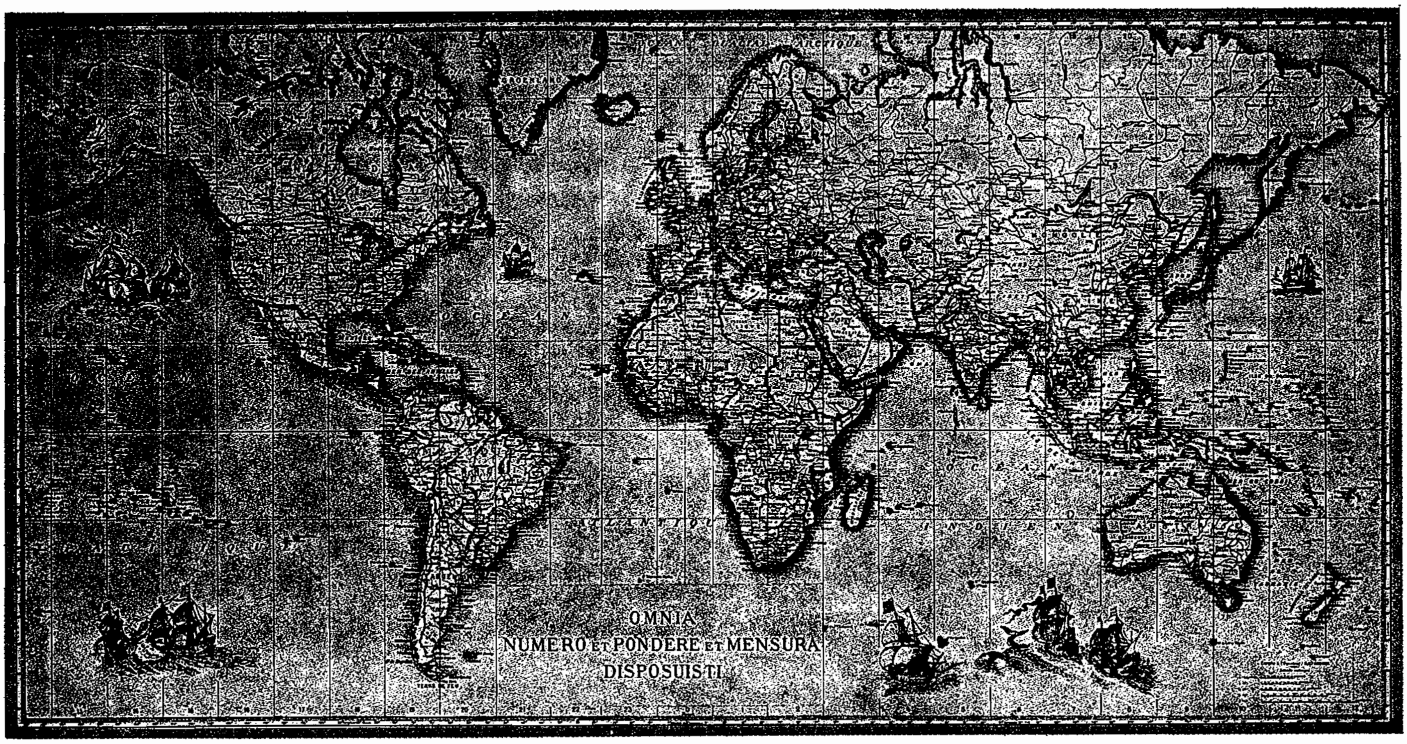
Bulletin OIML n° 114
Mars 1989

ISSN 0473-2812

BULLETIN

DE

L'ORGANISATION INTERNATIONALE DE MÉTROLOGIE LÉGALE



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11, Rue Turgot — 75009 PARIS — France

Bulletin OIML n° 114
Mars 1989
Trimestriel

ISSN 0473-2812

BULLETIN
de
l'ORGANISATION INTERNATIONALE de MÉTROLOGIE LÉGALE

SOMMAIRE

Pages

INFORMATIONS

DOCUMENTATION

Abonnement pour 1989 : Europe : 175 F-français
Autres pays : 230 F-français
Chèques postaux : Paris 8 046-24 X
Banque de France : B.P. 140-01 - 75049 Paris Cedex 01
Comptes Courants, Banques Etrangères, Cpte n° 5051-7

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REPUBLIQUE FEDERALE D'ALLEMAGNE

MOBILE EQUIPMENT for the VERIFICATION of WEIGHBRIDGES up to 50 TONNES *

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SUMMARY — Since 1981, a special-purpose vehicle for testing and verification of weighbridges has been on duty at the verification authority of Rheinland-Pfalz, a state of the Federal Republic of Germany.

This vehicle was conceived in such a way, that the test can be carried out either according to the "substitution step method" or according to the "full standard weights method" (in latter case only for a maximum capacity of 37 tonnes).

Special auxiliary equipment enables the driver to place the whole load of 50 tonnes also on short platforms of 8.5 m length and more.

The vehicle consists of a lorry (26 t) and a trailer (24 t). The trailer is adjusted as standard weight and is being verified regularly by the means of a weighbridge with a capacity of 30 tonnes and a sensitivity of 0.1 kg, which was installed mainly for this purpose.

Advantages of and necessity for mobile equipment for testing and verification of road weighbridges

In connection with testing and verification of weighbridges there have been again and again great difficulties in providing proper means to attain the maximum capacity of the weighbridge. For many years mobile equipment — in the form of special purpose vehicles in different versions — has been in use in many countries for testing of road weighbridges. Some of these vehicles are equipped with water-tanks, to be filled on-site.

Due to the increase in the number of weighbridges with a maximum capacity of 50 t, especially of direct reading and recording scales, the verification authority of Rheinland-Pfalz was convinced that at that time, about 10 years ago, an own mobile equipment would be profitable. About 850 weighbridges with a maximum capacity of 20 t or more had to be verified in our district every three years.

During the projecting stage, we tried to identify the advantages as well as the disadvantages of those vehicles, which were in use at that time in the Federal Republic of Germany. We found that the following conditions should be fulfilled by our vehicle :

1. Total weight 50 tonnes
2. The maximum load of standard weights should be as high as possible
3. The vehicle must be equipped with a device which allows to load or unload the mass standards as quickly as possible

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* Lecture presented at the 9th International Symposium on Metrology — INSYMET '88 —, Bratislava, CSSR, on 6 September 1988.

4. The form and the size of a mass standard must allow easy handling on the ground without any device
5. The trailer itself should serve as standard weight and it should be possible to split up its total weight if necessary
6. It must be possible to apply all testing methods according to our testing and verification instructions for scales
7. It should be possible that the total load, i.e. the whole vehicle of 50 t, can be positioned on even short bridges of a length of 10 m or less
8. The driver should have independent means of transportation, for example a motorcycle temporarily attached to the vehicle.

Some of these conditions were the consequence of the new testing and verification instructions for scales, which became effective in 1980 [1]. They prescribe exactly which conditions have to be fulfilled with regard to the repeatability of scales in order to apply a certain testing method. In any case of testing a truck scale, a mobile load is absolutely necessary.

The substitution method with more than one substitution step may not be used unless the repeatability is satisfactory.

It was our desire to equip the vehicle in a way which would enable us to test a weighbridge up to a maximum capacity of 50 t by means of only one substitution step. In this case, only a part of the standard load had to be replaced once by an unknown load, namely the empty tractor, during the testing operation.

By strictly following the verification instructions, it would not be possible to proceed with the test by means of a mobile equipment, when the lack of repeatability exceeds a certain limit and more than one substitution step would be necessary to determine the error at the maximum capacity test point. In this case, additional standard load had to be transported to the spot despite the existence of a special purpose vehicle ; otherwise it would be necessary to try to repair the weighing machine and thereby reduce the deviations in the repeatability to an acceptable value where the application of the substitution method with more than one step would be possible.

Now I want to explain how we have realized all these basic requirements. It is quite likely that the conception of our vehicle has been adopted by others in the meantime.

The tractor

We looked for a tractor with a low empty weight, short axle base, high powered motor and a solid construction for a total weight of considerably more than the 22 t which are generally allowed by the German Road Traffic Regulations for a single vehicle. We chose a Mercedes-Benz tractor type 2632 K 6x4, 235 kilowatt (320 HP), empty weight 8.2 tonnes, big driver cabin including a sleeping berth (Fig. 1).

Due to the fact, that we did not limit the operational area to the state of Rheinland-Pfalz and the range of action would be quite large, a motorcycle was bought for official use by the driver. This enables him to move around for other official tasks without the tractor or without having to depend on the availability of public transportation.

When the loading crane and other accessories were mounted, we arrived at an empty weight of nearly 13 t, the additional load of standard weights is also 13 t. Therefore, the total weight of the tractor is 26 t, which makes for a ratio of 1:1 between empty weight of the tractor and the standard load. This means, that in exceptional cases we are able to test smaller weighbridges with maximum capacities of less than 26 t by means of the tractor combined with only one substitution step.

The 500 kg standard weights of cylindrical shape are made of cast iron. The handling of those weights is quite easy, this allows to bring up the standard load on the corners or on the sides of the bridge to execute eccentric tests very quickly (Fig. 2).

Fig. 1 — Mobile equipment for testing and verification of weighbridges

Fig. 2 — Handling of 500 kg standard weights on the ground without any device

The driver can operate the loading crane in the rear of the tractor by remote control, he therefore can change his position when required to have a clear view and — if no assistant is present — he can attach the cylindrical weights to the hook without help (Fig. 3).

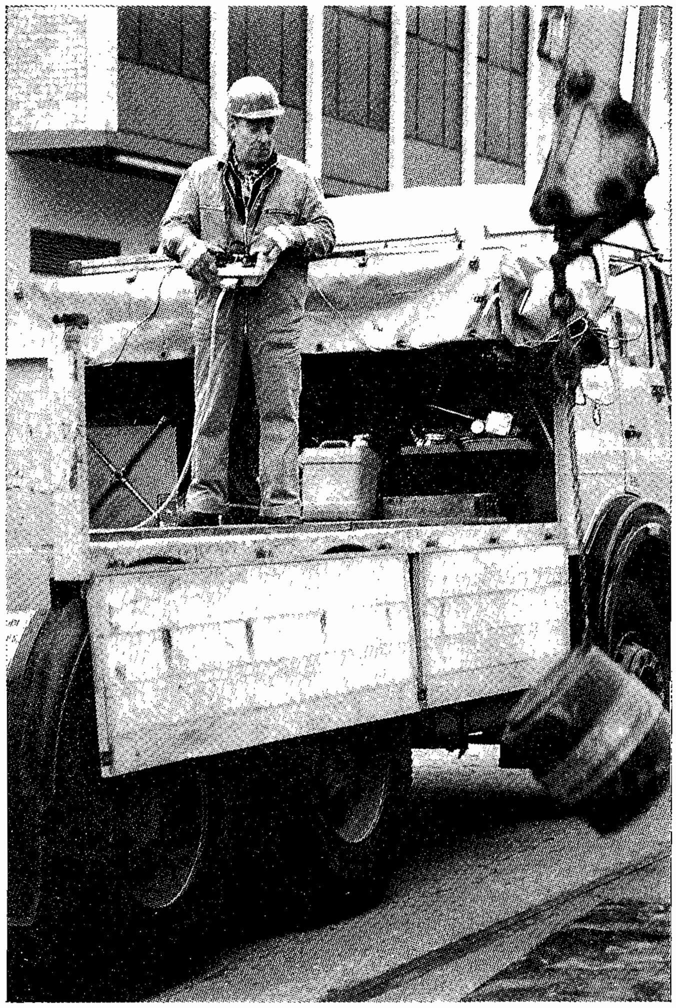

Fig. 3 — Operation of the loading crane by remote control

The trailer

The trailer has 3 axles with an axle base between the first and the third axle of 4 m. Its empty weight is 6.5 t and the additional load of standard weights is 17.5 t. The total weight of the trailer is 24 t (Fig. 4).

If necessary, each half of the roof can be raised separately for loading or unloading the standard weights. This happens very rarely, though, because of the fact that the ratio between empty weight of the tractor and its additional load is 1:1 which allows to carry out all substitution steps with the tractor and its standard load.

Fig. 4 — Top view of the trailer with roof opened

Verification of the standard weights

The 500 kg standard weights, transported on the tractor, are tested and adjusted after a 6 months period of use. The limit of error is 85 g. As a result of using the weights almost everyday, a mass loss is occuring which may come up to 100 g within one half year. Therefore, we adjust the mass to a value of about 30 g above the nominal value.

There is practically no mass loss on the standard weights transported on the trailer, because they have to be unloaded and rolled on the ground only in exceptional cases. They are adjusted to their nominal value of 500 kg and therefore at any time available for weighing machines with more than 5 000 scale intervals which need to be tested and verified by means of standard weights with tighter limits of error than usual.

The working standard weights belonging to the mobile equipment are compared with a 500 kg reference standard, made of stainless steel, by means of a drop-weight balance with a scale division of 1 g and an ascertained standard deviation of about 1 g. The reference standard is calibrated and verified by the Physikalisch-Technische Bundesanstalt in Braunschweig.

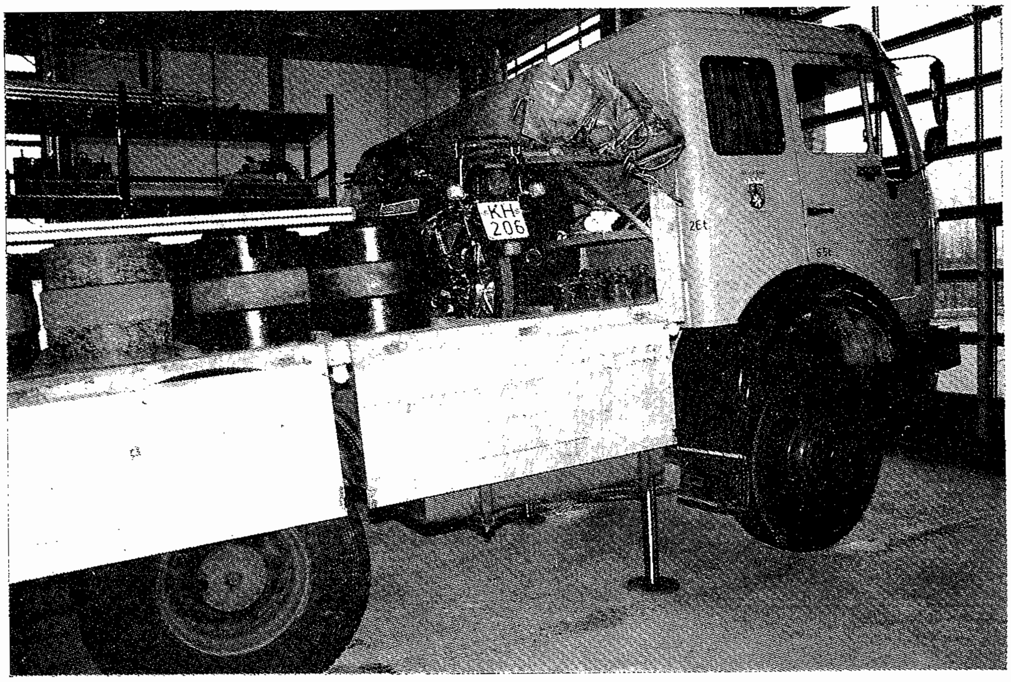

Fig. 5 — Front wheels of the tractor lifted by means of hydraulic jacks

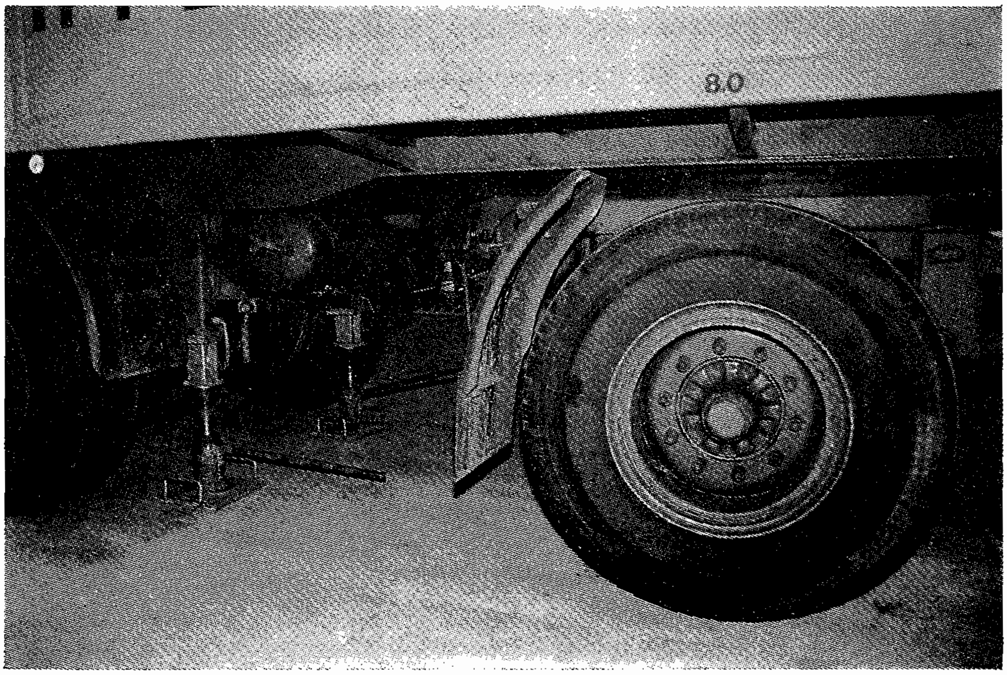

Fig. 6 — Lifted wheels of the trailer

The empty weight of the trailer is also used as a standard-weight and adjusted to a nominal value of 6 500 kg exactly. We produce a verification certificate about that in order to present it to weights and measure officials, if wanted, when the vehicle is hired for use outside of Rheinland-Pfalz. The empty weight of the trailer is calibrated by means of an indoor direct-reading truck scale equipped with a gyroscopic transducer, especially installed for this purpose on the premises of the verification authority at Bad Kreuznach. The maximum capacity is 30 t and one scale interval is 0.1 kg. The manufacturer of our truck scale is Wöhwa-Waagenbau, D-7114 Pfedelbach.

It is obvious, that the mass of the trailer changes due to dirt, wetness etc. Therefore, we examine the total weight as often as possible. We have found, that the total weight of the trailer in some cases has increased up to 12 kg above the full nominal value of 24 000 kg due to dirt and wetness, but it did not deviate more than 2 kg when the trailer was clean and dry.

Truck scales with short bridges

There are scales installed with maximum capacities of 50 t and extremely short bridges of only 10 m or even less. In these cases, special auxiliary equipment in the form of hydraulic jacks placed behind the front wheels of the tractor and almost in the middle of the trailer enables us to lift wheels off the ground to reduce the distance between the points of support. In this way it is possible to place the total weight of 50 t on a bridge of 8.5 m of length (Fig. 5 and 6).

Conclusions

The advantages of our mobile equipment can be summarized as follows :

— All weighbridges up to a maximum capacity of 50 t can be tested with only one additional substitution step,

— the standard weights located on the trailer can also be used for scales with more than 5 000 scale divisions, without adjusting and verifying other standard weights needed for this purpose,

— the cylindrical shape of the standard weights provides for easy and safe handling on the ground,

— the total amount of standard load in form of 500 kg pieces is 30.5 t,

— the total load of 50 t can be put on a bridge of only 8.5 m of length,

— the existence of a motorcycle makes the driver independent of the vehicle.

References

[1] Allgemeine Verwaltungsrichtlinien für die Eichung von nichtselbsttätigen Waagen — Teil I und Teil II, vom 19.06.1980 (Ministerialblatt des Bundesministers der Finanzen und des Bundesministers für Wirtschaft, Seite 386)

Photographs D. Scheidt

FRANCE

SURVEY of METHODS USED in EUROPE for the VERIFICATION of LPG DISPENSERS *

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SUMMARY — This paper reviews the results of an intercomparison of various LPG calibration methods undertaken in 1982 within the framework of the European Community.

LPG dispensers located at four different places in Europe were calibrated with a mobile piston prover and with one of the four following measuring systems: closed volumetric prover (bombola), prover with double water displacement, single water displacement prover and master meter.

RESUME — Cet exposé résume les résultats d'une intercomparaison de différentes méthodes d'étalonnage, entreprise en 1982 dans le cadre de la Communauté Européenne.

*Des distributeurs routiers de GPL installés à quatre endroits différents en Europe ont été étalonnés en même temps par un tube à piston et un des quatre moyens suivants: jauge volumétrique fermée (bombola), jauge à double déplacement d'eau, jauge simple à déplacement d'eau et compteur pilote**.*

1 - Introduction

With the appearance in Europe of an ever increasing population of LPG dispensers most of the metrology services have found themselves confronted with the problem of verifying these instruments and have developed or acquired verification equipment which is suitable but often of very different design.

The very characteristics of LPG and the specificity of the dispensers for this product make that the matter is far from being finalized and that improvements can be envisaged concerning the standards as well as the calibration methods. The great number of presentations on this subject at this seminar is an additional illustration of the interest for such calibration.

It therefore seems appropriate as an introduction to other presentations to make a brief survey of some of the means used in Europe.

The values (numbers) contained in the present paper originate from the intercomparison made in 1982 within the framework of Community Bureau of References (B.C.R.) of the Commission of the European Communities. These results were found using rigorous methods but they are now more than five years old. It is therefore necessary to-day to take into account the technical evolution of the equipment and the appearance of new technologies. This presentation does therefore not pretend to be a full survey but needs to be completed by the other papers presented and the discussions.

(*) Presented at the OIML seminar on Calibration of Liquid Volume Measuring Installations, Arles, France, 11-15 May 1987.

(**) Des copies de la version française de cet exposé peuvent être obtenues du BIML.

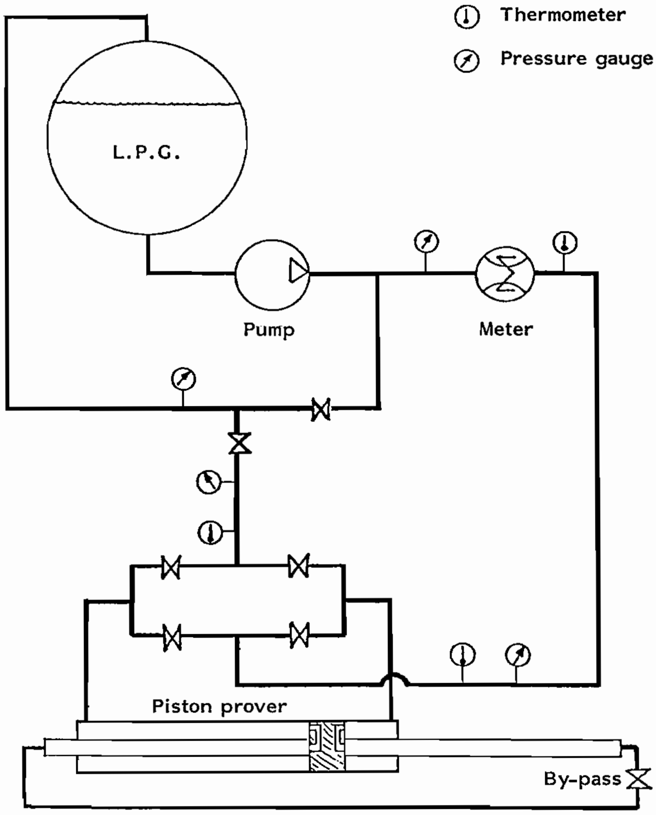

Fig. 1 — Calibration by piston prover

2 - The B.C.R. intercomparison

The BCR intercomparison concerned five different types of equipment :

1) Piston prover
2) Closed prover (bombola)
3) Single water displacement prover
4) Prover with dual displacement of water
5) Master meter

The piston prover was chosen to be compared with the other standards. Calibrations of a dispenser were thus undertaken at four locations using successively the piston prover and the four other measuring systems.

The tests were made on volumetric LPG dispensers measuring systems having the following data :

— cyclic volume : 1 L
— maximum flowrate : 3 m^3/h
— minimum flowrate : 0.3 m^3/h
— maximum operating pressure : 25 bar

These tests were generally made at 5 different flowrates.

Each measuring point was repeated 3 to 5 times and the following parameters were determined :

— mean error : E_m
— maximum deviation between results : E
— confidence interval for 95 % probability : e_R

The collection of all the results are published in the BCR report referenced EUR 8324 EN September 1982.

3 - Piston prover

3.1. **Principle of operation** (see Fig. 1)

The piston prover is a streight tube with a tightly moving piston. The displacement of the piston is detected at two points separated by a fixed distance and thus representing a constant volume.

The system is bi-directional so as to bring back all the moving parts to their original position at each cycle. The reference volume is the sum of the volumes generated by the piston for two consecutive strokes in opposite directions ; i.e. 30 litres in the case of the prover used at the BCR intercomparison.

The piston prover has an outer fixed horizontal cylinder closed at each end by two cylindrical heads. The piston is attached on each of its sides to tubes which pass through these heads. Each of these tubes has openings in their walls close to the piston. Inside the piston tubes another tube connects the boxes closing the ends of the piston tubes so as to create a by-pass circuit.

In one of these boxes a valve actuated from outside can close the internal communication between the tubes. This by-pass valve is opened automatically by the piston at the end of its stroke.

A two-way flow diverting device permits the change of flow direction of the liquid inside the prover without modifying nor interrupting the general direction of flow : storage tank - pump - dispenser under test - piston prover - storage tank.

The flow diverter, the piston and the valve closing the internal tube are fitted with a leakage test facility operating by differential pressure.

The end of one of the piston tubes is fitted with a switch, the lever of which is actuated by two cams fixed on a ruler. The spacing between these cams can be adjusted. The switch controls the start and stop of the counting of impulses emitted by a generator fitted to the partial volume indicating device of the dispenser to be calibrated.

The input and the output of the prover are fitted with thermometer wells and manometers.

The output pipework is fitted with a special valve for fine adjustment of the pressure in the prover.

The global uncertainty of the system when calibrated by weighing is $2 \cdot 10^{-4}$.

3.2. **Influence factors**

3.2.1. Temperature

Measurements are disregarded unless the difference between the temperature of the liquid inside the dispenser and that inside the prover is very small (0.1 °C). This thermal equilibrium is obtained using by-pass operation before the calibration.

The influence of temperature is taken into account for the computation of the internal (calibrated) volume of the prover using the volume expansion coefficient of the prover body. The volume of the prover is in fact determined by the internal section of the prover cylinder and the length of the piston displacement ; it is thus necessary to make corrections for piston diameter and the length represented by the distance separating the two switch cams.

This correction is obtained using the following formula :

$$V = V_o \left[1 + 2\alpha\ (t_j - 20) + \alpha\ (t_r - 20)\right]$$

where :

V_o = volume of the prover at 20 °C

α = expansion coefficient of the prover material (steel)

t_j = temperature of the liquid inside the prover

t_r = temperature of the ruler supporting the switch cams

3.2.2. Pressure

A variation of the pressure of the liquid creates a variation of the internal volume of the prover. This influence can be characterized by the formula :

$$V = V_o \left[1 + \frac{D}{E \cdot e} (P - P_o)\right]$$

where :

V_o = calibrated volume at 20 °C and 1 bar

P = actual pressure inside the prover

P_o = pressure inside the prover at its calibration

E = Young's modulus

D = internal diameter of the prover (in mm)

e = wall thickness of the prover cylinder (in mm)

The influence of the pressure is small ($8 \cdot 10^{-5}$) and may thus be considered as negligible.

According to the test results there was no pressure variation during the tests. In addition the hydraulic circuit allows for adjustment of the flowrate and the pressure during calibration.

3.2.3. Flowrate

No variation of the flowrate was noticed during the calibrations.

3.2.4. Influence of the cyclic distorsion of the metering element

The piston prover had been specially designed for the calibration of LPG dispenser measuring assemblies. However all the meters equipping these assemblies, which are pattern approved in France for use with LPG, are of the volumetric type having a cyclic volume of one litre. In case of wear or drift an adjustment device is used to adjust the cyclic volume to one litre. (This is the case for all the types of meters used at the intercomparison).

In order to make the influence of the cyclic distorsion negligeable the reference volume of the standard prover must be equal to a multiple of the cyclic volume of the meters to be calibrated. The internal volume of the piston prover used (JP 330) is 15 litres.

3.2.5. Viscosity

This type of prover is by its principle not affected by viscosity. However, there must be a total efficiency of the piston rings. In fact, due to the low viscosity of LPG, a small leakage can have important consequences on the calibration results. This is the reason why the piston is equipped with leak detectors which permit to stop the calibration in case of leakage.

There was no evidence of leakage during any of the test sessions.

3.2.6. Sensitivity of the detectors

The useful volume of the piston prover is generated by the displacement of the piston along a distance defined by the spacing of two switch cams.

The triggering sensitivity of the switch detector is 0.07 mm and the spacing between the cams is by design : 1 010.51 mm.

The relative uncertainty of one detection is thus

$$\frac{0.07}{1\,010.51} = 0.7 \cdot 10^{-4}$$

however, as two detections are necessary for defining the piston reference volume, the global detection uncertainty during calibration can thus reach $1.5 \cdot 10^{-4}$.

3.2.7. Drift of standard prover volume

In normal use there should be no drift of the standard volume.

This has been confirmed by the annual recalibrations made since several years.

3.3. **Results obtained at the BCR intercomparison**

The following table indicates, as an example, the results obtained for the calibration of one LPG dispenser by repeating five times the tests for each flowrate :

Q	E_m	E	e_R
2.6 m^3/h	+ 1.5 ‰	0.4 ‰	0.2 ‰
1.9	+ 2.5	0.8	0.4
1.0	+ 3.5	0.8	0.3
0.6	+ 3.7	0.9	0.4
0.3	+ 2.3	1.3	0.6

Note : $1\ ‰ = \frac{1}{1\,000} = 0.1$ per cent

4 - Closed prover ("Bombola")

4.1. **Principle of operation** (Fig. 2)

This means of calibration, equally known under the name of "bombola", is constituted by a pressurized tank designed as a one neck volumetric standard equipped with an external level indicating device. After having verified that there is no liquid inside the tank it is filled with LPG through the meter to be tested up to the required level. Depending on the method used the upper part of the prover is either closed or connected to the gas phase of the storage tank of the installation. In the two cases it is necessary to make important corrections. Thus with a closed prover it is necessary to take into account the partial reliquefication of the gas compressed during the filling. This phenomenon brings about an increase in temperature which is not uniform and changes during the tests. In the case when the upper part of the prover is connected to the storage tank it is necessary to estimate the amount of liquid which is evaporated and returns to the storage tank. In both cases the pressure

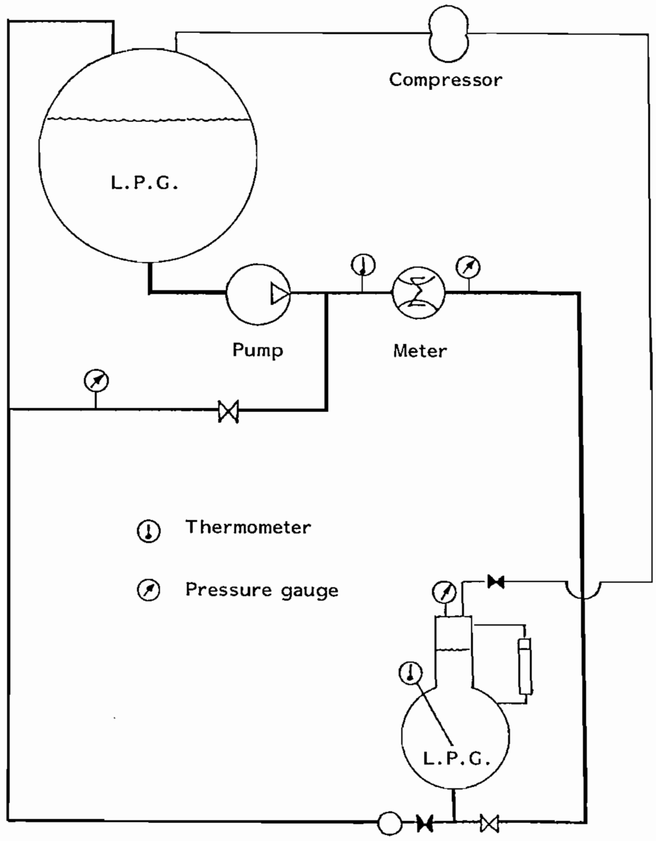

Fig. 2 — Calibration by "Bombola" type of closed prover

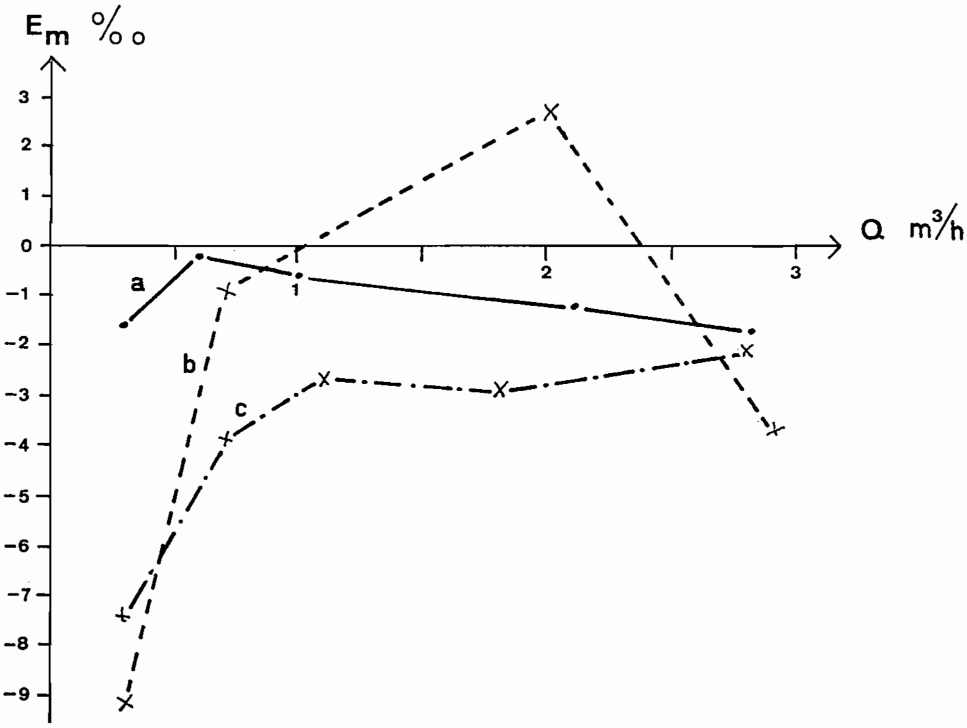

Fig. 3 — Results obtained with "Bombola" prover on measuring assembly No 55 989
a = calibration with piston prover JP 330
b = calibration with the "Bombola" and return to the vapour phase (open gas connection)
c = calibration with the "Bombola" and no return the vapour phase (closed gas connection)

at the end of a test is different from that of the gas phase contained in the prover at the start of the test and appropriate corrections have to be made.

The apparatus has low weight and is thus easy to transport.

4.2. **Influence factors**

4.2.1. Temperature

When the gas phase connection "bombola-storage tank" is open, the temperature difference between the liquid in the prover and that of the storage tank creates an evaporation of LPG from the prover to the storage tank resulting in important temperature variations in the prover. Only one temperature measuring point is provided on the prover.

Because of the important difference in temperature between the liquid in the meter and that contained in the prover it is necessary to make corrections :

$$V_c = V_j \left[1 + 2.5 \cdot 10^{-3} (t_c - t_j) + 3.6 \cdot 10^{-5} (t_j - 15)\right]$$

where

V_c = volume of liquid corrected to 15 °C

V_j = liquid volume inside the prover

t_c = temperature of the liquid in the meter

t_j = temperature of the liquid in the prover.

When there is no connection between the prover and the storage tank, the increase of temperature is due to the increase of pressure during the calibration. It can be corrected for by calculating the development of heat due to condensation of the product during the increase of pressure.

The formula used is :

$$V_1 = 2.9 \cdot 10^{-3} (5\ P_1 - P_2) \text{ litres}$$

where

P_1 = initial pressure in the prover

P_2 = final pressure in the prover.

For the equipment used at the intercomparison it was not foreseen to make corrections for the difference in temperature between the prover and the meter nor for the thermal expansion of the metal of the prover.

4.2.2. Pressure

When the gas phase connection is open, the pressure does not vary during the calibration. No corrections were made during the intercomparison to take into account possible differences in pressure between the meter and the prover or between the effective use of the prover and its calibration.

When the gas phase connection is closed, the increase of pressure creates a condensation of the gas which was originally contained in the prover, it is thus necessary to evaluate the volume of the gas liquefied during the filling procedure and to subtract this volume from the prover indication.

The formula is :

$$V_2 = 15.5 \cdot 10^{-3} (5\ P_1 - P_2) \text{ litres}$$

4.2.3. Flowrate

The variable back-pressure created in the prover when the gas phase connection is closed makes it difficult to maintain a constant flowrate.

4.2.4. Viscosity

As for all the provers the low viscosity of the liquid constitutes a favourable factor. However, a check of the tightness of the valves would be desirable.

4.2.5. Errors of observation

The operator taking the readings of the liquid level of the prover, of the meter at the start and at the end of a test and of the temperatures is likely to make errors of observation which, expressed in relative values of volume, can be estimated to $2.5 \cdot 10^{-4}$, $2.5 \cdot 10^{-4}$ and $0.75 \cdot 10^{-5}$ respectively.

4.2.6. Drift of prover volume

Under normal conditions of use it is expected that there is no drift of the standard volume of the prover.

4.2.7. Climatic conditions

If there is no flow of the liquid between two tests it may be expected that direct sunshine on the equipment creates important heating of the liquid contained in the pipework.

Furthermore, when this liquid is arriving at higher temperature in the prover there will be a corresponding evaporation through the gas phase connection if open. At low flowrates (test time 3 minutes) this effect can attain 10^{-3} in relative volume.

4.3. **Results**

The tables below show the results obtained at the BCR intercomparison.

Figure 3 shows the calibration curves obtained with the "bombola" prover for one of the meters tested.

In conclusion, different problems appeared during the calibrations with the two types of "bombola" in particular as concerns the repeatability. The results obtained with the constant pressure bombola (open gas connection) are deceiving and show that it is practically impossible to master the whole of the parameters. The results obtained with the closed gas connection are better but improvements are desirable in particular as regards the corrections to make during the tests.

	Q	E_m	E	e_R
Open gas connection (mean values of 5 measurements at each flowrate)	2.9 m³/h	— 3.7 ‰	3.2 ‰	2.3 ‰
	2.0	+ 2.7	1.7	15.0
	0.7	— 0.8	0.8	7.1
	0.3	— 9.1	0.5	4.5
Closed gas connection (mean values of 5 measurements at each flowrate)	2.8	— 2.1	2.8	1.9
	1.8	— 2.9	0.6	3.8
	1.1	— 2.7	1.0	6.3
	0.7	— 3.9	0.5	0.7
	0.3	— 7.5	2.1	2.9

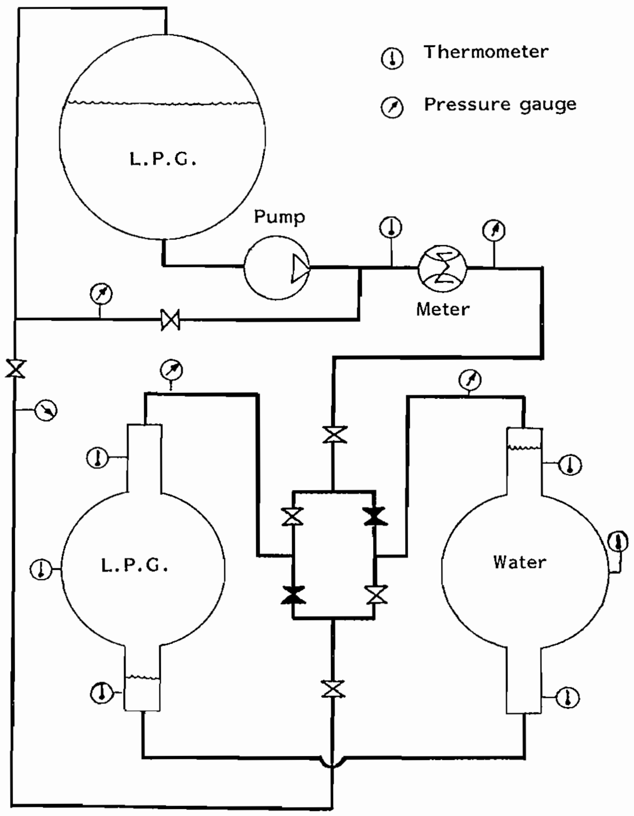

Fig. 4 — Calibration by double prover with water displacement

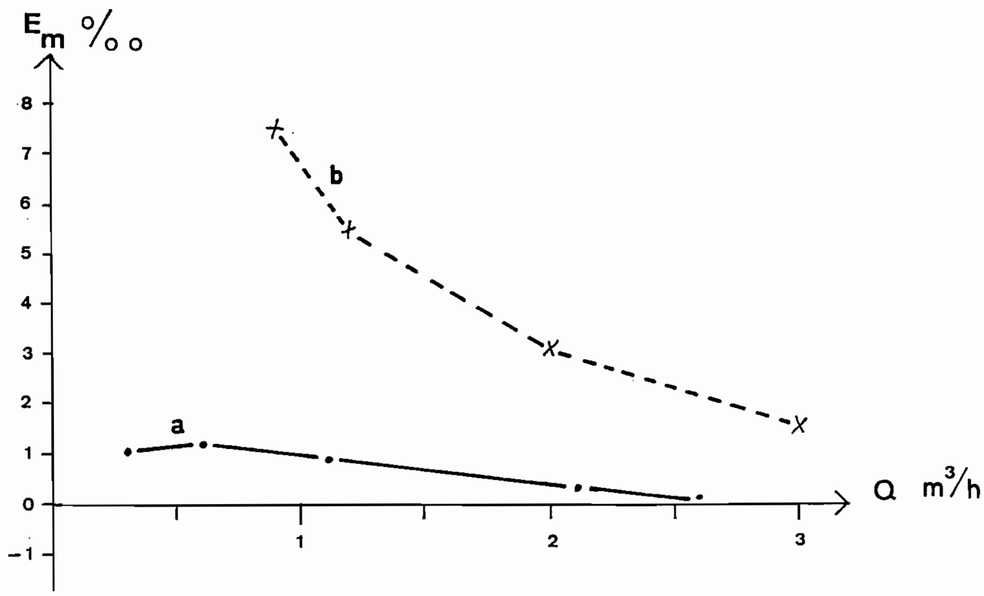

Fig. 5 — Results obtained with water displacement double prover on measuring assembly No 45 533
a = calibration with piston prover JP 330
b = calibration with the water displacement closed tank double prover

5 - Double prover with water displacement

5.1. **Principle of operation** (see Fig. 4)

This system was specially designed for high flowrates (20 to 50 m^3/h). It has the form of two double-necked and pressure-resistant prover tanks which are interconnected at their bottom parts. They contain an amount of water which is equivalent to the nominal volume of one of the prover tanks. The whole operates by transfer of water from one tank to the other when pushed by the LPG flowing through the meter under test.

A reversal system makes it possible to alternate the arrival of LPG on the tank which contains the water while the other prover tank evacuates its content to the storage reservoir. It is necessary to operate with a great reference volume (in this case 500 litres) so as to neutralize the effects of cyclic distorsion and observation errors of the meter under test as well as of the important variations in flowrate at the start and by the end of a test. The duration of the measurements at small flowrates is long and makes it hard to control the test conditions (in particular as regards temperature). The corrections are difficult because when a difference in temperature is noticed between the water and the LPG, or at different levels of the LPG, one does never know which partial volume of the liquid is really affected by the thermal expansion.

5.2. **Results**

Without studying in detail the effect of each influence factor it rapidly appears that this means of calibration is unsuitable for the verification of LPG retail dispensers in particular at low flowrates. The influence of temperature and the duration of the tests are such that usual climatic variations create important errors.

Though the uncertainty of the measurements is too important for significant results, figure 5 shows a calibration curve obtained with this method compared to that of the piston prover.

6 - Water displacement prover

6.1. **Principle of operation** (see Fig. 6)

This system is also called "water transfer tank at atmospheric pressure". It is composed of a cylindrical vertical tank containing water. The LPG flowing through the meter under test is entering the tank at its top. The water contained in the tank is pushed through the bottom part of the tank and collected in classical neck-type volumetric standards. The volume of LPG introduced in the tank therefore corresponds to the same volume of water leaving the tank.

Thermometers and manometers are installed at the meter under test and on the transfer tank so as to enable corrections for temperature and pressure differences between the LPG contained in the meter and in the tank as well as between the water contained in the tank and in the volumetric standard.

Contrary to the preceding system the capacity of this type of prover can be chosen according to the needs as regards flowrate and cyclic volume of the meter. The volume of a test must however, once more, be sufficiently great so as to neutralize the effects of flowrate variations in the beginning and by the end of a test as well as the reading error of the meter.

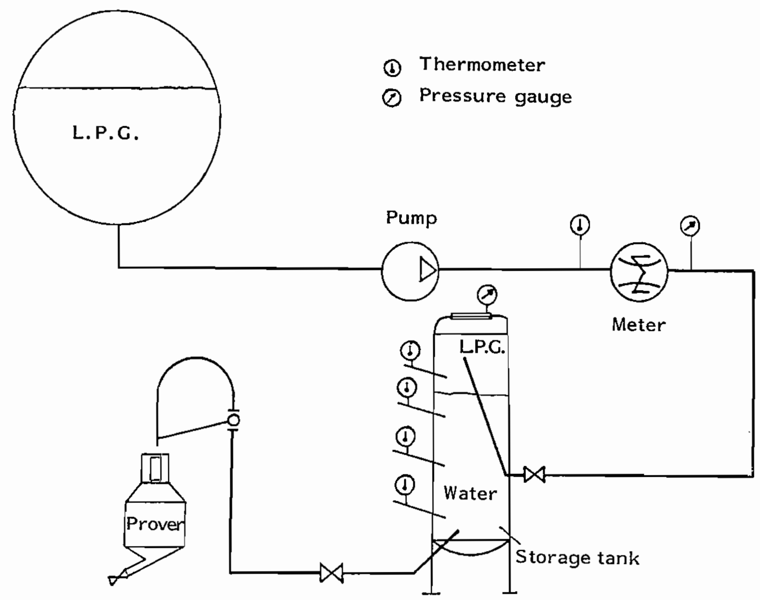

Fig. 6 — Calibration by open tank water displacement prover (water transfer tank at atmospheric pressure)

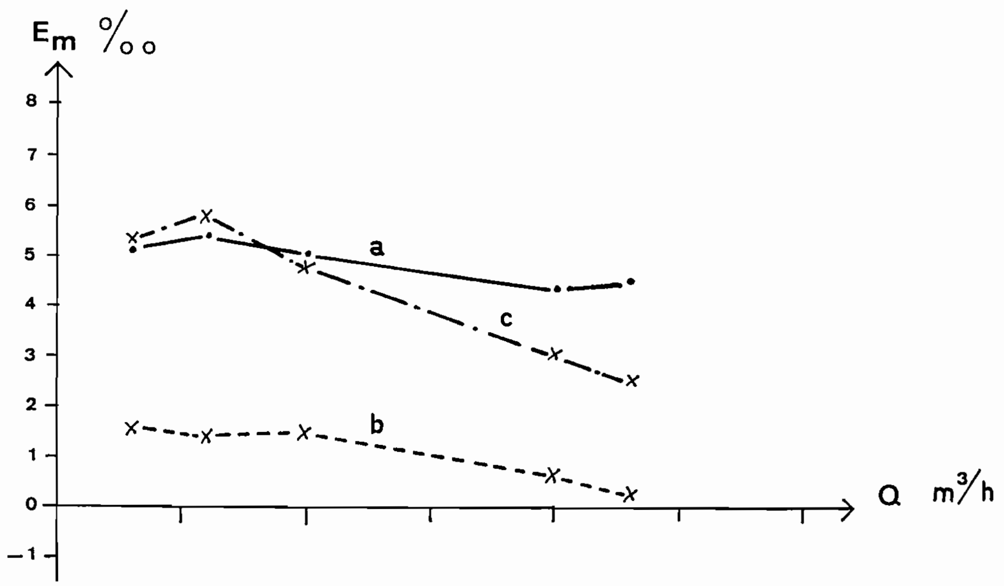

Fig. 7 — Results obtained with water displacement open tank prover on measuring assembly No 46 321

a = calibration with piston prover JP 330

b = calibration with the water displacement open tank prover

c = calibration with the water displacement open tank prover using modified formula for the temperature corrections.

6.2. **Influence factors**

6.2.1. Temperature

As it has been said previously it is necessary to make corrections so as to take into account :

— the difference in temperature between the LPG flowing through meter and that contained in the transfer tank,

— the difference in temperature between the water in the transfer tank and that contained in the volumetric standard,

— the difference in the actual temperature of the water contained in the volumetric standard and the reference temperature for which the volumetric standard has been calibrated

$$\frac{\Delta V}{V} = 3\alpha\ (t_w - t_o) + \gamma_F\ (t_o - t_F) + \gamma_w\ (t_w - t^N)$$

where

α = expansion coefficient of the metal of the volumetric standard

γ_F = thermal expansion coefficient of LPG

γ_w = thermal expansion coefficient of water

t_N = temperature of the volumetric standard

t_o = 20 °C

t_p = temperature of LPG in the meter

t_F = temperature of LPG in the transfer tank

t_w = temperature of water in the transfer tank

The second term in this formula is the most important. The difficulty of the method is the correct measurement of the temperature t_F knowing that the mixing of the LPG flowing from the meters and that already contained in the tank is very imperfect.

6.2.2. Pressure

It is also necessary to take into account the difference in pressure between the LPG in the meter and that contained in the transfer tank as well as the pressure of the water contained in the transfer tank and that contained in the volumetric standard.

$$\frac{\Delta V}{V} = \varkappa_F\ (P_2 - P) + \varkappa_w\ (P_N - P_2)$$

where

$\varkappa_F$ = compressibility coefficient of LPG

$\varkappa_w$ = compressibility coefficient of water

P = pressure in the meter

P_2 = pressure in the transfer tank

P_N = pressure in the volumetric standard

6.2.3. Cyclic distorsion

In order to make this influence negligible the volumetric standards are chosen so as to have a volume equal to a multiple of the cyclic volume of the meters.

6.2.4. Errors of observation

The errors of observation of the level on the volumetric standard, on the meter and of the temperatures lead to an uncertainty in relative volume of the order of 10^{-4} when using high quality volumetric standards with a capacity of 50 litres.

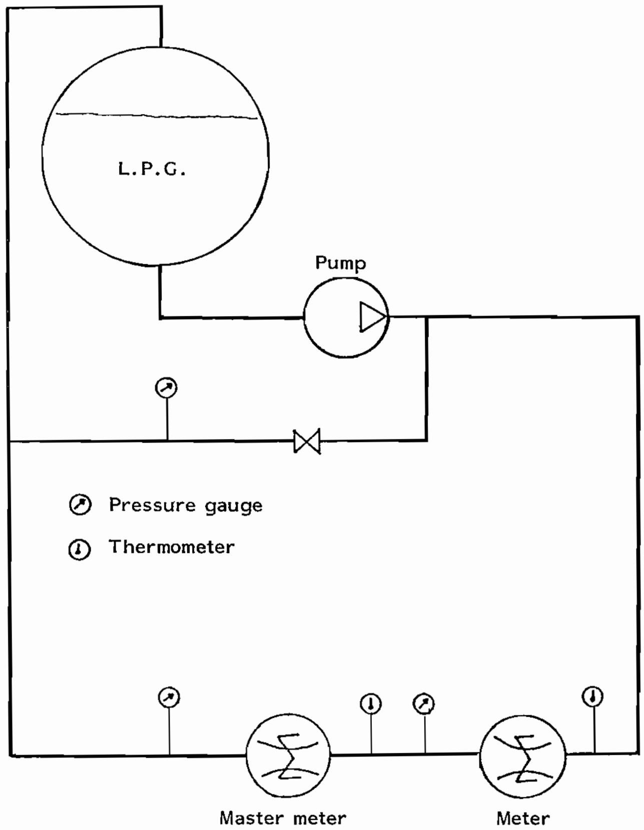

Fig. 8 — Calibration by master meter

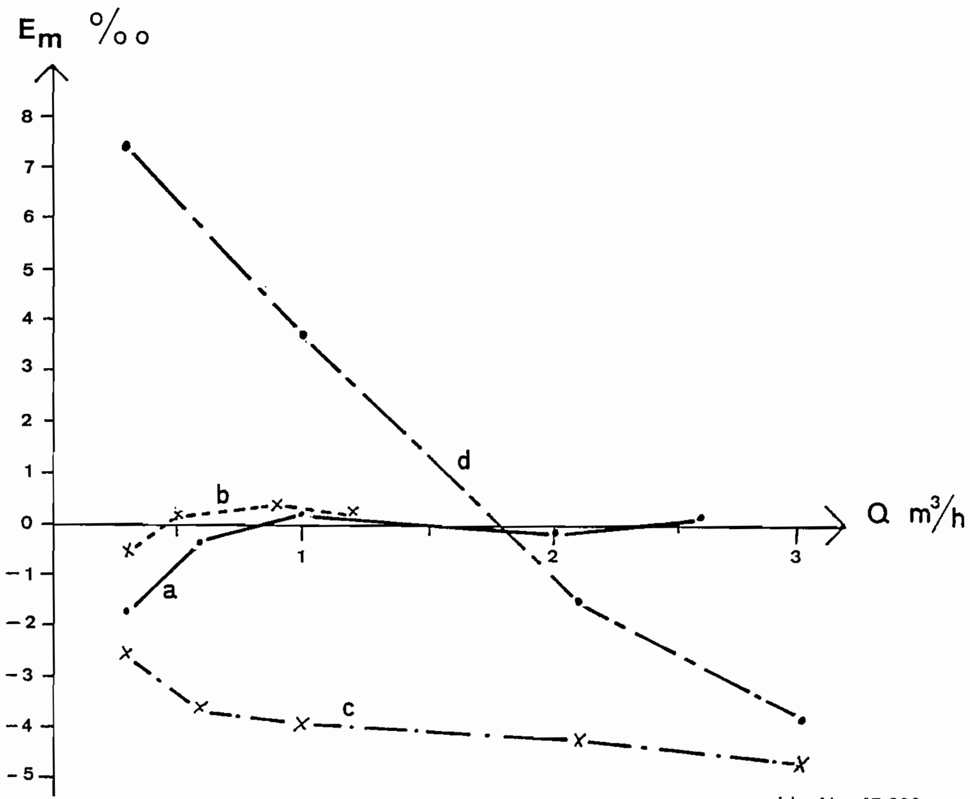

Fig. 9 — Results obtained with master meter on measuring assembly No 45 632
a, b = calibrations with piston prover JP 330
c = uncorrected result of the calibration with the master meter
d = calibration result with the master meter

6.2.5. Drift of the prover

In normal use there is no drift of this type of prover.

6.2.6. Climatic conditions

The influence of the climatic conditions are minimized through the corrections made. However, direct sunshine on the equipment can create non-uniformity of the temperatures in the tank.

6.3. **Results**

The table below gives the results obtained at the BCR comparison. The mean dispersion of the results is 2 ‰ (0.2 percent).

Q	E_m	E	e_R
2.3 m^3/h	+ 0.4 ‰	2.3 ‰	2.9 ‰
2.0	+ 0.7	1.0	1.4
1.0	+ 1.5	1.8	2.3
0.6	+ 1.4	1.6	2.0
0.3	+ 1.6	1.1	1.5

A second computation of the results was made after modification of the formula used to determine the mean LPG temperature in the tank (t_{F2}) from the various temperature measurements. The calibration curves are shown in Fig. 7.

7 - Master meter

7.1. **Principle of operation** (see Fig. 8)

This is the most simple and the most convenient means to apply. The standard is constituted by a meter of classical construction which has recently been calibrated. It is mounted at the output of the dispenser measuring assembly.

It is only necessary to compare the results of the two meters and possibly make corrections for temperature and pressure, and of course, also apply corrections for the errors of the master meter.

7.2. **Influence factors**

7.2.1. Temperature and pressure

In this system of calibration the liquid which passes through the master meter and through the meter under test has the same termodynamic state. It is therefore generally not necessary to apply corrections and a check of the physical characteristics of the product is sufficient.

7.2.2. Cyclic distorsion

In order to render this effect negligible it is sufficient to use a test volume equal to a multiple of the cyclic volume.

7.2.3. Errors of observation

The errors of observation of the indications of the two meters may introduce a maximum global error of $5 \cdot 10^{-4}$ for a test volume of 20 litres.

7.2.4. Drift of the standard

The master meter is subject to drift, the magnitude of which depends on many factors.

In any case this drift must be carefully determined. The frequency of recalibration depends on the planned use of the master meter and must of course be conformed to. In addition it is necessary to pay careful attention in the use and maintenance of this instrument.

7.3. **Results**

The results obtained at the BCR comparison are indicated in the following table and in Fig. 9.

Q	E_m	E	e_R
3.4 m^3/h	— 4.8 ‰	0.4 ‰	0.5 ‰
2.1	— 1.5	0.8	1.1
1.0	+ 3.8	0.7	0.9
0.6	+ 6.0	3.2	4.2
0.3	+ 7.4	1.4	1.8

The mean dispersion is 1.7 ‰ (0.17 percent).

These tests show the ease of use and the good performance of the master meter. They also show that for correct use of the method it is necessary not only to have a high quality meter which can be recalibrated at appropriate intervals, but also that the standard used for its calibration must be very accurate.

8 - Conclusion

This survey shows the difficulties encountered in selecting or developing suitable calibration means having the desired metrological characteristics. Luckily, it also shows that these difficulties can be overcome and there exist to-day several systems which permit to make verifications with an uncertainty which is compatible with the maximum permissible errors to be established for LPG dispensers (0.5 %). The other presentations at this seminar will probably lead to the same conclusions.

Finally this survey as well as the experience we have in France concerning LPG dispensers leads to think that the quality of these instruments is such that they can all be maintained within the maximum permissible errors of 0.5 % over a flow-rate ratio of 10.

HOW DEVELOPING COUNTRIES CAN BENEFIT from OIML ACTIVITIES and IMPLEMENT INTERNATIONAL RECOMMENDATIONS *

by **S.A. THULIN**
Assistant Director, BIML

SUMMARY — Metrology staff in developing countries which take up their duties may, even when they have adequate scientific education, sometimes find it difficult to apply some of the OIML Recommendations in their country taking into account local conditions.

This paper reviews some of these problems related to the field of classical weights and measures activities for which the BIML has made special efforts by issuing brochures for developing countries to facilitate the practical interpretation and application of the International Recommendations.

Introduction

There is no clear definition of what is a developing country, all countries are in fact more or less developing. Some developing countries are very large, have a great population and generally some industrial manufacturing of measuring instruments. What will be considered in this presentation concerns mainly smaller developing countries which have practically no own instrument industry except possibly workshops making simple balances, weights or measures for liquids.

The legal metrology authority in such a country is faced with the problems of technically fulfilling the duties laid down by laws and regulations which, classically, are intended to protect the consumer from the economic and safety point of view. However, more and more, developing countries are also faced with problems of industrial nature related to quality control of imported and exported goods or of products locally produced for local consumption. Such control may also form part of legal acts involving compulsory quality standards or product certification schemes which have metrology and testing aspects.

Classical weights and measures or integrated metrology schemes

For historical or technical reasons the metrology for consumers protection and that for product control are administratively separated in many countries. However, a number of countries have adopted the so-called " integrated " approach whereby the metrology and main product testing activities are carried out by the same organisation. There is no doubt that the metrology required for industrial production is at least as important in a developing country as that pertaining to the classical weights and measures scheme. This makes frequently the duties of the official metrology service in a developing country still more difficult than those in developed countries, where the metrology for product quality control is handled by the producing industries and quality assured by market competition.

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* Paper presented at the OIML international seminar on legal metrology, Havana, April 11-12, 1988.

Heavy metrology

A particular problem is heavy industrial equipment such as high-capacity weighing machines and bulk flow meters used for import or export purposes and currently involving great economic loss if the acceptable limits of error are exceeded. Means and staff for verification of such equipment must be present. This is however frequently not the case and legal metrology services then concentrate their work to instruments and measures used in retail trade to individual consumers. However, these consumers will sooner or later have to pay for the errors committed in the bulk trade ! The lack of adequate bulk verification facilities and trained staff for such verification is very common in developing countries and even in some developed countries.

This is the reason why such problems were chosen as topics for two OIML seminars :

— The verification of bulk weighing installations,
Paris, 22-25 April 1985

and

— Calibration of liquid volume measuring installations,
Arles, 11-15 May 1987.

The lectures presented at these seminars have been published in the OIML Bulletin.

Guidance about the special equipment and procedures for verification of heavy weighbridges is given in the brochure :

— Mobile equipment for the verification of road weighbridges,
French-English edition, BIML, 1982.

Admission into the country

The legal metrology service may have to verify a very great variety of makes and models of individual instruments of different origin while having very little technical information about their design and their nominal performance.

In most OIML Member States, instruments which are subject to regulations have to be pattern approved. Such a procedure can be very difficult to apply in a developing country on one hand because the amount of instruments imported of a same pattern may be very small and expenditures for approval testing prohibitive or the metrology service may not have the necessary means, staff or simply sufficient time for such testing.

On the other hand, the laws or the regulations usually stipulate that no other than " approved " and verified instruments shall be used in trade (and for public health purposes).

Such approval is usually granted by the national metrology service. Though the national law may not directly accept foreign pattern approval, the metrology service may take an approval decision after having received confirmation from another national metrology service that the instrument conforms to the relevant OIML Recommendations. In this case local approval will usually require an inspection of the instruments but mainly for identification purposes. Furthermore the nature of many instruments is such that a reverification of the performance may be required at its site of use or installation even when it has been initially verified at the manufacturing site. Transport in fact frequently causes shifts of the instrument's adjustment.

The OIML has for several years worked on a scheme tending to create a kind of international pattern approval system. This work is generally labelled " certification ".

A certificate system recognized by all Member States will probably still take some time to be fully operative though harmonized and detailed test procedures are now being worked out for several instruments such as weighing machines and dispensers of liquids.

It is however already possible for developing countries to request that imported instruments should be supplied with statements that they conform to OIML Recommendations. Such declarations may typically be issued by verification authorities in the country of manufacture and must include reference to identification evidence such as instrument serial numbers, initial verification stamps and seals, etc.

A model for such declarations of conformity (formerly called export certificates) was adopted by the 21st meeting of CIML in 1986.

Simplified verification procedures

By its principle verification comprises mainly two steps :

1. A check that the instrument conforms to an approved pattern and has not been subject to modifications.
2. A verification of its limits of error (by comparison to working standards).

For imported instruments of advanced design comprising for instance electronic devices the first step can usually be accomplished by visual inspection of the seals. If the seals have been broken for reasons of repair or other adjustment it may be necessary to obtain a certified statement by the repair service (or the user) as to which parts have been adjusted or replaced. In addition step 2 may in this case have to be enlarged to comprise a complete calibration, if necessary by varying operating conditions such as increased temperature and lowered mains supply voltage.

The step 2 usually for an electronic instrument comprises tests for each range at least at low, medium and maximum input. The initial verification of each instrument should generally be done at the place of use but exceptions are made for weights and portable instruments.

Metrology services in developing countries may find some of the OIML Recommendations difficult to apply in particular as regards modern electronic instrumentation.

It is in fact common in a developing country that the most recent electronic instrument designs are used at the same time as traditional mechanical instruments. For reasons of equity a legal metrology service must apply identical or at least approaching, limits of error to these instruments regardless of their design.

With a view of assisting these countries BIML edited in 1985 a brochure called " Guidelines for the establishment of simplified metrology regulations ".

Mass measurements

In this brochure a scheme for mass verification is presented which divides commercial transactions into two categories :

— General trade

and

— Trade in valuable goods (precious metals, jewellery and pharmaceutical products).

The brochure suggests as a simplification two series of limits of error for weights corresponding to each of these two types of trade, see Table 1. The series for general trade corresponds as regards tolerances to OIML class 0 weights subject to the International Recommendation No. 52. However it has been found necessary to extend the range downwards to comprise also weights of 50 g down to 1 g (usually brass weights). The weights for trade with valuable goods may correspond to OIML class M_1 described in the International Recommendation No. 20, however the limits of error from 100 g and downwards can be slightly increased so as not to be lower than 1 mg, for in-service controls.

The verification of weighing machines requires the establishment of some simplified rules applying to both purely mechanical and electronic designs. In the guideline brochure we have suggested the use of limits of error for non self-indicating machines according to their capacity which is usually stated on the beam or elsewhere, see Tables 2 and 3.

For self-indicating machines (mechanical or electronic) the scale interval (d) marked on the instrument is usually the same as the verification interval (e) and as a simplification it is suggested to apply at initial verification error limits equal to e (or d) up to 2 000 scale divisions for general trade and up to 20 000 scale divisions for instruments used for trade with valuable goods. These error limits are increased to 2 e above these indications (Fig. 1).

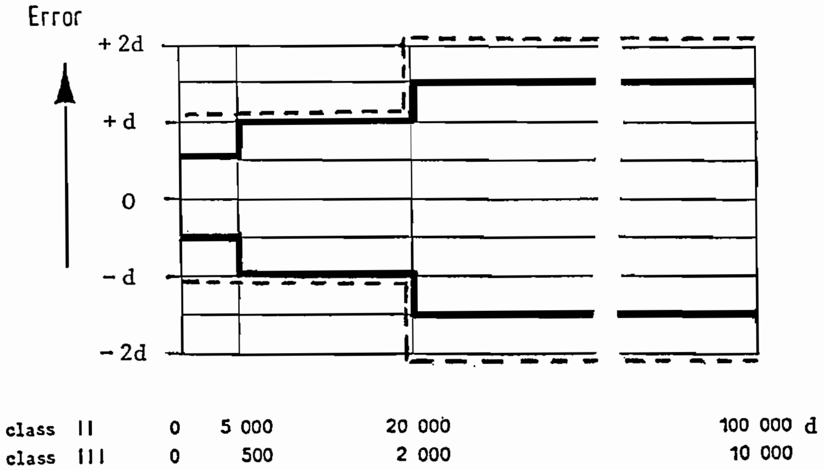

Fig. 1 — Maximum permissible errors for the verification of self-indicating weighing instruments with non automatic loading as a fonction of the load expressed in scale intervals d.

Class II = trade with valuable goods

Class III = general trade

Thick lines according to RI 3

Dotted lines according to BIML brochure " Guidelines for the establishment of simplified metrology regulations ".

The relevant OIML Recommendation specifies three zones of error limits corresponding to 0.5 e, 1 e and 1.5 e. The testing of half scale intervals on digital machines is in fact possible but the procedure is more complicated, hence the simplifications suggested in the brochure.

A detailed study of Tables 2 and 3 will show that the requirements for mechanical non-self indicating machines correspond in this way quite closely to the requirements expressed in scale intervals for digital electronic machines.

The working standards to be used by the inspectors shall at all times conform as regards their limits of error to OIML class F_2 described in the International Recommendation No. 20.

Meters for liquids

The verification procedure for liquid dispensers, many times simply called petrol pumps, can follow quite closely the relevant OIML Recommendations.

The " Guidelines " indicate with a rather brief wording the steps for the inspection of such a dispenser.

The verification usually comprises a test at low flow rate (below 10 litres per minute) using a 5 L standard measure and a test at normal or maximum flow rate, generally by using 20 L measures.

The limits of error to apply for the verification may require some explanations.

The maximum permissible errors for a complete volumetric metering assembly are given in OIML RI 57 (and in RI 5). When expressed in millilitres they increase with the delivered volume by steps and with slopes in between the steps up to a volume of 2 L. For a delivered volume of 2 L and more, the maximum permissible error is basically 0.5 % of the delivered volume. There is however another condition : the actual limit of error shall not be lower than the double of the error for the volume designated as " minimum delivery ".

The " minimum delivery " is a value fixed by the manufacturer of the whole assembly in liaison with the pattern approving authority in the country of manufacture and depends on the construction of the meter itself together with its measuring chamber and indicating devices, on the pump, the pipework and finally also on hose dilation.

Usually complete petrol dispensers indicating by 0.01 L scale intervals have minimum deliveries of 2 L or 5 L depending on the length and type of delivery hose. The corresponding minimum error limit would in this case be 2 × 0.5 % of 2 L or 5 L i.e. 20 or 50 mL respectively. In order to simplify the regulations in a developing country and make them independent of individual constructions or installations it is proposed in the Guidelines to take 50 mL as the lowest error limit. In practice, this means that the maximum permissible error should be ± 50 mL and constant from a volume corresponding to minimum delivery up to a delivered volume of 10 L and thereafter proportional and equal to 0.5 % of the delivered volume, see Fig. 2.

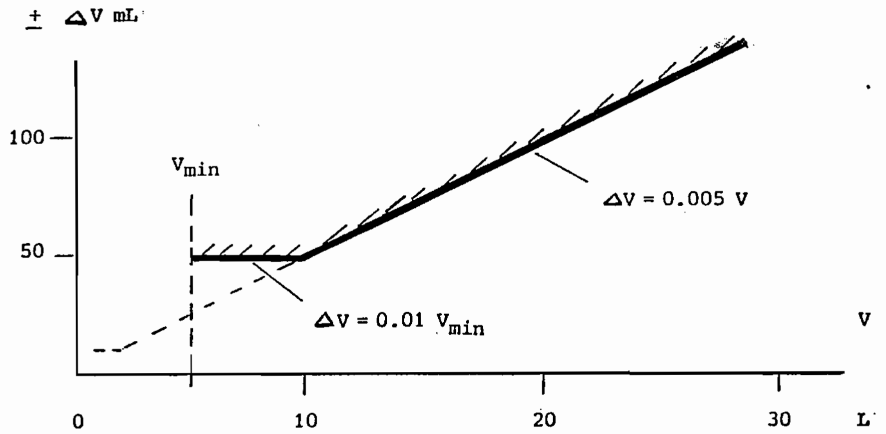

Fig. 2 — Limits of error for a petrol pump installation with a minimum delivery of 5 L

For bulk meters which are used with vehicle tanks, the " minimum delivery " is frequently 100 or 200 L. It may here be appropriate to fix the minimum error limit to for instance ± 2 L which means that this error will apply from minimum delivery up to 400 L and thereafter the limit of error is 0.5 % of the delivered volume.

The limits of error we have discussed for petrol pumps and bulk meters apply on initial verification and for the full working range of flow rates. Some countries do allow higher limits of error when the instruments are in actual service (in between repairs or periodic verifications). In view of the actual cost of hydrocarbon products and the high minimum limits of error suggested (± 50 ml and ± 2 L respectively) we think that it is feasable to maintain the in-service limits of error at the same level as those for initial verification. This, however, requires that installation and repair services for such equipment have to adjust the meters to errors much smaller than the permissible limits. Liquid dispensers and bulk meters are subject to wear and may need frequent verification and if necessary adjustment (at least yearly for petrol pumps and every 6 month for bulk meters).

Volume measures

Small volume measures for retail sale of liquids have practically disappeared in developed countries where liquids are usually sold as prepackages.

They are however still frequently used in developing countries and the local authorities may have to control the design and use of such measures with respect to fraud and health regulations.

There is no particular OIML Recommendation which applies to those measures except RI 29 which applies only to serving measures for drinks sold in restaurants etc.

Some national regulations state surprisingly small limits of error for retail sale measures. In practice one has, however, to take into account the problems of verification with respect to the liquids for which they are normally used as well as the equity from the legal point of view, when compared to the sale of the same liquids as prepackages or by use of dispensers (petrol pumps).

The limits of error to be set for such measures must thus be a compromise and it is useful to make a comparison as shown in Table 4.

It will be seen that the limits of error for serving measures (3 % of the capacity) are too high to be used for sale of large quantities. The "Guidelines" in the 1985 version therefore suggested more or less progressive tolerances.

A slight modification of some of these values (indicated between brackets) may however be preferred as it will bring the limits of error identical to those of the OIML draft for measuring container bottles.

The limits of error are then from 2 L and upwards also identical to those which are generally applied for petrol pumps.

These limits of error do not apply to laboratory glassware used for instance for pharmaceutical dispensing which should generally be conform to ISO standards. The tolerances for graduated measuring cylinders made of glass (ISO 4788) or plastic (ISO 6706) are reproduced for comparison in Annex 5.

Glass measures which can be used by the inspectors as working standards for verification are subject to OIML Recommendations and can usually be obtained from laboratory suppliers by referring to the equivalent ISO standards, as follows

OIML RI 4	One-mark volumetric flasks	ISO 1042 (class A)
OIML RI 40	Graduated pipettes	ISO 835 (class A)
OIML RI 41	Burettes	ISO 385 (class A)

The special graduated flasks for verification agents described in RI 43 are generally not series-manufactured and must if required be specially ordered. It seems however, in this case more appropriate, and cheaper, to purchase one-mark flasks corresponding for instance to ISO 1042 class B on which additional lines are to be engraved corresponding to the tolerance limits for the measures to be verified.

Working standard measures with capacities above 2 L are usually made from stainless steel or other corrosion protected metal. There is so far no OIML Recommendation about such measures, there is however no difficulty in setting their limits of adjustment to ± 0.1 %.

Volume standards can be calibrated by the national laboratory by weighing distilled water. Routine calibration can be made using fixed volume over-flow standards. A Recommendation on such standards sometimes called "automatic pipettes" is being elaborated by the OIML reporting secretariat SP 5S-Sr 3.

Length measures

Length measures for use in trade do generally not change their calibration with time if we except end measures which are subject to wear and long tapes which occasionally can change due to bad handling.

The metrological requirements for such measures are laid down in detail in the OIML Recommendation No. 35 where the accuracy class II in most cases corresponds to the requirements for use in trade.

New length measures are usually controlled by legal metrology authorities using a sampling technique. There exists a scheme for such sampling within the European Community (Council Directive 85/146/CEE). It is also expected that OIML will elaborate an International Document on such sampling techniques within SP 2-Sr 5.

The " Guidelines " we have referred to simply give some hints as regards the limits of error which may apply to in-situ inspection, taking into account temperature variations.

Prepacked products

The control of prepacked products for consumers protection in developing countries probably is, or is becoming, even more important than the control of individual instruments in market places. Reasons for this are numerous : the packers may have only a relatively small production and may not have suitable control of the filling. The latter can also be the case for large scale production when using modern filling equipment run by technicians with inadequate means or training in metrology and statistics.

Another problem is caused by the climatic conditions which affect the packed product and finally there are probably cases of deliberate fraud.

The control of prepacked products has been subject to work within OIML for many years and has now resulted in two International Recommendations : " Information on package labels " and " Net content in packages ".

There has so far not been any special guidelines elaborated for such testing, but a bibliography was issued by BIML in 1983 and the various problems were also treated at a seminar on prepacked products in Berne, Switzerland the same year. Most of the papers of this seminar were subsequently published in the OIML Bulletin.

More details are given in a summary of the OIML activities in the field of prepacked products published in OIML Bulletin No. 108, September 1987. This paper also includes references to more recent publications which may be helpful in applying sampling techniques.

TABLE 1 — PROPOSED LIMITS OF ERROR FOR WEIGHTS USED FOR TRADE

Denomination (as marked)	Limit of error (at stamping)	
	Weights for general trade	Weights for trade with valuable goods
10 mg	—	± 0.5 mg
20	—	0.5
50	—	0.5
100	—	1
200	—	1
500	—	1
1 g	± 20 mg	2
2	20	2
5	50	5
10	50	5
20	50	5
50	100	10
100	100	10
200	100	10
500	250	25
1 kg	500	50
2	1 000	100
5	2 500	250
10	5 000	500
20	10 000	1 000

IN-SERVICE CONTROLS

It is suggested to permit the use of weights for trade, which have been duly stamped at initial verification, as long as the errors during subsequent controls do not exceed the double of the limits of error indicated in the table above.

In case of periodic subsequent verification it is not advised to prescribe renewal of the stamping of a weight unless the in-service errors are exceeded and the weight requires readjustment. The limits of error after such readjustment are identical to those for new weights.

Note : Precision weights used for trade with valuable goods and which have a denomination of 100 g or less shall preferably not be stamped by the national legal metrology service otherwise than on a compulsory identification plate on top of the storage box.

TABLE 2 — PROPOSED LIMITS OF ERROR FOR ON-SITE VERIFICATION OF WEIGHING MACHINES USED FOR GENERAL TRADE

NON-SELF-INDICATING WEIGHING MACHINES

Maximum capacity equal to or greater than	and lower than	Limit of error
100 g	500 g	± 0.5 g
500	1 kg	1
1 kg	2.5	2
2.5	10	5
10	20	10
20	50	20
50	100	50
100	200	100
200	500	200
500	1 000	500
1 000	2 000	1 kg
2 000	5 000	2
5 000	10 000	5
10 000	20 000	10
20 000	50 000	20
50 000	100 000	50

SELF-INDICATING WEIGHING MACHINES

The scale interval d shall generally not be greater than the limits of error indicated in the table above with a view of ensuring sufficient accuracy at low loads (low Min-value). The minimum number of scale intervals for capacities of 5 kg and more shall thus be at least 1 000. For some applications such as use in slaughter-houses and weighing of bulk agricultural products machines with only 500 scale intervals shall however be permitted.

For reasons of simplification it is proposed to accept for on-site verification a limit of error of 1 scale interval except for loads exceeding 2 000 scale intervals where the limit of error at verification is increased to 2 scale intervals.

IN-SERVICE CONTROLS

During controls of machines in service when seals have not been broken the errors shall not exceed the double of the limits of error, however not be more than 3 scale intervals for self-indicating machines at loads exceeding 2 000 scale intervals.

TABLE 3 — PROPOSED LIMITS OF ERROR FOR ON-SITE VERIFICATION OF WEIGHING INSTRUMENTS FOR VALUABLE GOODS

(precious metals, pharmaceutical products etc.)

NON-SELF-INDICATING INSTRUMENTS

Maximum capacity equal to or greater than	and	lower than	Limit of error
2 g		50 g	± 2 mg
50		100	5
100		200	10
200		500	20
500		1 kg	50
1 kg		2.5	100
2.5		10	200
10		20	500
20		100 (included)	1 000

SELF-INDICATING INSTRUMENTS

The scale interval d shall not be greater than the limit of error indicated in the table above for the respective weighing capacity.

For reasons of simplification it is proposed to accept for on-site verification a limit of error of 1 scale interval except for loads exceeding 20 000 scale intervals where the limit of error at verification is increased to 2 scale intervals.

IN-SERVICE CONTROLS

During control of instruments in use when seals have not been broken the errors shall not exceed the double of the limits of error, however not be more than 3 scale intervals for self-indicating instruments at loads exceeding 20 000 scale intervals.

TABLE 4 — LIMITS OF ERROR FOR MEASURES OF VOLUME USED FOR RETAIL TRADE OF LIQUIDS

Volume	Tolerances in millilitres				
	Retail measures suggestions in " Guidelines "	Serving measures RI 29	Prepackages OIML draft T-value	Measuring container bottles OIML draft	Measuring cylinders glass or plastic ISO
50 mL	± 2	± 1.5	— 4.5	± 3	± 1
100	3	3	4.5	3	1
200	5 (6)	6	9	6	—
250	5 (6)	7.5	9	6	2
500	10	15	15	10	5
1 L	15 (10)	30	15	10	10
2	25 (20)	60	30	20	20
5	50	150	75	50	
10	80 (50)		150		
15 (or more)	0.5 %		1 %		

TRAVAUX de l'OIML — WORK of OIML

1988-1989

Nous indiquons ci-après sous une forme condensée et bilingue l'état de préparation des Recommandations Internationales, Documents Internationaux et autres travaux de l'OIML tel qu'il découle des rapports annuels et autres informations reçues par le BIML.

Dans cette liste ne sont pas inclus les sujets dont les travaux ont donné lieu à des publications définitives parues avant 1988.

Les avant-projets et projets indiqués dans cette liste ne sont disponibles que pour les membres des groupes de travail concernés.

We are hereafter indicating in a condensed and bilingual form the stage of preparation of International Recommendations, International Documents and other work of OIML as it appears from the annual reports and other information received by BIML.

This list does not include work which has been subject to final publication before 1988.

The preliminary drafts and drafts mentioned in this list are available only to the members of the respective working groups.

LEGENDES

AP	=	Avant-projet *Preliminary draft*
P	=	Projet *Draft*
Enquête	=	*Enquiry*
Préparation	=	Elaboration d'un avant-projet *Preparation of a preliminary draft*
Etude Sr	=	Observations et nouvelle version étudiée par Sr *Comments and new version studied by Sr*
Etude SP	=	Etude du projet par le Secrétariat Pilote *Study of the draft by the Pilot Secretariat*
Vote CIML	=	Vote par le CIML sur le projet *Vote on the draft by CIML*
Conference	=	Présentation à la 8e Conférence
D	=	Document International
R	=	Recommandation Internationale

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation*	
			1988	1989
SP 1	TERMINOLOGIE *TERMINOLOGY*			
Sr 1	Addenda au VML *Addenda to VML*			1 AP
Sr 2, Sr 3	Conformité terminologique *Conformity of terminology*		Activité permanente	
SP 2	METROLOGIE LEGALE, GENERALITES *LEGAL METROLOGY, GENERAL*			
Sr 2	Unités de mesure légales (revision D 2) *Legal units of measurement*	D	Préparation	1 AP
Sr 4	Règles de fonctionnement du Système de Certificats OIML *Operational rules of the OIML Certificate Scheme*		1 AP	CIML
Sr 5	Utilisation des méthodes statistiques de vérification *Application of statistics in verification procedures*	D	1 AP	2 AP
Sr 6	Exigences générales pour les instruments électroniques (revision D 11) *General requirements for electronic instruments*	D	1 AP	2 AP
SP 4	MESURES DE LONGUEURS, SURFACES, ANGLES *MEASUREMENT OF LENGTH, AREA, ANGLE*			
Sr 1	Mesures à traits de haute précision *High precision line measures of length*	R	P	Vote CIML
	Calibres à bouts plans (revision R 30) *End measures of length*	R	P	
Sr 4	Schéma de hiérarchie, mesures de longueur *Hierarchy scheme for length measuring instruments*	D	5 AP	P
Sr 5	Schéma de hiérarchie, mesures d'angle *Hierarchy scheme for angle measuring instruments*	D	P	Etude SP
	Méthodes de reproduction d'unités d'angle plan *Methods of reproduction of plane angle units*	D	Etude SP	Etude SP
Sr 6	Appareils de mesure de la superficie des peaux *Instruments measuring the area of hides*	R	Préparation	3 AP
Sr 7	Terminologie utilisée en métrologie dimensionnelle *Terminology used in dimensional metrology*	D	5 AP	P
SP 5S	MESURE STATIQUE DES QUANTITES DE LIQUIDES *STATIC MEASUREMENT OF QUANTITIES OF LIQUIDS*			
Sr 2	Schémas de hiérarchie *Hierarchy schemes*	D	4 AP	P
Sr 3	Pipettes automatiques en verre *Glass delivery measures (Automatic pipettes)*	R	4 AP	P

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation* 1988	1989
SP 5S	MESURE STATIQUE DES QUANTITES DE LIQUIDES (suite)			
Sr 4	Seringues médicales *Medical syringes*	R	3 AP	P
Sr 5	Bouteilles récipients-mesures *Measuring container bottles*	R	Vote CIML	CIML
Sr 9	Camions et wagons citernes *Road and rail tankers*	R 80	Conférence	
Sr 10	Citernes de bateaux *Ship tanks*	R	Vote CIML	CIML
Sr 11	Mesure automatique des niveaux de liquides *Automatic measurement of the level of liquid in tanks*	R 85	Conférence	
Sr 12	Mesurage statique de masses de liquides *Static direct mass measurement of liquids*	R	Préparation	1 AP
SP 5D	MESURE DYNAMIQUE DES QUANTITES DE LIQUIDES *DYNAMIC MEASUREMENT OF QUANTITIES OF LIQUIDS*			
Sr 1	Ensembles de mesure - Dispositions particulières *Measuring assemblies - Special provisions*	R 77	Conférence	
	Ensembles de mesurage de liquides autres que l'eau (compilation) *Measuring assemblies for liquids other than water (compilation)*	R	1 AP	2 AP
Sr 2	Compteurs cryogéniques *Meters for cryogenic liquids*	R 81	Conférence	
Sr 3	Compteurs d'eau froide (revision R 49) *Cold water meters*	R	2 AP	Etude Sr
	Vérification par échantillonnage des compteurs d'eau *Statistical testing of water meters*	D	Préparation	Préparation
Sr 4	Compteurs à tambour pour alcool *Drum meters for alcohol*	R 86	Conférence	
Sr 6	Dispositifs électroniques des ensembles de mesure de liquides *Electronic devices in measuring assemblies for liquids*	R	3 AP	Etude SP
Sr 7	Etalons de volume utilisés pour la vérification des ensembles de mesure *Standard volume measures used for verification of measuring assemblies*	R	P	Etude SP, Vote CIML
	Tubes étalons utilisés pour la vérification des ensembles de mesure *Pipe provers used for verification of measuring assemblies*	R	2 AP	P, Etude SP

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publi-cation *Status*	Etat de préparation *Stage of preparation* 1988	 1989
SP 5D	MESURE DYNAMIQUE DES QUANTITES DE LIQUIDES (suite)			
	Méthodes d'essai de compteurs routiers de carburant liquide *Testing procedures for liquid fuel dispensers*	D	1 AP, 2 AP	P, Etude SP
Sr 8	Compteurs électromagnétiques *Electromagnetic meters*	R	Préparation	1 AP
Sr 9	Compteurs vortex *Vortex meters*	R	1 AP	2 AP
Sr 10	Compteurs massiques *Direct mass-flow measuring instruments*	R	1 AP	2 AP
SP 6	MESURE DES GAZ *MEASUREMENT OF GAS*			
Sr 1	Prescriptions générales pour compteurs de volume de gaz (revision R 6) *General specifications for meters for volumes of gas*	R 6	Conférence	
	Compteurs de gaz à parois déformables *Diaphragm gas meters* (revision R 31)	R 31	Conférence	
Sr 2	Compteurs de gaz à pistons rotatifs et à turbine (revision R 32) *Rotary piston gas meters and turbine gas meters*	R 32	Conférence	
	Complément/*Additions*	R		1 AP
Sr 3	Voludéprimomètres pour gaz *Differential pressure meters*	R	Préparation	1 AP
Sr 4	Mesure des hydrocarbures gazeux distribués par pipeline *Measurement of hydrocarbon gases distributed by pipeline*	D	2 AP	3 AP
Sr 9	Correcteurs de volume de gaz *Correctors of gas volumes*	R	Préparation	1 AP
SP 7	MESURE DES MASSES *MEASUREMENT OF MASS*			
Sr 2	Instruments de pesage électroniques *Electronic weighing instruments*	R 74	Conférence	
Sr 3	Instruments de pesage pour vérification des masses-étalons *Weighing instruments used for verification of mass standards*	D		1 AP
Sr 4	Instruments de pesage non automatiques (revision R 3 et R 28) *Non-automatic weighing instruments (revision R 3 and R 28)*	R 76	Conférence	
Sr 5	Instruments de pesage totalisateurs continus (revision R 50) *Continuous totalising weighing machines*	R	Préparation	2 AP

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation* 1988	1989
SP 7	MESURE DES MASSES (suite)			
	Instruments de pesage totalisateurs discontinus *Discontinuous totalising weighing machines*	R	5 AP	P
	Ponts-bascules ferroviaires à fonctionnement automatique *Automatic rail-weighbridges*	R	5 AP	P
	Trieuses pondérales (revision R 51) *Checkweighing instruments*	R		1 AP
	Doseuses pondérales (revision R 61) *Gravimetric filling instruments*	R		1 AP
Sr 7	Contrôle en service des instruments de pesage *In-service control procedures of weighing instruments*	D		1 AP
Sr 8	Réglementation métrologique des cellules de pesée (revision R 60) *Metrological regulations for load cells*	R	1 AP	Vote CIML
SP 8	POIDS *WEIGHTS*			
Sr 1	Spécifications métrologiques pour les poids (compilation) *Metrological specifications for weights (compilation)*	D	1 AP	1 AP
SP 9	MESURE DE MASSES VOLUMIQUES *MEASUREMENT OF DENSITY*			
Sr 3	Aréomètres pour usages spécifiques *Hydrometers for specific uses*	R	P	Etude SP
Sr 9	Terminologie *Terminology*	D	2 AP	P
SP 10	INSTRUMENTS DE MESURE POUR VEHICULES *MEASURING INSTRUMENTS FOR VEHICLES*			
Sr 1	Cinémomètres radar pour trafic routier *Radar speed control meters*	R 91	Conférence	
Sr 2	Instruments de mesure de vitesse et distance dans les véhicules (revision R 55) *Speed and distance measuring instruments for vehicles*	R	Préparation	1 AP
Sr 3	Taximètres (revision R 21, extension aux taximètres électroniques) *Taximeters*	R	2 AP	3 AP

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation* 1988	 1989
SP 11	MESURE DES PRESSIONS *MEASUREMENT OF PRESSURE*			
Sr 2	Schémas de hiérarchie *Hierarchy schemes*	D	Préparation	3 AP
Sr 3	Manomètres à piston *Pressure balances*	R	Vote CIML	CIML
Sr 4	Méthodes de vérification de manomètres indicateurs et enregistreurs *Verification methods for indicating and recording pressure gauges*	R 94	Conférence	
	Manomètres pour pneumatiques (revision R 23) *Tyre pressure gauges*	R	2 AP	3 AP
	Manomètres de référence à éléments élastiques *Reference manometers with elastic sensors*	R	3 AP	P
	Revision des R 17 et R 19 *Revision of R 17 and R 19*	R	Etude SP	Vote CIML
	Caractéristiques des éléments récepteurs élastiques (revision R 53) *Characteristics of elastic sensing elements*	R	Préparation	1 AP
Sr 5	Manomètres pour la pression artérielle (revision R 16) *Manometers for instruments measuring blood pressure*	R	Préparation	2 AP
Sr 7	Baromètres *Barometers*	R	Vote CIML	CIML
SP 12	MESURE DES TEMPERATURES ET DE L'ENERGIE CALORIFIQUE *MEASUREMENT OF TEMPERATURE AND HEAT*			
Sr 3	Capteurs à résistance thermométrique *Resistance-thermometer sensors*	R 84	Conférence	
Sr 5	Thermocouples, tables de f.e.m. et tolérances *Thermocouples, tables of EMF and tolerances*	R	Préparation	2 AP
Sr 6	Pyromètres optiques à filament disparaissant (revision R 18) *Optical pyrometers - Disappearing filament type*	R 18	Conférence	
	Pyromètres à radiation totale *Total radiation pyrometers*	R	P	Vote CIML
	Classification des pyromètres à radiation *Classification of radiation pyrometers*	D	P	Vote CIML
	Lampes à ruban de tungstène pour l'étalonnage de pyromètres optiques (revision R 48) *Tungsten ribbon lamps for calibration of optical pyrometers*	R	1 AP	2 AP

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation* 1988	1989
SP 12	MESURE DES TEMPERATURES (suite)			
Sr 7	Thermomètres électriques médicaux à maximum *Clinical electrical thermometers with maximum device*	R	1 P	2 P
	Thermomètres électriques médicaux pour mesures continues *Clinical electrical thermometers for continuous measurement*	R	1 P	2 P
Sr 8	Compteurs d'énergie thermique *Heat meters*	R 75	Conférence	
Sr 9	Méthodes de vérification des thermocouples étalons *Methods for verification of reference and ordinary thermocouples*	R	P	Etude SP
SP 13	MESURES ELECTRIQUES ET MAGNETIQUES *MEASUREMENT OF ELECTRICAL AND MAGNETIC QUANTITIES*			
Sr 3	Compteurs d'énergie électrique active (revision R 46) *Active electrical energy meters*	R		1 AP
Sr 5	Instruments de mesure de courant, tension et fréquence *Indicating measuring instruments for current, voltage and frequency*	R	P	Vote CIML
SP 14	ACOUSTIQUE ET VIBRATIONS *ACOUSTICS AND VIBRATION*			
Sr 1	Sonomètres intégrateurs *Integrating sound level meters*	R 88	Conférence	
	Sources sonores de référence *Sound calibrators*	R	2 AP	P
Sr 2	Audiomètres à son pur *Pure tone audiometers*	R	Préparation	Préparation
Sr 3	Instruments de mesure de vibrations *Measuring instruments for response to vibration*	R	Préparation	1 AP
SP 15	OPTIQUE *OPTICS*			
Sr 1	Dioptrimètres *Focimeters*	R 93	Conférence	
Sr 2	Illuminancemètres *Illuminancemeters*	R	1 AP	2 AP

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation* 1988	1989
SP 16	RAYONNEMENTS IONISANTS *IONIZING RADIATION*			
Sr 2	Laboratoires secondaires d'étalonnage en dosimétrie *Secondary standard dosimetry laboratories for the calibration of dosimeters*	D	Vote CIML	
SP 17	MESURE DES POLLUTIONS *MEASUREMENT OF POLLUTION*			
Sr 1	Instruments de mesure des gaz d'échappement *Exhaust emission measuring instruments*	R	P	Etude SP
Sr 2	Chromatographes à spectromètre de masse pour l'analyse des polluants de l'eau *Gas chromatograph-mass spectrometer for analysis of organic pollutants in water*	R 83	Conférence	
	Spectrophotomètres à absorption atomique pour la mesure des polluants métalliques dans l'eau *Atomic absorption spectrophotometers for measuring metal pollutants in water*	R	P	Vote CIML
	Spectromètres à plasma couplés inductivement *Inductively coupled plasma emission spectrometers*	R	1 AP	2 AP
Sr 4	Chromatographes pour l'analyse de la pollution due aux pesticides et substances toxiques *Gas chromatographs for measuring pesticides and toxic substances pollution*	R 82	Conférence	
	Chromatographes à phase liquide de hautes performances pour la mesure de pesticides et autres substances toxiques *High performance liquid chromatographs for measuring pesticide and toxic substances pollution (HPLC)*	R	3 AP	P
Sr 5	Instruments portables pour la mesure des polluants de l'air provenant des déchets dangereux *Portable instruments for assessing airborne pollutants arising from hazardous wastes*	D	P	Etude SP
	Chromatographes en phase gazeuse portatifs pour polluants gazeux *Portable gas chromatographs for gaseous pollutants*	R	1 AP	2 AP
SP 18	MESURE DES CARACTERISTIQUES DES PRODUITS ALIMENTAIRES *MEASUREMENT OF CHARACTERISTICS OF FOOD PRODUCTS*			
Sr 3	Saccharimètres polarimétriques (revision R 14) *Polarimetric saccharimeters*	R	1 AP	P

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation*	
			1988	1989
SP 18	MESURE DES CARACTERISTIQUES DES PRODUITS ALIMENTAIRES (suite)			
Sr 6	Réfractomètres automatiques pour la mesure de la teneur en sucre des moûts de raisin *Automatic refractometers for the measurement of the sugar content of grape musts*	R	Etude Sr	2 AP
SP 19	MESURE DES CARACTERISTIQUES DES MATERIAUX *MEASUREMENT OF CHARACTERISTICS OF MATERIALS*			
Sr 3	Dureté (blocs de référence et machines d'essai) *Hardness (reference blocks and testing machines)*	R	Enquête	
Sr 4	Intercomparaison des étalons de dureté *Intercomparison of hardness standards*		Programme	Comparaisons
Sr 6	Vocabulaire de dureté *Hardness testing dictionary*	D		Publication
SP 20	PRODUITS PREEMBALLES *PREPACKAGED PRODUCTS*			
Sr 1	Contenu informatif de l'étiquetage *Information on package labels*	R 79	Conférence	
Sr 2	Vérification des quantités contenues dans les emballages *Verification of net contents in packages*	R 87	Conférence	
SP 21	NORMALISATION DES CARACTERISTIQUES METROLOGIQUES DES INSTRUMENTS DE MESURE *METROLOGICAL CHARACTERISTICS OF MEASURING INSTRUMENTS*			
Sr 1	Caractéristiques à normaliser pour un modèle déterminé d'instrument de mesure *Metrological characteristics to be standardized for a particular pattern of measuring instruments*	D	Etude SP	
Sr 2	Principes de détermination expérimentale des caractéristiques dynamiques des instruments de mesure linéaires *Principles of experimental determination of dynamic characteristics of linear measuring instruments*	D	Etude SP	
Sr 5	Exigences pour les méthodes de contrôle des caractéristiques métrologiques des instruments de mesure *Requirements for the methods of control of metrological characteristics of measuring instruments*	D	Etude SP	
Sr 6	Certification métrologique des systèmes de mesure *Metrological certification of measuring systems*	D	1 AP	

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publi-cation *Status*	Etat de préparation *Stage of preparation* 1988	 1989
SP 22	PRINCIPES DU CONTROLE METROLOGIQUE *PRINCIPLES OF METROLOGICAL CONTROL*			
Sr 5	Expertise métrologique *Metrological expertise*	D	2 AP	3 AP
SP 23	METHODES ET MOYENS D'ATTESTATION DES DISPOSITIFS DE VERIFICATION *METHODS AND MEANS USED FOR CERTIFICATION OF VERIFICATION DEVICES*			
Sr 1	Principes du choix et de l'expression des caractéristiques métrologiques des étalons *Principles for the selection and expression of metrological characteristics of measurement standards*	D	1 AP	2 AP
Sr 4	Principes du contrôle métrologique des dispositifs de vérification *Principles for metrological control of devices used for verification*	D	Etude SP	Vote CIML
SP 26	INSTRUMENTS DE MESURE UTILISES DANS LE DOMAINE DE LA SANTE *MEASURING INSTRUMENTS USED IN THE FIELD OF HEALTH*			
Sr 3	Tubes Westergren pour la mesure de la vitesse de sédimentation du sang *Westergren tubes for the measurement of erythrocyte sedimentation rate*	R 78	Conférence	
Sr 4	Electroencéphalographes *Electroencephalographs*	R 89	Conférence	
	Electrocardiographes (ECG) *Electrocardiographs*	R 90	Conférence	
	Electrocardioscopes (Appendice 1 à ECG)	R	1 AP	Etude SP
	Electrocardioscopes et électrocardiographes numériques (Appendice 2 à ECG) *Digital electrocardioscopes and electrocardiographs*	R	1 AP	Etude SP
	Représentation des caractéristiques des instruments de mesure bio-médicaux *Presentation of metrological characteristics of bio-electrical measuring instruments*	D	P, Etude SP	Vote CIML
	Electrodes pour cardiographes et encéphalographes *Electrodes for cardiographs and encephalographs*	R	1 P	Etude SP
	Amplificateurs bioélectriques *Bio-electric amplifiers*	R	2 AP	3 AP
	Enregistreurs et oscilloscopes à usage médical *Recorders and oscilloscopes for medical use*	R	2 AP	3 AP

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation* 1988	 1989
SP 27	PRINCIPES GENERAUX D'UTILISATION DES MATERIAUX DE REFERENCE *GENERAL PRINCIPLES FOR THE USE OF REFERENCE MATERIALS*			
Sr 3	Methodes d'essai d'homogénéité des matériaux de référence poudreux et solides certifiés *Methods of testing the homogeneity of powdered and solid certified reference materials*	D	2 AP	P, Etude SP
Sr 4	Principes généraux de la certification des matériaux de référence de propriétés *General principles of certification of reference materials of properties*	D	1 AP	2 AP, P, Etude SP
	Principes généraux et statistiques des méthodes de la certification des matériaux de référence *General and statistical principles of methods for certification of reference materials*	D	Préparation	1 AP
Sr 5	Evaluation des méthodes de mesure pour la composition d'échantillons de substance *Assessment of measurement procedures for the composition of substance samples*	D	1 AP	2 AP, P, Etude SP
	Utilisation des matériaux de référence certifiés pour l'étalonnage des spectrophotomètres *Use of certified reference materials for spectrophotometer calibration*	D	1 AP	2 AP, P, Etude SP
SP 30	MESURES PHYSICO-CHIMIQUES *PHYSICO-CHEMICAL MEASUREMENTS*			
Sr 1	Echelle de pH des solutions aqueuses (revision R 54) *pH scale for aqueous solutions*	R	P	Etude SP
	pH-métrie et ionométrie. Méthodes de mesurage *pH and ion measurements. Measuring methods*	R	2 AP	P
	Méthode de vérification des pH-mètres *Verification method of pH-meters*	R		1 AP
	Solutions pour la vérification des pH-mètres *Solutions for the verification of pH-meters*	R		1 AP
Sr 2	Méthodes de mesure de la conductivité des électrolytes *Methods of conductivity measurement of electrolytic solutions*	R	P	Etude SP
	Schéma de hiérarchie en conductométrie *Hierarchy scheme of conductometry*	D	2 AP	P
	Solutions-étalons de conductivité (revision R 56) *Standard solutions for conductivity*	R	1 AP	2 AP
	Etalonnage des cellules de conductivité (revision R 68) *Calibration of conductivity cells*	R	1 AP	2 AP

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publi-cation *Status*	Etat de préparation *Stage of preparation* 1988	1989
SP 30	MESURES PHYSICO-CHIMIQUES (suite)			
	Solutions pour la vérification de conductomètres *Solutions for the verification of conductometers*	R		1 AP
Sr 3	Echelle d'humidité relative de l'air utilisant des solutions salines saturées *Scale of relative humidity of air using saturated salt solutions*	R	P	Etude SP
	Tables psychrométriques universelles *Universal psychrometric tables*	R	5 AP	5 AP
Sr 4	Hygromètres pour bois. Méthodes de vérification *Wood moisture meters. Verification methods*	R 92	Conférence	
	Vérification des dispositifs thermogravimétriques pour la mesure de l'humidité des solides *Verification of thermogravimetric devices for measuring the moisture content of solids*	R	P	P
	Humidimètres pour solides *Moisture meters of solid substances*	R		1 AP
	Humidimètres capacitifs *Capacitive moisture meters*	R		1 AP
Sr 6	Schéma de hiérarchie des instruments de mesure de l'humidité des gaz *Hierarchy scheme for instruments measuring the humidity of gases*	D	4 AP	5 AP, P
	Méthodes et moyens d'essai des psychromètres *Methods and means for testing psychrometers*	R	2 AP	3 AP
	Définitions de l'hygrométrie des gaz *Definitions in the hygrometry of gases*	D		1 AP
Sr 9	Liquides étalons pour l'étalonnage de viscosimètres *Standard liquids used for the calibration of viscometers*	R	P	Etude SP
	Viscosimètres à bille. Méthodes d'étalonnage *Falling-ball viscometer. Calibration methods*	R	3 AP	P, Etude SP
Sr 10	Méthodes et moyens pour la vérification des instruments de mesure de la teneur pondérale des polluants dans l'air *Methods and means for the verification of instruments measuring the mass concentration of pollutants in air*	R	3 AP	P
Sr 12	Explosimètres *Explosimeters*	R	Etude Sr	2 AP
Sr 13	Ethylomètres *Breath testers*	R	2 AP	3 AP

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation* 1988	1989
SP 31	ENSEIGNEMENT DE LA METROLOGIE *TEACHING OF METROLOGY*			
Sr 1	Cours de métrologie générale pour ingénieurs *Basic metrology course for engineers*	D	Vote CIML	
	Programme des cours de mesures mécaniques *Programme of the mechanical measurement course*	D	2 AP	P
	Programme des cours de mesures électriques *Programme of the electrical measurement course*	D	2 AP	P
	Programme des cours de mesures thermiques *Programme of the thermotechnical measurement course*	D		1 AP
Sr 2	Formation de techniciens de métrologie légale *Training of legal metrology technicians*	D	Vote CIML	

INFORMATIONS

MEMBRES DU COMITE

BULGARIE — M. P. ZLATAREV ayant pris sa retraite a été remplacé par M. Vassil TZAREVSKI, 1er Vice-Président du Comité de la Qualité auprès du Conseil des Ministres.

Rép. Pop. de CHINE — M. SONG YONGLIN a été appelé à d'autres fonctions dans son administration et le nouveau Membre du CIML est M. BAI JINGZHONG, Deputy Director General of the State Bureau of Technical Supervision.

IRLANDE — M. P. FANNING a été appelé à d'autres fonctions et le nouveau Membre du CIML est M. James LOWE, Secrétaire adjoint au Ministère de l'Industrie et du Commerce.

MEMBRES CORRESPONDANTS

Trois nouveaux Membres Correspondants ont été admis dans notre Organisation depuis novembre 1988 :

— SEYCHELLES
— MALAISIE
— MEXIQUE.

IMEKO

Le onzième Congrès de la Confédération Internationale de Mesure IMEKO a été organisé du 17 au 21 octobre 1988 à Houston, Texas, Etats-Unis, pour la première fois hors d'Europe en trente ans d'existence de l'organisation. L'OIML était parmi les " Sociétés Internationales Coopérantes ". En même temps, dans les mêmes bâtiments, l'Instrument Society of America a tenu sa Conférence Internationale et une gigantesque exposition d'instruments de mesure où plus de 600 constructeurs ont présenté leurs produits nouveaux. 460 participants (dont 70 des Etats-Unis), venus de 38 pays, ont été enregistrés à l'IMEKO XI.

Pendant les conférences plénières les exposés ont porté sur la réponse de la métrologie au défi de la technologie moderne, puis les systèmes intelligents de mesure, les applications nouvelles de l'optique dans l'industrie et l'informatique, méthodes d'essai et de mesure assistées par ordinateur, l'instrumentation intelligente dans la médecine et l'éducation en métrologie. Parmi les conférences scientifiques présentées en sessions parallèles il y a eu 168 exposés oraux et 108 exposés affichés. Les exposés ont été publiés en cinq volumes. Le slogan du programme scientifique était " Instruments pour le XXIe Siècle ".

Plusieurs Comités Techniques (TC) ont tenu des discussions en table ronde. Une session spéciale avec 90 participants fut consacrée au cinquantenaire de l'invention de la jauge de contrainte. Les exposés sur son histoire, ainsi que sur celle de la cellule de pesée, ont été publiées dans un volume séparé.

Un séminaire a été organisé après le Congrès dans l'Institut NIST (auparavant NBS) à Washington.

Le XIIe Congrès IMEKO se tiendra en 1991 à Pékin, et le XIIIe en 1994 en Italie.

F.P.

ORAN

Un séminaire important sur la métrologie fut organisé du 5 au 14 décembre 1988 à Addis Abeba (Ethiopie) par l'Organisation Régionale Africaine de Normalisation avec participation des pays suivants : Burkina Faso, Cameroun, Egypte, Ethiopie, Ghana, Guinée, Kenya, Malawi, Ile Maurice, Nigeria, Sénégal et Zambie. Il y avait également des délégués des secrétariats généraux d'ORAN, ISO, OIML et ONUDI. Les sujets traités par des exposés et des discussions s'étendaient depuis l'organisation et le fonctionnement de services de métrologie aux activités spécifiques dans les domaines de mesures de masses, longueurs, températures, électricité, fréquence et temps. Le Directeur du BIML a présenté des exposés sur les activités des organisations internationales dans le domaine de la métrologie et sur les grandeurs et unités du système SI. Les participants ont également pu exposer la situation de la métrologie dans leur propre pays.

Deux jours complets ont été consacrés à la démonstration de l'équipement et moyens d'étalonnage des laboratoires de l'organisme éthiopien de normalisation (ESA).

En conclusion ce séminaire aura sans doute une influence très positive sur les activités métrologiques de l'ORAN et sa coopération avec l'OIML.

Le Directeur du BIML a également participé à l'Assemblée Générale de l'ORAN qui s'est tenue à Nairobi du 23 au 27 janvier 1989. On peut remarquer que le Programme de Développement des Nations-Unies a accepté de financer une mission à long terme d'un expert attaché au Secrétariat Général de l'ORAN et qui a été recruté par l'ONUDI.

LITTERATURE

HONGRIE — " Bevezetés az âltalânos metrolôgiâba " ou, en français, Introduction à la métrologie générale, est un livre de 582 pages publié en 1988 par l'Office national de métrologie de Hongrie (OMH). Les éditeurs sont le Membre du CIML M. D. Beledi et M. P. Bölöni. Les neuf chapitres du livre ont été rédigés par différents spécialistes de l'OMH et M. F. Petik du BIML a contribué avec un premier chapitre intitulé Métrologie et Métrologie Légale. Le livre est surtout destiné aux participants des cours de métrologie organisés par OMH mais peut également être recommandé à tous ceux qui s'occupent de la métrologie ou de la conception des instruments de mesure.

Le livre contient également en annexe une version multilingue (anglais, français, hongrois, russe) du Vocabulaire International de Métrologie.

Rép. Féd. d'ALLEMAGNE — Le PTB a édité une brochure en allemand sur la détermination de l'humidité des céréales et sur l'essai des instruments de mesure de l'humidité. Le texte est basé sur la Recommandation Internationale de l'OIML N° 59 et sur les Normes ISO dont cette Recommandation fait référence :

Getreidefeuchte

bearbeitet von Dr R. Balhorn

PTB-Prüfregeln Band 18, 19 pages, 1988.

ROYAUME-UNI — Un nouveau livre sur la mesure de débit de fluides vient de paraître. Il est basé sur les exposés présentés à la " Fourth International Conference on Industrial Flow Measurement " et contient des articles sur les derniers développements dans la mesure de débits, techniques d'étalonnage, conception de compteurs, etc. :

Developments in Industrial Flow Measurement edited by O. Smith

IBC Technical Services Ltd

IBC House, Canada Road, Byfleet, Surrey KT 147 JL.

SUISSE — Le recueil des exposés du 8e symposium sur la compatibilité électromagnétique, Zurich, 7-9 mars 1989, peut être commandé à :

EMC Proceedings
ETH-Zentrum-IKT
CH-8092 Zurich

ETATS-UNIS d'AMERIQUE — Une nouvelle bibliographie sur les recherches dans le domaine de l'électromagnétisme effectuées depuis 1970 par les spécialistes du NBS (maintenant appelé NIST) a été publié :

Metrology for Electromagnetic Technology : A Bibliography of NBS Publications (NBSIR 88-3097).

Pour les commandes, s'adresser à : National Technical Information Service, Springfield, Va. 22161.

INFORMATION

COMMITTEE MEMBERS

BULGARIA — Mr P. ZLATAREV has retired and is replaced by Mr Vassil TZAREVSKI. 1st Vice-President of the Committee of Quality of the Council of Ministers.

People's Republic of CHINA — Mr SONG YONGLIN has taken up other duties in his administration and the new CIML Member is Mr BAI JINGZHONG, Deputy Director General of the State Bureau of Technical Supervision.

IRELAND — Mr P. FANNING has taken up other duties and the new CIML Member is Mr James LOWE, Assistant Secretary, Department of Industry and Commerce.

CORRESPONDING MEMBERS

Three new Corresponding Members have been admitted in our Organisation since November 1988 :

— SEYCHELLES,
— MALAYSIA,
— MEXICO.

IMEKO

The eleventh Congress of the International Measurement Confederation IMEKO was held from 17 through 21 October 1988 in Houston, Texas, USA, the first time outside Europe during the thirty years' existence of the Organization. OIML was among the " International Cooperating Societies ". At the same time, in the same buildings, the Instrument Society of America held its International Conference and a huge measuring instrument exhibition where more than 600 manufacturers showed their latest products. The participation at IMEKO XI was 460 registrants (of these 70 from the USA) coming from 38 countries.

Papers presented at the plenary sessions discussed the response of measurement to the technology challenge, further intelligent measuring systems, new applications of optics in industry and information problems, computer aided testing and measurement techniques (CAT), intelligent instrumentation in medicine, and formation in measurement. Among the scientific papers presented in parallel sessions there were 168 oral and 108 poster presentations. Papers were published in five volumes. The slogan of the scientific program was : " Instrumentation for the 21th Century ".

Various Technical Committees organized round table discussions. A special session with 90 participants was consecrated to the 50-year-jubilee of the invention of the strain gauge. Papers on the history of strain gauges and load cells were published in a separate volume.

A post-convention Seminar was held in the National Institute of Standards and Technology (former NBS) in Washington, D.C.

The 12th IMEKO Congress will be organized in 1991 in Pekin, the 13th in 1994 in Italy.

F.P.

ARSO

An important workshop on metrology was organized 5-14 December 1988 in Addis Abeba (Ethiopia) by the African Regional Organization for Standardization with active participation from the following countries : Burkina Faso, Cameroon, Egypt, Ethiopia, Ghana, Guinea, Kenya, Malawi, Mauritius, Nigeria, Senegal and Zambia. There were also delegates from the Headquarters of ARSO, ISO, OIML and UNIDO. The subjects covered by lectures and followed by discussions extended from the organization and operation of metrology services to specific activities within the field of mass, length, temperature, electrical and time and frequency measurements. The Director of BIML delivered lectures on the activities of the international organizations in the field of metrology and on the quantities and units of the SI-system. The participants were also given the opportunity to present the situation of metrology in their home countries.

Two full days were spent on demonstration of the equipment and calibration facilities at the laboratories of the Ethiopian Authority for Standardization (ESA).

As a conclusion this workshop will ne doubt have a very positive influence on the metrology activities of ARSO and its cooperation with OIML.

The Director of BIML also assisted at the General Assembly of ARSO which was held in Nairobi from 23-27 January 1989. It must be noted that United Nations Development Programme has accepted to finance a long-term mission of a metrology expert attached to ARSO headquarters and recruited through UNIDO.

LITERATURE

HUNGARY — " Bevezetés az általános metrológiába " or, in English, Introduction to General Metrology is a book of 582 pages published in 1988 by the Hungarian National Office for metrology (OMH). The editors are the member of CIML Mr D. Beledi and Mr P. Bölöni. The nine chapters of the book are written by different OMH staff members and Mr F. Petik of BIML has contributed with an introductory chapter on Metrology and Legal Metrology. The book is mainly intended to be used by participants in metrology courses organized by OMH but can be recommended to everybody connected with measurements and instrument design.

It also contains in annex a multilingual version (English, French, Russian, Hungarian) of the International Vocabulary of Metrology.

Fed. Rep. of GERMANY — The PTB has issued a brochure in German on the determination of the humidity of cereals and testing of humidity measuring apparatus. It is largely based on OIML Recommendation No. 59 and on the ISO Standards referred to therein :

Getreidefeuchte

bearbeitet von Dr R. Balhorn

PTB-Prüfregeln Band 18, 19 pages, 1988.

UNITED KINGDOM — A new book on flow measurements based on the Fourth International Conference on Industrial Flow Measurement and containing papers on recent developments in flow measurement, calibration techniques, meter design etc. is now available :

Developments in Industrial Flow Measurement edited by O. Smith

IBC Technical Services Ltd

IBC House, Canada Road, Byfleet, Surrey KT 147 JL

SWITZERLAND — The Proceeding of 8th International Symposium on Electromagnetic Compatibility, Zurich 7-9 March, 1989 can be ordered from

EMC Proceedings
ETH-Zentrum-IKT
CH-8092 Zurich

U.S.A. — A new bibliography on electromagnetic research work made by NBS (now called NIST) scientists since 1970 has been published :

Metrology for Electromagnetic Technology : A Bibliography of NBS Publications (NBSIR 88-3097)

Order from the National Technical Information Service, Springfield, Va. 22161.

Séminaire technique de l'OIML

INSTRUMENTS DE PESAGE ELECTRONIQUES

BRAUNSCHWEIG

15-18 mai 1990

Un séminaire de l'OIML sur les instruments de pesage électroniques sera organisé à Braunschweig, Rép. Féd. d'Allemagne du 15 au 18 mai 1990 avec le concours de la PTB.

Ce séminaire a pour but de réunir des spécialistes en métrologie légale afin de discuter, avec la participation des experts de l'industrie, les développements récents aussi bien en ce qui concerne la conception que le contrôle légal des instruments de pesage.

Les exposés seront faits soit en anglais, soit en français, sans traduction simultanée. Une version dactylographiée dans l'autre langue doit cependant si possible être fournie par le conférencier afin de permettre de suivre les exposés pour ceux qui ne comprennent pas la présentation orale. Des discussions doivent être possibles dans les deux langues avec l'aide de participants bilingues.

L'appel des exposés concerne les sujets suivants :

1 — Conception et construction des instruments de pesage électroniques

2 — Assurance qualité et certification par le constructeur, vérification primitive et ultérieure

3 — Essais des instruments de pesage électroniques pour l'approbation de modèle et lors des vérifications

4 — Expériences et problèmes d'application de certaines exigences de OIML R 76 (par exemple concernant cellules de pesage, interfaces et périphériques, calculateurs faisant partie de l'instrument, etc.)

Alors que les sujets ci-dessus concernent surtout les instruments de pesage non automatiques, il est également proposé de discuter comme sujet supplémentaire :

5 — Conceptions et exigences communes aux instruments automatiques et non automatiques.

Des suggestions pour l'inclusion d'autres sujets considérés appropriés seront également bienvenues.

Le comité d'organisation est à la PTB conduit par Dr Chr. U. VOLKMANN et ses collaborateurs.

Pour nous permettre d'établir, avec le comité d'organisation, le programme définitif, le BIML souhaite recevoir les titres des exposés et un court résumé (d'environ une demi-page) avant le

31 juillet 1989

Il sera ensuite demandé aux conférenciers de soumettre le texte complet (avant fin janvier 1990) afin de permettre la reproduction.

Nous vous demandons également de nous faire connaître les noms et adresses des participants dès que possible et en tout cas avant le 31 mars 1990. Des informations sur les moyens d'accès à Braunschweig et réservations d'hôtel seront communiquées ultérieurement.

OIML Technical Seminar

ELECTRONIC WEIGHING INSTRUMENTS

BRAUNSCHWEIG

15-18 May 1990

An OIML Seminar on electronic weighing instruments will be held, with the support of PTB, from May 15 to May 18, 1990, in Braunschweig, Federal Republic of Germany.

The seminar is intended to bring legal metrologists together to discuss with invited industrial specialists, recent developments in both design of weighing instruments and their legal control.

Lectures will be given in either English or French without simultaneous interpretation. A typed version in the other language should whenever possible be made available by the lecturer to help those who do not understand the spoken version. It should also be possible to conduct the discussions in both languages, with the assistance of bilingual participants.

Lectures are invited on the following topics :

1 — Design and construction of electronic weighing instruments

2 — Quality assurance and self-certification, initial and subsequent verification

3 — Testing of electronic weighing instruments for pattern approval and verification

4 — Experience and problems in applying certain requirements of OIML R 76
(e.g. concerning load cells ; interfaces and peripherals ; computers forming part of the instrument).

While the above topics will deal mainly with non automatic instruments, it is also proposed that an additional subject be discussed :

5 — Technology and requirements common to both automatic and non automatic weighing instruments.

Suggestions for other topics that might be worthy of inclusion are also welcome.

The organizing committee at PTB comprises Dr Chr. U. VOLKMANN and his staff.

In order to fix the programme with the organizing committee BIML would appreciate receiving titles and half-page summaries of the papers not later than

July 31st, 1989.

Authors will be asked to submit their papers in full (before end of January 1990) so that copies may be provided for all those attending.

Those interested in the seminar should announce their intention to attend at their earliest convenience, but not later than March 31st, 1990. Further information on travel and hotel arrangements will be provided later.

QUELQUES EVENEMENTS A VENIR — SOME COMING EVENTS

6-9 juin 1989	Salon International des Capteurs de Mesure (International Sensor Exhibition), Porte de Versailles, Paris Information : CIAME, 9, rue Huysmans, 75006 Paris, France
19-22 août 1989	International Symposium on Electromagnetic Metrology ISEM 89, Beijing, China Information : Mr Zhang Zhihai, National Organizing Committee, ISEM 89, c/o Chinese Society for Measurement, P.O. Box 1413, Beijing, People's Republic of China
20-22 septembre 1989	5th Symposium on Dimensional Metrology in Production and Quality Control (IMEKO-VDE/VDI), Braunschweig, F.R. of Germany Information : VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik. Mr M. Schatz, P.O. Box 1139, D-4000 Düsseldorf 1, R.F. d'Allemagne
25-26 septembre 1989	Séminaire OIML pour pays en développement sur la planification et l'équipement des laboratoires - OIML seminar for developing countries on planning and equipping metrology and testing laboratories Information : BIML, 11, rue Turgot, 75009 Paris
9-14 octobre 1989	FLOMEKO 89 - 5th Conference on non-invasive methods of flow measurement (IMEKO-VDE/VDI), Düsseldorf, F.R. of Germany Information : VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik, P.O. Box 1139, D-4000 Düsseldorf 1, R.F. d'Allemagne
17-20 octobre 1989	9th International Congress on LPG (9e Congrès international sur le gaz naturel liquéfié - GNL 9) Palais Acropolis, Nice, France Information : Association technique de l'industrie du gaz en France, 62, rue de Courcelles, 75008 Paris, France
6-10 novembre 1989	Solid state dosimetry, Seibersdorf, Austria Information : Austrian Research Centre, A-2444 Seibersdorf, Austria
21-23 novembre 1989	Congrès International de Métrologie, Hôtel Pullman St Jacques, Paris Information : Secrétariat Métrologie 89, Tour Europe, Cedex 07, 92080 Paris La Défense
8-9 mai 1990	8th International Symposium on Hardness Testing (IMEKO-VDI/VDE) Information : VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik, Attn Mr M. Schatz, P.O. Box 1139, D-4000 Düsseldorf 1, R.F. d'Allemagne
15-18 mai 1990	Séminaire OIML sur le pesage électronique - OIML seminar on electronic weighing, Braunschweig, R.F. d'Allemagne Information : BIML, 11, rue Turgot, 75009 Paris
6-8 juin 1990	2nd International Symposium on Fluid Flow Measurement, Calgary, Canada Information : Mr John P. Erickson, P.E., American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209, U.S.A.

REUNIONS OIML

	Groupes de travail	Dates	Lieux
SP 5D - Sr 10	Mesurage massique direct en dynamique des quantités de liquides	5-6 avril 1989	TEDDINGTON ROYAUME-UNI
SP 8	Poids	7 avril 1989	TEDDINGTON ROYAUME-UNI
SP 7 - Sr 5	Instruments de pesage à fonctionnement automatique	10-14 avril 1989	TEDDINGTON ROYAUME-UNI
SP 17 et ses Secrétariats-rapporteurs	Mesure des pollutions	17-21 avril 1989	BERLIN-OUEST
SP 5D - Sr 1	Compteurs et ensembles de mesure de liquides autres que l'eau à chambres mesureuses ou à turbine	17-21 avril 1989	PARIS FRANCE
SP 5D - Sr 6	Dispositifs électroniques appliqués à la mesure des volumes de liquides		
SP 30 - Sr 13	Ethylomètres	9-12 mai 1989 *(provisoire)*	PARIS FRANCE
SP 30 et SP 30 - Sr 1, Sr 2, Sr 4, Sr 6, Sr 9, Sr 10	Mesures physico-chimiques	22-27 mai 1989	TBILISSI URSS

Conseil de la Présidence	13-14 avril 1989	BIML PARIS
Séminaire sur la planification et l'équipement de laboratoires de métrologie et d'essai + Conseil de Développement	25-26 sept. 1989	PARIS FRANCE
24e Réunion du CIML	27-29 sept. 1989	PARIS FRANCE

Note : Cette liste a été établie le 15 mars 1989 et peut ne plus être à jour.
This list was established 15th March 1989 and may no longer be up to date.

PUBLICATIONS

— Vocabulaire de métrologie légale
Vocabulary of legal metrology

— Vocabulaire international des termes fondamentaux et généraux de métrologie
International vocabulary of basic and general terms in metrology

RECOMMANDATIONS INTERNATIONALES
INTERNATIONAL RECOMMENDATIONS

R N°

1 — Poids cylindriques de 1 g à 10 kg (de la classe de précision moyenne)
Cylindrical weights from 1 g to 10 kg (medium accuracy class)

2 — Poids parallélépipédiques de 5 à 50 kg (de la classe de précision moyenne)
Rectangular bar weights from 5 to 50 kg (medium accuracy class)

3 — Voir R 76
See R 76

4 — Fioles jaugées (à un trait) en verre
Volumetric flasks (one mark) in glass

5 — Compteurs de liquides autres que l'eau à chambres mesureuses
Meters for liquids other than water with measuring chambers

6 — Dispositions générales pour les compteurs de volume de gaz
General provisions for gas volume meters

7 — Thermomètres médicaux (à mercure, en verre, avec dispositif à maximum)
Clinical thermometers (mercury-in-glass, with maximum device)

9 — Vérification et étalonnage des blocs de référence de dureté Brinell
Verification and calibration of Brinell hardness standardized blocks

10 — Vérification et étalonnage des blocs de référence de dureté Vickers
Verification and calibration of Vickers hardness standardized blocks

11 — Vérification et étalonnage des blocs de référence de dureté Rockwell B
Verification and calibration of Rockwell B hardness standardized blocks

12 — Vérification et étalonnage des blocs de référence de dureté Rockwell C
Verification and calibration of Rockwell C hardness standardized blocks

14 — Saccharimètres polarimétriques
Polarimetric saccharimeters

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

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

17 — Manomètres, vacuomètres, manovacuomètres indicateurs
Indicating pressure gauges, vacuum gauges and pressure-vacuum gauges

18 — Pyromètres optiques à filament disparaissant
Optical pyrometers of the disappearing filament type

19 — Manomètres, vacuomètres, manovacuomètres enregistreurs
Recording pressure gauges, vacuum gauges, and pressure-vacuum gauges

20 — Poids des classes de précision E_1 E_2 F_1 F_2 M_1 de 50 kg à 1 mg
Weights of accuracy classes E_1 E_2 F_1 F_2 M_1 *from 50 kg to 1 mg*

21 — Taximètres
Taximeters

22 — Tables alcoométriques internationales
International alcoholometric tables

23 — Manomètres pour pneumatiques de véhicules automobiles
Tyre pressure gauges for motor vehicles

24 — Mètre étalon rigide pour agents de vérification
Standard one metre bar for verification officers

25 — Poids étalons pour agents de vérification
Standard weights for verification officers

26 — Seringues médicales
Medical syringes

27 — Compteurs de volume de liquides (autres que l'eau). Dispositifs complémentaires
Volume meters for liquids (other than water). Ancillary equipment

28 — Voir R 76
See R 76

29 — Mesures de capacité de service
Capacity serving measures

30 — Mesures de longueur à bouts plans (calibres à bouts plans ou cales-étalons)
End standards of length (gauge blocks)

31 — Compteurs de volume de gaz à parois déformables
Diaphragm gas meters

32 — Compteurs de volume de gaz à pistons rotatifs et compteurs de volume de gaz à turbine
Rotary piston gas meters and turbine gas meters

33 — Valeur conventionnelle du résultat des pesées dans l'air
Conventional value of the result of weighing in air

34 — Classes de précision des instruments de mesurage
Accuracy classes of measuring instruments

35 — Mesures matérialisées de longueur pour usages généraux
Material measures of length for general use

36 — Vérification des pénétrateurs des machines d'essai de dureté
Verification of indenters for hardness testing machines

37 — Vérification des machines d'essai de dureté (système Brinell)
Verification of hardness testing machines (Brinell system)

38 — Vérification des machines d'essai de dureté (système Vickers)
Verification of hardness testing machines (Vickers system)

39 — Vérification des machines d'essai de dureté (systèmes Rockwell B, F, T - C, A, N)
Verification of hardness testing machines (Rockwell systems B, F, T - C, A, N)

40 — Pipettes graduées étalons pour agents de vérification
Standard graduated pipettes for verification officers

41 — Burettes étalons pour agents de vérification
Standard burettes for verification officers

42 — Poinçons de métal pour agents de vérification
Metal stamps for verification officers

43 — Fioles étalons graduées en verre pour agents de vérification
Standard graduated glass flasks for verification officers

44 — Alcoomètres et aréomètres pour alcool et thermomètres utilisés en alcoométrie
Alcoholometers and alcohol hydrometers and thermometers for use in alcoholometry

45 — Tonneaux et futailles
Casks and barrels

46 — Compteurs d'énergie électrique active à branchement direct (de la classe 2)
Active electrical energy meters for direct connection (class 2)

47 — Poids étalons pour le contrôle des instruments de pesage de portée élevée
Standard weights for testing of high capacity weighing machines

48 — Lampes à ruban de tungstène pour l'étalonnage des pyromètres optiques
Tungsten ribbon lamps for calibration of optical pyrometers

49 — Compteurs d'eau (destinés au mesurage de l'eau froide)
Water meters (intended for the metering of cold water)

50 — Instruments de pesage totalisateurs continus à fonctionnement automatique
Continuous totalising automatic weighing machines

51 — Trieuses pondérales de contrôle et trieuses pondérales de classement
Checkweighing and weight grading machines

52 — Poids hexagonaux. Classe de précision ordinaire de 100 g à 50 kg
Hexagonal weights. Ordinary accuracy class, from 100 g to 50 kg

53 — Caractéristiques métrologiques des éléments récepteurs élastiques utilisés pour le mesurage de la pression. Méthodes de leur détermination
Metrological characteristics of elastic sensing elements used for measurement of pressure. Determination methods

54 — Echelle de pH des solutions aqueuses
pH scale for aqueous solutions

55 — Compteurs de vitesse, compteurs mécaniques de distances et chronotachygraphes des véhicules automobiles - Réglementation métrologique
Speedometers, mechanical odometers and chronotachographs for motor vehicles. Metrological regulations

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

57 — Ensembles de mesurage de liquides autres que l'eau équipés de compteurs de volumes. Dispositions générales
Measuring assemblies for liquids other than water fitted with volume meters. General provisions.

58 — Sonomètres
Sound level meters

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

60 — Réglementation métrologique des cellules de pesée
Metrological regulations for load cells

61 — Doseuses pondérales à fonctionnement automatique
Automatic gravimetric filling machines

62 — Caractéristiques de performance des extensomètres métalliques à résistance
Performance characteristics of metallic resistance strain gages

63 — Tables de mesure du pétrole
Petroleum measurement tables

64 — Exigences générales pour les machines d'essai des matériaux
General requirements for materials testing machines

65 — Exigences pour les machines d'essai des matériaux en traction et en compression
Requirements for machines for tension and compression testing of materials

66 — Instruments mesureurs de longueurs
Length measuring instruments

67 — Ensembles de mesurage de liquides autres que l'eau équipés de compteurs de volumes. Contrôles métrologiques
Measuring assemblies for liquids other than water fitted with volume meters. Metrological controls

68 — Méthode d'étalonnage des cellules de conductivité
Calibration method for conductivity cells

69 — Viscosimètres à capillaire, en verre, pour la mesure de la viscosité cinématique
Glass capillary viscometers for the measurement of kinematic viscosity.

70 — Détermination des erreurs de base et d'hystérésis des analyseurs de gaz
Determination of intrinsic and hysteresis errors of gas analysers

71 — Réservoirs de stockage fixes. Prescriptions générales
Fixed storage tanks. General requirements

72 — Compteurs d'eau destinés au mesurage de l'eau chaude
Hot water meters

73 — 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
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

74 — Instruments de pesage électroniques
Electronic weighing instruments

75 — Compteurs d'énergie thermique
Heat meters

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

Partie 1 : Exigences métrologiques et techniques - Essais
Part 1 : Metrological and technical requirements - Tests

Partie 2 : Rapport d'essai de modèle
Part 2 : Pattern evaluation report

DOCUMENTS INTERNATIONAUX

INTERNATIONAL DOCUMENTS

D N°

1 — Loi de métrologie
Law on metrology

2 — Unités de mesure légales
Legal units of measurement

3 — Qualification légale des instruments de mesurage
Legal qualification of measuring instruments

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

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

6 — Documentation pour les étalons et les dispositifs d'étalonnage
Documentation for measurement standards and calibration devices

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

8 — Principes concernant le choix, la reconnaissance officielle, l'utilisation et la conservation des étalons
Principles concerning choice, official recognition, use and conservation of measurement standards

9 — Principes de la surveillance métrologique
Principles of metrological supervision

10 — Conseils pour la détermination des intervalles de réétalonnage des équipements de mesure utilisés dans les laboratoires d'essais
Guidelines for the determination of recalibration intervals of measuring equipment used in testing laboratories

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General requirements for electronic measuring instruments

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Fields of use of measuring instruments subject to verification

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Guidelines for bi- or multilateral arrangements on the recognition of : test results - pattern approvals - verifications

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Qualification of legal metrology personnel

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

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Principles of assurance of metrological control

17 — Schéma de hiérarchie des instruments de mesure de la viscosité des liquides
Hierarchy scheme for instruments measuring the viscosity of liquids

18 — Principes généraux d'utilisation des matériaux de référence certifiés dans les mesurages
General principles of the use of certified reference materials in measurements

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Pattern evaluation and pattern approval

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