.3 (10^{-4})</td>
<td>103.6</td>
</tr>
<tr>
<td>ZnSe</td>
<td>80.0 (10^{-4})</td>
<td>69.0</td>
</tr>
<tr>
<td>CdTe</td>
<td>110.9 (10^{-4})</td>
<td>49.8</td>
</tr>
<tr>
<td>GaAs</td>
<td>167.5 (10^{-4})</td>
<td>33.0</td>
</tr>
<tr>
<td>Si</td>
<td>174.2 (10^{-4})</td>
<td>31.8</td>
</tr>
<tr>
<td>Ge</td>
<td>419.4 (10^{-6})</td>
<td>15.4</td>
</tr>
<tr>
<td>Quartz</td>
<td>10.7 (10^{-6})</td>
<td>516.2</td>
</tr>
<tr>
<td>IRG 100</td>
<td>95.3 (10^{-4})</td>
<td>58.0</td>
</tr>
</tbody>
</table>
Figure 7 illustrates the structure of the entire correlation photometer. The radiation from the radiation source is modulated by the chopper and enters collimator lens 1. Behind the lens is a sample cell containing the gaseous mixture to be analyzed, followed by the thermally-tuneable etalon. The distance between the radiation source and lens 1 is adjusted such that the image of the incandescent coil is formed at the site of the etalon. The radiation is limited to the required spectral region by means of the interference filter. The following collimator lens 2 focuses the radiation onto the photodetector.

The incandescent coil features the dimensions 2.5 mm × 5 mm. The electrical power is approximately 3 W and corresponds to a color temperature of approximately 700 K. Based on Wien's law, maximum radiation occurs at a wavelength of approximately 4.1 μm. The lenses are made from calcium fluoride, exhibiting sufficient transmission in the infrared region examined. A thermoelectrically cooled PbSe detector, operating at −20 °C is used for measuring the radiation flux. The detector signal is rectified with a lock-in amplifier in a phase-sensitive manner. Further signal processing is done by a computer.

for making contact on the ends of the nickel resistor. Due to the extremely small layer thickness, the heat is transferred very rapidly from the silicon to the nickel strip resulting in a temperature measurement with a quick response (see caption of Fig. 5).

The optical radiation to be filtered enters area A (diameter 6 mm). The reflectance \( r = 0.3 \) is obtained for silicon by using the Fresnel equation [14]. Hence the pure silicon plate can be used immediately as an etalon, even if the narrowness is relatively limited. To enhance the reflection narrowness, surface A can be coated on both sides with dielectric mirrors. Electrical contacts with the etalon are carried out by bonding.

The base plays a decisive role in the etalon operation for mechanical fastening and for electrical contacts (bonding). However, the base's function as a defined heat dissipation is much more important; operation without it would result in an unacceptably long cooling time. The material to be used should demonstrate long-term stability up to 250 °C and be electrically insulated, while exhibiting sufficient heat dissipation. Few materials are capable of demonstrating these characteristics; two examples of materials suitable for this task are: glass-reinforced PTFE or ceramics. Figure 6 illustrates the entire structure of the etalon with a PTFE base. An electronic PI controller (not shown in the diagram) is used for precise adjustment of the required etalon temperature.
Only two discrete values, rather than the entire correlation function, are used for measuring the concentration of the gas component required. The etalon temperature is tuned during the measurement phase such that the interference lines coincide exactly with the absorption lines of the measuring component (resonance position), and the interference pattern is shifted by a half interference order during the reference phase (antiresonance position). Both phases are shown opposite each other in Fig. 8. In the case of the CO measurement, the temperature difference between the measurement and reference phases is only approximately 16 °C. The overlapping spectra of the sample gas and of the Fabry-Perot are integrated across the wavenumber by the wideband detector.

Two properties are of paramount importance: although the measurement and reference radiations differ with respect to their spectral line structure, their spectral center of gravity is identical. Both the measurement and reference radiations pass through the same optical beam path. If the quotient \( I_m / I_r \) is calculated from the time-multiplex detector signals \( I_m \) and \( I_r \), corresponding to the measurement phase or reference phase, a signal independent of the non-specific fluctuations of the radiant power and detector sensitivity is obtained. In this manner, the preconditions for high stability of zero point and sensitivity are fulfilled.

5 Measurements

The time response of the silicon etalon is important when using the thermally-tuneable silicon etalon method. Figure 9 illustrates the warm-up and cool-down behavior when the etalon oscillates permanently between two temperatures. The difference between both setpoint temperatures of the controller corresponds to approximately the distance between the resonance and antiresonance position when measuring CO.

The functional course during the warm-up phase, assuming practically a rectangular shape, clearly shows that the control system is sufficiently rapid. The cooldown rate is however about 4.5 times less than the warm-up rate and can only be increased by employing a base material with a higher thermal conductivity. The first exemplary measuring component is CO whose correlation function (see section 2) is measured as a function of the etalon temperature. The results are given in Fig. 10. The lower diagram shows the correlation function of the structured absorbing component N₂O. Due to the smaller distance between the N₂O lines, about four times the oscillation frequency of the correlation function is obtained. The N₂O correlation contrast is less by approximately one order of magnitude than that of CO, even though the

![Diagram showing the correlation function of CO and N₂O.](image_url)
absolute correlation degree is practically one order of magnitude above that of CO. Converted to the same concentration as that of the measuring and interfering component, a contrast ratio of 50 is obtained. Therefore, the suppression degree for the interfering component is also 50.

The two vertical lines indicate two temperature values for the resonance and antiresonance position (measurement and reference phases). With respect to the interfering component, these temperature values represent the most unfavorable case: the N₂O contrast fully appears. Selectivity can, however, be optimized by using the “phase alignment”. By increasing the reference temperature by approximately 3 °C, the N₂O influence can be fully compensated, with the CO measurement effect being only slightly reduced. To make matters simple, a 10 mm-thick sapphire window is used as a wideband absorbing interfering component and is placed in the optical beam path in the vicinity of the etalon. The absolute transmission is approximately 0.4 in the wavenumber range around 2150 cm⁻¹.

The measurement yields the correlation degree 0.38 whereas no correlation contrast can be noticed within the measuring accuracy, and therefore no graphic representation is given. The second example is the measuring component NO with the interfering component water vapor, whose absorption spectrum completely overlaps the NO spectrum. The measured correlation functions of NO and water vapor are illustrated in Fig. 11. The conditions obtained here are less favorable than those in the first example; the correlation contrast of both functions is of approximately the same magnitude and the oscillation frequencies are identical. Again, one must determine the most favorable combination of measurement and reference temperatures at which the water vapor influence virtually disappears. The broken lines in the diagram indicate a suitable solution where the maximum NO contrast is reduced by only about 20 %.

The measurement results obtained from the two measuring systems chosen demonstrate the high selectivity of the correlation photometer. In all cases, it is possible to effectively suppress both the wideband and the structured absorbing interfering components. By using the optimal temperature values for the measurement and reference phases, it is possible to measure the correlation degree as a function of time: for this purpose, the etalon temperature is regulated such that it permanently oscillates between both values. The radiation flux measured in each case is sampled and the time-dependent function \( c(t) = 1 - I_m / I_r \) is calculated, showing the gas concentration in the linear approximation (\( I_m \) detector signal in the measurement phase, \( I_r \) detector signal in the reference phase).

Figure 12 illustrates the time-dependent concentration measurement, using the measuring component CO as an example. The inert gas nitrogen
(N₂) is used for zero-point adjustment. The selectivity of the system has been tested using the sapphire window described earlier (wideband absorption) as well as the interfering gas N₂O (structured absorption). The measurement curve clearly indicates that both interfering components can be suppressed. The two major signal deflections in the center of the diagram are caused by the inward and outward movements of the sapphire. The radiation flux is briefly interrupted here and the input signal adapts to the new values according to the lock-in time constant. A detection limit of approximately 2 ppm CO can be derived from the diagram. If necessary, this value can be further enhanced by increasing the correlation contrast (e.g. a longer sample cell).

6 Comparison with NDIR correlation method

The relevant features of the Fabry-Perot correlation method are compared with those of the NDIR correlation method (with two-layer detector). The latter method is a long established procedure [26, 28] representing an industrial standard. The selectivity of the methods can be conveniently compared by using their reference function. The reference function of the Fabry-Perot correlation method is expressed as

\[ R(\nu) = P_R(\nu) - P_M(\nu), \]

where \( P_R \) and \( P_M \) denote the Airy function in the reference phase or measurement phase (see section 2). The function therefore represents the reference spectrum which has been modulated with respect to the wavenumber, and interferometrically saved in the measuring instrument since it is used for simulating the absorption spectrum of the measuring component. Important qualitative conclusions can be drawn by considering the spectra in the Fourier domain [27].

Figure 13 shows the Fourier transform (FT) amplitude of the CO absorption spectrum and the associated reference function versus path difference. The path difference is the Fourier-associated variable with respect to the wavenumber. In the CO spectrum, one notices two maximum values at approximately 0.26 cm path difference; the reciprocal value of this path difference gives the distance between the CO rotation lines. Accordingly, the path difference can also be interpreted as a fine frequency (not wavenumber). Apart from the basic frequency, one can also observe the frequency multiples as 'harmonics', which are well pronounced due to the sharp Lorentz lines. The resonance frequency of the Fabry-Perot interferometer coincides with the CO basic frequency. Apart from the Fabry-Perot resonance frequency, uneven frequency multiples can be observed (with a very slight amplitude).

In principle, this measuring process is sensitive only for the path difference for which the Fourier transform amplitude is a value other than zero. Therefore, a gas component can only be measured when the Fourier transforms of the gas spectrum and the reference function overlap. However, maximum sensitivity occurs only when both spectra are 'in phase'. With regard to the suppression of an interfering component, no Fourier transform should overlap. If they do overlap, the interfering component can generally be suppressed.
by phase alignment. The following statement is valid for the illustrated Fabry-Perot reference function: since the FT amplitude is zero for a path difference of zero, wideband absorbing interfering components are ideally suppressed, as confirmed by the measurements in section 5. Favorable preconditions are also given for the suppression of structured absorbing interfering components. Due to the very small portion of frequency multiples, there is only a slight probability of overlapping.

The reference function of the two-layer NDIR method is expressed as

\[
R_{\text{NDIR}}(\nu) = 1 - 2\exp \left[ -a_1(\nu) \cdot c_R \cdot l_{R1} \right] \\
+ \exp \left[ -a_1(\nu) \cdot c_R \cdot (l_{R1} + l_{R2}) \right]
\]

(5)

where \( l_{R1} \) is the length of the front detector chamber, \( l_{R2} \) is that of the rear chamber, \( c_R \) is the filling gas concentration and \( a_1(\nu) \) is the absorption spectrum of the filling gas [14]. The FT amplitude of a typical CO reference function is shown in Fig. 14.

Unlike the Fabry-Perot method, pronounced harmonic contents are manifested by the NDIR method, resulting in a considerably greater probability of overlapping by an interfering component. As shown above, the amplitude is zero for a path difference of zero, but the first maximum appears for a small path difference (see Fig. 14). Overall, one can state that unstructured interfering components can be well compensated, but less selectivity must be expected in the case of structured absorbing components. Selectivity can be enhanced within certain limits by altering the chamber geometry; nevertheless, the NDIR method shows a fundamental drawback: unlike the Fabry-Perot method, the phase position of the reference spectrum cannot be arbitrarily modified; the phase position is fixed by the gas filling of the detector chamber.

The NDIR method performs better when sensitivity is concerned, being twice that of the Fabry-Perot method. This can be attributed to the exact coincidence between the line positions in the reference and measuring component spectra. This is not the case in the Fabry-Perot method, since the interference lines are equidistant but the gas lines are not usually arranged equidistantly. If one compares zero stability, the Fabry-Perot method has the advantage that the measurement and reference radiations traverse the same optical beam path so that, for example, contamination of the sample cell can be easily compensated. In the case of the NDIR method, one measurement cell and one reference cell are always needed and these may exhibit different contaminations.

7 Conclusions

Measurements performed with the laboratory prototype demonstrate that a high-performance Fabry-Perot correlation photometer can be designed. This is mainly attributed to the newly designed, tuneable silicon etalon. By virtue of its small dimensions, a compact photometer can be obtained and further advantages arise from the fact that the etalon features no movable parts and can be easily and economically manufactured using thin-film technology.

Due to the high zero stability, the method is particularly destined for in-situ measurements, whose calibration problems are well-known. The Fabry-Perot correlation photometer is characterized by very high selectivity due to the flexibility of the interference lines and therefore promises interesting application possibilities in industrial gas analysis where, due to inadequate zero stability or selectivity, other methods run the risk of producing incorrect measurement data.

References


[23] Firmenschriften von Schott Glaswerke, Mainz.


FLOW MEASUREMENT

KRISS high-pressure gas flow standard system

D. CHI, K. PARK, and J. S. PAIK
Korea Research Institute of Standards and Science (KRISS)

1 Introduction

Natural gas consumption in Korea has rapidly increased since the late 1980's due to the development of industry and an improved standard of living. Korea Gas Corporation (KGC) imports close to five million tons of liquefied natural gas annually. Research on the high-pressure gas flow measurement technology is of paramount importance for efficient and effective operation and better accuracy. Under these circumstances, KRISS began building a high-pressure gas flow primary standard system in the late 1980's under the sponsorship of KGC.

For the design of the standard system, four different types of facilities, i.e., a phase change loop type, a blow-down type, a flow-through type and recirculating flow loop type, were thoroughly investigated at several research institutes throughout the world. A blow-down type was chosen due to the possibility of designing a large capacity standard system with an optimal combination of a compressor and a storage tank at low initial installation and maintenance costs. The disadvantages of this type are the following: it takes longer to fill the storage tank when the capacity of the compressor is rather low; there are also some difficulties when controlling the discharge of high-pressure gas for generating high quality steady state conditions for a desired period of time.

2 Primary high-pressure gas flow standard system

The standard system at KRISS can generate steady state air flows within the pressure range of 0.1 to 5 MPa. A gravimetric method using a fast actuating diverting valve system and a gyroscopic weighing system was employed for the primary standard of mass flow rate. The maximum steady state flow rate, which should be maintained long enough to do a primary calibration, was 10,000 m$^3$/h at the standard state (101.325 kPa and 293.15 K). The schematic diagram of this standard system is shown in Fig. 1.

Two compressors with a free air delivery of 0.33 m$^3$/s and outlet pressure of 7.1 MPa are used to fill a 20 m$^3$ storage tank at up to 6.5 MPa. The storage tank is made of two pieces of pipes, both with a length of 30 m and a diameter of 0.66 m. Compressed air passes through a purification filtering system to provide rather clean air with an oil content not greater than 5 ppm and a dewpoint temperature lower than -40 °C. All dust and particles with sizes greater than 5 μm are removed using a particle filter.

In order to obtain stable temperature and pressure conditions during a test run, air pressure from the storage tank is regulated at about 5 MPa and then stored again in the temperature control loop until the air temperature stabilizes. The entire length of the loop is about 45 m and its volume is 7 m$^3$. For calibration of the flowmeter, air from the temperature control loop is regulated again to a working pressure and discharged into the test line.

![Schematic diagram of the high-pressure gas flow standard system.](image)

Fig. 1 Schematic diagram of the high-pressure gas flow standard system.
Air passed through a sonic nozzle may be directed either to the open air via a silencer or to the weighing tank placed on a gyroscopic weighing system. A nozzle installation package is designed according to an ISO standard [2]. Two ball valves of the diverting system are installed as shown in Fig. 2 and operated by a pinion and rack with a hydraulic system.

The weighing tank can be disconnected from the pipeline by a specially-designed coupling before and after the collection of air. The weighing tank has a volume of 2 m³, has a cylindrical shape and withstands pressure up to 5 MPa and temperature ranges from -10 °C to 40 °C. The weighing tank is balanced on a gyroscopic weighing system which was custom-built for KRISS by Wohwa Waagenbau of Germany.

For accurate measurement of the mass of air passed through the sonic nozzle, compensation has to be made for unweighed air contained in the pipeline between the nozzle and the block valve at the weighing tank inlet. The volume of the unweighed air, which amounts to 0.8 % of the volume of the weighing tank, has been determined by volume measurement with an accuracy of ± 1 %. The pressure and temperature of air contained in the pipeline are measured and recorded at the beginning and end of each diversion to determine the mass of unweighed air.

The testline, which consists of a pipe of 9 m x 0.1 m, is used to pass air from the sonic nozzle to a test meter. By installation of a nozzle bank at the end of the test line, the flow rate can be changed with any combination of five nozzles from 10 to 1240 m³/h. The test meter can either be calibrated against the sonic nozzle upstream of the test meter or against the nozzle bank downstream of the test meter.

The hardware and software of the data acquisition system exclusively developed for the high-pressure flow standard system provide a comprehensive and rapid means for collecting flow-related data over the entire range of operating conditions. The hardware consists of measuring instruments interfaced to a computer as shown in Fig. 3.

Pressures upstream of the sonic nozzle and the testline are measured using two Ruska fused quartz pressure gauges (RUSKA 6000). Output of the fused quartz gauge is sent to the data acquisition system (HP 3852) interfaced to a microcomputer (HP 310). Pressure at the pipeline between the diverter and the block valve is measured using a Heise precision pressure gauge (CMM 45388). The pressure monitoring console consists of six Bourdon gauges for monitoring pressure at the compressor outlets of the storage tank, the temperature control loop, and the testline. Atmospheric pressure is measured using a digital barometer (CEC 2500). Two high precision PT-100 sensors are used to measure temperatures upstream of the sonic nozzle and in the pipeline connected to the weighing tank. Another three PT-100 sensors are installed at the storage tank, the temperature control loop and the testline. Those PT-100 sensors are interfaced with the data acquisition system.

The collection time of air into the weighing tank is measured with a counter (HP 5316B) triggered by a photo-interrupter in the diverting system. All instruments (including the gyroscopic weighing system indicator) are interfaced with the computer. The software for data acquisition and processing was developed to interface instruments and to perform necessary computations by utilizing experimental data. For the determination of the pressure and temperature upstream of the sonic nozzle, pressures and temperatures are measured ten times while air is collected in the weighing tank, and the average value of ten measured data is used for computing the discharge coefficient.

3 Evaluation test of the standard system

In the gravimetric flow standard system, the standard mass flow rate is determined by weighing the mass of air collected over a well-defined period of time. The
errors associated with mass and time measurements influence the final accuracy of the standard mass flow rate, and furthermore, the pressure and temperature stability of the air flow may be considered as an additional factor. Prior to the primary calibration of critical sonic nozzles against the gravimetric standard system, the gyroscopic weighing system should be calibrated to determine the mass measurement error using deadweights traceable to the national standard. Subsequently, the pressure and temperature variations of the flow were observed as a function of time at different flow rates. The error arising from the collection time measurement was investigated by testing the flow diverting system.

3.1 Mass measurement error

After installation of the gyroscopic weighing system, the sensitivity of the weighing system was found to be 2 g over the entire weighing range from 0 to 80 kg with a tare weight of 2.2 tons. However, it was found that air movement in the laboratory can result in a small movement of the weighing tank, therefore making the indication of the weighing system unstable. By reducing the sensitivity to 5 g, stability of this indication was improved. Calibration of the gyroscopic weighing system was performed using deadweights traceable to the national standard. Deadweight was increased from zero to 80 kg with 10 kg intervals and then decreased by 10 kg to zero. The same procedure was repeated three times and the data scattering did not exceed ± 5 g. The results of the calibration are shown in Fig. 4.

3.2 Pressure and temperature stability

The variations of pressure and temperature upstream of the sonic nozzle were monitored over the pressure range from 1 to 5 MPa as a function of time. Since the air collection time required for each calibration is different, behavior of the pressure and temperature fluctuations from approaching gas to the nozzle during calibration has to be investigated in order to assess the magnitude of errors arising from the data processing method.

For determining the pressure and temperature upstream of the sonic nozzle, these are measured ten times while air is collected in the weighing tank, and the average value of ten measured data is used for computing the discharge coefficient. The test results at the flow rate of 4 000 m³/h at a standard condition are shown in Fig. 5. The pressure fluctuation was found to be less than ± 1 kPa at 5 MPa and the temperature fluctuation was less than ± 0.02 K at 290 K during an observation period of one minute.

3.3 Time measurement error

The collection time of the compressed air into the weighing tank is measured by a counter triggered by a movement of the pinion and rack system which opens and closes ball valves. Pressure of the hydraulic system of the diverting system was adjusted in order to open and close valves within 50 ms and the counter triggering position was adjusted as suggested in ISO 4185 [3] for further reduction of the collection time measurement error (see Fig. 6). When the air collection time is longer than 60 s, the time measurement error associated with flow diversion may be considered to be less than ± 0.08%. The counter itself appears to have a negligible error since its resolution is smaller than 0.01 ms. This is estimated by taking into account the
In equation (1), the changes in volume of the weighing tank and the pipeline due to the pressure and temperature variations were neglected. The uncertainty of the system can be calculated by the following equation:

\[
\frac{\delta q_m}{q_m} = \pm \left[ \left( \frac{\delta m}{m} \right)^2 + \left( \frac{\delta m'}{m'} \right)^2 \right]^{1/2}
\]

(2)

where:

\[
\delta m = \frac{\delta m' + \delta [V_d(\rho_{\text{atm},2} - \rho_{\text{atm},1})] + \delta [V_L(\rho_2 - \rho_1)]}{m' + V_d(\rho_{\text{atm},2} - \rho_{\text{atm},1}) + V_L(\rho_2 - \rho_1)}
\]

As discussed earlier in the section 3 Evaluation test of the standard system, the weighing error of the gyroscopic weighing system (\(\delta m'\)) does not exceed 5 g. Temperature of the outer wall of the weighing tank is increased while the tank is filled with air. Therefore, it may be considered that there is a very thin thermal boundary layer outside the tank. If the control volume includes the thin thermal boundary layer, the buoyancy force, \(V_d(\rho_{\text{atm},2} - \rho_{\text{atm},1})\), can be expected to increase as much as the volume of the thermal boundary layer. An experimental increase of the buoyancy force was found to be negligible because the weight only decreased by 5 g during an approximate wait of 30 minutes for thermal equilibrium.

Furthermore, this force works in the opposite direction of buoyancy effect. In fact, the zero point of the gyroscopic weighing system always remains constant during the calibration. Since the pipeline volume between the nozzle throat and the stop valve at the inlet of the weighing tank is only about 0.8% of the weighing tank volume, 1% of measurement error for the pipeline volume at 4 MPa results in a compensation error of ±0.16 g. Therefore, the mass determination error of the air passed through the sonic nozzle is governed by the sensitivity setting value of the gyroscopic weighing system.

At the selected counter triggering point (x = 4.5), the discharge coefficient variation of the "8.501 mm nozzle" was observed as a function of collection time. For this experiment the pressure of the flow was adjusted to about 4 MPa and the temperature was fixed at about 20 °C. The Reynolds number at the nozzle throat was estimated as 5.2 × 10^6. The counter used for the measurement of collection time has an uncertainty of less than ±0.001% when the duration of the collection time is maintained longer than 10 s. In Fig. 7, scattering
of the data is less than ± 0.02 % when the collection time is longer than 30 s. However, it increases to ± 0.05 % when the collection time is 10 s.

Considering the capacity of the nozzle used for the experiment, it is impossible to collect more than 6 kg of air for 10 s and this results in a significant weighing uncertainty which appears to have caused large scattering. The weighing uncertainty is less than ± 0.03 % when the collection time exceeds 30 s with this nozzle. In fact, by extending collection time to 120 s, about 67 kg of air was collected and the scattering of the discharge coefficient data decreased to less than ± 0.01 %. The systematic deviation due to collection time tends to increase as the collection time becomes shorter; it is about 0.05 % when the collection time is 30 s, but less than 0.02 % when collection time is more than 60 s.

When a critical sonic nozzle is calibrated against the system, the equation for discharge coefficient is given as follows:

$$\frac{C_d}{\sqrt{\frac{A^*}{C^*}}} = \frac{(m/t)}{A^*C^*P_0/\sqrt{RT_d/M}} \quad (3)$$

where:
- \(m\) : mass of the air passed through the nozzle throat;
- \(A^*\) : cross sectional area of the nozzle throat;
- \(C^*\) : critical flow function;
- \(P_0\) and \(T_0\) : stagnation pressure and temperature upstream of the nozzle;
- \(R\) : universal gas constant; and
- \(M\) : molecular weight of air.

The overall uncertainty associated with the determination of the discharge coefficient of a critical sonic nozzle is given as follows:

$$\frac{\delta C_d}{C_d} = \pm \left[ \left( \frac{\delta m}{m/t} \right)^2 + \left( \frac{\delta A^*}{A^*} \right)^2 + \left( \frac{\delta C^*}{C^*} \right)^2 \right]^{1/2} + \frac{1}{4} \left( \frac{\delta P_0}{P_0} \right)^2 + \frac{1}{4} \left( \frac{\delta T_0}{T_0} \right)^2 + \frac{1}{4} \left( \frac{\delta M}{M} \right)^2 \right]^{1/2} \quad (4)$$

In equation (3), when air is used as a test fluid, the critical flow function \(C^*\) is determined from published data [1] and considered as not having an uncertainty. The molecular weight error of the air depends on the composition change but its change is negligible. The measurement error of the nozzle throat is about 1 mm. Since the smallest nozzle used during this study is 4.225 mm, \(\delta A^*/A^*\) is less than 0.047 %. Uncertainty factors and their estimated magnitudes are summarized in Table 1.

Overall random and systematic errors associated with primary calibration of sonic nozzles may be estimated from Table 1. In the calibration data, only the random error appears to be repeatable. It should be less than ± 0.02 % when more than 25 kg of air is collected for weighing. Systematic error varies depending on the nozzle size and the working pressure. The effect of pressure drift becomes significant when upstream pressure of the nozzle is low. Calibration data of the nozzle having a throat diameter of 8.501 mm are shown in Fig. 8 as a function of the Reynolds number. When about 32 kg of air is collected for 60 s at a stagnation pressure of 4 MPa, scattering of data is less than ± 0.02 %. It increases as the Reynolds number decreases by lowering the pressure. At 1 MPa, the mass

<table>
<thead>
<tr>
<th>Source</th>
<th>Magnitude</th>
<th>Comment</th>
<th>Magnitude</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass</td>
<td>± 0.008 %</td>
<td>± 0.02 %</td>
<td>&gt; 25 kg</td>
<td>± 0.1 %</td>
</tr>
<tr>
<td>Time</td>
<td>± 0.05 %</td>
<td>t = 30 s</td>
<td>&lt; ± 0.001 %</td>
<td>t &gt; 10 s</td>
</tr>
<tr>
<td></td>
<td>&lt; ± 0.02 %</td>
<td>t &gt; 20 s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure</td>
<td>± 0.1 %</td>
<td>at 1 MPa</td>
<td>± 0.025 %</td>
<td></td>
</tr>
<tr>
<td></td>
<td>± 0.025 %</td>
<td>at 4 MPa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>± 0.035 %</td>
<td>at 20 °C</td>
<td>± 0.007 %</td>
<td></td>
</tr>
<tr>
<td>A*</td>
<td>± 0.047 %</td>
<td>Ø = 4.2 mm</td>
<td>± 0.02 %</td>
<td>Ø &gt; 8.5 mm</td>
</tr>
</tbody>
</table>

Fig. 7 Discharge coefficient of sonic nozzle with variation of collection time at x = 4.5 mm.
of air collected in the weighing tank during a period of 60 s is about 8 kg and the weighing uncertainty is expected to be as high as ± 0.063 %.

Calibration results of six nozzles obtained at 4 MPa or at the highest possible pressure in the case of nozzles with large throat diameters are summarized in Fig. 9. Since the effect of systematic error sources does not appear until they are compared with data obtained by different systems of different laboratories, discharge coefficient values calculated according to ISO 9300 [2] are used as a reference. The 24.010 mm nozzle shows a relatively large deviation because this nozzle cannot have a long enough collection time to minimize the diversion error.

In fact, about 50 kg of air was collected in the weighing tank for 12 s at 3 MPa. Due to a relatively short collection time, at least 0.05 % of the systematic diversion error was expected. Meanwhile, the 4.285 mm nozzle needs a collection time of more than 360 s in order to collect about 50 kg of air. Larger scattering of calibration data than expected might have been caused by an excessively long diversion time. Systematic effect caused by the measurement error of the nozzle throat diameter is also significant for a nozzle of this size.

5 Conclusions

- A high-pressure gas flow standard system of 10 000 m³/h was developed for the primary standard calibration and its overall uncertainty was estimated as ± 0.05 %.
- The magnitude of random error is governed by the sensitivity setting of the weighing scale. With the sensitivity of 5 g, more than 25 kg of air has to be weighed to be within ± 0.02 % uncertainty limit.
- Uncertainty in air collection time measurement as well as pressure and temperature stability of the system have a systematic effect on the primary calibration results.
- Discharge coefficients of sonic nozzles satisfactorily agreed with the values suggested in the relevant ISO documents [2, 3].

References

VERIFICATION ON SITE

Mobile mass comparator for verification and calibration of weights

T. MYKLEBUST
National Measurement Service, Norway

1 Introduction

This article describes a newly developed mobile 500 kg weighing system that will be used on site for calibrating and verifying M1 and M2 weights. The repeatability obtained with this system is better than 2.5 g. Our national measurement service verifies more than 900 class M1 500 kg weights per year, these being distributed all over the country. Up to now, many of the nine verification offices in Norway have used a mobile mechanical 500 kg balance to verify their 500 kg weights. The drawbacks with this balance are that it takes a long time to mount on site, it is cumbersome in use and it is difficult to transport due to the size of its transportation case which is approximately 2 m³.

2 Requirements

The general requirements for a new mobile weighing system are as follows:

Metrological requirements

- It must be possible to use the system to verify M1 weights and to calibrate M2 weights.
- The system should be capable of verifying 500 kg M1 weights, which means that the standard deviation of 10 measurements must be less than or equal to 1/10 of the M1 tolerance (7.5 g) [2].
- When calibrating M1 weights the expanded uncertainty, U (calculated for a coverage factor k = 2), must be at least less than 1/3 of the M1 tolerance (8.3 g) [5].

Practical requirements

- The system should be easily and quickly mountable on site, and capable of verifying weights of different designs. The different weights used by our service are shown in Fig. 1.
- For verifying M2 weights, we aimed at using an industrial crane. This is an important requirement for avoiding the purchase and transport of a special crane for this purpose.

- It should be possible to transport the system in a common automobile, with the possibility of transporting the mechanical and loadcell systems in two or more parts.

3 Description of the mobile weighing instrument

3.1 Loadcell

The loadcell must have low creep and good repeatability. As a result of this requirement it was necessary to purchase a specially tested loadcell. The manufacturer sent us the best loadcell in a production series: an HBM Z3H3 with a sensitivity of 2 mV/V. We chose a tension cell because our repeatability requirement was not too strict and because it is easier to construct the necessary mechanics when such a loadcell is used. The tension cell is constructed as a strain gauge with a Z design. When loaded, this cell is stretched to about 0.22 mm vertically and about

Fig. 1 Illustration of the diversity of weights used in Norway.
0.001 mm horizontally. The connection box is mounted on the side of the loadcell. This may cause side forces and may be compensated for by loading the loadcell on the opposite side.

3.2 Mechanical system

Different mechanical components were used to ensure that the resulting force is correctly applied by the system. At the main connecting points, we used cones and conical pans which were manufactured to enable easy replacement after some years of use. At places of secondary importance, we used knuckles for connecting the different parts. Figure 2 illustrates the mechanical parts of the measuring system.

Since we aimed at using this system with a common industrial crane, a system is included in order to damp possible vibrations and oscillations. The system has a natural frequency between 10-20 Hz which is satisfactory. Between the cone/pan system and the triangle (see Fig. 2), a component ensures free rotation in a horizontal plane.

3.3 Personal computer and electronic parts

An EMC compatible box without display was chosen due to the fact that the system would be used in industry and connected to a personal computer. The resolution of the system is 10^-5.

3.4 Software

The software was developed using Lab-windows with the language C as the basic system. This software is suitable for programming and displaying graphs (Fig. 3). The measurement signal must be displayed continuously on the computer screen during the measurement procedure in order to check the following information:

- whether the instrument starts to measure too early (before it has reached stability)
- whether there are any vibrations that might influence the measurements
- stability of the indication. This has been found to be useful in checking the stability of the crane itself (stiffness of mechanical devices)
- whether all the signals have been transferred correctly.

The software is used to reduce the influence of creep since it performs the measurements at specified time intervals.

4 Tests of the weighing system

These tests are based primarily on OIML R 76.

Stability

The stability of the system is very good. At zero, the indication is within 1 g (during a period of 60 s) and at 500 kg, the indication is within 2 g. At 500 kg, the necessary time for reaching stability is about 40 s.
Repeatability

Repeatability is taken as the standard deviation of 10 consecutive measurements at 500 kg. The standard deviation is 2.5 g, when using an industrial crane with a capacity of 1 t.

Sensitivity and linearity

These tests were performed at 500 kg. Figure 4 shows the results of overloading by 10 weights of 1 g. For overloading by 0.1–1 kg, the error is within ± 1 g. Above 1 kg, the error increased to about 12 g (at ± 5 kg). Since all the weights should be within ± 75 g (equal to the M2 tolerance), the sensitivity error may be considered as negligible.

Eccentricity

The eccentricity is tested by placing a 5 kg weight on top of the 500 kg weight, successively in each corner of the surface. This test results in an error of less than 1 g (due to the linearity error).

5 Conclusions

From the abovementioned results, it appears that all the requirements are satisfied, and due to the system's efficiency, verifying 80 weights of 500 kg per day is now possible. Another benefit of this system is that the same PC and electronics may be used when constructing a 50 kg weighing system.

References

Part 1 Metrology

1 Introduction

Measurement provides numerical descriptions of a wide variety of products and activities. Consequently, it serves as the basis for an extensive range of decisions concerning the everyday lives of human beings in fields such as trade, science and technology, industry, agriculture, health, and safety.

Measurement made possible the birth of science and fostered the scientific progress that contributed to the development of civilization. In turn, the buildup of societies increased the demand for measurements: industrialization brought a wider range of technologies and a greater number and complexity of business transactions; mass production and automation introduced the need for interchangeability of parts; and urbanization led to larger scales of human interaction.

Metrology is both the science and activity related to measurements. It includes:

- measurement theory
- units of measurement and their physical realization
- characteristics of measuring instruments
- measurement procedures and methods
- persons and organizations involved in implementing measurements

2 Measurement credibility

Anyone directly or indirectly concerned with measurements expects credible measurement results, i.e., results that do not deviate from the value of that which is measured by more than an accepted amount. Measurement credibility depends on a number of interconnected aspects associated with the measurement process, e.g., calibration and traceability, conformity assessment, staff competence, and laboratory proficiency.

3 Metrological infrastructure

A metrological infrastructure is essential for achieving measurement credibility and it consists of elements such as information, education, expertise, material resources, and calibration facilities. These tools make it possible to solve a measurement problem by knowing what to measure, how to measure it, and how to assess and report the measurement result. Such infrastructures exist in most countries and are also present in specific fields such as mechanical engineering, environmental monitoring, and medical diagnosis and treatment.

Whatever the number, size, or specialization of metrological infrastructures, they must work in a uniform and harmonized manner. For example, aircraft components manufactured in different countries must have dimensional and mechanical characteristics that have been measured in a consistent manner; otherwise, the final assembly would be impossible. Such consistency is ensured through cooperation among the national metrology infrastructures at international and regional levels.
4 Governmental role in metrology

In any given country, governmental authorities are involved in activities aimed at encouraging economic development, ensuring the health and safety of the population, supporting education and research, monitoring national competitiveness, and initiating other actions related to public interest. In the field of metrology, governmental responsibility may be considered as the need to ensure the correct operation of a metrological infrastructure intended to provide certain safeguards for the population.

The governmental role in metrology mainly includes the following:

- Definition of compatible units of measurement
- Maintenance of national measurement standards for length, mass, time, etc., and assurance of their uniformity with similar measurement standards in other countries
- Organization of metrological links (traceability) between national measurement standards and measurement processes
- Establishment of legal metrology
- Establishment of accreditation systems for metrology laboratories
- Participation in the development of metrological research, training, and information

National metrology services are generally responsible for carrying out this role. However, metrology extends into areas such as research and development, industry, trade, medicine, occupational safety, and environmental control; it also covers accuracy levels which range from those of primary measurement standards to those of ordinary measuring instruments. Given this broad scope of application, different bodies may be responsible for handling specific metrological matters. In such cases, national metrology services act to coordinate various activities in order to achieve the necessary harmony in metrology.

5 Legal metrology

Certain applications of metrology focus on the need for confidence and equity in measurements which directly concern the public. Legal metrology addresses such needs mainly through regulations (or through contracts) which are implemented to ensure an appropriate level of credibility in measurement results. Measurement credibility is especially necessary whenever conflicting interests exist, or whenever incorrect measurements pose adverse risks for individuals or society. This explains the need for governmental interest in legal metrology activities.

Legal metrology originated from the need to ensure fair trade. One of its most important contributions to society is its role in increasing efficiency in commerce by maintaining confidence in measurements and reducing transaction costs. The need to protect society in health, safety, and environmental protection has also led to important legal metrology developments in these areas.

In all its applications, legal metrology covers measurement units, measuring instruments, and other matters such as prepacked products. With regard to measuring instruments, legal metrology specifies performance requirements, verification procedures, means for ensuring traceability to legally-defined measurement units, and mandatory guidelines for use.

Legal metrology regulations are implemented by or on behalf of a legal metrology department that is preferably part of a national metrology service, or at least closely connected to it. In some countries, however, the responsibilities of the legal metrology department are limited to trade, therefore resulting in the implementation of certain metrology regulations (e.g. for safety or environmental protection) by other bodies. There is nevertheless a need for a uniform application of the metrological provisions for measurement units, traceability, and metrological control and in some cases, a single body may be effective in coordinating the activities of other national legal metrology bodies.

6 International cooperation

Internationalization is an essential characteristic of measurement: international trade determines the world’s economy; scientific, technological, and medical research depends on international cooperation; and pollutant emissions are not contained in national borders. Since measurement constitutes a foundation for many activities within these parameters, international exchanges of knowledge and expertise are important steps toward progress in a diversity of sectors.
A number of international institutions deal with metrology in areas such as standardization, accreditation, certification, physics, chemistry, and health. In order to address metrological subjects of special concern to governments, international intergovernmental cooperation in metrology has been established through the Metre Convention and the International Organization of Legal Metrology (OIML). The Metre Convention is mainly responsible for defining an international system of measurement units (the S.I.) and maintaining international measurement standards for establishing links with corresponding national standards. The objective of OIML is to establish the cooperation necessary for addressing legal metrology matters of international interest. The elimination of technical barriers that result from non-harmonized national metrology regulations is a particular concern for OIML.

The bodies of the Metre Convention and OIML maintain close liaisons with other international and regional bodies concerned with metrology and it is through this cooperation that international metrology issues can be addressed and resolved.

Part 3  OIML strategy

1 Introduction

There are a variety of tools that may be used for ensuring measurement credibility. For a given measurement, the appropriate tool must be chosen, and this choice is based on a number of factors such as the necessary accuracy to be obtained within acceptable ranges of uncertainty, measurement cost, quality of the measuring instrument, efficiency of the measurement procedure, and expertise of those who perform the measurement.

Legal metrology is one of these tools. It is applied in fields where conflicting interests may exist with regard to measurement results, or where incorrect measurement results may adversely affect individuals or the society. Legal metrology is the entirety of the legislative, administrative and technical procedures established by, or by reference to, public authorities and implemented on their behalf in order to specify and to ensure, in a regulatory or contractual manner, the appropriate quality and credibility of measurements related to official controls, trade, health, safety, and the environment.

2 International harmonization

The harmonization of legal metrology concepts, requirements, and procedures is an ongoing process. Legal metrology may differ from country to country by the following:

- Extent of its application

In some countries, metrology regulations cover only a part of the applications in trade, health,
safety, and environmental monitoring whereas in others, a wider range of applications are covered by regulations, e.g. standard measuring instruments and measuring instruments used in industrial processes.

- **Nature of the national bodies responsible for legal metrology implementation**

There are countries in which a national legal metrology service is only responsible for limited applications of legal metrology (for example, instruments used for retail trade). In such cases, other national bodies are charged with the implementation of regulations concerning measuring instruments used in the fields of health, safety, and the environment.

- **Nature of the requirements**

Legal metrology requirements may exist either as regulations or as standards developed by different national bodies having different international liaisons.

- **Metrological content of the requirements**

OIML Recommendations are implemented to various degrees.

- **Application of the requirements**

Identical requirements may be interpreted and implemented differently.

- **Degree of economic and technical development of countries, and extent of resources available for legal metrology**

The objectives outlined by the GATT and other related regional agreements for the removal of trade barriers, particularly those of a technical nature, make it necessary to accelerate the harmonization of legal metrology requirements and their implementation. Simultaneously, there is a trend towards privatization and deregulation of legal metrology at the national level; this could result in an increase in the number of bodies charged with legal metrology implementation, or it could also replace regulations by other categories of provisions, thereby risking new types of trade barriers. This new approach to the implementation of legal metrology requires international harmonization.

These are the challenges OIML is facing. A clear definition of objectives and strategic action is therefore necessary for successfully meeting these challenges.

### 3 Objectives

In order to achieve the international harmonization of legal metrology, OIML has the following objectives:

- To contribute to the global recognition of metrology as an essential infrastructure for scientific, industrial, and economic development.
- To maintain leadership in the international development and harmonization of legal metrology activities.
- To promote legal metrology as an important tool for specifying and ensuring appropriate levels of credibility for measurement results in all fields of public interest including trade, health, safety, and the environment.
- To eliminate technical trade barriers that result from non-harmonized national metrology regulations or from non-harmonized procedures for implementing harmonized regulations.
- To promote the manufacture and use of measuring instruments complying with OIML Recommendations.
- To promote national, regional, and international cooperation among legal metrology services and other bodies responsible for various aspects of metrology, e.g. testing and certification of measuring instruments, accreditation of calibration and testing laboratories, and manufacturer's quality systems registration.
- To promote mutual confidence and recognition of measurement and test results performed in accordance with OIML Recommendations.
- To advise OIML Members, and especially those undergoing development, on all matters related to carrying out legal metrology activities.

### 4 Strategy

A strategy has been developed with a view to fulfilling these objectives; it includes general actions to be taken with regard to policy decisions, and a technical strategy focusing on the development and implementation of OIML International Recommendations and Documents.

#### 4.1 General

- Keep governmental authorities informed of OIML objectives and policies in order to obtain their support for active participation of relevant national bodies in OIML activities.
- Encourage the participation of manufacturers and users of measuring instruments, as well as other interested parties, in OIML activities.
- Establish liaisons and cooperation with relevant international and regional institutions with a view to defining and implementing procedures for eliminating duplication of work and ensuring necessary compatibility between activities.
- Encourage regional cooperation and coordination in legal metrology among relevant regional bodies.
- Establish and promote implementation of general rules ensuring the integrity in measurements performed for legal metrology purposes, in particular when using third party accreditation and certification.
- Promote the adoption of OIML technical publications as national regulations or voluntary specifications, where appropriate.
- Develop means, e.g. intercomparisons and training, for promoting mutual confidence in test results among OIML Members.
- Promote the OIML Certificate System and encourage the recognition of certificates and their use in order to facilitate and accelerate the granting of national or regional pattern approvals; develop the System for possible application to individual instruments; and take actions in case of misuse of the System.
- Develop OIML communications through publications such as the OIML Bulletin and other informative brochures.
- Conduct technical seminars with a view to defining a basis for OIML work programs, disseminating information, and promoting cooperation within the metrological community.
- Advise CIML Members, upon their request, about the establishment of appropriate legal metrology infrastructures.
- Address specific needs of developing countries by implementing programs of the OIML Development Council, developing guidance in fields in which OIML is competent, and encouraging and promoting financial or technical assistance for metrological development.
- Take into consideration reports concerning the economic impacts of legal metrology.
- Encourage the establishment and use of proficiency testing and accreditation as applied to manufacturers of measuring instruments and to laboratories for testing and verifying measuring instruments.

4.2 Technical
- Periodically review, for confirmation or revision, the work program of OIML technical committees and subcommittees and establish priorities as appropriate.
- Accelerate the development of new Recommendations or the revision of existing Recommendations which cover measuring instruments used for applications of an urgent nature, as identified by national legal metrology services, the public, manufacturers and users of instruments, or other international and regional bodies. This can be carried out directly or by reference to existing international standards and applies to measuring instruments in the following fields:

Trade
Automatic weighing instruments, measuring systems for liquids, gas meters, water meters, electronic taximeters

Safety
Breath testers, occupational-safety measuring instruments, dosimetry instruments

Environment
Instruments for measuring pollutants in air, water, and soil

Health
A variety of clinical and medical measuring instruments

- Review publications that are more than five years old and decide whether to reaffirm, revise or withdraw them.
- Ensure that every new and revised Recommendation contains provisions for testing and reporting test results.
- Rapidly extend the application of the OIML Certificate System to instruments such as automatic weighing instruments, vehicle exhaust emissions measuring instruments, liquid meters, gas meters, taximeters, instruments for measuring pollutants, and medical instruments.
- Develop general guidelines for harmonizing national activities related to pattern evaluation, verification, and supervision, including new procedures such as quality assurance and principles of instrument verification by sampling.
• Develop guidelines for assisting Members of the International Committee of Legal Metrology (CIML) in encouraging national participation in the technical work of OIML, e.g. participation of bodies related to accreditation and certification.

5 Assessment

Strategy is a dynamic concept and the resulting actions must be reviewed and revised as appropriate. In order to monitor the success of the OIML strategy, CIML will assess the progress of certain activities in accordance with a set time period (see table). In addition, BIML will conduct inquiries from time to time among OIML Members and relevant international and regional bodies with a view to obtaining input concerning OIML activities. On the basis of such inquiries, CIML will consider possible reorientations of the OIML strategy.

The complete text of the OIML long-term policy (Parts 1, 2 and 3) may be obtained from BIML.

Assessment of OIML strategy and activities

<table>
<thead>
<tr>
<th>Item to be evaluated</th>
<th>Time period</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Number of OIML Members</td>
<td>Every four years</td>
</tr>
<tr>
<td>• Number of new and revised OIML Recommendations, Documents, and other publications issued</td>
<td>Every year</td>
</tr>
<tr>
<td>• Number and effectiveness of participation of OIML Members in technical committees and subcommittees</td>
<td>Every year</td>
</tr>
<tr>
<td>• Number and effectiveness of liaisons with other international and regional bodies</td>
<td>Every year</td>
</tr>
<tr>
<td>• Degree of implementation of OIML Recommendations by OIML Members</td>
<td>Every four years</td>
</tr>
<tr>
<td>• Number of categories of measuring instruments covered by the OIML Certificate System</td>
<td>Every two years</td>
</tr>
<tr>
<td>• Number of OIML certificates issued</td>
<td>Every year</td>
</tr>
<tr>
<td>• Degree of acceptance of OIML certificates by OIML Members</td>
<td>Every two years</td>
</tr>
<tr>
<td>• Number of subscribers to the OIML Bulletin and purchasers of OIML publications</td>
<td>Every year</td>
</tr>
<tr>
<td>• Number of technical seminars and participants</td>
<td>Every two years</td>
</tr>
<tr>
<td>• Number and type of activities in support of development</td>
<td>Every two years</td>
</tr>
</tbody>
</table>
Partie 1 Métrologie

1 Introduction
La mesure fournit une description quantitative d’un très large éventail de produits et d’activités. Elle constitue ainsi la base de décisions s’appliquant dans la vie quotidienne dans des domaines aussi vastes et nombreux que le commerce, les sciences et la technologie, l’industrie, l’agriculture, la santé ou la sécurité.

La mesure a permis aux sciences de naître et a favorisé le progrès scientifique, lequel a contribué au développement de la civilisation. En retour, l’édification des sociétés a accru les demandes en matière de mesures : l’industrialisation a apporté une gamme toujours plus large de technologies et une complexité et un nombre toujours plus grands de transactions commerciales ; la production de série et l’automatisation ont créé le besoin d’interchangeabilité des composants ; enfin l’urbanisation a élargi les interactions humaines.

La métrologie, à la fois science et activité de la mesure, comprend :
- la théorie de la mesure
- les unités de mesure et leur réalisation physique
- les caractéristiques des instruments de mesure
- les méthodes et procédures de mesure
- les personnes et organismes concernés par les applications de la mesure

2 Crédibilité des mesurages
Toute personne impliquée directement ou non dans des mesurages s’attend à des résultats de mesure crédibles, autrement dit que les résultats ne s’écartent pas de la valeur de ce que l’on mesure de plus qu’une certaine quantité acceptée. La crédibilité des mesurages dépend d’un certain nombre d’aspects liés entre eux et au processus de mesure ; étalonnage et traçabilité, assurance de conformité, compétence du personnel, compétence du laboratoire.

3 Infrastructure métrologique
Une infrastructure métrologique est essentielle pour obtenir la crédibilité des mesurages ; elle est faite d’éléments tels que information, éducation, savoir-faire, ressources matérielles, moyens d’étalonnage. Ces outils permettent de résoudre un problème de mesure en sachant quoi mesurer, comment le mesurer, et comment évaluer et formuler le résultat de mesure. De telles infrastructures existent dans la plupart des pays ainsi qu’au niveau de domaines spécifiques comme l’ingénierie, le contrôle de l’environnement, ou les diagnostiques et traitements médicaux.

Quels que soient le nombre, la taille, ou la spécialisation des infrastructures métrologiques, elles doivent opérer de façon uniforme et harmonisée. Par exemple, les différentes parties d’un avion, fabriquées en des pays différents, doivent avoir des caractéristiques dimensionnelles et mécaniques qui ont été mesurées de façon consis-tante ; sinon l’assemblage final en serait impossible. Cette consistance est assurée par une coopération, aux niveaux international et régional, entre les infrastructures métrologiques nationales.
4 Implication gouvernementale en matière de métrologie

Dans tout pays les autorités gouvernementales sont impliquées dans des activités qui visent à encourager le développement économique, à assurer la santé et la sécurité de la population, à encourager l'éducation et la recherche, à contrôler la compétitivité nationale, et à initier les actions d'intérêt public. Dans le domaine de la métrologie, la responsabilité gouvernementale peut être considérée comme consistant à satisfaire le besoin d'assurer un fonctionnement correct d'une infrastructure métrologique destinée à fournir certaines protections à la population.

L'implication gouvernementale en métrologie couvre principalement les sujets suivants:

- Définition d'unités de mesure compatibles entre elles
- Maintien des étalons nationaux de longueur, masse, temps, etc. et garantie de leur conformité aux étalons similaires des autres pays
- Constitution de liens métrologiques (traceabilité) entre étalons et processus de mesure
- Établissement de la métrologie légale
- Création de systèmes d'accréditation des laboratoires de métrologie
- Participation aux développements de la recherche, de l'enseignement et de l'information en matière de métrologie

En général, cette implication se traduit par l'existence de services nationaux de métrologie. Cependant, la métrologie s'étend sur un vaste domaine: recherche et développement, industrie, commerce, médecine, sécurité sur les lieux de travail, environnement; elle couvre également des niveaux d'exactitude très différents, depuis les étalons primaires jusqu'aux instruments de mesure ordinaires. En raison de ce large éventail d'applications, plusieurs organismes peuvent être responsables de domaines spécifiques de la métrologie. Le service national de métrologie agit alors pour coordonner ces diverses activités et obtenir la nécessaire harmonie.

5 Métrologie légale

Certaines applications de la métrologie mettent l'accent sur le besoin de confiance et d'équité dans les mesurages d'intérêt direct pour le public. La métrologie légale répond à ce besoin principalement par le biais de réglementations (ou de contrats) mises en application pour assurer un niveau de crédibilité approprié aux résultats de mesure. La crédibilité des mesurages est tout spécialement nécessaire lorsque des intérêts conflictuels existent, ou chaque fois que des mesurages incorrects créent des risques pour les individus ou la société. Cela explique le besoin d'un intérêt gouvernemental dans les activités de métrologie légale.

La métrologie légale est née du besoin d'assurer la loyauté des transactions commerciales et l'une de ses plus importantes contributions à la société est le rôle qu'elle a joué dans l'augmentation de l'efficacité du commerce, en maintenant la confiance dans les mesurages et en réduisant le coût des transactions. Le besoin de protéger la société en ce qui concerne la santé, la sécurité, et la protection de l'environnement a aussi conduit à d'importants développements de la métrologie légale dans ces domaines.

Dans toutes ses applications, la métrologie légale couvre les unités et instruments de mesure et d'autres sujets comme les produits préemballés. En ce qui concerne les instruments de mesure, la métrologie légale spécifie les exigences sur leurs performances, les procédures de vérification, les moyens pour assurer leur traçabilité aux unités de mesure légalement définies, et les instructions obligatoires quant à leur utilisation.

Les réglementations de métrologie légale sont mises en application par ou au nom d'un département de métrologie légale, faisant de préférence partie du service national de métrologie ou au moins étroitement lié à celui-ci. Dans certains pays cependant, les responsabilités du département de métrologie légale sont limitées au commerce, ce
qui fait que la mise en application de certaines réglementations métrologiques (par exemple pour la sécurité ou la protection de l'environnement) est à la charge d'autres organismes. Il y a néanmoins un besoin d'uniformité dans la mise en application des dispositions métrologiques relatives aux unités de mesure, à la traçabilité, et aux contrôles métrologiques et, dans certains cas, un organisme unique peut constituer une solution efficace pour coordonner les activités des autres organismes nationaux de métrologie légale.

6 Coopération internationale

L'internationalisation est une caractéristique essentielle de la mesure : le commerce international définit l'économie mondiale ; la recherche dans les domaines des sciences, de la technologie, et de la médecine repose sur la coopération internationale; quant aux émissions de polluants, elles ne sont pas contenues par les frontières nationales. Etant donné que la mesure constitue une base de nombreuses activités liées à ces domaines, les échanges internationaux de connaissance et de savoir-faire sont des étapes importantes vers le progrès dans de très nombreux secteurs.

Un certain nombre d'institutions internationales s'occupent de métrologie dans des domaines tels que ceux de la normalisation, l'accréditation, la certification, la physique, la chimie, la santé. Afin de traiter des sujets métrologiques d'intérêt spécial pour les gouvernements, une coopération internationale et intergouvernementale en métrologie a été établie à travers la Convention du Mètre et l'Organisation Internationale de Métrologie Légale (OIML).

La Convention du Mètre est principalement responsable de la définition d'un système international d'unités de mesure (le S.I.) et du maintien d'étalons de mesure internationaux auxquels sont liés les étalons nationaux correspondants. L'objectif de l'OIML est d'établir la coopération nécessaire à la solution des questions de métrologie légale d'intérêt international. L'élimination des barrières techniques résultant de réglementations métrologiques nationales non harmonisées est un sujet d'intérêt particulier pour l'OIML.

Les organes de la Convention du Mètre et l'OIML maintiennent des liens étroits avec les autres organismes internationaux et régionaux concernés par la métrologie : c'est à travers cette coopération que les questions de métrologie de caractére international peuvent être abordées et résolues.

Partie 3 Stratégie de l'OIML

Dans la société d'aujourd'hui existe une vaste et souvent invisible infrastructure de services et de réseaux d'approvisionnement, de transport et de communication. Leur existence est en général considérée comme donnée bien que leur présence et leur fonctionnement soient essentiels pour la vie de tous les jours. La métrologie, science de la mesure, constitue une partie de cette infrastructure cachée. La confiance dans les mesurages fait partie de notre vie de multiples façons...


1 Introduction

De nombreux outils peuvent être utilisés pour assurer la crédibilité des mesurages. Pour un mesurage donné, l'outil approprié doit être choisi sur la base d'un certain nombre de facteurs tels que l'exactitude que l'on veut atteindre avec une limite d'incertitude acceptable, le coût du mesurage, les qualités de l'instrument de mesure, l'efficacité de la procédure de mesure, et le savoir-faire de ceux qui accomplissent le mesurage.

La métrologie légale constitue l'un de ces outils. Elle s'applique dans les domaines où des intérêts conflictuels peuvent exister vis-à-vis de résultats de mesurage, ou lorsque des résultats de mesurage incorrects peuvent affecter des individus ou la société. La métrologie légale est constituée par la totalité des procédures législatives, administratives et techniques établies par les autorités publiques, ou par référence à elles, et appliquées en leur nom dans le but de spécifier et d'assurer, de manière réglementaire ou contractuelle, un degré approprié de qualité et de crédibilité dans les mesurages qui concernent les contrôles officiels, le commerce, la santé, la sécurité, et l'environnement.

2 Harmonisation internationale

L'harmonisation des concepts, exigences, et procédures de métrologie légale est un processus en cours. La métrologie légale peut différer de pays à pays par les éléments suivants:
• Étendue de son application
Dans certains pays, les réglementations métrologiques ne couvrent qu´une partie des applications au commerce, à la santé, à la sécurité, et au contrôle de l’environnement, alors que dans d’ autres, une plage plus grande d’applications est couverte par des réglementations qui peuvent, par exemple, s’appliquer aux instruments de mesure étalons et à ceux utilisés dans les processus industriels.

• Nature des organismes nationaux responsables pour la mise en application de la métrologie légale
Il y a des pays dans lesquels le service national de métrologie légale n’ est responsable que d’une partie limitée des applications de métrologie légale (par exemple les instruments utilisés pour le commerce de détail). Dans ce cas, d’autres organismes nationaux sont chargés de la mise en application des réglementations sur les instruments de mesure utilisés dans les domaines de la santé, de la sécurité et de l’environnement.

• Nature des exigences
Les exigences en métrologie légale peuvent exister sous la forme soit de réglementations, soit de normes, développées par des organismes nationaux différents qui ont des liaisons internationales différentes.

• Contenu métrologique des exigences
Les Recommandations OIML sont mises en application à des degrés variables.

• Application des exigences
Des exigences identiques peuvent être interprétées et mises en application de façon différente.

• Degré du développement économique et technique des pays, et étendue des ressources disponibles pour la métrologie légale.

Les objectifs fixés par le GATT et autres accords régionaux pour l’élimination des barrières au commerce, en particulier celles de nature technique, rendent nécessaire l’accélération de l’harmonisation des exigences de métrologie légale et de leur mise en application. Il y a simultanément, dans certains pays, des tendances vers la privatisation et la déréglementation du domaine de métrologie légale.

Cela pourrait résulter en un accroissement du nombre des organismes chargés de la mise en application de la métrologie légale, ou encore en un remplacement des réglementations par d’autres catégories de dispositions, avec le risque de création de nouveaux types de barrières au commerce. Cette nouvelle approche de la mise en application de la métrologie légale exige une harmonisation internationale.

Tels sont les défis qui se posent à l’OIML. Une définition claire des objectifs et de la stratégie à suivre est donc nécessaire pour y faire face avec succès.

3 Objectifs
Voici les objectifs de l’OIML, visant à réaliser l’harmonisation internationale de la métrologie légale:

• Contribuer à la reconnaissance globale de la métrologie en tant qu’infrastructure essentielle pour le développement scientifique, industriel et économique.
• Maintenir son leadership dans le développement international et l’harmonisation des activités de métrologie légale.
• Promouvoir la métrologie légale en tant qu’outil important pour spécifier et assurer des niveaux de crédibilité appropriés aux résultats de mesure dans tous les domaines d’intérêt public, y compris le commerce, la santé, la sécurité, et l’environnement.
• Éliminer les barrières techniques au commerce résultant de réglementations métrologiques nationales non harmonisées ou d’un manque d’harmonisation dans la mise en application des réglementations harmonisées.
• Promouvoir la fabrication et l’utilisation d’instruments de mesure conformes aux Recommandations OIML.
• Promouvoir au niveau national, régional et international, la co-
opération entre services de métrologie légale et autres organismes responsables des divers aspects de la métrologie, par exemple dans les domaines des essais et de la certification des instruments de mesure, de l'accreditation des laboratoires d'étalonnage et d'essai, et de la reconnaissance des systèmes de qualité des fabricants.

- Promouvoir la confiance et la reconnaissance mutuelle des résultats de mesure et d'essai effectués selon les Recommandations OIML.
- Conseiller les Membres de l'OIML, et spécialement ceux qui sont en développement, sur tous les sujets relatifs à l'accomplissement des activités de métrologie légale.

4 Stratégie

Une stratégie a été développée afin d'atteindre les objectifs ci-dessus; elle comprend des actions générales touchant à des décisions de caractère politique, et des actions techniques qui se concentrent sur le développement et la mise en application des Recommandations et Documents Internationaux de l'OIML.

4.1 Actions générales

- Maintenir les autorités gouvernementales informées des objectifs et de la politique de l'OIML afin qu'elles encouragent une participation active des organismes nationaux concernés aux activités de l'OIML.
- Encourager la participation des fabricants et utilisateurs d'instruments de mesure et autres parties intéressées aux activités de l'OIML.
- Établir des liaisons et une coopération avec les institutions internationales et régionales concernées afin de définir et d'appliquer des procédures permettant d'élminer les doubles emplois et d'assurer la compatibilité nécessaire entre les différentes activités.
- Encourager la coopération et la coordination en matière de métrologie légale entre les organes régionaux concernés.
- Établir des règles générales visant à assurer la qualité globale des mesures effectuées dans le cadre de la métrologie légale, en particulier dans le cas d'accréditation et de certification par tierce partie; promouvoir la mise en application de ces règles par les Membres de l'OIML.
- Promouvoir l'adoption des publications techniques de l'OIML comme réglementations nationales ou spécifications volontaires, selon le cas.
- Développer des moyens, par exemple les intercomparaisons et l'éducation, permettant de promouvoir la confiance mutuelle dans les résultats d'essai entre les Membres de l'OIML.
- Promouvoir le Système de Certificats OIML et encourager la reconnaissance des certificats et leur utilisation pour faciliter et accélérer la délivrance d'approbations de modèle nationales ou régionales; développer le Système en vue de son éventuelle application aux instruments individuels; réagir à toute utilisation inappropriée du Système.
- Développer la politique de communication de l'OIML par des publications telles que le Bulletin OIML et autres brochures informatives.
- Organiser des séminaires techniques pour définir les bases des programmes de travail de l'OIML, disséminer l'information, et promouvoir la communication au sein de la communauté métrologique.
- Conseiller, sur leur demande, les Membres de l'OIML sur l'établissement d'infrastructures de métrologie légale appropriées.
- Examinier les besoins spécifiques aux pays en développement en mettant en application les programmes définis par le Conseil de Développement de l'OIML, en préparant des guides dans les domaines de la compétence de l'OIML, et en encourageant et promouvant une assistance financière et technique en faveur du développement de la métrologie.
- Prendre en considération les rapports relatifs aux impacts économiques de la métrologie légale.
- Encourager l'établissement et l'utilisation des techniques de contrôle de compétence et d'accréditation appliquées aux constructeurs d'instruments de mesure et aux laboratoires d'essai et de vérification des instruments de mesure.

4.2 Actions techniques

- Réexaminer périodiquement, pour confirmation ou révision, le programme de travail des comités techniques et sous-comités
OIML et établir les priorités appropriées.

- Accélérer le développement de nouvelles Recommandations et la révision des Recommandations existantes couvrant les instruments de mesure utilisés dans les domaines présentant un caractère d’urgence pour les services nationaux de méto逻gie légale, le public, les fabricants et utilisateurs d’instruments, ou autres organismes internationaux et régionaux. Ce travail peut s’effectuer soit directement, soit par référence à des normes internationales existantes, et s’applique aux instruments de mesure utilisés dans les domaines suivants:

Commerce
Instruments de pesage à fonctionnement automatique, ensembles de mesure de liquides, compteurs de gaz, compteurs d’eau, taximètres électroniques

Sécurité
Ethylomètres, instruments de mesure pour la sécurité sur les lieux de travail, dosimètres

Environnement
Instruments de mesure des polluants de l’air, de l’eau et du sol

Santé
Divers instruments de mesure à usage médical et clinique

- Réexaminer les publications vieilles de plus de cinq ans et décider s’il convient de les confirmer, de les réviser ou de les annuler.

- Faire en sorte que chaque Recommandation nouvelle ou révisée contienne des dispositions pour les essais et les rapports d’essai.

- Étendre rapidement l’application du Système de Certificats OIML aux instruments tels que les instruments de pesage à fonctionnement automatique, les instruments de mesure des gaz d’échappement des véhicules, les compteurs de liquides, les compteurs de gaz, les taximètres, les instruments de mesure des polluants, les instruments médicaux.

- Développer des guides généraux pour harmoniser les activités nationales relatives à l’essai de modèle, à la vérification et à la surveillance, en y incluant les nouvelles procédures telles que l’assurance de qualité et les principes gouvernant la vérification statistique des instruments.

- Développer des guides aidant les Membres du Comité International de Métrologie Légale (CIML) à encourager la participation nationale dans les travaux techniques de l’OIML, par exemple celle des organismes travaillant dans les domaines de l’accréditation et de la certification.

5 Evaluation
Toute stratégie constitue un concept dynamique et les actions qui en résultent doivent être réexaminées et réorientées chaque fois que nécessaire. Afin de suivre le succès de la stratégie de l’OIML, le CIML évaluera le progrès de certaines activités à intervalles réguliers (voir tableau). De plus, le BIML effectuera de temps en temps des enquêtes auprès des Membres de l’OIML et des organismes internationaux et régionaux concernés afin d’obtenir leurs vues sur les activités de l’OIML. Sur la base de ces enquêtes, le CIML examinera les besoins de réorientation de la stratégie de l’OIML.

Le texte complet de la politique à long terme de l’OIML (parties 1, 2 et 3) est disponible auprès du BIML.
The inaugural meeting of the Asia Pacific Legal Metrology Forum was held in Sydney, Australia 27-30 Nov. 1994. The Legal Metrology Forum is the fifth technical infrastructure regional organisation to be established in the Asia Pacific region.

Other regional organisations cover physical standards of measurement (Asia Pacific Metrology Program – APMP), laboratory accreditation (Asia Pacific Laboratory Accreditation Cooperation – APLAC), standardisation (Pacific Asia Standards Congress – PASC), certification (Pacific Accreditation Cooperation – PAC).

Asia Pacific Economic Cooperation (APEC)

The Asia Pacific regional technical organisations have seen a marked increase in the importance of their role since the formation of APEC - the Asia Pacific Economic Cooperation in 1989. APEC membership now comprises eighteen economies viz Chile, Mexico, USA, Canada, Japan, Republic of Korea, China, Chinese Taipei, Hong Kong, Thailand, Malaysia, Singapore, Indonesia, Brunei, Philippines, Papua-New Guinea, Australia and New Zealand with a combined population of over 2 000 million and together they account for nearly half of the worlds total exports.

APEC's aims are to
• raise living standards in the Asia Pacific region through sustained economic development;
• encourage the interflow of goods, services, capital and technology;
• strengthen an open multilateral trading system; and
• bring about regional trade liberalisations.

Following a series of Ministerial meetings between 1989 and 1993 leaders meetings were held in Seattle in November 1993 hosted by President Clinton and at Bogor in November 1994 hosted by President Suharto. The Bogor meeting issued a declaration committing the APEC economies to the goal of free and open trade in the region by 2020 (and by 2010 for the developed economies).

The APEC Committee on Trade and Investment has established a Standards and Conformance Subcommittee which has established a framework for APEC standards and conformance, adopted general principles and key elements for mutual recognition arrangements and identified priority areas for technical infrastructure development. It was recognised that this subcommittee will need to develop a close working relationship with the technical regional organisations if the APEC agenda on standards and conformance was to be advanced in an efficient and effective way.

Inaugural meeting of the Asia Pacific Legal Metrology Forum

The Asia Pacific Legal Metrology Forum was held in Sydney less than two weeks after the APEC leaders meeting in Bogor. Legal metrology authorities in the eighteen APEC economies were invited to attend and thirty representatives from authorities in fourteen economies attended viz USA, Canada, Republic of Korea,
China, Japan, Chinese Taipei, Thailand, Malaysia, Singapore, Indonesia, Philippines, Papua-New Guinea, Australia and New Zealand.

M. Bernard Athané, Director of the BIML, also attended as did representatives from APMP and APLAC and observers from Cook Islands, Fiji, Western Samoa, Solomon Islands, Tonga and Vanuatu. The Forum was chaired by Professor Julian Goldsmid, Emeritus Professor of Experimental Physics, University of New South Wales and Chairman of the National Standards Commission.

The Forum was opened by Senator the Honourable Chris Schacht, Minister for Small Business, Customs and Construction which includes responsibility for Australia’s technical infrastructure. Senator Schacht stressed that legal metrology, with its responsibilities for measurement and technical regulations, would make an important contribution to the achievement of free and open trade in the region.

M. Bernard Athané addressed the Forum on OIML and the OIML Certificate Scheme. Of the eighteen APEC economies, seven are full members of OIML, seven are corresponding members and four have no relationship with OIML. The Forum affirmed its commitment to cooperate with OIML and promote the use and acceptance of OIML International Recommendations and the OIML Certification Scheme.

The meeting agreed to establish the Asia Pacific Legal Metrology Forum, consistent with the principles of the APEC Head of Economies declaration of free and open trade in the region and with certain objectives (see below).

The Forum elected Mr John Birch AM Executive Director of the National Standards Commission to be Convenor of the Forum and Australia to provide the secretariat until 1998.

It is proposed to hold further meetings of the Forum in Beijing on 24 Sept. 1995 and in Vancouver in Nov. 1996. Both of these meetings will be in association with OIML meetings. A meeting of the five Asia Pacific regional organisations will be held in Fukuoka, Japan 6–9 Feb. 1995 to discuss coordination of work programs and to meet with the APEC Standards and Conformance sub committee.

Contact information:
John Birch AM convenor
PO Box 282
North Ryde NSW 2113
Australia
Fax 61-2 888 3033

---

**ASIA PACIFIC LEGAL METROLOGY FORUM**

**Objectives**

- To develop and maintain mutual confidence between legal metrology authorities in the Asia Pacific region.
- To provide a forum for exchanges of information between legal metrology authorities.
- To identify and promote the removal of technical or administrative barriers to trade in the field of legal metrology.
- To promote mutual recognition arrangements between members and with other regional groups and individual nations.
- To cooperate with the International Organisation of Legal Metrology (OIML) and promote the use and acceptance of OIML International Recommendations and other publications as well as the OIML Certification Scheme.
- To collaborate with other regional bodies including APMP, APLAC, PASC and PAC.
- To coordinate regional training courses in legal metrology and facilitate exchanges of staff between authorities.
- To facilitate the provision of cooperation assistance for the development of legal metrology infrastructures.
- The Forum shall perform such tasks as necessary to achieve these objectives. These tasks may include:
  i. Organisation of interlaboratory test comparisons;
  ii. Establishment of working groups in specific fields of legal metrology;
  iii. Publication of a Directory of Legal Metrology in the Asia Pacific region and other appropriate publications.

**Work program for 1995**

- Form a Working Party to harmonise legislative requirements including compliance assessment for legal metrology
- Form a Working Party on inter-comparison of pattern approval testing of non-automatic weighing instruments and mass standards
- Form a Working Party to identify opportunities for training in legal metrology and exchanges of staff between legal metrology authorities
- Form a Working Party to harmonize requirements for pre-packed articles
- Publication of the Directory of Legal Metrology in the Asia Pacific
OIML technical activities

1994 Review
1995 Forecasts

The information given on pp. 39–44 is based on 1994 annual reports submitted by OIML secretariats. Work projects are listed for each active technical committee and subcommittee together with the state of progress at the end of 1994 and projections for 1995 when appropriate.

Activités techniques OIML

Rapport 1994
Prévisions 1995


Key to abbreviations used

<table>
<thead>
<tr>
<th>WD</th>
<th>Working draft (Preparatory stage)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Projet de travail (Stade de préparation)</td>
</tr>
<tr>
<td>CD</td>
<td>Committee draft (Committee stage)</td>
</tr>
<tr>
<td></td>
<td>Projet de comité (Stade de comité)</td>
</tr>
<tr>
<td>DR/DD</td>
<td>Draft Recommendation/Document (Approval stage)</td>
</tr>
<tr>
<td></td>
<td>Projet de Recommandation/Document (Stade d’approbation)</td>
</tr>
<tr>
<td>Vote</td>
<td>CIML postal vote on the draft</td>
</tr>
<tr>
<td></td>
<td>Vote postal CIML sur le projet</td>
</tr>
<tr>
<td>Appr.</td>
<td>Approval or submission to CIML/Conference for approval</td>
</tr>
<tr>
<td></td>
<td>Approbation ou présentation pour approbation par CIML/Conférence</td>
</tr>
<tr>
<td>R/D</td>
<td>International Recommendation/Document (Publication stage)</td>
</tr>
<tr>
<td></td>
<td>For availability; see list of publications</td>
</tr>
<tr>
<td></td>
<td>Recommandation/Document International (Stade de publication)</td>
</tr>
<tr>
<td></td>
<td>Pour disponibilité: voir liste des publications</td>
</tr>
</tbody>
</table>
## OIML Technical Activities

<table>
<thead>
<tr>
<th>TC 1 Terminology</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision V 1: Vocabulary of legal metrology</td>
<td>–</td>
<td>I CD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 2 Units of measurement</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision D 2: Legal units of measurement</td>
<td>3 CD</td>
<td>DD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 3/SC 1 Pattern approval and verification</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Initial verification of measuring instruments utilizing the manufacturer's quality system</td>
<td>2 CD</td>
<td>DD</td>
</tr>
<tr>
<td>• Revision D 13: Guidelines for bi- or multilateral arrangements for the recognition of test results for pattern evaluations and verifications</td>
<td>WD</td>
<td>1 CD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 4 Measurement standards and calibration and verification devices</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Principles for the selection and expression of metrological characteristics of standards and devices used for calibration and verification</td>
<td>–</td>
<td>WD</td>
</tr>
<tr>
<td>• Revision D 5: Principles for the establishment of hierarchy schemes for measuring instruments</td>
<td>–</td>
<td>WD</td>
</tr>
<tr>
<td>• Revision D 10: Recalibration intervals of measurement standards and calibration devices</td>
<td>–</td>
<td>WD</td>
</tr>
<tr>
<td>• Revision D 23: Principles of the metrological control of devices used for verification</td>
<td>–</td>
<td>WD</td>
</tr>
<tr>
<td>• Revision D 6 + D 8: Measurement standards. Requirements and documentation</td>
<td>–</td>
<td>WD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 5 Electronic instruments</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision D 11: General requirements for electronic measuring instruments</td>
<td>D</td>
<td>–</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 6 Prepackaged products</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision R 79: Information on package labels</td>
<td>2 CD</td>
<td>DR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruments for measuring the areas of leather</td>
<td>4 CD</td>
<td>5 CD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 7/SC 4 Measuring instruments for road traffic</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision R 55: Speedometers, mechanical odometers and chronotachographs for motor vehicles. Metrological regulations</td>
<td>3 CD</td>
<td>–</td>
</tr>
</tbody>
</table>
## OIML TECHNICAL ACTIVITIES

<table>
<thead>
<tr>
<th>TC 7/SC 5 Dimensional measuring instruments</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metrological and technical requirements, test procedures and test report format for multi-dimensional measuring instruments for parcels</td>
<td>WD</td>
<td>1 CD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 8 Measurement of quantities of fluids</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics of standard capacity measures and test methods for measuring systems</td>
<td>R</td>
<td>–</td>
</tr>
<tr>
<td>Pipe provers for testing of measuring systems for liquids</td>
<td>R</td>
<td>–</td>
</tr>
<tr>
<td>Revision R 63: Petroleum measurement tables</td>
<td>R</td>
<td>–</td>
</tr>
<tr>
<td>Vortex meters</td>
<td>D</td>
<td>–</td>
</tr>
<tr>
<td>Glass delivery measures - Automatic pipettes</td>
<td>D</td>
<td>–</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 8/SC 1 Static volume measurement</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision R 85: Automatic level gauges for measuring the level of liquid in fixed storage tanks</td>
<td>CD</td>
<td>DR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 8/SC 2 Static mass measurement</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct static mass measurement of quantities of liquid, test procedures, test report format</td>
<td>4 CD</td>
<td>DR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 8/SC 3 Dynamic volume measurement (liquids other than water)</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring assemblies for liquids other than water (Revision R 5, R 27, R 57, R 67, R 77)</td>
<td>R</td>
<td>–</td>
</tr>
<tr>
<td>Testing procedures for pattern examination of fuel dispenser for motor vehicles</td>
<td>R</td>
<td>–</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 8/SC 4 Dynamic mass measurement (liquids other than water)</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annex to R 105: Test report format for the evaluation of direct mass flow measuring systems for quantities of liquids</td>
<td>R</td>
<td>–</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 8/SC 5 Water meters</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision R 49: Water meters intended for the metering of cold water</td>
<td>WD</td>
<td>WD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision R 81: Measuring devices and measuring systems for cryogenic liquids (including tables of density for liquid argon, helium, hydrogen, nitrogen and oxygen)</td>
<td>1 CD</td>
<td>2 CD</td>
</tr>
</tbody>
</table>
### OIML Technical Activities

#### TC 8/SC 8 Gas meters
- Revision R 6: General provisions for gas volume meters
- Revision R 31: Diaphragm gas meters
- Revision R 32: Rotary piston gas meters and turbine gas meters

#### TC 9 Instruments for measuring mass and density
Revision R 60: Load cells

#### TC 9/SC 1 Non automatic weighing instruments
- Amendment 1 to R 76-1: Metrological and technical requirements - Tests
- 2nd revision R 76-1

#### TC 9/SC 2 Automatic weighing instruments
- Annex to R 50: Test procedures and test report format for the evaluation of continuous totalizing automatic weighing instruments
- Revision R 51: Automatic catchweighing instruments (including test procedures and test report format)
- Revision R 61: Automatic gravimetric filling machines
- Annex to R 106: Test procedures and test report format for the evaluation of automatic railweighbridges
- Annex to R 107: Test procedures and test report format for the evaluation of discontinuous totalizing automatic weighing instruments

#### TC 9/SC 3 Weights
Annex to R 111: Test procedures and test report format for the evaluation of weights of classes E₁, E₂, F₁, F₂, M₁, M₂, M₃

#### TC 10/SC 2 Pressure gauges with elastic sensing elements
- Pressure transmitters with elastic sensing elements
- Annex to R 101: Test procedures and test report format for the evaluation of pressure gauges with elastic sensing elements (ordinary instruments)
- Annex to R 109: Test procedures and test report format for the evaluation of pressure gauges with elastic sensing elements (standard instruments)
## OIML Technical Activities

**TC 10/SC 4 Material testing machines**
- Requirements for force measuring instruments for verifying material testing machines
- Force measuring systems of material testing machines
  (Revision R 64: General requirements for material testing machines
  + Revision R 65: Requirements for machines for tension and compression testing)

**TC 10/SC 5 Hardness standardized blocks and hardness testing machines**
International intercomparison of hardness blocks (Rockwell hardness blocks)

**TC 10/SC 6 Strain gauges**
Revision R 62: Strain gauges

**TC 11 Instruments for measuring temperature and associated quantities**
Revision R 75: Heat meters

**TC 11/SC 1 Resistance thermometers**
Revision R 84: Resistance-thermometers sensors made of platinum, copper or nickel (for industrial and commercial use) and inclusion of metallic electrical platinum, copper and nickel resistance thermometers with extended range

**TC 11/SC 2 Contact thermometers**
- Standardized thermometers
- Liquid-in-glass thermometers

**TC 11/SC 3 Radiation thermometers**
- Revision R 18: Visual disappearing filament pyrometers
- Revision R 48: Tungsten ribbon lamps for calibration of optical pyrometers

**TC 13 Measuring instruments for acoustics and vibration**
- Revision R 58 including development of Annex: Test report format for the evaluation of sound level meters
### OIML Technical Activities

<table>
<thead>
<tr>
<th>TC 13 Measuring instruments for acoustics and vibration (cont.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Revision R 88 including development of Annex: Test report format for the evaluation of integrating-averaging sound level meters</td>
</tr>
<tr>
<td>• Annex to R 102: Test procedures and test report format for the evaluation of sound calibrators</td>
</tr>
<tr>
<td>• Revision R 104: Pure-tone audiometers</td>
</tr>
<tr>
<td>• Speech audiometers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 14 Measuring instruments used for optics</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Annex to R 93: Test report format for fociometers</td>
</tr>
<tr>
<td>• Illuminance meters</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 15 Measuring instruments for ionizing radiations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiochromic film dosimetry system for measuring absorbed dose in products from gamma and electron radiation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 16/SC 1 Air pollution</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Continuous measuring instruments for NO\textsubscript{2} emissions</td>
</tr>
<tr>
<td>• Continuous measuring instruments for SO\textsubscript{2} emissions</td>
</tr>
<tr>
<td>• Continuous measuring instruments for CO emissions</td>
</tr>
<tr>
<td>• Revision R 99: Instruments for measuring vehicle exhaust emissions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 16/SC 2 Water pollution</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Inductively coupled plasma atomic emission spectrometers for measuring metal pollutants in water</td>
</tr>
<tr>
<td>• Revision R 83: Gas chromatograph - mass spectrometer</td>
</tr>
<tr>
<td>• Revision R 100: Atomic absorption spectrometers for measuring metal pollutants in water</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 16/SC 3 Pesticides and other toxic substances pollutants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision R 82: Gas chromatographs for measuring pollution from pesticides and other toxic substances</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC 16/SC 4 Field measurements of hazardous (toxic) pollutants</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Portable and transportable X-ray fluorescence spectrometers for field measurements of hazardous elemental pollutants</td>
</tr>
<tr>
<td>• Air sampling devices for toxic chemical pollutants at hazardous waste sites</td>
</tr>
</tbody>
</table>
## OIML Technical Activities

| TC 16/SC 4 Field measurements of hazardous (toxic) pollutants (suite) |
| WD | 1 CD |
| TC 17/SC 1 Humidity |
| R | – |
| TC 17/SC 2 Saccharimetry |
| R | – |
| CD | Vote |
| TC 17/SC 3 pH-metry |
| 2 CD | Vote |
| TC 17/SC 5 Viscometry |
| CD | CD |
| TC 17/SC 7 Breath testers |
| 3 CD | DR |
| TC 18 Medical measuring instruments |
| WD | CD |
| TC 18/SC 1 Blood pressure instruments |
| 3 CD | 4 CD |
| TC 18/SC 2 Medical thermometers |
| R | – |
| R | – |
| TC 18/SC 5 Measuring instruments for medical laboratories |
| 1 CD | 1 CD |
ADMINISTRATION

- Distribution of the minutes for the OIML Ninth International Conference of Legal Metrology (Greece, Nov. 1992)
- Distribution of the minutes for the 28th Meeting of the International Committee of Legal Metrology (Germany, Oct. 1993) and implementation of decisions and resolutions
- Administrative work associated with CIML approval of International Recommendations and Documents
- Preparation of a new edition of the brochure "Metrology in OIML Members"

- 5th International Symposium on Metrology (Bucharest, May 1994)
- IMEKO TC 11 (Braunschweig, Sept. 1994)
- First meeting of the Asia Pacific Legal Metrology Forum (Sydney, Nov. 1994)

OIML CERTIFICATE SYSTEM

- Registration of some forty OIML certificates and information distributed to all bodies concerned
- Establishment of a data base for certificates
- Establishment of a technical advisory group on certification

OIML LONG-TERM POLICY

Participation in finalizing the paper on OIML policy and strategy

COMMUNICATION

- Ensuring exchanges of information between OIML Members and with liaison institutions
- Regional visit to Far East Asiatic Members for studying communication matters with metrology services and other bodies
- Preparation of a brochure on OIML
- Preparation of four issues of the OIML Bulletin and marketing efforts for developing its readership
OIML MEETINGS

- Preparation and organization of the Presidential Council meeting (Paris, Feb. 1994)
- Arrangements for the 29th CIML Meeting (Paris, Oct. 1994) and preparation of documents
- Arrangement for the Development Council Meeting (Paris, Oct. 1994) and preparation of documents
- Participation in OIML technical meetings: TC 11 (Berlin), TC 9 and TC 9/SC 2 (Teddington)

OTHER MEETINGS

- COOMET (Bratislava, Mar. 1994)
- WELMEC and EUROMET (Oslo, May 1994)
- EAL (Paris, May 1994)
- ISO General Assembly and DEVCO (Nice, Sept. 1994)

MAINTAINING LIAISONS WITH INTERNATIONAL INSTITUTIONS

- Commission of the European Communities
- International Standardization Organization (ISO) and International Electrotechnical Commission (IEC)
- United Nations Industrial Development Organization (UNIDO)
- International Union of Pure and Applied Chemistry (IUPAC)
- Comité Européen de Normalisation (CEN) and Comité Européen de Normalisation Electrotechnique (CENELEC)
- European Cooperation in Legal Metrology (WELMEC)
- Metrological Cooperation for Central and Eastern European Countries (COOMET)
- Asia-Pacific Legal Metrology Forum and other Asia-Pacific bodies
- Commonwealth India Metrology Center (CIMET)
- North-American Metrology Cooperation (NORAMET)
- Economical Commission for Europe of the United Nations (ECE-UNO)
- and others

PRESIDENTIAL COUNCIL

The OIML Presidential Council met at BIML, 31 Jan.–1 Feb. 1995 to discuss various matters concerning the Organisation.

President: G. J. Faber
Vice-Presidents: S. E. Chappell, M. Kochsieck
Participation: S. J. Bennett, J. Birch, L. K. Issac, B. Ahané as observers: BIML technical agents

Main points

- The composition of the Council was considered; at present it includes six members, three of which occupy the positions of CIML President and Vice-Presidents; the three others have been appointed by the CIML President. It may be envisaged in the future to slightly enlarge the Council’s composition.

- Preparations for the seminar on weighing instruments, the symposium for developing countries, the 30th CIML meeting and the 10th Conference were reviewed. A round-table will be organized for the 30th CIML meeting to address “confidence in type approval”.

- A report was given on the activities of OIML TCs and SCs; their progress is encouraging for the future of OIML.

- The OIML long-term policy documents and the OIML brochure were discussed;
La publication of both documents was set for spring 1995.

The development of regional cooperation in legal metrology was discussed and OIML policy for this subject must be to encourage such cooperation and to establish close links with regional bodies.

The Council considered it necessary to prepare a document concerning OIML policy with regard to international and regional organizations, for publication during 1996.

Le Conseil de la Présidence de l'OIML s'est réuni au BIML, les 31 janvier et 1er février 1995, pour discuter de différentes questions concernant l'Organisation.

Président: G.J. Faber
Vice-Présidents: S.E. Chappell, M. Kochsiek
Participation: S.J. Bennett, J. Birch, L.K. Issaev, B. Athané en tant qu'observateurs; les agents techniques du BIML

Points principaux

La composition du Conseil a été examinée; il comprend actuellement six membres, dont trois occupent les positions de Président et Vice-Présidents du CIML; les trois autres ont été nommés par le Président du CIML. Cependant, on peut envisager dans le futur d'élargir légèrement la composition du Conseil.

Les préparatifs du séminaire OIML sur les instruments de pesage, du symposium OIML pour les pays en développement, de la 30e réunion du CIML et de la 10e Conférence, ont été examinés. Une table ronde sera organisée pendant la 30e réunion du CIML pour discuter du thème "confiance dans les approbations de modèle".

Un rapport sur l'activité des TC et SC OIML a été donné; leur progrès semble encourageant pour l'avenir de l'OIML.

Les documents sur la politique à long terme de l'OIML et la brochure OIML ont été examinés; la publication de ces documents est prévue pour le printemps 1995.

Le développement de la coopération régionale en métrologie légale a été discuté et la politique de l'OIML à ce sujet doit être d'encourager la coopération régionale, et d'établir des liens étroits avec les organismes régionaux.

Le Conseil a jugé nécessaire de préparer un document sur la politique de l'OIML en ce qui concerne les organisations internationales et régionales, pour publication courant 1996.

Participation: 14 delegates representing 14 P-members; 4 representatives of industry (Comité Européen des Constructeurs d'Instruments de Pesage, CECIP, and COPAMA, UK); Ph. Degavre from BIML.

Main points

Revision of OIML R 61 Automatic gravimetric filling machines

A 8th committee draft which included test procedures and the test report format was discussed and submitted for vote. Taking into account many written or oral comments, this committee draft was amended during the meeting and registered as Draft Recommendation with positive votes by the unanimity of the delegates.

Revision of OIML R 51 Automatic catchweighers

A 7th committee draft which includes test procedures and the test report format was discussed. After having clarified the amendments proposed by the secretariat, particularly those concerning the maximum permissible errors in function of the different instrument categories covered by this Recommendation, the committee draft was amended during the meeting and registered as a Draft Recommendation with positive votes by the unanimity of the delegates.

Automatic road weighbridges; new OIML Recommendation project

An initial draft was distributed before the meeting and should be discussed during the next
TC 9/SC 2 meeting, 18–20 Sept. 1995, Paris. This meeting will be hosted by the Sous Direction de la Métrologie, after the OIML seminar “Weighing towards the year 2000” organized by BIML, and chaired by S. Bennett, Chief Executive of NWML and Member of the OIML Presidential Council.

Contact information:
Martin Birdseye
National Weights and Measures Laboratory
Stanton Avenue
Teddington, Middlesex TW11 OJZ
United Kingdom
Tel: 44 81 943 72 74
Fax: 44 81 943 72 70

---

**TC 9/SC 2**

Instruments de pesage à fonctionnement automatique

**Secrétariat: Royaume-Uni**


**Président: M. D. Jones, NWML**

**Participation:** 14 délégués représentant 14 membres-P; 4 représentants de l’industrie (Comité Européen des Constructeurs d’Instruments de Pesage, CECIP et COPAMA); Ph. Degavre du BIML.

**Points principaux**

- Révision de OIML R 61 Doseuses pondérales à fonctionnement automatique.
- Un 8e projet de comité incluant les procédures d’essai et le format de rapport d’essai a été discuté et soumis au vote. Ce projet de comité a été modifié pendant la réunion en tenant compte des différents commentaires écrits ou oraux et a été enregistré comme Projet de Recommandation après un vote positif à l’unanimité des délégués.
- Révision de OIML R 51 Instruments trieurs-étiqueteurs
- Un 7e projet de comité incluant les procédures d’essai et le format de rapport d’essai a été discuté. Après avoir clarifié les propositions de modifications du secrétariat, en particulier celles qui concernaient les erreurs maximales tolérées en fonction des catégories d’instrument couvertes par cette Recommandation, ce projet de comité a été modifié pendant la réunion et a également été enregistré comme Projet de Recommandation après un vote positif à l’unanimité des délégués.

**Ponts-bascules routiers à fonctionnement automatique; nouveau projet de Recommandation OIML**


Contact pour information:
Martin Birdseye
National Weights and Measures Laboratory
Stanton Avenue
Teddington, Middlesex TW11 OJZ
United Kingdom
Tel: 44 81 943 72 74
Fax: 44 81 943 72 70

---

**NEW PUBLICATIONS / NOUVELLES PUBLICATIONS**

| R 31 | (new edition) Diaphragm gas meters (nouvelle édition) Compteurs de gaz à parois déformables |
| R 76-2 Amendment | Nonautomatic weighing instruments Part 2: Pattern evaluation report Instruments de pesage à fonctionnement non automatique Partie 2: Rapport d’essai de modèle |
| R 114 | Clinical electrical thermometers for continuous measurement Thermomètres électriques médicaux pour mesurage en continu |
| R 115 | Clinical electrical thermometers with maximum device Thermomètres électriques médicaux avec dispositif à maximum |

Available in French and English (see OIML Bulletin supplement for price-list).

To order a publication, please contact OIML headquarters:
Bureau International de Métrologie Légale
11, rue Turgot, 75009 Paris, France Fax: 33 1 42 82 17 27

---

48 OIML Bulletin Volume XXXVI • Number 2 • April 1995
OIML CERTIFICATES registered from December 1994 to February 1995
CERTIFICATS OIML enregistrés de décembre 1994 à février 1995

HOW TO USE THE LIST OF OIML CERTIFICATES
COMMENT UTILISER LA LISTE DES CERTIFICATS OIML

This list is classified by issuing authority; updated information on these authorities may be obtained from BIML.
Cette liste est classée par autorité de délivrance; les informations à jour relatives à ces autorités sont disponibles auprès du BIML.

Issued by/Délivré par:
Physikalisch-Technische Bundesanstalt (PTB), Germany

- R 76/1992 - DE - 93.01
  Sartorius AG
  Weender Landstraße 94-108
  D-37073 Göttingen
  Germany
  BA BA 1200
  BA BB 200, ...

Year of issue
Année de délivrance

The code (ISO) of the Member State in which the certificate was issued.
Le code (ISO) indicatif de l'État Membre ayant délivré le certificat.

Manufacturer / Fabricant
Certified pattern(s) / Modèle(s) certifié(s)

OIML Recommendation applicable within the System / Year of publication
Recommandation OIML applicable dans le cadre du Système / Année d'édition

CATÉGORIE D'INSTRUMENT Cellules de pesée R 60 (1991), Annexe A (1993)

Issued by/Délivré par:
Ministère de l'Industrie, des Postes et Télécommunications et du Commerce Extérieur – Sous-Direction de la Métrologie, France

- R 60/1991-FR-94.02
  Scame SA
  Le Bois de Juvigny, BP 501
  74105 Annemasse, France
  Capteurs à jauges de contrainte Scame types S30X 300 C., S30X 600 C., S30X 1200 C., and S30X 2500 C... (Class C)

- R 60/1991-GB-95.02
  Sensortronics Inc.
  677 Arrow Grand Circle
  Cavin, CA 91722, USA
  Load Cell Model No Sensortronics 65023C-S (Class C)

- R 60/1991-GB-95.01
  Sensortronics Inc.
  677 Arrow Grand Circle
  Cavin, CA 91722, USA
  Load Cell Model No Sensortronics 60001C (Class C)

- R 60/1991-GB-95.03
  Sensortronics Inc.
  677 Arrow Grand Circle
  Cavin, CA 91722, USA
  Load Cell Model No Sensortronics 60005C (Class C)
NEW APPLICATIONS FOR OIML CERTIFICATION

The publication of OIML Recommendations R 114 and R 115, Clinical electrical thermometers for continuous measurement and Clinical electrical thermometers with maximum device results in a wider field of application for OIML certification. Medical measuring instruments constitute a vast area of development in legal metrology; it is important that these instruments work correctly and reliably, even when used by persons who are not expert in metrology. Medical diagnosis and health care efficiency are partly based on measurements: e.g. body temperature, blood pressure, rapidity of blood cell sedimentation, etc.

OIML certification of medical measuring instruments, beginning with electrical thermometers, will contribute to efforts for assuring the high metrological performance of these necessary tools. A special issue of the OIML Bulletin on medical measuring instruments is planned for the months to come.

Moreover, the new edition of OIML Recommendation R 31 on Diaphragm gas meters makes it possible for these instruments to receive OIML certificates. At present, only mechanical meters are concerned, with certification of electronic gas meters possible as soon as the new edition of OIML Recommendation R 6 (now being revised) is published.
NOUVELLES APPLICATIONS DE LA CERTIFICATION OIML

Avec la publication des Recommandations OIML R 114 et R 115, Thermomètres électriques médicaux pour mesure en continu et Thermomètres électriques médicaux avec dispositif à maximum, le champ d'application de la certification OIML s'étend.

Les instruments de mesure médicaux constituent un vaste domaine de développement de la métrologie légale, en raison de l'importance qu'il y a à ce que ces instruments fonctionnent correctement et de manière fiable même entre les mains de personnes non expertes en matière de métrologie. En effet, les diagnostics médicaux et l'efficacité des soins sont en partie basés sur des mesures: température du corps, pression artérielle, vitesse de sédimentation des globules, etc.

La certification OIML des instruments de mesure médicaux, qui débute avec les thermomètres électriques, contribuera à assurer de bonnes performances métrologiques à ces outils indispensables; le Bulletin OIML consacrera un de ses prochains numéros à l'instrumentation de mesure médicale.

Par ailleurs, avec la publication d'une nouvelle édition de la Recommandation OIML R 31 Compteurs de gaz à parois déformables, ces instruments peuvent également faire l'objet de certificats OIML; dans l'immédiat, seuls les compteurs mécaniques seront concernés; les compteurs de gaz électroniques devront, pour pouvoir être certifiés, attendre la publication de la nouvelle édition de la Recommandation OIML R 6, actuellement en cours de révision.

---

**METROMED 95**

International Scientific and Practical Conference

Measuring information technologies and instruments for health care

20–22 June 1995
St. Petersburg, Russia

This Conference is organized by the State Technical University together with the Academy of Metrology, International Scientific and Technical Society of Instruments Engineers and Metrologists.

The main objective of the Conference is to draw the intellectual potential of instrument engineers and metrologists towards finding solutions to the problems of manufacturing medical instruments and to enable the realization of the newest medical technologies.

Contact information:
Organizing Committee
METROMED 95
STLSP
Polytechnicheskoja str., 29
195251 St. Petersburg
Russia
Fax: 7-812-552 60 86

---

Now available: International Vocabulary of Basic and General Terms in Metrology (VIM) in Spanish

**PRESENTACIÓN DEL VOCABULARIO**

Cuando en marzo de 1984, OIML anuncia que el Vocabulario Internacional de los términos fundamentales y generales de Metrología (VIM) estará disponible en breve plazo y será publicado por el Secretariado Central del ISO, en nombre de las cuatro organizaciones que en aquella época habían participado en su redacción (BIPM, CEI, ISO, OIML), el Centro Español de Metrología acoge con gran interés la sugerencia que le hace la Organización de preparar una traducción al español que facilite así la coordinación terminológica entre todos los organismos, laboratorios, fabricantes de instrumentos de medida, y en general, entre todos aquellos interesados en la Metrología.

Para ello, se constituye dentro del CEM, un Grupo de Trabajo que aborda de inmediato un proyecto de traducción que una vez finalizado se remite a los países de habla hispana para que efectuaran los comentarios oportunos al mismo.

Paralelamente se solicitó de organismos españoles tan acreditados como la Real Academia de las Ciencias y la Asociación Española de la Calidad, entre otras, que efectuaran también una traducción para poder llegar a una versión consensuada y conjunta.

Este trabajo quedó momentáneamente paralizado debido al anuncio de una revisión al citado vocabulario por parte del grupo ISO TAG 4. Una vez finalizada esta revisión y disponiendo ya del texto final, el CEM reanudó sus trabajos que han concluido recientemente con la publicación, en español, del citado vocabulario, que esperamos y deseamos constituya un paso más en la armonización de la terminología metroológica en todos los países que hablan nuestra lengua.
Legal metrology cooperation in the South West Pacific

In association with the Asia Pacific Legal Metrology Forum, held in Sydney from 27–30 November 1994, a two-day meeting of legal metrology authorities in the SW Pacific was held at the National Standards Commission in Sydney from 1–2 December 1994.

The meeting was attended by 17 delegates from Cook Islands, Fiji, New Zealand, Papua-New Guinea, Western Samoa, Solomon Islands, Tonga, Vanuatu and Australia. Development and harmonisation of legalisation, intercomparisons of mass and volume standards, regional standards and testing facilities and training in legal metrology were addressed.

The Papua-New Guinea delegate Mr Kialou Angat reported on the development of the Papua-New Guinea National Institute of Standards and Industrial Technology. The forum also discussed the problems of small island states in developing effective technical infrastructures, including training in legal metrology.

The meeting recognised that coordination and cooperation would be assisted by improved information flow between authorities. It was agreed to publish a Directory of Legal Metrology in the South West Pacific in 1995 and give consideration to the publication of a newsletter.

The meeting adopted an active program of cooperation for 1995 and aims to hold a further meeting in early 1996 in one of the SW Pacific nations.

Contact information:
John Birch, AM Executive Director National Standards Commission PO Box 282 North Ryde NSW 2113 Australia

9th General Assembly of the African Regional Organization for Standardization

ARSO held its 9th General Assembly at the International Conference Center in Grand Baie, Mauritius from 23–25 January 1995.

The meeting was opened by the Mauritius Minister of Industry and assembled delegations from Burkina Faso, Ethiopia, Gana, Kenya, Malawi, Mauritius, Nigeria, Sierra Leone, Sudan, and Uganda, and observers from Lesotho, Mozambique, and South Africa.

Several regional organizations were also represented, including the Economic Commission of the United Nations for Africa; RESOURCE, a British body for assisting development; as well as two international organizations, FAO and OIML.

ARSO’s metrological activity mainly consists of organizing training courses (in which OIML has participated on numerous occasions), developing regional metrology centers, elaborating regional metrological standards (often taken from OIML publications), and making African governments more aware of metrology.

B. Athané, Director of BIML, suggested that ARSO develop more regional cooperation in close collaboration with OIML, i.e. by using more OIML publications of interest to African countries; encouraging the use of OIML certified measuring instruments; and participating in OIML activities addressing development matters.

9e Assemblée Générale de l’Organisation Régionale Africaine de Normalisation


La réunion, ouverte par le Ministre Mauricien de l’Industrie, a rassemblé des délégations de Burkina Faso, Ethiopie, Ghana, Kenya, Malawi, Ile Maurice, Nigéria, Sierra Leone, Soudan, et Ouganda, ainsi que des observateurs de Lesotho, Mozambique et Afrique du Sud.

De nombreuses organisations régionales, dont la Commission Économique pour l’Afrique des Nations-Unies, un organisme britannique d’aide au développement, Resource, ainsi que deux organisations internationales, la FAO et l’OIML, y avaient envoyé des représentants.

L’activité de l’ARSO dans le domaine de la métrologie comprend principalement l’organisation de cours de formation (auxquels l’OIML a participé à plusieurs reprises), le développement de centres métrologiques régionaux, la mise au point de normes métrologiques régionales (biennent souvent reprises des publications OIML), et la sensibilisation des gouvernements africains à la métrologie.

B. Athané, le directeur du BIML, a suggéré que l’ARSO développe encore davantage la coopération régionale, en étroite coopération avec l’OIML, c’est-à-dire en utilisant davantage les publications OIML d’intérêt pour les pays africains; en faisant appel de préférence à des instruments de mesure certifiés OIML; et en s’associant aux activités OIML tournées vers les questions de développement.
WELMEC
European cooperation in legal metrology
8th Committee meeting

The European cooperation in legal metrology (WELMEC) held its
8th Committee meeting, hosted by the European Commission,
January 12-13 in Brussels.

As explained in previous issues of the OIML Bulletin, this Committee
comprises delegates from EC and EFTA national bodies that have
signed the Memorandum of Understanding; it is chaired by Dr Seton
Bennett, Chief Executive of the National Weights and Measures
Laboratory in the UK.

In his opening speech, Dr Bennett explained the substantial
progress that was made in 1994 by the WELMEC working groups
and announced the future possibility of associating six new European
countries with WELMEC activities: Bulgaria, Czech Republic, Hungary,
Poland, Romania, and Slovakia.

Main points of the meeting

- New logo for the Organization
  The name WELMEC was retained, to be accompanied by the words
  "European cooperation in legal metrology".

- Extension of the
  Type Approval Agreement
  It was decided to establish a new working group (WG 9) to oversee
  the Type Approval Agreement, to analyze a possible extension of the
  Agreement, and to propose inter-comparison exercises.

- Cooperation between EC notified bodies in the field of measuring
  instruments
  The European Commission envisaged to establish cooperation bet-
  tween notified bodies in sectoral groups by creating technical and
  administrative secretariats. WELMEC provides the appropriate
  framework for such a cooperation in legal metrology and indicated to
  the European Commission its willingness to undertake this work.

- Publications
  The WELMEC Committee agreed to publish the following docu-
  ments:
  - European legal metrology Directory
  - Guide for Examining Software (Non-automatic Weighing
    Instruments)
  - Guide for Testing Indicators (Non-automatic Weighing
    Instruments)
  - Guide for Testing Point of Sale Devices (Non-automatic
    Weighing Instruments)

- EMeTAS project: the set-up of a
  European metrological pattern
  approval database
  Mr J. A. J. Basten, Director NMI Certin B.V. and Chairman of the
  WG 3, presented the advances
  made in preparing the implementation of a European database
  of EC pattern approval certificates.
  WG 3 was invited by the Committee to make recommendations
  for the establishment of a Steering
  Group (3 or 4 persons from legal
  metrology services) which will be
  in charge of supervising EMeTAS
  (quality of services and management
  of financial aspects).

- Additional cooperation
  The Committee invited EAL and
  EAC to discuss with WG 4 the
  issues arising from the application
  of certification and accreditation in
  legal metrology.

39th EOQ ANNUAL CONGRESS
12 - 16 June 1995
Palais de Beaulieu
Lausanne, Switzerland

The 39th Annual Congress of the European Organization for Quality
(EOQ) will be organized around four parallel streams and 11 sessions
during which almost 100 papers will be presented by authors from
30 different countries.

A half-day workshop on self-assessment will be conducted before the
Congress by the European Foundation for Quality Management, on behalf
of EOQ.

Main themes of the Congress

Stream A
People for Quality

Stream B
Quality for People

Stream C
Cases and Methods - Country Cases,
small and medium size enterprises,
advanced methods and practice

Stream D
Cases and Methods - ISO 9000,
Company and Branch Cases

Special stream
Food session: safety aspects
of food quality

Special Events
Poster session, Exhibition,
Quality Garden

Contact information:
Lausanne Tourist Office
Ref. AGC/EOQ '95
P.O. Box 49
CH-1000 Lausanne
Tel: 41-21-617 73 21
Fax: 41-21-616 86 47
Scope of MERA 95

- Measuring instruments, sensors, transmitters
- Calibration, testing, quality assurance
- Systems for controlling and automation
- Indicators
- Weighing instruments
- Medical instruments, apparatus and facilities
- Computers
- Laboratory equipment
- Dentistry
- Biotechnology

Contact information:
International Scientific and Technical Society of Instrument Engineers and Metrologists
102 Mohovaya
121019 Moscow
Tel: 7-095-202 65 71
Fax: 7-095-202 14 73

All-Russia Exhibition Centre
V.V.C., Upravlenie Vneshtim svjazej
129223 Moscow
Tel: 7-095-216 5374
Fax: 7-095-181 64 10

The monthly scientific-technical magazine Izmeritelnaya Tekhnika (IT) was founded in the USSR in 1939. This magazine (and its supplement, Metrology) is one of its kind and is devoted to measurement theory and practices. IT addresses not only the problems of Measurement Uniformity Assurance in Science and Technology, but those of Legal Metrology as well.

IT, to some extent, is an encyclopaedic publication for several subjects, including fundamental and general problems of measurements, definite fields of measurements, metrological assurance for the manufacture of products, governmental metrology services, and new principles and methods for the measurement of physical values.

IT unifies the efforts of scientists, R & D specialists, professors for the support of measurement activity in Russia on a modern level and was rated in "the Soros list of publications".

In accordance with an agreement between Plenum Publishing Corporation (New York) and Gosstandart (Moscow), IT has been translated and published in English as Measurement Technique (MT) since 1958.

There are many subscribers throughout the world for both IT (with Metrology) and MT (without Metrology). Subscriptions for "IT" are handled by the branches of SA "Mezdunarodnaya Kniga".

Contact information for IT (Russian):
Gosstandart, IT Editorial division
9, Leninsky Prospect
117049 Moscow
Russia
Tel: 7-095-236-24 44
Fax: 7-095-237 60 32

Contact information for MT (English):
Plenum Publishing Corporation
233 Spring St.
New York, N.Y. 10013
Fax: 1-212-807 10 47

in the United Kingdom:
Plenum Publishing Corporation
88/90 Middlesex St.
London E17EZ
The basic principles and practice of flow measurement

Five-day course
15–19 May 1995
NEL, United Kingdom

Held annually for the past eighteen years, this course on flow measurement presents subject matter that is continually reviewed to keep it up to date. It is directed towards personnel involved in the design of plants requiring flow monitoring, or in the purchase, application and calibration of flow measuring equipment.

This course is not intended for flow measurement experts, but for the engineer seeking to know how to choose the flowmeter best adapted for his particular needs, and how to get the most out of it when in service.

Program

- Elements of pipe flow and properties of measuring instruments; differential pressure meters; ultrasonic meters; a meter manufacturer's view of the flow measurement scene; two-phase flow measurement.
- Calibration of meters with liquids and gases; velocity probes and integration techniques; construction and performance of positive displacement and turbine meters; vortex meters.
- Electromagnetic flowmeters; flowmeters secondary instrumentation; mass flow measurement.
- Assessment of uncertainties; national standards, transfer standards and traceability; pulsating flow measurement; troubleshooting and diagnosing faults.
- Site calibration methods; choosing the right flowmeter for the application; installation effects.

Contact information:
Mr D. Stewart / Mrs E. Campbell
Flow Centre, Reynolds Building
NEL
East Kilbride, Glasgow G75 0QU
Tel: 44-13552-72448/72361
Fax: 44-13552-72536

OIML WELCOMES ITS NEW MEMBERS

Member State
Kazakhstan

CIML Members
Mr J. C. Bueno, Brazil
Mr J. F. Magana, France
Mr A. Nejar, Morocco

Corresponding Members
Thailand
Uruguay

Bibliography

A new age gas meter

Gas sensors

Measurement of pipe flow by an electromagnetic probe

The new approach
CEN Distribution and Sales Unit, rue de Stassart, 36, 1050 Brussels, Belgium.

Standards for access to the European market
CEN Distribution and Sales Unit, rue de Stassart, 36, 1050 Brussels, Belgium.

Quality Promotion in Europe - A review of European Community Member States National and Regional Schemes and Measures in the Field of Quality

Biosensors: a viable monitoring technology?

Calibration of an electronically scanned white-light interferometric transducer for high-pressure measurements
Shi Huang (Dept. d’Ingenierie, Quebec Univ., Trois-Rivieres, Que., Canada), R. Z. Morawski, A. Barwicz, W. J. Bock, W. Urbanczyk.

Thick film strain gauges on insulated metal substrates for high sensitivity mechanical sensors
<table>
<thead>
<tr>
<th>Month</th>
<th>Date</th>
<th>Subject</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>1995</td>
<td>TC 3/SC 2 Metr. supervision</td>
<td>Prague or Brno</td>
</tr>
<tr>
<td>April</td>
<td>19–21</td>
<td>TC 8/SC 5 Water meters</td>
<td>London</td>
</tr>
<tr>
<td>May</td>
<td>1995</td>
<td>TC 13/WG 2 Audimeters</td>
<td>TO BE FIXED</td>
</tr>
<tr>
<td>June</td>
<td>12–15</td>
<td>TC 3 and TC 4 Metrological control and</td>
<td>Paris/BIML</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measurement standards and calibration and</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>verification devices</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>1995</td>
<td>TC 7/SC 5 Dimensional measuring instruments</td>
<td>Paris</td>
</tr>
<tr>
<td></td>
<td>11–12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>13–15</td>
<td>OIML seminar: &quot;Weighing towards the year 2000&quot;</td>
<td>Paris</td>
</tr>
<tr>
<td></td>
<td>18–20</td>
<td>TC 9 and TC 9/SC 2 Instruments for measuring</td>
<td>Paris</td>
</tr>
<tr>
<td></td>
<td></td>
<td>mass and density and Automatic weighing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>instruments</td>
<td></td>
</tr>
<tr>
<td>October</td>
<td>1995</td>
<td>OIML Symposium on metrological activities</td>
<td>Beijing</td>
</tr>
<tr>
<td></td>
<td>23–24</td>
<td>in developing countries</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>Development Council meeting</td>
<td>Beijing</td>
</tr>
<tr>
<td></td>
<td>25–27</td>
<td>30th OIML meeting</td>
<td>Beijing</td>
</tr>
<tr>
<td>November</td>
<td>1995</td>
<td>TC 17/SC 3 pH-metry</td>
<td>UK or Paris/BIML</td>
</tr>
<tr>
<td></td>
<td>(provisional)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>January</td>
<td>or</td>
<td>TC 11 Instruments for measuring</td>
<td>TO BE FIXED</td>
</tr>
<tr>
<td>February</td>
<td>1996</td>
<td>temperature</td>
<td></td>
</tr>
</tbody>
</table>
CONTACT INFORMATION

Member States – Members of the International Committee of Legal Metrology
Corresponding members – National metrology services

PUBLICATIONS

classified by subject and number

International Recommendations
International Documents
Other publications
CHINA
Mr Li Chuanqian
Director General
State Bureau of Technical Supervision
4, Zhi Chun Lu, Hai Dian
Beijing 100088
Tel.: 86-10-202 58 35
Fax: 86-10-203 10 10
Telex 210269 SBTS CN
Telegraph: 1918 Beijing

CUBA
Eng. L. Reveltto Fortuoso
c/o Mr. J. Acosta Alemany
Director, International Relations
National Bureau of Standards
Calle E No. 261 entre 11 y 13
Vedado, La Habana 10400
Ciudad de la Habana
Tel.: 537-30 00 25
Fax: 537-33 80 48
Telex 512245

CYPRUS
Mr G. Tsakirtzis
Controller of Weights and Measures
Ministry of Commerce and Industry
Nicosia
Tel.: 357-2-40 34 41
Fax: 357-2-36 61 20
Telex 2283 MIN COMIND
Telegram Minicommission Nicosia

CZECH REPUBLIC
Mr Pavel Klemovsky
Director
Czech Metrological Institute
Okruzni 31
63800 Brno
Tel.: 42-5-52 87 55
Fax: 42-5-52 91 49

DENMARK
Mr P. C. Johansen
Assistant Head
Secretariat for Metrology
Danish Agency for Development of Trade and Industry
Tegnergade 135
DK-2290 Copenhagen N
Tel.: 45-35-86-86-86
Fax: 45-35-86-86-87
Telex 15768 INDKA DK

EGYPT
The President
Egyptian Organization for Standardisation and Quality Control
2 Latin America Street, Garden City
Cairo
Tel.: 20-2-354 97 20
Fax: 20-2-355 78 41
Telex 93 396 GOS UN
Telegram TAWHID

ETHIOPIA
Mr Tesfaye Muluneh
Head of Metrology Department
Ethiopian Authority for Standardization
P.O. Box 2310
Addis Ababa
Tel.: 231-1-35 04 00 and 15 04 25
Telex 21725 ETHSAS ET
Telegram ETHIOSTAN

FINLAND
Mr M. Karjalainen
Assistant Director on Legal Metrology
Technical Inspection Centre
Technical Department:Weights and Measures
P.O. Box 284, Linnunraatteen 37
SF-00181 Helsinki
Tel.: 358-0-61 67 489
Fax: 358-0-60 54 74

FRANCE
Mr J.P. Magana
Sous-Directeur de la Métrologie
Ministère de l'Industrie, des Postes et Télécommunications
e du Commerce extérieur
22, rue Mauje
75005 Paris
Tel.: 33-1-43 19 51 40
Fax: 33-1-43 19 51 36

GERMANY
Mr M. Kochtker
Member of the Presidental Board
Physikalisch-Technische Bundesanstalt
Postfach 3345
D-38023 Braunschweig
Tel.: 49-531-544 10 00
Fax: 49-531-544 10 02
Telex 9-52 822 PTB d
Telegraph Bundesphysik Braunschweig

GREECE
Mr A. Dessaix
Technical Officer
Directorate of Weights and Measures
Ministry of Commerce
Canning Sq.,
10181 Athens
Tel.: 30-1-381 41 68
Fax: 30-1-384 26 42
Telex 21 67 35 DRAG GR
and 21 52 82 YPEM GR

HUNGARY
Mr P. Palka
President
Országh Mérésügyi Hivatal
P.O. Box 919
H-1535 Budapest
Tel.: 36-1-1567 722
Fax: 36-1-1550 599
Telegram HUNGMETRE Budapest

INDIA
Mr P. A. Krishnamurthy
Director, Weights & Measures
Ministry of Civil Supplies, Consumer Affairs and Public Distribution
Weights and Measures Unit
11-A, Jarr Nagar House
New Delhi 110 011
Tel.: 91-11-38 53 44
Telex 31 6902 COOP IN
Telegram POORTISSAKAR

INDONESIA
Mr G. M. Putern
Director of Metrology
Directorate General of Domestic Trade
Departemen Perdagangan
Janan Puswet 27
40171 Bandung
Tel.: 62-22-44 35 97 and 43 06 09
Fax: 62-22-420 70 35
Telex 28 176 BD

IRELAND
Mr S. Murray
Principal Officer
Department of Enterprise and Employment
Frederick Building, Seatona Centre
South Frederick Street,
Dublin 2
Tel.: 353-1-661 44 44
Fax: 353-1-661 54 77
Telex 59370

ISRAEL
Mr A. Ronen
Controller of Weights, Measures and Standards
Ministry of Industry and Trade
P.O. Box 295
Jerusalem 91002
Tel.: 972-2-75 01 11
Fax: 972-2-24 51 10

ITALY
Mr G. Visconti
Direttore Generale del Commercio Interno e dei Consumi Industriali
c/o Ufficio Cerdi Centro Merce
Via Antonio Bosia, 15
I-00161 Roma
Tel.: 39-6-841 68 25
Fax: 39-6-841 41 94

JAPAN
Mr Y. Kurita
Director General
National Research Laboratory of Metrology
1-4, Umerono-I-Chome, Tsukuba
Ibaraki 305
Tel.: 81-298-54 41 49
Fax: 81-298-54 41 35
Telex 03652770 AST
Telegram KEIYOKKEN TSUCHURA

KAZAKHSTAN
The President of Gosstandart of Kazakhstan
83, prospct i. Altynara
Almati 400035
Tel.: 8-327-21 08 03
Fax: 8-327-28 68 22

KENYA
The acting Director of Weights and Measures
Weights and Measures Department
Ministry of Commerce and Industry
P.O. Box 41071
Nairobi
Tel.: 254-2-30 46 44/4
Telegraph ASSIZERS, Nairobi

DEM. P. REP. OF KOREA
Mr Ho Chang Guk
Vice-President
Committee for Standardization of the D.P.R. of Korea
Zung Gu Yok Sungli-Seen
Pyeongyang
Telex 5972 TECH KP
REPUBLIC OF KOREA
Mr Shin Song-Hyun
Director, Department of Metrology
Bureau of Metrology and Technical Assistance
Industrial Advancement Administration
2, Cheongna-dong
Kwandong-City, Kyonggi-Do 427-010
Tel.: 82-2-803 79 35
Fax: 82-2-502 41 07
Telex 28456 Finch K

MONACO
Mr A Veigli
Ingénieur au Centre Scientifique de Monaco
16, Boulevard de Suisse
MC 98900 Monte Carlo
Tel.: 33-93-30 33 71

MOROCCO
Mr Abdallah Nejjar
Directeur de la Normalisation et de la Promotion de la Qualité
Ministère du Commerce et de l’Industrie
Quartier administratif
Rabat-Challah
Tel.: 212-7-37 37 33
Fax: 212-7-37 62 96

NETHERLANDS
Mr G. J. Faber
Director General
Nederlandse Merkinstuut nv
Hugo de Grootplein 1
3316 EG Dordrecht
Tel.: 31-78-33 23 32
Fax: 31-78-33 23 09
Telex 83 333 BKWZ NL

NORWAY
The General Director
National Measurement Service
Postbox 6832 St. Olavs Plass
0130 Oslo 1
Tel.: 47-22-20 02 26
Fax 47-22-20 77 72

PAKISTAN
Mr M. Asad Hasan
Director
Pakistan Standards Institution
35-40 Pratap Nagar, Saddar
Karachi-74000
Tel.: 92-21-572 95 27
Fax 92-21-572 81 24
Telex 42974 PEYASA1

POLAND
Mr Krzysztof Marecki
President
Central Office of Measures
ul. Elektoralna 2
P.O. Box P-10
PL 80-950 Warsaw
Tel.: 48-22-20 07 47
Fax: 48-22-20 83 78

PORTUGAL
Mr J. N. Cariazo Reis
Director General
Instituto Português de Metrologia
Rua C Avenida das Três Vales
2825 Monte da Caparica
Tel.: 351-1-294 81 96
Fax: 351-1-294 81 88

ROMANIA
Mr P. G. Jordachescu
Director General
Bureau Roumain de Métrologie Ligale
21, Boulevard Nicolae Balcescu
70112 Bucharest
Tel.: 40-1-613 16 54
Fax: 40-1-512 05 01

RUSSIAN FEDERATION
Mr L. K. Issaev
Vice-President
Gosstandart of Russia
Leninsky Prospect 9
117049 Moscow
Tel.: 7-985-236 40 44
Fax: 7-985-237 60 32
Telex 411378 GOST
Telegram Moskva-Standart

SAUDI ARABIA
Mr Khaleed Y. Al-Khalifa
Director General
Saudi Arabian Standards Organization
P.O. Box 3437
14171 Riyadh
Tel.: 966-1-452 00 00
Fax: 966-1-452 00 96
Telex 40 16 10 susr sa

SLOVAKIA
Mr Lubomir Sutek
President
Úrad pre Normalizáciu
Metrologie a Strojomenstva SR
Štefanovicka 3
814 39 Bratislava
Tel.: 42-7-491 085
Fax: 42-7-491 090

SLOVENIA
Mr Vasja Hrovat
Director of SMIS
Ministrstvo za znanost in tehnologijo
Uradi za standardizacijo in mezinadzoro
Kotnikova 6
61000 Ljubljana
Tel.: 386-61-13 12 32
Fax: 386-61-31 882

SWEDEN
Mrs A. Ebbesson
Technical Officer
SWEDAC
Box 978
S-100 38 Stockholm
Tel.: 46-31-77 77 00
Fax: 46-31-10 13 92

SWITZERLAND
Mr O. Pilli
Director
Office Fédéral de Métrologie
Lindenweg 50
CH-3064 Wabern
Tel.: 41-31-963 31 11
Fax: 41-31-963 32 10
Telegram OFMET

TANZANIA
Mr A. H. M. Tukal
Commissioner for Weights and Measures
Weights and Measures Bureau
Ministry of Industries and Trade
P.O. Box 313
Dar es Salaam
Tel.: 255-01-76 24 74
Fax: 255-01-76 23 19 02

THE FORMER YUGOSLAVE REPUBLIC
OF MACEDONIA
The Assistant of the Minister
Department of Weights and Measures
Ministry of Economy
Samarovibi 10
91000 Skopje
Tel.: 389-91-22 47 74
Fax: 389-91-22 19 02

TUNISIA
Mr Ali Ben Guid
Président Directeur Général
Institut National de la Normalisation
de la Propriété Industrielle
Boîte postale 23
1012 Tunis Belvédère
Tel.: 216-1-857 922
Fax: 216-1-781 563
Telex 13 602 INORPI
CORRESPONDING MEMBERS

ALBANIA
The Director
National Directorate
Direktorja Komitetit e Mezatitjë dhe e Kombimit (OMMK)
Rruga "Samt Frasheri", No. 33
Tirana

BAHRAIN
The Responsible of Metrology
Standards and Metrology Section
Ministry of Commerce and Agriculture
P.O. Box 5479
Manama

BANGLADESH
The Director General
Bangladesh Standards and Testing Institution
116-A Tejgaon Industrial Area
Dhaka 1208

BARRADOS
The Director
Barbados Standards and Testing Authority
Culloden Road
St. Michael
Barbados W.I.

BENIN
Direction de la Qualité
et des Instruments de Mesure
Ministère du Commerce et du Tourisme
Cotonou

BOTSWANA
The Permanent Secretary
Division of Weights and Measures
Department of Commerce and Consumer Affairs
Private Bag 48
Gaborone

BURKINA FASO
Direction Générale des Prix
Ministère du Commerce
et de l'Approvisionnement du Peuple
BP 19
Ouagadougou

COLOMBIA
Superintendencia de Industria y Comercio
Centro de Control de Calidad y Metrologia
Cra. 37 No 52-85, 4° piso
Bogota D.E.

COSTA RICA
Oficina Nacional de Normas y Unidades de Medida
Ministerio de Economia y Comercio
Apartado 10 216
San Jose

CROATIA
Director General
State Office for Standardization
and Metrology
Avenija Vukovar 78
41000 Zagreb

ECUADOR
The General Director
Instituto Ecuadoriano de Normalizacion
Rasquerico Moreno No. 454 y Almagro
Casilla 17-01 3999
Quito

FIJI
The Chief Inspector of Weights and Measures
Ministry of Economic Development, Planning
and Tourism
Government Buildings
P.O. Box 2118
Suva

GHANA
The Director
Ghana Standards Board
P.O. Box M. 245
Accra

HONG KONG
Commissioner of Customs and Excise
Customs and Excise Department
Trade Department Tower
16/F
700 Nathan Road
Kowloon

ICELAND
The Director
Icelandic Bureau of Legal Metrology
Laeglingsgarðurinn
Síðanum 13
P.O. Box 8114
128 Reykjavik

HONORARY MEMBERS
Mr. K. Birkeland
Norway
Immediate Past President of CIML

Mr. V. Evmenkov
Russian Federation
former CIML Vice-President

Mr. A. Perlauf
Switzerland
former member of the Presidential Council

Mr. W. Mühe
Germany
former CIML Vice-President

Mr. H. W. Luks
Germany
former member of the Presidential Council
JORDAN
Directorate of Standards
Ministry of Industry and Trade
P.O. Box 2019
Amman

MONGOLIA
The Director General
Mongolian National Institute for Standardization and Metrology
P.O. Box 185
Ulaanbaatar 51

SYRIA
The General Director
The Syrian Arab Organization for Standardization and Metrology
P.O. Box 11836
Damascus

NEPAL
The Chief Inspector
Nepal Bureau of Standards and Metrology
P.O. Box 985
Sundhara
Kathmandu

THAILAND
The Director General
Department of Commercial Registration
Ministry of Commerce
Maharaj Road
Bangkok 10200

NEW ZEALAND
The Manager
Trade Measurement Unit
Ministry of Consumer Affairs
P.O. Box 1473
Wellington

TRINIDAD AND TOBAGO
The Director
Trinidad and Tobago Bureau of Standards
Century Drive, Trinity Industrial Estate,
P.O. Box 467
Morooya, Tunapuna, Trinidad, W.I

OMAN
The General Director
for Specifications and Measurements
Ministry of Commerce and Industry
P.O. Box 550
Muscat

TURKEY
The General Director
Sanayi ve Ticaret Bakani
Olbetler ve Standardlar Genel Mudurlugu
06100 Tandogan
Ankara

LITHUANIA
The Director
Lieiniai Standartizacijos Taryba
A. Jabio g 1/25
2600 Vilnius

UGANDA
Commissioner for Weights and Measures
Weights and Measures Department
Ministry of Commerce
P.O. Box 7192
Kampala

MALAYSIA
The Director of Standards
Standards and Industrial Research
Institute of Malaysia
P.O. Box 7035
40911 Shah Alam
Selangor Darul Ehsan

URUGUAY
Director Nacional
Direccion Nacional de Metrologia Legal
Ministerio de Industria, Energia y Mineria
Buenos Aires 495
Montevideo

MALAWI
The Principal Assizer
Assizer Department
P.O. Box 156
Lilongwe

PERU
The Director General
INDECOPI
Instituto Nacional de Defensa de la Competencia y de la Proteccion de la Propiedad Intelectual
Próspero Guardia Civil No.400
Esq. con Av. Cano, San Borja
Lima 41

WEG |
Bureau of Product Standards
Department of Trade and Industry
3rd floor DFI Building
361 Sen. Gil J. Puyat Avenue
Makati, Metro Manila
Philippines 1117

VENEZUELA
The Director
Direccion General de Tecnologias
Servicio Nacional de Metrologia
Ministerio de Fomento
Av. Javier Ustariz, Edif. Parque Residencial
Urb. San Bernardino
Caracas

MEXICO
Direccion General de Normas
Secretaria de Comercio y Fomento Industrial
Sistema Nacional de Calibracion
Ave. Paseo de Texcoco, no. 6
Plaza Baja
Lomas de Tezcapochtli, Seccion Fuentes
53950 Naucalpan de Juarez

S. R. VIETNAM
General Department for Standardization, Metrology and Quality Control
70 Tran Hung Dao St.
Hanoi

Mauritius
The Permanent Secretary
Ministry of Trade and Shipping
(Division of Weights and Measures)
New Government Centre
Port Louis

SEYCHELLES
The Director
Seychelles Bureau of Standards
P.O. Box 648
Victoria

YEMEN
The Director General
Yemen Standardization & Metrology Organization
P.O. Box 19213
San'a
Below are lists of OIML publications classified by subject and number. The following abbreviations are used: International Recommendation (R), International Document (D), vocabulary (V), miscellaneous publication (P). Publications are available in French and English in the form of separate leaflets, unless otherwise indicated. Prices are given in French-francs and do not include postage.

To order publications, please contact the OIML Secretariat by letter or fax:

BUREAU INTERNATIONAL DE METROLOGIE LEGALE
11, RUE TURGOT, 75009 PARIS, FRANCE
TEL: 33 1 48 78 12 82 OR 33 1 42 85 27 11
FAX: 33 1 42 82 17 27


Ces publications peuvent être commandées par lettre ou fax au BIML (voir adresse plus haut).

**General**

**Généralités**

R 34 (1979-1974)
Accuracy classes of measuring instruments
Classes de précision des instruments de mesure

R 42 (1981-1977)
Metal stamps for verification officers
Poinçons de métal pour Agents de vérification

D 1 (1975)
Law on metrology
Loi de métrologie

D 2 (in revision - en cours de révision)
Legal units of measurement
Unités de mesure légales

D 3 (1974)
Legal qualification of measuring instruments
Qualification légale des instruments de mesure

D 5 (1982)
Principles for the establishment of hierarchy schemes for measuring instruments
Principes pour l'établissement des schémas de hiérarchie des instruments de mesure

D 9 (1984)
Principles of metrological supervision
Principes de la surveillance métrologique

D 12 (1986)
Fields of use of measuring instruments subject to verification
Domaines d'utilisation des instruments de mesure assujettis à la vérification

D 13 (1986)
Guidelines for bi- or multilateral arrangements on the recognition of test results - pattern approvals - verifications
Conseils pour les arrangements bi- ou multilatéraux de reconnaissance des résultats d'essais - approbations de modèles - vérifications

D 14 (1989)
Training of legal metrology personnel - Qualification - Training programmes
Formation du personnel en métrologie légale - Qualification - Programmes d'étude

D 15 (1986)
Principles of selection of characteristics for the examination of measuring instruments
Principes du choix des caractéristiques pour l'examen des instruments de mesure usuels

D 16 (1986)
Principles of assurance of metrological control
Principes d'assurance du contrôle métrologique

D 19 (1988)
Pattern evaluation and pattern approval
Essai de modèle et approbation de modèle
D 20 (1988) 80 FRF
Initial and subsequent verification of measuring instruments and processes
Vérifications primitive et ultérieure des instruments et procédés de mesure

V 1 (1978) 100 FRF
Vocabulary of legal metrology (bilingual French-English)
Vocabulaire de métrologie légale (bilingue français-anglais)

V 2 (1993) 200 FRF
International vocabulary of basic and general terms in metrology (bilingual French-English)
Vocabulaire international des termes fondamentaux et généraux de métrologie (bilingue français-anglais)

P 1 (1991) 60 FRF
OIML Certificate System for Measuring Instruments
Système de Certificats OIML pour les Instruments de Mesure

P 2 (1987) 100 FRF
Metrology training - Synthesis and bibliography (bilingual French-English)
Formation en métrologie - Synthèse et bibliographie (bilingue français-anglais)

P 3 (being printed - en cours de publication)
Metrology in Member States and Corresponding Member Countries
Métrie dans les Etats Membres et Pays Membres Correspondants de l'OIML

P 9 (1992) 100 FRF
Guidelines for the establishment of simplified metrology regulations

P 17 (1993) 300 FRF
Guide to the expression of uncertainty in measurement

Measurement standards
and verification equipment
Étalons et équipement de vérification

D 6 (1983) 60 FRF
Documentation for measurement standards and calibration devices
Documentation pour les étalons et les dispositifs d'étalonnage

D 8 (1984) 60 FRF
Principles concerning choice, official recognition, use and conservation of measurement standards
Principes concernant le choix, la reconnaissance officielle, l'utilisation et la conservation des étalons

D 10 (1984) 50 FRF
Guidelines for the determination of recalibration intervals of measuring equipment used in testing laboratories
Conseils pour la détermination des intervalles de rééquilibrage des équipements de mesure utilisés dans les laboratoires d'essais

D 18 (1987) 50 FRF
General principles of the use of certified reference materials in measurements
Principes généraux d'utilisation des matériaux de référence certifiés dans les mesures

D 23 (1993) 80 FRF
Principles of metrological control of equipment used for verification
Principes du contrôle métrologique des équipements utilisés pour la vérification

P 4 (1986-1981) 100 FRF
Verification equipment for National Metrology Services
Equipement d'un Service national de métrologie

P 6 (1987) 100 FRF
Suppliers of verification equipment (bilingual French-English)
Fournisseurs d'équipement de vérification (bilingue français-anglais)

P 7 (1989) 100 FRF
Planning of metrology and testing laboratories
Planification de laboratoires de métrologie et d'essais

P 15 (1989) 100 FRF
Guide to calibration

Mass and density
Masses et masses volumiques

Instruments for measuring the hectolitre mass of cereals
Instruments de mesure de la masse à l'hectolitre des céréales

R 22 (1975) 150 FRF
International alcoholometric tables (trilingual French-English-Spanish version)
Tables alcoométriques internationales (version trilingue français-anglais-espagne)

R 33 (1979-1973) 50 FRF
Conventional value of the result of weighing in air
Valeur conventionnelle du résultat des pesées dans l'air

R 44 (1985) 50 FRF
Alcoholometers and alcohol hydrometers and thermometers for use in alcoholometry
Alcoomètres et seringues pour alcool et thermomètres utilisés en alcoométrie

R 47 (1979-1978) 60 FRF
Standard weights for testing of high capacity weighing machines
Pois d'étalons pour le contrôle des instruments de pesage de portée élevée

R 50 (1994) 100 FRF
Continuous totaling automatic weighing instruments
Instruments de pesage totalisateurs continus à fonctionnement automatique

R 51 (1985) 80 FRF
Checkweighting and weight grading machines
Titres pondérales de contrôle et titres pondérales de classement
Length and speed
Longueurs et vitesses

R 21 (1975–1973)  60 FRF
Taximeters
Taximètres

R 24 (1975–1973)  50 FRF
Standard one metre bar for verification officers
Mètre-éclat rigide pour Agents de vérification

R 30 (1981)  60 FRF
End standards of length (gauge blocks)
Mesures de longueur à bouts plans (cales étalons)

R 35 (1983)  80 FRF
Material measures of length for general use
Mesures matérialisées de longueur pour usages généraux

R 55 (1981)  50 FRF
Speedometers, mechanical odometers and chromatographs for motor vehicles. Meteorological regulations
Compteurs de vitesse, compteurs mécaniques de distance et chromatographes des véhicules automobiles. Réglementation météorologique

R 66 (1985)  60 FRF
Length measuring instruments
Instruments mesureurs de longueurs

R 91 (1990)  60 FRF
Radial equipment for the measurement of the speed of vehicles
Cinématiques radar pour la mesure de la vitesse des véhicules

R 98 (1991)  60 FRF
High-precision line measures of length
Mesures matérialisées de longueur à traits de haute précision

Liquid measurement
Mesurage des liquides

R 4 (1972–1970)  50 FRF
Volumetric flasks (one mark) in glass
Flacons réguliers à un trait en verre

R 29 (1979–1973)  50 FRF
Capacity serving measures
Mesures de capacité de service

R 40 (1981–1977)  60 FRF
Standard graduated pipettes for verification officers
Pipettes graduées étalons pour Agents de vérification

R 41 (1981–1977)  60 FRF
Standard burettes for verification officers
Burettes étalons pour Agents de vérification

R 43 (1981–1977)  60 FRF
Standard graduated glass flasks for verification officers
Flacons étalons gradués en verre pour Agents de vérification

R 45 (1980–1977)  50 FRF
Casks and barrels
Tonneaux et fûts
R 49 (in revision - en cours de révision)
Water meters intended for the metering of cold water
Compteurs d'eau destinés au mesurage de l'eau froide

R 63 (1994)
Petroleum measurement tables
Tables de mesure du pétrole

R 71 (1980)
Fixed storage tanks. General requirements
Réervoirs de stockage fixes. Prescriptions générales

R 72 (1985)
Hot water meters
Compteurs d'eau destinés au mesurage de l'eau chaude

R 80 (1989)
Road and rail tankers
Camiots et wagons-citernes

R 81 (1989)
Measuring devices and measuring systems for cryogenic liquids (including tables of density for liquid argon, helium, hydrogen, nitrogen and oxygen)
Dispositifs et systèmes de mesure de liquides cryogéniques (comprend tables de masse volumique pour argon, hélium, hydrogène, azote et oxygène liquides)

R 85 (1989)
Automatic level gauges for measuring the level of liquid in fixed storage tanks
Jaugeurs automatiques pour le mesurage des niveaux de liquide dans les réservoirs de stockage fixes

R 86 (1989)
Drum meters for alcohol and their supplementary devices
Compteurs à tambour pour alcool et leurs dispositifs complémentaires

R 95 (1990)
Ships' tanks - General requirements
Bataux-citernes - Prescriptions générales

R 96 (1990)
Measuring container bottles
Bouteilles récipients-mesures

R 105 (1993)
Direct mass flow measuring systems for quantities of liquids
Ensembles de mesurage massiques directs de quantités de liquides
Annex (being printed - en cours de publication)
Test report format
Format du rapport d'essai

R 117 (being printed - en cours de publication)
Measuring assemblies for liquids other than water
Ensembles de mesure de liquides autres que l'eau

R 118 (being printed - en cours de publication)
Testing procedures for pattern examination of fuel dispensers for motor vehicles
Procédures d'évaluation des modèles de distributeurs de carburants pour véhicules à moteur

R 119 (being printed - en cours de publication)
Pipe provers for testing of measuring systems for liquids other than water
Tubes étalons pour l'essai des ensembles de mesure de liquidés autres que l'eau

R 120 (being printed - en cours de publication)
Characteristics of standard capacity measures and test methods for measuring systems for liquids other than water
Caractéristiques des mesures de capacité standards et méthodes d'essai des ensembles de mesurage de liquidés autres que l'eau

D 4 (1981)
Installation and storage conditions for cold water meters
Conditions d'installation et de stockage des compteurs d'eau froide

D 7 (1984)
The evaluation of flow standards and facilities used for testing water meters
Évaluation des établis de débitmètre et des dispositifs utilisés pour l'essai des compteurs d'eau

D 25 (being printed - en cours de publication)
Vortex meters used in measuring systems for fluids
Compteurs à vortex utilisés dans les ensembles de mesure de fluides

D 26 (being printed - en cours de publication)
Glass delivery measures - Automatic pipettes
Mesures en verre à délivrer - Pipettes automatiques

Gas measurement
Mesurage des gaz(*)

R 6 (1989)
General provisions for gas volume meters
Dispositions générales pour les compteurs de volume de gaz

R 31 (1995)
Diaphragm gas meters
Compteurs de gaz à parois deformables

R 32 (1989)
Rotary piston gas meters and turbine gas meters
Compteurs de volume de gaz à pistons rotatifs et compteurs de volume de gaz à turbine

Pressure
Pressions(**)

R 23 (1975-1977)
Tyre pressure gauges for motor vehicles
Manomètres pour pneumatiques de véhicules automobiles

(*) See also "Liquid measurement" D 25 - Voir aussi "Mesurage des liquides" D 25.
(**) See also "Medical instruments" - Voir aussi "Instrumentes médicaux".
R 53 (1982) 60 FRF
Metrological characteristics of elastic sensing elements used for measurement of pressure. Determination methods
Caractéristiques métrologiques des éléments récepteurs élastiques utilisés pour le mesurage de la pression. Méthodes de leur détermination

R 97 (1990) 60 FRF
Barometers
Baromètres

R 101 (1991) 80 FRF
Indicating and recording pressure gauges, vacuum gauges and pressure vacuum gauges with elastic sensing elements (ordinary instruments)
Manomètres, vacuomètres et manovacuomètres indicateurs et enregistreurs à élément récepteur élastique (instruments usuels)

R 109 (1993) 60 FRF
Pressure gauges and vacuum gauges with elastic sensing elements (standard instruments)
Manomètres et vacuomètres à élément récepteur élastique (instruments étalons)

R 110 (1994) 80 FRF
Pressure balances
Manomètres à piston

Temperature
Températures(∗)

R 18 (1989) 60 FRF
Visual disappearing filament pyrometers
Pyrnomètres à filament disparissant

R 48 (1980–1978) 50 FRF
Tungsten ribbon lamps for calibration of optical pyrometers
Lampes à ruban de tungstène pour l'étalonnage des pyromètres optiques

R 75 (1988) 60 FRF
Heat meters
Compteurs d'énergie thermique

R 84 (1989) 60 FRF
Resistance-thermometer sensors made of platinum, copper or nickel (for industrial and commercial use)
Capteurs de résistance thermométrique de platine, de cuivre ou de nickel (pour usages techniques et commerciaux)

D 24 (being printed - en cours de publication)
Total radiation pyrometers
Pyrnomètres à radiation totale

P 16 (1991) 100 FRF
Guide to practical temperature measurements
Guide à la mesure des températures pratiques

Electricity
Electricité

R 46 (1990–1978) 80 FRF
Active electrical energy meters for direct connection of class 2
Compteurs d'énergie électrique active à branchement direct de la classe 2

D 11 (1994) 80 FRF
General requirements for electronic measuring instruments
Évènements générales pour les instruments de mesure électroniques

Acoustics and vibration
Acoustique et vibrations(∗)

R 58 (1984) 50 FRF
Sound level meters
Sondomètres

R 88 (1989) 50 FRF
Integrating-averaging sound level meters
Sondomètres intégrateurs-moyenneurs

R 102 (1992) 50 FRF
Sound calibrators
Calibrateurs acoustiques
Annex (being printed - en cours de publication)
Test procedures and test report format
Procédures d'essai et format du rapport d'essai

R 103 (1992) 60 FRF
Measuring instrumentation for human response to vibration
Appareillage de mesure pour la réponse des individus aux vibrations

R 104 (1993) 60 FRF
Pure-tone audiometers
Audiomètres à sons purs

Environment
Environnement

R 82 (1989) 80 FRF
Gas chromatographs for measuring pollution from pesticides and other toxic substances
Chromatographies en phase gazeuse pour la mesure des pollutions par pesticides et autres substances toxiques

R 83 (1990) 80 FRF
Gas chromatograph/mass spectrometer/data system for analysis of organic pollutants in water
Chromatographie en phase gazeuse équipé d'un spectromètre de masse et d'un système de traitement de données pour l'analyse des polluants organiques dans l'eau

R 99 (1991) 100 FRF
Instruments for measuring vehicle exhaust emissions
Instruments de mesure des gaz d'échappement des véhicules

(∗) See also "Medical instruments" - Voir aussi "Instruments médicaux".
R 100 (1991) 80 FRF
Atomic absorption spectrometers for measuring metal pollutants in water
Spectromètres d’absorption atomique pour la mesure des polluants métalliques dans l’eau

R 112 (1994) 80 FRF
High performance liquid chromatographs for measurement of pesticides and other toxic substances
Chromatographes en phase liquide de haute performance pour la mesure des pesticides et autres substances toxiques

R 113 (1994) 80 FRF
Portable gas chromatographs for field measurements of hazardous chemical pollutants
Chromatographes en phase gazeuse portatifs pour la mesure sur site des polluants chimiques dangereux

R 116 (being printed - en cours de publication) 80 FRF
Inductively coupled plasma atomic emission spectrometers for measurement of metal pollutants in water
Spectromètres à émission atomique de plasma couplés inductivement pour le mesurage des polluants métalliques dans l’eau

D 22 (1991) 80 FRF
Guide to portable instruments for assessing airborne pollutants arising from hazardous wastes
Guide sur les instruments portatifs pour l’évaluation des polluants atmosphériques émanant de sites dangereux

Physico-chemical measurements
Mesures physico-chimiques

R 14 (being printed - en cours de publication) 80 FRF
Polarimetric saccharimeters
Sécomètres polarimétriques

R 54 (in revision - en cours de révision) 80 FRF
pH scale for aqueous solutions
Échelle de pH des solutions aqueuses

R 56 (1981) 50 FRF
Standard solutions reproducing the conductivity of electrolytes
Solutions-définites reproduisant la conductivité des électrolytes

R 59 (1984) 80 FRF
Moisture meters for cereal grains and oilseeds
Humidimètres pour grains de céréales et grains oléagineux

R 68 (1985) 50 FRF
Calibration method for conductivity cells
Méthode d’étalonnage des cellules de conductivité

R 69 (1985) 50 FRF
Glass capillary viscometers for the measurement of kinematic viscosity, Verification method
Viscosimètres à capillaires, en verre, pour la mesure de la viscosité cinématique, Méthode de vérification

R 70 (1985) 50 FRF
Determination of intrinsic and hysteresis errors of gas analysers
Détermination des erreurs de base et d’hiérarchies des analyseurs de gaz

R 73 (1983) 50 FRF
Requirements concerning pure gases CO, CO₂, CH₄, H₂, O₂, N₂
and Ar intended for the preparation of reference gas mixtures
Prescriptions pour les gaz purs CO, CO₂, CH₄, H₂, O₂, N₂ et Ar destinés à la préparation des mélanges de gaz de référence

R 92 (1989) 60 FRF
Wood-moisture meters - Verification methods and equipment: general provisions
Humidimètres pour le bois - Méthodes et moyens de vérification: exigences générales

R 108 (1993) 60 FRF
Refractometers for the measurement of the sugar content of fruit juices
Rafraîchisseurs pour la mesure de la teneur en sucre des jus de fruits

R 121 (being printed - en cours de publication) 50 FRF
The scale of relative humidity of air certified against saturated salt solutions
Échelle d’humidité relative de l’air certifiée par rapport à des solutions saturées de sel

D 17 (1987) 50 FRF
Hierarchy scheme for instruments measuring the viscosity of liquids
Schéma de hiérarchie des instruments de mesure de la viscosité des liquides

Medical instruments
Instruments médicaux

R 7 (1979–1978) 60 FRF
Clinical thermometers, mercury-in-glass with maximum device
Thermomètres médicaux à mercure, en verre, avec dispositif à maximum

R 16 (1973–1979) 50 FRF
Manometers for instruments for measuring blood pressure
(sphygmomanometers)
Manomètres des instruments de mesure de la tension artérielle
(sphygmomanomètres)

R 26 (1978–1972) 50 FRF
Medical syringes
Seringues médicales

R 78 (1989) 50 FRF
Westergren tubes for measurement of erythrocyte sedimentation rate
Pièces Westergren pour la mesure de la vitesse de sédimentation des hématies

R 89 (1990) 80 FRF
Electroencephalographs - Metrological characteristics - Methods and equipment for verification
Electroencephalographes - Caractéristiques métrologiques - Méthodes et moyens de vérification
Testing of materials
Essais des matériaux

R 9 (1972-1970) 60 FRF
Verification and calibration of Brinell hardness standardized blocks
Vérification et étalonnage des blocs de référence de dureté Brinell

R 10 (1974-1970) 60 FRF
Verification and calibration of Vickers hardness standardized blocks
Vérification et étalonnage des blocs de référence de dureté Vickers

R 11 (1974-1970) 60 FRF
Verification and calibration of Rockwell B hardness standardized blocks
Vérification et étalonnage des blocs de référence de dureté Rockwell B

R 12 (1974-1970) 60 FRF
Verification and calibration of Rockwell C hardness standardized blocks
Vérification et étalonnage des blocs de référence de dureté Rockwell C

R 36 (1980-1977) 60 FRF
Verification of indenters for hardness testing machines
Vérification des poinçonneurs des machines d'essai de dureté

R 37 (1981-1977) 60 FRF
Verification of hardness testing machines (Brinell system)
Vérification des machines d'essai de dureté (système Brinell)

R 38 (1981-1977) 60 FRF
Verification of hardness testing machines (Vickers system)
Vérification des machines d'essai de dureté (système Vickers)

R 39 (1981-1977) 60 FRF
Verification of hardness testing machines (Rockwell systems B,F,T-C.A.N)
Vérification des machines d'essai de dureté (systèmes Rockwell B,F,T-C.A.N)

R 62 (1985) 80 FRF
Performance characteristics of metallic resistance strain gauges
Caractéristiques de performance des extensomètres métalliques à résistance

R 64 (1985) 50 FRF
General requirements for materials testing machines
Études générales pour les machines d'essai des matériaux

R 65 (1985) 60 FRF
Requirements for machines for tension and compression testing of materials
Études générales pour les machines d'essai des matériaux en traction et en compression

V 3 (1991) 80 FRF
Hardness testing dictionary (quadri-lingual French-English-German-Russian)
Dictionnaire des essais de dureté (quadri-lingual français-anglais-allemand-ruisseau)

P 10 (1981) 50 FRF
The metrology of hardness scales - Bibliography

P 11 (1983) 100 FRF
Factors influencing hardness measurement

P 12 (1984) 100 FRF
Hardness test blocks and indenters

P 13 (1989) 100 FRF
Hardness standard equipment

P 14 (1991) 100 FRF
The unification of hardness measurement

Prepackaging
Préemballages

R 79 (1989) 50 FRF
Information on package labels
Étiquetage des préemballages

R 87 (1989) 50 FRF
Net content in packages
Contenu net des préemballages
INTERNATIONAL RECOMMENDATIONS
RECOMMANDATIONS INTERNATIONALES

R 8 (1970-1972)
Volume in glass.
R 6 (1959)
General provisions for gas volume meters.
R 7 (1972-1978)
Clinical thermometer, mercury-in-glass with maximum device.
R 9 (1972-1970)
Verification and calibration of Brinnell hardness standardised blocks.
Verification and calibration of Vickers hardness standardised blocks.
Verification and calibration of Rockwell B hardness standardised blocks.
Verification and calibration of Rockwell C hardness standardised blocks.
R 14 (being printed - en cours de publication)
Polysynthetic sintered materials.
Instruments for measuring the lecithin mass of cereals.
R 16 (1973-1970)
Manometers for measuring blood pressure (sphygmomanometers).
R 18 (1989)
Visual disappearance flamel pyrometers.
R 21 (1975-1973)
Taximeters.
R 22 (1975-1973)
International alcohonometers tables (bilingual French-English-Spanish).
R 23 (1975-1973)
Tyre pressure gauges for motor vehicles.
R 24 (1975-1973)
Standard one metre bar for verification officers.
R 26 (1972-1973)
Medical syringes.
R 29 (1979-1973)
Capacity sampling measures.
R 30 (1961)
End standards of length (gauge blocks).
R 31 (1956)
Diasphragm gas meters.
R 32 (1959)
Rotary piston gas meters and turbine gas meters.
R 33 (1979-1973)
Conventional value of the result of weighing in air.

R 34 (1979-1975)
Acidity classes of measuring instruments.
R 35 (1983)
Material measures of length for general use.
R 36 (1980-1977)
Verification of indicators for hardness testing machines.
R 37 (1981-1977)
Verification of hardness testing machines (Brinnell system).
R 38 (1981-1977)
Verification of hardness testing machines (Vickers system).
R 39 (1981-1977)
Verification of hardness testing machines (Rockwell systems B, F, T, C, A, N).
R 40 (1981-1977)
Standard graduated pipettes for verification officers.
R 41 (1951-1977)
Standard burette for verification officers.
R 42 (1981-1977)
Metal stamps for verification officers.
R 43 (1981-1977)
Standardized graduated glass flasks for verification officers.
R 44 (1983)
Alcohonometers and alcohol hydrometers and thermometers for use in olonomatry.
R 45 (1950-1977)
Corks and bungs.
R 46 (1960-1978)
Active electrical energy meters for direct connection of class 2.
R 47 (1979-1978)
Standard weights for testing of high capacity weighing machines.
R 48 (1980-1978)
Tungsten ribbon lamps for calibration of optical pyrometers.
R 49 (in revision - en cours de révision)
Water meters calibrated for the measuring of cold water.
R 50 (1994)
Continuously totalizing automatic weighing instruments (load weighers).
R 51 (1963)
Check weighing and weight grading machines.
R 52 (1963)
Hexagonal weights, ordinary accuracy class from 100 g to 50 kg.
R 53 (1963)
Metallurgical characteristics of elastic sensing elements used for measurement of pressure. Determination methods.
Metrologie reglementation
Comprennent de vitesse, comprennent indicatrices de distance et chemocathermographes des vehicules automobilistes. Reglementation metropolitique

R 56 (1981) Standard solutions reproducing the conductivity of electrolytes
Solutions-elektrolytes reproduisant la conductivite des electrolytes

R 58 (1984) Sound level meters
Sonometres

R 59 (1984) Moisture meters for cereal grains and oilseeds
Humidimetres pour grains de cereales et graines oleagineuses

R 60 (1991) Metrological regulation for blood cells
Reglementation metropolitique des cellules de la pempe
Annex (1993) Test report format for the evaluation of blood cells
Format du rapport d'evaluation des cellules de la pempe

R 61 (1985) Automaticgravimetric filling machines
Dispositifs manuellement de fonctionnement automatique

R 62 (1985) Performance characteristics of metallic resistance strain gauges
Caracteristiques de performances des autonosmometres metaliques a la tension

R 63 (1994) Petroleum measurement tables
Tables de mesure du p6trole

R 64 (1985) General requirements for materials testing machines
Exigences generales pour les machines d'essai des materiaux

R 65 (1985) Requirements for materials testing machines for tension and compression testing of materials
Exigences pour les machines d'essai des materiaux en traction et en compression

R 66 (1985) Length measuring instruments
Instruments mesureurs de longeur

R 68 (1985) Calibration method for conductivite cells
Methode d'etalonnage des cellules de conducivite

R 69 (1985) Grass capillary viscometers for the measurement of kinemetic viscosity, Verification method
Viscometre a capillaire, un verre, pour la mesure de la viscosite cinematique.
Methode de verification

R 70 (1985) Determination of intrinsic and hysteretic errors of gas analyzers
Determination des erreurs de base et d'hysteresis des analyseurs de gaz

R 71 (1985) Fixed storage tanks. General requirements
Reservoirs de stockage fixes. Exigences generales

R 72 (1985) Hot water meters
Compteur d'eau destin6 aux mesures de l'eau chaude

R 73 (1985) Requirements concerning pure gases CO, CO2, CH4, H2, C2H6, N2, and Ar intended for the prepaition of reference gas mixtures
Prescriptions pour les gaz purs CO, CO2, CH4, H2, C2H6, N2, et Ar destin6s a la preparation des melanges de gaz de reference

R 74 (1993) Electronic weighing instruments
Instruments de pesage electroniques

R 75 (1980) Heat meters
Compteur d'energie thermique

Instruments de pesage a fonctionnement non automatique. Partie 1. Exigences metropolitique et techniques - Tests
Amfement No. 1 (1994) free / gratuit

Instruments de pesage a fonctionnement non automatique. Partie 2: Rapport d'essai de modele
Amendment No. 1 (1995) free / gratuit

R 78 (1989) Westergren tubes for measurement of erythrocyte sedimentation rate
Pipelets Westergren pour la mesure de la vitesse de sedimentation des leucocytes

R 79 (1989) Information on package labels
Etiquetage des emballages

R 80 (1989) Road and rail tankers
Cisternes et wagons-cisternes

R 81 (1989) Measuring devices and measuring system for cryogenic liquids including tables and denized for liquid oxygen, hydrogen, nitrogen and oxygen
Dispositifs et systemes de mesure de liquides cryogeniques (comprend tableaux de masse volumique pour organ, helium, hydrog6ne, azote et oxygene liquides)

R 82 (1999) Gas chromatographs for measuring pollution from pesticides and other toxic substances
Chromatographes en phase gazeuse pour la mesure des pollutions par pesticides et autres substances toxiques

R 83 (1990) Gas chromatograph/mass spectrometer/dota system for analysis of organic pollutants in water
Chromatographes en phase gazeuse equip6 d'un spectrometre de masse et d'un systeme de traitement de donnees pour l'analyse des pollutants organiques dans l'eau

R 84 (1989) Resistance-thermometer sensors made of platinum, copper or nickel for industrial and commercial use
Capteurs a resistance thermometrique de platine, de cuivre ou de nickel (pour usages techniques et commerciaux)

R 85 (1989) Autonomic level gauges for measuring the level of liquid in fixed storage tanks
Jaugeurs automatiques pour la mesure des niveaux de liquide dans les reservoirs de stockage fixes

R 86 (1989) Drum meters for alcohol and their supplementary devices
Compteur a tambour pour alcool et leurs dispositifs complementaires

R 87 (1989) Net content in packages
Contenu net des emballages

R 88 (1999) Integrating averaging sound level meters
Sonometres integrateurs/moyeneurs

R 89 (1990) Electroencephalographs - Metrological characteristics - Methods and equipment for verification
Electroencephalographes - Caracteristiques metropolitiques - Methodes et moyens de verification

R 90 (1990) Electroencephalographs - Metrological characteristics - Methods and equipment for verification
Electroencephalographes - Caracteristiques metropolitiques - Methodes et moyens de verification

R 91 (1990) Radar equipment for the measurement of the speed of vehicles
Contermetre radar pour la mesure de la vitesse des vehicules

R 92 (1989) Wodd moisture meters - Verification methods and equipment; general provisions
Humidimetres pour le bois - Methodes et moyens de verification; exigences generales
R 93 (1992)
Fumacettes
60 FRF

R 95 (1992)
Spatelés - General requirements
60 FRF

R 96 (1992)
Mesuring container beakers
50 FRF

R 97 (1992)
Baromètrées
60 FRF

R 98 (1991)
High precision line measures of length
60 FRF

R 99 (1991)
Instruments for measuring vehicle exhaust emissions
100 FRF

R 100 (1991)
Atomic absorption spectrometers for measuring metal pollutants in water
80 FRF

R 101 (1991)
Indicating and recording pressure gauges, vacuum gauges and pressure vacuum
gauges with elastic sensing elements (ordinary instruments)
80 FRF

R 102 (1992)
Sound calibrators
50 FRF

R 103 (1991)
Appareillage de mesure pour la réponse des individus aux vibrations
60 FRF

R 104 (1993)
Pure-tone audiometers
60 FRF

R 105 (1993)
Direct mass flow measuring systems for quantities of liquids
100 FRF

R 106 (1993)
Automatic rail weighbridges
100 FRF

R 107 (1993)
Discontinuous and continuous automatic weighing instruments (loading hopper weighers)
100 FRF

R 108 (1993)
Refraactometers for the measurement of the sugar content of fresh juices
40 FRF

R 109 (1993)
Pressure gauges and vacuum gauges with elastic sensing elements (standard instruments)
40 FRF

R 110 (1994)
Pressure balance
80 FRF

R 111 (1994d)
Weights of classes E, F, F₁, F₂, F₃, M₁, M₂, M₃
80 FRF

R 112 (1994d)
High performance liquid chromatography for measurement of pesticides and other toxic substances
80 FRF

R 113 (1994)
Chromatographes en phase liquide de haute performance pour la mesure des
pesticides et autres substances toxiques
80 FRF

R 114 (1995)
Portable gas chromatographs for field measurements of hazardous chemical
pollutants
80 FRF

R 115 (1995)
Thermomètres électroniques pour mesure en continu
80 FRF

R 116 (1995)
Inductively coupled plasma atomic emission spectrometers for measurement of metal
pollutants in water
80 FRF

R 117 (1995)
Appareillage de mesure de l'eau pour l'ensemble
des mesures de polluants métalliques dans l'eau
80 FRF

R 118 (1995)
Acier pour test de résistance des tôles perforées pour voitures
80 FRF

Résistance de l'eau à l'endurance des tôles perforées pour voitures
80 FRF

R 120 (1995)
Ensemble de mesures pour l'eau de la résistance des tôles perforées pour voitures
80 FRF

R 121 (1995)
Eau de source pour test de résistance des tôles perforées pour voitures
80 FRF

R 122 (1995)
Eau de source pour test de résistance des tôles perforées pour voitures
80 FRF

INTERNATIONAL DOCUMENTS

D 1 (1975)
Law on metrology
50 FRF

D 2 (1978)
Law on metrology
50 FRF

D 3 (1990)
Law on metrology
50 FRF

D 4 (1981)
Law on metrology
50 FRF

D 5 (1980)
Law on metrology
50 FRF

D 6 (1983)
Law on metrology
50 FRF
D 7 (1984)  
The evaluation of flow standards and facilities used for testing water meters. Evaluation des échelles de débitmètre et des dispositifs utilisés pour l’essai des compteurs d’eau  
80 FRF

D 8 (1984)  
Principes concernant choix, officiel recognition, use and conservation of measurement standards  
Principes concernant le choix, la reconnaissance officielle, l’utilisation et la conservation des échelles  
60 FRF

D 9 (1984)  
Principes de métrologie supervisée  
Principes de la surveillance métrologique  
60 FRF

D 10 (1984)  
Guidelines for the determination of calibration intervals of measuring equipment used in testing laboratories  
Conventions pour la détermination des intervalles de réétalonnage des équipements de mesure utilisés dans les laboratoires d’essais  
50 FRF

D 11 (1994)  
General requirements for electronic measuring instruments  
Exigences générales pour les instruments de mesure électroniques  
80 FRF

D 12 (1986)  
Fields of use of measuring instruments subject to verification  
Domaines d’utilisation des instruments de mesure soumis à la vérification  
50 FRF

D 13 (1985)  
Guidelines for bi- or multilateral arrangements on the recognition of test results - pattern approvals - certifications  
Conseils pour les arrangements bi- ou multilatéraux de reconnaissance des résultats d’essais - approbations de modèles - certifications  
50 FRF

D 14 (1989)  
Training of legal metrology personnel - Qualification - Training programmes  
Formation du personnel en métrologie légale - Qualification - Programmes d’études  
60 FRF

D 15 (1986)  
Principles of selection of characteristics for the examination of measuring instruments  
Principes du choix des caractéristiques pour l’examen des instruments de mesure usuels  
90 FRF

D 16 (1986)  
Principles of assurance of metrological control  
Principes de garantie du contrôle métrologique  
60 FRF

D 17 (1987)  
Hierarchy scheme for instruments measuring the viscosity of liquids  
Schéma hiérarchique des instruments de mesure de la viscosité des fluides  
50 FRF

D 18 (1987)  
General principles of the use of certified reference materials in measurements  
Principes généraux d’utilisation des matériaux de référence certifiés dans les mesurages  
50 FRF

D 19 (1988)  
Pattern evaluation and pattern approval  
Essai de modèles et approbation de modèles  
80 FRF

D 20 (1988)  
Initial and subsequent verification of measuring instruments and processes  
Vérification initiale et ultérieure des instruments et proces de mesure  
80 FRF

D 21 (1990)  
Secondary standard dosemeters for the calibration of dosimeters used in radiotherapy laboratories  
Dosedosimètres secondaires d’écalorimétrie en électron pour l’étalonnage des dosimètres utilisés en radiothérapie  
80 FRF

D 22 (1991)  
Guides for portable instruments for assessing airborne pollutants arising from hazardous wastes  
Guide sur les instruments portables pour l’évaluation des pollutions atmosphériques liées aux déchets dangereux  
80 FRF

D 23 (1992)  
Principles of metrological control of equipment used for verification  
Principes de contrôle métrologique des équipements utilisés pour la vérification  
80 FRF

D 24 (1991)  
Total radiation pyrometers  
Pyromètres à radiation totale  
80 FRF

D 25 (1991)  
Vortex meters used in measuring systems for liquids  
Compteur à vortex utilisés dans des assemblées de mesurage de fluides  
80 FRF

D 26 (1991)  
Glass delivery measures - Automatic pipettes  
Mesures en verre à délivrer - Pipettes automatiques  
80 FRF

VOCABULARIES  
V 1 (1978)  
Vocabulaire de la métrologie (bilingue français-anglais)  
Vocabulary de la métrologie (bilingue français-anglais)  
100 FRF

V 2 (1979)  
International vocabulary of basic and general terms in metrology (bilingue français-anglais)  
Vocabulaire international des termes fondamentaux et généraux de métrologie (bilingue français-anglais)  
200 FRF

V 3 (1979)  
Handbook testing dictionary (quadri-bilingue French-English-German-Russian)  
Dictionnaire des essais du bâtiment (quadri-bilingue français-anglais-allemand-roumain)  
80 FRF

OTHER PUBLICATIONS  
AUTRES PUBLICATIONS

P 1 (1991)  
OML Certificate System for Measuring Instruments  
Système des Certificats OML pour les instruments de mesure  
60 FRF

P 2 (1987)  
Metrology training - Synthese and bibliography (bilingue français-anglais)  
Formations en métrologie - Synthèse et bibliographie (bilingue français-anglais)  
100 FRF

P 3 (1989)  
Documentation for National Metrology Institutes  
Métérologie des Instituts National de Métrologie  
100 FRF

Verifications equipment for National Metrology Services  
EQUIPEMENTS DE VERIFICATIONS DE SERVICE NATIONAL DE METEOLOGIE  
100 FRF

P 5 (1992)  
Mobile equipment for the verification of road weighbridges (bilingue French-English)  
EQUIPEMENTS MOBILES POUR LA VERIFICATION DES PONTS-BORDEAUX ROUTIERES (bilingue français-anglais)  
100 FRF

P 6 (1987)  
Suppliers of verification equipment (bilingue French-English)  
Fournisseurs d’équipement de vérification (bilingue français-anglais)  
100 FRF

P 7 (1989)  
Flaring of metrology and testing laboratories  
Flamansment de laboratoires de métrologie et d’assais  
100 FRF

P 8 (1987)  
Density measurement  
Mesures de la masse volumique  
100 FRF

P 9 (1992)  
Guidelines for the establishment of simplified metrology regulations  
Guidelines for the establishment of simplified metrology regulations  
100 FRF

P 10 (1991)  
The metrology of hardness scales - Bibliography  
La métrologie des écailleures durées - Bibliographie  
50 FRF

P 11 (1993)  
Factors influencing hardness measurement  
Facteurs influençant la mesure d’induration  
100 FRF

P 12 (1994)  
Hardness test blocks and indentes  
Échantillons de dureté et indenteurs  
100 FRF

P 13 (1991)  
Hardness standard equipment  
Équipements de dureté standard  
100 FRF

P 14 (1991)  
The unification of hardness measurement  
La unification de la mesure des durées  
100 FRF

P 15 (1991)  
Guide to calibration  
Guide à calibration  
100 FRF

P 16 (1991)  
Guides for practical temperature measurements  
Guide à la pratique de la température  
100 FRF

P 17 (1993)  
Guide to the expression of uncertainty in measurement  
Guide à l’expression de l’incertitude d’mesures  
100 FRF

OIML bulletin Volume XXXVI • Number 2 • April 1993
CALL FOR PAPERS

The Editors of the OIML Bulletin welcome the submission of technical papers and articles that address new advances in metrology, particularly in the fields of trade, health, environment, and safety in which the credibility of measurements remains a challenging priority.

Metrology is adapting to the changes that are rapidly occurring worldwide and the OIML Bulletin strives to reflect this adaptation. National, regional, and international activities concerning evaluation procedures, accreditation and certification, measuring techniques and instrumentation, and implementation of OIML Recommendations as well as other international publications relative to metrology are of interest to the expanding audience of the OIML Bulletin.

In addition to a manuscript and visual materials (photos, illustrations, slides, etc.), a disk copy of the submission should be included whenever possible. Authors are also encouraged to send a passport-size photo for publication. Selected papers will be remunerated at the rate of 150 FRF per printed page, provided that they have not been previously published. The Editors of the OIML Bulletin reserve the right to edit contributions for style and space restrictions.

Papers should be sent to the Bureau International de Métrologie Légale, Attn. Editors of the OIML Bulletin, 11, rue Turgot, 75009 Paris France.