OIML BULLETIN

VOLUME XXXIX • NUMBER 2 • APRIL 1998

ORGANISATION INTERNATIONALE DE MÉTROLOGIE LÉGALE

QUARTERLY JOURNAL

ISSN 0473-2812

Presidents of ILAC, CIPM, CIML and IMEKO - Key meeting held at the BIML

OIML BULLETIN
VOLUME XXXIX • NUMBER 2
APRIL 1998

THE OIML BULLETIN IS THE QUARTERLY JOURNAL OF THE ORGANISATION INTERNATIONALE DE MÉTROLOGIE LÉGALE.

The Organisation Internationale de Métrologie Légale (OIML), established 12 October 1955, is an intergovernmental organization whose principal aim is to harmonize the regulations and metrological controls applied by the national metrology services of its Members.

OIML SECRETARIAT

BUREAU INTERNATIONAL DE MÉTROLOGIE LÉGALE (BIML)

11 RUE TURGOT, 75009 PARIS, FRANCE
TEL: 33 (0)1 48 78 12 82 OR 42 85 27 11
FAX: 33 (0)1 42 82 17 27
E-MAIL: biml@oiml.org
INTERNET: http://www.oiml.org

1998 SUBSCRIPTION RATES
EUROPE: 400 FRF
OUTSIDE EUROPE: 450 FRF

ISSN 0473-2812
DEPOT LEGAL NO 9252
PRINTED IN FRANCE
GRANDE IMPRIMERIE DE TROYES
130, RUE GÉNÉRAL DE GAULLE
10000 TROYES

OIML

MEMBER STATES

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

CORRESPONDING MEMBERS

ALBANIA
ARGENTINA
BAHRAIN
BANGLADESH
BARBADOS
BENIN
BOSNIA AND HERZEGOVINA
BOTSWANA
COLOMBIA
COSTA RICA
CROATIA
ECUADOR
ESTONIA
FIJI
GHANA
HONG KONG, CHINA
ICELAND
JORDAN
KUWAIT
LATVIA
LITHUANIA
LUXEMBURG
MALAWI
MALAYSIA
MAURITIUS
MEXICO
MOLDAVIA
MONGOLIA
MOZAMBIQUE
NEPAL
NEW ZEALAND
OMAN
PANAMA
PAPUA NEW GUINEA
PERU
PHILIPPINES
SEYCHELLES
SINGAPORE
SYRIA
CHINESE TAIPEI
THAILAND
TRINIDAD AND TOBAGO
TURKEY
UKRAINE
URUGUAY
VIETNAM

OIML BULLETIN

VOLUME XXXIX • NUMBER 2 • APRIL 1998

technique

evolutions

update

INTER-ORGANIZATIONAL COOPERATION

PRESIDENTS OF ILAC, CIPM, CIML AND IMEKO, PICTURED AT THE BIML

Photo: BIML

OIML BULLETIN

VOLUME XXXIX • NUMÉRO 2 • AVRIL 1998

technique

évolutions

informations

OIML

Editorial

International cooperation in metrology

The last week of February 1998 will have been a busy but very successful time for international cooperation in metrology and accreditation.

- At the *Bureau International des Poids et Mesures* (the well known Pavillon de Breteuil, headquarters of the *Convention du Mètre*) the Directors of the National Metrology Institutes of thirty-six countries met to sign an agreement on mutual recognition of national measurement standards and calibration certificates issued by national metrology laboratories. This agreement constitutes the metrological basis for other agreements on recognition of test results, including legal metrology pattern approvals and verifications, and OIML certificates.

  During the same meeting, a report on international metrological needs and the role of the BIPM was officially presented before being distributed to the Member States of the *Convention du Mètre* and to liaison institutions.

  Bilateral ILAC/BIPM discussions also took place concerning the application to national metrology laboratories of the ISO/IEC Guide 25 on accreditation.

- At the same time, a meeting of the CIML Presidential Council was held at the *Bureau International de Métrologie Légale*, of which a report is included in this Bulletin.

  There was also a meeting of the OIML *Accreditation Working Group*, with the participation of ILAC representatives, to discuss ways of developing mutual confidence (including through accreditation) among national legal metrology services as regards test results and the application of Guide 25 to these services.

- Last but not least, representatives of the *Convention du Mètre*, of ILAC and of the OIML met at the BIML in order to discuss matters of common interest and to identify possible joint actions.

  The preparations for the International Seminar on *The role of metrology in social and economic development*, jointly organized by the BIPM, IMEKO, OIML and the PTB to take place in June this year were discussed (IMEKO being represented by its President who is also Vice-President of the CIPM).

  Among the other matters discussed was the newly established *Joint Committee for Guides in Metrology* in which the BIPM, ILAC and OIML cooperate with the other international institutions concerned.

  This meeting at the BIML was a unique opportunity for the Presidents of the four main international metrology organizations, Messrs. Kovalevsky for the CIPM, Gilmour for ILAC, Faber for the OIML, and Iizuka for IMEKO to gather together - they are pictured left to right on the front cover of this issue. ■

BIML

TEST FACILITIES

Verification of light mineral oil measuring systems incorporated in tanker lorries

E. REDELBACH, Head of Koblenz Verification Office, Verification Authority of Rhineland-Palatinate, Germany

Hendricks, one of Germany's largest independent manufacturers of tanker and utility lorries, operates a maintenance and repair service for these vehicles in Rhineland-Palatinate.

A test facility using proving tanks made of CrNi steel (see Fig. 1) has been set up to verify systems mounted on tanker lorries for measuring light mineral oils.

Designed and constructed using comparatively simple means by Hendricks itself in cooperation with the Verification Authority of Rhineland-Palatinate, this is a conventional and compact facility (as can be seen from the photographs), which uses volumetric tanks as standard capacity measures. It meets all the requirements for the verification of measuring systems in mineral oil tanker lorries.

After its completion, the facility was tested by the Verification Authority and sealed with a protective mark; its correct functioning will subsequently be checked regularly by the Verification Authority, and the verification of measuring systems in tanker lorries will always be carried out by a qualified Verification Authority officer.

The installation of the test facility at a private enterprise is advantageous to all parties involved, since:

- the owners of tanker lorries can combine repair and maintenance with the verification of the measuring systems, thus saving time and money;
- entrepreneurs can offer their customers the whole spectrum of services and need not refer them to a verification office after the repair and maintenance work has been carried out;
- it is advantageous for the verification office not to have to make available expensive test facilities.

The facility has been installed in a hall which allows measuring systems incorporated in articulated lorries with capacities of up to 36 000 l to be tested independently of meteorological conditions and has been designed for the testing and verification of measuring systems with and without pump operation (discharge capacities of Q_{max} = 300–1 000 l/min). For this purpose, about 3 000 l of fuel oil are stored in a storage tank, though the operator of the measuring system can make available all light mineral oils (i.e. fuel oil, diesel and petrol) for the metrological test so that the meter can be optimized for the intended use.

Table 1 Technical data of the test facility - proving tanks

Standard volume V_{EX} (l)	1000	500	200
Scale division (l)	0.5	0.2	0.1
Sensitivity (mm / 0.1 %)	16.6	18.75	17.6
Sensitivity (mm / scale mark)	8.3	7.5	8.8
Reading range (l)	+/- 10	+5 / -4	+/- 2
Reading	inspection glass with gauge scale		
Max permissible error (%)		0.06	
Reference temperature (°C)		15	
Balancing of the tanks		by emptying	
Drainage time (s)		30	
Expansion coefficient 3β ($10^{-6} \times K^{-1}$)		49.5	

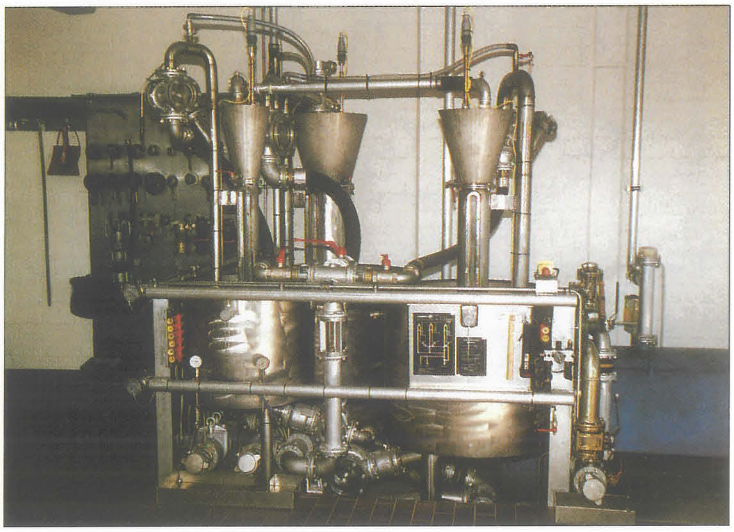


Fig. 1 General view of the test facility

Filling the proving tank (see Fig. 2)

When the tanks are filled, the path of the test liquid downstream of the measuring system is as follows:

a) Tanker lorry - connecting hose, depending on the type of discharge, optionally to:

b_1) Connection I: in the case of empty hose: without pump via suction pump (1), or

b_2) Connection II: in the case of full hose or empty hose: with pump;

c) Riser pipe with inspection glass (2);

d) Distributor to individual tanks, with ball valves (3);

e) Overflow inspection glass (4) with separation edge and vent (5) in the pipe bend;

f) Filling pipe (13).

Discharge of the proving tanks and product recovery

The tanks are discharged with the aid of pneumatic open-close valves (6) and controlled with illuminated droplet inspection glasses downstream. The collecting pipe (behind) feeds the product to a vane-cell discharge pump (7). The operating modes of the discharge pump (volume flows) are as follows:

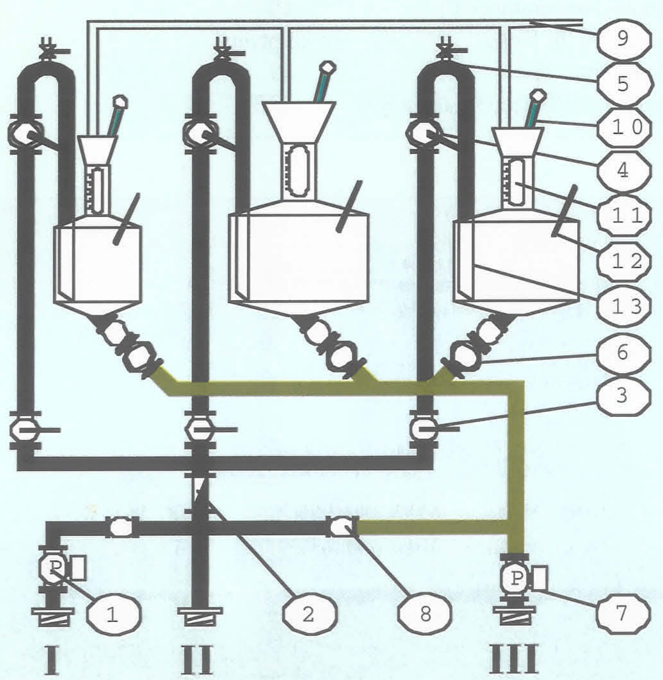
a) From the proving tank to the tanker lorry;
b) From the proving tank to the storage tank;
c) From the storage tank to the tanker lorry;
d) From the tanker lorry to the storage tank.

Note: Not all of these modes of operation are shown in Fig. 2.

Upon completion of the tests, the section between connections I and II and the overflow inspection glasses (4) must also be emptied. For this purpose, valve (8) is opened, and a hand pump has been installed for discharging the residual oil (approx. 5 l) in the case of product change.

Vapor recovery and safety devices

Vapor recovery (9) takes place between the tanks and the tanker lorry. A fuel/air mixture develops above the test liquid in both the tank and the tanker lorry; when the tank is filled, to avoid pollution of the environment the gas displaced is fed to and recovered in the emptied space in the tanker lorry, and vice versa. Only pressure equalization takes place in the surrounding air. Each tank is equipped with an overfill prevention device (10): when a tank is overfilled, the volume flow in the tank is automatically interrupted.



I filling with suction pump
II filling with pump of the measuring system
III discharge

1 suction pump
2 inspection glass
3 ball valve
4 overflow inspection glass with separation edge
5 vent valve
6 discharge valve with droplet inspection glass
7 discharge pump
8 valve for discharge of the filling pipe
9 vapor recovery pipe
10 overfill prevention device (limiting value indicator)
11 inspection glass with gauge scale
12 temperature measurement (thermometer)
13 filling pipe

Fig. 2 Diagrammatic view of the system

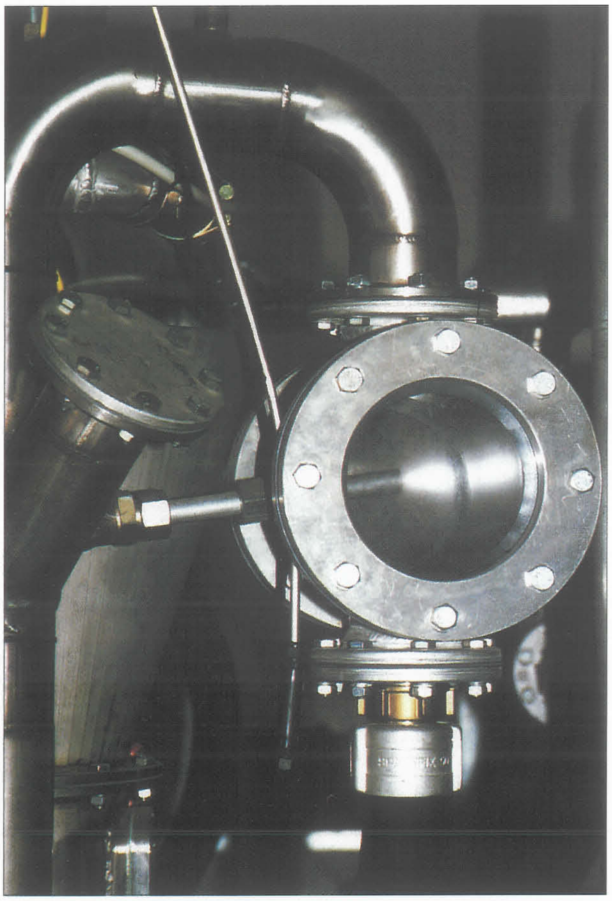


Fig. 3 Overflow inspection glass

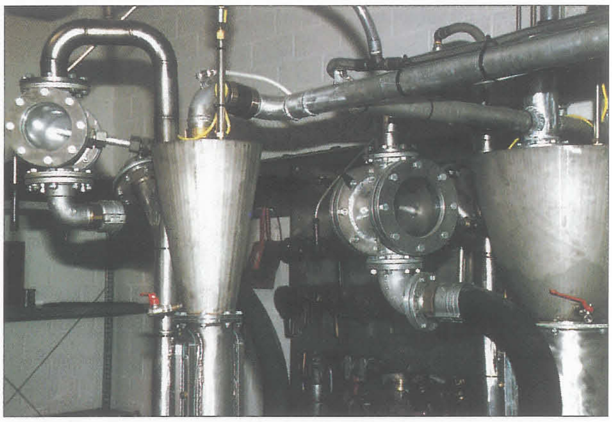


Fig. 4 Overflow inspection glass with filling pipe

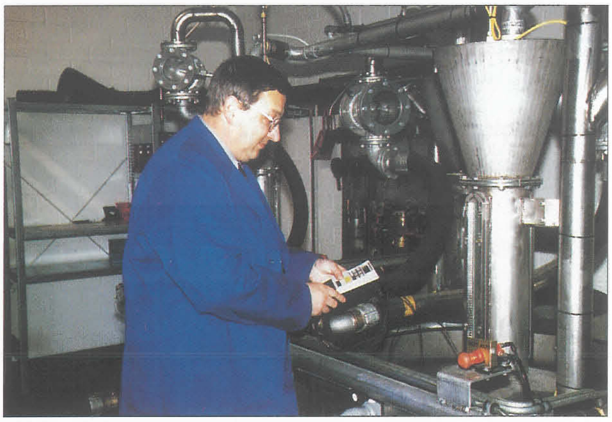


Fig. 5 Temperature measurement in the proving tank by the verification officer

For pressure control, a vacuum/over-pressure gauge has been provided on connection I (on the suction side of the suction pump), and an over-pressure gauge on connection II (pressure connection of the filling pipe).

To avoid the risk of explosion, the pumps are driven by hydraulic motors whose operating mechanism is housed in an adjacent room not subject to explosion hazards.

Verification of a measuring system

Depending on the mode of operation, either the measuring system pump or the test facility pump is used to carry out a preliminary run in order to fill and vent the filling pipe and to wet the tanks. Care must be taken that the pipe bends are vented over the vent valves (5) and that the liquid levels adjust themselves at the separation edges (4) - see Figs. 3 and 4. After that, the tanks must be emptied again and the vent valves (5) must be closed for testing. The structure of the test facility allows three measurements to be carried out in succession; ball valves (3) are used to control the quantities and flow velocities. To reduce spraying and the formation of foam, the liquid to be measured is fed into the tank through the filling pipe (13), at the lowest point. After the measurements have been completed, the pipe bend must be vented again, and time must be allowed for the liquid level to adjust itself at the separation edge. Only then can the standard volumes be read on the scales (11) and compared with the values actually indicated by the system under test. A test program based on *Microsoft Excel®* is available to calculate the measurement errors.

Since 1994 German federal law has prescribed that the volume of light fuel oil must be indicated in litres at a temperature of 15 °C. Many firms now sell all light mineral oils (diesel and petrol) in wholesale trade on the basis of a "litre at 15 °C", as has already been common practice under fiscal law. This means that today almost all tanker lorries are equipped with electronic temperature-compensating meters.

Table 2 Example of a test record with fuel oil at different flowrates

Input values	#1#	#2#	#3#	#4#	#5#
Medium: flowrate (l/min)	800	600	400	250	100
Medium: reference temperature t_0 (°C)	15.0	15.0	15.0	15.0	15.0
Medium: density at 15 °C (kg/m³)	845.0	845.0	845.0	845.0	845.0
Meter: temperature indicated t_M (°C)	4.8	4.7	4.8	5.0	5.0
Meter: temperature measured t_{MS} (°C)	5.0	4.9	4.8	4.9	4.9
Standard: temperature t_S (°C) [Fig. 2 (12)]	6.0	5.9	5.6	5.8	5.5
Standard: reference temperature t_r (°C)	15.0	15.0	15.0	15.0	15.0
Standard: material	CrNi steel	CrNi steel	CrNi steel	CrNi steel	CrNi steel
Standard: indicated volume V_S (l)	**1000.0**	**1000.1**	**500.5**	**499.6**	**200.4**
Standard: temperature volume correction $t_r \rightarrow t_S$: (l)	–0.45	–0.45	–0.23	–0.23	–0.09
Standard: temperature volume correction $t_S \rightarrow t_{MS}$: (l)	–0.84	–0.84	–0.34	–0.38	–0.10
Standard: corrected volume at t_{MS} (l) 1)	**998.7**	**998.8**	**499.9**	**499.0**	**200.2**
Meter: indicated non-corrected volume V_M (l at measured t_{MS} but indicated t_M)1)	1001.0	1002.0	501.0	500.4	200.0
Meter: indicated corrected volume V_{0M} (l at t_0, based on t_M) 2)	1009.4	1010.5	505.4	504.6	201.7
Meter: theoretical volume V_{0th} (l at t_0, based on t_{MS}) 2)	1009.5	1010.6	505.3	504.6	201.7
Measurement results					
Meas. error t (°C) MPE = 0.5 °C	**–0.2**	**–0.2**	**0.0**	**0.1**	**0.1**
1) Meas. error V_t (%) MPE = 0.3 %	**0.23**	**0.32**	**0.22**	**0.28**	**–0.10**
2) Meas. error T_K (%) MPE = 0.2 %	**–0.01**	**–0.01**	**0.02**	**0.00**	**0.00**
1)+2) Tot. meas. error V_0 (%) MPE = 0.5 %	**0.22**	**0.31**	**0.24**	**0.29**	**–0.10**

Evaluation

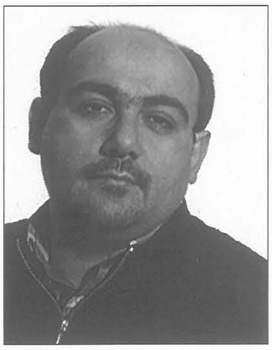
Verification first of all consists in comparing the actual volume and the standard volume at operating conditions. If required, the standard volume is corrected by the cubical expansion of the tank and the expansion of the product due to the temperature difference between meter and standard (see Fig. 5). In the second step, the temperature-dependent volume correction is checked by converting V_M into V_{0th} according to the procedure defined in DIN 51757 (in conjunction with ASTM D1250-80 and API Std 2450-80) on the basis of the density ratios and comparing it with the indication V_{0M}.

For the measuring systems to be tested, the maximum permissible errors on verification amount to ± 0.5 %. None of the errors in a test series may exceed half the maximum permissible errors on verification if their signs are identical.

Summary

When the test facility was designed, alternatives under discussion were a deep level test facility with free fall and one with a weighing system. The first proposal was not adopted due to the high costs of constructing the cellar and the risk of explosion (gas accumulation in underground rooms). As regards the weighing system, experience in routine operation was lacking (stability of the weighing instrument, operational reliability and determination of the density). The operator finally decided in favor of the suction method which has proved its worth for many decades. Experience gained to date shows that this decision was in fact well founded.

With this test facility, Rhineland-Palatinate offers the owners of measuring instruments another central site for the repair and verification of measuring systems in tanker lorries. ■



CHECKING OF PREPACKAGES

A proposal for the semi-statistical processing of random package lots for legal acceptance

G. ARDIMENTO, Ufficio Provinciale Metrico e del Saggio dei Metalli Preziosi, Napoli, Italy

Introduction

A random package can be defined as *a package that is one of a lot, shipment, or delivery of packages of the same consumer commodity with varying weights; i.e. packages of the same consumer commodity with no fixed pattern of weight* ([1] Appendix C: Glossary).

Few legal metrology services (see [1] point 3.8 and [2] procedure 4) have adopted a full statistical approach to investigating the weight properties of random package lots in order to ascertain the quality level with a view to legal acceptance.

In Italy, a random package lot is considered as being made up of objects which are sold at retail by weight but which are previously weighed and packaged [3]; i.e. the sale of the goods is time-delayed compared to their packaging.

Therefore any variability in random packaging is not allowed at all. For this reason legal acceptance inspections should be enforced by 100 % batch screening and require considerable resource expenses.

This paper deals with the attempt to introduce a semi-statistical approach to investigate the weight properties of this kind of prepackages by only considering the errors and variability characteristics of the weighing instruments used in the process to produce them.

1 Two principles of legal acceptance for random package lots

In order to ensure that only those errors and uncertainties occur which are actually due to the characteristics of the weighing instrument used (typically an OIML Class III type), a suitable principle defining a variables sampling plan to be adopted could be:

1.1 *One which ensures that a lot having 2 % of non-conforming packages has a 50 % probability of being accepted.*

In respect of this principle, a non-conforming package is one which has a negative error L (where L = *Actual weight – Labeled weight*) greater than the negative maximum in-service permissible error of the weighing instrument ($L = -3e$, where e is the scale division of the weighing instrument).

Assuming a rectangular probability density distribution for the maximum allowed range of variability of the indications for the weighing instrument in service ($[-3e, 3e]$) the lot can be considered as having a *known variability* σ given by:

$$\sigma = (3e)/\sqrt{3} = \sqrt{3}e \qquad (1)$$

Another acceptance principle should be adopted in order to detect "fraudulent" lots, i.e. lots that have too many *excessively non-conforming* packages to be considered as exclusively affected by errors due to the characteristics of the weighing instrument itself and the packaging employee's fatigue. For the latter, such an attribute double sampling plan should be adopted (see [4] chapter 12) which shall have:

1.2 *Such an Operating Characteristic (OC) curve that a lot having an excessive non-conforming packages percentage of 5 % has a 50 % acceptance probability.*

In respect of 1.2, an *excessively non-conforming package* is defined as one which shows a *too excessive* or *unreasonable* error, for example 10 times the scale division e.

Editor's note:

The Author acknowledges that this paper only represents his own views on a matter which is uniquely ruled in Italy by the law quoted in Reference [3]; these views fall in line neither with OIML R 87 *Net content in packages* nor with the relevant European Directives.

2 The variables sampling plan

Adopting a sampling plan which operates on variables gives a better guarantee of quality protection than an attribute sampling plan which uses the same sample lot size.

The acceptance probability of the inspected lot versus the percentage of non-conforming packages (the OC curve) can only be determined by making some assumptions about the probability density distribution of the quality characteristic, i.e. the net weight, in the prepackages population:

- It is assumed that the net weight values have a normal probability density distribution;
- The variance of the normal probability density distribution is known, i.e. the packing process has a *known variability* [5]; the estimated variance of the weighing instrument used to control the packages shall be assumed as being the process variance.

Variables used:

n = the number of items which form the lot sample;
X_i = the error of the ith package, i.e.
X_i = *Actual weight – Labeled weight;*
X_M = the sample mean of the errors;
L = the lower limit for the errors;
σ = the standard deviation of the packing process.

The acceptance criterion can be written as follows:

$$X_M \geq L + k' \cdot \sigma \qquad (2)$$

The lower limit is set out to be equal to the negative maximum permissible in-service error of the weighing instrument:

$$L = -3e \qquad (3)$$

As previously stated, σ is assumed to be known and its value can be considered as being equal to the standard uncertainty of the weighing instrument, its value coming from equation (1).

The value of k' has to be chosen in such a way as to allow the acceptance criterion proposed in 1.1 to be verified. For this purpose, considering the distribution of the X_M value, because of the *central limit theorem*, it can be stated that the X_M-distribution is also normal, with a standard deviation which is $1/\sqrt{n}$ times smaller than the standard deviation of the X-distribution. The situation is as depicted in Fig. 1.

If K is the minimum allowable X_M value, for a lower specification the following condition is derived from (2):

$$K = L + k' \cdot \sigma \qquad (4)$$

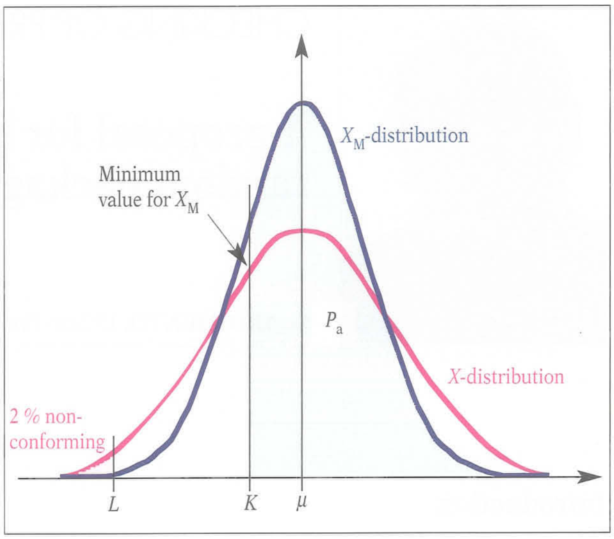


Fig. 1

For a specified fraction of non-conforming packages and in terms of criterion 1.1, among the mean of the population μ, the limit L and σ the following relation holds:

$$\mu = L + z_p \cdot \sigma \qquad (5)$$

where z_p is the normalized value of the statistic corresponding to the specified percentage of non-conforming packages.

In order to obtain the value of z_a to ascertain the corresponding acceptance probability for the X_M-distribution, the following can be written:

$$z_a = (K - \mu)/(\sigma/\sqrt{n}) = \sqrt{n}\,(k' - z_p) \qquad (6)$$

Note: The right-hand equality in (6) holds because of (4) and (5).

Thus, the probability of acceptance for the X_M-value criterion adopted in (2) is:

$$P_a = 1 - F(z_a) \qquad (7)$$

In equation (7) F is the normal probability density distribution function N(0,1), i.e.:

$$F(z) = (1/\sqrt{(2\pi)}) \cdot exp(-z^2/2)$$

which can be found tabulated in a number of statistics handbooks (for example, reference [6]).

The z_p-value for a percentage of non-conforming prepackages of 2 % is –2.055.

To obtain a 50 % level of confidence for the X_M-value distribution versus the stated percentage of non-conforming packages it is necessary that the probability of acceptance is:

$$P_a = 1 - F(z_a) = 0.5 \quad (8)$$

From equation (8) it can be deduced that:

$$F(z_a) = 0.5 \quad (9)$$

From equation (9), by considering the normal probability density distribution, the corresponding z_a-value can be assumed as being zero:

$$z_a = 0 \quad (10)$$

Substituting equation (10) in equation (6) and taking the z_p-value established as being 2.055 (as a positive value for the symmetry of the normal distribution) yields:

$$\sqrt{n} \cdot (k' - 2.055) = 0 \quad (11)$$

i.e.:

$$k' = 2.055 \quad (12)$$

It is therefore evident that the k'-value is independent of the sample size n; thus, the acceptance criterion (2), because of (12), becomes:

$$X_M \geq -3e + 2.055 \times 1.732e = 0.559e \cong 0.6e \quad (12')$$

i.e.:

$$X_M \geq 0.6e \quad (13)$$

3 The attribute sampling plan

As previously stated, the constant k' which appears in (12) does not depend on the sample size n. This fact suggests adopting such a sample size to design a suitable attribute sampling plan in order to detect *fraudulent lots*.

It seems appropriate to draw two samples each of 20 items at random from the whole population of packages constituting the lot under test.

The acceptance criterion (13) is applied to the first sample: if this condition holds good then the test continues with the attributes sampling plan, otherwise the inspection session finishes with a negative result and the packager may be considered for prosecution for unfair trading.

For the attributes sampling plan, a package is defined as not conforming if it has a negative error greater than $10e$, based on the need for clearly detecting *fraudulent lots*.

The selected sampling plan is a double sampling type which ensures that the statement in 1.2 is met. It can be described by means of an operating table (see Table 1).

The operating characteristic can be calculated based on the assumption that a binomial probability distribution suits the actual situation closely enough.

That assumption is equivalent to assuming that the population of packages is an infinite universe with each item therein having an equal probability of being drawn.

Moreover, to simplify calculations, assuming that the finite population of the lot is large enough when compared to the sample size, the probability of the binomial distribution has been calculated using the Poisson distribution as the limit of the binomial probability distribution, as the population of the lot tends towards infinity (see [4] chapter 6 and [7]).

The results of these calculations are reported in Table 2.

As can be observed, the statement in 1.2 is fairly met by the selected plan.

Table 1

Sample number	Individual sample size	Combined sample size	Acceptance number	Rejection number
1	20	20	0	2
2	20	40	1	2

Table 2

p % of non-conforming items	P_a acceptance probability	p % of non-conforming items	P_a acceptance probability
1	0.952	7	0.332
2	0.850	8	0.267
3	0.730	9	0.214
4	0.611	10	0.172
5	**0.503**	15	0.057
6	0.410	20	0.019

4 Summary

In order to better summarize the test procedure, its steps are reiterated below:

i) Draw two samples of 20 items each from the lot;

ii) For the first sample calculate $X_M = (\Sigma X_i)/n$.

If (13) holds then continue with point iii), otherwise terminate the test session and consider prosecution for unfair trading in packaging;

iii) Apply the attribute sampling plan described in Table 1 using the two samples previously drawn from the lot. If the results are positive the lot is accepted, otherwise consider prosecution for unfair trading in packaging.

5 Conclusions

To gain efficiency in inspecting random package lots it is proposed to carry out quasi-statistical processing of them; only the sources of variability due to the weighing process have been considered and a suitable level of statistical confidence in evaluating the characteristics of a lot for the purposes of legal acceptance have been calculated.

Acknowledgment

The author wishes to thank Mrs. Carrol S. Brickenkamp and Mr. Kenneth S. Butcher of the *National Institute of Standards and Technology* (NIST), Gaithersburg, USA, for their courtesy in granting useful information about the NBS Handbook 133 [1]. ■

References

[1] US Department of Commerce, National Institute of Standards and Technology: *NBS Handbook 133 "Checking the net contents of packaged goods"*

[2] *Directions for Swedish Verification Officers concerning Sampling Inspections of Prepacked Commodities*, OIML Bulletin No. 84, September 1981

[3] Law dated 5 August 1981 No. 441, *"Vendita a peso netto delle merci"*, published in the Gazzetta Ufficiale della Repubblica Italiana No. 218 on 10th August 1981

[4] E. L. Grant, R. S. Leavenworth: *Statistical Quality Control*, McGraw-Hill, 6th Edition

[5] The Superintendent of Documents, *Military Standard 414: "Sampling Procedures and Tables for Inspections by Variables for Percent Defective"*, US Government Printing Office, Washington DC, 1957 or ISO 3951 (1980)

[6] R. S. Burington, D. C. May jr, *Handbook of Probability and Statistics with Tables*, 2nd Edition, McGraw-Hill, 1970

[7] E. C. Molina, *Poisson's Exponential Binomial Limit*, D. Van Nostrand Reinhold Company, Inc., Princeton, NJ, 1942.

METROLOGY AND GEOGRAPHY

Dependence of electronic weighing instruments on the value of acceleration due to gravity

S. GUPTA, Ex Scientist, National Physical Laboratory, New Delhi, India
P. KRISHNAMOORTHY, Director, Legal Metrology, Ministry of Food & Consumer Affaires, Govt. of India, New Delhi

Abstract

All weighing instruments which are not based on the principle of levers are affected by acceleration due to gravity (g). The relative error of indication in the weighing instrument has been shown to be equal to the fractional change in the value of g; values of g, their fractional change per degree of latitude and cumulative change have been tabulated for latitudes from 0–70°. The fractional change in the value of g per degree of latitude (and hence the error due to this factor) depends on the value of the latitude itself and indeed on the altitude.

One third of the maximum permissible error (mpe) at maximum load has been taken as being a significant error. It has been observed that practically all classes of weighing instruments are affected: even Class IIII scales suffer an error of two verification scale intervals when transported in a north-south direction, for example from one end of India to the other. Significant errors will develop when Class III weighing instruments are moved from one place to another which differ in latitude by 0.5° for places having latitudes around 45°. The fractional change in the value of g is therefore too large to allow Class I or II weighing instruments to be transported any reasonable distance in a north-south direction.

The effect of a change in the value of g with respect to altitude is discussed in detail in this paper: a Class I weighing instrument, when subjected to a height difference of only 7.5 m, will suffer an error equal to its mpe.

The problem of inter-state movement in India due to changes in latitude and altitude is also highlighted, and a special problem encountered in using Class I weighing instruments as self-indicating instruments is explored.

The principles of indication and adjustment of weighing scales are mentioned, and practical hints are suggested for adjusting scales manufactured in one place but used in another.

In addition it is recommended that the place at which adjustment may be carried out is specified by every manufacturer - this should be such that a seal of a competent authority may be affixed to the instrument, whereby no adjustment is possible without conspicuously mutilating the seal.

1 Introduction

There is a group of weighing instruments in which gravitational forces, acting both on the body to be weighed and on another standard body of known mass, are compared; the mass of the body to be weighed is calculated or displayed in terms of the mass of the standard body. All weighing instruments using the principle of levers such as equi-arm double-pan or unequi-arm single-pan balances, self- or semi-self-indicating counter-type weighing instruments, platform weighing scales, weigh bridges etc. belong to this group. Such weighing instruments are not affected by acceleration due to gravity or its variation. They can therefore be transported from one place to another without their accuracy being affected.

In another group of weighing instruments, output is directly proportional to the gravitational force acting on the body to be weighed. Weighing instruments using strain gauges of any type, principles of electromagnetic force compensation or changes in inductance, capacitance or frequency, belong to this group. The output is generally voltage or current, which is electronically processed and directly displayed in the form of a digital indication in terms of mass units. Such instruments are called electronic balances/weighing instruments or systems. Their indications (output) are directly proportional to the value of *g* at the place of use.

Hence such instruments are affected by the value of *g* and its variation. Mechanical spring balances also fall in this category.

The error due to changes in the value of *g* (which varies in line with latitude and altitude), the mpe of nonautomatic weighing instruments, the criterion for the significant error due to a change in g as regards the mpe, errors affecting weighing instruments of various classes due to changes in latitude and altitude together with methods to overcome this problem, are subjects discussed below.

2 Error E_g due to changes in g

As an example, take a balance which has been adjusted to give a correct indication I at a geographical location where $g = g_1$, when loaded with a body of mass $n{\cdot}e$ (where n is a natural number and e is the value of the verification scale interval in the mass unit):

$$n{\cdot}e{\cdot}g_1 = \mathrm{K}.I \qquad (1)$$

(K is a constant of proportionality).

If the same balance is then taken to a place where $g = g_2$ and it requires a mass $n{\cdot}e - E_g$ to give the same indication I, then:

$$(n{\cdot}e - E_g){\cdot}g_2 = \mathrm{K}.I \qquad (2)$$

Eliminating I from (1) and (2) gives:

$$E_g = n{\cdot}e{\cdot}(g_2 - g_1)/g_2 \qquad (3)$$

E_g is the error due to the change in the value of g, which may be positive or negative depending upon the sign of $(g_2 - g_1)$. The relative error FE_g (i.e. the error divided by the load) is given by:

$$FE_g = E_g/n{\cdot}e = (g_2 - g_1)/g_2 \qquad (4)$$

3 Change in the value of g

3.1 Value of g in terms of latitude Φ

The value of g_Φ (in m/s²) at a place having $\Phi°$ latitude, as given in [1], is:

$$g_\Phi = 9.780318\,[1 + 0.005324\sin^2(\Phi) - 0.000059\sin^2(2\Phi)] \qquad (5)$$

Using the above equation, g_Φ values have been calculated for latitudes from 0–70° in steps of 1°. The fractional change $(g_\Phi - g_{\Phi-1})/g_\Phi$ for each latitude and their cumulative changes have also been calculated (see Tables 1A and 1B).

Table 1A Value of g for latitudes from 0° to 35° in steps of 1°

No.	° Lat.	Value of g m/s²	Fractional change /°	Cumulative change
1	0	9.780 318	———	———
2	1	9.780 333	1.607E-06	1.607E-06
3	2	9.780 381	4.821E-06	6.429E-06
4	3	9.780 459	8.029E-06	1.445E-05
5	4	9.780 569	1.122E-05	2.568E-05
6	5	9.780 710	1.441E-05	4.009E-05
7	6	9.780 882	1.757E-05	5.767E-05
8	7	9.781 085	2.072E-05	7.840E-05
9	8	9.781 318	2.384E-05	1.022E-04
10	9	9.781 581	2.693E-05	1.291E-04
11	10	9.781 875	2.999E-05	1.591E-04
12	11	9.782 198	3.301E-05	1.922E-04
13	12	9.782 550	3.600E-05	2.282E-04
14	13	9.782 931	3.894E-05	2.671E-04
15	14	9.783 340	4.183E-05	3.089E-04
16	15	9.783 777	4.467E-05	3.536E-04
17	16	9.784 242	4.746E-05	4.011E-04
18	17	9.784 733	5.019E-05	4.513E-04
19	18	9.785 250	5.285E-05	5.041E-04
20	19	9.785 793	5.546E-05	5.596E-04
21	20	9.786 360	5.800E-05	6.176E-04
22	21	9.786 952	6.046E-05	6.780E-04
23	22	9.787 567	6.286E-05	7.409E-04
24	23	9.788 205	6.517E-05	8.061E-04
25	24	9.788 865	6.741E-05	8.735E-04
26	25	9.789 546	6.957E-05	9.431E-04
27	26	9.790 248	7.164E-05	1.014E-03
28	27	9.790 969	7.362E-05	1.088E-03
29	28	9.791 708	7.552E-05	1.163E-03
30	29	9.792 465	7.732E-05	1.241E-03
31	30	9.793 239	7.903E-05	1.320E-03
32	31	9.794 029	8.064E-05	1.400E-03
33	32	9.794 834	8.216E-05	1.483E-03
34	33	9.795 653	8.358E-05	1.566E-03
35	34	9.796 484	8.489E-05	1.651E-03
36	35	9.797 328	8.610E-05	1.737E-03

In Table 1A, values of g_Φ, its fractional change per degree and cumulative change for latitudes 0–35° have been covered - this may cater for the needs of India, Sri Lanka, Burma, East and far East countries such as Indonesia, Thailand, Vietnam, Malaysia, the Philippines and part of China, Africa and Australia. African countries such as Zaire, Tanzania, Zambia, Rhodesia, Botswana, Zimbabwe, Mozambique, Namibia and South Africa lie between latitudes 0–35° S, whereas Ethiopia, Somalia, Egypt, Libya, Uganda, Gabon, Cameroon, Nigeria, Niger, Algeria, Sudan, Mauritania, Chad, Tunisia and Morocco etc. lie between latitudes

0–35° N. Kenya lies almost equally to either side of the equator, and Australia is between latitudes 15–35° S.

Table 1B (latitudes 35–70°) covers Europe, Canada, Russia and surrounding countries; Japan lies between parallels 30–45° N. It has been observed that no major country lies beyond latitude 70°.

Table 1B Value of g for latitudes from 35° to 70° in steps of 1°

No.	° Lat.	Value of g m/s^2	Fractional change /°	Cumulative change
1	35	9.797 328	8.610E-05	———
2	36	9.798 183	8.721E-05	8.721E-05
3	37	9.799 047	8.821E-05	1.754E-04
4	38	9.799 920	8.910E-05	2.645E-04
5	39	9.800 801	8.988E-05	3.544E-04
6	40	9.801 689	9.056E-05	4.449E-04
7	41	9.802 582	9.112E-05	5.361E-04
8	42	9.803 480	9.158E-05	6.276E-04
9	43	9.804 381	9.192E-05	7.196E-04
10	44	9.805 285	9.215E-05	8.117E-04
11	45	9.806 190	9.227E-05	9.040E-04
12	46	9.807 095	9.228E-05	9.963E-04
13	47	9.807 999	9.217E-05	1.088E-03
14	48	9.808 901	9.195E-05	1.180E-03
15	49	9.809 800	9.162E-05	1.272E-03
16	50	9.810 694	9.118E-05	1.363E-03
17	51	9.811 583	9.062E-05	1.453E-03
18	52	9.812 466	8.996E-05	1.543E-03
19	53	9.813 341	8.918E-05	1.633E-03
20	54	9.814 208	8.830E-05	1.721E-03
21	55	9.815 065	8.731E-05	1.808E-03
22	56	9.815 911	8.621E-05	1.894E-03
23	57	9.816 746	8.501E-05	1.979E-03
24	58	9.817 568	8.370E-05	2.063E-03
25	59	9.818 376	8.229E-05	2.145E-03
26	60	9.819 169	8.079E-05	2.226E-03
27	61	9.819 947	7.918E-05	2.305E-03
28	62	9.820 707	7.747E-05	2.383E-03
29	63	9.821 451	7.567E-05	2.459E-03
30	64	9.822 175	7.378E-05	2.532E-03
31	65	9.822 881	7.180E-05	2.604E-03
32	66	9.823 566	6.973E-05	2.674E-03
33	67	9.824 230	6.758E-05	2.741E-03
34	68	9.824 872	6.534E-05	2.807E-03
35	69	9.825 491	6.302E-05	2.870E-03
36	70	9.826 087	6.063E-05	2.930E-03

Differentiating (5) with respect to Φ, we obtain:

$$(dg_\Phi/d\Phi) = 9.780318[a.\sin(2\Phi) - 2b.\sin(4\Phi)] \quad (6)$$

showing that $dg_\Phi/d\Phi$ is zero at $\Phi = 0$.

Here a = 0.005324, b = 0.000059.

Differentiating again with respect to Φ:

$$(d^2g_\Phi/d\Phi^2) = 9.780318[2a.\cos(2\Phi) - 8b.\cos 4\Phi)] \quad (7)$$

From (7), it may easily be seen that the maximum change in g_Φ with respect to the latitude will be around 45°. Calculation of the maximum change in g_Φ per degree latitude gives 9.228 in 10^5 at 46°. (The whole of central Europe lies in between 44° and 54° N).

3.2 Variation in g due to altitude

Let R = the radius of the earth;
M = the mass of the earth;
D = the mean density of earth, and
G = constant of gravitation.

At a point P in space h meters above mean sea level (msl), g_h is expressed as:

$$g_h = GM/(R+h)^2 = (GM/R^2)[1 - 2h/R] = g_e[1 - 2h/R] \quad (8)$$

where $g_e = GM/R^2$.

But the point P is on a plateau, so there would be an additional acceleration of gravity, as given in [2]:

$$G\cdot 2\pi dh \quad (9)$$

To eliminate M, g_e may be expressed as:

$$g_e = (G4\pi/3\cdot R^3\cdot D)/R^2 = G\cdot 4\pi RD/3 \quad (10)$$

Substituting the value of G from (10) in (9), the additional acceleration becomes:

$$g_e(3/2)\cdot(h/R)\cdot(d/D) \quad (11)$$

Roughly, the mean density d of matter on a plateau is half the mean density D of earth, so (11) becomes :

$$g_e(3h/4R)$$

so the effective value of g_h at a point P, h meters above msl on a plateau is given as:

$$g_h = g_e[1 - 2h/R + 3h/4R] = g_e[1 - 5h/4R] \quad (12)$$

Taking R = 6 378 136 m as given in [3], the change in the value of g due to altitude is:

$$-g_e\cdot 5h/4R \cong -2\cdot 10^{-7}\cdot h\cdot g_e$$

The fractional change in the value of g due to the change in altitude (only) is then given as:

$$-2\cdot 10^{-7}\cdot h \text{ (approximately)} \quad (13)$$

4 Mpe of nonautomatic weighing instruments

As per OIML R 76 [4] and the Seventh Schedule - Heading B of the Standards of Weights and Measures (General) Rules, 1987, Government of India, all non-automatic weighing instruments have been grouped in four Classes I–IIII. Grouping is based on n (the maximum number of verification scale intervals) and e (the value of the verification scale interval). The mpe values depending on the load are as follows:

Load value in terms of e	mpe in terms of e	
$n_{min} < n < n_1$	0.5	
$n_1 < n < n_2$	1.0	(14)
$n_2 < n < n_{max}$	1.5	

The values for n_{min}, n_1, n_2 and n_{max} for various Classes are given in Table 2.

Table 2

Class	n_{min}	n_1	n_2	n_{max}
IIII	10	50	200	1 000
III	20	500	2 000	10 000
II	50	5 000	20 000	100 000
I	100	50 000	200 000	no limit

The fractional mpe, i.e. the mpe divided by the maximum load at the change points, is given as:

For Class IIII	1 in 10^2,	2 in 10^3,	1.5 in 10^3	
For Class III	1 in 10^3,	2 in 10^4,	1.5 in 10^4	(15)
For Class II	1 in 10^4,	2 in 10^5,	1.5 in 10^5	
For Class I	1 in 10^5,	2 in 10^6,	1.5 in 10^6	

The maximum load for Class I weighing instruments has been taken as $10^6 \cdot e$.

The fractional mpe at maximum load has been calculated on the assumption that each weighing instrument has a maximum permitted number of verification scale intervals, according to the Class it belongs to.

5 Criterion for significant error due to a change in g

The OIML has recommended that the error tolerable in the standard weights for verification [5] should not be larger than 1/3 of the mpe allowed for the weighing instrument. Following this principle, E_g (the error due to the change in g) which could be taken as significant should be 1/3 of the mpe of the weighing instrument. From (15), it may be seen that the fractional mpe is minimal at the maximum load. So, if the relative error FE_g due to the change in g is acceptable at the maximum load, then it will automatically be acceptable at all other loads. Furthermore FE_g based on (4) is equal to the fractional change in the g value; the value of the latter which would cause a significant error in weighing instruments of different Classes would be as follows:

For Class IIII	5 in 10^4	
For Class III	5 in 10^5	
For Class II	5 in 10^6	(16)
For Class I	5 in 10^7	

This, in absolute terms, means an error equal to half the value of the verification scale interval at maximum load.

6 Discussions

For the purpose of discussing the allowable variation in g, it has been assumed that each weighing instrument has a maximum number of verification scale intervals permitted for the Class to which it belongs.

6.1 Error due to change in latitude

6.1.1 With reference to India

It may be noted from Table 1A (column 4) that when a Class I or II instrument is transported from one place to another differing by 1° in latitude, the error at maximum load varies from 24–85 verification scale intervals for Class I and 2–8 for Class II. Hence there appears to be no option but to adjust and verify all Class I and II instruments on site. (India lies roughly in between latitudes 8–40° N).

Furthermore it can be seen that the fractional change in the g value per degree change of latitude varies from 2.38 in 10^5 at 8° (i.e. at Kanniya Kumari) to 8.49 in 10^5 at 34° (at Srinagar). This means that all Class III weighing instruments are affected even for a change in latitude of 1° from Srinagar (34°) to Hyderabad (17°). However the situation at the Southern tip is better as the errors for Class III scales will remain within significant limits even for a 2° difference in latitudes.

Even Class IIII instruments cannot be transported all over the country without exceeding the significant errors fixed in section 5. For example, a Bombay based manufacturer which adjusted its Class IIII scales at its factory can supply them from Kanniya Kumari to Lucknow or to cities having latitudes between 8–27°. Similarly a Class IIII scale verified in Srinagar is to be re-verified if it travels southwards below latitude 27°.

For general guidance, extreme values of latitudes are given in Table 3, where Class IIII instruments adjusted by the manufacturer based in various cities such as Bangalore (13°), Hyderabad (17°), Bombay (19°), Bhubaneswar (21°), Ahmedabad or Calcutta (23°), Lucknow or Jaipur (27°), Delhi (29°) remain within the significant error.

Table 3

Manufacturer's base	Extreme parallels of latitude	
Bangalore	South: 7° North: 22°	all places in Southern India Baroda, Bhavnagar, Billaspur
Hyderabad	South: 7° North: 25°	all places in Southern India Bhagalpur, Gaya, Rewa, Udaipur
Bombay	South: 7° North: 27°	all places in Southern India Lucknow, Jaipur, Gangtok, Agra, Darjeeling
Bhubaneshwar	South: 10° North: 28°	Alleppy, Madurai Alwar, Mathura, Shahajahanpur
Ahmedabad or Calcutta	South: 14° North: 29°	Cuddapaha, Delhi, Rampur
Lucknow or Jaipur	South: 20° North: 33°	Aurangabad, Nasik Amritsar
Delhi	South: 22° North: 34°	Baroda, Bhavnagar, Billaspur All places in North India

It may be mentioned that a Bombay based manufacturer may supply Class IIII instruments to countries such as Saudi Arabia, Oman, Kuwait, Qatar and Yemen *without* incurring a significant error due to a change in g resulting from a change in latitude.

6.1.2 For places having latitudes more than 36°

The rate of change in the value of g with respect to latitude is nearly 9 in 10^5 for latitudes from 40–57° (see Table 1B column 4).

Any north-south displacement of Class I weighing instruments by 0.5 km or of Class II instruments by 5 km will cause a significant error for instruments loaded to maximum capacity. It may be mentioned that a 1° latitude change means 111 km on the surface of the earth in a north-south direction.

The error at maximum load due to a change in the g value will be around $1e$ per degree of latitude even for Class III. A significant error at maximum load will occur in Class IIII instruments if these are moved between places which differ in latitude by 5°.

These remarks are important since within the aforementioned latitudes lie Japan, Northern China, the whole of central Europe, a major portion of industrialized Canada and adjoining States of the USA such as Minnesota, North & South Dakota, etc. Among these countries, specially those sharing common markets, the flow of trade (including weighing instruments) is almost unrestricted.

6.2 Error due to change in altitude alone

The change in altitude h (in meters) which will cause a significant error in various classes of weighing instruments - as calculated from (13) - is given below:

Weighing instrument	Height h (m)	
Class IIII	2 500 m	
Class III	250 m	(17)
Class II	25 m	
Class I	2.5 m	

The above values show that a Class IIII instrument is normally not affected by a change in altitude only. However, a Class III weighing instrument found to be correct at Madras (latitude 13° - altitude 6 m) which is moved to Bangalore (same latitude - altitude 920 m) will, at maximum load, show an error almost equal to the value of two verification scale intervals, far exceeding its mpe.

Incidentally, a Class II scale cannot be moved even from the ground floor to the top floor of an 8-storey building without incurring an extra error of half the value of its verification scale interval at maximum load.

Similarly a significant error will occur in a Class I weighing instrument if it is moved from one floor to the next in the same building.

Moving a weighing instrument from a valley to a hill will cause a change in the indication for two reasons:

(i) a decrease in the g value will cause the indication to decrease, and
(ii) a decrease in air density will decrease air buoyancy and will hence increase the indication.

However, the errors due to these two reasons are not equal, hence they do not compensate each other. Kochsiek and Wünsche [6] reported that the air buoyancy effect is almost one order of magnitude lower than that of the change in the g value.

6.3 Problems with Class I weighing instruments

The error FE_g which can be tolerated in Class I instruments is 5 in 10^7 which may occur due to a latitude change of the order of 0.01° (which corresponds to only 1 km), hence these instruments are to be verified at the place of use only. Furthermore, the standard weights used for their verification should not have errors of more than 5 in 10^7, which corresponds to the mpe of Class E_1 weights [8]: for example 0.5 mg is the mpe for a 1 kg Class E_1 weight. But the highest class of weights normally provided to legal metrology services are of Class E_2, having an mpe of 1.5 in 10^6, i.e. 1.5 mg for a 1 kg weight; this question also needs to be addressed. One method is to use the actual mass values of the standard weights employed in their verification. In that case the requirement is to calibrate these weights to an uncertainty less than 5 in 10^7. This accuracy requirement is normally achievable in most national metrology laboratories.

Any change in altitude of more than 2.5 m will entail an error of 5 in 10^7. Even temporal changes in the g value at a given place may be of the order of 5 in 10^7. Hence maintenance of weighing accuracy of Class I instruments (if used as fully self-indicating instruments) will always be a problem, and so it is strongly advised that Class I weighing instruments should be used only as comparators.

7 Adjustment at the manufacturer's premises before transportation

7.1 Principle of adjustment

For a given indicating device, the indication I will be the same if (and only if) a fixed current i passes through it. Normally this current is made to pass through the indicating device via a micro potentiometer, which itself is fed by the current produced by the gravitational force mg, the weight of the body placed on the load receptor. For a body of same mass, the current produced by the force mg may vary due to a change in the g value, but by manipulating the micro potentiometer, it should be possible to allow the same current i to pass through the indicating device.

Let i_1 and i_2 currents respectively be produced and fed to the resistor R of the micro potentiometer when forces mg_1 and mg_2 act on the load receptor. By choosing resistances R_1 and R_2 of the potentiometer, the current i is made to pass through the indicating device, such that:

$$R_1 \cdot i_1 = i \cdot r \text{ and } R_2 \cdot i_2 = i \cdot r \tag{18}$$

$$\text{so, } i = R_1 \cdot i_1 / r = R_2 \cdot i_2 / r,\ i_1 = i \cdot r / R_1 \text{ and } i_2 = i \cdot r / R_2 \tag{19}$$

But i_1 and i_2 currents are respectively produced by mg_1 and mg_2 forces, giving:

$$mg_1 = \mathrm{k}.i_1 = \mathrm{k}.i.r/R_1 = \mathrm{K}.I/R_1 \tag{20}$$

Similarly:

$$mg_2 = \mathrm{k}.i_2 = \mathrm{k}.i.r/R_2 = \mathrm{K}.I/R_2 \tag{21}$$

Combining the two gives:

$$m = \mathrm{K}.I/g_1 \cdot R_1 = \mathrm{K} \cdot I/g_2 \cdot R_2 \tag{22}$$

where k and K are constants of proportionality.

It may be noted that each of R_1 and R_2 is less than R. Also to obtain the same indication for the given mass at two different places with different values of g, it is necessary that:

$$g_1 \cdot R_1 = g_2 \cdot R_2 \tag{23}$$

So by manipulating the micro potentiometer it is possible that a weighing instrument gives correct results at two different places with different values of g.

Let us consider a situation where a weighing instrument is manufactured at a place A where $g = g_1$ and is to be used at another place B where $g = g_2$. If we wish to adjust it at place A to give a correct result at place B, the correct resistance R_2 may be chosen by observing the indication only, in the manner described below.

Note that every time the micro potentiometer is adjusted or the g value changes, the zero of the indicating device will also change.

Let the current be fed to the indicating device by applying it across resistance R_2 carrying the current i_1 produced by the gravitational force mg_1 at place A. The new current $i^\wedge$ through the indicating device will be such that:

$$i^\wedge \cdot r = R_2 \cdot i_1 = i_1 \cdot R_1 \cdot g_1/g_2 = i \cdot r \cdot g_1/g_2$$

$$\text{giving} \quad i^\wedge = i \cdot g_1/g_2 \tag{24}$$

But I is strictly proportional to the current passing through the indicating device, hence the new indication $I + \delta I$ by the modified current $i^\wedge$ will be:

$$I + \delta I = I \cdot (g_1/g_2) = I[1 - (g_2 - g_1)/g_2], \text{ giving}$$

$$\delta I = -(g_2 - g_1) \cdot I/g_2 \tag{25}$$

Here the values of g_2, g_1 and I are known, so the potentiometer may be adjusted in such a way that the indication is $I + \delta I$ instead of I when the weighing instrument is adjusted at a place A (where $g = g_1$) and used at place B (where $g = g_2$). δI is approximated in terms of $0.5e$.

It may further be noticed that δI is positive if $g_2 < g_1$ and negative if $g_2 > g_1$. Therefore, the weighing instrument is advanced if the value of g is lower in the place of operation than in the place of manufacture and vice versa.

7.2 Practical hints for adjustment

7.2.1 Advancing by 0.5e

Load the weighing instrument to near maximum capacity with a standard load nominally equal to I, adjust the micro potentiometer such that I just changes by one verification scale interval, i.e. fluctuates between I and $I + e$. The value of P (indication prior to rounding) is given as:

$$P = I + 0.5e \tag{26}$$

giving the error E as:

$$E = +0.5e \tag{27}$$

In other words the weighing instrument is advanced by half the value of the verification scale interval.

Now if such a weighing instrument is taken to a place where the effective g value is lower such that the error due to it is $0.5e$, then the indication will be I when a standard load nominally equal to I is placed on it, thus compensating for the change in the value of g.

7.2.2 Retarding by 0.5e

If the weighing instrument is to be taken to a place with a higher value of g then it is initially adjusted to give a negative error (i.e. retarded). In this case the micro potentiometer is adjusted in such a way that the indication decreases by one verification scale interval value, or fluctuates between I and $I - e$, making $P = I - 0.5e$.

7.2.3 Error-free adjustment

It may be noted that for error-free adjustment of the weighing instrument, the load nominally equal to $I + 0.5e$ is placed on the load receptor and the micro potentiometer is so adjusted that the indication fluctuates between I and $I + e$.

7.2.4 Advancing or retarding by 1e

In order to retard the weighing instrument by one verification scale interval, the micro potentiometer is to be adjusted in such a way that the indication fluctuates between I and $I - e$. To advance it, the indication should fluctuate between $I + e$ and $I + 2e$ respectively. In each case, the load will remain nominally equal to $I + 0.5e$.

8 Conclusions

The fractional rate of change in g per degree of latitude varies from 1.6 in 10^6 at 0° to 9.3 in 10^5 at 46° (maximum value reached at 46°). The fractional rate of change in g with respect to altitude h, in meters, is around 2 parts per ten million.

Electronic weighing instruments of all classes are affected by changes in latitude and altitude. The error due to a change in latitude depends upon the value of the latitude, and an error equal to 1/3 mpe at maximum load is taken as being significant.

A significant error will develop for every change of:

Class I: 0.01° in latitude;
Class II: 0.1° at places with latitudes around 11°;
Class III: 1° at latitudes 17–34°.

Class IIII instruments are therefore least affected by changes in latitude, however their movements are restricted and depend on the latitude of the place at which they were manufactured. For example Calcutta-based (23°) manufactures can send their instruments to all places lying between latitudes 14–28° without any significant error occurring.

For Class III instruments although the height of buildings may be ignored, altitudes of hill stations are to be taken in account. Class II scales may develop errors due to changes in height of > 25 m, and Class I weighing instruments are more susceptible to changes in heights. A height change of 2.5 m may cause a significant error in Class I weighing instruments.

It has been established that it is difficult to maintain the accuracy of Class I instruments under normal environmental conditions if they are used as fully self-indicating devices.

Inter-state movement of Class III instruments is to be regulated due to changes in latitudes and altitudes.

From the above discussions it is apparent that an adjustment facility should be provided with each instrument, however fraudulent use of such a facility is to be eliminated. Firstly it should not be external. In some cases it has been observed that by placing a standard weight on the instrument and pushing a button, the instrument is automatically set to the nominal value of the weight, which led to fraudulent use since any sub-standard weight may be used and the instrument simply advanced. The place from where (or button by which) adjustment may be carried out is to be specified by every manufacturer and should be such that a proper seal of a competent authority can be affixed. It should be such that without conspicuously mutilating the seal no adjustment is possible.

An adjustment facility may include any self-calibration, auto-calibration device, program for adjustment or any other similar device which is intended for adjusting the indication. It is essential that any such device should not be employed to defraud or cheat the consumer. ■

9 References

[1] OIML Recommendation R 69 (1985) *Glass capillary viscometers for the measurement of kinematic viscosity*

[2] Loney, S. L.: *Statics*, Macmillan & Co., London, p. 319 (1912)

[3] The New Encyclopedia Britannica, Vol. 17, p. 539 (1988), Encyclopedia Britannica Inc., London

[4] OIML Recommendation R 76 (1993) *Nonautomatic weighing instruments*

[5] OIML Recommendation R 47 (1979) *Standard weights for testing of high capacity weighing instruments*

[6] Kochsiek, M. and Wünsche, W.: *Testing of weighing machines dependent on the acceleration due to gravity*, OIML Bulletin No. 80 (1980) p. 10

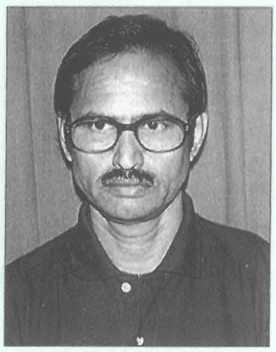
[7] Government of India, Standards of Weights and Measures (Enforcement) Act 1985, No. 54

[8] OIML Recommendation R 111 (1994) *Weights of classes E_1, E_2, F_1, F_2, M_1, M_2 and M_3*

Authors' note:

The views expressed in this paper are those of the authors, and not those of the Government of India.

S. V. Gupta



P. A. Krishnamoorthy

PRIMARY STANDARD FOR HEAT METERING IN HUNGARY

Calibration of compact heat meters by electrical energy measurement

T. KOVÁCS, T. MAGYARLAKI, G. SZILÁGYI, National Office of Measures, Hungary

Traditional measurement of heat energy

For measuring heat in a heat-exchange circuit, different types of heat meters are used and the measured energy can be expressed by the following equation:

$$E_h = V \cdot \Delta T \cdot K$$

where:

E_h = the measured energy (MJ);
V = the volume of the energy-conveying liquid (m^3);
ΔT = the temperature difference of the liquid before and after heat exchange (K);
K = the actual heat coefficient of the liquid ($MJ/m^3 \cdot K$).

For calibration of a heat meter, these three parameters must be checked individually, their maximum permissible errors being given in OIML Recommendation R 75 *Heat meters*. The calibration procedure requires much more precise sub-assemblies than a single-parameter method. To perform such calibration, the authors developed an apparatus with absolute energy measurement.

Basic principle of the measurement

Measurement of certain physical quantities by substitution of electrical energy is a well-established concept, for example microwave, optical or radioactive radiation.

By absorption of these radiations a temperature rise occurs on the target; this temperature difference can also be produced by using a measurable electrical heating energy. In this way the measurement of unknown energy can be converted into an electrical energy measurement with high sensitivity. The accuracy of the procedure depends on the quality of substitution.

In the case of heat meter calibration the primary parameter is the measured electrical energy that is

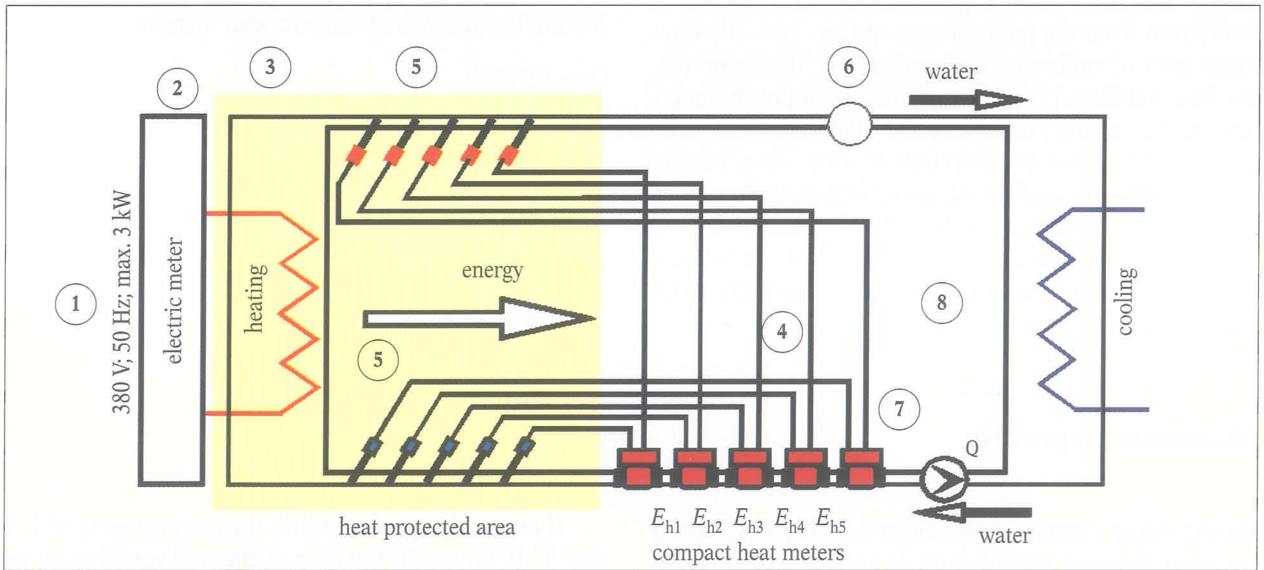


Fig. 1 Measurement circuit

Fig. 2 The first experimental apparatus for energy metering

transformed into heat energy. The transformer is a heat flux compensated boiler with electrical heating. The boiler is protected against heat loss in two ways: firstly by thermal insulation and secondly by means of an active compensation using a heat flux sensor with a compensation heater. The heat loss on the boiler wall can theoretically be zero if the heat flux sensor reads "0" W/m^2.

Arrangement of the measurement circuit

From the 380 V, 50 Hz network the boiler heater uses 1, 2 and 3 kW electrical power. As shown in Fig. 1, this will be integrated in time and measured as electrical energy by an electricity meter standard (2). The boiler is the part of the water circuit that has a well protected area, free of heat loss (3).

The immersion tubes for ΔT temperature sensors of calibrated heat meters (5) are also placed in the protected area. The further part of the water circuit is indifferent from the point of view of heat loss. The flow meter part of calibrated heat meters (4), the pump (6), the flow stabilizer (7) and the cooler (8) can be mounted outside the strictly protected area. There are two different flow directions: the direction of water flow, i.e. the water circulation, and the direction of energy flow from the heater towards the cooler. This E_e energy flow is measured electrically and compared with the individual E_h registered heat energy by compact heat meters to be calibrated.

Measurement process

During water circulation the electric heater is switched on until thermal equilibrium is reached. The temperature increase in the boiler (ΔT) depends on the

Fig. 3a The completed apparatus for heat energy calibration

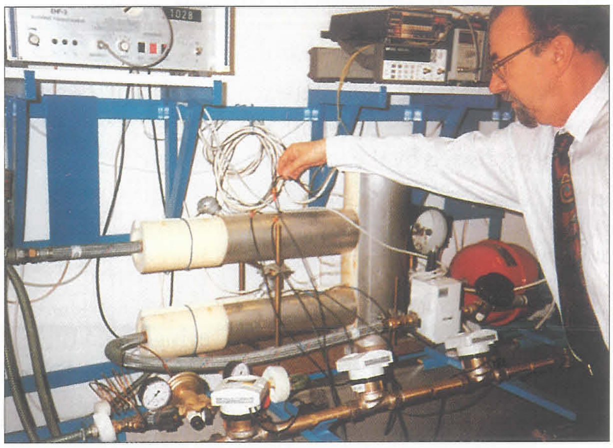


Fig. 3b The equipment in service

electrical power. The average water temperature can be achieved by regulating the cooling power. The example below shows the applied working points for calibration.

Nominal parameters of compact heat meters:

$Q_n = 1.5\ m^3/h$

$t_{max} = 90\ °C$

Working points:

Q [l/h]	ΔT [K]	t_1 [°C]
140	3	70
57	15	70
57	30	70
860	3	70

$\Delta T = t_1 - t_2$

These working points fulfill the requirements of 1, 2 and 3 kW power. In the case of thermal equilibrium an energy comparison between the E_e [kJ] electric and E_h

[kJ] heat energy is performed. The energy accumulation requires about 10 minutes. The calibration error is expressed as:

$$E = \frac{E_h - E_e}{E_e} \times 100\ \%$$

where:

E = the relative error of calibrated compact heat meters in %;
E_e = the electric energy integrated during the calibration time period in kJ or kWh;
E_h = the energy increase on compact heat meters during the calibration time period in kJ or kWh.

Experimental assembled apparatus

Figure 2 shows the first experimental apparatus built for testing the measurement principle.

The cooler was a radiator that overheated the test lab area. The boiler (as a heat exchanger) was protected only by passive insulation and this assembly was suitable to determine the main parameters.

Construction of the heat energy standard

The improved apparatus can be seen in Fig. 3. The heat loss prevention consists of heat flux compensation and the heat energy is dissipated by water cooling. A flow generator creates stable water flow.

Parameters of the energy standard:

Max. electric heating power	3 kW
Flow range	30–1000 l/h
Nominal diameters	1.2"; 3/4"
Temperature range	30–90 °C
Temperature difference	1–30 K
Uncertainty	better than 0.4 %
Working pressure	1.6 bar
Max. number of measured compact heat meters	5
Units applied at calibration	MJ, kWh

Uncertainty budget of the energy meter:

The expanded uncertainties of components with $k = 2$ are as follows:

Electric energy	$U = 0.2\ \%$
Heat loss under heat flux compensation	$U = 0.1\ \%$
Static error at temperature sensors in immersion tubes	$U = 0.3\ \%$ (0.01 K at $\Delta T = 3$ K)
Time measurement	$U = 0.2\ \%$ (at 10 minutes)

Expanded uncertainty of energy measurement:

$$U = \sqrt{0.2^2 + 0.1^2 + 0.3^2 + 0.2^2} = \sqrt{0.18} = 0.42 \cong 0.4\ \%$$

This estimated uncertainty is calculated for the worst case of working point combination at the comparison:

t_1 = 70 °C
ΔT = 3 K
P = 1 kW

Testing program

The authors were unable to realize a comparison on another energy standard, and were therefore obliged to find a proper comparison with the traditional calibration standards for a compact heat meter. This is the relative method using the reported traditional parameters such as temperature, temperature difference, flow measurement and enthalpy correction. Five calibration laboratories (Clorius, Ista, Kamstrup-Metro, Slovak Institute of Metrology and the OMH) took part in this program and calibrated their compact heat meters in their laboratories with the highest care. The calibrated meters were transferred to the National Office of Measures (OMH) for energy calibration. The deviations between the energy calibration of participants (home) and the OMH are given in Diagrams A–E, in line with different parameters.

Conclusions

1 The compact heat meters fulfill the accuracy requirements of OIML R 75 both for the home and the OMH calibrations.
2 The average deviation between home and OMH calibration is 0.24 % (Diagrams A–E).
3 From the diagrams, the conclusion is drawn that in the production process of the heat meters the ΔT calibration is the critical point, much more so than the flow meter calibration.

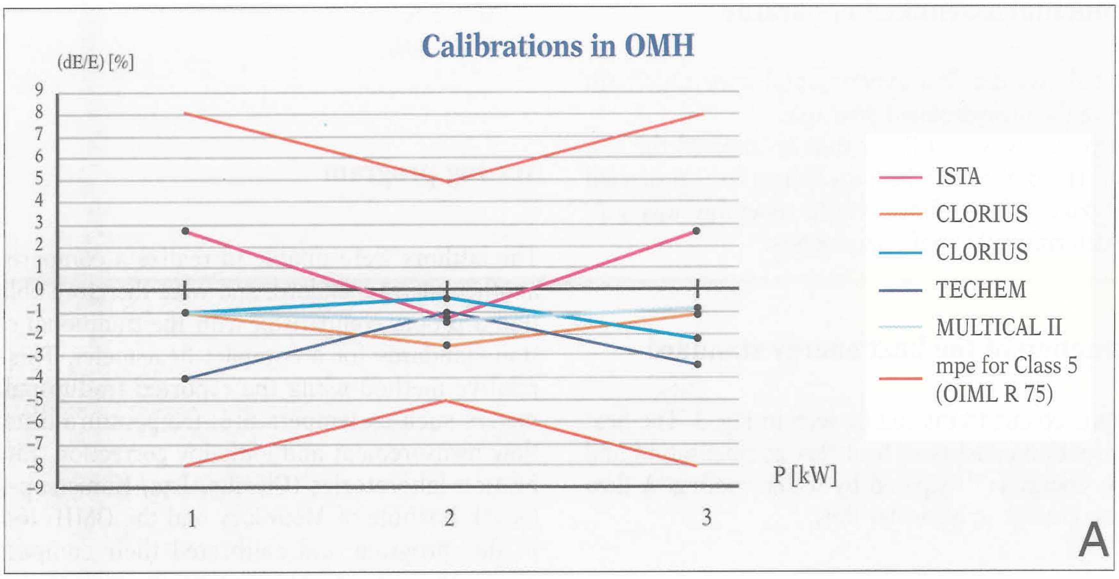
Advantages of the application of the heat energy standard

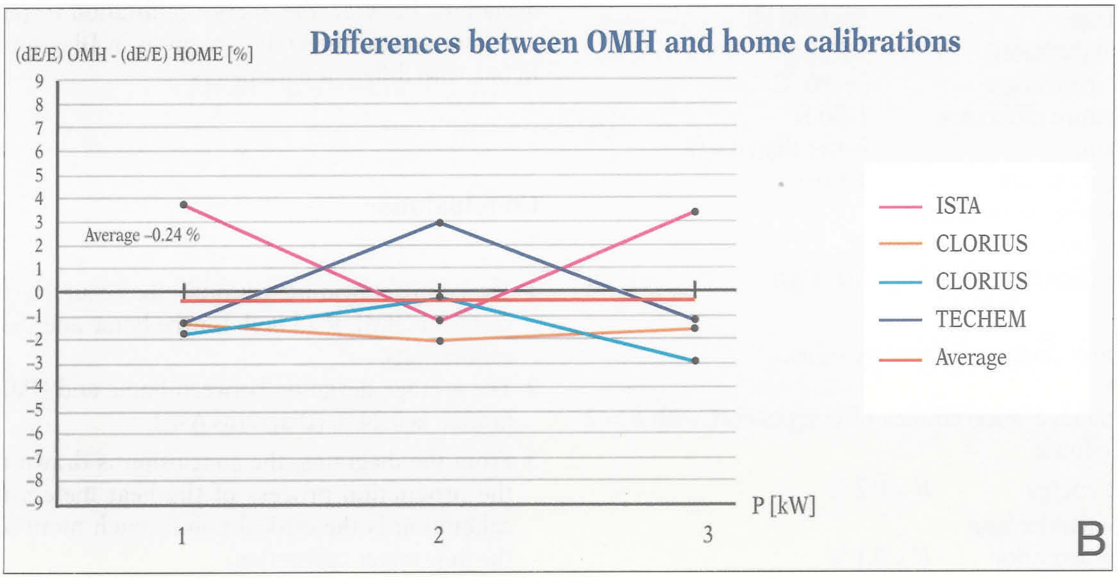
- This kind of energy calibration does not require the K-value to be known (the enthalpy and density correction of water);
- There is no trouble with the calibration of the ΔT sensor pair;
- Unknown sources of error can be revealed, e.g. the static error of the temperature sensor built into the body of the flow meter;
- The K-value of unknown conveying liquid can be determined from the measured energy;
- During the calibration process the flow meter operates at the real working temperature.

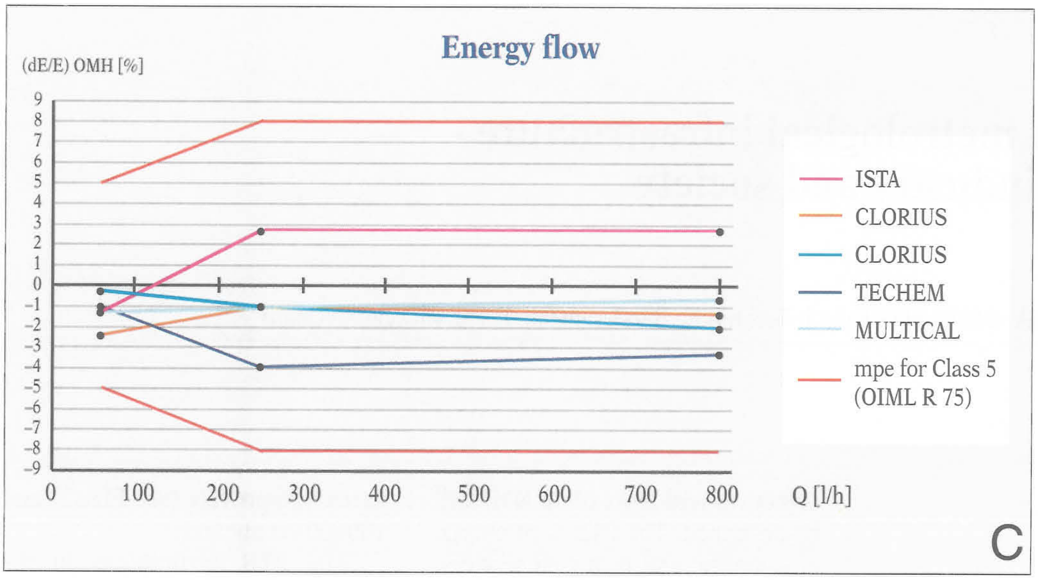
Recommendation

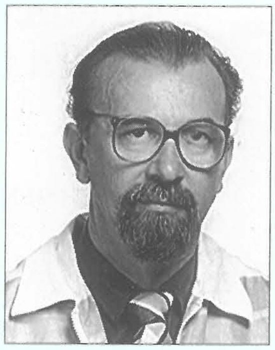
On the occasion of the revision of OIML R 75 it may be appropriate to complement the calibration process with the direct energy measurement and its deduced variant, the energy simulation, as an option in the future.

The traditional calibration, producing single parameters for sub-assemblies, is economically reasonable. However the energy calibration of compact heat meters at control can assure higher efficiency. ■

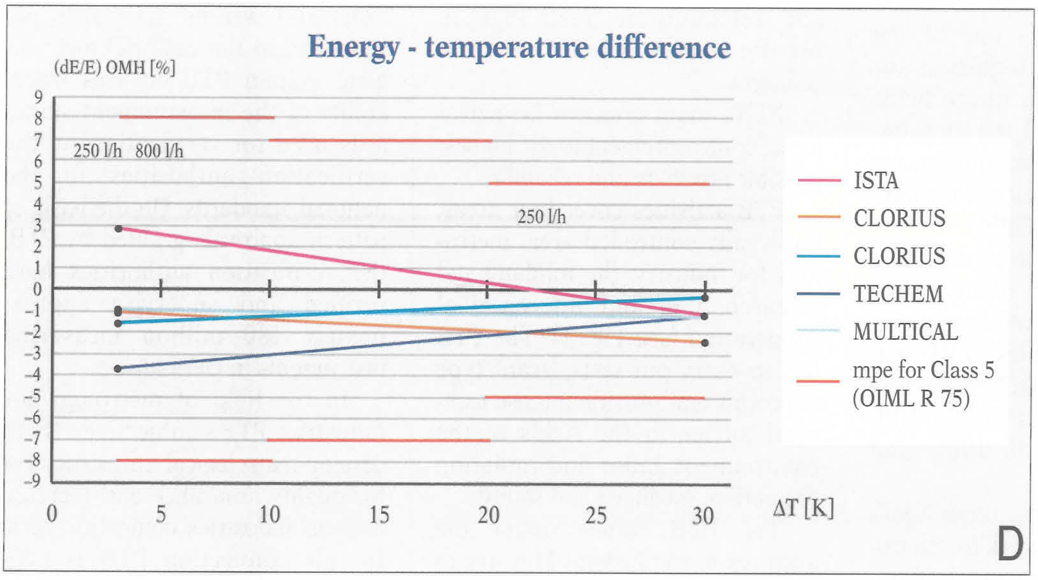


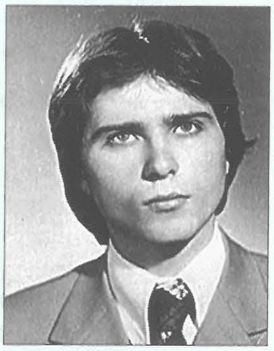




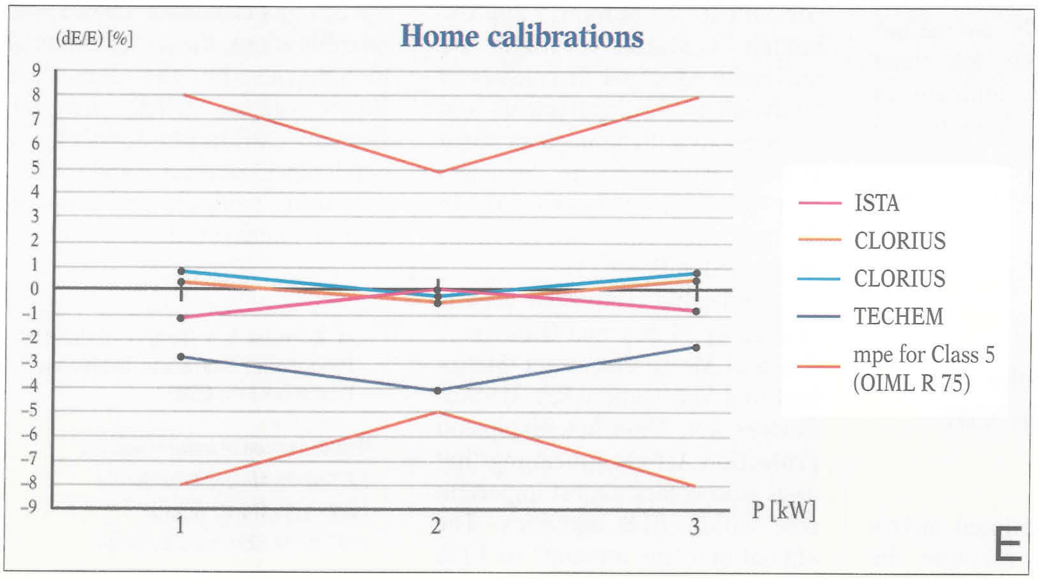


T. Kovács





T. Magyarlaki



G. Szilágyi

IN-DEPTH FEATURE

An efficient metrological infrastructure - benefit for industry and society

M. KOCHSIEK* **and A. ODIN,** Physikalisch-Technische Bundesanstalt, Braunschweig, Germany

1 Introduction

In all countries, a highly developed metrology system is one of the most important prerequisites for consumer protection in the fields of health, labor and the environment. It is also a precondition for trade/industry and science/technology to function efficiently.

After the *Convention du Mètre* was founded in 1875, many industrialized countries established national metrology institutes (NMI), e.g. PTB (Germany) in 1887, Mendeleev Institute (Russia) in 1893, NPL (United Kingdom) in 1900, and NBS (USA) in 1901.

For many decades these NMI's have done research work for metrology, realized the national standards, disseminated units of measurement and have partly carried out verifications and tests. For some years now, the development in metrology has been characterized by regionalization of the economies and by globalization of trade and services.

2 Objectives, tasks and structure of an NMI

Using Germany's national metrology institute as an example, the objectives and tasks of an NMI will be described. The PTB is in charge of scientific and technical services, and its work is focused on progress and reliability in metrology to benefit society, science and the economy.

PTB's main concern is metrology, i.e. measurement to the highest possible precision and reliability.

PTB activities cover four areas: the legally controlled area, metrology for industry, the fundamental research area and international cooperation (see Fig. 1). The PTB has to carry out tests, grant type approvals and provide intense technical advice in the fields of the environment, labor and radiation protection, medicine and safety.

The PTB comes under the auspices of the Federal Ministry of Economics and has some 1600 permanent employees, approximately a quarter of whom are university educated. It consists of 10 divisions, 35 departments and 100 sections with a budget of about DM 250 million; its headquarters and presidential board are in Braunschweig, and two divisions are located in Berlin [1].

The legally controlled area is covered by 34 Acts and Ordinances (Units of Measurement Act, Metrology and Verification Act, Medical Devices Act, Time Act, Explosion Protection Act etc.) meaning that legal aspects play a most important role within PTB activities. The annual outcome amounts to 1200 pattern approvals (see Fig. 2) and 100000 certificates.

The PTB participates in the elaboration of 500 technical regulations and written standards per year. Within the national metrological system PTB ensures traceability of the measurement standards used for verification by the verification authorities to the national standards. On the basis of pattern approvals granted by PTB, the verification authorities have verified and supervise approximately 180 million measuring instruments in Germany.

In the field of metrology for industry, PTB's objective is to develop metrological infrastructures for quality assurance and increase national industries' competitiveness. In this connection PTB is concerned with the dissemination of the SI units of measurement based on calibrations, the accreditation of laboratories by the Deutscher Kalibrierdienst (DKD, i.e. the German Calibration Service), the development of precise and reliable measuring methods, and cooperation in standardization. Under the

* M. Kochsiek is a Member of the PTB Presidential Board and is also Vice-President of the CIML.

Written version of lectures held on:
1997-07-25 Almaty, Kazakhstan;
1997-09-30 Minsk, Belarus;
1997-10-24 Florianopolis, Brazil.

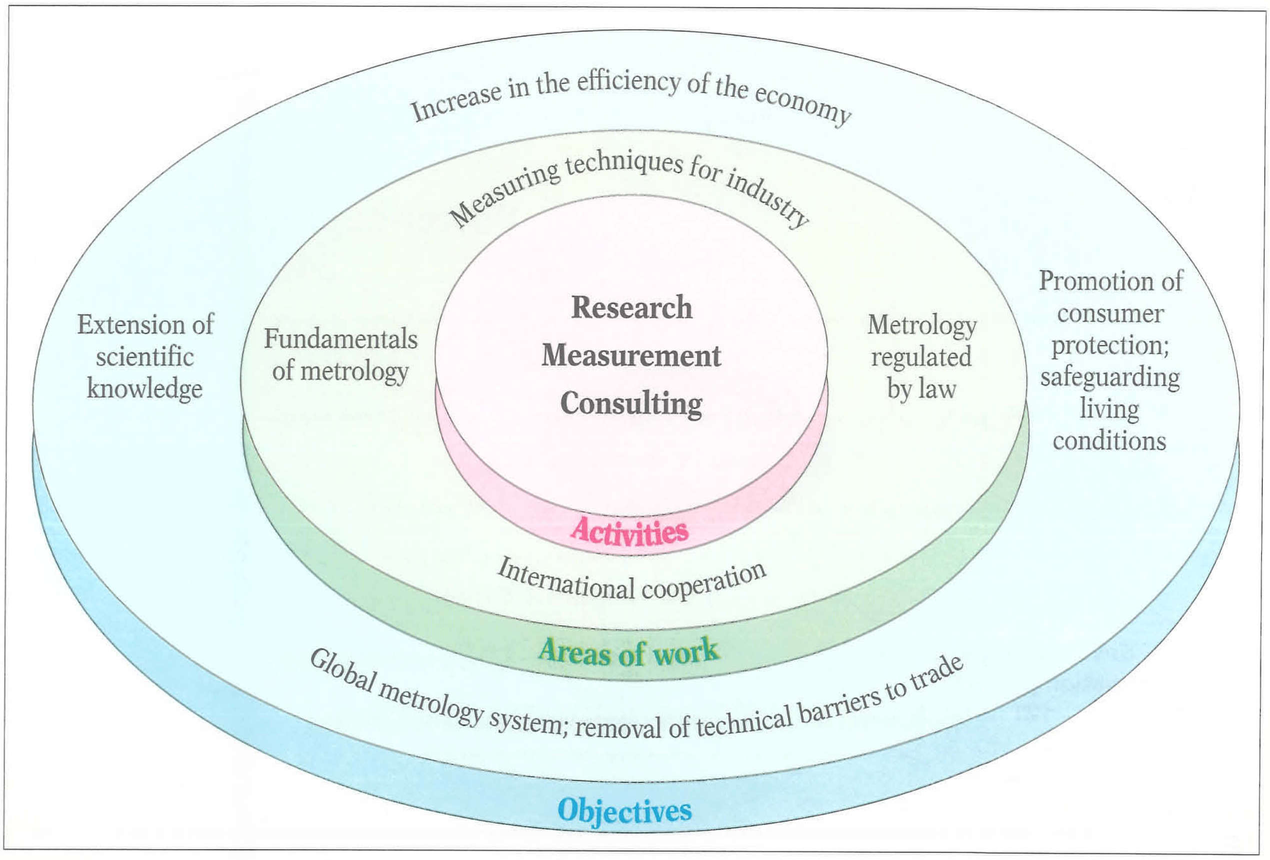


Fig. 1 Aims, activities and major tasks of national metrology institutes in the four areas of metrology

umbrella of DKD about 200 calibration laboratories carry out 80000 calibrations per year with DKD certificates and in addition issue more than 700000 in-house calibration certificates. DKD also provides approximately 5000 consultations per year.

The criteria for ranking tasks are their economic significance and their complexity/level of difficulty. The PTB increasingly tries to provide overall services which enable the client (i.e. partners from industry) to have various requirements such as safety, electromagnetic compatibility and resistance to interferences checked by just *one* competent body and to have the results confirmed by this same body.

Activities in the field of fundamental metrology aim to increase scientific knowledge and technological innovation. Fields of work cover the development of national measurement standards, the determination of fundamental and physical constants, the use of quantum effects for the realization of physical units, the establishment of reference material traceable to SI units and the determination of material properties. The metrology-relevant fundamental research work is indispensable for maintaining the metrological competence of PTB. Being clearly defined, PTB's research work differs from that undertaken by universities and other research institutions, thus providing a good basis for cooperation with the latter. This work results in more than 600 publications and over 600 lectures and seminars per year.

The objectives of international cooperation are the worldwide standardization of metrology and the removal of technical barriers to trade. PTB cooperates with European (EUROMET, WELMEC, EAL) and international (CIPM, OIML, ILAC) metrology organizations, other metrology institutes and research institutions. It participates in international research programs (e.g. under the umbrella of the European Union) and provides technical support to developing countries and those in transition towards a market economy. The fulfillment of international contracts and agreements, the economic and metrological importance of the task as well as the increase in efficiency, accuracy and reliability of measurements are the criteria for those tasks which are to be given priority. In fact, the PTB cooperates with over 100 regional and international bodies, and provides technical support to 40 projects in 30 countries.

Nowadays, NMI's face a number of new challenges, for example:

- analytical chemistry: traceability to SI units and also to reference material if possible;

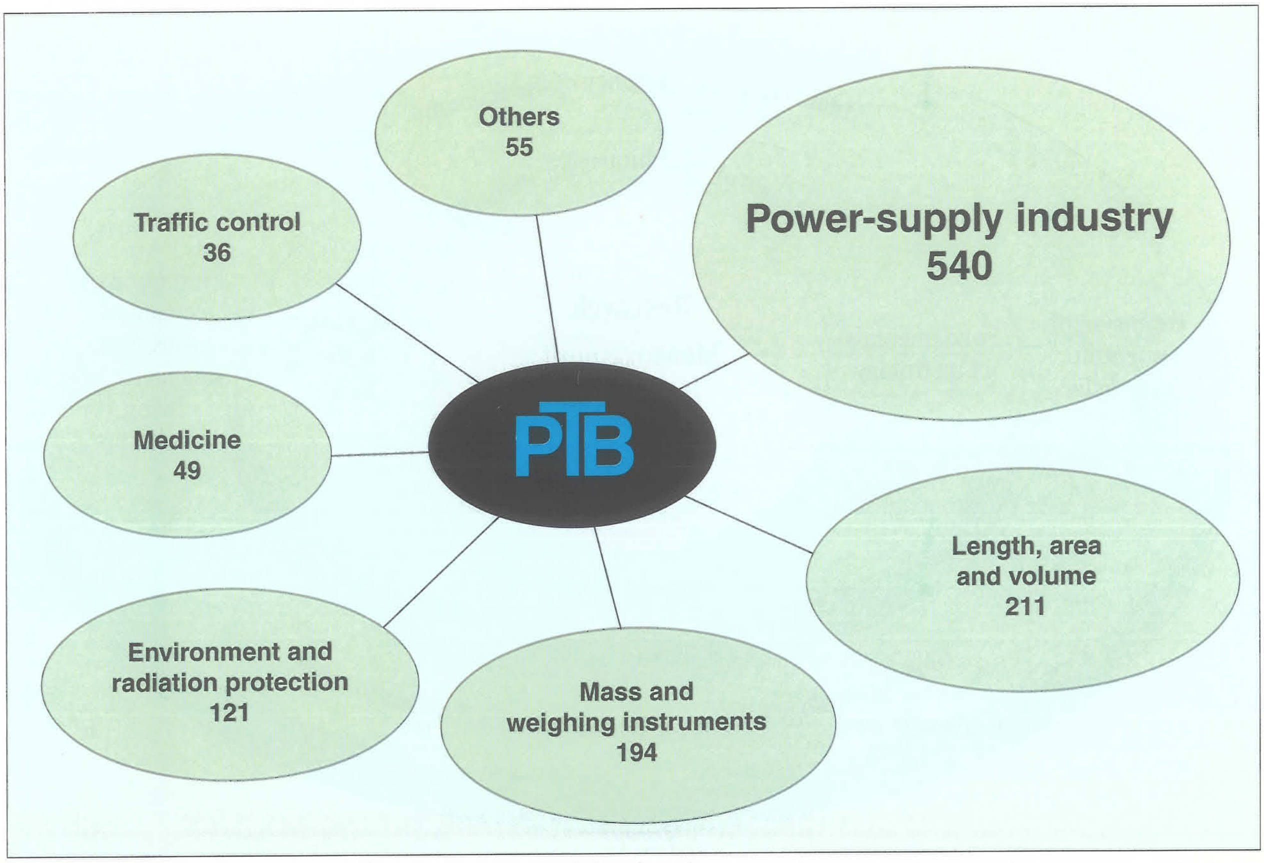


Fig. 2 PTB's main fields of activity regarding pattern approvals (as of 1996)

- information technology: software quality management; determination of uncertainty caused by data processing algorithms, data conversions; determination and conformity testing of interfaces in hardware, software and communication, data security;
- medical measuring techniques: reference standards, harmonized conformity assessment procedures of measuring instruments, e.g. for instruments which determine and monitor patients' vital functions such as electrocardiographs, blood-pressure or clinical monitoring systems;
- global/regional measurement system: the global measurement system provides a coherent formal system which ensures that measurements can be made on a consistent, appropriately accurate, transparent and internationally recognized basis throughout the world. It comprises the relevant international cooperation and all the activities that provide measurement data [2].

Besides these new fields, NMI's have to cope with a number of general management problems such as controlling, quality management and project management, etc. so as to increase work efficiency.

3 Regionalization in metrology

Only very few of the more than 200 independent countries in the world have an NMI covering all the aforementioned areas. In fact the size and tasks of an NMI should be directed to the needs of society, industry and science. Different models can be seen especially taking regionalization into account.

Many countries work closely together within regional economic and political organizations. For the organization of an NMI there are several possibilities, i.e. models A to E, which are described and discussed in detail in the OIML Bulletin [3]:

- for an NMI covering all activities (fundamental, industrial, legal metrology), model A or model B (only some fields) apply;
- for an NMI maintaining secondary standards linked to primary standards of other countries, model C applies;
- if primary and/or secondary standards are maintained in one or various institutions under central administrative supervision (in a country or a region), model D applies;
- if no measurement standards are maintained, bodies which coordinate information as to where

traceability to other national institutes (e.g. accredited laboratories, verification offices) is achievable, can be addressed. Here, model E applies.

The general trend towards cost reduction obliges many countries to increase economic cooperation with their neighbors within regional organizations. In the European Union (EU) and other regional economic areas, metrology is playing an ever increasing role to establish worldwide free trade within the region and between regions. The most significant international and regional (Europe) organizations founded in the past are illustrated in Table 1.

4 Globalization

The globalization of trade and services has an enormous influence on metrology.

Political pressure on metrological institutions, formerly exerted via the GATT, is now exerted via the WTO in order to render measuring procedures and standards more transparent and in order to ensure their subsequent harmonization. (TBT Agreement - see [4]).

Manufacturers and users of measuring instruments are both interested in harmonization: the former want to circulate their products worldwide and the latter want to pay competitive prices.

For metrological barriers to trade to be eliminated, harmonization of technical regulations and written product specifications as well as requirements to be met by calibration and test procedures and conformity assessment is necessary but not sufficient, i.e. it is necessary in addition to establish mutual confidence with regard to a uniform application of these written requirements. As far as the requirements to be met by laboratories are concerned, the accreditation of calibration and test laboratories and certification bodies is an appropriate means, supported by interlaboratory comparisons and peer evaluations. On this basis mutual recognition agreements may be reached which guarantee uniform technical competence.

Table 1 International and regional metrological organizations

Level	Organization	Task
International	BIPM	Units, measurement standards
	OIML	Legal metrology
	ISO/IEC	Standardization
	ILAC	Accreditation
	IMEKO	Science, training
Regional (Europe)	EUROMET	Units, measurement standards, calibration
	EA	Accreditation
	WELMEC	Legal metrology
	CEN / CENELEC	Standardization
	COOMET	Metrology

If the above-mentioned preconditions are met, the one-stop testing goal required by industry will be achieved, meaning that tests and certifications carried out in one country will not have to be repeated in another. These harmonization activities will finally serve to increase worldwide acceptance of certificates.

Figure 3 illustrates the above. Here, the guarantee of metrological equivalence of the measurements presents a certain problem.

5 Measures to achieve and safeguard technical competence

Independent of the model chosen by an NMI, the metrological equivalence of the measurement standards has to be ensured. This can only be done on the basis of international interlaboratory comparisons. The organization, evaluation and publication of these may be performed under the umbrella of international organizations such as the BIPM, by NMI's or by accreditation bodies.

The evaluation of the comparison results can be taken as being a decisive criterion for the assessment of technical competence. All

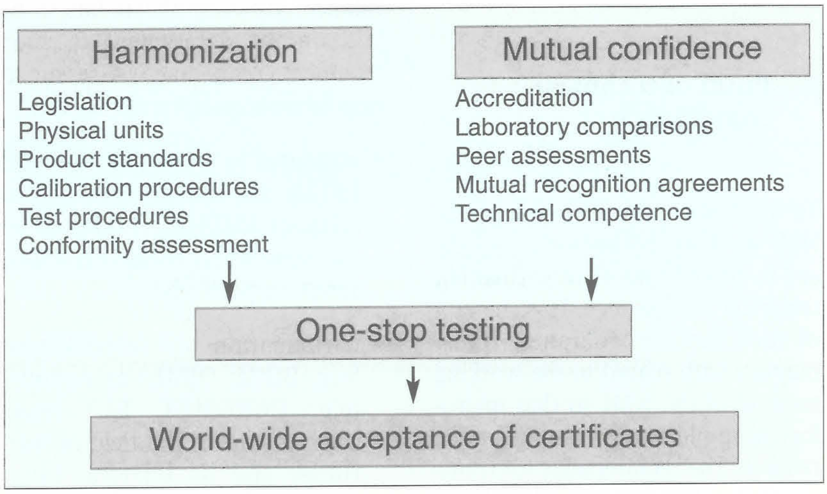


Fig. 3 Removal of metrological barriers to trade

the measures indicating that the criteria of ISO/IEC Guide 25 or EN 45 001 standards series are met also serve this purpose. These standards contain the general requirements to be met by a laboratory in order to be considered competent to carry out tests and/or calibrations. The establishment of a quality system in the sense of these standards is an important confidence-creating measure, which supplements the continuous exchange of knowledge and experience that has traditionally taken place between the NMI's at regional and international levels (symposia, seminars, workshops).

This also applies to legal metrology because there is a public interest in precise and reliable measurements. Nowadays the kinds of controls required for measuring instruments are determined in many fields by regional directives. In the European Directives criteria are laid down according to which public and private institutions may undertake these tasks. The permanent meeting of the requirements is the prerequisite for notification and an entry in the list of Notified Bodies. It is taken for granted that those Notified Bodies which are able to provide evidence of their conformity with the harmonized standards of the EN 45000 series meet the requirements of the directive.

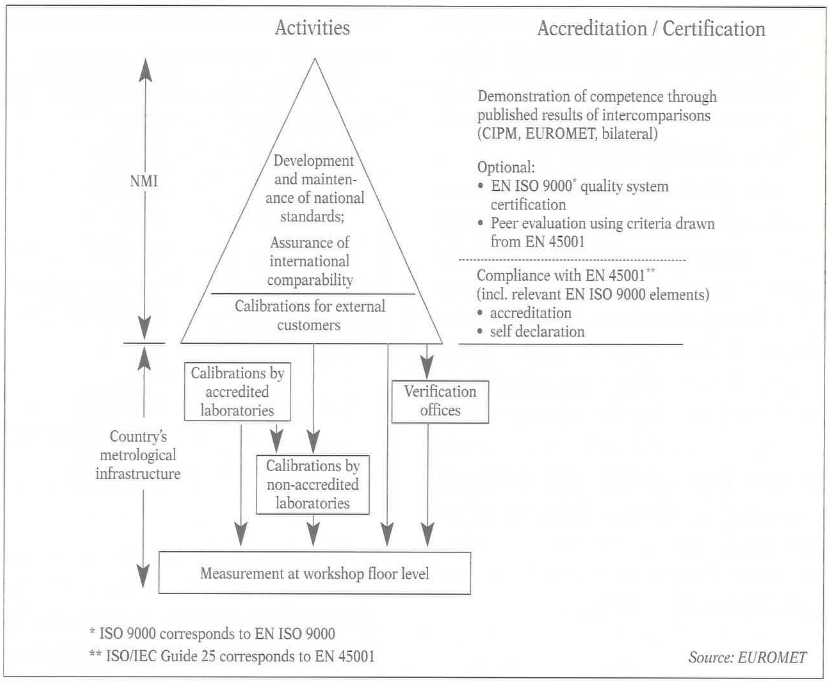


Fig. 4 The National Metrology Institute (NMI) in the metrological hierarchy

6 Proof of technical competence

To maintain mutual confidence in NMI working methods it is expedient to provide proof of permanent technical competence. It is the aim of such proof to guarantee transparency with regard to the working method of the NMI so that metrological results can be assumed to be reliable. The requirements for transparency also contain the documentation of the quality system in a quality manual describing the organization and technical working procedures of the NMI. Formal accreditation of the NMI or certification of its quality system is not possible or advisable in all cases, because an NMI heads the metrological hierarchy [6]. Figure 4 shows the interconnections within this hierarchy.

As the technical competence has a decisive impact on the services to be rendered and on the confidence, great emphasis has to be laid on the assessment of such technical competence. Assessment may be performed on the basis of:

- measures to show that the NMI fulfills all the criteria of the relevant ISO/IEC Guides or of the standards in the EN 45000 series, respectively;
- participation in international (e.g. BIPM, OIML) or regional (e.g. EUROMET, EU) intercomparisons in the field of metrology and by bilateral intercomparisons;
- publication of the results of all the intercomparisons upon detailed consultation and discussion by competent participants.

Whenever the fundamental standards of the EN 45000 series for the assessment of technical competence, independence, impartiality and integrity of NMI's are made use of, the criteria laid down in the standards have to be applied to the special fields of activity of the NMI.

Independent of the method chosen to prove technical competence, the metrological equivalence of the measurement standards must be guaranteed - this is increasingly done on the basis of international intercomparisons. The organization, assessment and publication of the results of the comparisons may be performed under the umbrella of NMI's, international organizations or accreditation bodies. The evaluation of the comparison results may be used as a criterion for the assessment of the technical competence. All these measures provide evidence of the fact that the criteria of ISO Guide 25 or of EN 45001 are fulfilled. These standards contain the general requirements to be met by a laboratory to prove its competence for the performance of tests and calibrations, and - as pointed out in the second paragraph of section 5 - the establishment of a quality system in this sense is a significant, confidence-creating measure which supplements the permanent exchange of knowledge and experience which has traditionally been practiced between the NMI's at regional and international levels. In the future an efficient quality system will be indispensable for an NMI.

An NMI has to be able to give evidence of its technical competence, e.g. by accreditation, by self-declaration or by "peer-evaluation", carried out by experts of other NMI's. The following elements are relevant in this context:

- documentation;
- implementation of the quality system;
- assurance of traceability;
- participation in interlaboratory comparisons;
- performance of quality audits and management review.

7 Achieving worldwide acceptance of certificates

An NMI is entitled to issue certificates or reports under its own logo. This means that:

- as a laboratory it issues calibration certificates or test reports. On these grounds the results of the evaluation of one or several product characteristics are given according to a certain method (standardized or not). As a rule, it does not imply whether certain requirements are fulfilled or not.
- as a product certification body it issues product certificates stating the compliance of the product with written specifications. Product certification establishes confidence in the product, which meets certain requirements.

The question of international acceptance of certificates is gaining increasing importance and has a bearing on the work of NMI's. The basic elements to establish and maintain multilateral agreements in metrology are:

- harmonization of requirements and operation procedures:
  - *standards* (ISO/IEC Guides, European Standards EN 45000);
  - *requirements*, e.g. measurement uncertainty, calibration certificates, OIML test reports;
  - *guidance publications* for laboratories (e.g. internal audits, traceability, calibration procedures, sectorial technical interpretations of basic standards);
- interlaboratory comparisons;
- evaluation visits.

Multilateral agreements assume the equivalence of national measurement standards and recognition of the validity of calibration certificates issued by NMI's - at present this is one of the major tasks of the BIPM. The degree of equivalence of national measurement standards is expressed quantitatively in terms of the deviation from an interlaboratory comparison reference value and the measurement uncertainties in these deviations. The smaller the deviations are, the higher is the degree of equivalence [7].

8 Conclusions for the future

Due to the ever increasing globalization and regionalization of trade and economy, new requirements to be met by the entire metrological infrastructure of a country also have to be established in the field of metrology. Here, the safeguarding of the metrological equivalence of national measurement standards and calibration and traceability problems are of essential significance. The extent to which the metrological equivalence of calibration (and other) measurement certificates may be mutually accepted and whether the duplication of work may be avoided, is dependent on solving these problems. Improved transparency of the work on the basis of high technical competence and the fulfillment of the requirements of ISO/IEC Guide 25 are important criteria in this connection.

To prepare solutions to the above problems the major international organizations are elaborating studies analyzing the significance of national and international metrology in the next millennium [8]. The conclusions to be drawn will have to be practically applied to metrology without delay.

The discussion and privatization of tasks performed by the state so far will lead to a shift in responsibility of tasks to private economies and non profit-oriented organizations; the ongoing changes in legal metrology in Europe are examples of this. This is a positive development since it leaves more space for the other major tasks of NMI's.

The existing metrological structures in Europe will have to meet the challenges of the development of the European Single Market as well as those of the social and economic changes in the countries of Central and Eastern Europe. A highly developed and functional metrology infrastructure is one of the fundamental prerequisites for social security and economic growth of these countries. ■

Bibliography

[1] PTB-Jahresbericht 1996, Braunschweig, 1997 (ISSN 0340-4366)

[2] K. Birkeland: Conditions and potential of legal metrology at the dawn of the 21st century (Draft of 14 November 1997)

[3] M. Kochsiek and A. Odin: "NMI's in present-day metrology", OIML Bulletin, Volume XXXVII, Number 2, April 1996, pp. 27–32

[4] The Agreement on Technical Barriers to Trade, 1995

[5] European Commission, CERTIF 97/5, 15 September 1997: The EN 45 000 Series of Standards and the Conformity Assessment Procedures of the Global Approach

[6] PTB-Mitteilungen 105 4/95 (Official Journal of PTB), Guidance on Accreditation of National Metrology Institutes and Certification of their Quality Systems, pp. 303-304

[7] BIPM, Agreement on the equivalence of national measurement standards and recognition of calibration certificates issued by national metrology institutes (Draft of 19 August 1997)

[8] W.R. Blevin: National and international needs relating to metrology, appropriate international collaborations, and the role of the BIPM (2nd Draft)

LEGAL METROLOGY MANAGEMENT

MOSEL, an organizational and accounting database to meet the modern requirements of a German verification office

H. EISENKOPF, Eichdirektion Rhineland-Palatinate, D-55543 Bad Kreuznach, Germany

As early as the late eighties, the Verification Authority of the German federal state Rhineland-Palatinate was confronted with the need for a data processing concept to master the organizational and accounting tasks resulting from the diverse sovereign testing activities and the ensuing 35 000 bills of costs made out every year by the five verification offices. This concept was to be open to future developments and - against the background of financial restraints - had to stand a good chance of being realized.

The name of a river and famous wine-growing region in Rhineland-Palatinate is used as an acronym for ***M**ehrplatzfähiges relationales **O**rganisations- und Rechnungs-Datenbank-**S**ystem der **E**ichbehörde des **L**andes Rheinland-Pfalz.*

Since the beginning of the nineties, the MOSEL verification office database has been developed and permanently extended on the basis of this concept which up to now has proved to be successful.

One of the central elements of MOSEL is the definition of the so-called objects. Objects are measuring facilities (measuring instruments, auxiliary equipment) and supervision tasks at the verification office itself or at customers' premises. When these objects are inspected by the verification office, results are assigned to them (verification, return, inspection testing), i.e. these objects can also be defined as activities and thus be used for making out bills. For this purpose these objects must, however, be appropriately defined such that all activities are covered and how charges are fixed can be clearly traced back. In a way, these objects define a service catalog which when broken down into individual services covers all activities. This can easily be illustrated by some examples of more than 2 000 objects (see Table 1).

A four-stage menu system serves to select these objects in MOSEL which are then available for selecting the activity. Within the scope of the database, different fields for the information to be

Table 1 Examples of object definitions

Obj4Num	Obj4Kurz	Obj4Text	Obj4Art	1	2	3	4
04020203	04KT	Transport measuring container, Vol: > 6 m^3–8 m^3	M	8 years	NO	04803	08
05029010	05FZDW	Printing mechanism	A	0 years	NO	00000	81
05029011	05FZKE	Coin/note acceptor	A	0 years	NO	00000	81
05029012	05FZTU	Temperature corrector	A	0 years	NO	00000	81
05031104	05TM	Measuring assembly, tank truck; Q_n: > 500 l/min–1 000 l/min	M	2 years	YES	05204	12
05011102	05ZM	Liquid fuel dispenser; Q_n: > 20 l/min–100 l/min	M	2 years	YES	05202	11
08070102	08E2	Weight (E_2): from 100 g–1 000 g	M	4 years	NO	00000	22
09011309	090HNV	Combination scale (III, n), Max + T: > 31 000 kg–81 000 kg	M	3 years	NO	09109	25
09053003	09APN0	Apothecaries' scale (II, n), Max + T: > 1 kg–5 kg	M	4 years	NO	09603	26
10080206	10EU6	Egg grading machine; 6 revolving scale paths	M	2 years	NO	00000	32
14010501	14G51	Glass therm.: Scale division 0.05 °C; test range: <= 25 °C	M	10 years	NO	00000	37c
15063101	15TL	Air pulse (non-contact) tonometer	M	2 years	NO	00000	42
18080201	18ACXA	Measuring instrument for CO, NO, HC, O_2	M	1 year	YES	00000	47b
81010102	81GS2	Sampling inspection, weight, > 50–80 packages	S	0 years	NO	00000	900

Note: column headings refer to the database field designations evaluated are assigned to the object definitions. In the column "Obj4Art", the kind of object - here measuring instruments (M), auxiliary equipment (A) and supervision tasks (S) - is defined. Furthermore, the statistics field (column 4) and the period of validity of verification (col. 1) are given.

A so-called characteristic (col. 3) allows different object sizes to be delimited. The exact values of the characteristic number are anchored in the corresponding set number of the table of characteristics. The values of the characteristic (e.g. Q_n > 20 l/min up to 100 l/min for liquid fuel dispensers or 50 t for the size of a vehicle scale) are of considerable importance for evaluating the staff and equipment necessary for testing the respective objects. Certain objects should, however, be identifiable (col. 2). Thus the device number can serve to set up a measuring instrument management system at the customer's premises. However, the identity numbers only relate to the individual object and are thus of minor importance for structural information. For reasons of clarity, other fields such as, for example, special filters, cost units, etc. have been omitted.

When the bill is made out in MOSEL, the object definition furnishes the first line of the bill. It can be seen from the example "liquid fuel dispenser", "measuring assembly in the tank truck" and "apothecaries' scale" that aspects to be considered by the verification authorities such as, for example, designations of measuring instruments or organizational boundary

Table 2 Object example from the four-stage menu

Obj1Numr	**Obj1Text**
0105	Volumemeters for flowing liquids other than water
Obj2Numr	**Obj2Text**
010501	Liquid fuel dispensers (mineral oil) for cars
Obj3Numr	**Obj3Text**
01050111	Liquid fuel dispensers for cars (measuring assembly)
Obj4Numr	**Obj4Text**
0105011102	Liquid fuel dispenser (meas. ass.); Q_N: > 20 l/min–100 l/min

Table 3 Activity criteria according to object used in Table 2 (see "Obj4Text")

Obj5Numr	**Obj5Text**
010501110201	Testing within the scope of a round trip
010501110202	Testing means and working aid made available
010501110203	Testing at the place of use upon request
010501110204	Presented at the agency

conditions may influence the object definition. For reasons of charges or to precisely estimate staff requirements, it may turn out to be necessary to make additional distinctions. Examples of this are the staff required (1, 2 or several persons), the kind of testing means (gravimetric or volumetric testing, testing facility, weights made available, etc.) and the kind of transportation means (size of vehicle).

There is an additional level which is independent of the object definition and in which special criteria are given which are relevant to the activity (e.g. testing at the agency, testing within the scope of a round trip, testing at the place of use upon request, testing means and working aid made available). In the bill, these criteria are given in the second line. They furnish additional information about the staff and other expenditure. So the activity-related information is to be made accessible for EDP evaluation independently of the object.

The example of the liquid fuel dispenser will serve to illustrate the official definition of the key number for the calculation of the charges in the legal regulation (short EBKVo):

Measuring systems for liquids other than water

Measuring assemblies tested within the scope of a round trip

05.3.2.2 more than 20 l/min up to 100 l/min .... DM 179.70

If more than two measuring assemblies exist, for the third and any additional assembly

05.3.3.2 more than 20 l/min to 100 l/min .... DM 120.84

Table 4 Bill lines corresponding to object example given in Tables 2 and 3

Key number	Text	Number	Results	Charges
05.3.2.2	Liquid fuel dispenser; Q_n: > 20 l/min–100 l/min testing within the scope of a round trip	2	V	DM 359.40
05.3.3.2	Liquid fuel dispenser; Q_n: > 20 l/min–100 l/min from 3rd dispenser	3	V	DM 362.52

In MOSEL, this selection takes place as follows:

1 Selection of the object via a menu (see Table 2);
2 Selection of the additional activity criterion (see Table 3);
3 Via a complex software algorithm the program automatically calculates a so-called quantity scale, and on the bill (for example, for five liquid fuel dispensers) the lines shown in Table 4 appear, including the number and the results V (verification).

Below the customer number corresponding to the place of installation of the liquid fuel dispensers (e.g. a petrol station in a town), the object number - in this case 0105011102 - is entered and can be evaluated by the database in many ways. Thus a measuring instrument management system furnishes more precise information about where the objects are used. From the period of validity of verification and additional information, organizational forms such as, for example, subsequent verification at regular intervals can be derived. MOSEL is based on the principle that the object definitions (cf. Table 1) represent the smallest information units. Accordingly, database evaluation is possible in arbitrary combinations (algebraic and logic operations). The characteristic and the input of identification criteria allow additional information to be obtained.

The central definition and provision of an object structure has far-reaching consequences. The data should be comparable over long periods of time (e.g. detailed statements on the metrological results for liquid fuel dispensers between Q_n = 20–100 l/min over several years). Particular importance must therefore be attached to data maintenance. Reference lists must be consistently evaluated for all unavoidable changes.

The focus areas of the current MOSEL version 2.3 which has been used by the verification offices for some years are:

- customer master data management with a list of towns and streets, including post code, for the whole Federal Republic, the regions covered by the respective verification offices, printing routines for correspondence (labels for letters and post cards, address lists);
- making out of bills via a four-stage object menu system or by entering activities. The menu system leads the user to the definition of the object (e.g. vehicle scale from 10–50 t, liquid fuel dispenser from 20–50 l/min, sampling inspection of prepackages from 5–13 packages). Depending on the workstation, the printouts are furnished by various printers in one office;
- accounting by the different methods applied by the treasuries of the federal states Rhineland-Palatinate, Saxony and Thuringia, considering the different titles;
- statistical evaluation of the objects relevant to billing (measuring instruments and prepackage testing);
- organization of subsequent verification in subsequent verification centers specifically set up for this purpose, with work lists and printout of notice post cards;
- management of weights and scheduling, reservations, printouts of delivery notes and bills;
- planning of the use of the 50 t verification vehicle for Rhineland-Palatinate, with scheduling, reservations, letters, commissions and printouts of bills.

The data of the MOSEL database system are subdivided into a master database (fixed data) and a verification office database (variable data). The master database is centrally maintained by Rhineland-Palatinate and exchanged in the case of changes (e.g. new EBKVo or updating of list of streets). The data structure of the verification office database is the same for all agencies, only the data content being different. In 1992 and 1993, the Verification Authorities of Saxony and Thuringia adopted the MOSEL system, meaning that the existing concept had to be extended. The uniform basic software was extended by the two employees of Saxony and Thruringia responsible for software issues, who integrated the modules specific to the two federal states. To adapt the databases to the topical requirements, the MOSEL partners meet at regular intervals. At the same time, their meetings are used as a forum for general EDP problems, and solutions are found. It may be expected that other federal states will adopt MOSEL in the near future.

MOSEL is based on the 4GL-PROGRESS software. This is a relational database system which can work both as client-server and as a single station under many platforms. As in the past this database system allowed all problems of the verification practice to be satisfactorily solved, the new, event-oriented version of MOSEL is also developed under PROGRESS V8. The Novell networks (version 3.12 and 4.1) with 10 to 50 users, which are used in the individual offices of the verification administrations of the federal states, have also proved to be fail-safe and reliable and thus will first be used unchanged under the new verification office database. As an alternative to a Novell server, operation of the database is also possible under an NT server.

The author expresses special thanks to Mr. Dipl. Ing. H.J. Knospe (Eichdirektion), who has realized the software, the system installation and the successful operation with extraordinary efforts and ingenious ideas.

This brief summary cannot replace comprehensive explanations, so presentations are held to further inform interested parties, who should contact the author (fax +49 671 73475) for more details. ■

METROLOGICAL INFRASTRUCTURES

Seventy-five years of metrology in the Republic of Kazakhstan

M. RYSBEKOV, President, Alma-Ata Standardization and Metrology Center (Gosstandard), Republic of Kazakhstan

In 1998 the national metrology service of the Republic of Kazakhstan celebrated its seventy-fifth anniversary.

Metrology - at all stages of its development - is of great national importance in so far as it regulates day to day practical activities in numerous fields concerning the gathering and subsequent application of measuring information.

Metrology in the Republic of Kazakhstan has a deep-rooted history: the first metrology institute was created in 1923 as the verification branch of the Main Chamber of Weights and Measures, set up at the end of the 19^{th} century by the scientist D. Mendeleev. Initial problems addressed included the verification and marking of weights. The verification branch was then transformed into an independent chamber due to the increasingly important role it played, and has since continued to make a decisive contribution to the development of the Republic's economy.

Today, the metrology service of the Republic of Kazakhstan, which is a government department, maintains uniformity of measurements in the Republic in close co-operation with the metrology services of the CIS (Community of Independent States) countries. These institutes include:

- the Gosstandard of the Republic of Kazakhstan;
- nineteen Gosstandard centers for standardization, metrology and certification, located in large regional cities;
- a specialized state enterprise (SE "Metrology");
- the state service for standard reference materials, and
- company metrological services.

The centers, equipped with modern verification equipment, carry out state supervision of observance of metrological rules and render metrological services. SE "Metrology" develops normative documents and coordinates the work for metrological supervision in the Republic.

A uniform system of maintenance of unity of measurements functioned before the disintegration of the USSR. These basic principles have been retained, taking into account the degree of integration of the economies of the CIS countries. Since the Republic of Kazakhstan became an independent state and its industries began to develop separately, development of the aspects of metrological supervision is a condition for ensuring international competitiveness.

Metrological activity is ruled in this country by a law concerning the uniformity of measurements. This law covers the units of physical quantities, state measurement standards and measuring instruments, requirements of means, methods and results of measurements, pattern evaluations and approvals, and verification and metrology certification of measuring instruments. SI units and other units accepted by the Gosstandard are applied within the country.

There are over eight million measuring instruments in the Republic, used for practically all kinds of measurements; these are subject to verification by Gosstandard bodies or by public and private companies' metrological services in order to establish their suitability.

The Gosstandard bodies verify the measuring instruments which are used in the realization of trade, customs, post and tax operations, the account of material assets and power resources, diagnosis and treatment of diseases, control of medicines, management of the environment, health and safety at work, transport and mineral mining.

Both the manufacturing and metrology servicing of measuring instruments may be carried out by the manufacturing and metrology services of public and private companies, provided that the appropriate license has been delivered by the Gosstandard.

The Republic owns seventeen national measurement standards, including standards of units of weight, length, deviation from rectilinearity and flatness, pressure, AC voltage, electrical capacity, specific electrical conductivity, temperature, acceleration at a shock movement, and the pH unit. Besides, more than 13 000 precision measuring instruments are available, thus ensuring accurate verification of the basic instruments used in the country.

The Gosstandard also has an acoustics and vibration laboratory equipped with anechoic chambers, standard verification installations and vibro transformers, ensuring verification of sound level meters and means concerning the measurement of vibration parameters not only within the Republic but also for Middle Asian CIS countries and Western Siberia. A specialized laboratory was created in the field of measurements of ionizing radiations, equipped with mobile verification installations and reference sources of alpha, beta and gamma radiation. This laboratory verifies ionizing radiation measuring instruments for Kazakhstan and Middle Asia.

To further develop a national measurement standard of units of physical quantities, the Gosstandard initiated a program of creation and development of a national reference basis until the year 2 000, as detailed below:

1 Increase in accuracy of measurements of separate units of physical quantities - for example, at the level of measurement standards necessary to ensure the accuracy of measurements of time and frequency, frequency modulation, electrical resistance, etc., to a total of 18 groups of standards of separate units.
2 The expansion of the measurement range of quantities - in the fields of measurement of force, pressure and temperature.
3 The introduction and development of new kinds of verification not previously carried out in the Republic, including instruments for measuring deviations from roundness, gear wheel parameters, external and internal sizes, ultrasonic and electromagnetic flowmeters of liquids, and other devices.

This program stipulates step-by-step implementation of 32 measurement standards, taking into account their rational accommodation in regional centers for standardization, metrology and certification.

The criteria for maintenance of uniformity and accuracy of measurements are increasing in line with the growing need to closely define the composition and properties of substances and materials with the development of industrial production, due to the complex use of raw materials, the creation and development of modern materials and a rational expenditure of resources.

The national service of standard reference materials carries out the development and certification of standard reference materials on ores and alloys of non-ferrous metals; the main consumers of these materials are, in addition to Kazakhstan companies, enterprises both within and outside the CIS countries, which use the raw materials and processed products of the Republic.

Changing market mechanisms led to the need to revise the sphere of national metrological supervision and to create a voluntary, professional, competent and profitable non-governmental verification service structure which guarantees the dissemination of physical quantities from the measurement standards to working measuring instruments. The creation in the Republic of the "metrological services" market will contribute to this evolution.

Understanding the role of ensuring the uniformity of measurements is vital in order to improve international cooperation; to this end the Gosstandard is co-executor of a program for the development of measurement standards, standard reference materials of composition and properties of substances and materials in the framework of the CIS Interstate Council for Standardization, Metrology and Certification.

Metrological cooperation agreements are ongoing both with CIS countries and with foreign institutes, and extend to the NIST (USA), to the Turkish Institute of Standards (TSE), to the Iranian Standards and Industrial Technology Institute (ISIR), and to the PTB in Germany; an important joint project was undertaken with the PTB to create a "National Mass Laboratory". Within the framework of this cooperation, the Gosstandard has accepted to participate in international intercomparisons of a 1 kg unit of measurement. Comparisons resulted in the fact that the national standard of this mass is on the same level as that of the European countries.

In 1994 the Republic of Kazakhstan became an OIML Member State; participation in OIML activities enables the ideas of the most representative international metrological organizations to be implemented, and OIML Recommendations provide appreciable support in the work of the Republic's metrological services.

The objective of the Gosstandard of the Republic of Kazakhstan is to continue to actively participate in the work of international metrological organizations (such as the OIML and COOMET) in order to ensure effective utilization of advanced scientific and technical experience in the field of maintenance of uniformity of measurement. ■

Meetings

activities OIML activités

Réunions

OIML Presidential Council Meeting

The CIML Presidential Council met at the BIML on 24th and 25th February 1998.

Together with CIML President Gérard Faber and the two Vice-Presidents Sam Chappell and Manfred Kochsiek were Seton Bennett, John Birch, Lev Issaev, Jean-François Magana and Bernard Athané, Members of the Council. Li Chuanqing was held up in Beijing by important meetings, and was represented by Wang Yiming and Han Jianping. Knut Birkeland (CIML Immediate Past President) participated in a part of the meeting, at which certain members of BIML technical staff were also present.

After examining the financial and administrative situation of the Organization, which was deemed to be satisfactory, the Council took note of a BIML report assessing OIML activities during the period 1995–1997. It was reported that whilst certain activities are progressing significantly well (such as certification and sales of publications), it would appear that technical activities are, on the contrary, not doing that well. Several reasons were suggested for this, notably the decrease in human and financial resources within the national legal metrology services of certain OIML Members. The Bureau was requested to analyze these reasons and to endeavor to pledge increased support to those technical committees and sub-committees who requested such assistance.

The Birkeland Study on the role of the OIML and international metrological cooperation, a task assigned one year ago by President Faber to his predecessor and which had been the object of a preliminary report presented at the Rio CIML meeting (see the January 1998 issue of the OIML Bulletin), was discussed in some depth by the Council. An updated draft will be circulated in the near future in advance of discussions due to be held in June this year in Braunschweig during the International Seminar organized by the OIML and the PTB in cooperation with the BIPM and IMEKO. Final sanctioning of the definitive report is scheduled for the next CIML meeting, due to be held in Seoul in October.

The Council also reviewed a number of key subjects of importance for the Organization: widening of the scope for technical participation of Corresponding Members, cooperation with regional legal metrology organizations, cooperation between the OIML and the World Trade Organization (the OIML has been admitted to the WTO *Technical barriers to trade* committee as an Observer-member), mutual recognition of test results and accreditation of laboratories carrying out legal metrology tests, etc. These subjects will all be developed at the next CIML meeting, and decisions may be taken on this occasion.

Lastly, the Council prepared the meeting held jointly with the BIPM and ILAC at the BIML on 26 February - an account of this can be found in the Editorial of this Bulletin. ■

Réunion du Conseil de la Présidence de l'OIML

Le Conseil de la Présidence du CIML s'est réuni les 24 et 25 février 1998 au BIML.

Autour du Président du CIML, G. Faber, et de ses deux Vice-Présidents, S. Chappell et M. Kochsiek, se sont retrouvés les Membres du Conseil: S. Bennett, J. Birch, L. Issaev, J.F. Magana et B. Athané. Li Chuanqing, retenu à Beijing par d'importantes réunions nationales, était représenté par Wang Yiming et Han Jianping. K. Birkeland, Président sortant du CIML, a participé à une partie de cette réunion, à laquelle ont également assisté certains agents techniques du BIML.

Après un examen de la situation financière et administrative de l'Organisation, jugée satisfaisante, le

Conseil a pris note d'un rapport du BIML sur l'évaluation des activités de l'OIML pour la période 1995–1997. Si certaines activités progressent de manière significative (certification, ventes de publications), il apparaît que les activités techniques sont en régression; plusieurs raisons peuvent être évoquées, en particulier la diminution des ressources humaines et financières des services nationaux de métrologie légale de certains Membres de l'OIML. Il a été demandé au Bureau d'analyser ces raisons et d'essayer d'apporter davantage de soutien aux comités techniques et sous-comités qui le demanderaient.

L'étude Birkeland sur le rôle de l'OIML et la coopération métrologique internationale, confiée il y a un an par le Président Faber à son prédécesseur et qui avait fait l'objet d'un rapport préliminaire à la réunion du CIML de Rio (voir Bulletin de janvier 1998), a été intensément discutée par le Conseil. Un nouveau projet doit être distribué prochainement en vue de nouvelles discussions en juin à Braunschweig, à l'occasion du Séminaire International organisé par l'OIML et la PTB en coopération avec le BIPM et l'IMEKO. L'approbation du rapport définitif est prévue pour la prochaine réunion du CIML en octobre à Séoul.

Le Conseil a également passé en revue un certain nombre de sujets d'importance pour l'Organisation: accroissement de la participation technique des Membres Correspondants, coopération avec les organisations régionales de métrologie légale, coopération entre l'OIML et l'Organisation Mondiale du Commerce (l'OIML a été admise comme Membre-observateur du comité de l'OMC sur les *Barrières techniques au commerce)*, reconnaissance mutuelle des résultats d'essais et accréditation des laboratoires effectuant les essais de métrologie légale, etc., questions qui feront l'objet de développements et peut-être de décisions à la prochaine réunion du CIML.

Le Conseil a enfin préparé la réunion conjointe avec le BIPM et l'ILAC tenue au BIML le 26 février (voir Éditorial de ce Bulletin). ■

Members of the OIML Presidential Council. From left to right:
S. Bennett (UK), L. Issaev (Russian Federation), Y. Wang (China), B. Athané (BIML Director), G. Faber (CIML President), M. Kochsiek (Germany), S. Chappell (USA), K. Birkeland (CIML Immediate Past President), J-F. Magana (France), J. Birch (Australia)

TC 8/SC 5

▶ Water meters

Secretariat: United Kingdom

The Austrian Metrology Service hosted the meeting of OIML TC 8/SC 5, held on 19–21 November 1997 in Vienna at the headquarters of BEV Gruppe Eichwesen.

Chairman:
Dr. M. Reader-Harris,
NEL Flow Centre, East Kilbride (UK)

Secretary:
Mr. J. Williamson,
NEL Flow Centre, East Kilbride (UK)

Participation: 27 delegates representing 12 P-member countries, standardization bodies (ISO and CEN) and Mr. B. Athané, BIML.

Main points

The Chairman reported that the draft revision of R 49 and the existing R 49 had both been withdrawn on the recommendation of the Tenth International Conference of Legal Metrology held in Vancouver in 1996. This was in order to avoid a potentially conflicting situation in view of the ongoing discussions on a new system of designating water meters, which will influence the next draft of ISO 4064.

Mr. Athané emphasized two points: firstly the urgent need for a new harmonized R 49 containing only the metrological requirements together with the test methods and test report format, and secondly the importance of reaching close agreement between ISO, the European Union (CEN) and the OIML based on the principle that regional work should not direct international work.

Mr. Strobel reported that the recent ISO TC 30/SC 7 meeting decided that ISO should work in parallel with the OIML, rather than waiting for CEN to complete its work on meter designation and to revise all existing ISO standards on water meters (irrespective of technology). ISO also recommended a joint ISO/OIML meeting within six months.

A report on the progress of the European Measuring Instruments Directive - the "MID", which lays down general essential requirements, test programs and specific essential requirements for measuring instruments, including water meters - indicated that within a few months all European countries would be required to follow this Directive.

The new designation system being proposed in CEN was described. This had arisen from the perceived problems with existing designation systems for water meters where a single meter can fall within more than one meter class. The CEN system defines the temperature ranges and the maximum permissible errors (mpe's) for both cold and hot water meters.

Comments were sought from Member States regarding the acceptability of the designation system proposed in Europe. Summarizing these comments, the Chairman said that the proposal was new to some countries and that non-Europeans had some reservations whereas the European countries were generally in favor of it.

Resolutions

12 Resolutions were taken at the Meeting. Among other points it was decided:

- to accept the proposed definitions for Qs;
- to fix values for some basic Q ratios;
- to include the maximum value of pressure loss;
- to include the ambient temperature range in the rated operating conditions;
- to subsequently incorporate test procedures and a test report format into R 49;
- to ask for written responses to the suggestion to include two accuracy classes in R 49, essentially 1 % / 3 % and 2 % / 5 %;
- that OIML TC 8/SC 5/WG 2 would provide a new draft of R 49 and invite all TC 8/SC 5 members to participate in WG 2;
- that OIML R 49 shall be restricted to legal metrology matters.

Working Group reports

The Convener of WG 1 *Electronic water meters* (Dr. Mencke) reported that the mpe values needed to be resolved before work could continue. This first requires a document emanating from WG 2.

The Convener of WG 2 *R 49 Revision* (Mr. Williamson) reported that in response to the request to change the meter designation, replies had been received from Japan, the UK and the USA.

WG 2 established a membership list of six representatives from five countries (with one more to be requested) and will redraft R 49 in time for it to be considered at a meeting proposed for September 1998.

Follow-up meetings

- OIML TC 8/SC 5/WG 2 *R 49 Revision* held a meeting at NIST, Gaithersburg (USA) on 19–20 February 1998 in connection with the ISO TC 30/SC 7/WG 7 meeting.

- OIML TC 8/SC 5 will hold its next meeting at the PTB, Braunschweig, Germany (21–22 September 1998) in connection with CEN TC 92 and possibly with ISO TC 30/SC 7 meetings.

The BIML would like to express its thanks to the organizers of the meeting for their hospitality and warm welcome. ■

Contact information:

Mr. J. Williamson
NEL Flow Centre
Tel. +44 (0)1355 272 089
Fax +44 (0)1355 272 536

TC 8/SC 5

▶ Compteurs d'eau

Secrétariat: Royaume-Uni

Le Service de Métrologie Autrichien a accueilli la réunion du sous-comité technique OIML TC 8/SC 5, qui s'est tenue du 19 au 21 novembre 1997 à Vienne au siège du BEV Gruppe Eichwesen.

Président:
Dr. M. Reader-Harris,
NEL Flow Centre, East Kilbride (Royaume-Uni)

Secrétaire:
M. J. Williamson,
NEL Flow Centre, East Kilbride (Royaume-Uni)

Participation: 27 délégués représentant 12 pays membres-P, organismes de normalisation (ISO et CEN) et M. B. Athané, BIML.

Points principaux

Le Président rapporte que le projet de révision de la R 49 et l'actuelle R 49 ont été tous deux retirés de la circulation sur la recommandation de la Dixième Conférence Internationale de Métrologie Légale tenue à Vancouver en 1996. Ceci afin d'éviter une situation potentiellement conflictuelle eu égard aux discussions ayant lieu actuellement sur un nouveau système de dénomination des compteurs d'eau, qui influencera le prochain projet d'ISO 4064.

M. Athané souligne deux points: le premier consiste à harmoniser d'urgence à nouveau la R 49 qui contiendra seulement les exigences métrologiques en même temps que les méthodes d'essai et le format du rapport d'essai; le deuxième réside dans l'importance d'arriver à un accord entre l'ISO, l'Union Européenne (CEN) et l'OIML basé sur le principe que le travail régional ne doit pas prévaloir sur le travail international.

M. Strobel rapporte que la récente réunion ISO TC 30/SC 7 a décidé que l'ISO doit travailler en parallèle avec l'OIML, plutôt que d'attendre que la CEN complète son travail sur la dénomination des compteurs et réviser toutes les normes ISO existantes sur les compteurs d'eau (indépendamment de la technologie). L'ISO recommande également la tenue d'une réunion commune ISO/OIML dans les six prochains mois.

Un rapport sur les progrès de la Directive Européenne sur les Instruments de Mesure - la "MID", qui précise les exigences générales essentielles, les programmes d'essais et les exigences essentielles spécifiques pour les instruments de mesure, y compris les compteurs d'eau - indique que d'ici quelques mois tous les pays européens devront suivre cette Directive.

Le système de dénomination actuellement proposé par la CEN est évoqué. Ceci vient du fait que des problèmes perçus dans les systèmes de dénomination existants pour les compteurs d'eau où un seul compteur peut se retrouver dans plus d'une classe de compteurs. Le système de la CEN définit les variations de température et les erreurs maximales tolérées (emt) pour les compteurs tant d'eau froide que d'eau chaude.

Il a été demandé aux États Membres de faire des commentaires sur l'acceptabilité du système de dénomination proposé en Europe. En résumant ces commentaires, le Président déclare que la proposition n'est pas encore connue pour certains pays et que les pays non-européens ont des réserves à émettre tandis que les pays européens sont en général favorables à cette proposition.

Résolutions

12 Résolutions ont été adoptées lors de la réunion. Parmi d'autres points il a été décidé:

- d'accepter les définitions proposées pour les Q;
- de fixer les valeurs de certains rapports Q de base;
- d'inclure la valeur maximale de perte de pression;
- d'inclure les variations de la température ambiante dans les conditions assignées de fonctionnement;
- d'incorporer par la suite des procédures d'essai et un format de rapport d'essai à la R 49;
- de demander des réponses écrites à la suggestion d'inclure deux classes d'exactitude dans la R 49, principalement 1 % / 3 % et 2 % / 5 %;
- que le sous-comité technique OIML TC 8/SC 5/WG 2 mette au point un nouveau projet de la R 49 et invite tous les membres du sous-comité technique TC 8/SC 5 à participer au WG 2;

- que la Recommandation OIML R 49 se limite à des sujets de métrologie légale.

Rapports des groupes de travail

Le responsable de la convocation de WG 1 *Compteurs d'eau électroniques* (Dr. Mencke) rapporte qu'il est nécessaire de résoudre la question des valeurs emt avant de continuer le travail. Ceci exige avant tout un document émanant de WG 2.

Le responsable de la convocation de WG 2 *Révision de la R 49* (M. Williamson) rapporte qu'en réponse à la requête de changer la dénomination du compteur, des réponses ont été reçues du Japon, du Royaume-Uni et des USA.

WG 2 établit la liste de six représentants originaires de cinq pays (un représentant supplémentaire devant être ajouté) et élaborera un nouveau projet de la R 49 de façon à ce qu'il soit examiné lors d'une réunion proposée pour septembre 1998.

Réunions ultérieures

- Le groupe de travail OIML TC 8/SC 5/WG 2 *Révision de la R 49* a tenu une réunion au NIST, Gaithersburg (USA) du 19 au 20 février 1998 en connexion avec la réunion du comité ISO TC 30/SC 7/WG 7.
- Le sous-comité technique OIML TC 8/SC 5 se réunira à nouveau au PTB à Braunschweig, Allemagne (21–22 septembre 1998) en connexion avec les réunions de CEN TC 92 et probablement de ISO TC 30/SC 7.

Le BIML exprime ses remerciements aux organisateurs de la réunion pour leur hospitalité et leur accueil chaleureux. ■

Contact pour information:

M. J. Williamson
Tél. +44 (0)1355 272 089
Fax +44 (0)1355 272 536

TC 8/SC 7

▶ Gas metering

Secretariat: Belgium/France

The Belgian Metrology Service hosted a meeting of OIML TC 8/SC 7 from 26–28 January 1998 in the *North Gate III* building of the Ministry of Economy in Brussels.

Chairman:
Mr. R. Eggermont
Belgian Metrology Service

Participation: 22 delegates representing 11 P-member countries and the Belgian Federation of gas distributors (FIGAZ).

Main points

General

The secretariat met several times during 1997 and prepared a 5th working draft on measuring systems for gaseous fuel, which was sent out in November 1997. The main objective of this third meeting was to discuss the draft and the various comments received in order to provide the secretariat with enough information to prepare a 1st committee draft (1 CD) on measuring systems for gaseous fuel, this title having been modified in line with a decision made by the working group.

Scope

The international working group confirmed the scope of the future OIML Recommendation which should apply to measuring systems for gaseous fuel and compressed natural gas (CNG systems for which the requirements will be presented in a separate chapter). Maximum permissible errors shall be defined and specified for complete systems (global approach). Some additional values shall be specified for mpe's of the various modules constituting the systems: these values are necessary and are required for pattern approvals of modules (modular approach). It should be the duty of Member States to choose between the global and modular approaches.

Terminology

Mainly those points concerning which comments had been received were discussed; all editorial changes were unanimously accepted.

General requirements

Participants were invited to explain their written comments or to present additional remarks to the group concerning the terminology - in general, the proposals were accepted and the secretariat will redraft or improve the text, in particular the following:

- Components of a measuring system;
- Maximum permissible errors;
- Ancillary devices;
- Determination of the gas calorific value;
- Correction of the volume at metering conditions;
- Data storage devices;
- Associated measuring instruments;
- Electronic devices;
- Checking facilities.

Technical requirements, metrological control and installation requirements

The text was discussed point by point; many modifications were approved with general consensus, in particular the following topics:

- Design and assembling requirements;
- Pattern approval;
- Initial verification;
- Piping requirements and acceptable flow profile.

Test procedures

The secretariat did not draft a proposal for this important appendix because of the work load involved in drafting the main part of the text (in particular the chapter concerning CNG measuring systems).

Taking into account the decisions of this meeting, the main part will be redrafted in a new format and will be sent out in September 1998. The next meeting of TC 8/SC 7 is scheduled to be held on 8–11 February 1999 in Brussels. One day will be devoted to a visit of gas metering stations installed in Belgium and France. ■

Contact information:

Mr. R. Eggermont
Tel. +32 2 206 47 35
Fax +32 2 206 57 45
E-mail metrology@pophost.eunet.be

TC 8/SC 7

▶ Mesurage des gaz

Secrétariat: Belgique/France

Sur invitation du Service belge de métrologie, le sous-comité technique OIML TC 8/SC 7 a tenu une réunion du 26 au 28 janvier 1998 au *North Gate III*, Ministère de l'Économie à Bruxelles.

Président:
M. R. Eggermont
Service belge de métrologie

Participation: 22 délégués représentant 11 pays membres-P et la Fédération belge des distributeurs de gaz (FIGAZ).

Points principaux

Généralités

Un 5ème projet de travail sur les ensembles de mesurage pour gaz combustible avait été préparé par le secrétariat qui s'était réuni plusieurs fois en 1997. Ce projet de travail a été distribué en novembre 1997. L'objectif principal de cette troisième réunion était de discuter le projet ainsi que les différents commentaires pour fournir suffisamment d'informations au secrétariat afin de préparer le 1er projet de comité (1 CD) sur les ensembles de mesurage pour gaz combustible.

Domaine d'application

Le groupe de travail international a confirmé le domaine d'application de la future Recommandation OIML qui devrait s'appliquer aux ensembles de mesurage pour gaz combustible et pour gaz naturel comprimé (ensembles de mesurage pour GNC, pour lesquels les exigences seront présentées dans un chapitre séparé). Les erreurs maximales tolérées doivent être définies et spécifiées pour les systèmes complets (approche globale). Des valeurs supplémentaires doivent être spécifiées pour les emt des divers modules constituant les systèmes: ces valeurs sont nécessaires et devraient être exigées pour les approbations de modèle des modules (approche modulaire). Il convient de donner aux États Membres le choix entre les approches globale et modulaire.

Terminologie

Principalement les points pour lesquels des commentaires avaient été reçus ont été discutés; les changements rédactionnels ont tous été acceptés à l'unanimité.

Exigences générales

Comme pour la terminologie, les participants ont été invités à expliquer leurs commentaires écrits ou de présenter des remarques supplémentaires au groupe; en général, les propositions ont été acceptées et le secrétariat a été chargé de rédiger ou d'améliorer le texte, en particulier sur les points suivants:

- Composants des ensembles de mesurage;
- Erreurs maximales tolérées;
- Dispositifs auxiliaires;
- Détermination du pouvoir calorifique du gaz;
- Correction du volume dans les conditions du mesurage;
- Dispositifs de mémorisation des données;
- Instruments de mesure associés;
- Dispositifs électroniques;
- Dispositifs de contrôle.

Exigences techniques, contrôle métrologique et exigences d'installation

Le texte a été discuté point par point; un grand nombre de modifications ont été approuvées avec un large consensus sur les points suivants:

- Exigences de conception et d'assemblage;
- Approbation de modèle;
- Vérification primitive;
- Exigences pour les canalisations et profils d'écoulement.

Procédures d'essai

Le secrétariat n'a pas fait de proposition pour cette importante annexe à cause de la charge de travail importante pour la rédaction de la partie principale du texte (notamment le chapitre relatif aux ensembles de mesurage pour GNC).

En tenant compte des décisions de la présente réunion, le texte principal sera revu dans un nouveau format et sera envoyé en septembre 1998. La prochaine réunion est prévue pour les 8–11 février 1999 à Bruxelles. Une journée sera consacrée à une visite de stations de mesurage de gaz installées en Belgique et en France. ■

Contact pour information:

M. R. Eggermont
Tél. +32 2 206 47 35
Fax +32 2 206 57 45
E-mail metrology@pophost.eunet.be

OIML activities / activités

OIML technical activities

1997 Review
1998 Forecasts

Activités techniques de l'OIML

Rapport 1997
Prévisions 1998

The information given on pp. 46–52 is based on 1997 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 1997 and projections for 1998, where appropriate.

Les informations données en pages 46–52 sont basées sur les rapports annuels de 1997, fournis par les secrétariats OIML. Les thèmes de travail sont donnés pour chaque comité technique ou sous-comité **actif** avec l'état d'avancement à la fin de 1997 et les prévisions pour 1998, si approprié.

KEY TO ABBREVIATIONS USED

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

OIML TECHNICAL ACTIVITIES	1997	1998
TC 1 Terminology		
• Revision V 1: Vocabulary of legal metrology	3 CD	4 CD
TC 2 Units of measurement		
• Revision D 2: Legal units of measurement	D	D
TC 3/SC 1 Pattern approval and verification		
• Initial verification of measuring instruments utilizing the manufacturer's quality system	2 CD	DD
• Revision D 3: Legal qualification of measuring instruments and inclusion in its text the existing D 19 and D 20	–	1 CD
TC 3/SC 2 Metrological supervision		
• Revision D 9: Principles of metrological supervision	1 CD	2 CD
TC 3/SC 3 Reference materials		
• Revision D 18: General principle of the use of certified reference materials in measurements	WD	1 CD
TC 4 Measurement standards and calibration and verification devices		
• Principles for the selection and expression of metrological characteristics of standards and devices used for calibration and verification	WD	1 CD
• Revision D 5: Principles for the establishment of hierarchy schemes for measuring instruments	WD	1 CD
• Revision D 10: Recalibration intervals of measurement standards and calibration devices	Postponed	Postponed
• Revision D 6 and D 8: Measurement standards. Requirements and documentation	WD	1 CD
TC 5 Electronic instruments		
• Revision D 11: General requirements for electronic measuring instruments	WD	WD / 1 CD
TC 6 Prepackaged products		
• Revision R 79: Information on package labels	R	–
• Revision R 87: Net content in packages	WD	1 CD

OIML TECHNICAL ACTIVITIES	1997	1998
TC 7/SC 1 Measuring instruments for length		
• Revision R 30: End standards of length (gauge blocks)	WD	1 CD
TC 7/SC 4 Measuring instruments for road traffic		
• Electronic taximeters	WD	WD
• Revision R 55: Speedometers, mechanical odometers and chronotachographs for motor vehicles. Metrological regulations	3 CD	DR
TC 7/SC 5 Dimensional measuring instruments		
• Multi-dimensional measuring instruments	3 CD	4 CD / DR
• Test report format for the evaluation of multi-dimensional measuring instruments	2 CD	3 CD
TC 8 Measurement of quantities of fluids		
• Laboratory volume measures - Automatic pipettes - D 26	D	D
• Annex to R 29: Test report format for the evaluation of capacity serving measures	–	WD
• Annex to R 40: Test report format for the evaluation of standard graduated pipettes for verification officers	–	WD
• Annex to R 41: Test report format for the evaluation of standard burettes for verification officers	–	WD
• Annex to R 43: Test report format for the evaluation of standard graduated glass flasks for verification officers	–	WD
• Annex to R 96: Test report format for the evaluation of measuring container bottles	–	WD
TC 8/SC 1 Static volume measurement		
• Revision R 85: Automatic level gauges for measuring the level of liquid in fixed storage tanks	Vote / Appr.	R
TC 8/SC 2 Static mass measurement		
• Measuring systems for the mass of liquids in tanks	Vote / Appr.	R
TC 8/SC 3 Dynamic volume measurement (liquids other than water)		
• Revision R 118: Testing procedures and test report format for pattern evaluation of fuel dispensers for motor vehicles	–	WD
TC 8/SC 5 Water meters		
• Revision R 49: Water meters intended for the metering of cold water	WD	1 CD

OIML TECHNICAL ACTIVITIES	1997	1998
TC 8/SC 6 Measurement of cryogenic liquids		
• Revision R 81: Measuring devices and measuring systems for cryogenic liquids (including tables of density for liquid argon, helium, hydrogen, nitrogen and oxygen) and including development of	Vote / Appr.	R
• Annex to R 81: Test report format	WD	1 CD
TC 8/SC 7 Gas metering		
• Metering systems for fuel gas	WD	1 CD
TC 8/SC 8 Gas meters		
• Revision R 6: General provisions for gas volume meters	WD	WD / 1 CD
• Revision R 32: Rotary piston gas meters and turbine gas meters	WD	WD / 1 CD
TC 9 Instruments for measuring mass and density		
• Revision R 60: Metrological regulation for load cells	2 CD	2 CD / DR
• Revision R 60 Annex A: Test report format	WD	1 CD / DR
TC 9/SC 1 Nonautomatic weighing instruments		
• Revision R 76-1: Nonautomatic weighing instruments	WD	1 CD
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	R	–
• Annex to R 106: Test procedures and test report format for the evaluation of automatic rail-weighbridges	R	–
• Annex to R 107: Test procedures and test report format for the evaluation of discontinuous totalizing automatic weighing instruments	R	–
• Automatic instruments for weighing road vehicles in motion	2 CD	3 CD
TC 9/SC 3 Weights		
• Annex to R 111: Test procedures and test report format for the evaluation of weights of classes E_1, E_2, F_1, F_2, M_1, M_2, M_3	WD	1 CD

OIML TECHNICAL ACTIVITIES	1997	1998
TC 9/SC 4 Densities		
• Hierarchy scheme for density measuring instruments	WD	1 CD
TC 10/SC 1 Pressure balances		
• Pressure transducers with uniform output signal	1 CD	2 CD
TC 10/SC 2 Pressure gauges with elastic sensing elements		
• Pressure transmitters with elastic sensing elements	WD	CD
• Annex to R 101: Test procedures and test report format for the evaluation of indicating and recording pressure gauges, vacuum gauges and pressure vacuum gauges with elastic sensing elements (ordinary instruments)	CD	2 CD / DR
• Annex to R 109: Test procedures and test report format for the evaluation of pressure gauges and vacuum gauges with elastic sensing elements (standard instruments)	CD	2 CD / DR
TC 10/SC 4 Material testing machines		
• Requirements for force measuring instruments for verifying materials testing machines	WD	1 CD
• Force measuring systems of materials testing machines (Revision R 64: General requirements for materials testing machines and Revision R 65: Requirements for machines for tension and compression testing of materials)	3 CD	DR
TC 10/SC 5 Hardness standardized blocks and hardness testing machines		
• Combined revision R 12 (Standardized blocks), R 36 (Intenders for hardness testing machines), and R 39 (Hardness testing machines) for Rockwell C standardized hardness blocks	–	WD
TC 11 Instruments for measuring temperature and associated quantities		
• Revision R 75: Heat meters	–	WD
TC 11/SC 1 Resistance thermometers		
• Revision R 84: Resistance-thermometer 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	WD	1 CD

OIML TECHNICAL ACTIVITIES	1997	1998
TC 11/SC 2 Contact thermometers		
• Standardized thermocouples	WD	1 CD
• Liquid-in-glass thermometers	2 CD	2 CD
TC 11/SC 3 Radiation thermometers		
• Revision R 48: Tungsten ribbon lamps for calibration of optical pyrometers	CD	DR
TC 12 Instruments for measuring electrical quantities		
• Revision R 46: Active electrical energy meters for direct connection of class 2	WD	WD / 1 CD
• Verification of watthour meters	–	WD
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	R	R
• Revision R 88 including development of Annex: Test report format for the evaluation of integrating-averaging sound level meters	R	R
• Annex to R 104: Test report format for the evaluation of pure-tone audiometers	R	–
• Annexes to R 122: Test procedures and test report format for the evaluation of equipment for speech audiometry	1 CD	DR
• Octave-band and fractional octave-band filters	2 CD	3 CD
TC 14 Measuring instruments used for optics		
• Amendment and Annex to R 93: Test report format for focimeters	CD	DR
TC 15 Measuring instruments for ionizing radiations		
• Radiochromic film dosimetry system for measuring absorbed dose in products from gamma and electron radiation	3 CD	DR
• Dosimeters and dose-rate meters of beta-radiation for application in therapy	WD	1 CD
• Polymethylmethacrylate (PMMA) dosimetry system for measuring ionizing radiations absorbed dose in materials and products	WD	1 CD
• Alanine (EPR) dosimetry system for measuring ionizing radiations absorbed dose in materials and products	WD	1 CD

OIML TECHNICAL ACTIVITIES

	1997	1998
TC 16/SC 1 Air pollution		
• Revision R 99 including development of Annex: Test report format for the evaluation of instruments for measuring vehicle exhaust emissions	Vote / Appr.	R (joint OIML-ISO publication)
• Continuous measuring instruments for NO_x emissions	–	WD
• Continuous measuring instruments for SO_2 emissions	–	WD
• Continuous measuring instruments for CO emissions	–	WD
TC 16/SC 2 Water pollution		
• Revision R 83: Gas chromatograph - mass spectrometer	WD	1 CD
• Revision R 100: Atomic absorption spectrometers for measuring metal pollutants in water	WD	1 CD
TC 16/SC 3 Pesticides and other pollutant toxic substances		
• Revision R 82: Gas chromatographs for measuring pollution from pesticides and other toxic substances	WD	1 CD
TC 16/SC 4 Field measurements of hazardous (toxic) pollutants		
• Portable and transportable X-ray fluorescence spectrometers for field measurement of hazardous elemental pollutants - R 123	R	R
• Air sampling devices for toxic chemical pollutants at hazardous waste sites	WD	1 CD
• Fourier transform infrared spectrometers for measurement of hazardous chemical products	WD	1 CD
TC 17/SC 2 Saccharimetry		
• Refractometers for the measurement of the sugar content of grape must - R 124	R	–
TC 17/SC 3 pH-metry		
• Revision R 54: pH-scale for aqueous solutions	Postponed	Postponed
• Method of carrying out pH-measurements. Certification methods of solutions for verification of pH-meters	Postponed	Postponed
TC 17/SC 4 Conductometry		
• Methods of measurement of the conductivity of electrolytic solutions	1 CD	2 CD

OIML TECHNICAL ACTIVITIES	1997	1998
TC 17/SC 5 Viscometry		
• Newtonian viscosity standard specimens for the calibration and verification of viscometers	2 CD	DR
TC 17/SC 7 Breath analyzers		
• Evidential breath analyzers	Vote / Appr.	R
• Procedures and test report format for the evaluation of portable breath testers used in open air	–	W
TC 18 Medical measuring instruments		
• Ergometers for foot crank work: definitions, requirements, tests	2 CD	DR
TC 18/SC 1 Blood pressure instruments		
• Revision R 16: Manometers for instruments for measuring blood pressure (sphygmomanometers)	4 CD	DR

certificate system
OIML
système de certificats

REGISTERED OIML CERTIFICATES - *CERTIFICATS OIML ENREGISTRÉS*

1997.12 – 1998.02

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.

▶ **Issuing authority** / ***Autorité de délivrance***

Physikalisch-Technische Bundesanstalt (PTB), Germany

For each Member State, certificates are numbered in the order of their issue (renumbered annually).

Pour chaque Etat Membre, les certificats sont numérotés par ordre de délivrance (cette numérotation est annuelle).

R 76/1992 - DE - 93.01
Sartorius AG
Weender Landstraße 94-108, D-37075 Göttingen, Germany
BA BA 200, BA BB 200, ...

OIML Recommendation applicable within the System / Year of publication

Recommandation OIML applicable dans le cadre du Système / Année d'édition

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'Etat Membre ayant délivré le certificat.

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

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

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

R 51 (1996)

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

Physikalisch-Technische Bundesanstalt (PTB), Germany

R51/1996-DE-97.04
Witec Wiegetechnik GmbH, Unter dem Rotdorn 2, 35578 Wetzlar, Germany
Type EC 4.0 (Class X(1))

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

Netherlands Measurement Institute (NMi) Certin B.V., The Netherlands

R51/1996-NL-97.04
Sorta Weigh, Main Road, Dovercourt, Harwich, Essex CO12 4LP, United Kingdom
System 200, System 400 and Guardian 2000 (Classes (X(1) and Y(a))

R51/1996-NL-97.05
Digi House, Rookwood Way, Haverhill, Suffolk CB9 8DG, United Kingdom
LI-3600E (Classes Y(a) and Y(b))

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Load cells
Cellules de pesée

R 60 (1991), Annex A (1993)

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

Danish Agency for Development of Trade & Industry, Denmark

R60/1991-DK-97.04
Cardinal Scale Manufacturing Co., 203 East Daugherty St., Webb City, Missouri 64870, USA
Compression load cell models 50K, 100K and 120K SCA (Class C)

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

National Weights and Measures Laboratory (NWML), United Kingdom

R60/1991-GB-95.11 Rev. 1
Sensortronics Inc., 677 Arrow Grand Circle, Covina, CA 91722, USA
Load Cell Model No. Sensortronics 65040C (Class C3)

R60/1991-GB-97.05
Sensortronics Inc., 677 Arrow Grand Circle, Covina, CA 91722, USA
Load Cell Model No. Shering SPT40A (Class C3)

R60/1991-GB-97.06
Sensortronics Inc., 677 Arrow Grand Circle, Covina, CA 91722, USA
Load Cell Model No. Intercomp 603053-AC (Class C3)

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

Netherlands Measurement Institute (NMi) Certin B.V., The Netherlands

R60/1991-NL-97.27
Gefran Sensori, Via Statale Sebina 74, 25050 Provaglio D'Iseo (BS), Italy
Type CB (Class C)

R60/1991-NL-97.28
Balea, 8 Avenue du Grand Chêne, Z.A. Les Avants, 34270 Saint-Mathieu de Tréviers, France
Type SWRC-120.G (Class C)

R60/1991-NL-97.29
Epel Industrial S.A., Ctra. Sta. Cruz de Calafell, 35 km. 9,400, 08830 Sant Boi de Llobregat, Barcelona, Spain
Type LCI (Class C)

R60/1991-NL-97.30
Hottinger Baldwin Messtechnic GmbH, Im Tiefen See 45, D-64293 Darmstadt, Germany
PW6K. ../.. K (Class C)

R60/1991-NL-97.31
Mettler-Toledo Inc., 1150 Dearborn Drive, Worthington, OH 43085-6712, USA
0743 (Class C)

R60/1991-NL-97.32
Celtron Technologies Inc., No. 1, Lane 86, Sec. 1, Pa Lien Road, Hsi Tzu, Taipei Hsien, Taiwan
LOC-.. (Class C)

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Nonautomatic weighing instruments
Instruments de pesage à fonctionnement non automatique

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

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

Physikalisch-Technische Bundesanstalt (PTB), Germany

R76/1992-DE-97.02
Rice Lake Weighing Systems, 230 West Coleman Street, Rice Lake, Wisconsin 54868, USA
Nonautomatic electromechanical weighing instrument type (Classes III and IIII)

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

Sous-direction de la Métrologie, France

R76/1992-FR-97.02
Société Testut, 957 rue de l'Horlogerie, BP 11, 62401 Béthune, France
Balance électronique TESTUT B300 (Classe III)

R76/1992-FR-97.03
Société Testut, 957 rue de l'Horlogerie, BP 11, 62401 Béthune, France
Balance électronique TESTUT ALPHA J8 (Classe III)

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

Netherlands Measurement Institute (NMi) Certin B.V., The Netherlands

R76/1992-NL-96.21 Rev. 2
A&D Instruments Ltd., Abingdon Science Park, Abingdon, Oxford OX14 3YS, United Kingdom
HM (Class I)

R76/1992-NL-97.22
Teraoka Seiko Co., Ltd., 13-12 Kugahara, 5-Chome, Ohta-ku, Tokyo 146, Japan
Type SM-90.. (Class III)

R76/1992-NL-97.23
Teraoka Seiko Co., Ltd., 13-12 Kugahara, 5-Chome, Ohta-ku, Tokyo 146, Japan
Type SM-80.. (Class III)

R76/1992-NL-97.24
Mettler-Toledo Inc., 1150 Dearborn Drive, Worthington, OH 43085-6712, USA
Mentor (Class III)

R76/1992-NL-97.25
Shinko Denshi Co., Ltd, 3-9-11 Yushima, Bunkyo-ku, Tokyo 113, Japan
CG-K (Class II)

R76/1992-NL-97.26
Mobba S.C.C.L., Colón 6, E-08912 Badalona- Barcelona, Spain
Jeep-bat (Class III)

R76/1992-NL-97.27
Ishida Co., Ltd., 44, Sanno-cho, Shogoin, Sakayo-ku, Kyoto, 606, Japan
NOVA-II series (Class III)

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

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

R 117 (1995) [+ R 118 (1995)]

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

National Weights and Measures Laboratory (NWML), United Kingdom

R117/1995-GB-97.01
Wayne, Butlerfield Industrial Estate, Bonnyrigg, Midlothian EH19 3JQ, United Kingdom
Fuel dispenser for motor vehicles, Wayne Highlander 9000 MK2, Japanese market version (Class 0.5)

R117/1995-GB-97.02
Wayne, Butlerfield Industrial Estate, Bonnyrigg, Midlothian EH19 3JQ, United Kingdom
Fuel dispenser for motor vehicles, Wayne HT Series, Japanese market version (Class 0.5)

Committee drafts received by BIML

December 1997 – February 1998

Stage of development	Title	TC/SC	Secretariat
WD	Measuring systems for fuel gas	TC 8/SC 7	Belgium & France
2 CD	Metrological regulations for load cells (Rev. R 60)	TC 9	USA
3 CD	Vocabulary of Legal Metrology	TC 1	Poland

Oficina Nacional de Normalizacion, Cuba

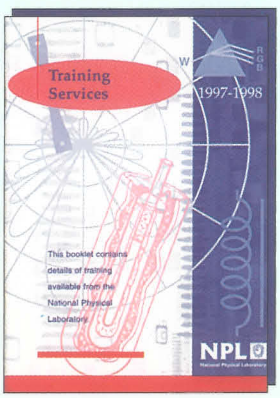
The ***Accredited Laboratory Condition*** was granted to the Testing Laboratory of the Metrology Research Institute (INIMET) of the National Bureau of Standards of the Republic of Cuba (NC) last December.

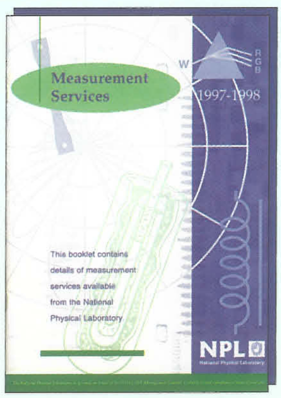
After rigorous substantiation that the requirements established in ISO/IEC Guide 25 (*General Requirements for the Competence of Calibration and Testing Laboratories*) had been fulfilled, the laboratory was granted the accreditation based on the scope of 11 tests:

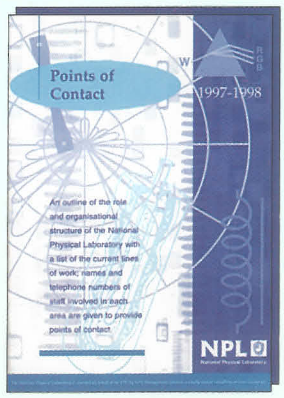
- Parametric tests (length, angle, mass, hardness, kinematics, temperature, ambient humidity, electricity and radio);
- Electrical safety;
- Electromagnetic compatibility;
- Climatics.

The Accredited Laboratory offers test services on measuring, control and medical equipment and its results are backed by a Quality System and supported by official and internationally acknowledged methods.

New booklets available from the NPL (UK)







For information on availability of these new booklets, contact the National Physical Laboratory (UK):

Tel.: +44 181 977 3222 Fax: +44 181 943 6458 E-mail: enquiry@npl.co.uk Internet: http://www.npl.co.uk

Bilan - Métrologie 97

20–23 octobre 1997

Besançon, France

Le 8ème Congrès International de Métrologie, organisé à Besançon du 20 au 23 octobre 1997 par le Collège Métrologie du *Mouvement Français pour la Qualité*, a été marqué par:

- l'ouverture du Congrès par M. Pierret, Secrétaire d'État à l'Industrie, devant 700 personnes, congressistes et représentants régionaux;
- une participation en augmentation: 500 congressistes se sont rendus à Besançon, soit 10 % de plus que lors de *Métrologie 95*;
- une participation étrangère doublée par rapport à 1995: 20 % des congressistes représentaient trente pays différents;
- la visite de 300 personnes extérieures au Congrès à l'exposition de matériel métrologique, présenté par 48 sociétés.

Comme lors des précédentes éditions, le public du Congrès se composait d'industriels (50 %), de responsables de laboratoires ou d'organismes nationaux (17 %), d'universitaires (15 %) et de prestataires de services ou consultants (17 %).

Les participants ont jugé les informations recueillies tout à fait satisfaisantes ou satisfaisantes dans 78 % des cas, et 40 % d'entre eux ont déclaré qu'ils reviendront de toutes façons pour *Métrologie 99*.

Le succès de l'édition 1997, assuré grâce à nos partenaires institutionnels et industriels, permet de préparer dès maintenant le Congrès qui aura lieu en 1999 à Bordeaux.

Evaluation - Metrology 97

20–23 October 1997

Besançon, France

The 8th International Congress of Metrology, organized in Besançon from 20th to 23rd October 1997 by the Metrology College of the *French Movement for Quality*, was marked by:

- the opening of the Congress by Mr. Pierret, State Secretary for Industry, in the presence of 700 people including Congress delegates and regional representatives;
- increased attendance: 500 delegates were present in Besançon, some 10 % more than for *Metrology 95*;
- twice the foreign participation compared to 1995: 20 % of delegates came from 30 different countries;
- the visit of 300 people (in addition to those attending the Congress) to an exhibition of metrological material, presented by 48 companies.

As previously, the public attending the Congress was made up of industrials (50 %), managers of laboratories or national organisms (17 %), university staff (15 %) and service providers or consultants (17 %).

Those who attended deemed that information gleaned was either very satisfactory or satisfactory in 78 % of cases, and 40 % of them declared that in any event they would be attending *Metrology 99*.

The success of the 1997 event, which was due to our institutional and industrial partners, enables us to start preparing the Congress which will be held in 1999 in Bordeaux.

Pour toutes informations supplémentaires, veuillez contacter / For further information, please contact:

Sandrine GAZAL
Secrétariat Général, Collège Métrologie
Mouvement Français pour la Qualité
41 Rue des Trois Fontanot

92024 NANTERRE Cedex, France

Tel. +33 (0)1 55 17 47 70 - Fax +33 (0)1 55 17 47 71

Thirteenth Asia-Pacific Metrology Program (APMP) Committee Meeting and associated activities

The Thirteenth APMP Committee Meeting and associated activities took place during the first week of December 1997 in Sydney, Australia, chaired by Dr. Barry Inglis, Director of the National Measurement Laboratory of Australia.

The Asia-Pacific Program is a program of collaboration between the National Measurement Standards Laboratories in the Asia-Pacific region. The APMP originated in 1977 and was formalized on 1 August 1997, when a Memorandum of Understanding was signed. It now formally consists of twenty-two Full Member organizations, four Associate Member organizations and one Corresponding Member.

Key issues of the APMP Committee Meeting were:

- A review of the impressive list of 136 APMP Projects: the Projects are subdivided into Workshop, Training, Bilateral cooperation, Seminar, Comparison and MoU/MRA projects. The APMP Comparison program at present covers 21 comparisons of primary measurement standards of the region, in a wide variety of fields of metrology;
- A draft APMP Mutual Recognition Agreement on Equivalence of Measurement Standards maintained by APMP Members. The purpose of the agreement is to formally record mutual recognition of the demonstrated measurement capability of APMP members to stated levels of uncertainty;
- The role of the APMP in regional metrology in the field of chemistry.

The Associated activities were well attended and included:

- APMP workshops on:
  - Time and frequency
  - Electrical metrology
  - Dimensional metrology;
- An APMP Symposium on International Traceability of Measurement;
- A meeting of Regional Metrological Organizations to discuss the global Mutual Recognition Agreement of national measurement standards and calibration certificates issued by national metrology institutes, as proposed by the BIPM.

Contact for further information:

Dr. Angela Samuel
APMP Secretariat
National Measurement Laboratory, CSIRO
PO Box 218, Lindfield, NSW 2070, Australia
Tel: +61 2 9413 7788
Fax: +61 2 9413 7383
E-mail: angela.samuel@tip.csiro.au

Report by Knut Birkeland, CIML Immediate Past President

European Quality Week 9-15 November 1998

This year's Quality Week is financially supported by the European Commission and organized by the European Quality Platform.

1997's Week was a great success, with even more activity than in 1996 - and the 1998 event is set to be equally successful.

Companies and organizations are asked to engineer their events, debates and publications with the aim of providing answers to the Week's slogan (see below).

For further information, please contact:

Anthony Hunter, European Organization for Quality
PO Box 5032, CH-3001 BERN, Switzerland
Tel. +41 31 320 61 66 - Fax +41 31 320 68 28

"Quality in Europe: Sharing responsibilities, sharing benefits"

Basic Principles and Practice of Flow Measurement

3-day training course, Scotland, 19–21 May 1998

A series of 20 in-depth lectures on a wide range of flow measurement concepts, including participatory demonstrations and informal discussion groups led by experts.

Contact details

D. Stewart / L. Campbell – Reynolds Admin Office – NEL (Scotland)
Tel. (+44) 1 355 272 457 • Fax (+44) 1 355 272 536

16th International

North Sea FLOW Workshop

Scotland, 26–29 October 1998

Specializing in practical hydrocarbon flow measurement, this Workshop attracts delegates from all the major North Sea oil and gas producers and suppliers. The aim is to encourage the discussion of practical experience, and the Workshop fills the gap between traditional courses and large scientific conferences.

Topics:

Practical field experience – Discharge monitoring – Marginal field metering – Multiphase metering - field experience – Wet gas sampling/sample conditioning – Fiscal metering – CRINE initiatives

Contact details

Miss Caroline R Whitla – The Flow Centre – NEL (Scotland)
Tel. (+44) 1 355 272 918 • Fax (+44) 1 355 272 536 • E-mail cwhitla@nel.uk

OIML meetings réunions

May 1998

19–22	TC 9/SC 3 Weights (R 111)	NIST, GAITHERSBURG, USA

June 1998

16–19	International Seminar: "The Role of Metrology in Economic and Social Development"	BRAUNSCHWEIG, GERMANY

September 1998

21–22	TC 8/SC 5 Water meters	BRAUNSCHWEIG, GERMANY

October 1998

26–30	33rd CIML meeting and other OIML meetings	SEOUL, REPUBLIC OF KOREA

November 1998

26–27	TC 1 Terminology	WARSAW, POLAND

March 1999

5	TC 13 Measuring instruments for acoustics and vibration	FRANKFURT, GERMANY

The OIML is pleased to welcome the new CIML Member for Ireland:

OIML

Mr. Tom Dempsey

info

The Role of Metrology in Economic and Social Development

IMEKO PTB OIML

16–19 June 1998

Braunschweig, Federal Republic of Germany

In their endeavor to assist developing countries and countries in transition towards a market economy in overcoming their difficulties, the three international organizations of metrology,

- The International Bureau of Weights and Measures (**BIPM**) of the Metre Convention;
- The International Organization of Legal Metrology (**OIML**);
- The International Measurement Confederation (**IMEKO**), especially its Technical Committee TC 11 *Metrological Infrastructures*

and Germany's national metrology institute, the Physikalisch-Technische Bundesanstalt (**PTB**), have called for a seminar. The aim is to discuss the global challenges and the necessity for developing appropriate and viable metrological infrastructures especially for these countries and for regional metrology organizations. The PTB will organize and host the seminar.

For last-minute details, contact:

PTB

Tel. (49) 531 592 8200
Fax (49) 531 592 8225

Organisation Internationale de Métrologie Légale

Secretariat
Bureau International de Métrologie Légale
11, rue Turgot, 75009 Paris, France
Tel: 33 (0)1 48 78 12 82 or 33 (0)1 42 85 27 11
Fax: 33 (0)1 42 82 17 27
E-mail: biml@oiml.org
Internet: http://www.oiml.org

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

Member States

ALGERIA
Le Directeur
Office National de Métrologie Légale
1, rue Kaddour Rahim
BP 415, 16040 Hussein Dey
Alger
Tel.: 213-2-77 77 37
Telex 65 599

AUSTRALIA
Mr J. Birch
Executive Director
National Standards Commission
P.O. Box 282
North Ryde, N.S.W. 2113
Tel.: 61-29-888 39 22
Fax: 61-29-888 30 33
Telex OTCD AA 100200
(Mail Box 6007:NSC001)

AUSTRIA
Director of the Metrology Service
Gruppe Eichwesen
Bundesamt für Eich- und Vermessungswesen
Postfach 20
Arltgasse 35
A-1163 Wien
Tel.: 43-1-49 11 01
Fax: 43-1-49 20 875

BELARUS
Mr N. A. Kusakin
Chief of the Metrology Department
Standardization, Metrology and Certification Committee (Belstandart)
93 Starovilensky Trakt
Minsk, 220053
Tel.: 375-172-37 52 13
Fax: 375-172-37 25 88

BELGIUM
Mr H. Voorhof
Conseiller Général
Service de la Métrologie
Ministère des Affaires Economiques
Administration de la Qualité et de la Sécurité
NG III, Bd E. Jacqmain 154
B-1000 Bruxelles
Tel.: 32-2-206 47 35
Fax: 32-2-206 57 45

BRAZIL
Mr R. Luiz de Lima Guimarães
Director of Legal Metrology
Instituto Nacional de Metrologia, Normalização e Qualidade Industrial (INMETRO)
Avenida N. S. das Graças, No. 50
Xerém, Duque de Caxias
25250-020 Rio de Janeiro RJ
Tel.: 55-21-679-1407
Fax: 55-21-679-1761

BULGARIA
Mr Ivan Temniskov
Secrétaire Général
Comité de Normalisation et de Métrologie
21, rue du 6 Septembre
Sofia 1000
Tel.: 359-2-8591
Fax: 359-2-801402
Telex 22 570 DKS BG

CAMEROON
Mr H. Ela Essi
Sous-Directeur de la Métrologie
Direction des Prix et de la Métrologie
Ministère de l'Economie et des Finances
BP 501
Yaoundé
Tel.: 237-22 31 16
Fax: 237-20 79 47

CANADA
Mr A. E. Johnston
President
Measurement Canada
Industry Canada
Main Building
Suite 2600
Tunney's Pasture
Ottawa
Ontario K1A OC9
Tel.: 1-613-952 06 55
Fax: 1-613-957 12 65

CHINA
Mr Li Chuanqing
Director General
State Bureau of Technical Supervision
4, Zhichunlu Haidian
P.O. Box 8010, Beijing 100088
Tel.: 86-10-6 236 94 19
Fax: 86-10-6 203 25 52
Telex 210209 SBTS CN
Telegram 1918 Beijing

CUBA
Mr Martin Antunez Ramirez
Director of Metrology
c/o Mr Alberto Marrero Terrero
Director, International Relations
National Bureau of Standards
Calle E No. 261 entre 11 y 13
Vedado, La Habana 10400
Ciudad de la Habana
Tel.: 53-7-30 00 22
Fax: 53-7-33 80 48
Telex 512245

CYPRUS
Mr G. Tsiartzazis
Controller of Weights and Measures
Ministry of Commerce and Industry
Nicosia
Tel.: 357-2-40 34 41
Fax: 357-2-37 51 20
Telex 2283 MIN COMIND
Telegram Mincommind Nicosia

CZECH REPUBLIC
Mr Pavel Klenovský
Director General
Czech Metrological Institute
Okružní 31
63800 Brno
Tel.: 420-5-45 22 27 27
Fax: 420-5-45 22 27 28

DENMARK
Mr P. C. Johansen
Assistant Head
Secretariat for Metrology
Danish Agency for Development of Trade and Industry
Tagensvej 135
DK-2200 Copenhagen N
Tel.: 45-35-86-86-86
Fax: 45-35-86-86-87
Telex 15768 INDTRA DK

EGYPT
Mr A. B. El-Sebai
President
Egyptian Organization for Standardization and Quality Control
2 Latin America Street, Garden City
Cairo
Tel.: 20-2-354 97 20
Fax: 20-2-355 78 41
Telex 93 296 EOS UN
Telegram TAWHID

ETHIOPIA
Mr Berhanu Werede
Head of Metrology Department
Ethiopian Authority for Standardization
P.O. Box 2310
Addis Ababa
Tel.: 251-1-61 01 11
Fax: 251-1-61 31 77
Telex 21725 ETHSA ETH

FINLAND
Mrs Marja Leena Junttila
Director, Legal Metrology and Articles of Precious Metals
Turvatekniikan Keskus
Safety Technology Authority
P.O. Box 123 (Lönnrotinkatu 37)
FIN-00181 Helsinki
Tel.: 358-9-40 580 3161
Fax: 358-9 605 474

FRANCE
Mr J. F. Magana
Sous-Directeur de la Métrologie
Ministère de l'Économie, des Finances et de l'Industrie
22, rue Monge
75005 Paris
Tel.: 33-(0)1-43 19 51 40
Fax: 33-(0)1-43 19 51 36

GERMANY
Mr M. Kochsiek
Member of the Presidential Board
Physikalisch-Technische Bundesanstalt
Postfach 3345
D-38023 Braunschweig
Tel.: 49-531-592 30 00
Fax: 49-531-592 30 02
Telex 9-52 822 PTB d
Telegram Bundesphysik Braunschweig

GREECE
Mr A. Dessis
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. Pákay
President
Országos Mérésügyi Hivatal
P.O. Box 919
H-1535 Budapest
Tel.: 36-1-1567 722
Fax: 36-1-1550 598
Telegram HUNGMETER Budapest

INDIA
Mr P. A. Krishnamoorthy
Director, Legal Metrology
Ministry of Food and Consumer Affairs
12-A, Jamnagar House
Shahjahan Road
New Delhi 110 011
Tel.: 91-11-338 94 89
Fax: 91-11-338 53 22

INDONESIA
The Director of Metrology
Directorate of Metrology
Directorate General of Domestic Trade
Departemen Perdagangan
Jalan Pasteur 27
40171 Bandung
Tel.: 62-22-44 35 97 and 43 06 09
Fax: 62-22-420 70 35
Telex 28 176 BD

ISLAMIC REPUBLIC OF IRAN
The Director
Public and International Relations
Institute of Standards and Industrial Research of Iran
P.O. Box 31585-163
Karaj
Tel.: 98-261-227 045
Fax: 98-261-225 015

IRELAND
Mr Tom Dempsey
Director
Legal Metrology Service
Forbairt
Glasnevin
Dublin 9
Tel.: 353-1-808 26 01
Fax: 353-1-808 20 26

ISRAEL
Mr G. Deitch
Commissioner of Standardization and Controller of Weights and Measures
Ministry of Industry and Trade
30 Agron Street
Jerusalem 94190
Tel.: 972-2-622 06 02
Fax: 972-2-623 63 03

ITALY
Mr A. Lirosi
Direttore Generale per l'Armonizzazione e la Tutela del Mercato
Ministero dell'Industria Commercio ed Artigianato
Ufficio Centrale Metrico
Via Antonio Bosio, 15
I-00161 Roma
Tel.: 39-6-841 68 25
Fax: 39-6-841 41 94

JAPAN
Mr H. Imai
Director General
National Research Laboratory of Metrology
1-4, Umezono 1-Chome, Tsukuba
Ibaraki 305
Tel.: 81-298-54 41 49
Fax: 81-298-54 42 02
Telex 3652570 AIST J
Telegram KEIRYOKEN TSUCHIURA

KAZAKHSTAN
Mr A. Sadikov
Director, Alma-Ata Standardization and Metrology Centre
83 Altinsarin Avenue
Alma-Ata 480035
Tel.: 7-327-221 69 72
Fax: 7-327-221 48 45

KENYA
Mr A. E. Ndegwa
Director of Weights and Measures
Weights and Measures Department
Ministry of Commerce and Industry
P.O. Box 41071
Nairobi
Tel.: 254-2-50 46 65/4
Fax: 254-2-50 46 33
Telegram ASSIZERS, Nairobi

DEM. P. REP. OF KOREA

Mr Kim Gwang Ho
Director, Bureau of Metrology
State Commission of Science and Technology
Zung Gu Yok, Seungli-Street
PO Box 140/Pyongyang
Tel.: 850-2-381 60 25
Fax: 850-2-381 45 37

REP. OF KOREA

Mr Yoo-Jin Koh
Director, International Cooperation and Metrology Division
Standards and Metrology Department
Korean National Institute of Technology and Quality (KNITQ)
1599 Kwanyang-dong, Tong an-gu
Anyang-shi, Kyunggi-do 431-060
Tel.: 82-343 84 1861
Fax: 82-343 84 6077

MONACO

Mr A. Veglia
Ingénieur au Centre Scientifique de Monaco
16, Boulevard de Suisse
MC-98000 Monte Carlo
Tel.: 33-93-30 33 71

MOROCCO

Mr Abdellah Nejjar
Directeur de la Normalisation et de la Promotion de la Qualité
Ministère du Commerce et de l'Industrie
Quartier administratif
Rabat-Challah
Tel.: 212-7-76 37 33
Fax: 212-7-76 62 96

NETHERLANDS

Mr G. J. Faber
Director General
Nederlands Meetinstituut nv
Hugo de Grootplein 1
3314 EG Dordrecht
Tel.: 31-78-633 23 32
Fax: 31-78-633 23 09

NORWAY

Mr H. Kildal
Director General
Norwegian Metrology and Accreditation Service
Justervesenet
Fetveien 99
2007 Kjeller
Tel.: 47-64-84 84 84
Fax: 47-64-84 84 85

PAKISTAN

Mr M. Asad Hasan
Director
Pakistan Standards Institution
39-Garden Road, Saddar
Karachi-74400
Tel.: 92-21-772 95 27
Fax: 92-21-772 81 24
Telegram PEYASAI

POLAND

Mr Krzysztof Mordziński
President
Central Office of Measures
ul. Elektoralna 2
P.O. Box P-10
PL 00-950 Warszawa
Tel.: 48-22-620 07 47
Fax: 48-22-620 83 78

PORTUGAL

Mr J. N. Cartaxo Reis
Director Serviço de Metrologia Legal
Instituto Português da Qualidade
Rua C à Avenida dos Três Vales
2825 Monte da Caparica
Tel.: 351-1-294 81 96
Fax: 351-1-294 81 88

ROMANIA

Mr S. Ocneanu
Directeur Général
Bureau Roumain de Métrologie Légale
21, Boulevard Nicolae Balcescu, sector 1
70112 Bucarest
Tel.: 40-1-613 16 54
Fax: 40-1-312 05 01

RUSSIAN FEDERATION

Mr L. K. Issaev
Vice-President
Gosstandart of Russia
Leninsky Prospect 9
117049 Moscow
Tel.: 7-095-236 75 60
Fax: 7-095 237 60 32
Telex 411 378 GOST
Telegram Moskva-Standart

SAUDI ARABIA

Mr Khaled Y. Al-Khalaf
Director General
Saudi Arabian Standards Organization
P.O. Box 3437
11471 Riyadh
Tel.: 966-1-452 00 00
Fax: 966-1-452 00 86
Telex 40 16 10 saso sj

SLOVAKIA

Mr Lubomír Sutek
President
Úrad pre Normalizáciu, Metrológiu a Skúšobníctvo SR
Štefanovičova 3 - PO Box 76
810 05 Bratislava 15
Tel.: 421-7-391 085
Fax: 421-7-391 050

SLOVENIA

Mr Vasja Hrovat
Adviser to the Director
Ministrstvo za znanost in tehnologijo
Urad za standardizacijo in meroslovje
Kotnikova 6
1000 Ljubljana
Tel.: 386-61-178 30 31
Fax: 386-61-178 31 96

SPAIN

The Director
Centro Español de Metrologia
c/ del alfar 2
28760 Tres Cantos (Madrid)
Tel.: 34-1-807 47 00
Fax: 34-1-807 48 07
Telex 47254 CEME E

SRI LANKA

Mr H. L. R. W. Madanayake
Deputy Commissioner of Internal Trade
Measurement Standards and Services Division
Department of Internal Trade
101, Park Road
Colombo 5
Tel.: 94-1-83 261
Telex 21908 COMECE CE

SWEDEN

Mrs A. Ebbesson
Technical Officer
Section for General Technology
SWEDAC
Box 878
S-501 15 Borås
Tel.: 46-33-17 77 00
Fax: 46-33-10 13 92

SWITZERLAND

Mr B. Vaucher
Vice-Directeur
Office Fédéral de Métrologie
Lindenweg 50
CH-3084 Wabern
Tel.: 41-31-323 32 05
Fax: 41-31-323 32 10
Telegram OFMET

TANZANIA

Mr A. H. M. Tukai
Commissioner for Weights and Measures
Weights and Measures Bureau
Ministry of Industries and Trade
P.O. Box 313
Dar es Salaam
Tel.: 864046/864808
Telex 41 689 INDTRA

THE FORMER YUGOSLAVE REPUBLIC OF MACEDONIA

Mr Grkov Zoran
Assistant to the Minister
Bureau of Standardization and Metrology
Ministry of Economy
Samoilova 10
91000 Skopje
Tel.: 389-91-13 11 02
Fax: 389-91-11 02 63

TUNISIA

Mrs Ghaïet El-Mouna Annabi
Directeur de la Qualité et de la Protection du Consommateur
Direction Générale de la Concurrence et du Commerce Intérieur
Ministère du Commerce
6 Rue Venezuela
1002 Tunis
Tel.: 216-1-78 08 15
Fax: 216-1-78 18 47

UNITED KINGDOM

Mr S. Bennett
Chief Executive
National Weights and Measures Laboratory
Stanton Avenue
Teddington, Middlesex TW11 OJZ
Tel.: 44-181-943 72 72
Fax: 44-181-943 72 70
Telex 9312131043 (WM G)

UNITED STATES OF AMERICA

Mr S. E. Chappell
Chief, Standards Management Program, 212
Office of Standards Services
National Institute of Standards and Technology
Building 820, Room 162
Gaithersburg, Maryland 20899
Tel.: 1-301-975 40 24
Fax: 1-301-963 28 71
Telex 197674 NBS UT

YUGOSLAVIA

Mr Z. M. Markovic
Deputy Director
Federal Bureau of Measures and Precious Metals
Mike Alasa 14
11000 Beograd
Tel.: 381-11-328 27 36
Fax: 381-11-18 16 68
Telex 11 020 YUZMBG

ZAMBIA

Mr L. N. Kakumba
Superintendent Assizer
Assize Department
Weights and Measures Office
Ministry of Commerce and Industry
P.O. Box 30 989
Lusaka
Tel.: 260-1-21 60 62
Fax: 260-1-22 67 27
Telegram Assize, LUSAKA
Telex 45630 COMIND ZA

CIML HONORARY MEMBERS

Mr K. Birkeland (Norway), Immediate Past President of CIML

Mr V. Ermakov (Russian Federation), former CIML Vice-President

Mr A. Perlstain (Switzerland), former member of the Presidential Council

Mr W. Mühe (Germany), former CIML Vice-President

Mr H. W. Liers (Germany), former member of the Presidential Council

CORRESPONDING MEMBERS

ALBANIA

The Director
National Directorate
Drejtoria Kombëtare e Metrologjisë dhe e Kalibrimit (DKMK)
Rruga "Sami Frashëri", Nr.33
Tirana

ARGENTINA

The Director
Ministerio de Economia y Obras y Servicios Publicos
Direccion Nacional de Commercio Interior
Julio A. Roca 651
Pise 4° - Sector 1 - (CP 1322)
Buenos Aires

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

BARBADOS

The Director
Barbados National Standards Institution
Culloden Road
St. Michael
Barbados W.I.

BENIN

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

BOSNIA AND HERZEGOVINA

The General Director
Institute for Standardization, Metrology and Patents of Bosnia and Herzegovina
BIH, 71000 Sarajevo
Dubrovačka 6

BOTSWANA

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

COLOMBIA

Superintendencia de Industria y Comercio
Carrera 13 No. 27-00
Piso 10
Santafé de Bogotá, D.C.

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

CROATIA
General Director
State Office for Standardization and Metrology
Ulica grada Vukovara 78
HR-10 000 Zagreb

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

ESTONIA
The Director General
National Standards Board of Estonia
Aru 10
EE-0003 Tallinn

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, CHINA
Commissioner of Customs and Excise
Customs and Excise Department
Units 1201-7
Nan Fung Commercial Centre
19 Lam Lok Street
Kowloon Bay

ICELAND
The Director
Icelandic Bureau of Legal Metrology
Löggildingarstofa
Síðumúli 13
108 Reykjavik

JORDAN
Jordanian Institution for Standardization and Metrology
P.O. Box 941287
Amman 11194

KUWAIT
The Under Secretary
Ministry of Commerce and Industry
Department of Standards and Metrology
Post Box No 2944
Kuwait

LATVIA
Latvian National Centre of Standardization and Metrology
157, Kr. Valdemara St.
LV-1013 Riga

LITHUANIA
The Director
Lithuanian Standards Board
T. Kosciuskos g.30
2600 Vilnius

LUXEMBURG
Le Préposé du Service de Métrologie
Administration des Contributions
Zone commerciale et artisanale
Cellule A2
rue J.F. Kennedy
L-7327 Steinsel

MALAWI
The Trade Metrology Manager
Malawi Bureau of Standards
Trade Metrology Division
P.O. Box 156
Lilongwe

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

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

MEXICO
Direccion General de Normas
Secretaria de Comercio y Fomento Industrial
Sistema Nacional de Calibracion
Ave. Puente de Tecamachalco no. 6
Planta Baja
Lomas de Tecamachalco, Seccion Fuentes
53950 Naucalpan de Juarez

MOLDAVIA
The Director General
Departamentul Standarde, Metrologie şi supraveghere tehnică al Republicii Moldova
str. S. Lazo, 48
277004, or. Chişinău

MONGOLIA
The Director General
Mongolian National Institute for Standardization and Metrology
Peace Str.
Ulaanbaatar 51

MOZAMBIQUE
The Director
Instituto Nacional de Normalizaçao e Qualidade
Av. 25 de Setembro n° 1179, 2° andar
Maputo

NEPAL
The Chief Inspector
Nepal Bureau of Standards and Metrology
P.B. 985, Sundhara
Kathmandu

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

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

PANAMA
The Director
Comision Panamena de Normas Industriales y Tecnicas
Ministerio de Comercio e Industrias
Apartado 9658, Panama 4

PAPUA NEW GUINEA
The Director General
National Institute of Standards and Industrial Technology
P.O. Box 3042, Boroko

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

PHILIPPINES

Bureau of Product Standards
Department of Trade and Industry
3rd floor DTI Building
361 Sen. Gil J. Puyat Avenue
Makati, Metro Manila
Philippines 3117

SEYCHELLES

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

SINGAPORE

Weights and Measures Office
Ministry of Trade and Industry
6 Bright Hill Drive
Singapore 57 95 98

SYRIA

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

CHINESE TAIPEI

The Director General
National Bureau of Standards
Ministry of Economic Affairs
3F, 185 Hsinhai Road
Taipei 106, Taiwan

THAILAND

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

TRINIDAD AND TOBAGO

The Director
Trinidad and Tobago Bureau of Standards
Century Drive, Trincity Industrial Estate
P.O. Box 467
Macoya, Tunapuna, Trinidad, W.I

TURKEY

The General Director
Sanayi ve Ticaret Bakanligi
Ölçüler ve Standardlar Genel
Müdürlügü
06100 Tandoğan
Ankara

UKRAINE

The President
Derjstandard of Ukraine
vul. Gorkogo 174
252650 KIEV-6
Ukraine

URUGUAY

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

S. R. VIETNAM

Directorate for Standards
and Quality (STAMEQ)
70 Tran Hung Dao St.
Hanoï

Below are lists of OIML publications classified by subject and number. The following abbreviations are used:

R International Recommendation;
D International Document;
V Vocabulary;
P Miscellaneous publication.

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. "NC" indicates "no charge".

OIML publications are available either from the BIML (see address below) or from national sale points in the countries listed below (please contact the relevant CIML Members at the addresses given in this document). ■

On trouvera ci-dessous une liste des publications OIML classées par sujets et par numéros. Les abréviations suivantes sont utilisées:

R Recommandation Internationale;
D Document International;
V Vocabulaire;
P Autre publication.

Ces publications sont disponibles en français et en anglais sous forme de fascicules séparés sauf indication contraire. Les prix sont donnés en francs-français et ne comprennent pas les frais d'expédition. "NC" signifie "gratuit".

Les publications OIML sont disponibles soit auprès du BIML (adresse ci-dessous), soit auprès des points de vente nationaux dans les pays mentionnés ci-dessous (contacter le Membre du CIML à l'adresse donnée dans ce document). ■

BUREAU INTERNATIONAL DE MÉTROLOGIE LÉGALE
11, RUE TURGOT, 75009 PARIS, FRANCE
TEL: 33 (0)1 48 78 12 82 OR 33 (0)1 42 85 27 11
FAX: 33 (0)1 42 82 17 27
E-MAIL: biml@oiml.org
INTERNET: http://www.oiml.org

■ NATIONAL SALE POINTS:
UNITED KINGDOM

General
Généralités

R 34 (1979-*1974*) 60 FRF
Accuracy classes of measuring instruments
Classes de précision des instruments de mesurage

R 42 (1981-*1977*) 50 FRF
Metal stamps for verification officers
Poinçons de métal pour Agents de vérification

D 1 (1975) 50 FRF
Law on metrology
Loi de métrologie

D 2 (being printed - *en cours de publication*)
Legal units of measurement
Unités de mesure légales

D 3 (1979) 60 FRF
Legal qualification of measuring instruments
Qualification légale des instruments de mesurage

D 5 (1982) 60 FRF
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) 60 FRF
Principles of metrological supervision
Principes de la surveillance métrologique

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

D 13 (1986) 50 FRF
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) 60 FRF
Training of legal metrology personnel - Qualification - Training programmes
Formation du personnel en métrologie légale - Qualification - Programmes d'étude

D 15 (1986) 80 FRF
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) * 80 FRF
Principles of assurance of metrological control
Principes d'assurance du contrôle métrologique

D 19 (1988) 80 FRF
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 processus 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 3-1 (1996) 400 FRF
Legal metrology in OIML Member States
Métrologie légale dans les Etats Membres de l'OIML

P 3-2 (1996) 300 FRF
Legal metrology in OIML Corresponding Members
Métrologie légale dans les Membres Correspondants de l'OIML

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

P 17 (1995) 300 FRF
Guide to the expression of uncertainty in measurement
Guide pour l'expression de l'incertitude de mesure

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 réétalonnage 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 mesurages

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

R 15 (1974-*1970*) 80 FRF
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-espagnol)

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 aréomètres pour alcool et thermomètres utilisés en alcoométrie

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

R 50-1 (1997) 150 FRF
Continuous totalizing automatic weighing instruments (Belt weighers). Part 1: Metrological and technical requirements - Tests
Instruments de pesage totalisateurs continus à fonctionnement automatique (peseuses sur bande) Partie 1: Exigences métrologiques et techniques - Essais

R 50-2 (1997) 200 FRF
Continuous totalizing automatic weighing instruments (Belt weighers). Part 2: Test report format
Instruments de pesage totalisateurs continus à fonctionnement automatique (peseuses sur bande) Partie 2: Format du rapport d'essai

R 51-1 (1996) 100 FRF

Automatic catchweighing instruments. Part 1: Metrological and technical requirements - Tests
Instruments de pesage trieurs-étiqueteurs à fonctionnement automatique. Partie 1: Exigences métrologiques et techniques - Essais

R 51-2 (1996) 300 FRF

Automatic catchweighing instruments. Part 2: Test report format
Instruments de pesage trieurs-étiqueteurs à fonctionnement automatique. Partie 2: Format du rapport d'essai

R 52 (1980) 50 FRF

Hexagonal weights, ordinary accuracy class from 100 g to 50 kg
Poids hexagonaux de classe de précision ordinaire, de 100 g à 50 kg

R 60 (1991) 80 FRF

Metrological regulation for load cells
Réglementation métrologique des cellules de pesée

Annex (1993) 80 FRF

Test report format for the evaluation of load cells
Format du rapport d'essai des cellules de pesée

R 61-1 (1996) 150 FRF

Automatic gravimetric filling instruments. Part 1: Metrological and technical requirements - Tests
Doseuses pondérales à fonctionnement automatique. Partie 1: Exigences métrologiques et techniques - Essais

R 61-2 (1996) 250 FRF

Automatic gravimetric filling instruments. Part 2: Test report format
Doseuses pondérales à fonctionnement automatique. Partie 2: Format du rapport d'essai

R 74 (1993) 80 FRF

Electronic weighing instruments
Instruments de pesage électroniques

R 76-1 (1992) 300 FRF

Nonautomatic weighing instruments. Part 1: Metrological and technical requirements - Tests
Instruments de pesage à fonctionnement non automatique. Partie 1: Exigences métrologiques et techniques - Essais

Amendment No. 1 (1994) NC

R 76-2 (1993) 200 FRF

Nonautomatic weighing instruments. Part 2: Pattern evaluation report
Instruments de pesage à fonctionnement non automatique. Partie 2: Rapport d'essai de modèle

Amendment No. 1 (1995) NC

R 106-1 (1997) 150 FRF

Automatic rail-weighbridges. Part 1: Metrological and technical requirements - Tests
Ponts-bascules ferroviaires à fonctionnement automatique. Partie 1: Exigences métrologiques et techniques - Essais

R 106-2 (1997) 250 FRF

Automatic rail-weighbridges. Part 2: Test report format
Ponts-bascules ferroviaires à fonctionnement automatique. Partie 2: Format du rapport d'essai

R 107-1 (1997) 150 FRF

Discontinuous totalizing automatic weighing instruments (totalizing hopper weighers). Part 1: Metrological and technical requirements - Tests
Instruments de pesage totalisateurs discontinus à fonctionnement automatique (peseuses totalisatrices à trémie) Partie 1: Exigences métrologiques et techniques - Essais

R 107-2 (1997) 300 FRF

Discontinuous totalizing automatic weighing instruments (totalizing hopper weighers). Part 2: Test report format
Instruments de pesage totalisateurs discontinus à fonctionnement automatique (peseuses totalisatrices à trémie) Partie 2: Format du rapport d'essai

R 111 (1994) 80 FRF

Weights of classes E_1, E_2, F_1, F_2, M_1, M_2, M_3
Poids des classes E_1, E_2, F_1, F_2, M_1, M_2, M_3

P 5 (1992) 100 FRF

Mobile equipment for the verification of road weighbridges (bilingual French-English)
Equipement mobile pour la vérification des ponts-bascules routiers (bilingue français-anglais)

P 8 (1987) 100 FRF

Density measurement
Mesure de la masse volumique

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 étalon 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 (1985) 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 chronotachographs for motor vehicles. Metrological regulations
Compteurs de vitesse, compteurs mécaniques de distance et chronotachygraphes des véhicules automobiles. Réglementation métrologique

R 66 (1985) 60 FRF

Length measuring instruments
Instruments mesureurs de longueurs

R 91 (1990) — 60 FRF
Radar equipment for the measurement of the speed of vehicles
Cinémomètres 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
Fioles jaugées 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
Fioles étalons graduées en verre pour Agents de vérification

R 45 (1980–*1977*) — 50 FRF
Casks and barrels
Tonneaux et futailles

R 49 (being revised - *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) — 50 FRF
Petroleum measurement tables
Tables de mesure du pétrole

R 71 (1985) — 80 FRF
Fixed storage tanks. General requirements
Réservoirs de stockage fixes. Prescriptions générales

R 72 (1985) — 60 FRF
Hot water meters
Compteurs d'eau destinés au mesurage de l'eau chaude

R 80 (1989) — 100 FRF
Road and rail tankers
Camions et wagons-citernes

R 81 (being printed - *en cours de publication*)
Dynamic measuring devices and systems for cryogenic liquids (including tables of density for liquid argon, helium, hydrogen, nitrogen and oxygen)
Dispositifs et systèmes de mesure dynamique de liquides cryogéniques (comprend tables de masse volumique pour argon, hélium, hydrogène, azote et oxygène liquides)

R 85 (being printed - *en cours de publication*)
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) — 50 FRF
Drum meters for alcohol and their supplementary devices
Compteurs à tambour pour alcool et leurs dispositifs complémentaires

R 95 (1990) — 60 FRF
Ships' tanks - General requirements
Bateaux-citernes - Prescriptions générales

R 96 (1990) — 50 FRF
Measuring container bottles
Bouteilles récipients-mesures

R 105 (1993) — 100 FRF
Direct mass flow measuring systems for quantities of liquids
Ensembles de mesurage massiques directs de quantités de liquides

Annex (1995) — 80 FRF
Test report format
Format du rapport d'essai

R 117 (1995) — 400 FRF
Measuring systems for liquids other than water
Ensembles de mesurage de liquides autres que l'eau

R 118 (1995) — 100 FRF
Testing procedures and test report format for pattern evaluation of fuel dispensers for motor vehicles
Procédures d'essai et format du rapport d'essai des modèles de distributeurs de carburant pour véhicules à moteur

R 119 (1996) — 80 FRF
Pipe provers for testing measuring systems for liquids other than water
Tubes étalons pour l'essai des ensembles de mesurage de liquides autres que l'eau

R 120 (1996) — 100 FRF
Standard capacity measures for testing measuring systems for liquids other than water
Mesures de capacité étalons pour l'essai des ensembles de mesurage de liquides autres que l'eau

R 125 (being printed - *en cours de publication*)
Measuring systems for the mass of liquids in tanks
Systèmes de mesure de la masse des liquides dans les réservoirs

D 4 (1981) — 50 FRF
Installation and storage conditions for cold water meters
Conditions d'installation et de stockage des compteurs d'eau froide

D 7 (1984) 80 FRF
The evaluation of flow standards and facilities used for testing water meters
Evaluation des étalons de débitmétrie et des dispositifs utilisés pour l'essai des compteurs d'eau

D 25 (1996) 60 FRF
Vortex meters used in measuring systems for fluids
Compteurs à vortex utilisés dans les ensembles de mesurage 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 (1)

R 6 (1989) 80 FRF
General provisions for gas volume meters
Dispositions générales pour les compteurs de volume de gaz

R 31 (1995) 80 FRF
Diaphragm gas meters
Compteurs de gaz à parois déformables

R 32 (1989) 60 FRF
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 (2)

R 23 (1975–*1973)* 60 FRF
Tyre pressure gauges for motor vehicles
Manomètres pour pneumatiques de véhicules automobiles

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)

(1) See also "Liquid measurement" D 25 – *Voir aussi "Mesurage des liquides" D 25*
(2) See also "Medical instruments" – *Voir aussi "Instruments médicaux"*

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 (2)

R 18 (1989) 60 FRF
Visual disappearing filament pyrometers
Pyromètres optiques à filament disparaissant

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 à résistance thermométrique de platine, de cuivre ou de nickel (à usages techniques et commerciaux)

D 24 (1996) 60 FRF
Total radiation pyrometers
Pyromètres à radiation totale

P 16 (1991) 100 FRF
Guide to practical temperature measurements

Electricity
Électricité

R 46 (being revised - *en cours de révision)*
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
Exigences générales pour les instruments de mesure électroniques

Acoustics and vibration
Acoustique et vibrations (1)

R 58 (1998) 80 FRF
Sound level meters
Sonomètres

R 88 (1998) 80 FRF

Integrating-averaging sound level meters
Sonomètres intégrateurs-moyenneurs

R 102 (1992) 50 FRF

Sound calibrators
Calibreurs acoustiques

Annex (1995) 80 FRF
Test methods for pattern evaluation and test report format
Méthodes d'essai de modèle 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

Annex F (1997) 100 FRF
Test report format
Format du rapport d'essai

Environment
Environnement

R 82 (1989) 80 FRF

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) 80 FRF

Gas chromatograph/mass spectrometer/data system for analysis of organic pollutants in water
Chromatographe 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 (being printed - *en cours de publication)*

Instruments for measuring vehicle exhaust emissions
Instruments de mesure des gaz d'échappement des véhicules

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 (1995) 80 FRF

Inductively coupled plasma atomic emission spectrometers for measurement of metal pollutants in water
Spectromètres à émission atomique de plasma couplé inductivement pour le mesurage des polluants métalliques dans l'eau

R 123 (1997) 100 FRF

Portable and transportable X-ray fluorescence spectrometers for field measurement of hazardous elemental pollutants
Spectromètres à fluorescence de rayons X portatifs et déplaçables pour la mesure sur le terrain d'éléments polluants dangereux

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 contenus dans l'air en provenance des sites de décharge de déchets dangereux

Physico-chemical measurements
Mesures physico-chimiques

R 14 (1995) 60 FRF

Polarimetric saccharimeters
Saccharimètres polarimétriques

R 54 (being revised - *en cours de révision)*

pH scale for aqueous solutions
Echelle de pH des solutions aqueuses

R 56 (1981) 50 FRF

Standard solutions reproducing the conductivity of electrolytes
Solutions-étalons reproduisant la conductivité des électrolytes

R 59 (1984) 80 FRF

Moisture meters for cereal grains and oilseeds
Humidimètres pour grains de céréales et graines oléagineuses

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 capillaire, 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'hystérésis des analyseurs de gaz

R 73 (1985) 50 FRF

Requirements concerning pure gases CO, CO_2, CH_4, H_2, O_2, N_2 and Ar intended for the preparation of reference gas mixtures
Prescriptions pour les gaz purs CO, CO_2, CH_4, H_2, O_2, N_2 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
Réfractomètres pour la mesure de la teneur en sucre des jus de fruits

R 121 (1996) 60 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 sels

R 124 (1997) 80 FRF

Refractometers for the measurement of the sugar content of grape must
Réfractomètres pour la mesure de la teneur en sucre des moûts de raisin

R 126 (being printed - *en cours de publication*)

Evidential breath analyzers
Éthylomètres

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-*1970*) 50 FRF

Manometers for instruments for measuring blood pressure (sphygmomanometers)
Manomètres des instruments de mesure de la tension artérielle (sphygmomanomètres)

R 26 (1978-*1973*) 50 FRF

Medical syringes
Seringues médicales

R 78 (1989) 50 FRF

Westergren tubes for measurement of erythrocyte sedimentation rate
Pipettes Westergren pour la mesure de la vitesse de sédimentation des hématies

R 89 (1990) 80 FRF

Electroencephalographs - Metrological characteristics - Methods and equipment for verification
Electroencéphalographes - Caractéristiques métrologiques - Méthodes et moyens de vérification

R 90 (1990) 80 FRF

Electrocardiographs - Metrological characteristics - Methods and equipment for verification
Electrocardiographes - Caractéristiques métrologiques - Méthodes et moyens de vérification

R 93 (1990) 60 FRF

Focimeters
Frontofocomètres

R 114 (1995) 80 FRF

Clinical electrical thermometers for continuous measurement
Thermomètres électriques médicaux pour mesurage en continu

R 115 (1995) 80 FRF

Clinical electrical thermometers with maximum device
Thermomètres électriques médicaux avec dispositif à maximum

R 122 (1996) 60 FRF

Equipment for speech audiometry
Appareils pour l'audiométrie vocale

D 21 (1990) 80 FRF

Secondary standard dosimetry laboratories for the calibration of dosimeters used in radiotherapy
Laboratoires secondaires d'étalonnage en dosimétrie pour l'étalonnage des dosimètres utilisés en radiothérapie

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 pénétrateurs 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
Exigences générales pour les machines d'essai des matériaux

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

V 3 (1991) 80 FRF
Hardness testing dictionary (quadrilingual French-English-German-Russian)
Dictionnaire des essais de dureté (quadrilingue français-anglais-allemand-russe)

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 (1997) 60 FRF
Labeling requirements for prepackaged products
Exigences pour l'étiquetage des produits préemballés

R 87 (1989) 50 FRF
Net content in packages
Contenu net des preemballages

OIML publications classified by number
Publications OIML classées par numéros

INTERNATIONAL RECOMMENDATIONS
RECOMMANDATIONS INTERNATIONALES

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

R 6 (1989) 80 FRF
General provisions for gas volume meters
Dispositions générales pour les compteurs de volume de gaz

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 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 14 (1995) 60 FRF
Polarimetric saccharimeters
Saccharimètres polarimétriques

R 15 (1974-1970) 80 FRF
Instruments for measuring the hectolitre mass of cereals
Instruments de mesure de la masse à l'hectolitre des céréales

R 16 (1973-1970) 50 FRF
Manometers for instruments for measuring blood pressure (sphygmomanometers)
Manomètres des instruments de mesure de la tension artérielle (sphygmomanomètres)

R 18 (1989) 60 FRF
Visual disappearing filament pyrometers
Pyromètres optiques à filament disparaissant

R 21 (1975-1973) 60 FRF
Taximeters
Taximètres

R 22 (1975-1973) 150 FRF
International alcoholometric tables (trilingual French-English-Spanish)
Tables alcoométriques internationales (trilingue français-anglais-espagnol)

R 23 (1975-1973) 60 FRF
Tyre pressure gauges for motor vehicles
Manomètres pour pneumatiques de véhicules automobiles

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

R 26 (1978-1973) 50 FRF
Medical syringes
Seringues médicales

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

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

R 31 (1995) 80 FRF
Diaphragm gas meters
Compteurs de gaz à parois déformables

R 32 (1989) 60 FRF
Rotary piston gas meters and turbine gas meters
Compteurs de volume de gaz à pistons rotatifs et compteurs de volume de gaz à turbine

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 34 (1979-1974) 60 FRF
Accuracy classes of measuring instruments
Classes de précision des instruments de mesurage

R 35 (1985) 80 FRF
Material measures of length for general use
Mesures matérialisées de longueur pour usages généraux

R 36 (1980-1977) 60 FRF
Verification of indenters for hardness testing machines
Vérification des pénétrateurs 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 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 42 (1981-1977) 50 FRF
Metal stamps for verification officers
Poinçons de métal pour agents de vérification

R 43 (1981-1977) 60 FRF
Standard graduated glass flasks for verification officers
Fioles étalons graduées en verre pour agents de vérification

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

R 45 (1980-1977) 50 FRF
Casks and barrels
Tonneaux et futailles

R 46 (being revised - *en cours de révision*)
Active electrical energy meters for direct connection of class 2
Compteurs d'énergie électrique active à branchement direct de la classe 2

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

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 49 (being revised - *en cours de révision*)
Water meters intended for the metering of cold water
Compteurs d'eau destinés au mesurage de l'eau froide

R 50-1 (1997) 150 FRF
Continuous totalizing automatic weighing instruments (Belt weighers). Part 1: Metrological and technical requirements - Tests
Instruments de pesage totalisateurs continus à fonction nement automatique (peseuses sur bande). Partie 1: Exigences métrologiques et techniques - Essais

R 50-2 (1997) 200 FRF
Continuous totalizing automatic weighing instruments (Belt weighers). Part 2: Test report format
Instruments de pesage totalisateurs continus à fonctionnement automatique (peseuses sur bande). Partie 2: Format du rapport d'essai

R 51-1 (1996) 100 FRF
Automatic catchweighing instruments. Part 1: Metrological and technical requirements - Tests
Instruments de pesage trieurs-étiqueteurs à fonctionnement automatique. Partie 1: Exigences métrologiques et techniques - Essais

R 51-2 (1996) 300 FRF
Automatic catchweighing instruments. Part 2: Test report format
Instruments de pesage trieurs-étiqueteurs à fonctionnement automatique. Partie 2: Format du rapport d'essai

R 52 (1980) 50 FRF
Hexagonal weights, ordinary accuracy class from 100 g to 50 kg
Poids hexagonaux de classe de précision ordinaire, de 100 g à 50 kg

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 54 (being revised - *en cours de révision*)
pH scale for aqueous solutions
Echelle de pH des solutions aqueuses

R 55 (1981) 50 FRF
Speedometers, mechanical odometers and chronotachographs for motor vehicles. Metrological regulations
Compteurs de vitesse, compteurs mécaniques de distance et chronotachygraphes des véhicules automobiles. Réglementation métrologique

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

R 58 (1998) 80 FRF
Sound level meters
Sonomètres

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

R 60 (1991) 80 FRF
Metrological regulation for load cells
Réglementation métrologique des cellules de pesée
Annex (1993) 80 FRF
Test report format for the evaluation of load cells
Format du rapport d'essai des cellules de pesée

R 61-1 (1996) 150 FRF
Automatic gravimetric filling instruments. Part 1: Metrological and test requirements - Tests
Doseuses pondérales à fonctionnement automatique. Partie 1: Exigences métrologiques et techniques - Essais

R 61-2 (1996) 250 FRF
Automatic gravimetric filling instruments. Part 2: Test report format
Doseuses pondérales à fonctionnement automatique. Partie 2: Format du rapport d'essai

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

R 63 (1994) 50 FRF
Petroleum measurement tables
Tables de mesure du pétrole

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

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

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

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 capillaire, 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'hystérésis des analyseurs de gaz

R 71 (1985) 80 FRF
Fixed storage tanks. General requirements
Réservoirs de stockage fixes. Prescriptions générales

R 72 (1985) 60 FRF
Hot water meters
Compteurs d'eau destinés au mesurage de l'eau chaude

R 73 (1985) 50 FRF
Requirements concerning pure gases CO, CO_2, CH_4, H_2, O_2, N_2 and Ar intended for the preparation of reference gas mixtures
Prescriptions pour les gaz purs CO, CO_2, CH_4, H_2, O_2, N_2 et Ar destinés à la préparation des mélanges de gaz de référence

R 74 (1993) 80 FRF
Electronic weighing instruments
Instruments de pesage électroniques

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

R 76-1 (1992) 300 FRF
Nonautomatic weighing instruments. Part 1: Metrological and technical requirements - Tests
Instruments de pesage à fonctionnement non automatique. Partie 1: Exigences métrologiques et techniques - Essais
Amendment No. 1 (1994) NC

R 76-2 (1993) 200 FRF
Nonautomatic weighing instruments. Part 2: Pattern evaluation report
Instruments de pesage à fonctionnement non automatique. Partie 2: Rapport d'essai de modèle
Amendment No. 1 (1995) NC

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

R 79 (1997) 60 FRF
Labeling requirements for prepackaged products
Exigences pour l'étiquetage des produits préemballés

R 80 (1989) 100 FRF
Road and rail tankers
Camions et wagons-citernes

R 81 (being printed - *en cours de publication*)
Dynamic measuring devices and systems for cryogenic liquids (including tables of density for liquid argon, helium, hydrogen, nitrogen and oxygen)
Dispositifs et systèmes de mesure dynamique de liquides cryogéniques (comprend tables de masse volumique pour argon, hélium, hydrogène, azote et oxygène liquides)

R 82 (1989) 80 FRF
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) 80 FRF
Gas chromatograph/mass spectrometer/data system for analysis of organic pollutants in water
Chromatographe 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 84 (1989) 60 FRF
Resistance-thermometer sensors made of platinum, copper or nickel (for industrial and commercial use)
Capteurs à résistance thermométrique de platine, de cuivre ou de nickel (à usages techniques et commerciaux)

R 85 (being printed - *en cours de publication*)
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) 50 FRF
Drum meters for alcohol and their supplementary devices
Compteurs à tambour pour alcool et leurs dispositifs complémentaires

R 87 (1989) 50 FRF
Net content in packages
Contenu net des préemballages

R 88 (1998) 80 FRF
Integrating-averaging sound level meters
Sonomètres intégrateurs-moyenneurs

R 89 (1990) 80 FRF
Electroencephalographs - Metrological characteristics - Methods and equipment for verification
Electroencéphalographes - Caractéristiques métrologiques - Méthodes et moyens de vérification

R 90 (1990) 80 FRF
Electrocardiographs - Metrological characteristics - Methods and equipment for verification
Electrocardiographes - Caractéristiques métrologiques - Méthodes et moyens de vérification

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

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 93 (1990) 60 FRF
Focimeters
Frontofocomètres

R 95 (1990) 60 FRF
Ships' tanks - General requirements
Bateaux-citernes - Prescriptions générales

R 96 (1990) 50 FRF
Measuring container bottles
Bouteilles récipients-mesures

R 97 (1990) 60 FRF
Barometers
Baromètres

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

R 99 (being printed - *en cours de publication*)
Instruments for measuring vehicle exhaust emissions
Instruments de mesure des gaz d'échappement des véhicules

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 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 102 (1992) 50 FRF
Sound calibrators
Calibreurs acoustiques

Annex (1995) 80 FRF
Test methods for pattern evaluation and test report format
Méthodes d'essai de modèle 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

Annex F (1997) 100 FRF
Test report format
Format du rapport d'essai

R 105 (1993) 100 FRF
Direct mass flow measuring systems for quantities of liquids
Ensembles de mesurage massiques directs de quantités de liquides

Annex (1995) 80 FRF
Test report format
Format du rapport d'essai

R 106-1 (1997) 150 FRF
Automatic rail-weighbridges. Part 1: Metrological and technical requirements - Tests
Ponts-bascules ferroviaires à fonctionnement automatique. Partie 1: Exigences métrologiques et techniques - Essais

R 106-2 (1997) 250 FRF
Automatic rail-weighbridges. Part 2: Test report format
Ponts-bascules ferroviaires à fonctionnement automatique. Partie 2: Format du rapport d'essai

R 107-1 (1997) 150 FRF
Discontinuous totalizing automatic weighing instruments (totalizing hopper weighers). Part 1: Metrological and technical requirements - Tests
Instruments de pesage totalisateurs discontinus à fonctionnement automatique (peseuses totalisatrices à trémie). Partie 1: Exigences métrologiques et techniques - Essais

R 107-2 (1997) 300 FRF
Discontinuous totalizing automatic weighing instruments (totalizing hopper weighers). Part 2: Test report format
Instruments de pesage totalisateurs discontinus à fonctionnement automatique (peseuses totalisatrices à trémie). Partie 2: Format du rapport d'essai

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

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

R 111 (1994) 80 FRF
Weights of classes E_1, E_2, F_1, F_2, M_1, M_2, M_3
Poids des classes E_1, E_2, F_1, F_2, M_1, M_2, M_3

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 114 (1995) 80 FRF
Clinical electrical thermometers for continuous measurement
Thermomètres électriques médicaux pour mesurage en continu

R 115 (1995) 80 FRF
Clinical electrical thermometers with maximum device
Thermomètres électriques médicaux avec dispositif à maximum

R 116 (1995) 80 FRF
Inductively coupled plasma atomic emission spectrometers for measurement of metal pollutants in water
Spectromètres à émission atomique de plasma couplé inductivement pour le mesurage des polluants métalliques dans l'eau

R 117 (1995) 400 FRF
Measuring systems for liquids other than water
Ensembles de mesurage de liquides autres que l'eau

R 118 (1995) 100 FRF
Testing procedures and test report format for pattern evaluation of fuel dispensers for motor vehicles
Procédures d'essai et format du rapport d'essai des modèles de distributeurs de carburant pour véhicules à moteur

R 119 (1996) 80 FRF
Pipe provers for testing measuring systems for liquids other than water
Tubes étalons pour l'essai des ensembles de mesurage de liquides autres que l'eau

R 120 (1996) 100 FRF
Standard capacity measures for testing measuring systems for liquids other than water
Mesures de capacité étalons pour l'essai des ensembles de mesurage de liquides autres que l'eau

R 121 (1996) 60 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 sels

R 122 (1996) 60 FRF
Equipment for speech audiometry
Appareils pour l'audiométrie vocale

R 123 (1997) 100 FRF
Portable and transportable X-ray fluorescence spectrometers for field measurement of hazardous elemental pollutants
Spectromètres à fluorescence de rayons X portatifs et déplaçables pour la mesure sur le terrain d'éléments polluants dangereux

R 124 (1997) 80 FRF
Refractometers for the measurement of the sugar content of grape must
Réfractomètres pour la mesure de la teneur en sucre des moûts de raisin

R 125 (being printed - *en cours de publication*)
Measuring systems for the mass of liquids in tanks
Systèmes de mesure de la masse des liquides dans les réservoirs

R 126 (being printed - *en cours de publication*)
Evidential breath analyzers
Éthylomètres

INTERNATIONAL DOCUMENTS
DOCUMENTS INTERNATIONAUX

D 1 (1975) 50 FRF
Law on metrology
Loi de métrologie

D 2 (being printed - *en cours de publication*)
Legal units of measurement
Unités de mesure légales

D 3 (1979) 60 FRF
Legal qualification of measuring instruments
Qualification légale des instruments de mesurage

D 4 (1981) 50 FRF
Installation and storage conditions for cold water meters
Conditions d'installation et de stockage des compteurs d'eau froide

D 5 (1982) 60 FRF
Principles for the establishment of hierarchy schemes for measuring instruments
Principes pour l'établissement des schémas de hiérarchie des instruments de mesure

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

D 7 (1984) 80 FRF
The evaluation of flow standards and facilities used for testing water meters
Evaluation des étalons de débitmétrie et des dispositifs utilisés pour l'essai des compteurs d'eau

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 9 (1984) 60 FRF
Principles of metrological supervision
Principes de la surveillance métrologique

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 réétalonnage des équipements de mesure utilisés dans les laboratoires d'essais

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

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

D 13 (1986) 50 FRF
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) 60 FRF
Training of legal metrology personnel - Qualification - Training programs
Formation du personnel en métrologie légale - Qualification - Programmes d'étude

D 15 (1986) 80 FRF
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) 80 FRF
Principles of assurance of metrological control
Principes d'assurance du contrôle métrologique

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

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 mesurages

D 19 (1988) 80 FRF
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 processus de mesure

D 21 (1990) 80 FRF
Secondary standard dosimetry laboratories for the calibration of dosimeters used in radiotherapy
Laboratoires secondaires d'étalonnage en dosimétrie pour l'étalonnage des dosimètres utilisés en radiothérapie

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 contenus dans l'air en provenance des sites de décharge de déchets dangereux

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

D 24 (1996) 60 FRF
Total radiation pyrometers
Pyromètres à radiation totale

D 25 (1996) 60 FRF
Vortex meters used in measuring systems for fluids
Compteurs à vortex utilisés dans les ensembles de mesurage de fluides

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

VOCABULARIES
VOCABULAIRES

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)

V 3 (1991) — 80 FRF
Hardness testing dictionary (quadrilingual French-English-German-Russian)
Dictionnaire des essais de dureté (quadrilingue français-anglais-allemand-russe)

OTHER PUBLICATIONS
AUTRES PUBLICATIONS

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 3-1 (1996) — 400 FRF
Legal metrology in OIML Member States
Métrologie légale dans les Etats Membres de l'OIML

P 3-2 (1996) — 300 FRF
Legal metrology in OIML Corresponding Members
Métrologie légale dans les Membres Correspondants de l'OIML

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

P 5 (1992) — 100 FRF
Mobile equipment for the verification of road weighbridges (bilingual French- English)
Equipement mobile pour la vérification des ponts-bascules routiers (bilingue français-anglais)

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 8 (1987) — 100 FRF
Density measurement
Mesure de la masse volumique

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

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

P 15 (1989) — 100 FRF
Guide to calibration

P 16 (1991) — 100 FRF
Guide to practical temperature measurements

P 17 (1995) — 300 FRF
Guide to the expression of uncertainty in measurement
Guide pour l'expression de l'incertitude de mesure

OIML BULLETIN

▸ CALL FOR PAPERS ◂

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

Authors are requested to submit a double-spaced, titled (typed) manuscript and accompanying visual materials (photos, illustrations, slides, etc.), together with a disk copy in one of the following formats: WordPerfect 5.1, Word 6 or 7 (or previous versions for PC or Macintosh), or Quark XPress for Macintosh. Authors are also requested to send a passport-size, black and white identity photo for publication.

Papers selected for publication will be remunerated at the rate of 150 FRF per printed page, provided that they have not already been published in other journals. The Editors reserve the right to edit contributions for style and space restrictions.

Please send submissions to:

The Editors
Bureau International de Métrologie Légale
11, rue Turgot - F-75009 Paris - France