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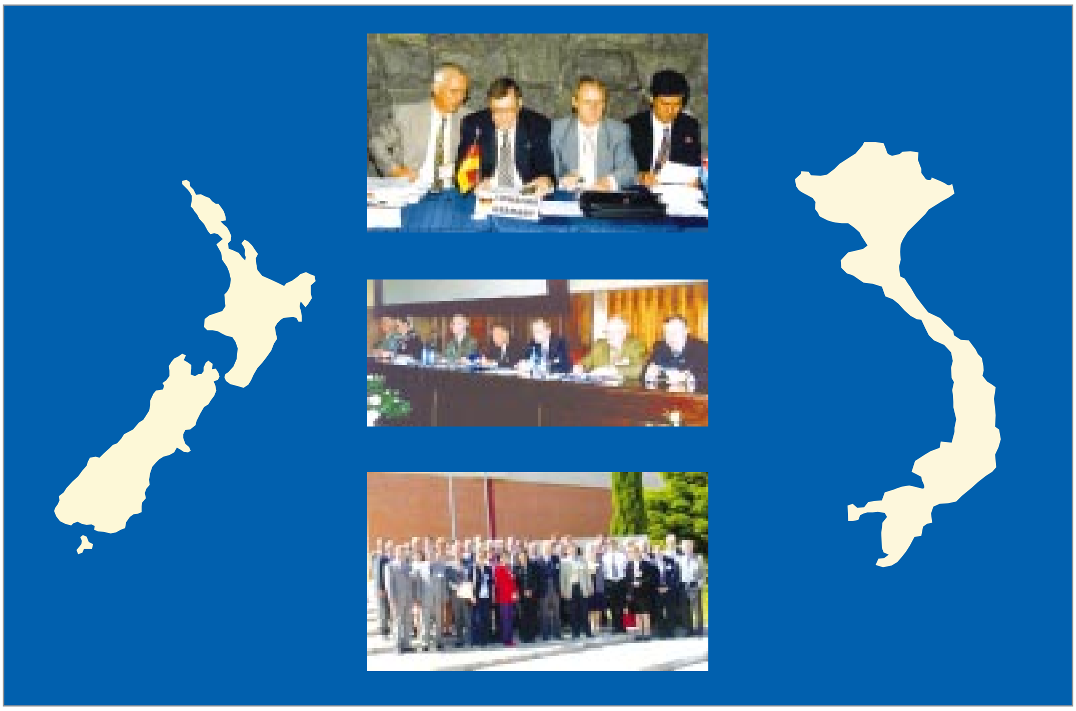

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A series of international meetings - and the OIML welcomes two new Member States: New Zealand and Vietnam

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Editorial

Jean-François Magaña
BIML Director

Welcome to our two newest Member States

OIML Membership is growing regularly and we are now pleased to announce that just as this edition of the Bulletin is going to press at the end of August, we are able to officially welcome two new Full Member States: New Zealand and Vietnam, both previously Corresponding Members.

The accession of these Countries as Full Members confirms the growing interest in the development of a *Global Legal Metrology System*, and encourages us to work actively on the basis of last year's Seminar *"What will Legal Metrology be in the Year 2020?"*, the proceedings of which were widely circulated, and the conclusions of which are being examined in detail by a small working group appointed by the CIML President.

Two Regional Awareness Seminars were organized jointly by the WTO, the IEC and the OIML during 2003 (in Peru and in Mozambique). This will hopefully aid in our task of raising awareness sufficiently to stimulate the interest of other countries in OIML work, resulting in a further increase in OIML Membership.

Several high priority projects have also significantly progressed in recent months, and in particular a very fruitful meeting was held in June 2003 in Paris, which has led to the Draft *Mutual Acceptance Arrangement* (MAA) Document being finalized with a view to its approval by the CIML in Kyoto.

Also during this meeting, significant progress was made on the Revision of OIML D 1 *Law on Metrology*. This Revision should be ready for presentation to the CIML at its 39th meeting in 2005.

All of the above goes to show the favorable situation our Organization is currently in, and we would like to thank all our Member States and Corresponding Members for their contribution to this progress. ■

Bienvenue à nos deux nouveaux États Membres

Le nombre de Membres de l'OIML augmente régulièrement, et nous sommes heureux d'annoncer qu'à ce jour de fin août où ce numéro du Bulletin part à l'impression, nous accueillons officiellement comme nouveaux États Membres la Nouvelle Zélande et le Vietnam, jusqu'ici tous deux Membres Correspondants.

L'accession de ces pays comme États Membres confirme l'intérêt croissant dans le développement d'un *Système Mondial de Métrologie Légale*, et nous encourage à travailler activement sur les bases du Séminaire de l'année dernière *"Que sera la Métrologie Légale en 2020?"*, dont les actes ont été largement diffusés, et dont les conclusions sont examinées en détail par un petit groupe de travail désigné par le Président du CIML.

Deux Séminaires Régionaux de sensibilisation ont été organisés conjointement par l'OMC, l'OIML et la CEI en 2003 (au Pérou et au Mozambique). Nous espérons que ceci contribuera à nos efforts de sensibilisation des autres pays aux travaux de l'OIML, et aura pour conséquence d'accroître encore le nombre d'États Membres de l'OIML.

Plusieurs projets de haute priorité ont aussi marqué des progrès significatifs dans les derniers mois, et en particulier une réunion très fructueuse s'est tenue en juin 2003 à Paris, qui a débouché sur le Projet de Document *Arrangement Mutuel d'Acceptation* (MAA), finalisé en vue de son approbation par le CIML à Kyoto.

Lors de cette réunion, des progrès significatifs ont également été accomplis sur la Révision du Document D 1 *"Loi de Métrologie"*. Cette Révision devrait être prête pour être présentée à la 39ème Réunion du CIML en 2005.

Tout ceci témoigne de la bonne santé de notre Organisation, et nous tenons à remercier tous nos États Membres et Membres Correspondants pour leur contribution à ces progrès. ■

WEIGHTS

Selection of standard weights for calibration of weighing instruments

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Abstract

This paper deals with the selection of standard weights or test loads for the calibration of single-interval weighing instruments. Four tables are given for the selection of weights of at most 50 kg. The tables contain information about the accuracy of the weights and the instruments to be calibrated. According to the accuracy of the instrument a table is chosen; with its aid the weights are selected so that their accuracy is appropriate in relation to that of the instrument.

1 Introduction

The weights dealt with here are those given in OIML Recommendations:

R 111, "Weights of classes E_1, E_2, F_1, F_2, M_1, M_2, M_3" (1994) [1] or

R 47, "Standard weights for testing of high capacity weighing machines" (1979–1978) [2]

R 111 covers weights of at most 50 kg and R 47 those from 50 kg to 5000 kg. Their errors are measured in connection with either the calibration or the verification of the weights. In both these cases the following conditions are supposed to be met:

1) The errors of the weights comply with the maximum permissible errors (mpe's) given in the Recommendations;
2) The measurement uncertainty of the error of each weight is a fractional part of the mpe of the weight (usually at most 1/3 × mpe). This uncertainty is the uncertainty of the weight.

A generally accepted principle for selecting the weights for calibrating an instrument is that the accuracy of the weights should be appropriate in relation to that of the instrument and the influence of the errors of the weights on the calibration results should be controlled.

One way to achieve this is to select the weights for each applied load so that the quotient of the error of the weights and a certain error of the instrument specified by its user (maximum tolerable error) is not greater than a chosen fraction.

Usually, the value of the fraction chosen is 1/3, but sometimes it is 1/6. The idea of using 1/6 is explained in 4.2.2.

The user can specify the maximum tolerable errors, e.g. by giving maximum differences between the indications of the instrument and the corresponding true values, as determined by the weights. In other words, he gives limits for the errors of the instrument obtained by means of calibration, and his expectation is that the errors are within the limits, the maximum tolerable errors. This is dealt with in more detail in Section 2.

In Section 3 the general rules for selecting R 111 and R 47 weights for the calibration of instruments are given, though these have been dealt with previously in the author's publication *Calibration of Weighing Instruments and Uncertainty of Calibration* [3]. However, the main subject of this paper is to select the weights of class E_2 to M_3 of R 111 (class E_1 is not dealt with here) using the tables given at the end of Section 4.

2 Maximum tolerable errors (MTEs) of instruments

Suppose that the user of an instrument has selected an error f representing the accuracy of the instrument or the accuracy of weighing with it (compare f with e in OIML R 76-1, T.3.2.3, 2.2 and 3.5.1 [4]). f may equal the scale interval of the instrument or a multiple thereof (OIML R 76-1, T.3.2.2). With the aid of f the user can define the maximum tolerable errors (MTEs) of the instrument. The MTEs can be:

± f for all the loads, or

± 0.5 f or ± f for certain "small" loads but ± f or ± 2 f for the larger loads, or

± 0.5 f or ± f for "small" loads, ± f or ± 2 f for certain "medium" loads and ± 1.5 f or ± 3 f for larger loads.

In the following the absolute values |MTE| of the MTEs are used. The cases:

1) |MTE| = 0.5 f, f & 1.5 f; 0.5 f & f, or only f

and

2) |MTE| = f, 2 f & 3 f, or f & 2 f

are dealt with separately.

The "small" and "medium" loads expressed in terms of f are defined in 4.3.

3 General rules for selecting the weights used for calibrating instruments

The quotient Max/f, where Max is the maximum weighing capacity of the instrument, plays an important role. It is used in the tables in Section 4 but also in one of the following rules based on the requirement of R 76-1, 3.7.1 concerning standard weights for the verification of instruments.

3.1 Verified weights

3.1.1 Weights of at most 50 kg (R 111)

The sum of the absolute values of the mpe's (sum of |mpe|'s) of the weights shall not be greater than 1/3 or 1/6 of the |MTE| of the instrument for the applied load (1/3 is used in R 76-1).

3.1.2 Weights from 50 kg to 5000 kg (R 47)

For these weights, rule 3.1.1 with the fraction 1/3 can be considered to be met if Max/f of the instrument is equal to or less than the n marked on the weights.

3.2 Calibrated weights

3.2.1 Errors of the indications of the instrument are not corrected for the errors of the weights

The sum of the absolute values of the errors of the weights shall not be greater than 1/3 or 1/6 of the |MTE| of the instrument for the applied load. However, on the basis of condition 1) in "Introduction" this rule is replaced with rule 3.1.1 here.

3.2.2 Errors of the indications of the instrument are corrected for the errors of the weights

The sum of the absolute values of the uncertainties of the weights shall not be greater than 1/3 of the |MTE| of the instrument for the applied load. The fraction 1/6 is not used here for this case.

3.3 Rules 3.1.1 to 3.2.2 only approximately met

Sometimes it is reasonable to allow the previous rules to be met only approximately. For example, 3.1.1 with the fraction 1/3 is approximately met if the sum of the |mpe|'s of the weights exceeds the limit 1/3 × |MTE| and the quotient of the excess and the limit is less than or about 1/10 for the applied load. This is applied similarly to the other rules too.

4 Tables for selecting weights of class E_2 to M_3 (R 111) according to Max/f of the instrument

4.1 General

4.1.1 Scope

Tables 1, 2, 3 and 4 at the end of this section cover the selection of the weights of class E_2 to M_3 of R 111 according to Max/f of the instrument to be calibrated. The tables are compiled so that the weights selected with their aid meet rule 3.1.1 above without any further action, however, with the exception of the weights for instruments/balances with "very" high Max/f.

The weights dealt with here are normally verified weights, but under the practice of 3.2.1 calibrated weights may also be concerned. The weights for the balances with "very" high Max/f are calibrated weights of class E_2 which meet rule 3.2.2, if applicable. This is one of the two procedures to be dealt with in the tables.

4.1.2 Differences between the tables

In Tables 1 and 2 the values of |MTE| are: 0.5 f, f & 1.5 f or 0.5 f & f, or only f, and in Tables 3 and 4: f, 2 f & 3 f or f & 2 f (if |MTE| only takes on the value f, Table 1 or 2 is referred to). The fraction is 1/3 in Tables 1 and 3 and 1/6 in Tables 2 and 4.

4.1.3 *Selection of a table, its use, groups 1), 2), 3) and 4) of the instruments and procedures*

The table is selected according to |MTE| and the fraction 1/3 or 1/6. Then Max/f of the instrument/ balance is calculated and, following the instructions given in the tables, it is assigned to one of the following groups (compare the groups with the accuracy classes for instruments/balances in R 76-1, 3.1.1 and 3.2):

Group 1): Special balances (Max/f is unlimited, special accuracy)

Group 2): Laboratory or precision balances (Max/f ≤ 100 000, high accuracy)

Group 3): Instruments for industrial weighing (Max/f ≤ 10 000, medium accuracy)

Group 4): Instruments for industrial weighing (Max/f ≤ 1 000, low accuracy)

On the basis of Max/f and the group of the instrument/balance the accuracy class of the weights, or the procedure to be applied (see 4.1.1), is obtained from the table chosen.

The procedures are:

- "Apply 3.2.2" or "No calibration". If Max/f is high enough, they are applied for some balances of Group 1).
- "Apply 3.2.2" means that calibrated weights of class E_2 are selected applying 3.2.2 and "No calibration" means that some balances are not calibrated with the weights dealt with here. The procedure "Apply 3.2.2" is used for Tables 1 and 3. It cannot be used for Tables 2 and 4 because the fraction is 1/6 for them. Due to this fraction rule 3.2.2 is excluded. Therefore, the procedure "No calibration" has to be used for Tables 2 and 4 instead of "Apply 3.2.2". Note that the highest value of Max/f dealt with in the tables is 650 000. More information about the use of the tables is given in the text below each table.

If weights ≤ 50 g are selected, problems caused by these weights are explained in 4.4. The application of the tables to the selection of the weights for verification of instruments/balances is dealt with in 4.5.

4.2 Practical use of the tables

The use of Tables 1, 2, 3 and 4 is illustrated in 4.2.1 to 4.2.4 by means of examples. In order to use the tables properly the "small" and "medium" loads for which the values of |MTE| are given in Section 2 should be defined. This is done in 4.3.

4.2.1 *Table 1*

This table is for |MTE| = 0.5 f, f & 1.5 f; 0.5 f & f or only f and for the fraction 1/3. Table A in 4.3 shows in which cases the values of |MTE| are used. According to Max/f and the group of the instrument/balance the accuracy class E_2 to M_3 of the weights (3.1.1 or 3.2.1) or the procedure "Apply 3.2.2" is obtained from Table 1.

Example 1: Group 4): Instruments for industrial weighing (Max/f ≤ 1 000, low accuracy)

a) If Max/f ≤ 660, weights of class M_3 are selected irrespective of the possible values of |MTE|. (Consider an instrument with Max 6 600 g, f = 10 g and Max/f = 660. Let the weights for the Max load be 5 kg, 1 kg , 500 g and 100 g of class M_3. Their |mpe|'s are 2.5 g, 0.5 g, 0.25 g and 0.05 g respectively.

1) Let |MTE| assume the value f = 10 g for all the loads. For the Max load the sum of the |mpe|'s of the weights is Σ|mpe| = (2.5 + 0.5 + 0.25 + 0.05) g = 3.3 g ≈ 1/3 × |MTE| ≈ 3.3 g.

2) Let |MTE| assume the values 0.5 f = 5 g, f = 10 g & 1.5 f = 15 g so that |MTE| = 0.5 f is used for the loads a) from 0 to 50 f (the loads are expressed in terms of f), |MTE| = f for the loads, b) > 50 f but ≤ 200 f and |MTE| = 1.5 f for the loads, c) over 200 f to Max. Let us investigate the sums Σ|mpe| of the weights (the test loads) which can be used at the greatest loads of the ranges a), b) and c) respectively. For the greatest load of the range a) Σ|mpe| = 0.25 g < 1/3 × 0.5 f ≈ 1.7 g, for that of b) Σ|mpe| = 1 g < 1/3 × f ≈ 3.3 g and for that of c) Σ|mpe| = 3.3 g < 1/3 × 1.5 f = 5 g).

b) If 660 < Max/f ≤ 1 000
- and |MTE| takes on the values 0.5 f, f & 1.5 f, the class is M_3
- the class is M_2 if |MTE| takes on the values 0.5 f & f or only f.

Example 2: Group 3): Instruments for industrial weighing (Max/f ≤ 10 000, medium accuracy)

If 2 200 < Max/f ≤ 3 300
- and |MTE| takes on the values 0.5 f, f & 1.5 f, the class is M_2
- the class is M_1 if |MTE| takes on the values 0.5 f & f or only f.

Example 3: Group 2): Laboratory or precision balances (Max/f ≤ 100 000, high accuracy)

Max/f = 6 500 (also see 4.4)

a) Consider a balance with Max 650 g and f = 0.1 g
- let |MTE| be 0.5 f = 0.05 g for loads ≤ 500 g and f = 0.1 g for > 500 g to 650 g. The quotient L/(0.5 f) = 500/0.05 has to be compared with Max/f = 6 500. Because 500/0.05 > 6 500 (L/(0.5 f) > Max/f), class

F_2 has to be used. Note that M_1 would be suitable for the load 650 g but not for 500 g. (For 650 g the sum of the |mpe|'s for weights of class M_1 is (25 + 5 + 3) mg = 33 mg ≈ 1/3 × |MTE| = 1/3 × 0.1 g ≈ 33 mg but for 500 g it is 25 mg > 1/3 × |MTE| = 1/3 × 0.05 g ≈ 16.7 mg).

- M_1 would be suitable if the choice of the values of |MTE| were made so that |MTE| = 0.5 f is used for loads ≤ 300 g and |MTE| = f for > 300 g to 650 g (*thus L/(0.5 f) = 300 g/(0.5 f) < Max/f*), or if |MTE| = f for all loads.

b) Consider a balance with Max 65 g and f = 10 mg. Obviously, the weights used are ≤ 50 g and they should be of class F_2 irrespective of the possible values of |MTE|.

Example 4: Group 1): Special balances (Max/f unlimited, special accuracy)

a) If 65 000 < Max/f ≤ 200 000 (also see 4.4)

- and |MTE| assumes the possible values 0.5 f & f or only f, weights of class E_2 are selected
- exceptionally, if weights of ≤ 50 g are used, 170 000 < Max/f < 200 000 and f = 1 mg, *calibrated* weights of class E_2 are selected applying 3.2.2, i.e., the procedure "Apply 3.2.2" is used. Such a balance might have Max 190 g, f = 1 mg, Max/f = 190 000. However, if f > 1 mg (e.g., Max 380 g, f = 2 mg, Max/f = 190 000), weights (3.1.1 or 3.2.1) of class E_2 are used.

b) If 200 000 < Max/f ≤ 300 000 (also see 4.4)

- and |MTE| = 0.5 f, f & 1.5 f, the class of the weights is E_2. (Consider a balance with Max 290g, f = 1mg, Max/f = 290 000 and |MTE| = 0.5 f, f & 1.5 f. Let the weights for the Max load be 200 g, 50 g and two of 20 g of class E_2. The sum of their |mpe|'s is (0.30 + 0.10 + 2 × 0.080) mg = 0.56 mg which exceeds 1/3 × |MTE| = 1/3 × 1.5 mg = 0.5 mg by 0.06 mg. This excess is neglected (3.3) because 0.06 mg/0.5 mg is near to 1/10).
- if |MTE| = 0.5 f & f or only f, *calibrated* weights of class E_2 are selected applying 3.2.2, i.e., the procedure "Apply 3.2.2" is used.

4.2.2 Table 2 and the idea of using the fraction 1/6

In this table |MTE| = 0.5 f, f & 1.5 f; 0.5 f & f or only f as in Table 1 but the fraction is 1/6. Table A in 4.3 shows in which cases the values of |MTE| are used. According to Max/f and the group of the instrument/balance the accuracy class E_2 to M_3 of the weights (3.1.1 or 3.2.1) or the procedure "No calibration" is obtained from Table 2.

When the weights of class E_2 to M_3 selected by means of Table 2 (with the fraction 1/6) are used for the calibration of instruments/balances, the consequences of their errors could be as follows.

1) If the weights are within the mpe's, as they should be, the sum of their |mpe|'s is ≤ 1/6 × |MTE| of the instrument/balance for the applied load. The sum reveals the influence of the errors of the weights on the calibration results.

2) Suppose that due to wear and tear the weights are not within the mpe's. However, if their errors can be estimated to be within the mpe's multiplied by 2, the weights can conditionally be used for the calibration of instruments/balances. The sum of the doubled |mpe|'s of the weights is ≤ 1/3 × |MTE|. So the influence of the errors of the weights on the calibration results is twice that in 1) and thus at most 1/3 × |MTE|. If this is accepted, the calibration with these weights can be regarded as correct.

A) In case 2), the increase of the influence of the errors of the weights from ≤ 1/6 × |MTE| to ≤ 1/3 × |MTE| has to be accepted. In principle this is not difficult because ≤ 1/3 × |MTE| is a generally accepted influence. Because the errors of the weights may exceed the limits of the mpe's even by 100 %, the period of readjustment of the weights can be extended. This is a considerable advantage. From this angle there are reasons to apply the fraction 1/6.

B) If the aim is to minimize the uncertainty of the calibration of instruments/balances, the influence of the errors of the weights should be kept as small as possible. ≤ 1/6 × |MTE| could be suitable. Therefore, the errors of the weights should strictly be within the mpe's as in 1) and the fraction 1/6 should be applied.

Note 1: In R 111 mpe's on initial verification (mpe's in 1) above) and in service are given. The latter are twice the mpe's on initial verification. The mpe's in service can be used in situations similar to the following. Parties concerned by weighings with legally controlled instruments/balances (e.g., non-self-indicating instruments) in which balance (the position of equilibrium) is obtained with the aid of weights, want to check whether the weights used are "acceptable". The weights were adjusted to be within the mpe's on initial verification. Now the errors of the weights are acceptable if they are within the mpe's in service. One could say that the mpe's in service give the user of the instrument protection against complaints about the incorrectness of the results of the instrument as far as the weights are concerned.

Note 2: Notwithstanding 2) above the weights, the errors of which are within the mpe's in service, are not for calibration, verification or testing of instruments/balances.

Example 5: Group 3): Instruments for industrial weighing (Max/f ≤ 10 000, medium accuracy)

If 1 100 < Max/f ≤ 3 300, the class is M_1 irrespective of |MTE|. (Consider an instrument with Max 6 000 g, f = 2 g, Max/f = 3 000 and |MTE| = f = 2 g for all the loads. Let the weights for the Max load be 5 kg and 1 kg of class M_1. The sum of their |mpe|'s is (250 + 50) mg = 0.30 g < 1/6 × |MTE| = 1/6 × 2 g ≈ 0.33 g).

Example 6: Group 2): Laboratory or precision balances (Max/f ≤ 100 000, high accuracy)

Max/f = 6 500 (6 000 < Max/f ≤ 11 000; also see 4.4)

a) Consider a balance with Max 650 g and f = 0.1 g. Let |MTE| be 0.5 f = 0.05 g for loads ≤ 500g and f = 0.1 g for > 500 g to 650 g. Weights of class F_2 are selected.
b) Consider a balance with Max 65 g and f = 10 mg. Obviously, the weights used are ≤ 50 g and they should be of class F_1 irrespective of the possible values of |MTE|.

Example 7: Group 1): Special balances (Max/f unlimited, special accuracy)

If Max/f ≤ 60 000 (also see 4.4)

- and the weights are > 50 g, calibration is performed with the weights of class E_2
- if the weights are ≤ 50 g and |MTE| = 0.5 f & f, calibration is not performed with the weights dealt with here, i.e., the procedure "No calibration" is used. However, calibration is performed with the weights ≤ 50 g of class E_2 if |MTE| = f for all the loads.

4.2.3 Table 3

Table 3 is for |MTE| = f, 2 f & 3 f or f & 2 f and for the fraction 1/3. If |MTE| = f for all the loads, apply Table 1. Table B in 4.3 shows in which cases the values of |MTE| are used. According to Max/f and the group of the instrument/balance the accuracy class E_2 to M_3 of the weights (3.1.1 or 3.2.1) or the procedure "Apply 3.2.2" is obtained from Table 3.

Example 8: Group 2): Laboratory or precision balances (Max/f ≤ 100 000, high accuracy)

Max/f = 6 500 (also see 4.4)

a) Consider a balance with Max 650 g and f = 0.1 g. Let |MTE| be f = 0.1 g for loads ≤ 500 g and 2 f =0.2 g for > 500 g to 650 g. Weights of class M_1 are selected.
b) Consider a balance with Max 65g and f = 10 mg. Let |MTE| be f = 10 mg for loads ≤ 50 g and 2 f = 20 mg for > 50 g to 65 g. Weights of class M_1 are selected.

4.2.4 Table 4

Table 4 is for |MTE| = f, 2 f & 3 f or f & 2 f and for the fraction 1/6. If |MTE| = f for all the loads, apply Table 2. Table B in 4.3 shows in which cases the values of |MTE| are used. According to Max/f and the group of the instrument/balance the accuracy class E_2 to M_3 of the weights (3.1.1 or 3.2.1) or the procedure "No calibration" is obtained from Table 4.

The consequences of using the fraction 1/6 are the same as in 1) and 2) in 4.2.2.

Example 9: Group 2): Laboratory or precision balances (Max/f ≤ 100 000, high accuracy)

Max/f = 6 500 (also see 4.4)

a) Consider a balance with Max 650 g and f = 0.1 g
   - let |MTE| be f = 0.1 g for loads ≤ 500 g and 2 f = 0.2 g for > 500 g to 650 g. The class is F_2 because L/f = 500 g/0.1 g = 5 000 > 3 000 (e.g. F_2 is necessary for the load 500 g)
   - if |MTE| = f = 0.1 g for loads ≤ 300 g and 2 f = 0.2 g for >300 g to 650 g, then L/f = 300 g/0.1 g = 3 000. So weights of class M_1 are selected.
b) Consider a balance with Max 65 g and f = 10 mg. Let |MTE| be f = 10 mg for loads ≤ 50 g and 2 f = 20 mg for > 50 g to 65 g. Because the weights for this balance are ≤ 50 g their class is F_2.

4.3 Values of |MTE| for Tables 1, 2, 3 and 4

The following auxiliary tables A and B give the values of |MTE| which are to be used when selecting weights for the calibration of instruments/balances with the aid of Tables 1, 2, 3 and 4. Table A (for Tables 1 and 2) and B (for Tables 3 and 4) are patterned on the model of R 76-1, 3.5.1.

Definition 1: "Small" loads for an instrument/ balance (expressed in terms of f) are those less than or equal to some chosen load which is not greater than 50 000 f, 5 000 f, 500 f or 50 f for groups 1), 2), 3) or 4) respectively. For example, for a balance of group 2) the "small" loads can be from 0 to 5 000 f or from 0 to a load less than 5 000 f, say, 3 000 f. 5 000 f or 3 000 f is the greatest "small" load L.

Example 10: If Max of a balance of group 2) equals 15 000 f, then Max/f = 15 000 and thus < 20 000. If the greatest "small" load L is 3 000 f, then according to Table A |MTE| is 0.5 f for the loads from 0 to 3 000 f and f for the loads over 3 000 f to Max. |MTE| can also be chosen to be only f from 0 to Max.

Definition 2: "Medium" loads for an instrument/ balance (expressed in terms of f) are those

Table A The values of |MTE| = 0.5 f, f & 1.5 f, or 0.5 f & f, or only f in relation to Max/f and the group of an instrument/balance for Tables 1 and 2 (the groups are defined in 4.1.3)

Max/f of an instrument/balance in:				
Group 1)	Group 2)	Group 3)	Group 4)	|MTE|
≤ 50 000	≤ 5 000	≤ 500	≤ 50	only f [1)]
≤ 200 000 [2)]	≤ 20 000 [2)]	≤ 2 000 [2)]	≤ 200 [2)]	0.5 f & f, or only f [3)]
> 200 000	> 20 000	> 2 000	> 200	0.5 f, f &1.5 f, or 0.5 f & f, or only f [4)]

[1)] from 0 to the greatest "small" load L (see Definition 1). In this case L = Max for the instrument/balance.
[2)] but greater than L/f in the same group.
[3)] 0.5 f for the "small" loads and f for larger loads, or only f for all the loads (see Example 10).
[4)] 0.5 f for the "small" loads, f for the "medium" loads (see Definition 2) and 1.5 f for the larger loads but |MTE| can also be chosen to be 0.5 f for the "small" loads and f for larger loads, or only f for all the loads.

Table B The values of |MTE| = f, 2 f & 3 f, or f & 2 f in relation to Max/f and the group of an instrument/balance for Tables 3 and 4 (the groups are defined in 4.1.3). (If for an instrument/ balance |MTE| = f for all the loads, then according to 4.2.3 and 4.2.4 Table 1 or 2 is used instead of Table 3 or 4 respectively.)

Max/f of an instrument/balance in:				
Group 1)	Group 2)	Group 3)	Group 4)	|MTE|
≤ 200 000 [1)]	≤ 20 000 [1)]	≤ 2 000 [1)]	≤ 200 [1)]	f & 2 f [2)]
> 200 000	> 20 000	> 2 000	> 200	f, 2 f & 3 f, or f & 2 f [3)]

[1)] but greater than L/f in the same group (L = the greatest "small" load, see Definition 1).
[2)] f for the "small" loads and 2 f for larger loads.
[3)] f for the "small" loads, 2 f for the "medium" loads (Definition 2) and 3 f for the larger loads but |MTE| can also be chosen to be f for the "small" loads and 2 f for larger loads (see Example 11 below).

greater than the greatest "small" load L but not greater than 200 000 f, 20 000 f, 2 000 f or 200 f for groups 1), 2), 3) or 4) respectively. For example, if the "small" loads for an instrument of group 3) are from 0 to 300 f, the "medium" loads are in the interval over 300 f to 2 000 f. *Note*: The lower limit of the "medium" loads is not predetermined because it depends on the choice of the greatest "small" load L. However, the corresponding upper limit is. It takes on the values 200 000 f to 200 f in the different groups respectively.

Example 11: If Max of an instrument of group 3) equals 2 500 f, then Max/f = 2 500 and thus > 2 000. Let the greatest "small" load L be 400 f. According to Table B |MTE| is f for the loads from 0 to 400 f, 2 f for the "medium" loads over 400 f to 2 000 f and 3 f for the loads over 2 000 f to Max. |MTE| can also be chosen to be f from 0 to 400 f and 2 f for the loads over 400 f to Max = 2 500 f.

4.4 Weights of nominal values ≤ 50 g

There are problems when selecting weights for balances in group 1) or 2), especially if weights of ≤ 50 g are to be used for the Max load.

In order to explain the nature of the problems consider Max 65 kg and Max 65 g balances both in group 1) with Max/f = 65 000. For the Max 65 kg balance the sum of the |mpe|'s of class F_1 weights of > 50 g is slightly below the limit 1/3 × |MTE| for the Max load (3.1.1), but for the Max 65 g balance the corresponding sum of the class F_1 weights of ≤ 50 g exceeds the limit.

In the tables the above problem is solved by giving two accuracy classes for some balances in group 1) or 2). One class is for weights > 50 g for balances with certain Max/f 's and "large" Max loads (e.g: F_1, Max/f = 65 000, Max 65 kg,), and the other for weights ≤ 50 g for balances with the same Max/f 's as above and "small" Max loads respectively (e.g.: E_2, Max/f = 65 000, Max 65 g).

Note: For a "large" Max load, e.g. 650 g there is no problem with a single weight of ≤ 50 g (i.e., weights of > 50 g are dominating) but for a "small" Max load, e.g. Max near to 100 g there may be.

In the column "Instruments/balances" of the tables several intervals of the values of Max/f are given. When using only weights > 50 g for balances of group 1) and 2) the upper limits of the intervals could be higher than those given in the tables. For example, in Table 1 the upper limits 20 000 (6 500 < Max/f ≤ 20 000) and 300 000 (200 000 < Max/f ≤ 300 000) could be raised to 22 000 and 330 000 respectively. But if weights ≤ 50 g were selected using the tables with the higher limits, their accuracy would not be suitable in all cases. Since weights ≤ 50 g are important for the calibration of the balances in question the limits have not been raised. As a result of this weights > 50 g selected using the tables may sometimes be more accurate than necessary.

4.5 Use of the tables to select weights for verification of instruments/balances

Table 1 or 2 (|MTE| = 0.5 f, f &1.5 f; 0.5 f & f, or f) can be applied to select the weights for the verification of instruments/balances. Then "f" is replaced with "e", "MTE" with "MPE"(maximum permissible error for instruments/balances), the "groups 1), 2), 3) and 4)" of the instruments/balances with the "accuracy classes I, II, III and IIII" respectively and "calibration" with "verification". If in Table 1 or 2:

1) only one accuracy class of weights is given for instruments/balances with a certain n = Max/e, then the correct class is obtained from the tables without any further action.
2) two accuracy classes of weights are given for instruments/balances with a certain n = Max/e, then to choose the right class the OIML requirements in R 76-1, 3.2 and 3.5.1 have to be taken into account. This is elucidated in the following.

4.5.1 |MPE |= 0.5 e, e & 1.5 e

For certain instruments/balances in Table 1 and 2 the accuracy classes of the weights are given in the form e.g.: *M_2 (M_1 if |MTE| = 0.5 f & f or f)*
or *F_2 (F_1 if |MTE| = 0.5 f & f or f).*

Use the replacements for |MTE|, f and groups 1) to 4) as given above. These accuracy classes are for instruments/balances with n = Max/e > 200 000 in class I, n > 20 000 in class II, n > 2 000 in class III or n > 200 in class IIII. Thus the values of the |MPE|'s to be applied are 0.5 e, e & 1.5 e. According to the information on the use of the tables (given in the text below the tables) the accuracy class of the weights given first (M_2 or F_2 in the above examples) is used. The second accuracy class given in parentheses is to be ignored because the condition *"if |MPE |= 0.5 e & e or e"* is not in accordance with the OIML requirements for the instruments/balances in question.

4.5.2 |MPE |= 0.5 e & e

For some balances in Table 1 and 2 there are accuracy classes of the weights in the form e.g.: *M_1 (F_2 if [1]). F_2 if |MTE| = 0.5 f & f and L/(0.5 f) > Max/f ...), F_2 (F_1 if [1])* or *E_2 (No calibration if [1] and |MTE|= 0.5 f & f).* [1] refers to the use of weights of ≤ 50 g. Use the replacements for |MTE|, f, groups 1) to 4) and calibration. This concerns class I balances with n = Max/e ≤ 200 000 but n > 50 000 and class II balances with n ≤ 20 000 but n > 5 000. The values of the |MPE|'s to be applied are 0.5 e & e. Accuracy classes of the weights similar to those in the above examples, and in advice under the heading "Exception" in Table 1, can be used. However, one has to check that only those instructions in the tables are followed which are or lead to results which are compatible with the OIML requirements (also see 4.5.4).

4.5.3 |MPE |= 0.5 e

In the case where |MPE| = 0.5 e is used for all the loads (e.g., n = Max/e = 50 000 and e ≥ 1 mg for class I balances or n = 5 000 and e ≥ 0.1 g for class II balances), Table 1 or 2 is exceptionally applied so that the weights are chosen according to Max/f where f = 0.5 e.

4.5.4 Restriction concerning balances of class II

The sections of Tables 1 and 2 which are intended for class II balances (originally intended for group 2) balances) can be used for the selection of weights only if for the balances e ≥ 10 mg. So if 1 mg ≤ e ≤ 5 mg (R 76-1, 3.2) for class II balances with |MPE|'s of 0.5 e & e, or only 0.5 e, the weights cannot be obtained correctly from the tables in all cases.

Table 1 Max/f and accuracy classes E_2 to M_3 of weights or procedure to be applied

* $\lvert\text{MTE}\rvert$ of the instrument/balance takes on the values: 1) 0.5 f, f & 1.5 f or 2) 0.5 f & f or 3) only f (the values are chosen following the instructions in Table A in 4.3)
* The fraction is 1/3 (the error of the weights shall not be greater than 1/3 × $\lvert\text{MTE}\rvert$ for the applied load)

Instruments/balances Max/f	**Weights** Accuracy class or procedure
Group 1): Special balances (Max/f unlimited, special accuracy); f ≥ 1 mg, e.g. f = 1 mg, 2 mg, 5 mg, 10 mg, 20 mg, etc.	
300 000 < Max/f ≤ 650 000	Apply 3.2.2
200 000 < Max/f ≤ 300 000	E_2 (Apply 3.2.2 if $\lvert\text{MTE}\rvert$ = 0.5 f & f or f)
65 000 < Max/f ≤ 200 000	E_2 <u>Exception</u>: Apply 3.2.2 if [1)], 170 000 < Max/f < 200 000 and f = 1 mg (E_2 if f >1 mg)
Max/f ≤ 65 000	F_1 (E_2 if [1)]. E_2 if $\lvert\text{MTE}\rvert$ = 0.5 f & f and L/(0.5 f) > Max/f [2)]; L is the greatest "small" load (4.3) for which $\lvert\text{MTE}\rvert$ = 0.5 f)
Group 2): Laboratory or precision balances (Max/f ≤ 100 000, high accuracy); f ≥ 10 mg, e.g., f = 10 mg, 20 mg, 50 mg or ≥ 0.1 g.	
65 000 < Max/f ≤ 100 000	F_1 (E_2 if $\lvert\text{MTE}\rvert$ = 0.5 f & f or f)
30 000 < Max/f ≤ 65 000	F_1
20 000 < Max/f ≤ 30 000	F_2 (F_1 if $\lvert\text{MTE}\rvert$ = 0.5 f & f or f)
6 500 < Max/f ≤ 20 000	F_2 <u>Exception</u>: F_1 if [1)] , 17 000 < Max/f < 20 000 and f = 10 mg (F_2 if f > 10 mg)
Max/f ≤ 6 500	M_1 (F_2 if [1)]. F_2 if $\lvert\text{MTE}\rvert$ = 0.5 f & f and L/(0.5 f) > Max/f [3)]; L is the greatest "small" load (4.3) for which $\lvert\text{MTE}\rvert$= 0.5 f)
Group 3): Instruments for industrial weighing (Max/f ≤ 10 000, medium accuracy); f ≥ 1 g, e.g., f = 2 g or 20 kg.	
6 600 < Max/f ≤ 10 000	M_1 (F_2 if $\lvert\text{MTE}\rvert$ = 0.5 f & f or f)
3 300 < Max/f ≤ 6 600	M_1
2 200 < Max/f ≤ 3 300	M_2 (M_1 if $\lvert\text{MTE}\rvert$ = 0.5 f & f or f)
Max/f ≤ 2 200	M_2
Group 4): Instruments for industrial weighing (Max/f ≤ 1 000, low accuracy); f ≥ 5 g, e.g., f = 50 g or 50 kg.	
660 < Max/f ≤ 1 000	M_3 (M_2 if $\lvert\text{MTE}\rvert$ = 0.5 f & f or f)
Max/f ≤ 660	M_3

1) Weights of ≤ 50 g are used (4.4).
2) F_1 if L/(0.5 f) ≤ Max/f, or if $\lvert\text{MTE}\rvert$ = f for all the loads. Weights of > 50 g are used/dominating (4.4).
3) M_1 if L/(0.5 f) ≤ Max/f, or if $\lvert\text{MTE}\rvert$ = f for all the loads. Weights of > 50 g are used/dominating (4.4).

In the column "Weights" the accuracy classes of the weights (3.1.1 or 3.2.1) and the procedure "Apply 3.2.2" (4.1.3) are given for the instruments/balances to be calibrated.

If there is only one accuracy class corresponding to a Max/f, it can be used irrespective of the values of $\lvert\text{MTE}\rvert$ given in 1), 2) or 3) above. Frequently, another accuracy class along with conditions for its use is given in parentheses. This class must be applied if the conditions are met, e.g., if $\lvert\text{MTE}\rvert$ = 0.5 f & f or f . Otherwise if $\lvert\text{MTE}\rvert$ = 0.5 f, f & 1.5 f, the class given first is used.

This scheme is analogously applied to the case where the procedure "Apply 3.2.2" is used. For example, if only "Apply 3.2.2 " is given, it is applied irrespective of the values of $\lvert\text{MTE}\rvert$.

Advice under the heading "<u>Exception</u>" is for certain special cases.

Table 2 Max/f and accuracy classes E_2 to M_3 of weights or procedure to be applied

* |MTE| of the instrument/balance takes on the values: 1) 0.5 f, f & 1.5 f or 2) 0.5 f & f or 3) only f (the values are chosen following the instructions in Table A in 4.3)
* The fraction is 1/6 (the error of the weights shall not be greater than 1/6 × |MTE| for the applied load)

Instruments/balances Max/f	**Weights** Accuracy class or procedure
Group 1): Special balances (Max/f unlimited, special accuracy); f ≥ 1mg, e.g. f = 1 mg, 2 mg, 5 mg, 10 mg, 20 mg, etc.	
Max/f > 110 000	No calibration
60 000 < Max/f ≤ 110 000	E_2 (No calibration if [1])
Max/f ≤ 60 000	E_2 (No calibration if [1] and |MTE| = 0.5 f & f [2])
Group 2): Laboratory or precision balances (Max/f ≤ 100 000, high accuracy); f ≥ 10 mg, e.g., f = 10 mg, 20 mg, 50 mg or ≥ 0.1 g.	
50 000 < Max/f ≤ 100 000	E_2
30 000 < Max/f ≤ 50 000	F_1 (E_2 if |MTE|= 0.5 f & f or f)
11 000 < Max/f ≤ 30 000	F_1
6 000 < Max/f ≤ 11 000	F_2 (F_1 if [1])
Max/f ≤ 6 000	F_2 (F_1 if [1] and |MTE| = 0.5 f & f [3])
Group 3): Instruments for industrial weighing (Max/f ≤ 10 000, medium accuracy); f ≥ 1 g, e.g., f = 2 g or 20 kg.	
5 000 < Max/f ≤ 10 000	F_2
3 300 < Max/f ≤ 5 000	M_1 (F_2 if |MTE| = 0.5 f & f or f)
1 100 < Max/f ≤ 3 300	M_1
Max/f ≤ 1 100	M_2
Group 4): Instruments for industrial weighing (Max/f ≤ 1 000, low accuracy); f ≥ 5 g, e.g., f =50 g or 50 kg.	
500 < Max/f ≤ 1 000	M_2
330 < Max/f ≤ 500	M_3 (M_2 if |MTE| = 0.5 f & f or f)
Max/f ≤ 330	M_3

[1] weights of ≤ 50 g are used (4.4).
[2] E_2 if [1] and |MTE|= f for all the loads or if weights of > 50 g are used/dominating (4.4).
[3] F_2 if [1] and |MTE|= f for all the loads or if weights of > 50 g are used/dominating (4.4).

In the column "Weights" the accuracy classes of the weights (3.1.1 or 3.2.1) and the procedure "No calibration" (4.1.3) are given for the instruments/ balances to be calibrated.

If there is only one accuracy class corresponding to a Max/f, it can be used irrespective of the values of |MTE| given in 1), 2) or 3) above. Sometimes, another accuracy class along with conditions for its use is given in parentheses. This class must be applied if the conditions are met, e.g., if [1] (if weights of ≤ 50 g are used). Otherwise if the weights are > 50 g, the class given first is used.

This scheme is analogously applied to the case where the procedure "No calibration" is used. For example, consider "E_2 (No calibration if [1])". If the weights are ≤ 50 g, calibration is not performed with the weights dealt with here. Otherwise, if the weights are > 50 g, calibration is performed with weights of class E_2.

Table 3 Max/f and accuracy classes E_2 to M_3 of weights or procedure to be applied

* |MTE| of the instrument/balance takes on the values: 1) f, 2 f & 3 f or 2) f & 2 f (the values are chosen following the instructions in Table B in 4.3). If |MTE| = f for all the loads, apply Table 1
* The fraction is 1/3 (the error of the weights shall not be greater than 1/3 × |MTE| for the applied load)

Instruments/balances Max/f	**Weights** Accuracy class or procedure
Group 1): Special balances **(Max/f unlimited, special accuracy);** f ≥ 1 mg, e.g., f = 1 mg, 2 mg, 5 mg, 10 mg, 20 mg etc.	
400 000 < Max/f ≤ 650 000	E_2 (Apply 3.2.2 if |MTE| = f & 2 f)
130 000 < Max/f ≤ 400 000	E_2
65 000 < Max/f ≤ 130 000	F_1 (E_2 if [1]) <u>Exception</u>: F_1 if [1], Max/f = 70 000 or 105 000 and L = 50 000 f [2]
Max/f ≤ 65 000	F_1
Group 2): Laboratory or precision balances **(Max/f ≤ 100 000, high accuracy);** f ≥ 10 mg, e.g., f = 10 mg, 20 mg, 50 mg or f ≥ 0.1 g.	
65 000 < Max/f ≤ 100 000	F_1
40 000 < Max/f ≤ 65 000	F_2 (F_1 if |MTE| = f & 2 f)
13 000 < Max/f ≤ 40 000	F_2
6 500 < Max/f ≤ 13 000	M_1 (F_2 if [1]) <u>Exception</u>: M_1 if [1], Max/f = 7 000 or 10 500 and L = 5 000 f [3]
Max/f ≤ 6 500	M_1
Group 3): Instruments for industrial weighing **(Max/f ≤ 10 000, medium accuracy);** f ≥ 1 g, e.g., f = 2 g or 20 kg.	
6 600 < Max/f ≤ 10 000	M_1
4 400 < Max/f ≤ 6 600	M_2 (M_1 if |MTE| = f & 2 f)
1 300 < Max/f ≤ 4 400	M_2
Max/f ≤ 1 300	M_3
Group 4): Instruments for industrial weighing **(Max/f ≤ 1 000, low accuracy);** f ≥ 5 g, e.g., f = 50 g or 50 kg.	
Max/f ≤ 1 000	M_3

[1] weights of ≤ 50g are used (4.4).
[2] L is the greatest “small” load for which |MTE| = f (see Definition 1 in 4.3).
[3] L is the greatest “small” load for which |MTE| = f (see Definition 1 in 4.3).

In the column “Weights” the accuracy classes of the weights (3.1.1 or 3.2.1) and the procedure “Apply 3.2.2” (4.1.3) are given for the instruments/balances to be calibrated.

If there is only one accuracy class corresponding to a Max/f, it can be used irrespective of the values of |MTE| given in 1) or 2) above. Sometimes, another accuracy class along with conditions for its use is given in parentheses. This class must be applied if the conditions are met, e.g., if |MTE| = f & 2 f. Otherwise if |MTE| = f, 2 f & 3 f, the class given first is used.

This scheme is analogously applied to the case where the procedure “Apply 3.2.2” is used. For example, consider “E_2 (Apply 3.2.2 if |MTE| = f &2 f)”. If |MTE| = f & 2 f , *calibrated* weights of class E_2 are used applying 3.2.2. Otherwise, if |MTE| = f, 2 f & 3 f, weights (3.1.1 or 3.2.1) of class E_2 are used.

Advice under the heading “Exception” is for certain special cases.

Table 4 Max/f and accuracy classes E_2 to M_3 of weights or procedure to be applied

* |MTE| of the instrument/balance takes on the values: 1) f, 2 f & 3 f or 2) f & 2 f (the values are chosen following the instructions in Table B in 4.3). If |MTE| = f for all the loads, apply Table 2
* The fraction is 1/6 (the error of the weights shall not be greater than 1/6 × |MTE| for the applied load)

Instruments/balances Max/f	**Weights** Accuracy class or procedure
Group 1): Special balances **(Max/f unlimited, special accuracy);** f ≥ 1mg, e.g. f = 1 mg, 2 mg, 5 mg, 10 mg, 20 mg etc.	
Max/f > 300 000	No calibration
200 000 < Max/f ≤ 300 000	E_2 (No calibration if |MTE| = f & 2 f)
65 000 < Max/f ≤ 200 000	E_2 Exception: No calibration if [1)], 170 000 < Max/f < 200 000 and f = 1 mg (E_2 if f > 1 mg)
Max/f ≤ 65 000	F_1 (E_2 if [1)]. E_2 if L/f > 30 000 [2)]; L is the greatest "small" load (4.3) for which |MTE| = f)
Group 2): Laboratory or precision balances **(Max/f ≤ 100 000, high accuracy);** f ≥ 10 mg, e.g., f = 10 mg, 20 mg, 50 mg or ≥ 0.1 g.	
65 000 < Max/f ≤ 100 000	F_1 (E_2 if |MTE| = f & 2 f)
30 000 < Max/f ≤ 65 000	F_1
20 000 < Max/f ≤ 30 000	F_2 (F_1 if |MTE| = f & 2 f)
6 500 < Max/f ≤ 20 000	F_2 Exception: F_1 if [1)], 17 000< Max/f < 20 000 and f = 10 mg (F_2 if f > 10 mg)
Max/f ≤ 6 500	M_1 (F_2 if [1)]. F_2 if L/f > 3 000 [3)]; L is the greatest "small" load (4.3) for which |MTE| = f)
Group 3): Instruments for industrial weighing **(Max/f ≤ 10 000, medium accuracy);** f ≥ 1 g, e.g., f = 2 g or 20 kg.	
6 600 < Max/f ≤ 10 000	M_1 (F_2 if |MTE| = f & 2 f)
3 300 < Max/f ≤ 6 600	M_1
2 200 < Max/f ≤ 3 300	M_2 (M_1 if |MTE| = f & 2 f)
Max/f ≤ 2 200	M_2
Group 4): Instruments for industrial weighing **(Max/f ≤ 1 000, low accuracy);** f ≥ 5 g, e.g., f = 50 g or 50 kg.	
660 < Max/f ≤ 1 000	M_3 (M_2 if |MTE| = f & 2 f)
Max/f ≤ 660	M_3

[1)] weights of ≤ 50g are used (4.4).
[2)] F_1 if L/f ≤ 30 000. Weights of > 50 g are used/dominating (4.4).
[3)] M_1 if L/f ≤ 3 000. Weights of > 50 g are used/dominating (4.4).

In the column "Weights" the accuracy classes of the weights (3.1.1 or 3.2.1) and the procedure "No calibration" (4.1.3) are given for the instruments/ balances to be calibrated.

If there is only one accuracy class corresponding to a Max/f, it can be used irrespective of the values of |MTE| given in 1) or 2) above. Frequently, another accuracy class along with conditions for its use is given in parentheses. This class must be applied if the conditions are met, e.g., if L/f > 3 000 (a balance in group 2) with Max/f ≤ 6 500). Otherwise if L/f ≤ 3 000, the class M_1 given first is used.

This scheme is analogously applied to the case where the procedure "No calibration" is used. For example consider "E_2 (No calibration if |MTE| = f & 2 f)". If |MTE| = f & 2 f, calibration is not performed with the weights dealt with here. Otherwise, if |MTE| = f, 2 f & 3 f, calibration is performed with weights of class E_2.

Advice under the heading "Exception" is for certain special cases.

References

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

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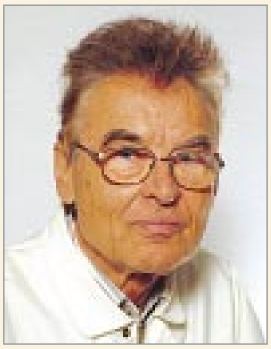


METROLOGICAL INFRASTRUCTURES

The metrology system in Chile: Present situation and outlook

Hartmut Apel, Ignacio Lira

Introduction

In a scenario in which national economies are increasingly integrated through growing international trade, even more important investments and the increase in the flow of capital, enterprises are forced to pursue global strategies. This involves locating their production activities in different countries in order to be able to supply products on competitive terms at any time and to any place. Whenever manufactured components for technical products have to be fit for their purpose so that their interchangeability can be guaranteed, metrology plays a vital role within this system in particular by ensuring traceability to the International System of Units (SI) both within the various regions and between them. As a result of this, calibration certificates and test reports issued in any particular country applying this system can be recognized and eventually accepted worldwide: in this way metrology faces the needs of today's international trade with an increasing impact [1].

The general public is not that aware of the importance of measurements. Even in industry, the impression prevails that the calibration requirements for measuring and testing devices under the ISO 9000 series of Quality Management Standards are exaggerated or even not justified at all. Leading industrialized countries established National Metrology Institutes more than 100 years ago or were urged to create functioning metrological networks when becoming members of regional economic associations such as the European Economic Community. In contrast to this, representatives of governments in developing countries are often not aware of the key role that a well-functioning metrological infrastructure plays in the economic and social development of their countries.

Chile is no exception to this. Whilst it is a small country (though more than 4000 km long) with 15.1 million inhabitants and a gross domestic product of a little under USD 5000 per capita, this Republic is one of the most liberal economies in the world. It is a member of the Asian-Pacific Economic Cooperation (APEC); it is a partner of the economic community of four Latin-American countries called MERCOSUR[1)]; it has signed free trade agreements with Canada, Central America, Mexico and recently also with South Korea and the United States; it has concluded negotiations on a free-trade agreement with the EFTA countries and on an economic and political association with the European Union. In addition, it participates actively in multilateral fora such as the World Trade Organization (WTO) and the Free Trade Area of the Americas (ALCA).

Chile's exports exceed USD 15.4 billion, mainly to the European Union, the United States, Asia, and the rest of Latin America. These exports are predominantly raw materials such as minerals (especially copper) and commodities from the agricultural sector (fish meal and timber). For export reasons, in order to foster agricultural raw materials and processed foodstuffs Chile has developed a remarkable network of laboratory facilities which are capable of competing successfully on the international markets. But the share of the manufacturing sector, although it has slowly increased and diversified over the last few years, has nevertheless remained relatively small. While a well-developed metrological infrastructure exists in all industrialized countries, the question for Chile remains: is it because of the composition of the export sector that Chile's metrological infrastructure has only recently been developed, or is the manufacturing sector behind schedule in relative terms due to certain deficiencies in the country's metrological capabilities?

The establishment of a metrological infrastructure in Chile

The first steps towards creating a metrological infrastructure in Chile were taken as late as 1990. At that time, a small number of private and public institutions were offering calibration services, but their traceability, if existent at all, could only be obtained abroad and at very high cost. A Japanese technological mission, composed of several experts in quality systems and metrology, was then arranged. After having studied the situation, the

1) MERCOSUR: Mercado Común del Cono Sur (de America Latina)

mission recommended adopting a metrology law to support the creation of a National Metrology Institute which would have cost at least USD 30 million. However, this advice was not followed because it was felt that such an amount of money should yield greater social dividends if invested in more "sensible" areas such as health, housing and education.

Due to increasing pressure from industries implementing quality systems, efforts were renewed in the mid 1990's - this time through a formal cooperation agreement with the German government in the area of metrology. The German agency in charge of the negotiations was the Physikalisch-Technische Bundesanstalt (PTB), Germany's National Metrology Institute. In Chile, however, either a special agency had to be created as the PTB's institutional counterpart or an existing institution had to be given responsibility for this task. The first option was definitely out of the question, because it had already for a long time been an official policy to reduce the sphere of influence of the State to the farthest possible extent. So it was decided to charge the Chilean National Standardization Institute (INN)[2)] with this responsibility since it was felt that this Institute, though dealing only with written standards and quality systems, had the closest ties to the matter at hand [2].

The INN had a long tradition in the homologation and development of technical documents as needed by Chilean industry but it did not have any experience in the area of metrology. Therefore, the PTB recommended holding a workshop with people from different sectors of the economy, having different professional backgrounds. The participants were chosen on the basis of the future stakeholders of the planned metrology system: private industry, certification companies, universities and other educational institutions, enterprises of the armed forces and state agencies. The output of the three-day seminar was a proposal to set up a metrological infrastructure that was to show some particular features: instead of creating a central NMI as recommended by the Japanese mission, it was decided that the next best solution was to establish a calibration network consisting of a small number of "nodes" entrusted with the task of maintaining national measurement standards for the quantities most needed by Chilean industry. Chemical quantities were not considered because it was felt that metrology in chemistry was an area that still needed to be further developed at the international level [3]. Thus, the first nodes of the network were to be in charge of the national standards for length, mass, temperature and force.

Detailed plans were drafted by the INN and then presented to the Chilean government. It was agreed that the State would make available USD 250,000 for each National Laboratory; these funds should be spent only on equipment. In exchange, the institutions that would assume responsibility for managing and operating the individual laboratories, would commit their own resources to building and making available the facilities and to hiring and training their personnel in Chile. In turn, the German government offered expert advice, training abroad, initial calibration of the standards and funding of the necessary accreditations by the German Calibration Service (DKD), the national accreditation agency for physical standards in Germany, which is affiliated to the PTB. The coordination and control of the Chilean National Metrology Network was entrusted to the INN which - as it did not have laboratories of its own - would not itself be actively involved in the system but which would coordinate the different operations.

This solution offered several advantages. First, existing capacities in the country would be utilized optimally. At that time there were mainly private institutions with certain experience, knowledge and management capabilities in offering metrological services. Second, the costs would be shared among the State and the private bodies concerned. Third, the operation of a decentralized system would be less prone to red tape. And finally, the system could be up and running in less time than it would take to implement a central NMI, and certainly at a much lesser cost than that estimated by the Japanese mission.

The next steps were the creation of a Coordination Unit at the INN, which started a survey to better define the national standards for the first four quantities, and to coordinate the process of establishing the specifications for a public invitation to bid. Bids were then received and evaluated, with technical help from a foreign expert and financial support from CORFO[3)], a State agency engaged in fostering technical development activities. The contract was awarded in December 1997.

In 1999, another call for tender was organized, this time for the National Laboratories for Pressure and Electrical Quantities. The technical evaluation of this second call was performed by experts from the PTB.

In 2001, as a result of a second planning and evaluation workshop organized and held by the INN and PTB experts, it was agreed to initiate a project to establish three further National Laboratories for chemical quantities in the areas of food products, mining and environmental protection. It was also agreed to draw up plans for the creation of National Laboratories for other measurement standards. Now it is planned to establish National Laboratories for torque, liquid and gas flows as well as for time and frequency.

2) **INN: Instituto Nacional de Normalización**

3) **CORFO: Corporación de Fomento de la Producción**

In parallel with these developments, the Accreditation Division of the INN assumed responsibility for reviewing the Quality Systems of the National Laboratories, and for accrediting a number of other private secondary calibration laboratories for various quantities.

The first four National Laboratories are now fully operational, and three of them have already been accredited by the DKD under the ISO 17025 standard. The fourth laboratory is just now undergoing the final stage of accreditation. The National Laboratory for pressure is also operational, while the National Laboratory for Electrical Quantities is expected to be commissioned in the near future. Some 30 secondary calibration laboratories have meanwhile been accredited by the INN, one of them serving as a national laboratory with special competence for liquid flow.

The operation of the National Metrology Network (NMN)

The NMN now consists of the five National Laboratories placed at the top of the Chilean calibration hierarchy. Their official name is “Custodian Laboratory of National Standards” for the respective quantity, or LCPN-X after their Spanish name where X is a letter designating a quantity: L for length, M for mass, T for temperature, F for force, P for pressure and ME for electrical quantities. The system operates under agreed regulations and is coordinated by the Coordination and Supervision Unit (UCS)[4] of the INN (see figure: the National Metrology Network (NMN) of Chile). Secondary calibration laboratories accredited by the INN would also have to be considered parts of the NMN should they agree to comply with the regulations. Meetings of all interested parties take place every two months in an advisory capacity called the Technical Metrology Committee (CTM) in which administrative matters of common interest are discussed. In addition, the heads of the LCPNs meet every two or three months to discuss particular problems they might be having, organize joint activities and offer suggestions for improvements of the system.

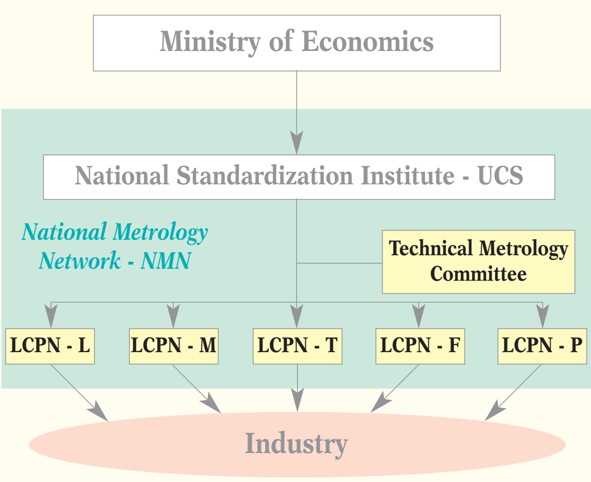
Besides the “official” metrology system described above, a private forum exists which is called the Chilean Metrology Association (CHILMET). This was conceived on a private initiative during an international symposium that took place in Miami towards the end of 1995. On that occasion, the large group of Chilean participants realized the need to formally organize themselves in the absence of an NMI. CHILMET has sponsored a number of courses, seminars and other training events, and has organized two successful international conferences, one in 1997 and the other in 2001. Since then its activities have, however, faltered mainly due to severe financial constraints. The President of CHILMET participates in the CTM meetings as an official delegate. In this way a private-public dialogue on metrology issues is maintained, which serves to intensify the exchange of information and experience accumulated in the two areas.

In principle, the outcome of these efforts would appear to be a success: from a total absence of an organized metrology system in 1995, the basic and most urgent calibration needs of industry can, eight years later, be satisfied in an adequate way by a system that seems to run smoothly from the point of view of its stakeholders.

A review of the Chilean metrological infrastructure

It should be noted that Chile does not have a metrology law which explicitly recognizes the internal and external roles of the various bodies forming the NMN and their financial needs. The legal basis of the LCPNs as keepers

The National Metrology Network (NMN) of Chile



UCS: Coordination and Supervision Unit

LCPN: Custodian Laboratory for the National Standards (for):
- L: Length
- M: Mass
- T: Temperature
- F: Force
- P: Pressure

4) UCS: Unidad de Coordinación y Supervisión

of the national measurement standards has been established by ad-hoc presidential decrees, but the regulations of the NMN are only of an internal nature as they have not been confirmed by law or decree and thus are not legally binding. Also, the NMN is only oriented towards the needs of industry. Matters of consumer protection as backed up by legal metrology in all industrialized countries in the world have completely been left out of the program so far. For example, there are neither procedures nor laboratories to verify road traffic radar devices, even though these devices are commonly (and legally) used by the police. Also, there is no official control of pre-packages, scales used in commerce or in international trade, fuel dispensers and the like.

Similarly, there is no scientific metrology: The LCPNs do not carry out research and development work on their own, their task being rather limited to offering calibration services to industry and to the secondary calibration laboratories. Chile has been a member state of the Metre Convention since 1908 (but its national representative generally does not attend the meetings of the *Comité International des Poids et Mesures* - CIPM) and of its Consultative or Joint Committees [4]. As for the OIML, currently composed of 58 Member States and 51 Corresponding Members from all around the globe, Chile is not a member. However, 10 countries in the Latin-American region - some with a much smaller economy than Chile - maintain Full or at least Corresponding Membership with this Organization. On the other hand, several bilateral cooperation agreements have been signed with further national metrology institutes, namely CEM (Spain), CENAM (Mexico), BNM (France) and BNQ (Canada), but these have been dormant so far.

With respect to international recognition, suitable LCPNs are expected to be accredited by the DKD, three of them having already met the requirements. In these cases, traceability is assured but this is not necessarily true for the rest of the accredited laboratories.

Not all of the accreditation bodies (national or international) require traceability, nor do they fully understand the uncertainty concept, which is an integral part of the accreditation process. They rather concentrate on questions such as whether the laboratories operate and apply appropriate quality systems, and whether their personnel are technically competent. This can mainly be demonstrated by comparison measurements and testing. But it must additionally be proved that the calibration results they obtain are comparable with those of laboratories of a similar metrological level not only once but always.

Represented by the head of the UCS of the INN, Chile signed the Mutual Recognition Arrangement (MRA) of the Metre Convention in October 2000. That same year it signed another MRA with the MERCOSUR countries. So far, however, only the LCPN-L is listed in the BIPM's database as an active participant in one regional intercomparison exercise organized by the Interamerican Metrology System (SIM).

But the most serious problems the NMN is likely to face are those of its internal organization, management and funding. A report compiled on behalf of the PTB in 2001 by two foreign experts and one Chilean coordinator identified several deficiencies in the current structure of the MNM. Those basically amount to problems due to the heterogeneous composition of the mother organizations of the LCPNs (private institutions, universities and the armed forces): their independence from one another, their differing orientations, business plans and structures. The fact that they compete in some of their services makes it difficult for the LCPNs to communicate fluidly and to have a strong sense of corporate identity. Despite the periodic meetings of their heads, it has not been possible to set up a web site nor to organize a coherent advisory group able to advise the political opinion leaders or to assist them in defining an effective national policy for metrology affairs. Similarly, it has not been possible to promote the vertical transfer of knowledge and experience from the LCPNs to the calibration laboratories and to establish an active program of internal intercomparison exercises among them, therefore their traceability cannot be completely guaranteed. Besides, the LCPNs experience a conflict between unpaid participation in technical activities beneficial to the NMN and their need to strive in the short run for commercial profitability.

Due to the lack of financial incentives to participate in international events of all kinds such as the meetings of technical committees of the SIM or laboratory intercomparisons, the technical development of the NMN is rather limited and almost sporadic. Finally, since the Government only plays the role of a coordinator and is not in a position to actively promote the development of the metrology system, it has not yet been decided whether laboratories for metrology in chemistry will be operated under the aegis of the NMN or organized within a system of its own. Either position has advantages and disadvantages.

The intensity of the calibration activities of the NMN's laboratories are directly influenced by the country's overall economic development, so the laboratories are vulnerable to factors beyond their control. This could be noticed in 1998 in particular when the Chilean growth rate fell abruptly from over 7 % to the current level of about 2 to 3 %. In times of depression, companies cut costs wherever possible, and the maintenance of measuring equipment is one of the first areas to be affected. In addition, the requirements of ISO 9000 have been among the most important promoters of the tremendous rise in calibration activities worldwide. But in Chile the penetration rate of ISO 9000 certification has been much lower than expected (currently only some 300 companies have been certified). Since certification auditors are generally not familiar with metrological requirements, there are companies in Chile and other countries that are certified but whose equipment cannot boast traceability. The awareness of the usefulness of calibrations in industry is exceedingly low. Most clients of the NMN hardly appear to use the information contained in calibration certificates for their measurement purposes. It rather seems that they would only need the certificates to present them at the request of auditors for the aim of their quality system. For all these reasons, the demand for calibrations is not as high as in other economies of a similar industrial development level.

Prospects for the National Metrology System

It is generally recognized that maintaining a metrological infrastructure is a very costly undertaking. Even industrialized countries with a long-standing tradition in technology nowadays cut down their budgets for their national institutes and attempt to outsource their measurement tasks or even privatize their testing facilities. In comparison with these developments, it has to be recognized that Chile has been able to set up a metrological infrastructure that developed from almost zero ten years ago into an operational system which today can satisfy the most pressing needs of a large number of its users. It consists for the time being of five independent but centrally coordinated National Laboratories. An accreditation agency has also been created providing acceptability for certificates issued by some 30 secondary calibration laboratories. Further, plans are under way to create additional National Laboratories in charge of other measurement standards - among them three National Laboratories for chemical quantities in the areas of food products, mining and environmental protection.

This apparently growth-oriented perspective does not, however, reveal the deficiencies and vulnerabilities of the whole system particularly in terms of financial solidity and technological progress - key factors for maintaining the technical competence which is vital to the system. Given the level of precision required by clients from industry, it is not necessary for the Custodian Laboratories of the National Standards to spearhead international development but it is sufficient for them to be - at least technically - one step ahead of them, thus providing adequate services to the majority of its clients. These are mainly the small and medium-sized companies which are generally not able to fund the metrological activities that are necessary for their technical development and international recognition, but which are somehow in contradiction to their immediate goal of business performance.

These activities comprise e.g. investments in advanced equipment, recalibration of standards, re-accreditation procedures, participation in national and international laboratory intercomparisons, travel expenses to attend external meetings and conferences organized by international organizations, etc.

These activities are vital to the metrology system to gain, and maintain, international recognition. They are a typical part of the overall economic framework which in all important economies is defined and subsidized to a greater or lesser extent by governments.

The current operation of the NMN beyond its initial, successful phase can in the long run be ensured only if the State decides to commit a permanent flux of funds for its operation. In other words, the "Chilean way to metrology" has had a good start but is now in a state of unstable dynamic equilibrium to support the infrastructure, and a strategic plan for future development is needed.

It is hoped that the Chilean Government will assume its role as a custodian of the national metrological infrastructure for the benefit of its stakeholders, thus promoting international recognition of the certificates issued under the NMN system and contributing to eliminating the barriers to trade. ■

Notes and references

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[2] Lira, I.: "Current developments in the Chilean metrology situation", Cal Lab, 3, 35–37 (1996).

[3] See Resolution 10 (Metrology in Chemistry) adopted by the 21st Conférence Générale des Poids et Mesures (CGPM), October 11–15, 1999.

[4] A Chilean institute participates in the working groups of the Consultative Committee for Amount of Substance – Metrology in Chemistry (CCQM). However, this institute is not part of the NMN.

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METROLOGICAL INFRASTRUCTURES

Measurement support services

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Introduction

The growing participation of developing countries in international trade has put an even stronger emphasis on the safe operation of their quality systems throughout the whole economy (industry, agriculture, scientific research, public health services, higher education, etc.) The operation of these systems requires increasingly sophisticated and expensive instruments, which also represent a sizeable part of national wealth.

The safe operation of precision measuring instruments is of essential importance in the creditable performance of quality systems and requires support services, whereas in developing countries there is a considerable shortage of such services.

This problem has been analyzed by numerous international organizations, including the American Association for the Advancement of Science (AAAS, Washington, USA) which summarized the problems encountered in maintaining and repairing measuring instruments in developing countries in a *Feasibility Study* [1] in July 1988. In this study several solutions were considered, as below:

1 Training Approach

This approach assumes that training is the solution to the equipment problem.

2 Increased Resources Approach

This approach assumes that merely increasing budgets will solve the problem.

3 System/Organizational Approach

This approach states that a comprehensive system has to be established for the safe operation, maintenance and repair of equipment.

4 Regional Approach

Manufacturers' representatives have to be assigned to regions rather than to specific countries.

In the framework of the System Approach, this paper summarizes the elements of the instrumentation support services which are essential for the safe operation of quality systems. It presents the latest experience gained in the application of the conception which was developed with the support of the PTB in different countries, and provides information on the step by step implementation and sustainability of such services.

1 Background information

The limited quantity and large variety of measuring instruments in developing countries cannot provide enough technical work to justify the establishment of the necessary efficient service stations by individual manufacturers. On the other hand, the wide variety of equipment/instruments being used by the various institutions in the country limits their capabilities and capacities in maintaining and repairing highly sophisticated precision measuring instruments [2].

In this way the safe operation of quality systems is strongly hindered by the poor condition of measuring instruments. The vast majority of measuring equipment is either inoperable, or cannot perform and measure as per specifications, and further the measurements carried out are not reliable and no local qualified service can be found to carry out these tasks. There is therefore an urgent and widespread need for the establishment of **local capability,** which can provide these services **on site** locally.

The ISO family of Standards and other quality programs such as Total Quality Commitment (TQC) determine which elements of the production process are required to maintain quality regardless of the product manufactured both in cases of export and import. A key issue within these programs is the product inspection and test.

Measurement standards and measuring equipment shall be calibrated, adjusted and used in an environment controlled to the extent necessary to ensure valid measurement results. Due consideration shall be given to temperature, rate of change of temperature, humidity, lighting, vibration, dust control, cleanliness, electromagnetic interference and other factors affecting the results of measurements. Where pertinent, these factors shall be continuously monitored and recorded and, when necessary, correcting compensations shall be applied to measurement results.

It is evident that quality cannot be assured without strict control and accurate measurements. Well-planned quality management systems are needed which depend upon the background services of the country's instrumentation infrastructure. Without an instrumentation infrastructure and suitable support instrumentation services it is impossible to build up and operate effective and economical quality systems, which are needed by manufacturing companies.

A recent example can be quoted: in the framework of the Southern African Developing Countries (SADC) Program on Standardization, Quality Assurance, Accreditation and Metrology (SADC SQAM), the Secretariat of SADC Co-operation in Measurement Traceability (SADCMET) is supporting the implementation of such projects which ensure the long-term viability of the joint vision of the SADC SQAM structures, namely the establishment of an internationally recognized conformity assessment infrastructure in the SADC region. A reliable infrastructure for maintaining and repairing the installed instrumentation base for testing and measurement is an indispensable element of this vision.

2 Measurement support services

In order to achieve the general objectives of the quality systems, a module system should be set up with the purpose of optimal utilization of the national stock of instruments. Developing countries and countries with economies in transition vary considerably in their degree of development, economic systems and market environments. Despite this diversity, they share a number of common features. One of these is the insufficient instrumentation infrastructure. According to our experience the background instrumentation services below may be needed [3, 4].

2.1 Instrument and measuring technique investment consulting services

In solving a measuring problem it is important to choose the proper measuring method and the appropriate instruments. Institutes and companies are forced to change their profile very often so they have to face new challenges from time to time. In the new fields they lack the suitable instrumentation and expertise to use the instruments. They can choose their new instruments from a wide selection and instrument suppliers are very aggressive in promoting their products, but it is very difficult to obtain unbiased, objective advice when purchasing instruments. The above problems create a steady demand for an effective consulting service. Such a service can be provided by a staff of experts specialized in different specific areas of measurement and instrumentation. Their personal expertise is extended by a comprehensive knowledge base, which consists of several independent databases, catalogues and leaflet libraries, etc.

2.2 Training and education on how to run and maintain the instruments

Education and training in all regions is identified as being of prime importance. Development of human resources is the cheapest way of investing with a relatively short-term return on investment. The lack of professional expert knowledge greatly hinders the efficient utilization of the instrument pool.

Training needs for the operation and maintenance of test equipment should be carefully assessed before purchase. In the absence of such training, expensive equipment may not give the desired accuracy or may remain out of action for long periods. In both cases, considerable material and moral damage can be caused.

The training program has to cover all needs for further education of the customers' experts, education and training of the engineers/technicians of the ISSC, and organized courses for outside experts (managers, service engineers).

2.3 Instrument maintenance and repair activity

Precision measuring equipment is suitable only when it functions with the specified accuracy. Even instruments of the highest quality which are operated correctly will sometimes break down. For the repair and servicing of instruments, experts with suitable qualifications and skills, as well as spare parts, are needed. Developing countries may not have adequate facilities for repairing instruments, especially sophisticated imported testing instruments. Arranging for visits of repair teams from abroad or sending equipment away to foreign centers for repair is expensive and time-consuming. Servicing includes putting instruments into operation, their servicing during and after the warranty, their repair, maintenance and overhaul. For that reason local capability to provide repair and maintenance services has to be established.

2.4 Renting and leasing of instruments

Often, instruments are needed only for short periods and would be redundant after accomplishing the task (e.g. while the instrument from the original set-up is under repair or calibration). In such cases purchase would be an unnecessary investment and delivery often takes a long time. Rental companies provide the instruments needed temporarily from their pool without delay. These instruments are checked and calibrated according to specifications and the customer only pays for the period during which the equipment is rented. Customers even can buy the rented instruments, either through leasing or direct payment.

2.5 Calibration

Calibration plays an important role in the operation of Quality Systems. The measuring and testing activity is useful only if the results of measurements are reliable, i.e. they are sufficiently accurate with a known degree of uncertainty. Calibration provides traceability, ensuring that the uncertainty level of every measurement made in the organization can be traced to known reference standards. A well-organized calibration scheme gives the manufacturer the certainty that the features of the products delivered are within the specification and it gives the customer the assurance that he is buying exactly what he expects in terms of technical parameters and performance levels.

Calibration of measuring and test equipment is essential to ensure the reliability of test data. For this it is necessary to maintain a list of all equipment with associated details. The equipment register should also contain associated calibration details and the measurement standards against which the equipment has been calibrated. The calibration methods, procedures and references should be traceable to national or international measurement standards, and appropriate certificates should be available.

2.6 Procurement of instruments, marketing and trading

The first step in establishing suitable inspection and testing facilities is the purchase of the equipment. Not every company has a purchase department well-versed in instrument procurement and business transactions. Even general trading firms are unaware of the instrument market and the reliability of different instrument suppliers. Companies which do have experience in instrument trade can solve the complex task of instrument procurement more effectively.

2.7 Measuring technique services

Instruments and testers in themselves are usually not enough to solve special measuring tasks. Specialized theoretical and practical expertise is also indispensable. At times companies cope with special measuring tasks which their own staff cannot solve. In these cases prompt technical help is needed from companies which can send experts having the necessary knowledge and practical experience to solve the given task. Sometimes in addition to the experts, special instrumentation is needed so the service provider offers a turnkey solution to the problem.

2.8 Development and design of special purpose instruments

Very often, special measuring demands cannot be met by means of general-purpose instruments currently available on the market. In these cases special purpose instruments or sensors with technical and construction specifications suited to the given task are required.

This order of support services does not mean a general priority order. On any site the list of services and the priority order has to be identified according to local requirements. The elements may be set up in the most practical sequence as defined according to the said requirements. The support services enable a more efficient use of resources; each activity serves and helps to solve the instrumentation management problems. However, it must be emphasized that their complex use within an organization such as the Instrumentation Support Services Center (ISSC) may even result in qualitative advantages, extended by a comprehensive knowledge base, which consists of several independent databases, catalogue and leaflet library, repair and maintenance service, etc. This service can be built up step by step in a modular structure and the more modules are implemented the more effective support of each module can be reached [5].

3 Local capabilities and the System Approach

3.1 General considerations

Efficient use of national instrumentation resources is necessary not only for the viable operation of the existing systems, but is also a prerequisite for technical, industrial and economic development. In developing countries, limited attention is paid to instrumentation both at the level of policy and strategy. A commonly recurring problem in those countries is the absence of sufficient repair and maintenance services with the result that many instruments are out of order. Further, all necessary support services (consultancy, measuring engineering, etc.) needed for the safe and reliable operation of the quality systems are lacking. The status of instrumentation in developing countries in general results in wastage of national resources, low efficiency and productivity of the instrumentation services. For that reason the establishment of local capability providing all necessary services for the quality control laboratories is an and widespread need. The optimal utilization of available precision measuring instruments can be achieved through the establishment of a local ISSC.

The System Approach to this lack of services enables all services needed for the operation of precision and control instruments to be managed together. The ISSC provides some or all of the services which are needed for the safe operation of precision measuring instruments. The main advantage of the ISSC concept is that the modules which provide seemingly independent services are implemented within the same organization and under the same management and each complements the other.

This system - according to the United Nations Industrial Development Organization (UNIDO, Vienna, Austria) - appears to be unique in its organization and services, responding to any complex problems or inquiries for instrumentation services in developing countries.

3.2 Reference applications of the System Approach

In Vietnam it was recognized as early as 1989 that there was an urgent need for the development of an instrumentation infrastructure. It was also recognized very early that within the technical infrastructure of the country, composed of the Bureau of Standards, Metrology Office and Quality Control Laboratories, the local ISSC also had to be incorporated. These institutions could act as an efficient basis for the elaboration and realization of an effective national instrumentation supply, management and policies whereby they could also be of great help in the optimal utilization of the available financial, technical and staff resources. As a first step the Repair and Maintenance, After Sales Service and Consultancy modules were implemented in 1991 [6, 7].

The Government of the Islamic Republic of Pakistan has recognized the necessity for the development of the instrumentation infrastructure which is essential in managing the background instrumentation services necessary for the smooth operation of the instruments used in all fields of the economy in the country. The Ministry of Science and Technology requested UNIDO's assistance in establishing a National Electronic Equipment and Scientific Instruments Register and also in the preparation of a National Instrumentation Policy Framework. In 1997-1998 as the output of the project, the National Instrumentation Policy Draft and the National Instrumentation Acquisition Policy Draft were elaborated in the framework of a complex program for the essential improvement of the level in measuring culture and its personal, technical and institutional background in Pakistan. Moreover, the finalized version of the National Electronic Equipment and Scientific Instruments Register (NEESIR) was installed on the PC system procured for this task in the National Institute of Electronics, Islamabad (NIE). NIE staff were trained to use NEESIR. The necessary activities for self-sufficient operation in the future were also outlined jointly with the responsible experts of NIE [8].

The PTB and MTA-MMSZ convened the series of Inter-regional Workshops on this topic in 1995 and 1996 [9]. During these courses, experience collected over the past 40 years and the economic system changes in Hungary were introduced to participants. As a result of the courses, preparatory work was commenced in several countries to develop the instrumentation services using the Hungarian approach. In Cambodia, Morocco, Nepal and Uganda, official requests with project proposals regarding their local ISSC were submitted to the German Embassies in order to ask for assistance in the development of these services.

The appropriate local strategy for the maintenance of university equipment in Morocco has also been built up based on experience gained through participation in workshops and meetings, organized mainly by UNIDO, PTB and MTA/MMSZ between 1987 and 1996 in Budapest and abroad.

MTA/MMSZ, in cooperation with the PTB, drew up a proposal to include instrumentation services in the development of the Measurement Standardization Test and Quality Control (MSTQ) infrastructure in developing countries. In the framework of the project: "Support of MSTQ in African and Arabic countries", a project was implemented by the PTB on behalf of the Ministry of Technical Cooperation and Development of Germany. In the framework of this project the PTB delegated MTA-MMSZ to prepare a conception of three phases for implementing a feasible local ISSCs in 1999 and suggested to UNIDO to contribute in the implementation of such a conception. In order to develop the safe operation of the Quality Schemes in developing countries, UNIDO positively considered the PTB's request for cooperation in the field of improving instrumentation support services in SADC countries. In this way no new preparatory assistance was needed in the case of the establishment of the local ISSC in Malawi, in the South Region, which is being implemented.

In West Africa the Standards Organization of Nigeria (SON, Lagos) is implementing its local ISSC with UNIDO support. The detailed survey was accomplished in June 2001 and the first training was carried out in December 2001, also with UNIDO support. Now SON is acquiring the minimum tools, measuring instruments and consumables from its own resources.

The main advantages of this approach are, as follows:

- The instrumentation background services necessary for the smooth operation of the projects implemented under the Donor's Aid Program could be facilitated through local services on a long-term basis;
- The assistance of the Donor in the instrumentation services field would also support, among others, the operation of the quality control systems in the recipient developing countries;
- The human resource base of the recipient developing country is enhanced;
- Better utilization of instrumentation resources is attained;
- Forming of the engineers/technicians in instrumentation and measuring culture can be achieved; and
- Because of its modular structure, step by step implementation is possible.

UNIDO's coordination with the PTB will ensure synergetic effects in the region during the implementation of the Malawi project, as the German cooperation is currently upgrading the ISSC attached to the Kenya Bureau of Standards in the East Region of Africa. The evaluation of Phase 1 of the program for the development of instrumentation support services furthers the results in approaching the sustainability of the local Malawi Bureau of Standards' ISSC unit and will be analyzed jointly by UNIDO and the PTB.

4 Sustainability of such services

Self-sufficiency, after the execution of the project, is an essential criterion for fund mobilization. The Systems Approach has been proved sustainable in the present economic transition in Hungary from a centrally-planned to a market economy. This may provide the same possibility for developing countries.

An independent non profit-making institute of the Hungarian Academy of Sciences MTA-MMSZ was founded as an ISSC in 1957 to provide background services for academic institutes in measurements and instrumentation. The company succeeded in becoming a profit-oriented, self-financing institution in 1974. By that time it already provided country-wide services. On the establishment of the institute, Hungary had a centrally-planned economy and economic conditions were very much like those of some developing countries. There was no free market and convertible resources were limited, however, technical connections with developed countries always existed.

After the change in the economic system, the markets of the former socialist countries practically collapsed. In this way, many hundreds of large and medium-sized enterprises became bankrupt. Nevertheless, the institute survived and was able to flexibly adapt itself to the fundamental change in the economy. The customers of its services changed from large companies to small and medium-sized enterprises. The professional staff was reduced by half (maintaining all its departments with a minimal working configuration with all essential services carried out by the most qualified engineers and technicians). Activities which did not produce profits were reduced or abolished. On the other hand, new activities were started (e.g. instrument purchase, leasing and trading) to meet the new requirements and costs were reduced as much as possible. From 1992 as a result of the economic changes, the institute has been working as a profit-oriented, private company. Institutes in developing countries may also establish their local, profit-oriented unit.

According to this example, self-sufficiency was reached two years after the relevant decision. Under one management, these services can be developed in a way enabling them to support one another and at the same time all incentives necessary for keeping trained staff for longer periods and motivating them for maximum output can be used efficiently.

In Vietnam the ISSC was privatized two years after the implementation of the relevant UNIDO/UNDP project in 1991 and it is still working under market conditions.

During the start of the implementation of the UNIDO project in Malawi, ISSC operation was commenced. The value of those precision measuring instruments repaired by the ISSC Unit during the first training was about USD 65 000 compared to a new value of approximately USD 200 000. This sum does not contain the added value, such as the value of the measurements carried out by the repaired measuring instruments and the effects of the measurements provided by the customers. New instruments would of course be more reliable and give results of higher accuracy (which is not needed in several cases) but the cost-saving is considerable. The cost of the basic tools could be partially covered by revenue of the Malawi Bureau of Standards (MBS) from the repair activity provided for external customers during the first training, which shows that the MBS ISSC Unit is on the way to becoming a self-sufficient organization [10].

5 Step by step implementation

Considering the modular structure [5] of the System Approach, it can be implemented step by step in developing countries and those in transition for more effective use of resources. According to a survey of the most important needs of different services (consultancy, repair and maintenance, etc.) the foundations of the first units of an ISSC should be established. The work can be started with four to eight persons.

For instance in Hungary, the MTA-MMSZ began its activity by renting; in this way it was possible to save convertible currency, as it was emphasized, which could help the procurement. The renting activity needs its own service basis for the necessary repair and calibration work, and this was the basis of the After Sales Service module. There was always steady demand for the advisory service, too, since all responsible decision makers needed special expert information before making a decision. And it was a well-known fact that the success of a decision depends on the information analyzed before making it. To satisfy this requirement the Consultancy module was implemented. The demand for solving special measuring and checking tasks was present throughout the whole national economy, and so the Measuring Engineering module was established.

When these modules were together in the institute the basic expertise necessary for development was available, and to explore this possibility the development of single purpose instruments/systems could be started. Without training and education it is impossible to perform any work in our world, so this module was needed to operate the system. The cooperation of units furnishes a great surplus for training.

The modules can be implemented individually or in the same or any other combination in new centers or existing institutes in order to meet the specific needs of a country. According to the conditions of the country the implementation of ISSC can be started by any of these modules.

In Malawi and Nigeria the Repair and Maintenance and the Instrument registry with the Consultancy activities were selected as the most important services. In case of the repair and maintenance of old measuring instruments it is essential to have information on the conditions of all customers' measuring instruments, which requires establishing the Instruments registry.

In order to achieve an efficient implementation of the local ISSC unit the analysis of the needs for instrumentation services and preparation of the priority order of the requirements is needed using the Instrument registry, to be able to focus efforts.

6 Important aspects of implementation

6.1 Management aspects

The importance of the management aspects (leadership, organization, motivation, functions, responsibilities, layout, necessary place for work, furniture, etc.) of the establishment of the local ISSC unit has to be emphasized. The reorganization of existing units (staff, layout of the workplace, administration) is suggested. The ISSC Unit has to be a profit center, which prepares its own profit and loss statement; its costs and income have to be separated from the institutes' other units. It is necessary to increase the individual responsibility of the repair staff. During the repair procedure all steps of the repair have to be recorded with the name and the actions of the person who does the job. The higher responsibility will also protect the instruments from damage during the repair and maintain the original technical condition of the instrument, as it was taken over for repair. The different functions in the ISSC Unit (repair, procurement/import, administration) have to be separated. The person in charge of each function has to be appointed to be able to carry out the efficient step by step implementation.

6.2 Technical background

The technical staff (consultants, repair engineers, registry operator) have to be carefully selected and an incentive system put in place.

The work place (stores, spare parts, room for "dirty" jobs) and racking (to store the incoming and outgoing instruments separately, storage of personal instruments, tools and catalogues in closed cabinets, and storage of consumables (some of which are poisonous and inflammable), have to be provided. The tools, measuring instruments and equipment can be acquired step by step too, partly in the home market and from own resources.

All technical material (technical descriptions, data sheets, catalogues, operation manuals, etc.) have to be collated. The sources of technical documentation of old measuring instruments, continuous support in special technical expertise and special spare parts have to be established too.

Information channels must be built up. Direct communication (such as via the Internet and e-mail) is needed for acquiring catalogues, data sheets, and manufacturers' brochures.

6.3 Decreasing support from the outside

The sustainability of such services enables the long-term operation of the local ISSC with less and less support from the outside. However, without outside support (financial and technical) the establishment of the local capabilities for providing the necessary services is not possible.

6.4 Regional aspects

Those local ISSCs which operate in a sustainable way should work as the basis of the region in the implementation of the local units in the neighboring countries. ■

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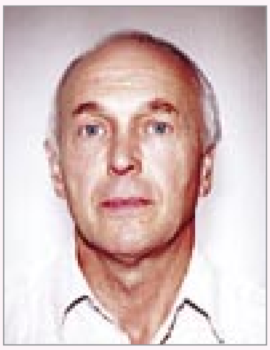

Legal metrology tendencies in the Russian Federation

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The beginning of a new stage in the development of legal metrology in the Russian Federation may be considered as dating back to 1993 when the Federal Law on *Assurance of measurement uniformity* was adopted. For the first time and at the highest level, this Law has established the basic norms and rules for the administration of metrological activities in our country. When developing this Law we took into account as much national and international experience as possible, with the objective of protecting society and the State from non-trustworthy measurement results. Of course, we relied on OIML D 1 *Law on metrology*, which at the moment is under review by a special Joint Working Group. We are preparing to comply with the new version of this Document, because the time is right to change our Federal Law of 1993.

There is no need to explain again the various elements of legal metrology in Russia established by the Law, since details have already been published in OIML Bulletins No.1, 1994, and No. 3, 1998.

The globalization of world trade, international integration, trends towards the establishment of a global measurement system, and the intention of Russia to join the WTO are just some of the reasons behind the reform of legal metrology in the Russian Federation. In view of these reasons we are developing our national metrology policy for the coming decades, and also the medium-term program for its realization. The objectives, tasks, and strategy are formulated for the new approach of metrology as a science and as specific activities related to measurements. All new challenges are divided up into three main directions: legislative (including legal metrology documents), executive (including metrological service, fundamental and applied metrology), and supervising (including state metrological control and supervision).

Concerning the legislative field, it is necessary to take into account the Federal Law *On Technical regulations*. As a consequence, there are some tendencies for legal metrology: more concentration on removal of barriers to trade, restriction of the sphere of control and supervision, harmonization of the organization of the principles of metrological activities with the international level, and paying more attention to consumer protection in the field of safety. Now we are in the process of establishing new technical regulations for the uniformity of measurement requirements, the assessment of conformity in legal metrology of domestic products and services for the competitiveness of Russian products, and appropriate adaptation of accreditation and certification processes based on international principles developed by ILAC, ISO and EA to the procedures of verification and type approval.

We are also preparing the adaptation of the future European Directive as a national technical regulation.

Last year, the Gosstandart of Russia adopted the ISO/IEC 17025 Standard (and others) as national standards dealing with accuracy in measurements. They represent the "master" standards for the development of legal metrology.

Legal metrology as a part of a national measurement system is a model for the global measurement system generally. Besides the procedures for conformity assessment and effective quality assurance systems for type approval testing and verification, it is necessary to lay down procedures for mutual recognition of test and verification results. This problem depends on the competence of laboratories and on accurate traceability of measurement results to the corresponding key comparisons of the national measurement standards. So, for the future it is necessary to harmonize all the arrangements of the international organizations concerned. ■

Legal metrology in 2020 – Role of Governments in Africa's developing countries

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Introduction

In Africa, as in every other society, weights and measures are ranked among the necessities of life. They feature among the earliest tools invented because rudimentary measurements were needed for tasks such as the construction of dwellings of an appropriate size and shape, fashioning cloth, or bartering food or raw materials.

As contacts with the international community developed during the colonial era, the international exchange of raw materials, goods, and communication led societies to evolve, and weights and measures became increasingly complex. It therefore became necessary for Africans and their trade partners to use measurement systems in which both parties had confidence. This led to the adoption of European and Asian measurement systems which were comparatively more accurate, consistent, and coherent.

Retrospective overview of governments' role

At independence some forty years ago, these systems were inherited by the new national governments for the following reasons:

- The meager resources of the new countries were preferably allocated to areas such as the civil service, building of roads, schools, and health centers;
- There were no viable indigenous private economic or civil sectors;
- Legal metrology was not considered a priority because its importance and role in social and economic development had not been established; and
- There were very few (or no) adequately qualified metrology personnel.

As society evolved, it became necessary for governments to protect consumers from unscrupulous traders. Also, they had to ensure that consistent and dependable measurements were carried out in fields such as petroleum, mining or agriculture, which were of substantial economic importance to the country. The inherited measurement systems were therefore modified and adapted to the afore-mentioned needs.

The resulting modified systems, some of which have remained unchanged to date, have the following major characteristics:

- Government is the sole regulatory and conformity assessment authority;
- Training of personnel is mainly "on the job" and is offered only by government services and agencies; and
- All funding for metrology activities is provided either directly or indirectly by government.

These systems have neither adequately qualified personnel, nor an appropriate metrology infrastructure. This partially explains the non-existence of:

- Traceability; and
- The accurate evaluation of the uncertainty of most measurement results.

Traceability and the existence of a hierarchical chain of standards each having its own stated uncertainty makes it possible for measurement results to be compared. Without traceability, comparability is impossible and confidence in the measurement result is absent.

Ultimately, this lack of confidence results in:

- Uncompetitive exports;
- Diminution of government revenues;
- Unsustainable development;
- Unemployment; and
- Social instability which in most cases leads to social unrest.

Impact of globalization

Following the demise of communism about fifteen years ago, the process of globalization characterized by the expansion of cross-border flows of ideas and information, goods and services, technology and capital, has advanced rapidly and broadly in Africa.

Most African developing countries have realized that in order to facilitate their progressive integration into the world economy, they have to:

- Lower trade barriers;
- Pursue joint ventures;
- Enforce intellectual property rights;
- Protect property rights;
- Reduce high import and export taxes;
- Eliminate government corruption;
- Support entrepreneurship;
- Remove restrictions on investment;
- Observe the rule of law; and
- Set up measurement systems with a coherent structure which ensure that measurements can be made in a constant, accurate, transparent, and internationally accepted manner.

As far as metrology is concerned, legal metrology is no longer considered as just "weights and measures", but rather as a science which is indispensable in fields such as health and safety, resource and environmental control, and other domains where accurate measurements also serve as a basis for important government decisions.

With the advent of globalization, small and medium sized enterprises which help in:

- Job creation;
- Dissemination of entrepreneurial capacities; and
- Promotion and diversification of exports

are faced with:

- Difficulties in adopting innovative technologies; and
- Problems of access to global markets.

Consequently, it has been realized that metrology-related technical barriers to trade such as differing standards, technical regulations, and conformity assessment requirements must be compatible with international practice in order to facilitate trade, which is an important mechanism for the economic development of the African countries in question.

Government's new role

Fifteen years ago, the economies of the developing countries of Africa were state-run, government-controlled, and experienced little or no growth. Today, most of these same economies are opened (or opening) and liberalizing. Governments are privatizing the para-statals and their economies are growing. The governments have realized that in the present globalization context, sustainable prosperity ultimately depends upon creating an environment for:

- Domestic capital formation;
- Private sector led growth; and
- Successful integration into global markets.

For this to be achieved, governments have the following policy-making, arbitration, and supervisory role to play:

- Put in place mandatory legal requirements for:
  - units of measurement,
  - methods of measurement,
  - measuring instruments and measurement results,

  used in the following areas of activity:

    - commerce and trade,
    - fiscal matters,
    - services and utility metering such as water, electricity, telecommunications, and taximetering,
    - resource control such as oil and fishing quotas,
    - environmental control and pollution such as automobile exhaust gases,
    - health care such as temperature and blood pressure measurements,
    - human safety matters such as radar speed control;
- Draw up coherent and non-fragmented laws and ensure that enforcement is uniform. This can be facilitated by the adoption of internationally recommended metrology requirements;
- Ensure that emphasis on societal concerns such as trade or health do not dominate fundamental aspects of metrology such as precision, uniform conformity assessment, and traceability, whenever national laws and regulations are being drawn up;
- Urge metrologists to provide them with analysis and guidance on realistic infrastructural needs which are necessary for the implementation of legislation; and
- Take measures to increase the availability of high quality education and training in metrology.

It should be noted that the above-mentioned duties are related to legislating and regulating metrology.

On the other hand, enforcement can no longer be a government monopoly and should be carried out by government services, para-statals and private bodies. The lack of the capacity to invest in the enforcement of laws and regulations in modern fields of metrology such as health, safety, and pollution monitoring by government, makes the use of the private sector indispensable.

However, the existence of a multitude of enforcement bodies might lead to the existence of multiple unrelated methods and procedures creating a state of incoherence and non-uniformity of assessment procedures.

For there to be confidence in the measurement system, the government has to monitor and supervise the activities of conformity assessment bodies to ensure uniformity and coherence.

This supervisory role makes it necessary for:

- All mandatory legal and technical metrological requirements to be registered, made public, and available to all; and
- All conformity assessment bodies to be registered.

Government should create a forum which will permit cooperation, consultation, coordination, and the development of fruitful relations between all the actors of the metrology sector (legislating and regulating bodies, enforcement bodies, and clients). Such a forum could be called "National Metrology Council".

Government should create conditions that will attract investors into the metrology sector because metrology infrastructures are expensive and government alone cannot bear the cost.

Legal metrology department

For government to play its role fully, it must have a department which is solely in charge of legal metrology. The form and structure of such a department will definitely depend on the political organization of each country. However, by the year 2020, a Legal Metrology Department placed directly under the authority of a member of government should be in charge of the following:

- The conception, definition, and implementation of a national legal metrology policy;
- The drafting of coherent legal metrology laws and regulations which meet national and international concerns for consistent, credible, and appropriately accurate measurements;
- The authorization, registration, and control of private legal metrology bodies delegated the responsibility to enforce mandatory technical and legal requirements. The aim here is to ensure and guarantee uniformity of enforcement;
- The secretariat of a national metrology council or any national forum set up to promote consensus, debates, discussions, consultations, cooperation, and good relations between all legal metrology bodies in the country;
- The drawing up of guidelines and the implementation of measures aimed at providing appropriate training and education in legal metrology;
- Advise the government on the following aspects relevant to the needs of legislation: measurement standards, calibration programs, traceability and accreditation;
- Representation of the government in all regional and international cooperation matters and organizations;
- Sensitization of national public opinion as to the importance of legal metrology in the socio-economic development of the country;
- Facilitate the development of partnerships between national and foreign metrology bodies, mobilize national and international capital for metrology development; and
- Ensure that legal metrology is not over-regulated for as it is often said, "too much of anything is a disease".

Conclusion

As the world's last great emerging market, Africa offers tremendous opportunities, especially as there are many areas still to be developed. About fifteen years ago, internal and foreign investors were not welcome in many parts of Africa, but today they are not only welcome, they are sought after. This shows the desire to leave behind marginalization, and includes legal metrology. The question is not the will but the way, especially as these countries possess limited financial resources.

The answer to this is regional and international cooperation. Africa is today divided into economic zones such as ECOWAS, CEMAC, SADEC, etc. Development of legal metrology along the same lines is both less expensive and faster. ■

Perspective for China's legal metrology

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1 Introduction

Legal metrology encompasses all the metrology laws, statutes, and technical regulations that have been drawn up and enforced by the authorities concerned. With the rapid development of science and technology and the advent of a global economy, the field of metrology is accordingly enlarged and its function becomes increasingly important. This paper is intended to analyze the present situation of China's legal metrology, give an account of the likely challenges, and provide a prospective for its development over the next twenty years.

2 Present situation of China's legal metrology

Since the implementation of reform and open policy, the social and economic systems have undergone major changes in China, and a socialist market economy framework has been constructed. Accordingly, an administrative system for legal metrology has also been developed covering metrology administration, technical metrological institutes, and legal metrology institutions. These institutions have played an indispensable role in the development of China's metrology enterprises and its socio-economic development.

The established state system of primary metrological standards includes 10 categories of primary standards with 191 items, state standards for 2,452 types of materials, and more than 43,000 metrological standards of various grades for public applications. Of the legal metrology services, 28 are responsible for the pattern evaluation of new measuring instruments. Up to now, they have implemented pattern approval for 475 series of imported measuring instruments, and done prototype testing for 21,094 types of new measuring instruments. On average, more than 700,000 sets/pieces of standard measuring instruments and more than 23,000,000 sets/pieces of working measuring instruments have undergone compulsory verification by these institutes annually. In addition, they have worked in cooperation with governmental metrology administration departments to effect product quality supervision sampling examination on more than 700,000 sets/pieces of measuring instruments and supervision sampling examination on more than 500,000 batches of prepackaged commodities with fixed content annually, and undertake more than 800 arbitrational verifications of metrological disputes.

However, since the Metrology Law of the People's Republic of China was enacted in 1985 in response to the needs of a planned economy at that time, it has become necessary to meet the new requirements of legal metrology that a market economy has called for.

2.1 Management of measuring instruments

Currently, there are a large number and variety of measuring instruments subject to legal metrology control in China which fall into three broad catalogues:

- Catalogue of measuring instruments supervised in accordance with the Law of the People's Republic of China (400 kinds);
- Catalogue of working measuring instruments subject to compulsory verification (116 kinds); and
- Catalogue of imported measuring instruments (18 kinds).

Moreover, China has also effected legal management of the primary standard measuring instruments, standard instruments and standard reference materials. On the one hand, the management is too wide-ranging; on the other hand, there is insufficient management of the measuring instruments used in such fields as resource control, safety, chemical metrology and governmental execution.

2.2 Transfer of the value of a quantity (Traceability)

According to the recent provisions of China's metrological laws and regulations, the major method for transferring the value of a quantity is verification rather than metrological calibration. Trial calibration work has been carried out in some areas of the country, but no well-defined national management system of calibration has been established yet. There have neither been specified subjects and objects of calibration management, nor norms and marketing thereof.

2.3 Measurement of the quantity of commodities

There are no specific provisions for measuring the quantity of commodities in the Metrology Law. What can be applied are only provisions such as:

- Provisions Regarding Metrological Supervision over the Weighing of Retail Goods;
- Provisions Regarding the Metrological Supervision over Prepackaged Goods with Fixed Content;
- Rules for the Punishment of Violations Against the Measurement of the Quantity of Commodities; and
- Rules of Metrological Inspection for Net Content of Prepackaged Commodities With Fixed Content.

These were issued by the former State Bureau of Quality Technical Supervision in the light of the new development of the socialist market economy. Although these regulations are complementary to the Metrology Law, and some international OIML Recommendations have been adopted, there is still much room for improvement in aspects such as their legal rationale and manipulation ability.

Besides, there is still a gap between what has been done and what is required by the OIML as concerns the management of metrological technical regulations, conformity assessment and the adoption of International Recommendations. All the above-mentioned have shown that there is still much to be done on China's legal metrology infrastructure in the future; otherwise, the authority and equity of legal metrology will be unfavorably affected. Moreover, legal metrology will not efficiently stand up for the benefit of customers, ensure the health and safety of the public and protect the environment, etc.

3 Challenge to legal metrology

The rapid development of science and technology in such fields as biological engineering, digital measurement, computer networks and nanometer technology will lead to changes not only in the mode of economic activities, but also in people's way of living and thinking. These, in turn, will have an effect on legal metrology. Moreover, the influence of globalization cannot be neglected, for the globalization of the economy will lead to the globalization of trade, which will inevitably influence legal metrology everywhere.

3.1 The influence of the new fields of legal metrology

Currently, the scope of legal metrology is well beyond the limits of weighing and measuring; it has entered many new fields such as the following:

- Trade: This includes retail and wholesaling, and domestic and foreign trade. These activities primarily entail the measurement of weight, volume of flow, and prepackaged commodities with fixed content. According to statistics, the volume of goods to be measured accounts for 60 % ~ 80 % of GDP, and will undergo repeated measurements by various metrological instruments in the whole process from producer to customer.
- Services: This field involves a variety of measuring meters, such as fuel dispensers with tax functions, taximeters with revenue functions, and all kinds of time and price meters and retail appliances for vegetable oil. In addition, it covers a wide range of measurements ranging from water, natural gas and coal gas, to electrical energy, heating, and so on.
- Medical metrology: Medical measuring instruments include thermometers, sphygmomanometers, radiation dosimeters, computer tomography, electrocardiography, electroencephalography, medical ultrasonic diagnostic equipment, etc. In recent decades, diagnosis and therapy measuring instruments have developed rapidly. Since medical metrology is concerned with the quality of life and even determines the difference between survival and death, it is vital to ensure the accuracy, consistency and reliability of measurements.
- Safety and protection: Human safety, in particular, becomes increasingly dependent on accurate measurements and timely control over systems. For example, the accuracy of instruments on ships, planes, automobiles, etc., radar velocity meters, speedometers for cars, detectors for the alcoholic content of breath, pressure meters and mechanical meters for architecture, are closely related to human safety.
- Environmental protection and pollution control: This is a field requiring management by law and substantially involves legal metrology. For example, physics, chemistry, or biology measurements are always applied to a variety of situations such as supervision measurement for nuclear power sta-

tions, measurement of CO, CO_2, SO_2 and suspended particulates in the air, supervision control for environmental noise, vehicle exhaust emissions and pollution of water, soil and gas, etc. In the 21st century, as an effective means for environmental protection and pollution control, metrology will give rise to more concern on the part of politicians, the public, economists and lawyers.

- Resource control: In the management of petroleum, minerals, fishing, and water quotas, we can hardly do without the application of legal metrology. Many kinds of resources, especially unproductive ones, are faced with the danger of exhaustion. Every country in the world, either out of political or economic consideration, is becoming increasingly concerned with the utilization and exploitation of their resources, which demands more and sometimes extremely accurate measurements.
- Lawsuits: In this field, legal metrology has a preventive effect. For example, when lawsuits involve medical services, human safety or pollution control, the result of measurements sometimes becomes important evidence for the courts to go by. Additionally, there is also a demand for legal metrology in measuring contracts and financial administration, tax collection and law enforcement.

3.2 Influence of the WTO TBT

The WTO TBT Agreement on Technical Barriers to Trade mainly addresses three issues:

- Standards;
- Technical regulations; and
- Conformity assessment.

Conformity assessment is currently developing very rapidly in China; the main cause is a drive for the promotion of commercial intercourse. Conformity assessment is a process whereby a product, process, service or system is evaluated against a standard. If a government issues regulations such as the pattern evaluation of newly-produced measuring instruments, to require products or services to conform to certain technical specifications or standards, it can be regarded as a case of conformity assessment. In order to reduce repetitive assessments, lower the cost and enhance the authority, it is necessary to build up worldwide confidence through bilateral accreditation, that is, the bilateral accreditation of each other's systems. The development of conformity assessment is a motivation for developing legal metrology because conformity assessment (particularly laboratory accreditation and product quality certification) is based on metrology, and bilateral accreditation of metrology systems is one of the bases of bilateral conformity assessment. Worldwide confidence must call for a global metrology system.

3.3 Challenge to administration reform

With the rapid development of the globalization of economies, administration reform is inevitable, and this presents a new challenge to legal metrology.

Firstly, public investments and governmental appropriations of many countries tend to be geared to projects with a short-term effect and quick returns resulting from the market economy. As the trend towards globalization develops rapidly and competition between countries becomes more intense, every country has to stimulate its own economic growth and strengthen the competitiveness of its domestic enterprises. Consequently, it is natural for them to invest in projects that have a quick return and attach importance to market economy.

Secondly, the general trend towards the reform of government agencies is to streamline the size of government, reduce costs and reposition the institutions serving politics and the economy. This is a universal trend. In order to accelerate economic growth and the development of trade, government agencies are bound to reform themselves step by step and gradually make a distinction between their supervision, public administration and service functions.

Thirdly, it is a global trend to loosen regulations and even repeal some of them. As a matter of fact, the reforms in China are mainly intended to prepare for entry into the WTO and tend to loosen or repeal regulations, approval procedures and supervision. The main reason behind this is to promote economic and commercial evolution.

3.4 Effect of technology and management on metrology

Technological and managerial progress may have some negative effect on metrology or cause it to face new challenges.

- Automatic measurements, especially digital ones, may pose a challenge to traditional metrology - though this problem is by no means a new one. Before digital measurements, weighing was a technology, no matter whether it involved the use of scales or a balance. The concept of uncertainty could be conveniently demonstrated, and the measured value of quantity may vary with the person making the measurement. With the use of automatic measurements, especially digital ones, measurement results are always accurate and consistent. Since no professional is needed in the process, the concept of uncertainty is difficult to detect. Therefore, it is even more necessary now to develop and popularize the awareness of metrology among the public.

- As more new fields of legal metrology emerge, it becomes difficult for the regular governmental legal metrology agencies to effect an all-encompassing administration in this field. Consequently, the management of legal metrology becomes the concern of many instead of just one department. This is actually the case everywhere in the world. This trend is quite disadvantageous for attaining the goal of a concerted management by the metrological departments and thus is often mentioned by the OIML as being a common problem. Presently, it seems feasible that the metrological departments, in cooperation with other departments concerned, implement the management of such new fields in legal metrology as medical care, environmental protection, resource monitoring and traffic safety.
- In the WTO TBT Agreement, there is little mention of metrology. This means the problems arising from metrology are not taken into consideration for settling problems arising from technical barriers to trade. Moreover, there is the problem of product verification. In China, systematic verification develops fast, which also includes requirements for metrology. Unfortunately, such requirements are often neglected. Since product verification involves testing, it is closely related to metrology. However, the requirement for product verification is often covered up by that of systematic verification, which makes it easy for customers to think that the certificate of systematic verification is effective for all situations. Actually, it is not feasible that the issue of quality is tackled only by means of a quality management system. As a developing country, China must attach importance to product verification; otherwise, it will pay the price.

4 Prospects for China's legal metrology over the next 20 years

According to developing world tendencies, the present situation and the challenge facing China's legal metrology, there is much legal metrological work to do over the next twenty years, which will involve consequential reforms.

4.1 The adjustment and fulfillment of the Metrology Law and Regulations

The modification of the Metrology Law is a prime assignment and will have far-reaching effects socially, economically, technically and metrologically.

Following the WTO Treaty and the relevant OIML Recommendations, the revised Metrology Law should take full account of China's present situation and effectively protect the country's estate and market. So, metrological legislation should be developed in three fields: unification of units of measurement, accuracy of the value of quantity, and regulation of market metrological action. Specially, it should be adjusted and fulfilled in the following directions:

- Build up the national metrology system in line with the global metrology system;
- Lessen the range of management to emphasize legal metrology;
- Expand the field but reduce compulsory verification;
- Strengthen metrological supervision for commodity quantities to regulate market metrological action; and
- Reinforce the admonishment of law and increase penalties.

4.2 The Fulfillment of the National Metrology System

China's present metrology system was originally implemented in accordance with the requirements of a planned economy, albeit somewhat adjusted. However, the disadvantage of such a system is that insufficient account is taken of market economy characteristics, and additionally it is partially incompatible with the WTO rules.

Therefore, over the next twenty years, a revised national metrology system is necessary in order to ensure that the legal metrology structure is better suited to China's changing environment. Some of the considerations are:

- Stipulate the relevant technical laws and regulations in force, and accept the WTO rules. Reference should also be made to the relevant regulations of the BIPM, OIML and ILAC and these should be combined with China's present situation to set up a coherent metrology system;
- The future metrology system should be a communicative, competitive and harmonious system. China should take part in international and regional

metrological activities which include calibration, participation in international comparisons and accreditation of the measuring and calibration competence of the metrology institutes, discussion of quality management systems and uncertainty of measurement;

- Development of the field of legal metrology makes it difficult to ensure traceability; the current trend is that one department exerts universal supervision management and several other departments apply traceability to the primary standards and international intercomparisons;
- The future legal metrology service will have an impact not only on measurements but also on measurement technology and will become the measurement technical research centers. It will not only be a part of the traceability of the values of quantities, but also a very important research institute within the metrology system;
- Make the best use of social resources. It is obvious that legal metrology is a governmental action, however, that does not mean that only the government controls the assignment of legal metrology. Particularly the verification and calibration of measuring instruments can be undertaken by non-governmental organizations, i.e. private laboratories or even factories themselves. This can serve to render legal metrology control effective and flexible. Of course, the determination of prerequisites and global management must remain under the control of the government.

Conclusions

Planning for a future global legal metrology structure requires consistency and reliability of measurement results to ensure that measuring instruments are accepted all over the world and that the ensuing measurement results are truly inter-exchangeable.

Therefore, the metrology system of every country should use the International System of Units, apply the reproducibility of reference materials, and set up national primary standards and a traceability system which has a unique standard of conformity assessment.

The establishment of such a global metrology system is currently the main focus of the development of international metrology, and a challenge to be faced over the next ten years leading to improved international cooperation (including training and technical assistance).

The OIML plays a role in ensuring that adequate cooperation exists between the various regions, and maintains close links with other international organizations such as the Meter Convention, IMEKO, ILAC, IAF, ISO, IEC, WTO, etc.

Although legal metrology leads to regulations being drawn up, the stipulation of metrology law and direct regulation is the responsibility of each country. The adoption of OIML International Recommendations is a moral obligation of each nation, but not a legal responsibility. And the WTO/TBT Agreement aims at reducing or eliminating technical barriers to trade - though in certain cases, technical barriers can be set up intentionally to protect lives, the environment and national security, though legal metrology is there to safeguard these fields.

To sum up, we can foresee three main trends in legal metrology over the next ten years:

- First, with the widespread implementation of the International System of Units based on physical constants, each nation's metrology system will gradually become a global metrology system. Though it is not a unique metrology system, it could at least enhance confidence among countries;
- Second, the field of legal metrology will gain much more importance with the increasing globalization of trade and the development of science and technology; and
- Third, the authority of the OIML can be strengthened and as a result, legal metrology in each country is guaranteed to be more harmonized and accompanied by an increased interchange between countries and regions. ■

OIML Certificate System:

Certificates registered 2003.05–2003.07

Up to date information (including P1): www.oiml.org

The *OIML Certificate System for Measuring Instruments* was introduced in 1991 to facilitate administrative procedures and lower costs associated with the international trade of measuring instruments subject to legal requirements.

The System provides the possibility for a manufacturer to obtain an OIML Certificate and a test report indicating that a given instrument pattern complies with the requirements of relevant OIML International Recommendations.

Certificates are delivered by OIML Member States that have established one or several Issuing Authorities responsible for processing applications by manufacturers wishing to have their instrument patterns certified.

The rules and conditions for the application, issuing and use of OIML Certificates are included in the 2003 edition of OIML P 1 *OIML Certificate System for Measuring Instruments.*

OIML Certificates are accepted by national metrology services on a voluntary basis, and as the climate for mutual confidence and recognition of test results develops between OIML Members, the OIML Certificate System serves to simplify the pattern approval process for manufacturers and metrology authorities by eliminating costly duplication of application and test procedures.

This list is classified by Issuing Authority; updated information on these Authorities may be obtained from the BIML.

Cette liste est classée par Autorité de délivrance; les informations à jour relatives à ces Autorités sont disponibles auprès du BIML.

► Issuing Authority / *Autorité de délivrance*

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

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

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

R60/2000-NL1-02.02
Type 0765 (Class C)
Mettler-Toledo Inc., 150 Accurate Way, Inman, SC 29349, USA

OIML Recommendation applicable within the System / Year of publication

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

The code (ISO) of the Member State in which the certificate was issued, with the Issuing Authority's serial number in that Member State.

Le code (ISO) indicatif de l'État Membre ayant délivré le certificat, avec le numéro de série de l'Autorité de Délivrance dans cet État Membre.

Year of issue
Année de délivrance

Certified pattern(s)
Modèle(s) certifié(s)

Applicant
Demandeur

Système de Certificats OIML:

Certificats enregistrés 2003.05–2003.07

Informations à jour (y compris le P1): www.oiml.org

Le *Système de Certificats OIML pour les Instruments de Mesure* a été introduit en 1991 afin de faciliter les procédures administratives et d'abaisser les coûts liés au commerce international des instruments de mesure soumis aux exigences légales.

Le Système permet à un constructeur d'obtenir un certificat OIML et un rapport d'essai indiquant qu'un modèle d'instrument satisfait aux exigences des Recommandations OIML applicables.

Les certificats sont délivrés par les États Membres de l'OIML, qui ont établi une ou plusieurs autorités de délivrance responsables du traitement des demandes présentées par des constructeurs souhaitant voir certifier leurs modèles d'instruments.

Les règles et conditions pour la demande, la délivrance et l'utilisation de Certificats OIML sont définies dans l'édition 2003 de la Publication P 1 *Système de Certificats OIML pour les Instruments de Mesure.*

Les services nationaux de métrologie légale peuvent accepter les certificats sur une base volontaire; avec le développement entre Membres OIML d'un climat de confiance mutuelle et de reconnaissance des résultats d'essais, le Système simplifie les processus d'approbation de modèle pour les constructeurs et les autorités métrologiques par l'élimination des répétitions coûteuses dans les procédures de demande et d'essai.

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Diaphragm gas meters
Compteurs de gaz à parois déformables

R 31 (1995)

▶ Issuing Authority / *Autorité de délivrance*

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

R31/1995-NL1-2003.02

Type KM-G2.5

Daehan GM Corporation, 717-7 Gojan - Dong, Namdong - Ku, Inchon, Rep. of Korea

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

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

R 51 (1996)

▶ Issuing Authority / *Autorité de délivrance*

Physikalisch-Technische Bundesanstalt (PTB), Germany

R51/1996-DE-2002.05 Rev. 1

CWM... with weighing system type WS... (accuracy class X(1))

Bizerba GmbH & Co. KG, Wilhelm-Kraut-Straße 65, D-72336 Balingen, Germany

R51/1996-DE-2003.03

Types EWK 1500, EWK 1500 plus, EWK 2000 and EWK 2000 plus (accuracy classes X(1) and Y(a))

Hans Boekels GmbH & Co., Am Gut Wolf 11, D-52070 Aachen, Germany

R51/1996-DE-2003.04

Types EWK 1000 plus WS 3 kg and EWK 1000 plus WS 6 kg (accuracy class X(1))

Hans Boekels GmbH & Co., Am Gut Wolf 11, D-52070 Aachen, Germany

R51/1996-DE-2003.05

Type CWM... with weighing system EM... (accuracy class X(1))

Bizerba GmbH & Co. KG, Wilhelm-Kraut-Straße 65, D-72336 Balingen, Germany

▶ Issuing Authority / *Autorité de délivrance*

National Weights and Measures Laboratory (NWML), United Kingdom

R51/1996-GB1-2001.01 Rev. 4

Type 8060 (Classes X(1) and Y(a))

Delford Sortaweigh Ltd, Main Road, Dovercourt, Harwich, Essex CO12 4LP, United Kingdom

R51/1996-GB1-2002.02 Rev. 1

Types AS1500, AS5000 and AS Draglink (Accuracy class X(0.5))

Loma Systems Ltd, Southwood, Farnborough, Hampshire GU14 0NY, United Kingdom

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

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

R 60 (2000)

▶ Issuing Authority / *Autorité de délivrance*

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

R60/2000-CN-2003.01

Type PA6342 (Class C3)

Yuyao Pacific Auto-Control Engineering Co. Ltd, 285 Tanjialing East Road, Yuyao, Zhejiang Province, China

R60/2000-CN-2003.02

Type TD132 (Class C3)

Yuyao TongDa Scales Co., Ltd, 21 South Heyan Road, Yuyao, Zhejiang Province, China

▶ Issuing Authority / *Autorité de délivrance*

Physikalisch-Technische Bundesanstalt (PTB), Germany

R60/2000-DE-2002.01 Rev. 1

Type C16 (Classes C1 up to C5)

Hottinger Baldwin Messtechnic Wägetechnik GmbH, Im Tiefen See 45, D-64293 Darmstadt, Germany

R60/2000-DE-2003.01

Type 0799 (Classes C3, C4 and C3 MI 6)

Mettler-Toledo Inc., 1150 Dearborn Drive, Worthington, Ohio 43085-6712, USA

R60/2000-DE-2003.02

Type ASC (Classes C3 - C6, MR, MI 7,5)

Revere Transducers Europe BV, Ramshoorn 7, NL-4824 AG Breda, The Netherlands

R60/2000-DE-2003.03

Type DSC (Classes C1 - C4, MR, MI 7,5)

Revere Transducers Europe BV, Ramshoorn 7, NL-4824 AG Breda, The Netherlands

R60/2000-DE-2003.04

Type RTNi (Classes C1 - C4)

Hottinger Baldwin Messtechnic Wägetechnik GmbH, Im Tiefen See 45, D-64293 Darmstadt, Germany

▶ Issuing Authority / *Autorité de délivrance*

National Agency for Enterprise and Housing Division of Metrology, Denmark

R60/2000-DK-2003.01

Type SSB (Class C)

ESIT Electronics, Mühürdar Cad. No. 91, Kadiköy, TR-81300 Istanbul, Turkey

R60/2000-DK-2003.02 Rev. 1

Type WSSB (Class C)

Welvaarts weegsystemen, De Tweeling 4, NL-5215 MC's-Hertogenbosch, The Netherlands

R60/2000-DK-2003.04 Rev. 1

Type SSB-R2-DME (Class C)

DIESSEL Mobile Electronics A/S, Samsovej 29, DK-8382 Hinnerup, Denmark

R60/2000-DK-2003.05 Rev. 1

Type SSB-R1-DME (Class C)

DIESSEL Mobile Electronics A/S, Samsovej 29, DK-8382 Hinnerup, Denmark

R60/2000-DK-2003.06 Rev. 1

Type 650 (Class C)

Revere Transducers Europe BV, Ramshoorn 7, Postbus 6909, NL-4802 HX Breda, The Netherlands

R60/2000-DK-2003.07

Type ACB (Class C)

Revere Transducers Europe BV, Ramshoorn 7, Postbus 6909, NL-4802 HX Breda, The Netherlands

▶ Issuing Authority / *Autorité de délivrance*

Centro Español de Metrologia, Spain

R60/2000-ES-2003.02

Type AW410/00500C (Class C)

Applied Weighing International Ltd., Unit 5, Southview Park, Caversham, Reading, Berkshire, United Kingdom

▶ Issuing Authority / *Autorité de délivrance*

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

R60/2000-NL1-2003.10

Type MT1241 (Class C)

Mettler-Toledo (Changzhou) Scale & System Ltd., 111 Changxi Road, Changzhou, Jiangsu 213001, China

R60/2000-NL1-2003.11

Types 1042 and 1042 Symmetric (Class C)

Vishay Tedea Huntleigh International Ltd., 5a Hatzoran St., New Industrial Zone, Netanya 42506, Israel

R60/2000-NL1-2003.12

Type 1263 (Class C)

Vishay Tedea Huntleigh International Ltd., 5a Hatzoran St., New Industrial Zone, Netanya 42506, Israel

R60/2000-NL1-2003.13

Type 1142 (Class C)

Vishay Tedea Huntleigh International Ltd., 5a Hatzoran St., New Industrial Zone, Netanya 42506, Israel

R60/2000-NL1-2003.14

Type MT-1260 (Class C)

Mettler-Toledo (Changzhou) Scale & System Ltd., 111 Changxi Road, Changzhou, Jiangsu 213001, China

R60/2000-NL1-2003.15

Type VC3700 (Class C)

Thames-Side Maywood Ltd., 17 Stadium Way, Tilehurst, Reading, Berkshire RG30 6BX, United Kingdom

R60/2000-NL1-2003.16

Type VC3700 (Class C)

Applied Weighing International Ltd., Unit 5, Southview Park, Caversham, Reading, Berkshire, United Kingdom

R60/2000-NL1-2003.17

Type SBL34 (Class C)

Dresser Wayne AB, Limhamnsvägen 109, SE-200 61 Limhamn, Sweden

R60/2000-NL1-2003.18

Type SBL35 (Class C)

Dresser Wayne AB, Limhamnsvägen 109, SE-200 61 Limhamn, Sweden

R60/2000-NL1-2003.19

Type BRL22 (Class C)

Dresser Wayne AB, Limhamnsvägen 109, SE-200 61 Limhamn, Sweden

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Nonautomatic weighing instruments
Instruments de pesage à fonctionnement non automatique

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

▸ **Issuing Authority / *Autorité de délivrance***

Physikalisch-Technische Bundesanstalt (PTB), Germany

R76/1992-DE-1999.08 Rev. 1

Types SIWAREX A, SIWAREX M, SIWAREX AWS (Classes III and IIII)

Siemens AG, Östliche Rheinbrücken Straße 50, D-76187 Karlsruhe, Germany

R76/1992-DE-2003.01

Types 635x2, 635x1, 645x2, 645x1, 665x2, 665x1, 675x2, 675x1 (Class III)

Seca Meß- und Wiegetechnik or Vogel & Halke GmbH & Co., Hammer Steindamm 9–25, D-22089 Hamburg, Germany

▸ **Issuing Authority / *Autorité de délivrance***

National Agency for Enterprise and Housing Division of Metrology, Denmark

R76/1992-DK-2003.01

Type ART (Classes III and IIII)

ESIT Electronics, Mühürdar Cad. No. 91, Kadiköy, TR-81300 Istanbul, Turkey

R76/1992-DK-2003.02

Type LCA (Classes III and IIII)

ESIT Electronics, Mühürdar Cad. No. 91, Kadiköy, TR-81300 Istanbul, Turkey

▸ **Issuing Authority / *Autorité de délivrance***

Centro Español de Metrologia, Spain

R76/1992-ES-2003.01

Type MAXIMA (Class III)

Campesa S.A., Avinguda Cova Solera 25-29, E-08191 Rubi-Barcelona, Spain

▸ **Issuing Authority / *Autorité de délivrance***

National Weights and Measures Laboratory (NWML), United Kingdom

R76/1992-GB1-2003.02

PC series (Class III)

Fabricantes De Basculas Torrey S.A. De C.V., Los Andes 605, Col. Coyoacan, Monterrey, N.L., C.P. 64510, Mexico

▸ **Issuing Authority / *Autorité de délivrance***

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

R76/1992-JP-2003.01

Type UW (Classes I, II and III)

Shimadzu Corporation, 1, Nishinokyo-Kuwabaracho, Nakagyo-ku, Kyoto 604, Japan

Issuing Authority / *Autorité de délivrance*

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

R76/1992-NL1-2000.09 Rev. 1
Type SM-90.. (Class III)

Teraoka Weigh-System PTE LTD, 4 Leng Kee Road, #06-01 SIS Building, 159088, Singapore

R76/1992-NL1-2002.38 Rev. 2
Type SM-300... (Class III)

Teraoka Weigh-System PTE LTD, 4 Leng Kee Road, #06-01 SIS Building, 159088, Singapore

R76/1992-NL1-2003.07 Rev. 1
Type SM-500... (Class III)

Teraoka Weigh-System PTE LTD, 4 Leng Kee Road, #06-01 SIS Building, 159088, Singapore

R76/1992-NL1-2003.09
Type PO-2300 (Class III)

Charder Electronic Co., Ltd, 103, Kuo Chung Road, Dah Li City, Taichung Hsien 412, R.O.C, Taiwan

R76/1992-NL1-2003.11
Type RN10... (Tiger II) (Class III)

Mettler-Toledo (Changzhou) Scale & System Ltd., 111 Changxi Road, Changzhou, Jiangsu 213001, China

R76/1992-NL1-2003.12
Type SM-700... (Class III)

Teraoka Weigh-System PTE LTD, 4 Leng Kee Road, #06-01 SIS Building, 159088, Singapore

R76/1992-NL1-2003.13
Type RM-40.. (Class III)

Shanghai Teraoka Electronic Co., Ltd., Tinglin Industry Developmental Zone, Jinshan District, Shanghai 201505, China

R76/1992-NL1-2003.14
Type Total Care (Class IIII)

ME-TopTroniq, No.3 Longtan Road, Chongwen District, Beijing, China

R76/1992-NL1-2003.15
Type PS60 (Class III)

Mettler-Toledo Inc., 1150 Dearborn Drive, Worthington, Ohio 43085-6712, USA

R76/1992-NL1-2003.16
Type PS15 (Class III)

Mettler-Toledo Inc., 1150 Dearborn Drive, Worthington, Ohio 43085-6712, USA

R76/1992-NL1-2003.17
Type K-series (Class III)

DIBAL S.A., c/ Astintze Kalea, 24, Poligono Industrial Neinver, E-48016 Derio (Bilbao-Vizcaya), Spain

R76/1992-NL1-2003.18
Class III

Manter b.v., Phileas Foggstraat 66, NL-7825 Al Emmen, The Netherlands

R76/1992-NL1-2003.19
Type NP-Series (Class III)

SNOWREX International Co., Ltd., 52F No. 9, Lane 50, Sec. 3, Nan-Kang Road, Taipei, R.O.C, Taiwan

R76/1992-NL1-2003.20
Types AB-S, GB-S and PB-S (Classes I, II and III)

Mettler-Toledo A.G., Im Langacher, CH-8606 Greifensee, Switzerland

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Automatic rail-weighbridges
Ponts-bascules ferroviaires à fonctionnement automatique

R 106 (1997)

Issuing Authority / *Autorité de délivrance*

Physikalisch-Technische Bundesanstalt (PTB), Germany

R106/1997-DE-2003.01
Type MULTIRAIL B plus for accuracy classes 0.2; 0.5; 1 and 2

Schenk Process GmbH, Landwehrstraße 55, D-64293 Darmstadt, Germany

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

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

R 117 (1995) + R 118 (1995)

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

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

R117/1995-NL1-2002.01 Rev. 3
Model SK700 for accuracy class 0.5
Gilbarco GmbH & Co. KG, Ferdinand-Henze-Straße 9, D-33154 Salzkotten, Germany

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Multi-dimensional measuring instruments
Instruments de mesure multidimensionnels

R 129 (2000)

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

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

R129/2000-NL1-2003.01
Type ODIS-200
SICK Auto Ident Inc., 5 Shawmut Road, MA 02021-1408, Canton, USA

OIML WORKSHOP REPORT

MAA – Checklists

Paris, France
2003.06.2–3

CHARLES D. EHRLICH
Group Leader, International Legal Metrology Group, NIST (USA)

JEAN-FRANÇOIS MAGAÑA
Director, BIML

"Framework for a Mutual Acceptance Arrangement on OIML Type Evaluations" (OIML MAA)

and

"Checklists for Issuing Authorities and Testing Laboratories Carrying out OIML Type Evaluations" (OIML Checklists)

The MAA Workshop was attended by representatives from 18 of the 58 OIML Member States (Australia, Austria, Bulgaria, Czech Republic, Denmark, France, Germany, Japan, Macedonia, Netherlands, Romania, Russia, Serbia & Montenegro, South Africa, Switzerland, Tunisia, United Kingdom and United States). Sweden, which had been one of the countries voting "no", had planned to attend but an air traffic control strike prevented them from attending. The main intention of the Workshop was to address several key remaining contentious issues concerning the MAA and Checklists to see if better understanding and compromise solutions could be reached.

Overview of key issues

The Workshop began with an overview presentation of what was in the 1 DD of the MAA, and identified the remaining key issues, which included:

- need for an MAA,
- clarification of the Scope,
- allowed methods of demonstrating competence of Issuing Authorities and Testing Laboratories,
- costs and their allocation,
- allowance of additional requirements beyond those in OIML Recommendations,
- potential conflict with the European Measuring Instrument Directive (MID),
- identifying who makes decisions and votes on MAA matters,
- status and purpose of the Checklists document, and
- whether full ISO documents should instead be used.

Following this presentation, most of the rest of the meeting was spent debating these issues and trying to identify solutions and agreements. The final hours of the Workshop were spent on the Checklists document and related issues.

Need for MAA?

Concerning the issue of the need for the MAA, it was discussed that while the OIML Certificate System might be working well within Europe, there were strong indications that it might not be working so well outside of Europe, and especially between Europe and other regions. It was agreed that the BIML would investigate this situation further, but probably not in time for a clear answer before the 38th CIML Meeting in November.

Scope-related issues

Several sub-issues and questions were raised concerning the scope of the MAA. First there was the question of whether requirements should be placed on both Issuing Authorities as well as Testing Laboratories. There was also the question of whether the MAA was meant to cover both "examination" as well as "testing", and, if so, which body should do which (or did this need to be specified?). Another question was whether the scope of the MAA covered just test reports, or also OIML Certificates. One other important issue discussed under the scope umbrella was simplification of who the "participants" in a Declaration of Mutual Confidence (DoMC) were, and who they could and should be.

Issuing Authorities and Testing Laboratories?

The simple answer to the first scope question of whether requirements are placed on both Issuing Authorities as well as Testing Laboratories was agreed to be "yes". All Testing Laboratories are required to be either appropriately accredited or peer-reviewed against ISO/IEC 17025 requirements. The requirements on Issuing Authorities depend on what they do. For Issuing Authorities that conduct tests and/or examinations that fall within the scope of the DoMC, the same accreditation or peer review is required as for Testing Laboratories. For all Issuing Authorities, the function of assessing and supervising the work of their Testing Laboratories, and of issuing a Certificate, shall require an internal audit according to ISO/IEC Guide 65 requirements.

Examination and testing?

The answer to the question of whether the MAA is meant to cover both "examination" as well as "testing", and, if so, which body does which (or does this need to be specified?) is that both examination and testing are covered and that examination can be conducted by either body, since it is handled differently in different countries. However, only those examinations for which there are detailed instructions and procedures in the appropriate OIML Recommendation will be covered under a particular DoMC. This is because examinations can sometimes be very subjective and given different degrees of importance in different countries, so a particular country may still wish to do its own examination under the MAA, especially for possible fraudulent use of the instrument. OIML TCs and SCs will be encouraged to provide more detailed examination procedures if necessary in the Recommendations for which they are responsible.

Test reports and Certificates?

The question of whether the scope of the MAA covers just test reports or also OIML Certificates led to the general agreement that Certificates should now be a required part of the MAA system as a clear demonstration that when a test report is formally issued under the MAA, the instrument has met the requirements in the appropriate OIML Recommendation (at least according to the Issuing Authority that issues the Certificate, although examination may still be an issue). If the instrument does not meet the OIML requirements the customer (manufacturer) is still entitled to a copy of the test report, however an OIML Certificate will not be issued and the test report will not be considered to be a formal test report under the MAA system. The possible use of the OIML logo (or perhaps a new OIML MAA logo) on a test report or Certificate was only briefly discussed and must still be discussed further and resolved.

Simplifying definition of "participants"

There was considerable discussion about simplifying the descriptions of who are the possible "participants" in a Declaration of Mutual Confidence (DoMC), and also about who they should be. The number of basic types of participants was reduced to two, those who only accept test reports and those who in addition will generate (review and transmit to the customer) test reports. It was agreed that those who only accept test reports could be further categorized as being either a national responsible body that does not conduct type evaluation, or an Issuing Authority that is not able or chooses not to issue OIML test reports under that DoMC. It was further agreed that, even though according to the current rules of the OIML Certificate System there can be only one OIML Issuing Authority per Member State for a particular category of instruments, there can still be more than one national Issuing Authority that is capable of performing the tests and completing the test report according to the requirements in the corresponding OIML Recommendation, and so all such bodies should be allowed on the possible basis of fair economic competition to be participants in a particular DoMC.

Therefore, it was agreed that the type of participant that generates test reports should be characterized as "an Issuing Authority that issues complete OIML test reports that are validated by an OIML Certificate issued by the OIML Issuing Authority in that country, which may or may not be the same body, and that receives and utilizes test reports from the customer that the customer has received from other participants". Such a characterization is adequate to allow multiple participants from one country in a DoMC, without needing to modify the terms of the OIML Certificate System concerning the number of allowed OIML Issuing Authorities per country, if the proposed participants are national Issuing Authorities, but would not be adequate if they were not.

Therefore, the BIML might institute an inquiry to the CIML concerning whether allowing more than one OIML Issuing Authority per country is acceptable. It was agreed that even if there was more than one participant per country that generates test reports in a particular DoMC, there would be only one representative per country on the corresponding "committee on participation review". That representative would be assigned by the CIML Member, and would be responsible for coordinating with all participants in that country on matters before the committee on participation review.

It was also suggested that, due to the growing importance and role of the "committee on participation review", that it be given a new name that sounds more permanent. This was not pursued further at the Workshop.

Also, the ability of an OIML Corresponding Member to take part in a DoMC as an "Associate" was clarified and endorsed.

Methods for demonstrating competence

While much of the discussion had already taken place during Subcommittee deliberations about what the allowed methods for demonstrating competence of Issuing Authorities and Testing Laboratories should be, there were still some lingering questions about the "equivalence" of peer assessment and accreditation, the cost tradeoffs, and the need for bodies that have been accredited to make very clear their scopes of accreditation, the composition of the team that accredited them, and other details concerning their accreditation that might warrant further investigation by the committee on participation review for that DoMC. It was agreed that peer assessment must be used to the extent necessary that members of the committee on participation review can achieve a good level of confidence in the Testing Laboratories, similar to the level of confidence that comes through accreditation, and that those performing the peer assessment must be approved by the committee on participation review. The issue of cost is of paramount importance to everyone, and it was agreed that the cost of either type of assessment is to be borne by the body being assessed.

Cost and funding issues

Besides the costs associated with accreditation and peer assessment, which might be able to be passed on to some extent to the manufacturers who use the testing and certification services, the other key issue of cost is that to the BIML for operating the MAA program. It was reported that by charging an annual registration fee of just over 300 euros per test report (or now OIML Certificate) it is anticipated that the MAA should be self-supporting so that countries who choose not to participate will not be funding the program through their annual contributions to the OIML. It was agreed to add explicit explanations to the MAA indicating this.

Additional requirements

There was considerable discussion about whether test reports that are generated (reviewed and transmitted to customers) under a DoMC may contain "not substantially different" requirements than those in the corresponding OIML Recommendation, as well as additional requirements beyond those in the corresponding OIML Recommendation. Concerning the "not substantially different" requirements, it was generally agreed that countries will typically use somewhat different ranges or procedures for carrying out tests according to the OIML test report format while still staying within the OIML framework and this is to be expected and tolerated.

While it was recognized that a long-range goal of the OIML is to have harmonized legal metrology requirements among Members, it was also recognized that it is not within OIML's authority to mandate harmonization, and furthermore there will always be situations where, for good technical reasons, there are additional test requirements that a country has (examples were given at the Workshop such as testing for dezincification in water meters in countries where this is a problem, software testing and testing at elevated temperatures in hot climates). In order for the MAA to help deliver the "one-stop testing" that manufacturers desire, it was agreed that additional tests could be specified in a DoMC as long as they were agreed to by all of the members of the corresponding committee on participation review, and as long as all Testing Laboratories that review and transmit test reports under the DoMC are given the option of performing all of the tests.

Conflict with MID?

Another issue that was raised by several European Members was whether a potential conflict existed between the MAA and the European Measuring Instrument Directive (MID). This question had been discussed on several occasions with European Members, and the conclusion was that there is no conflict. When a manufacturer applies for a "Type Examination Certificate" according to Annex B of the MID (EU equivalent to type approval), the "notified body" (body entitled to issue this Certificate) examines any evidence of conformity provided by the applicant and decides whether or not to accept this evidence.

Test results issued under the relevant DoMC and provided by the manufacturer are part of such possible evidence and may be accepted by the notified body for issuing European type approval certificates. As the MAA makes no legal obligation to systematically accept these results, the notified body keeps its ability to examine these test results and to decide on their acceptability. Therefore a notified body of an OIML Member State would be permitted to participate in the DoMC.

Committee on participation review, participation and decisions

Besides the matters already discussed above concerning membership and the role of the committee on participation review in deciding on experts for peer review assessments, allowed "additional" requirements in a DoMC, etc., there was also discussion about how decisions are to be made in the committee on participation review, and identifying who makes the decisions. It was agreed that all of the participants in a DoMC, and not just those that review and transmit test reports to customers, should be involved in reviewing and making decisions concerning the report that the committee on participation review prepares on the competence of all of the participants, especially those that review and transmit test reports to customers. This is because all participants will be agreeing to accept test reports from participants that review and transmit test reports to customers, so that all must be aware of and comfortable with the evaluations of the competences of all participants. It was noted that even participants (and Associates) that only agree to accept (review and utilize) test reports have an obligation under the terms of the MAA that their application requirements for issuing a national certificate are consistent with the requirements of Clause 3.1 of the OIML Certificate System.

Status/use of Checklists document

While no time was left to review the text of the Checklist document, this was not a big problem since much of the document simply provides interpretation from a legal metrology perspective of the corresponding ISO/IEC 17025 and ISO/IEC Guide 65. However, the key general issues provided by Members in their comments on the Checklists were discussed (such as whether there was a need for the Checklists, whether they were confusing and possibly misleading, and their status and purpose). Foremost, it was pointed out that the Checklists are intended to be used only as guidelines for each committee on participation review to use to develop more specific Checklist documents for each particular DoMC. The Checklists are not intended to deviate from, replace or supersede the corresponding ISO/IEC Standard and Guide. Also, the text of the MAA has been modified to reflect the fact that use of the Checklists is not mandatory if accreditations with appropriate scopes and acceptable documentation have been used, and if the audit team was appropriately comprised. ■

COOMET

COOMET TC 2 Meeting *Legal Metrology*

Jalta, Ukraine

2003.03.28

Rainer Hahnewald (COOMET TC 2 Chairman)
Head of the Verification Authority
of a German Federal State

Task and structure of COOMET TC 2

In response to the growing interest in developing stronger cooperation in legal metrology, the COOMET Working Group "Legal Metrology" was established in 2000. Previously, the majority of COOMET projects had primarily concerned comparisons of measurements and reference materials, but following COOMET's structural changes, a new Technical Committee was formed. The Figure above shows the four Subcommittees which make up TC 2 and the Subcommittees' projects include topics such as:

- Harmonization of metrological regulations and norms;
- Harmonization of type approval;

- Assessment of the technical competence of verification laboratories; and
- Testing of software.

The goal is the mutual acknowledgement of test results, type approvals and conformity declarations.

First results

Under the coordination of Belarus, the Project 207/BY/00 "Development of a Recommendation stipulating the information which should be contained in the type approval description" was completed during the third meeting held in 2002, and the requirements were agreed on to form a COOMET Recommendation.

A second Project (204/DE/00) was also completed in 2002: "Harmonization of technical requirements in the field of legal metrology" and recommended that the exchange of information should serve as a first step towards harmonization. Eight countries contributed information and the Project covers:

- Fields of mandatory surveillance of measuring instruments;
- Type approval and surveillance (verification, inspections);
- Verification validity duration (in years); and
- Statement to staff.

Other projects

The development of COOMET Recommendations for the harmonization of metrological regulations and norms, and the assessment of the technical competence of verification laboratories, will soon form Project 263/RU-a/02. With this new project the results of the Project 206/RU/00 "Analysis of legal documents in the field of metrology for working out suggestions on their harmonization" (which is still being worked on) are used to the fullest extent possible.

The basis for developing Project 213/BY/00 is WELMEC Guide 7.1 "Software requirements" and work is still ongoing.

In 2003, work will begin on a new project 208/UA/03 "Development of a COOMET Recommendation regarding the content of bilateral agreements on mutual recognition of test results and certificates of initial verification of measuring instruments".

Conclusion

COOMET Members are all following the work of COOMET TC 2 with great interest and all those who participated in the 13th COOMET Committee meeting (Jalta, Ukraine) also attended the 4th meeting of TC 2. Ongoing work is reported back to the COOMET Committee (see photo).

OIML Recommendations have an important influence on this work, and standard ISO/IEC 17025 is increasingly being taken into consideration for the competence of testing laboratories. At the end of 2003 the final version of the EU MID is expected; this Directive will also affect developments in countries outside of the EU. ■

2	Legal Metrology Technical Committee *approved by the Committee*
SC2.1	**Liaisons with OIML, Regional Organizations and National Metrological Institutions**
SC2.2	**Software testing**
SC2.3	**Harmonization of metrological regulations and norms**
SC2.4	**Technical competence, assessment of verification laboratories**

WELMEC

19th WELMEC Committee Meeting

Madrid, Spain

8–9 May 2003

GABRIELE WESSELY
WELMEC Secretary

The 19th WELMEC Committee meeting was held in Madrid, Spain, from 8–9 May 2003 and was opened by CEM President Dr. Gonzalo Léon from the Ministry for Science and Technology, and CEM Director Dr. Angel Garcia.

Mr. José Robles (WELMEC representative from Spain and Head of the CEM Force Division) gave a presentation entitled *The Metrological Infrastructure in Spain*, including historical milestones, structural reforms and recent developments, which was of great interest.

Mr. Freistetter began by informing the Committee that recognition of WELMEC as an Administrative Cooperation for NAWI is not an issue for official recognition. Nevertheless, it was suggested to add a note to the Strategy Document stating that one of the aims of WELMEC is to be an Administrative Cooperation for the purposes of the NAWI Directive and the forthcoming MID.

Another important subject discussed was the expansion of WELMEC: up to now, the Committee had stated that it had no intention of changing the WELMEC Member Policy, but that it would consider the situations of Cyprus and Malta on a case-by-case basis.

Mr. Tsiartzazis (Cyprus) informed attendees about the *status quo* in his country and Mr. Farrugia (Malta) also gave a short report.

Even though these two countries have not signed the Europe Agreement, in April 2003 (Athens) they were accepted as candidates to join the EU in 2004, and the Committee discussed their respective situations. Other Associate Members of WELMEC also signed the accession agreement to the EU in Athens, so all these countries should be given the same right of access to WELMEC. There were no objections from the Committee so Cyprus and Malta were welcomed as Associate Members.

Next, the Chairman instructed members to send their views (by 30 September 2003) on additional groups of measuring instruments to be included in the Type Approval Agreement which would be examined to clarify the requirements for any new WELMEC Member to be admitted.

Mr. Freistetter informed the Committee that the Commission had relayed the ideas concerning the MID to the European Parliament and that the latter was satisfied; this view was confirmed by Mr. Dessis on behalf of the Greek Commission Presidency. Mr. Dessis went on to inform the Committee about the status of the MID, saying that outstanding tasks had been completed and amendments made, and that it would be discussed at Council level on 19 May. The next Presidency, Italy, confirmed that view, and the Committee was informed that translations have been drawn up and that the transition period for implementation and application was still under discussion, though this was not considered as being a very crucial point.

Reports of the Working Groups

WG 2 Directive Implementation

The report for WG 2 was presented by Mr. Birdseye (UK) and the Committee agreed that there was still a need to harmonize NAWIs as well as AWIs, since new questions had arisen from manufacturers and the issue of the green "m" had not been resolved as yet.

WG 4 General Aspects of Legal Metrology

Mr. Lindlov, WG 4 Chairman, reported that the first meeting of this new Working Group had already taken place in March. He presented proposals to the Committee for the new name of this WG and also the new Terms of Reference, which were open for discussion.

The Committee suggested that WG 4 should take the work of the OIML into account, a suggestion welcomed by Mr. Magaña. Thus the proposal will be included in the TOR and both the new name *General Aspects of Legal Metrology* and the TOR were accepted by the Committee. The next meeting will take place in November and there is still a need for more participants in WG 4.

WG 5 Metrological Supervision

Mr. Harvey (LACORS) presented the WG 5 report and informed the Committee that the country information was only recently put on the web site. He also presented the *Draft Guide on Market Surveillance* for discussion. There was also a suggestion to include details of manufacturers with type approvals for their quality systems in the information provided by WELMEC.

WG 6 Prepackages

The WG 6 Report was presented by Mr. Burnett (LACORS). The new draft *Guide on Packers* (6.4) will be sent out about two weeks after the Committee meeting. Guides 6.5 and 6.6 have already been approved and are already available on the WELMEC web site. At the moment the priority of WG 6 is to complete the work on Guide 6.6 by the next meeting, and to finalize Guide 6.0. Guide 6.7 relating to market surveillance of prepackaged goods is to be finalized this year.

WG 7 Software

Working Group 7 and MID Software Status Report updates were given by Vice-chairman Mr. Schulz, since the progress of WG 7 is closely linked to that of the MID-Software project. On this occasion, the Committee and the OIML were invited to take part in a FASIT Workshop that will take place in Ljubljana in September this year. The WG 7 TOR were accepted by the Committee without further comment.

WG 8 Measuring Instruments Directive

Mrs. Lagauterie (France) gave a report on WG 8 on behalf of Mr. Lagauterie and suggested that new subgroups should be created to cope with the new categories in the scope of the MID (MI-001 to MI-010) and this was approved by the Committee.

WG 10 Measuring Equipment for Liquids Other Than Water

Finally, Ms van Spronssen (Netherlands) informed the Committee on behalf of WG 10 that Guide 10.1 would soon be uploaded onto the WELMEC web site, as would the French version of Guide 10.2. There were comments from Germany on Guide 10.3 that still had to be included before releasing the final version of this Guide. A paper concerning *Organization and Procedures WG 10* was discussed and will be revised and presented during the next Committee meeting. Again, the Committee suggested engaging in close cooperation with the OIML for this project.

Other Reports

As usual, reports were also given by Observer Organizations. The EA report was given by Ms. Rivera (ENAC) and included an update on recent projects, an organizational chart and a list of member countries.

Mr. Klenovský (Czech Republic) next updated the Committee on progress within EUROMET and MERA, a project that was started on 1 September 2002 and which was currently at consultation stage to review national structures and priorities, establish the views and requirements of industrial users and metrology services, and consult the Accession Countries.

Finally, Mr. Magaña informed the Committee about current issues concerning the OIML, such as the preparation of the Draft Mutual Acceptance Arrangement (MAA) that was sent out for preliminary vote in April and he also gave updated information on the OIML Certificate System.

Mr. Obdrzalek (Slovakia) invited the Committee to hold its next meeting in Bratislava on 13–14 May 2004 and the Committee was pleased to accept his invitation. The main decisions (among others) of the 19^{th} WELMEC Committee meeting are presented on the following page.

The WELMEC Committee:

Approves	the Minutes of the 18th Committee Meeting held in Vienna
Accepts	the Chairman's Report for 2003
Approves	the report concerning the budget for 2002–2003
Approves	the subscriptions for 2004, which will remain at their 2003 level
Approves	the WELMEC Strategy Document 2003
Approves	the Organizational Chart
Instructs	the Chairman to take into account the results of the discussion concerning the Guidelines for Working Groups and send it out for comments and e-mail approval
Approves	the Guidelines for the Chairman's Group
Approves	the document concerning the Transition of Associate Members to full Membership in WELMEC
Welcomes	Cyprus and Malta as Associate Members of WELMEC
Takes note	of the requirement to elect a Vice-Chairperson during the 20th Committee Meeting
Instructs	the Committee Members to send their views on additional groups of measuring instruments to be included in the Type Approval Agreement by 30 September 2003
Instructs	the Chairman to examine the Type Approval Agreement to clarify the requirements for being included as a WELMEC Member, and send it out for comments in 2003
Approves	the Proposal for WELMEC Working Groups
Approves	all the Working Group Reports
Instructs	WG 5 to finalize the Draft Guide concerning Market Surveillance and submit it to the WELMEC Secretariat with a view to obtaining comments from the Committee Members and voting by e-mail
Instructs	WG 8 to draft the TOR in accordance with the topics discussed under point 8.2 of the agenda and to send it to the WELMEC Secretariat for comments and confirmation by the WELMEC Committee via e-mail
Instructs	the WELMEC Committee to send their questions, comments and proposals for topics to be discussed concerning Information Exchange and for the convenorship of a new (ad hoc) Working Group up to 30th September 2003 to the WELMEC Secretariat
Thanks	the CEM for hosting the 19th Committee Meeting
Accepts	the invitation to hold the 20th Committee Meeting on 13–14 May 2004 (exact date to be confirmed) in Bratislava.

CECIP

53ème Assemblée Générale

Interlaken / Berne, Suisse

30 mai 2003

MICHEL TURPAIN
Secrétaire Permanent

Le CECIP, Comité Européen des Constructeurs d'Instruments de Pesage, vient de tenir sa 53ème Assemblée Générale à Berne et à Interlaken en Suisse, à l'invitation de l'Association Suisse pour les Instruments de Pesage.

Notre Assemblée Générale s'est tenue dans les locaux de l'Office Fédéral Suisse de Métrologie et d'Accréditation à Berne. Nous avons été accueillis par le Dr Bruno Vaucher, Directeur Adjoint de l'Office, que nous remercions particulièrement et qui nous a présenté une approche globale de la métrologie légale, très appréciée par les délégués.

Cette année nous avons eu le grand plaisir d'accueillir trois nouvelles Fédérations au sein du CECIP, un record pour une seule Assemblée Générale:

- l'Association des Constructeurs et des Artisans du Pesage Polonais représentée par M. Piotr Cholewa, Président de l'Association,
- l'Union des Fabricants, des Importateurs et des Distributeurs d'Instruments de Mesure et de Contrôle de Roumanie, représentée par M. Virgil Petcu, Président de l'Association,
- l'Association des Constructeurs Russes d'Instruments de Pesage, représentée par le Dr Alexander Korobkin, Président de l'Association.

Les industriels du pesage de ces trois pays ont su créer très rapidement une Fédération représentative dans leur pays en collaboration avec le CECIP et ont pu ainsi demander leur adhésion au CECIP.

Le CECIP est donc composé aujourd'hui de 15 Fédérations venant des pays suivants:

Allemagne	Roumanie
Espagne	Royaume-Uni
Finlande	Russie
France	République Slovaque
Hongrie	Suisse
Italie	République Tchèque
Pays-Bas	Ukraine
Pologne	

Chaque Fédération a présenté la situation de l'industrie du pesage dans son pays, résumée dans un tableau récapitulatif détaillant la production d'instruments de pesage en Europe et montrant une baisse générale de la production par rapport à 2001, année qui avait bénéficié d'un renouvellement des balances poids-prix dans le domaine du commerce et de la grande distribution avec l'arrivée de l'Euro.

La partie statutaire s'est déroulée l'après-midi avec le programme habituel comme décrit ci-dessous.

Rapports d'activité de chaque groupe de travail

- Le Groupe Métrologie Légale, qui poursuit sa tâche de propositions et d'examens:
  - des documents de l'OIML, en particulier la révision des Recommandations touchant les instruments de pesage à fonctionnement automatique,
  - des documents de la Commission Européenne, en particulier le projet de Directive sur les Instruments de Mesure,
  - des documents du WELMEC, European Cooperation in Legal Metrology, en particulier les guides d'harmonisation,
- Le Groupe Affaires et Commerce, qui veille à une concurrence saine sur les marchés et aux intérêts des constructeurs et des consommateurs, en particulier dans le projet de Directive sur les Instruments de Mesure,
- Le Bureau, qui assure la gestion quotidienne du Comité et son développement, en apportant notre expérience aux jeunes Fédérations des pays qui frappent à la porte de l'Union Européenne, en prenant contact avec les Fédérations de constructeurs d'instruments de pesage à travers le monde, amenant de nouveaux membres au CECIP, comme la Pologne, la Roumanie et la Russie cette année, en créant des liens avec les Fédérations de Chine, des États-Unis d'Amérique ou du Japon.

Election d'un Président

- Après le départ de notre Président, M. Tim Cooper, en décembre 2002, nous devions procéder à une élection partielle pour le remplacer. M. David Castle, présenté par la Fédération du Royaume-Uni, a été élu comme nouveau Président du CECIP. Le bureau du CECIP a donc la composition suivante:

Président	David Castle	Fédération Royaume-Uni
Vice-Présidente	Caroline Obrecht	Fédération Suisse
Vice-Président	Fabio Martignoni	Fédération Italie
Vice-Président	Dr Klaus Wurster	Fédération Allemagne
Secrétaire Permanent	Michel Turpain	Fédération France

Nos amis suisses avaient parfaitement organisé cette Assemblée Générale dans un cadre superbe de lacs et de montagnes. Cette journée de travail fut suivie d'une excursion en train à crémaillère à la Jungfraujoch à 3 454 m d'altitude qui nous a fait découvrir un extraordinaire panorama avec les sommets de la Jungfrau, de l'Eiger et du Mönch dominant les glaciers. Le soleil était au rendez-vous et rendait ce lieu encore plus grandiose. Merci à nos amis Suisses, Caroline Obrecht et Paul Ryser en particulier, et à l'année prochaine en Espagne !

Statistiques - Industrie du Pesage *Année 2002* / Results - Weighing Industry *Year 2002*

Pays / **Country**	**Production** Hors taxe Monnaie locale Local currency	**Production** Hors taxe Without tax Million Euro	**Variation** 2002 / 2001	**Export** Variation/2001 Million Euro	**Import** Variation/2001 Million Euro
ALLEMAGNE *GERMANY*		662,3	– 10,4 %	458,9 – 4,3 %	225,2 – 11,7 %
ESPAGNE *SPAIN*		73,3	– 39,4 %	25,2 – 10 %	6,3 – 47,5 %
FINLANDE *FINLAND*		27,7	+ 10 %	5,9 0 %	10,7 0 %
FRANCE *FRANCE*		173,2	– 11 %	94,2 + 31,4 %	129,4 – 10,6 %
HONGRIE *HUNGARY*					
ITALIE *ITALY*		81,2	– 37,2 %	24,3 – 4,6 %	36,9 – 4,4 %
PAYS-BAS *NETHERLANDS*					
REPUBLIQUE SLOVAQUE *SLOVAK REPUBLIC*					
REPUBLIQUE TCHEQUE *CZECH REPUBLIC*		11,8	+ 3,6 %	1,49 + 1,4 %	12,2 + 25 %
ROYAUME-UNI *United Kingdom*		185,5	– 5 %	123,6 + 1,68 %	114,5 – 13,24 %
SUISSE *SWITZERLAND*				135 + 4,5 %	35 – 0,3 %
UKRAINE *UKRAINE*					

CECIP

53rd General Assembly

Interlaken / Berne, Switzerland

30 May 2003

MICHEL TURPAIN
Permanent Secretary

CECIP, the European Committee of Weighing Instrument Manufacturers, held its 53rd General Assembly in Berne and Interlaken, Switzerland, at the invitation of the Swiss Association for Weighing Instruments.

The General Assembly was held at the Swiss Federal Office of Metrology and Accreditation in Berne. Dr. Bruno Vaucher, Deputy Director of the Office, welcomed participants and gave a presentation on a global approach to legal metrology which delegates particularly appreciated. Thanks were expressed to him for his introduction to the event.

Over the last year CECIP has been pleased to welcome three new Federations which joined the Committee, a record number of new members for one General Assembly:

- The Association of Polish Scales Manufacturers and Craftsmen, represented by Mr. Piotr Cholewa, President of the Association,
- The Union of Manufacturers, Importers and Distributors of Measure and Control Instruments from Romania, represented by Mr. Virgil Petcu, President of the Association,
- The Association of Russian Manufacturers of Weighing Equipment, represented by Dr. Alexander Korobkin, President of the Association.

Weighing industrials from these three countries have rapidly succeeded in creating Federations that represent their countries in association with CECIP, and in this way have requested membership of CECIP.

CECIP now therefore comprises 15 Federations from the following countries:

Czech Republic
Finland
France
Germany
Hungary
Italy
The Netherlands
Poland
Romania
Russian Federation
Slovak Republic
Spain
Switzerland
Ukraine
United Kingdom

Each Federation then presented the situation of the weighing industry in its country. The table opposite summarizes weighing instrument production in Europe and indicates a general decrease compared to 2001, a year in which the introduction of the Euro called for price-computing scales to be replaced both in the field of trade and in the retail sector.

During the afternoon the statutory part included, as in previous years, the usual program as described below.

Activity reports for each Working Group

- The Legal Metrology Group, which is continuing with its task of coming up with proposals and examinations:
  - of OIML documents, especially the revision of Recommendations dealing with automatic weighing instruments;
  - of European Commission documents, especially the draft Measuring Instruments Directive;
  - of WELMEC (European Cooperation in Legal Metrology) documents, especially harmonization guides.
- The Business and Trade Group, which ensures healthy market competition and which monitors the interests of manufacturers and consumers, especially concerning the draft Measuring Instruments Directive,
- The Bureau, which takes care of the day-to-day management of the Committee and of its development by passing on experience acquired to the younger Federations of those countries that come knocking at the European Union's door, and by creating ties with the Federations of weighing instrument manufacturers around the world, bringing on board new CECIP members, such as Poland, Romania and Russia this year, and by creating ties with the Chinese, American, or Japanese Federations.

Election of a President

■ Following the departure in December 2002 of our President, Mr. Tim Cooper, a partial election had to be carried out to replace him. Mr. David Castle, whose candidacy was put forward by the United Kingdom, was elected as the new CECIP President. The CECIP Bureau is therefore now made up as follows:

President	David Castle	UK Federation
Vice-President	Caroline Obrecht	Swiss Federation
Vice-President	Fabio Martignoni	Italian Federation
Vice-President	Dr. Klaus Wurster	German Federation
Permanent Secretary	Michel Turpain	French Federation

Our Swiss friends had made an excellent job of organizing this General Assembly in superb settings amidst the lakes and mountains. The day's work was followed by a cog-train journey to the Jungfraujoch (altitude 3 454 m) which offered beautiful panoramic views of the summits of the Jungfrau, Eiger and Mönch which dominate the glaciers. The sunshine added to the splendor of the area and we extend our thanks to our Swiss friends, and to Caroline Obrecht and Paul Ryser in particular. See you next year in Spain! ■

INTERNATIONAL CONFERENCE

The Role of Metrology in the Conditions of a Globalized Market

Moscow, Russia

2003.05.12–14

NIKOLAY ZHAGORA, BelGIM, Belarus
HANS-DIETER VELFE, PTB, Germany
VLADIMIR LAKHOV, Gosstandart, Russia

The International Conference *The Role of Metrology in the Conditions of a Globalized Market* was organized by the Gosstandart of Russia on 12–14 May, 2003 in Moscow following a proposal by COOMET (Euro-Asian Cooperation of State Metrology Institutions) with the support of the PTB, Germany, and the OIML.

The conference was attended by more than 200 experts representing national metrology institutions and state legislation and industry departments from 15 countries: Belarus, Bulgaria, Germany, Georgia, Kyrgyzstan, Cuba, China, D.P.R. Korea, Moldova, The Netherlands, Russia, Romania, Slovakia, Uzbekistan and the Ukraine.

In the framework of the Conference, three topic meetings were held, as detailed below.

1 Global aspects

The first topic meeting *Global aspects* was dedicated to the issues involved in creating a global system of measurements in the field of metrology. The increasing globalization of world trade and economic changes in general are a distinct feature in current times, and call for the elimination of various barriers to trade and international sharing of metrology experts; these are the key issues to be solved and ideas were put forward by four speakers at this meeting: Mr. Gerard Faber (President, CIML), Mr. Eberhard Seiler (PTB, Germany), Mr. Vladimir Lakhov and Mr. Vladimir Belotserkovsky (Gosstandart of Russia).

Participants also discussed questions regarding a model strategy and procedures for establishing mutual confidence in the results of measurements and calibrations, competence of calibration and testing laboratories, as well as the impact of mutual recognition arrangements initiated by international metrology and accreditation organizations such as the Metre Convention, OIML and ILAC, aiming at eliminating technical barriers to trade. The role of Regional Metrology Organizations in supporting the globalized system was especially emphasized.

2 Regional cooperation in the field of metrology

At the second topic meeting *Regional cooperation in the field of metrology*, issues regarding the role of regional metrology organizations as well as trends in regional cooperation were highlighted, due to their considerable impact on globalization. Regional cooperation is now actively developing in Europe, in the Asia-Pacific area, in America and in South Africa. The development of cooperation at regional level also determines the cooperation infrastructure in the field of metrology.

The importance and role of regional cooperation is today increasing due to the introduction of the CIPM Mutual Recognition Arrangement for Measurement Standards and its realization is a key priority to achieve such cooperation.

Information about regional cooperation activities was presented in reports given by:

- Mr. Nikolay Zhagora, BelGIM, Belarus
  COOMET President (COOMET),
- Mr. Hans-Dieter Velfe, PTB
  (European Collaboration on Measurement Standards - EUROMET),
- Mr. Roman Schwartz, PTB
  (European Cooperation in Legal Metrology - WELMEC),
- Mr. Klaus Brinkmann, PTB
  (European Co-operation for Accreditation - EA),
- Mr. Vladimir Lakhov, Gosstandart of Russia
  (Euro-Asian Interstate Council for Standardization, Metrology and Certification of the Commonwealth of Independent States - EASC CIS), and
- Mr. Christian Mengersen, PTB
  (Urgent issues of state market surveillance in the European Union).

3 Measuring Instruments Directive (MID)

The third topic meeting concerned the MID, notably issues related to the development and implementation of the Directive, which intends to create a single market for measuring instruments subject to legal metrology control in Europe. This will be achieved by setting up general technical requirements, and also requirements for compliance assessment for the purpose of establishing mutual confidence in the results of such assessment and maintaining a high level of consumer protection.

In the reports by speakers from Germany (Mr. Christian Mengersen, Mr. Klaus-Dieter Sommer and Mr. Thomas Ernst) the conception, objectives and current situation of the implementation of the MID were described in detail. Their reports also gave an overview of general requirements and various approaches to proving conformance of measuring instruments and state surveillance over measuring instruments subject to MID requirements in the single European market. Mr. Lev Issaev (VNIIMS, Russia) gave a report on the possibility of implementing the MID in Russia, taking national legislation into consideration. Mrs. Lidia Astafijeva (BelGIM, Belarus) reported on the experience gained in testing measuring instruments and appliances against the requirements of European Directives.

Closing discussions in this third meeting revealed that there was a high level of interest in the MID on the part of the participants, and the role of the Directive is increasing in view of the recent introduction of a new technical regulation infrastructure in CIS countries. Currently, the MID may be used as a model in working out initial technical regulations in the field of metrology and measuring equipment.

Delegates underlined the importance of the problems discussed at the Conference in consideration of increasing cooperation in trade and in technical fields at international level.

The recommendations adopted at the Conference include the following:

- Both the Conference participants and indeed all metrology organizations involving COOMET member countries and corresponding organizations of CIS countries should carry out an analysis of the Conference proceedings and estimate to what degree it is possible to apply the conclusions to both national practice and international cooperation;
- The Conference proceedings should be published in the OIML Bulletin and in metrological publications of Russia and other countries (reports may first submitted to the Conference Secretariat);
- A series of in-depth studies and workshops should be organized regarding the issues discussed at the Conference, including steps to establish a global measurement system and to implement the MID and accreditation issues. These topics should also be taken into consideration in COOMET programs; and
- The OIML should continue to organize such Conferences and workshops for developing countries - and those in transition - by obtaining the support of donor organizations, and of UNIDO.

Participants acknowledged the role of the Gosstandart of Russia, PTB, COOMET and the OIML for organizing the Conference, and also thanked the lecturers for their instructive and interesting reports. Thanks were also expressed to the Conference sponsors for their technical assistance, and to the publishers for their information support role.

In the framework of the Conference, an exhibition entitled "Laboratory 2003" was held, along with visits to laboratories of the all-Russian Scientific Research Institute of Optics and Physical Measurements (VNIIOFI) and the all-Russian Scientific Research Institute of Metrological Service (VNIIMS). ■

OIML Makes Award to Dr. Mencke

During the 37th Meeting of the International Committee of Legal Metrology (CIML) in October 2002 in Saint-Jean-de-Luz, France, the Committee decided to make awards to three distinguished experts who had greatly contributed to the work of the OIML.

The award consists of a special bronze Medal struck by the Mint of Paris, and a Certificate. The front of the medal bears the OIML globe logo and the Organization's full title in French and in English. The back has the French text "Avec la Reconnaissance de l'OIML" (with the recognition of the OIML), and the name of the expert concerned. The Certificate includes the text "The OIML expresses its gratitude to Mr. .... for his outstanding contribution to the development of international legal metrology", and is signed by the CIML President, Mr. Gerard Faber.

The photo above shows the presentation of the Medal and the Certificate to Dr. Detlev Mencke by Prof. Manfred Kochsiek, CIML Vice-President, at the PTB in Braunschweig, Germany. Although Dr. Mencke has been retired since the end of 1999, he still continues his work for the OIML as Chairman of TC 8/SC 3 "Dynamic volume measurement of liquids other than water".

Walter Mühe, 1921-2003

It is with deep regret that we inform readers of the OIML Bulletin of the recent passing away of Dr. Walter Mühe, who died in July 2003 at the age of 82.

As a young scientist at the PTB, Germany, Walter Mühe witnessed the foundation of the OIML in person and over the years, greatly influenced the Organization's history as CIML Member for Germany by actively contributing to the elaboration of many OIML Recommendations.

In 1970 he was appointed Member of the Presidential Council and in 1983, CIML Second Vice-President.

Dr. Mühe's work was a major factor in the OIML's sustained development and his key role was recognized by the Committee, which appointed him CIML Honorary Member on his retirement in 1986.

He will be dearly missed by his family, colleagues and friends and will long be remembered as a pioneer figure in the development of the OIML.

Welcome to Two New OIML Member States

The OIML is pleased to announce the accession of two full Member States, both previously Corresponding Members, and extends a warm welcome to these two Countries:

- The Government of the Socialist Republic of Vietnam acceded to the Convention Establishing an International Organization of Legal Metrology on 25 August 2003;
- The Government of New Zealand acceded to the said Convention on 27 August 2003.

The OIML is pleased to welcome the following new

CIML Member

Poland

Mrs. Barbera Lisowska

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OIML Meetings

7 October 2003 - Brussels, Belgium

TC 8/SC 5 Water Meters: SC meeting on future projects and reviews (In conjunction with the ISO TC30/SC7 and CEN TC92 meetings on 8 October 2003 in Brussels)

6–9 October 2003 - Paris, France

TC 8/SC 3 Dynamic volume measurement (liquids other than water) +
TC 8/SC 4 Dynamic mass measurement (liquids other than water)
Revisions of R 86, R 105, R 117

15–16 October 2003 - Beijing, China

TC 17/SC 1 Humidity
Revision R 59

20–24 October 2003 - Rio de Janeiro (Venue to be confirmed)

TC 12 Instruments for measuring electrical quantities (WG meeting)
Revision R 46

30–31 October 2003 - Vienna, Austria

TC 8/SC 1 Static volume measurement
SC meeting on all projects and reviews

4–8 November 2003 - Kyoto, Japan

Development Council Meeting
38th CIML Meeting

Committee Drafts

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Revision R 83: Gas chromatograph/ mass spectrometer system for analysis of organic pollutants in water	E	1 CD	TC 16/SC 2	US
Revision R 59: Moisture Meters for Cereal Grain and Oilseeds	E	1 CD	TC 17/SC 1	CN
Automatic instruments for weighing road vehicles in motion - Part B Axle weighing (R 134 Part B)	E	3 CD	TC 9/SC 1	UK
Revision D 11 General requirements for electronic instruments	E	3 CD	TC 5/SC 1	NL