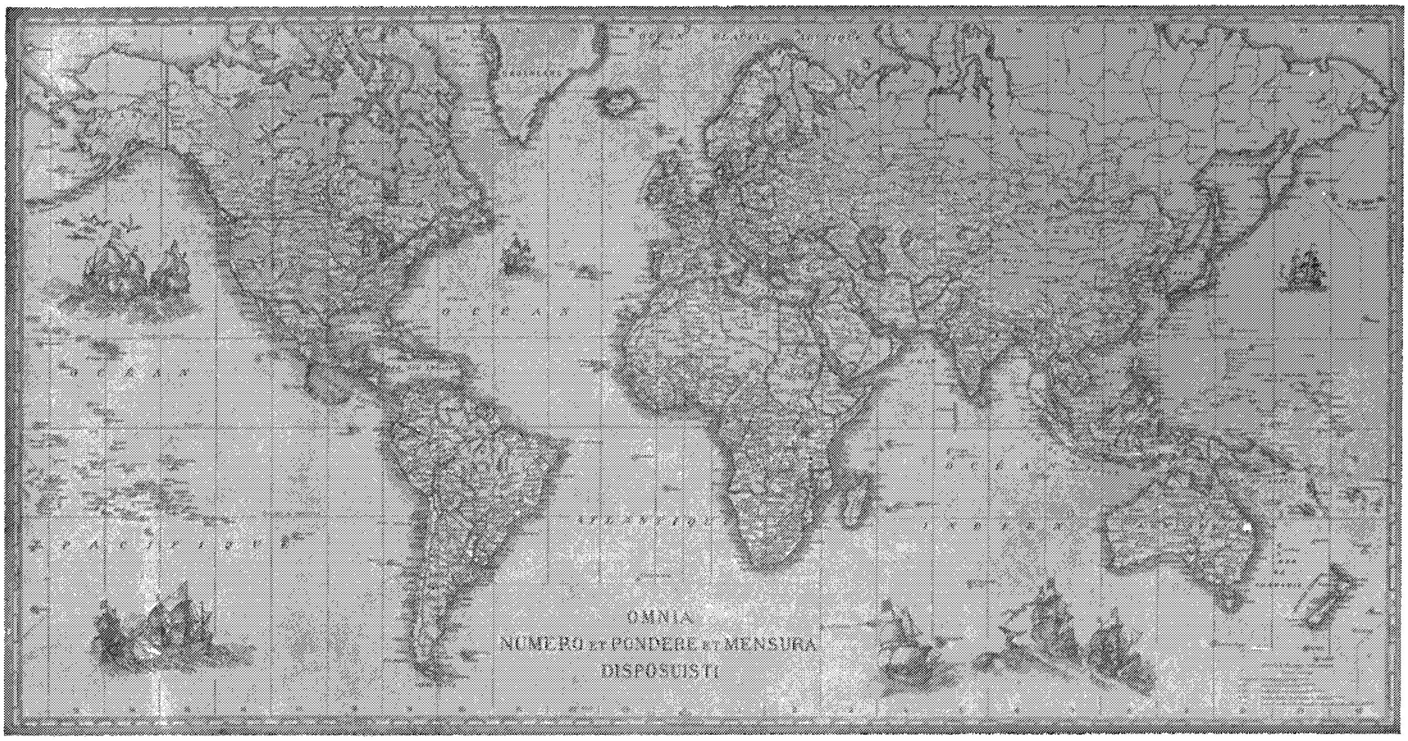
Bulletin n° 75
(20e Année — Juin 1979)
TRIMESTRIEL

BULLETIN

DE

L'ORGANISATION INTERNATIONALE DE MÉTROLOGIE LÉGALE

(Organe de Liaison entre les Etats-membres de l'Institution)



BUREAU INTERNATIONAL DE METROLOGIE LEGALE
11, Rue Turgot — 75009 PARIS — France

Bull. O.I.M.L. — N° 75 — pp. 1 à 52 — Paris, Juin 1979

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L'ORGANISATION INTERNATIONALE DE MÉTROLOGIE LÉGALE

Organe de liaison interne entre les Etats-membres de l'Institution dont l'importance et la régularité de parution peuvent varier selon les exigences des activités de l'Organisation (en principe édition trimestrielle).

BULLETIN

de

l'ORGANISATION INTERNATIONALE de MÉTROLOGIE LÉGALE

75e Bulletin trimestriel
20e Année — Juin 1979

Abonnement annuel : EUROPE : 60 F-français
Autres Pays : 75 F-français
Compte Chèques postaux : Paris-8 046-24 X
Compte Banque de France, Banque Centrale, Paris : n° 5 051-7

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REPUBLIQUE FEDERALE d'ALLEMAGNE

CONTRIBUTION to the TESTING of STRAIN GAUGE LOAD CELLS for SUITABILITY for USE in ELECTROMECHANICAL WEIGHING MACHINES *

by **B. MEISSNER/R. SUSS**
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SUMMARY

Among other things, the Physikalisch-Technische Bundesanstalt (PTB) tests strain gauge load cells (DMS-WZ) within the framework of type approvals of electromechanical weighing machines which are acceptable for verification. The necessary requirements for the strain gauge load cells are taken from legal regulations, in particular from the Eichordnung (Directive for specifications and tolerances), Annex 9 : « Non automatic weighing machines ». In the repeated transformation of the measured quantities, force-strain-resistance variation, the measuring uncertainty is influenced by the materials selected and by the changes of the material properties depending upon time and application. The present testing capabilities of the PTB range from smallest nominal loads (direct loading with standard mass) up to 220 t (pressure load cell), whereby the temperature can be varied between — 10 °C and + 40 °C. The universal applicability of strain gauge load cells requires — in particular with regard to type approvals of industrial weighing machines — extensive investigations on the behaviour of the load sells under different conditions of use.

1. INTRODUCTION

1.1. Legal fundamentals, General.

The necessity for type approval for measuring instruments that are to be used in commerce requiring standardization, is derived from the legal requirements. Corresponding laws exist in all industrialized countries.

(*) Texte extrait de VDI-Berichte 312-1978 publié avec l'aimable autorisation de l'Editeur, VDI-Verlag, Düsseldorf, R.F.A. Les Auteurs remercient le NBS pour la traduction anglaise de ce texte.

Decisive for the Federal Republic, is the « Law concerning Mesuring and standardization (EichG) » (1) along with other legal regulations. Among others, scales that are to be applied to commerce requiring standardization, are subject to this. The standardization laws require that a scale must, largely, i.e. within prescribed limits of error, maintain its measurement-technical properties for the duration of the validity of its standardization (in the case of scale, usually two or three years). This requirement for long-period stability may call for tedious investigations on various test samples in connection with type approval tests, especially when the testing institution uses a « black box test ».

In the case of simultaneous testing of the construction of the measuring instrument — e.g. a scale — more assured judgements are possible with reduced measuring effort, if there is sufficient experience and the manufacturer builds in a reproducible manner. The requirement for identical behaviour of sample and series can only be guaranteed if the manufacturer has sufficient measurement devices in order to be able to regularly measure the interference factor (2) of various influencing values.

A strain gauge load cell is a special form of an electromechanical force pick-up, whose task it is to transform the weight-force of a mass to be weighed into an electrical signal that is clearly related to the mass. It must be capable of accomplishing this under difficult application conditions.

1.2. Reasons for the introduction of WZ-test reports.

According to law, type approval can be provided only for a complete measuring instrument or for a supplementary device. However, the PTB has gone to testing strain gauge load cells, in part, separately and to provide a test report for them (see also 4), for the following reasons :

a. Many load cell types are presented by various scale manufacturers in various scale designs.
b. The so-called « broad-band type approvals for industrial scales permit the permit holder to vary manner of installation, pre-load and degree of utilization under certain preconditions. (For this reason, one cannot limit oneself to a single application case, to begin with, in connection with load cell testing).
c. Scale test samples with load cells of high nominal load ($\geqslant$ 10 tons) cannot any longer be subjected to a temperature test because of limited test installations.
d. The analysis of load cell construction in respect of measuring stability requires the direct contact between load cell manufacturer and PTB.

The requirements necessary for the construction of scales to be approved in respect of the requirements for the strain gauge load cells, have, at the present time, not been explicitly published in any regulation. They must be derived from the measurement-technical requirements of the standardization law, the standardization regulation and the standardization directive. These regulations, in turn, must be applied equally to all scales, independent of the physical action principle of the weighing.

The terms used in the following for the description of the properties of load cells are, mostly, specified in the VDI/VDE guidelines 2637 Draft (3).

1.3. Structure of a strain gauge load cell.

In principle, the strain gauge load cell consists of the parts shown in Figure 1. The weight-force is converted by means of a deformation body (measuring spring) into elongation, which, in turn is converted into a change of resistive relationships by means of several strain gauges. Numerous forms of measuring springs exist (Figure 2) which, essentially are to positively influence the characteristic properties of strain gauge load cells (4).

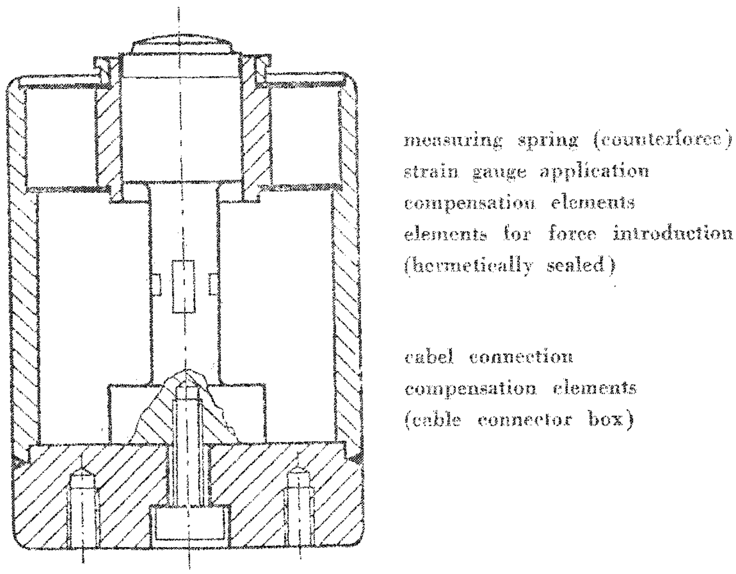

Figure 1 : Elements of a Strain gauge load cell.

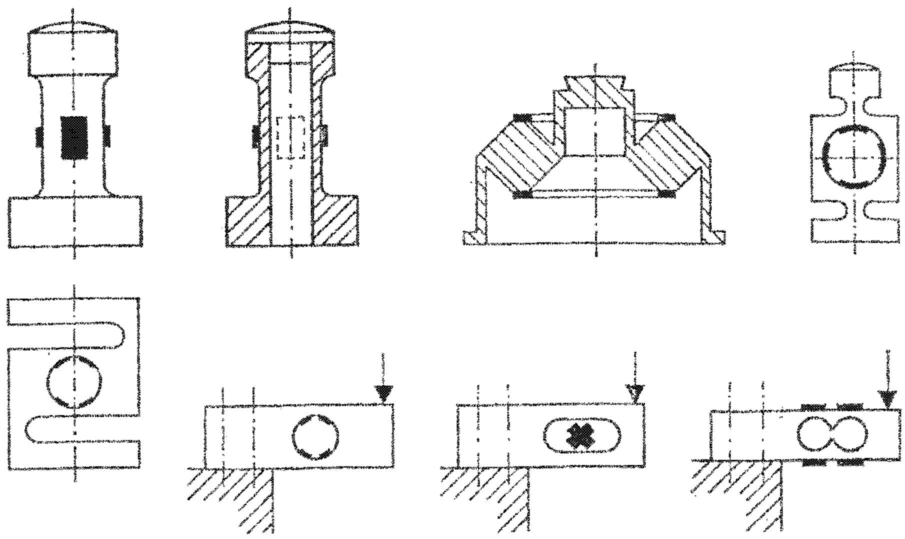

Figure 2 : Typical shapes of measuring springs (counter force)

1.4. Problems with measuring spring systems (counter force systems).

According to their physical function, scales with strain gauge load cells belong into the group of spring scales. The utilization of characteristic material values that is connected with this, is considerably influenced by several factors.

— Hook's curve is valid only for a single-axial tension condition. This can only be partially approximated in embedded measuring springs, among others, when the measuring path ($\Delta\varepsilon$) remains small enough.

— The slope of Hook's curve, i.e. the modulus of elasticity is temperature-dependent. For example in the case of steel, there is within the interesting range

$$\partial\,(\Delta E/E)/\partial T \approx -3 \cdot 10^{-4} \cdot K^{-1};$$

from this follows that at $\Delta T = 50$ K, the compensation must improve the temperature influence for a load cell with 3 000 d (d = division value of the scale) by at least a factor of 30.

— The internal tensions of the measuring system (condition prior to measurement) are of influence.

— Time and temperature influence the recrystallization (relaxation) of the measuring body under mechanical stress.

— The speed of stress (load) influences the partial temperature rise by adiabatic heating.

Phenomenologically, these effects are described as non-linearity, temperature variation, hysteresis and creeping. Mathematically, the latter behaviour can be considered to be a memory function (incomplete equation for the measurement errors alone) :

$$Y = C(F)\,F(t) + \int_{-\infty}^{t} a\, e^{-\alpha t} F(t)\, dt + \int_{-\infty}^{t} \gamma(F)\, e_{dF}\, dF \quad (1)$$

— The first partial expression contains the ideal starting function plus non-linearities,

— the second term is descriptive of creep processes (memory : time-load),

— the third term describes hysteresis effects (memory : load-load direction ; e_{dF} represents the unit vector in the direction of the load change).

All coefficients are temperature-dependent and can be complex beyond this, i.e. the original signal is frequency-dependent resp. it is, in practice, dependent on the loading speed (*).

1.5. Capability of strain gauge load cells.

The approved and widely used electromechanical scales with strain gauge load cells of « good accuracy », presently have, as a rule, an indication range of 2 000 e to 3 000 e (e = standardization value). In connection with this, the nominal loads

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(*) This description considers only the measuring spring, without paying attention to the application !

of the load cells range from 7 kg to 330 tons. Higher resolutions, generally fail because of hysteresis, creeping, non-reproducibility, temperature variation and non-linearity of the strain gauge load cells. It has been shown that the present state of technology does not yet permit the construction of approvable scales with strain gauge load cells, economically, with more than 6 000 divisions for the weighing range.

Up to now, 8 different load cell types (the nominal load is part of the type designation) could be introduced by three load cell manufacturers within the framework of the approval process for scales, that make possible a resolution to 6 000 (scale-) divisions for the weighing range.

2. TESTING OF STRAIN GAUGE LOAD CELLS.

2.1. Test crietria.

No official test procedures have been established in the Federal Republic for the analysis of strain gauge load cells.

The measurement-technical requirements that are to be applied to strain gauge load cells are, therefore, derived primarily from the regulations of the German standardization directive — especially from appendix 9 (EO 9) for « non-automatic scales ». These regulations essentially correspond to the EWG (EEC) regulation 73/360/EWG resp. to the OIML-recommendation No. 3 « non-automatic scales » (1).

The following represents the individual regulations of EO 9 that appropriately apply to load cells, under indication of the number. In this respect, all statements concerning permissible errors refer to the so-called standardization value « e » of the scale. In the case of commercial scales with digital readout, this is identical to the digital division value « d ». The number n of the permissible numerical steps is, indirectly, a measure for the relative accuracy of the scale. On the basis of their capability characteristics strain gauge load cells can be applied only in commercial- and coars scales (accuracy class (III) resp. (IIII)).

The standardization errors for scales of class (III) and (IIII) according to EO 9 No. 4.1. are presented in Figure 3.

The *scale error* now must be situated within the permissible limits of error under the *influence* of *interfering values.*

The following is specified in respect of the essential interfering value, temperature, resp. temperature change :

According to No. 8.2.1, the limits of error must be maintained for the scale in a temperature range of between — 10 °C and + 40 °C.

According to No. 8.2.2 limitations to a range of at least 30 K are possible.

The error curves of the scales must remain within the permissible limits of error at all temperatures of the above mentioned ranges for upward- as well as downward- loading. This means that temperature-conditioned changes in nominal values, errors through non-linearity and hysteresis are, in this case, measured as total, rather than individually.

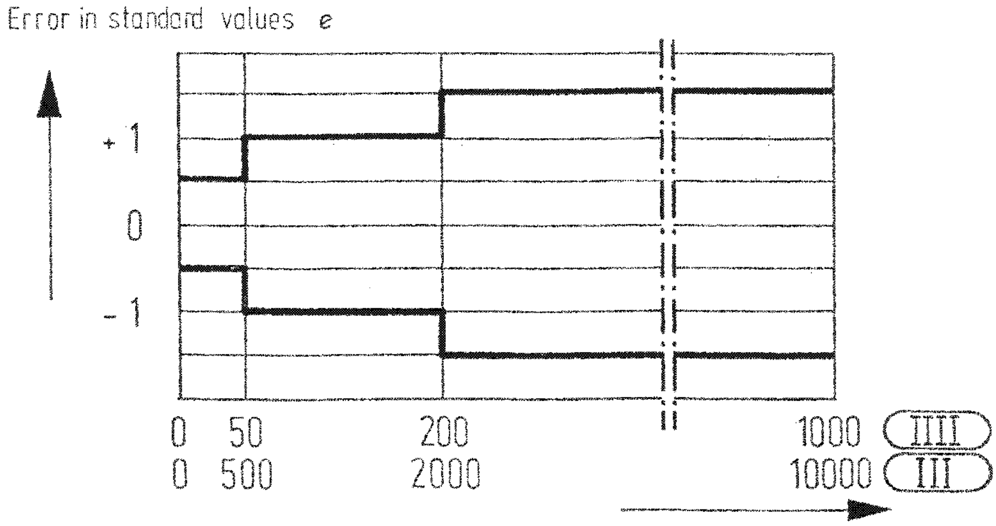

Figure 3 : Standardization error limits for scales of accuracy class (III) and (IIII) .

In connection with this, the zero point of the scale is adjusted prior to the measurements, however, according to 8.2.3, it may not vary by more than 1 e per 5 K of temperature change.

Other interference values are generally listed in No. 8.4 (electromagnetic, electrostatic interference fields, vibrations, mechanical stress).

The *influence* of the component *time on the measurement result* leads to further demands on scales and especially on strain gauge load cells in respect of creep behaviour.

According to 4.3.3, the weighing result after application of the load and 8 hours later, may not change by more than the amount of error limit that applies to that load.

According to No. 4.3.4, the change of the zero indication immediately prior to and subsequent to a half-hour load, may not amount to more than 0.5 e.

According to No. 8.2.1, it is required that both must be maintained at various temperatures within the required temperature range.

The standardization directive limits itself to information concerning the permissible total-error of scales. The error of the total scale must, in any case and for all weighings, be within the limits of error. That part of the total error that is required in this case by the load cell itself, must, therefore, be appropriately smaller. The remainder is needed for errors that are caused by non-linearity, temperature dependence, ageing and non-reproducibility of the electronic evaluation instrument and the lever arrangement (if present) as well as the power input into the load cell.

The share of the total error which, in this case, can be permitted for the load cells is, according to experience-values of the PTB and of various scale manufacturers between 50 % and 70 % of the scale error limit.

An additional requirement results for scales with tare-provision. No. 4.3.2.1. indicates that the limits of error of the scales must be maintained for all net loads at every possible tare load. For scales with tare-provision, this means that hysteresis of the scale error curve may not be larger than 0.5 d in any position of the taring range. In addition, in the case of platform scales with several load cells, it is necessary to assure that the characteristic values of the load cells agree sufficiently well because of the possibility of eccentric loading possibilities (No. 7.2.3.2.1.2).

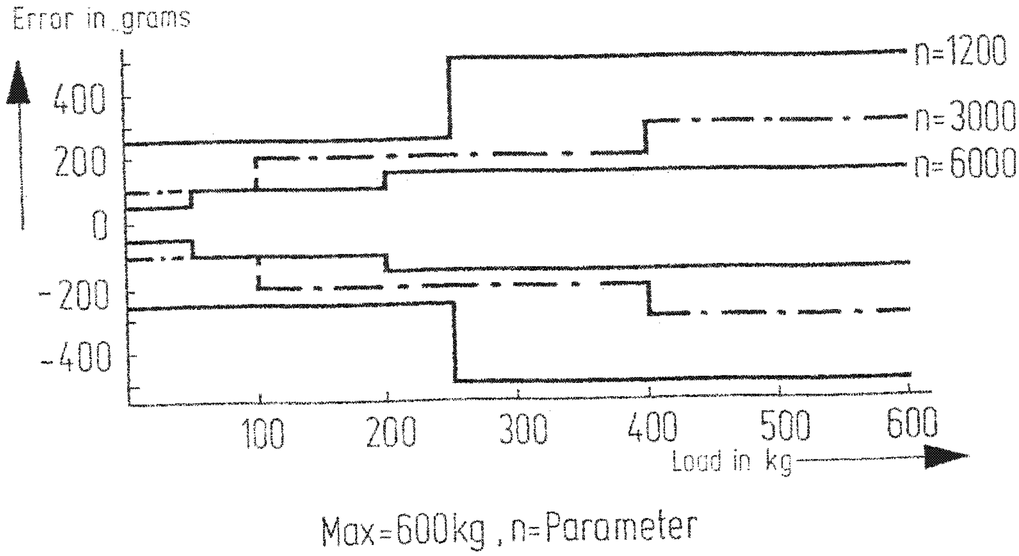

Figure 4 : Limits of standard error of a commercial scale (III) Max = 600 kg, n = parameter.

In the same way, non-linear curves that, in principle, may be linearized in the computing instrument, lead to the limitation of the division number of the weighing range. This applies particularly to scales with several load cells unless a seperate linearization circuit can be provided for each of the load cells.

In the case of electromechanical scales with lever arrangements and a single load cell with computing arrangement, linearizations of even larger measure are relatively simply arranged.

2.2. Test possibilities for load cells in PTB

The test possibilities largely depend on the value of the nominal load as well as on the type of construction of the load cell.

a. Tension- pressure- and beam load cells of small nominal load (maximum 2 tons) are tested in a temperature box or a temperature chamber with the aid of load dishes and normal masses or disc weight sets and, as required with pulleys with direct loads.

   The pre-load (L_p) from pulleys and load dishes should amount to less than 5 % of the nominal load (L_n).

b. Load cells of medium nominal load up to about 5 tons can be tested in combination (combined testing of several parallel arranged load cells) in platform scales up to max = 20 tons in a large temperature-controlled chamber.

c. load cells above 10 tons must be tested in the force-standard measurement installations of the laboratory for force measurement.

2.3. Peculiarities in measurements in force standard measurement installations

It is necessary that the load cells can be tested, with the help of temperature chambers (5) within the prescribed temperature range of — 10 °C to + 40 °C.

Because of the additional space requirement of the temperature chamber, not every force standard measuring installation can be used. The force standard measurement installations that are suitable and available for the purpose, are listed in Table 1.

Table 1 : Force-standard measuring installations for the testing of load cells.

max. force	loading principle	relative measurement uncertainty
0.1 MN (10 tons)	direct loading	10^{-5}
1 MN (100 t)	direct loading	10^{-5}
6 MN (600 t)	hydraulic transmission	10^{-4}
15 MN (1 500 t)	hydraulic transmission	10^{-4}

The multiple repetition of the measurements at different temperatures, each, especially the measurement of creep processes as well as the times required for temperature adjustment of the load cells represent a considerable expense in equipment time.

In this way, for example, the testing of a 100-ton load cell, including installation and removal, requires about 2 to 3 weeks. This expenditure in time shows how costly such tests can become with accurate measurements.

Tension-load cells cannot, presently be tested sufficiently well in force standard measurement installations since the suitable temperature adjustment systems are still lacking.

3. SPECIAL CONSIDERATIONS IN THE TESTING OF STRAIN GAUGE LOAD CELLS.

3.1. Partial utilization.

When loading a scale with its maximum load, the strain gauge load cells are, as a rule, only loaded in part. In most cases, the course of the characteristic curve is then more suitable or, at least equal, i.e. potentially, the characteristic curves of the load cells are more linear in partial loading and the hysteresis is smaller in relation to the level indicator range.

There are, however, also cells with inverse behaviour :

— in some take-ups (< 3 000 d) an increase of the relative hysteresis was noted in partial loads.

— especially in the case of sophisticated load cells, i.e. load cells with high scale division numbers (> 3 000 d), it is possible for higher hysteresis values to occur with programmed hysteresis compensation and creep compensation in partial loading.

— Finally, even with very slight compensation, it is possible that the temperature compensation (compensation of the E-modulus) is no longer correct. Under certain circumstances, this can already be seen in the slope of the characteristic curve bundle with fully compensated load cell (μ = 100 %, temperature as parameter).

3.2. Pre-load

Some load cell types show, at the beginning range of their characteristic loading curve almost a break. In such load cells, it is advantageous that they be compensated for beyond this break in scales as a result of the dead-load of the scale platform. In addition, this will aid in the reduction of set-phenomena of the peripheral power input elements.

3.3. Minimum loading.

Both, the relatively small output signal of the load cells (approx. 10 mV at full load) and the maximally permissible zero point change in its dependence on temperature (1 standard value per 5 °C) requires a minimum load range of the load cells for the weighing range of the scale. In the same way, it is necessary to consider the interference influence of air pressure in respect of load cells of small nominal load.

3.4. Compensation circuit.

The compensation that can take place with circuit means will be explained on hand of a strain gauge load cell circuit (Figure 5).

— The course of temperature of the zero point and that of the characteristic value as well as the linearization are compensated for in the interior space of the load cell (basic compensation), in part, they are even over-compensated. The temperature-active compensation elements and the measuring spring have to be arranged close to each other, since, other-wise, the load cells can become very sensitive to temperature gradients. The final equalization can take place by means of relatively temperature-insensitive resistors only after the final assembly of the load cells in the laod cell connection box, since new temperature-dependent zero point displacements and influences on the characteristic values occur by the parallel load path of a biased membrane.

— The course of temperature of the characteristic value of the load cell can be made very small with appropriate compensation effort. However, difficulties will appear in many load cells in partial loading and simultaneous high resolution of the measuring range (see also 3.1.).

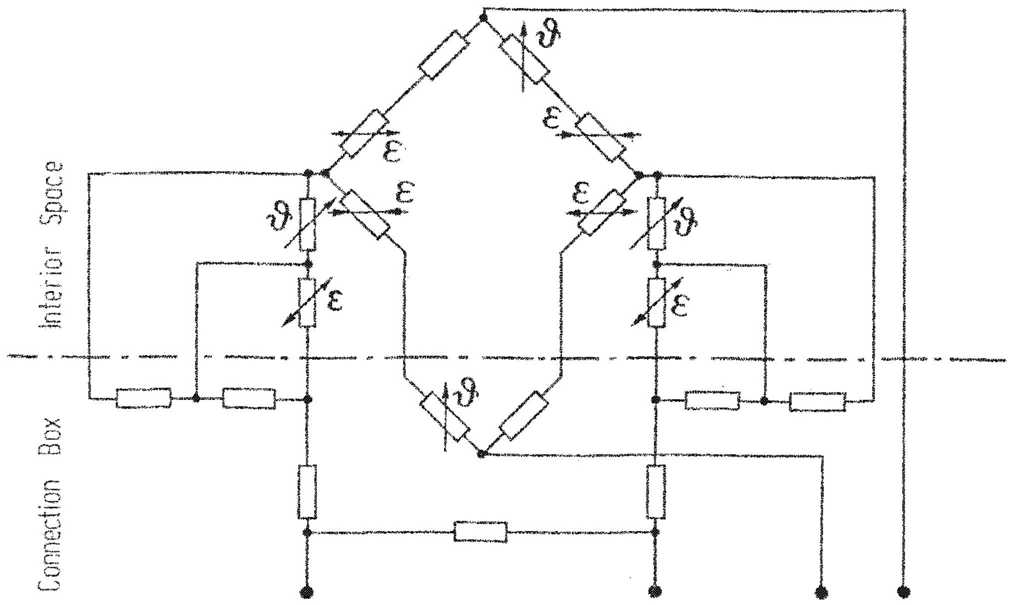

Figure 5 : Schematic of a strain gauge load cell.

— The ratio of the resistance of the compensation strip and compensation resistance influences the linearity of the compensated course of temperature. Breaks in the characteristic curve often exist outside of the required temperature range in the sensitivity curve above the temperature. During the course of production, such a characteristic break can displace itself into the required temperature range, if the behaviour of the load cells is not regularly controlled up to the extreme values and, in this manner, e.g. even slight changes of the raw materials composition, the properties of the adhesive, of the production method and others, are recognized early enough.

— Since, for the time being, PTB can only test a single or few test samples of load cells, the responsibility for sufficient testing, of series production must be assigned to the manufacturer.

— Linearization elements are required for all rod-types because of the multi-axial stress condition.

3.5. Creep and hysteresis

Creep- and hysteresis phenomena cannot be compensated electrically. The compensation factor required for creep lies lower by a factor of ten than that of the course of temperature, but, at the present time, it can take place only by experience in respect of raw materials selection and geometric dimensioning. Nos. 4.2.3.1, 4.3.3 and 4.3.4 of EO 9 represent a difficult requirement in respect of creep and hysteresis in combination with 8.2.1 (temperature range) for strain gauge load cells.

Hysteresis cannot be cleanly separated from the creep process in measurements. Loading cannot take place in sufficiently short a period of time : there is either an overshoot of the measuring value (hysteresis) or a time-loss in initial creep.

(In the draft of VDI/VDE 2637, the attempt was made to provide uniform recommendations for loading- and subsequent balancing-periods). Direct loading of load cells with high nominal load results in especially high time consumption. Beyond this, the interfering local temperature increase in the load cell also depends on the partial mechanical stresses, the thermal load-offs and the speed of loading. The amount of work that had been applied to the measurement process and the temperature increase that is connected with it cannot be described by the hysteresis surface, as in the case of electrical transformers, in connection with strain gauge load cells. If this were possible, then an energy gain would have to develop in the case of the existing negative hysteresis of some strain gauge load cells. The creep process also falsifies the characteristic curves in respect of characteristic value and hysteresis during testing of load cells.

3.6. Pre-treatment

In testing power measuring devices, the power storage device is loaded three times with 110 % of the nominal load according to regulation (6). According to equation (1), this corresponds to a partial memory-laundering of the power storage device.

One cannot work with similar conditions in the application of strain gauge load cells in electromechanical scales. On the one hand, the scale may have been entirely unused for several hours or it may have been exposed to continuous load changes. For this reason it is necessary to analyze, in load cell testing, with varying conditions — i.e. without directly prior loading as well as after several loadings.

3.7. Protection of the measurement system.

The hermetic encapsulation of the load cells is a further considerable problem in respect of long-term measurement dependability. The measurement system, on the one hand, must be protected against mechanical destruction, on the other hand, moisture, carbon dust and other atmospheric impurities can cause errors and can even destroy application (applicability). Aside of application in chemical plants, which must be considered a special case for now, a durable protection of the strain gauge application must be guaranteed, so that one can work on the basis of the assumption that the system will work reliably for the duration of several standardization periods.

An additional metallic encapsulation of the load cell and corresponding cable connections and, perhaps, glass lead-throughs for the electrical connections between load cell connection box and load cell interior space can best protect a system.

The insulation resistance circuit-mass is of the order of magnitude of 10^{11} Ohms. Moisture and leak resistances that originate from it, primarily influence the zero point, but also the characteristic value of the load cell. Extended moisture influence leads to swellings, oxydations and the partial destruction of the application.

Investigation on not metallic encapsulated systems that would be capable of providing specific information are, at the present time, not yet available. The tedious testing of long-period seals and the establishment, resp. the selection of a suitable standardized test method are problematic.

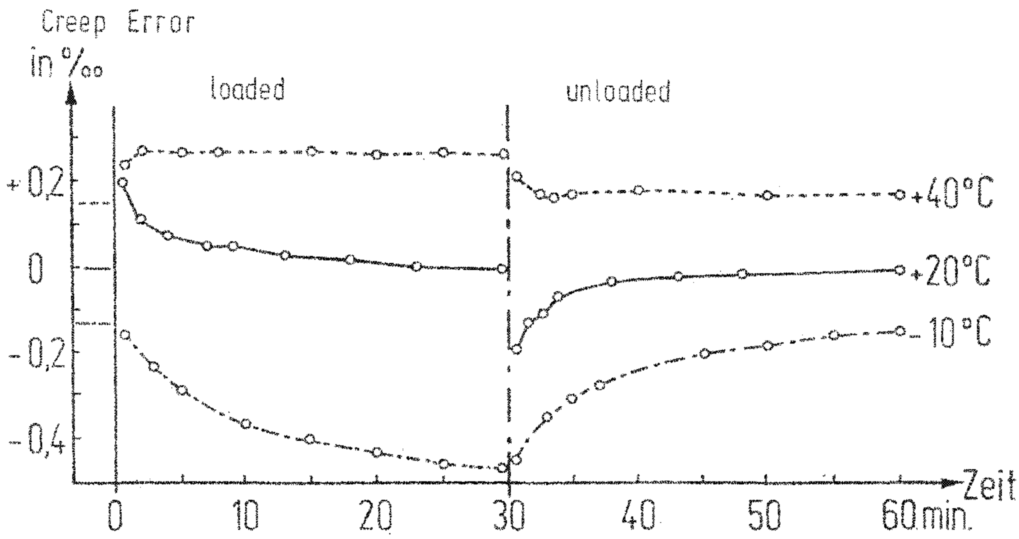

Figure 6 : Temperature-dependence of creep-behaviour

4. TEST REPORT.

For reasons of rationalization (see 1.2A,b) as well as for reasons of testability (see 1.2 c) PTB has started to provide test reports for strain gauge load cells as well. In addition to this, this test report allows the load cell producer to provide a quality designation of the load cells in respect of their application in electromechanical scales. The investigation in respect of measurement reliability of the load cell construction as well as the transfer of responsibility in respect of identical behaviour of test sample and series-product are possible only on the basis of direct contact between load cell manufacturer and PTB. The test report, therefore, acknowledges that the load cell may be installed in approvable electromechanical scales. It does not replace the approval of the construction type of a scale ; in exchange for this, however, the specific testing of the load cells in largely eliminated in the approval test.

No listing of the errors found according to linearity, hysteresis, course of temperature and others does not take place.

The test report provides the load cell user with technical construction suggestions concerning the application of the load cell as well as some limiting conditions (such as, e.g. permissible number of scale sections for the scale, type of power input and overload protection), so that the measurement-technical properties of the load cells are guaranteed within the scale. Further specifications will have to be established, especially in the case of high scale divisions, in regard of tare range and/or temperature range, pre-load, minimum loading and maximal utilization for the weighing range.

5. CONCLUDING OBSERVATIONS.

It was attempted to present the requirements for strain gauge load cells under consideration of some peculiarities for the application in electromechanical scales. Since load cells are often applied universally, the test conditions are quite voluminous.

The VDI/VDE guideline 2637, draft, January, 1977, for the first time produced a uniform specification of terms in its « characteristic values of load cells ».

The International Organization of Legal Metrology (OIML) (Organisation Internationale de Métrologie Légale) agreed during the end of 1976 at Paris to form a reporting secretariat (PS7/RS8) with its seat in the USA, that will concern itself with « Load cell measurement ». The national working group in the USA has divided the task area into : a) Terminology, b) Error of Determination and Accuracy Classes and c) Verification testing.

A preliminary draft has been issued on part b) (7) on January 12, 1978, which adheres stringently formally to OIML IR 3 : Non-automatic scales ». In this, however, parts of Section 2.1 as well as the total of Section 3 of this article are not being considered.

Literature :

1. Law concerning measurements and standardization (Standardization law) of July 11, 1969, amended July 6, 1976 :
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7. OIML PS7/RS8 preliminary draft of the US working group, Jan. 12, 1978 : Load cell measurement, Chapt. II, III and IV.

REPUBLIQUE DEMOCRATIQUE ALLEMANDE

NEUES VERFAHREN bei der PERIODISCHEN NACHEICHUNG von MESSMITTELN in der DDR

Ing. **Herbert GROSSE**

Mitteilung aus dem Amt für Standardisierung, Messwesen und Warenprüfung

Die Entwicklung von Wissenschaft und Technick erfordert und ermöglicht auch auf dem Gebiet der gesetzlichen Metrologie neue Wege zu beschreiten, um rationell und wirkungsvoll die Richtigkeit der Messmittel zu sichern. In der Deutschen Demokratischen Republik wurde ein neues Verfahren der periodischen Nacheichung von Messmitteln entwickelt, bei dem die festen Nacheichfristen durch technisch-ökonomisch begründete Auswechselzeitpunkte abgelöst werden. Das Verfahren wird seit einigen Jahren bei der periodischen Nacheichung von Elektrizitätszählern, Gaszählern und Wasserzählern angewendet. Es bringt bei voller Sicherung der Richtigkeit der Messmittel beträchtliche Einsparungen für Messmittelanwender und Organe der gesetzlichen Metrologie.

GRUNDGEDANKEN DES VERFAHRENS

Für die Gültigkeit der Eichung bei Messmitteln sind im allgemeinen feste Fristen (Nacheichfristen) gesetzlich festgelegt. Die Messmitteln müssen vor Ablauf der Fristen zur Nacheichung vorgelegt werden. Die Dauer der Nacheichfirst wird wesentlich von den am stärksten beanspruchten Messmitteln und der schlechsten Qualität der Messmittel bestimmt. Es müssen, um weniger unrichtige Messmittel herauszufinden, eine grosse Anzahl Messmittel geprüft werden. Dies ist mit erheblichen Aufwendungen verbunden. Um diese Aufwendungen in volkswirtschaftlich vertretbaren Grenzen zu halten, ist das neue Verfahren der periodischen Nacheichung von Messmitteln entwickelt worden. Es is anwendbar für Messmittel, die in grossen Stückzahlen im Einsatz sind.

Um den Aufwand für die periodische Nacheichung der Messmittel den tatsächlichen Erfordernissen anzupassen, ist es notwendig, den Zeitpunkt zu ermitteln, an dem zu erwarten ist, dass die vorgegebenen Fehlergrenzen überschritten werden. Dieser Zeitpunkt ist wesentlich von der Bauart, der Qualität, der Fertigung, den Einsatzbedingungen und der Benutzungshäufigkeit des Messmittels abhängig. Er kann durch entsprechende Untersuchungen mit Hilfe mathematisch-statistischer Methoden ermittelt werden.

Bei dem Verfahren zur Ermittlung der Auswechselzeitpunkte werden neben den messtechnischen Belangen auch ökonomische Gesichtspunkte berücksichtigt. Aus diesem Grund wird von technisch-ökonomisch begründeten Auswechselzeitpunkten gesprochen.

AUFBAU DES VERFAHRENS

Das Verfahren zur Ermittlung technisch-ökonomisch begründeter Auswechselzeitpunkte (im folgenden als Auswechselzeitpunkte bezeichnet) hat im wesentlichen folgenden Aufbau :

— Wissenschaftlich-technische Untersuchungen zur Modifizierung des Verfahrens
— Erfassung der Daten
— Auswertung der Daten und Zusammenfassung der Messmittel mit gleichen oder ähnlichen Daten zu Messmittelgruppen für die Stichprobenkontrolle
— Stichprobenkontrolle zur Ermittlung des Auswechselzeitpunktes
— Festlegung des Auswechselzeitpunktes
— Instandsetzung der Messmittel und Vorlage zur Eichung.

WISSENSCHAFTLICH-TECHNISCHE UNTERSUCHUNGEN

Die Untersuchungen haben den Zweck,

— die Messmittel zu fixieren, die in das Verfahren einbezogen werden sollen
— die Daten der Messmittel und des Einsatzes zu ermitteln, die für das messtechnische Langzeitverhalten von Bedeutung sind.
— die Methoden zur Datenerfassung, Verarbeitung und zur Stichprobenkontrolle zu erarbeiten, die spezifischen Gegebenheiten bei den Messmitteln und ihrem Einsatz berücksichtigen.

So wurden beispielsweise Untersuchungen hinsichtlich der möglichen Einsatzzeit bei Hauswasserzählern vorgenommen (1). Die Untersuchungen haben ergeben, dass folgende Einflussfaktoren für die Einsatzzeit von Bedeutung sind :

— Alter des Zählers
— Anzahl der Einbauwechsel
— Durchgeflossenes Volumen während der Einsatzzeit
— Bauart des Zählers
— Grösse des Zählers
— Chemische Eigenschaften des Wassers am Einsatzort
— Art der Durchführung der Reparatur

Die Untersuchungen ergaben ferner, dass bei

— Ringkolbenzählern mit einem Alter $\leq$ 8 Jahren eine Auswechslung nach 8 Jahren Einsatzzeit
— Ringkolbenzählern mit einem Alter $\leq$ 16 Jahre und Anzahl der Wechsel gleich 2 eine Auswechslung nach 4 Jahren Einsatzzeit
— Flügelradzählern der Grössen 5, 10, 20 und 30 m^3/h mit einem Alter $\leq$ 7 Jahre und Anzahl der Wechsel $\leq$ 1 eine Auswechslung nach 7 Jahren

— Flügelradzähler mit einem Alter ≤ 6 Jahre sowie Anzahl der Wechsel ≤ 1 eine Auswechslung nach 5 Jahren.

zu erwarten ist.

DATENERFASSUNG

Die für die Durchfürhung des Verfahrens notwendigen Daten sind aus einer Messmittelkartei oder anderweitigen Unterlagen zu entnehmen. Dabei wird es für die weitere Verarbeitung der Daten für zweckmässig erachtet, dass diese Daten auf einen Datenträger aufgebracht werden.

BILDUNG VON MESSMITTELGRUPPEN UND DATENAUSWERTUNG

Es empfiehlt sich, die Erfassung der Daten nach zwei Gruppen vorzunehmen, und zwar eine erste Gruppe mit unveränderlichen Daten und eine zweite Gruppe mit veränderlichen Daten. In der ersten Gruppe werden zum Beispiel erfasst, Hersteller, Jahr der Inbetriebnahme, Typ, Messgut, Ergebnisse der messtechnischen Prüfung und in der zweiten Gruppe, Benutzungshäufigkeit, Art und Ursache von Defekten sowie Reparaturen. Aus diesen Daten werden Messmittelgruppen mit gleichen oder ähnlichen Merkmalen gebildet.

STICHPROBENKONTROLLEN

Aus jeder Messmittelgruppe ist nach einem vorgegebenen Stichprobenplan eine Stichprobe zu ziehen. Die Messmittel der Stichprobe sind messtechnisch zu prüfen und unter Beachtung der Annahmezahl der Stichprobe, der Häufigkeitsverteilung der Anzeigefehler, der Benutzungshäufigkeit und der Beanspruchung im Messbereich die Ergebnisse auszuwerten.

FESTLEGUNG DER AUSWECHSELZEITPUNKTES

Im Ergebnis der Auswertung der Stichprobe wird darauf geschlossen, ob die Gesamtheit der Messmittelgruppe die vorgeschriebenen Fehlergrenzen mit einer entsprechenden statistischen Sicherheit einhält. Das Ziehen von Stichproben und die Auswertung der Ergebnisse ist in gleichmässigen Zeitabständen zu wiederholen und so lange fortzusetzen, bis festgestellt wird, das die Fehlergrenzen für die Gesamtheit der Gruppe nicht mehr eingehalten werden. Damit ist der Auswechslezeitpunkt erreicht.

INSTANDSETZUNG DER MESSMITTEL UND VORLAGE ZUR EICHUNG

Mit Erreichung des Auswechselzeitpunktes sind die Messmittel der gesamten Messmittelgruppe auszubauen und soweit zweckmässig instandzusetzen. Nach der Instandsetzung dieser Messmittel sind sie zur verschärften Nacheichung vorzulegen.

Für die Erfassung, Speicherung und Auswertung von Daten ist zweckmässiger Weise eine elektronische Datenverarbeitungsanlage zu verwenden, um diese Arbeiten rationell ausführen zu können.

VERANTWORTUNG

Für die Durchführung des Verfarhens sind die Organe zuständig, in dessen Verantwortungsbereich die Messmittel eingesetzt sind.

Die Aufgabe der Organe der gesetzlichen Metrologie umfasst
— die Vorgabe staatlicher Mindestforderungen
— die Prüfung der Ergebnisse der Untersuchungen und des speziellen Verfahrens
— die Kontrolle der Durchführung des Verfahrens
— die staatliche Eichung der Messmittel nach Auswechslung und Instandsetzung

STAATLICHE VORGABEN

Zur Sicherung der Einheitlichkeit der einzelnen Verfahren sind in Vorschriften staatliche Vorgaben festzulegen. So wurden bereits für Elektrizitätszähler, Gaszähler und Wasserzähler staatliche Vorgaben erarbeitet und in Vorschriften (2) (3) (4) aufgenommen.

Die von den Anwendern entwickelten Verfahren bedürfen der Zulassung des Amtes für Standardisierung, Messwesen und Warenprüfung.

Für das Verfahren ist im wesentlichen folgendes festgelegt worden :
— Das Verfahren muss gewährleisten, dass bei 99 % der zur Gesamtheit gehörenden Messmittelgruppe die vorgeschriebenen Fehlergrenzen nicht überschritten werden.
— Zur Ermittlung der Auswechselzeitpunkte sind die Häufigkeitsverteilung der Anzeigefehler, die Benutzungshäufigkeit und Beanspruchung im Messbereich sowie ökonomische Aspekte zugrunde zu legen.
— Beim statistischen Stichprobenverfahren muss der Stichprobenumfang mindestens der Prüfstufe IV nach Standard TGL 14 452 (5) entsprechen.
— der Einsatz der Messmittel muss mindestens zwei Jahre betragen.
— die Messmittel sind entsprechend ihrem Einsatz in Stufen einzuordnen, die einen bestimmten Zeitabschnitt umfassen.
— Die messtechnische Prüfung der Messmittel ist nach der normativ-technischen Dokumentation vorzunehmen.

STAATLICHE KONTROLLAUFGABEN

Durch die staatlichen Kontrollen wird gesichert, dass die Stichprobenprüfungen regelmässig durchgeführt und ordnungsgemäss ausgewertet werden. Weiterhin sind zur Kontrolle Stichprobenprüfungen an im Einsatz befindlichen Messmitteln durch das metrologische Staatsamt selbst vorzunehmen.

BISHERIGE ERFAHRUNGEN

Die bisher gesammelten Erfahrungen bei Anwendung von Auswechselzeitpunkten anstelle fester Nacheichfristen haben die Erwartungen voll erfüllt. Es hat sich gezeigt, dass wesentlich längere Fristen angängig sind, als die bisherigen Nacheichfristen. So können beispielsweise bei Hauswasserzählern, für die ursprünglich eine Nacheichfrist von 3 Jahren vorgeschrieben war, nach den bisherigen Stichprobenprüfungen Auswechselzeitpunkte bis zu 8 Jahren erreicht werden. Ähnliche Ergebnisse wurden bei Elektrizitätszählern und Balgengaszählern erzielt.

SCHLUSSBETRACHTUNGEN

Dieses Verfahren gewährleistet mit wesentlich geringeren Aufwendungen als bei den bischer üblichen Verfahren der periodischen Einzelprüfung aller Messmittel eine einwandfreie messtechnische Funktion der eingesetzten Messmittel. Die Einsparung bei der Prüfung von Elektrizitätszählern, Balgengaszählern und Kaltwasserzählern betragen jährlich mehrere Mill. Mark.

Ausserdem schaffen sie die Möglichkeit

— den Aufwand für Instandsetzungen den tatsächlichen Erfordernissen anzupassen,
— die Ersatzteilbeschaffung und Verschleissteilbeschaffung exakt zu planen und
— solche Messmittelbauarten auszuwählen, die hinsichtlich ihres Langzeitverhaltens eine gute Qualität aufweisen.

Literatur

1 Abschlussbericht des VEB Wasserversorgung und Abwasserbehandlung Berlin zum Ersatzproblem und optimalen Umfang von Reparaturmassnahmen bei Hauswasserzählern.

2 ASMW-VM 146/02, Elektrische Energie, Wechselstromzähler, Technisch-ökonomisch begründete Nacheichfristen für Wirkenergiezähler.

3 ASMW-VM 253/02, Volumen, Balgengaszähler, Technisch-ökonomisch begründete Auswechselzeitpunkte.

4 ASMW-VM 196/02, Volumen, Kaltwasserzähler, Technisch-ökonomisch begründete Auswechselzeitpunkte.

5 TGL 14 452, Statistische Qualitätskontrolle, Stichprobenpläne für die Variablenprüfung von normalverteilten Merkmalen.

AUTRICHE

ATTEMPT of a GRAPHICAL REPRESENTATION of SI*

by **F. ROTTER**
Chief of Legal Metrology Section
Bundesamt für Eich- und Vermessungswesen

The set of SI-units has become so extensive that it cannot be surveyed anymore. Therefore an attempt has been made to represent all SI-units with special names in five simple diagrams.

GEOMETRY and KINETIC

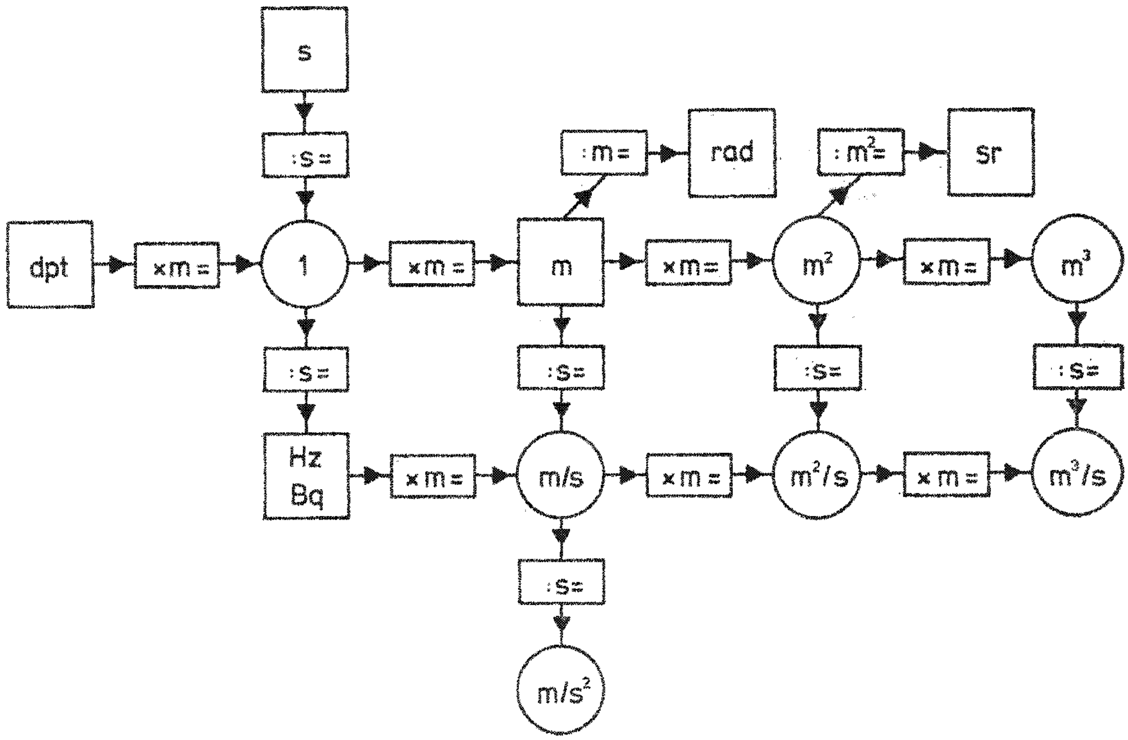


Diagram 1

Diagram 1 covers the fields of geometry and kinetics. It contains SI-units, enclosed in circles or squares, and operators, enclosed in rectangles. SI-units in squares have special names, SI-units in circles, however, have composed names. These units are often called composed units, but this is not correct, for not the units are composed but their names.

(*) Die Urschrift in Deutsch ist verfügbar im BIML.

Generally, the name of any unit may be represented as a product or as a quotient of other units. These products and quotients of units will briefly be called « Unit-Terms ».

Each operator contains one of the mathematical symbols x or :, a unit and also the symbol =.

Diagram 1 is based horizontally on the operator | x m = |, which means « times metre » and vertically on the operator | : s = |, which means « per second ».

In the first horizontal line we find proceding from left to right the diopter (dpt), the unit of vergency which equals m^{-1}, then the pure number 1, followed by the unit of length metre (m), the unit of surface square metre (m^2) and the unit of volume cubic metre (m^3).

Units with special names are the diopter (a name which is not accepted inter-(nationally) and the metre. Two typical unit-terms are square metre and cubic metre. We have to state here that also the number 1 must be considered as SI-unit.

In the first column there are the unit of time, second (s), the pure number 1 and the two units hertz (Hz) and becquerel (Bq) which are instead of s^{-1}, the hertz meaning a cycle per second and the becquerel a nuclear transition per second.

In the second column there are the metre (m), the metre per second (m/s) and the metre per square second (m/s^2).

The third column contains the square metre (m^2), the square metre per second (m^2/s) and the fourth column at last the cubic metre (m^3) and the cubic metre per second (m^3/s).

These four columns are also linked in the second line by the operator | x m = |.

We see, that the SI-units of geometry and kinetics are located in a single plane, where the neighbour units are linked horizontally by the factor metre and vertically by the factor second. Of course it is possible to extend this graph in any direction of this plane.

Outsiders are the supplementary units radian and steradian. The radian is the SI-unit of plane angle ; it is the angle which has arc and radius of equal length, that is an angle of about 57°. Therefore it can be derived also from the unit metre by using the operator | : m = |, which leads to the expression metre per metre (m/m).

If you reduce this fraction by metre, the relation to the metre disappears and you can interpret it either as a special name for the pure number 1 or as base unit, since it is independent of any other unit. All these possibilities are correct, they all produce correct results. They may be exchanged at any time without any restrictions. It is only a question of point of view and suitableness which possibility is made use of. You can also make the same considerations for the SI-unit of the solid angle, the steradian. It may be represented either as m^2/m^2 or as a special name for the pure number 1 or as a base unit.

We have discussed this diagram so detailed for its principles are also valid in the following diagrams.

MECHANIC

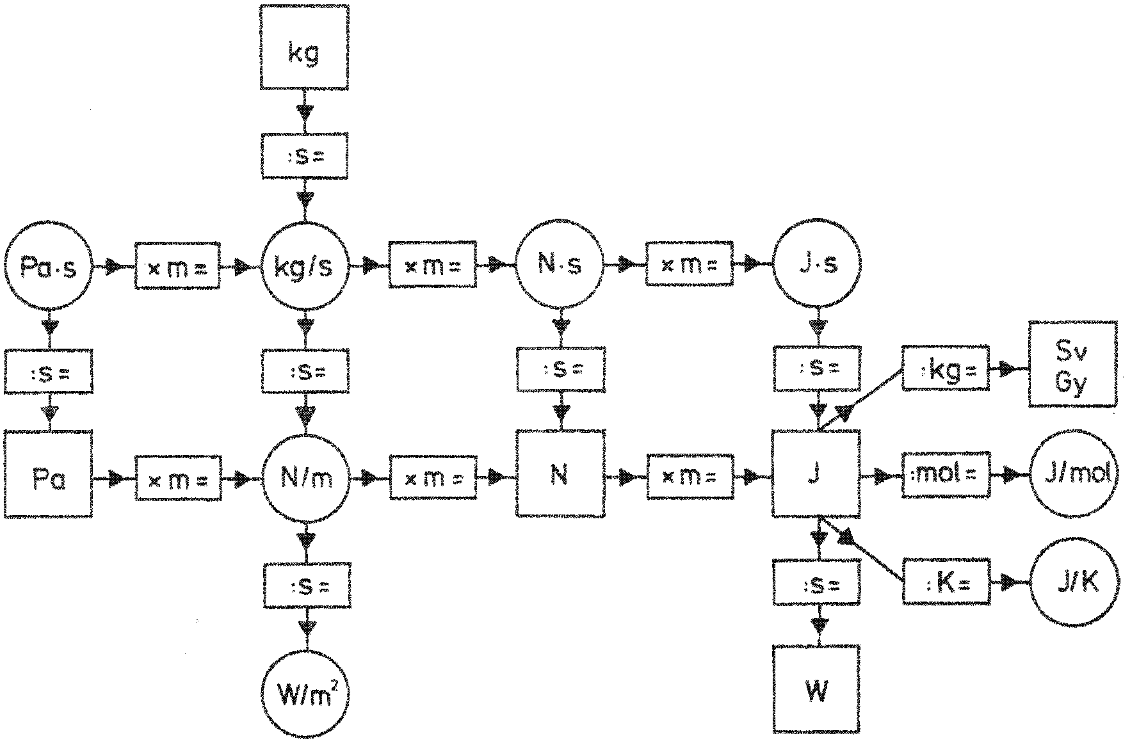


Diagram 2

Diagram 2 shows us the SI-units of mechanics. They are also located in a single plane and are also linked by the operators [x m =] and [: s =]. You get always a unit of mechanics if you multiply any unit of geometry and kinetics by one kilogram.

In other words, the plane of geometry and kinetics and the plane of mechanics are parallel ones having a distance of one kilogram. There is no unit in the field of mechanics which contains a higher power of the kilogram than one.

Let us start with the second column. There is the kilogram on the top followed by the units kg/s, N/m and W/m^2.

There is no mistake, if we get by using this column the equation

$$1\ \mathrm{N/m} = 1\,\frac{\mathrm{kg/s}}{\mathrm{s}}$$

We see at once : 1 N = 1 kg·m·s^{-2} and this equation is evidently correct.

In the first line there is the pascal second (Pa·s) for the dynamic viscosity, the kilogram per second (kg/s) for the mass flow rate, the newton second (N·s) for the momentum and the joule second (J·s) for the action.

In the next line there is the pascal (Pa) for the pressure, the newton per metre (N/m) for the surface tension, the newton (N) for the force and the joule (J) for the energy.

On the bottom there are the units watt per square metre (W/m^2) for the irradiance and the watt for the power.

From the joule you can derive with the operator | : kg = | the gray (Gy) for the absorbed dose of ionizing radiations and the sievert (Sv) for the equivalent dose. Both units are formally identical.

With the operator | : mol = | results the joule per mol (J/mol) for the molar energy and with the operator | : K = | the joule per kelvin (J/K) for the entropy.

The last four units are not situated in the plane of mechanics, they are the beginning of further planes.

In diagram 2 the degree Celsius is missing, but it represents the same interval of temperature as the kelvin.

The diagram demonstrates, that the joule may be represented as well as N·m but also as W·s but also as $Pa \cdot m^3$. These different possibilities of the representation of the SI-unit joule by different unit terms may be a little disturbing in the first moment. In fact, there is a way to explain physical relations, which cannot be seen otherwise so easily. However, any SI-unit may be derived in only a single way from the seven base units.

May I finally draw your attention to the couple of units joule and watt, we shall need it again in the next diagram.

ELECTRICITY I

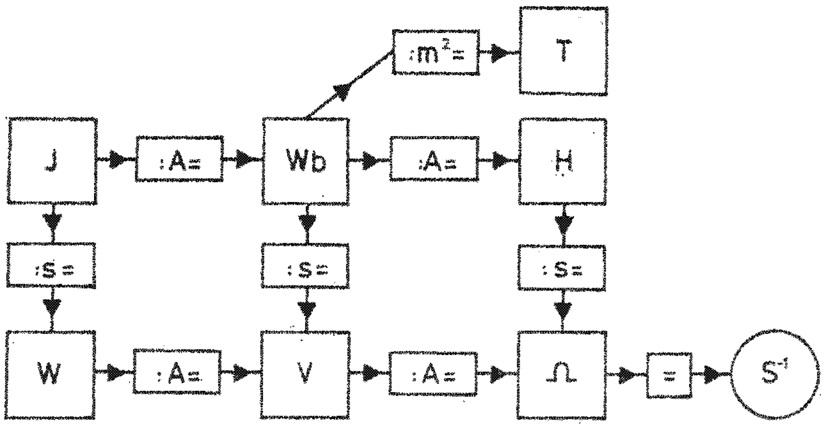


Diagram 3

Diagram 3 shows us, beginning with the couple of units joule and watt, one part of the units in the field of electricity.

Vertically we use as before the operator |: s =|, but horizontally the operator |: A =| is applied.

In the first line there are three SI-units : joule (J), weber (Wb), henry (H) and in the second line watt (W), volt (V), ohm (Ω) which equals the reciprocal of siemens (S^{-1}). From the weber there is derived with the operator |: m² =| the tesla (T). In the second column of the diagram there are the units weber (Wb) and volt (V) for the field quantities, and in the third column the units henry (H) and ohm (Ω) for properties of material.

ELECTRICITY II

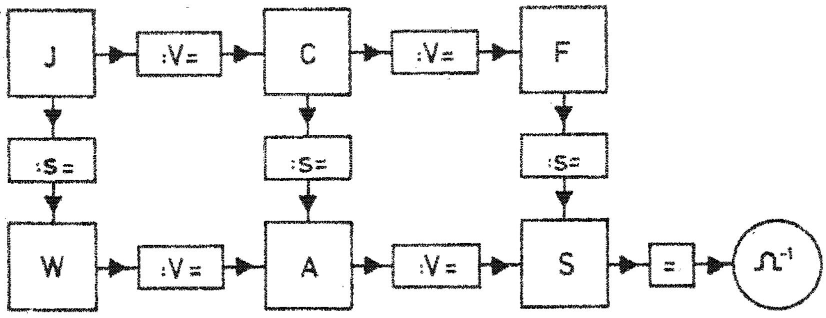


Diagram 4

The diagram 4 contains the rest of the electrical units. It is like the preceding diagram, but uses horizontally the operator |: V =|. Even this diagram begins with the couple of units joule and watt. There you find again in the second column the units of field quantities, the coulomb (C) and the ampere (A) and in the third column the units for properties of material namely the farad (F) and the siemens (S) which is the reciprocal of the ohm.

Diagrams 3 and 4 contain all the SI-units in the field of electricity which have special names. Units which are expressed by unit-terms have been omitted intentionally in order to make the diagram more easily to survey.

Diagram 5 contains the SI-units of light. It also begins with the couple of units joule and watt. By using the spectral luminous efficiency V(λ) of the human eye we get the lumen-second (lm·s) for the light exposure and the lumen (lm) for the luminous flux. From the lumen the rest of the units of light is derived by the operators |: m² =| and |: sr =|. So we get the candela (cd), the unit of luminous intensity, the lux (lx) for the illuminance and the candela per square metre (cd/m²) for the luminance.

It is a little amazing that the base unit candela is derived from the watt. But that is no contradiction. In reality the watt and the candela are given and the integration with V(λ) is made in such a way that it is appropriate to the both given units. It should be marked that this diagram will not change with the new definition of candela which has been proposed.

LIGHT

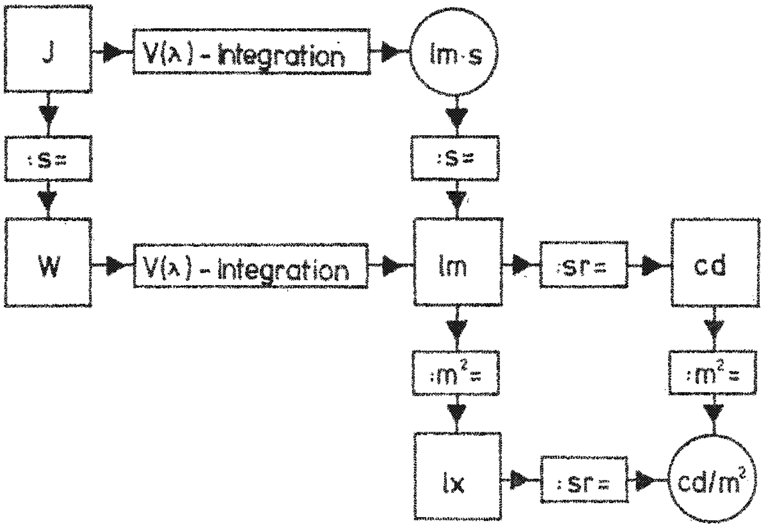


Diagram 5

These diagrams contain all SI-units with special names with exception of the degree Celsius which I have mentionned already. Reciprocals and units which are expressed by unit-terms only have been normally omitted since their derivation is trivial and their number is infinite.

It is very interesting that all units may be located in few different planes which cut each other generally in the axes joule-watt. In my opinion we find here the wasp's waist of the SI which is no property of SI but physically determined.

You come by yourself to the result that energy in the most important central physical quantity so that the units of energy and power locate themselves in the centre. This idea is confirmed if you look at any of the many possibilities to express the joule by unit-terms.

REPRESENTATIONS OF JOULE

$$\begin{aligned} J &= N.m = W.s = Pa.m^3 = Gy\cdot kg = Sv\cdot kg \\ &= Wb.A = C.V = H.A^2 \\ &= F.V^2 = kg.m^2/s^2 \\ &= T.A^2.m^2 = V\cdot A\cdot s \\ &= \Omega.A^2.s = S\cdot V^2\cdot s \end{aligned}$$

But with this problem we come to metaphysics.

INFORMATIONS

Publication of an English - Russian Dictionary on Metrology and Precise Measurement Technology

(Information received from GOSSTANDART, USSR)

In 1980, Russian Language Publishers are to put out for the first time the *English-Russian Dictionary on Metrology and Precise Measurement Technology,* dealing with practically all kinds of measurements.

The dictionary will contain some 20,000 terms and terminological phrases pertaining to many aspects of metrology and to some aspects of science and technology related to metrological practice and measurement technology.

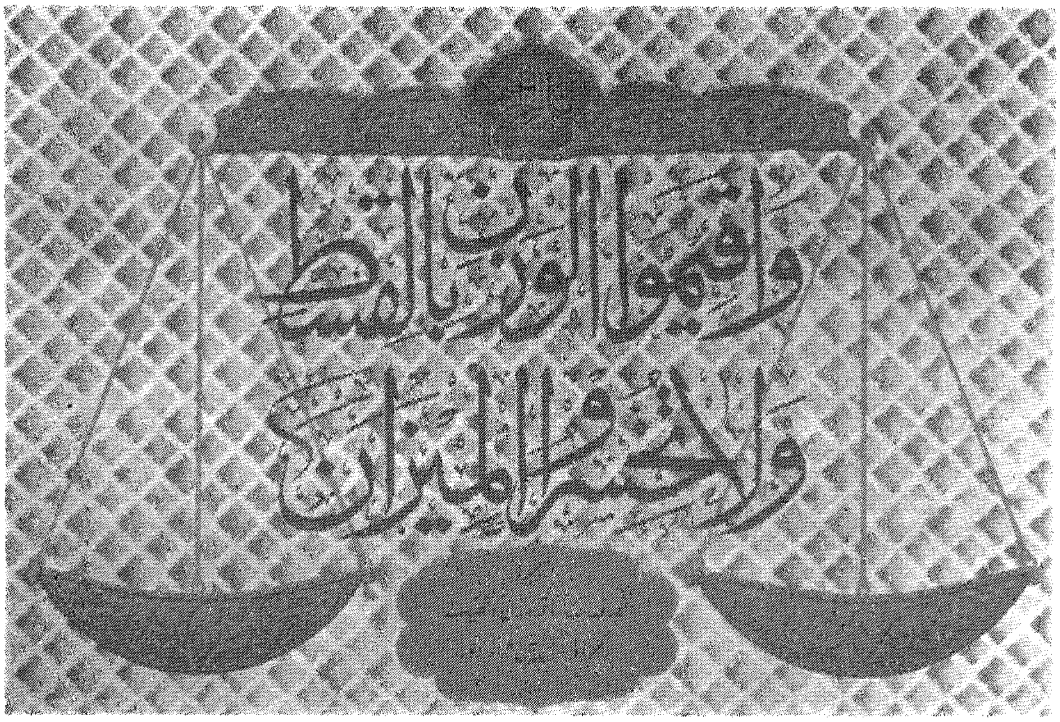
In compiling the dictionary, the English translations of the Soviet journal *Izmeritelnaya Tekhnika* (*Measurement Techniques*) by the Instrument Society of America and the experience gained from the cooperation in the field of metrology between the Gosstandart and foreign metrological organisations have been taken into consideration. The compilers have also drawn on the *Vocabulary of Legal Metrology* of the International Organisation of Legal Metrology and a number of foreign metrological periodicals and monographs. The dictionary has been compiled with the participation of a number of research institutes on metrology, USSR.

The comprehensiveness of the dictionary and the inclusion in it of terminology pertaining to standards, reference devices, calibrating equipment, reference materials, measurement methods, methods of the certification, calibration, testing, supervision and inspection of measuring instruments, and also to data processing, make this dictionary useful to a wide range of specialists.

To pack the dictionary with as much information as possible it has been supplied with a list of abbreviations, an index of Russian terms, and a number of appendixes containing much reference material, in the form of tables for converting the non-metric units used in Great Britain and the USA into the metric ones, basic and supplementary units of the International System (SI), and the prefixes for the formation of multiple and submultiple units.

The dictionary will prove useful to metrologists, workers of metrological services, instrument designers, research workers and engineers using measuring instruments and devices, specialists taking part in international metrological activities and also teachers, postgraduates and college and university students.

The broadening international economic, scientific and technical contacts based on an extensive exchange of information obtained by measuring, and the mutual acceptance of the results of measurements and tests which, in their turn, call for a standardisation of concepts and terms, make the publication of this dictionary all the more timely.



1979

MAY

FRI	SAT	SUN	MON	TUE	WED	THU
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

JUNE

FRI	SAT	SUN	MON	TUE	WED	THU
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15	16	17	18	19	20	21
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29	30					

JULY

FRI	SAT	SUN	MON	TUE	WED	THU
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

AUGUST

FRI	SAT	SUN	MON	TUE	WED	THU
31					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

وزن

1000 ملی گرام — ایک گرام
1000 گرام — ایک کلوگرام
1000 کلوگرام — ایک میٹرک ٹن
ایک کلوگرام — 17 چھٹانک
یا
2 پونڈ 3 اونس

درجہ حرارت

فارن ہائیٹ کو سنٹی گریڈ میں تبدیل کرنے کیلئے کسی بھی ڈگری میں سے 32 منفی کر کے باقی کو 5 سے ضرب دے کر 9 سے تقسیم کریں۔ سنٹی گریڈ کو فارن ہائیٹ میں تبدیل کرنے کے لئے کسی بھی ڈگری کو 9 سے ضرب دیکر 5 سے تقسیم کریں، حاصل میں 32 جمع کریں

لمبائی

10 ملی میٹر — ایک سنٹی میٹر
100 سنٹی میٹر — ایک میٹر
1000 میٹر — ایک کلومیٹر
ایک میٹر — ایک گز 3 انچ
یا 3 فٹ 3 انچ

حجم

1000 ملی لیٹر — ایک لیٹر
1000 لیٹر — ایک کیوبک میٹر
ایک لیٹر — 0.22 گیلن
یا
ایک گیلن — 4½ لیٹر

رقبہ

100 مربع میٹر = ایک ایئر
100 ایئر یا 10000 مربع میٹر = ایک ہیکٹیئر
ایک مربع میٹر = 1⅕ مربع گز
ایک ہیکٹیئر = 2½ ایکڑ

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CALENDARS to FOSTER SI

Publishing illustrated calendars is one of the means chosen by some of our Member Countries to foster the correct use of measuring instruments and the International System of Units SI.

In a recent issue of the Bulletin (n° 72 - September 1978) we copied a cartoon from a calendar of this kind published by the Federal Bureau of Measures and Precious Metals in Yugoslavia.

The illustration in the opposite page is extracted from a calendar issued by the Weights and Measures Cell in Pakistan. We thank the Administration of this Service for having kindly permitted us to copy it.

The script in the middle of the upper side is a quotation from the Koran commanding to weigh equitably and not to cheat in using the scale.

On the right of the calendar there is a table of SI units of mass, length, volume, surface and temperature given in terms of their decimal multiples and submultiples.

In the lower strip, reference is made to the « International System » and to the « Weights and Measures Cell » responsible for its application.

PROMOUVOIR le SYSTEME SI au MOYEN de CALENDRIERS

La publication de calendriers illustrés est l'un des moyens choisis par quelques-uns de nos Pays-membres pour promouvoir l'utilisation correcte des instruments de mesure et du Système International d'unités SI.

Dans un numéro récent du Bulletin (n° 72 - septembre 1978) nous avons reproduit un dessin extrait d'un calendrier de ce genre, publié par le Bureau Fédéral des Mesures et Métaux Précieux en Yougoslavie.

L'illustration ci-contre est extraite d'un calendrier publié par le Service des Poids et Mesures au Pakistan. Nous remercions l'Administration de ce Service de nous en avoir aimablement permis la reproduction.

L'inscription au milieu de la partie supérieure est une citation du Coran ordonnant de peser équitablement et de pas utiliser frauduleusement la balance.

A droite du calendrier, il y a une table des unités SI de masse, longueur, volume, surface et température, données en fonction de leurs multiples et sous-multiples décimaux.

Dans la bande inférieure il est fait référence au « Système International » et au « Service des Poids et Mesures » responsable de son application.

SUMMARY REPORT on INAUGURAL MEETING of OIML-ISO WATER METER LIAISON GROUP*

London, 2-4 April 1979

A meeting was held in London on 2-4 April 1979 of members appointed from the two committees ISO/TC30/SC7 - OIML/PS5/RS16 with the task of reviewing the problems of mutual interest which had created difficulties in the drafting of the ISO Standards and OIML Recommendations on cold-water meters.

Members attending were :

Mr R. FRAYSSINOUX	France	AFNOR
Mr P. HARRISON	UK	BSI Chairman
Mr J. LE CLERCQ	Netherlands	AQUA Chairman
Dr H. ONODA	Japan	JWWA J. Meas. Inst. Fed.
Mr R. SLUKA	Austria	Aus. Fed. Bureau Wts-Measures
Mr H.E. SNIDER	USA	ANSI/NBS/AWWA
Mr M. SOLLMAN	Netherlands	IWSA - EUREAU
Dr E.A. SPENCER	UK	OIML Secretariat
Mr T. STOTEN	UK	BIMCAM/BSI
Mr R. VERMERSCH	France	ISO Chairman

Dr SPENCER chaired the meeting.

The main conclusions were the following :

1 — The Liaison Group having considered various methods for dealing with the problem of the overlapping areas of responsibility between the ISO and OIML on the subject of water meters concluded that it would be best to deal with specific problems as soon as they arise rather than set up a combined committee to cover the drafting of a common document.

It was recommended that the two committees should therefore exchange their draft proposals for standards and recommendations for the comments of the other and, either by correspondence or through the official liaison, representatives at each others meetings find solutions to specific conflicting requirements.

It was considered important that the documents to be discussed at the two committees meetings should be circulated sufficiently ahead of the meetings at

(*) The complete report is available from BIML.

which they are to be considered so that there is proper opportunity for all the member countries to submit written comments.

It was also strongly recommended that cooperation between the Secretariats should continue so that the meetings of the ISO and OIML Committees could be held sequentially in the same place in order that travelling expenses for members of both committees could be kept to a minimum.

2 — It was agreed to recommend to the respective OIML and ISO Committees that both documents should refer to each other.

3 — The major problem which the Liaison Group was asked to tackle was on the subject of the conflicting use of Q_{max} and Q_{nom} as the basis of water meter designation. It was discussed at length first by a small study group composed of Dr ONODA, Mr SLUKA and Mr FRAYSSINOUX and then by the full group. While it was agreed that a single universally recognized designation was required no agreement could be reached either on an interim or a long-term solution.

After a long discussion, the positive recommendation was made that member countries should be asked to obtain further test data on all sizes and types of meters so that the selection of a suitable designation for the water meter could be made by the OIML and ISO water meter Committees.

NOUVEL ETAT MEMBRE

L'IRLANDE, précédemment Membre Correspondant de notre Institution depuis décembre 1973, a déposé le 5 mars 1979, auprès du Ministère des Affaires Etrangères de la République Française, les instruments d'adhésion à la Convention instituant l'Organisation Internationale de Métrologie Légale.

Devenant le 44e Etat-Membre de notre Institution, l'IRLANDE désignera prochainement son Représentant au Comité International de Métrologie Légale.

NOUVEAUX MEMBRES CORRESPONDANTS

L'Institut de Normalisation de l'EQUATEUR, ainsi que le Ministère du Commerce et de l'Industrie de l'ILE MAURICE, nous ont fait connaître le désir de ces Pays de devenir Membres Correspondants de notre Organisation.

Monsieur le Président du Comité a accepté avec plaisir ces demandes qui portent à 60 (44 Etats Membres + 16 Correspondants) le nombre des Membres de notre Organisation.

ERRATUM

SYMPOSIUM INSYMET 1978. Par suite d'une erreur de disposition, la liste des Personnalités présentes au Symposium INSYMET 1978, dont notre précédent Bulletin a publié le compte rendu succinct, était malheureusement incomplète. Il faut y ajouter, pour la République Fédérale d'Allemagne, les noms de MM. KIND et BERGEEST, Physikalisch-Technische Bundesanstalt ; pour l'U.R.S.S., le nom de M. OLEJNIK, Institut de Métrologie Mendeleev.

PROCHAINES REUNIONS

Groupes de travail		Dates	Lieux
SP.7 - Sr.8	Cellules de pesée	**5-8 juin 1979**	B.I.M.L.
SP.12 - Sr.8	Compteurs d'énergie thermique	**12-14 juin 1979**	HANNOVER
SP.7 - Sr.4	Instruments de pesage à fonctionnement non automatique	**18-20 septembre 1979**	BRAUNSCHWEIG
SP.18 - Sr.1	Humidimètres pour grains de céréales et graines oléagineuses	**2-4 octobre 1979**	PARIS
SP.26	Instruments de mesurage utilisés dans le domaine de la santé publique	**23-26 octobre 1979**	BRAUNSCHWEIG
SP.5 - Sr.16	Compteurs d'eau	**octobre 1979** *(provisoire)*	———
SP.4 - Sr.5	Mesurage des angles	**octobre ou novembre 1979** *(provisoire)*	POLOGNE
SP.25 - Sr.3	Matériel nécessaire pour le fonctionnement d'un Service national de métrologie légale	**13-16 novembre 1979**	RIGA
SP.5 - Sr.13 et 19	Compteurs de liquides autres que l'eau à chambres mesureuses et à turbine. Dispositifs électroniques appliqués au mesurage des quantités de liquides	**début 1980** *(provisoire)*	———
SP.1	Terminologie	**début 1980** *(provisoire)*	———
SP.1 - Sr.1	Vocabulaire de Métrologie légale Termes fondamentaux		
SP.1 - Sr.2	Vocabulaire des divers domaines de mesurage		
SP.23	Méthodes et moyens d'attestation des dispositifs de vérification	**mars ou avril 1980**	B.I.M.L.
SP.21 - Sr.1	Caractéristiques métrologiques normalisées des instruments de mesurage lors du mesurage des quantités constantes dans le temps	**avril 1980** *(provisoire)*	U.R.S.S.
SP.21 - Sr.2	Caractéristiques métrologiques normalisées des instruments de mesurage lors du mesurage des quantités variables dans le temps		

Conseil de Développement	**11-12 juin 1979**	B.I.M.L.
Groupe ad hoc « Marque OIML »	**13-15 juin 1979**	B.I.M.L.
Conseil de la Présidence	**25-27 sept. 1979**	B.I.M.L.
Sixième Conférence Internationale de Métrologie Légale	**16-20 juin 1980**	WASHINGTON
Dix-septième Réunion du Comité International de Métrologie Légale	**16 juin 1980**	WASHINGTON

CENTRE de DOCUMENTATION

Documents reçus au cours du 2e trimestre 1979

ORGANISATION INTERNATIONALE DE NORMALISATION — ISO

— ISO/TC 12 : Grandeurs, unités, symboles, facteurs de conversion et tables de conversion

ISO 31/V-1979 : Grandeurs et unités d'électricité et de magnétisme (Fr. Ang.)

— ISO/TC 17 : Acier

ISO 4965-1979 : Machines d'essai de fatigue par charge axiale — Etalonnage dynamique — Technique des jauges de déformation (Fr. Ang.)

— ISO/TC 158 : Analyse des gaz

ISO 6146-1979 : Analyse des gaz — Préparation des mélanges de gaz pour étalonnage — Méthode par voie manométrique

COMMUNAUTE ECONOMIQUE EUROPEENNE — CEE

— Journal officiel des Communautés Européennes.

Directive 78/365/CEE du 31-3-1978 portant deuxième adaptation au progrès technique de la directive 71/318/CEE relative aux compteurs de volume de gaz (Fr. Ang.)

Directive 78/629/CEE du 19-6-1978 portant adaptation au progrès technique de la directive 73/362/CEE relative aux mesures matérialisées de longueur (Fr. Ang.)

Directive 78/888/CEE du 9-10-1978 arrêtant une action concertée dans le domaine de l'analyse des micropolluants organiques dans l'eau (Fr. et Ang.)

Directive 78/889/CEE du 9-10-1978 arrêtant une action concertée dans le domaine du comportement physico-chimique des polluants atmosphériques (Fr. et Ang.)

Directive 78/891/CEE du 28-9-1978 portant adaptation au progrès technique des annexes des directives 75/106/CEE du 19-12-1974 et 76/211/CEE du 20-1-1976 dans le secteur des préemballages (Fr. et Ang.)

ORGANISATION MONDIALE de la SANTE — OMS

— The SI for the Health Professions (1977)

INTERNATIONAL MEASUREMENT CONFEDERATION — IMEKO

— IMEKO Secretariat, Budapest

Proceeding of Symposium of the IMEKO Technical Committee on Measurement Theory — TC 7 : « Application of statistical methods in measurement » (Leningrad, USSR — 16-19 May 1978)

REPUBLIQUE FEDERALE d'ALLEMAGNE

— Amtliche Bekanntmachungen

Anforderungen der PTB an Kohlenmonoxid-Abgasmessgeräte und Prüfgase für CO-Abgasmessgeräte vom 1-11-1978

Bedingungen für die Bauartprüfung von Hörgeräten durch die PTB vom 1-1-1979

ETATS-UNIS d'AMERIQUE

— National Bureau of Standards

Booklet : Automation in the Marketplace (Feb. 1979)

NBS Special Publication 260 (April 1979) — NBS Standard Reference Materials Catalog 1979-80 Edition

NBS Special Publication 539 (April 1979) — Metrology in Industry and Government : How to find out who needs what services (Proceeding of a Regional Seminar held Sept. 27-28, 1978 at the Korea Standards Research Institute Dae Jeon, Korea ; by H. Steffen, R.C. Sangsten and Wun Jung)

1978 Replacement sheets for NBS, Handbook 44, Fourth edition

— US Metric Association

Statement on Spelling of metre, Dec. 1978

AUSTRALIE

— Metric Conversion Board

Eigth Annual Report for year 1977-78

BELGIQUE

— Ministère des Affaires Economiques

Arrêté royal du 9-8-1978 relatif aux alcoomètres et aréomètres pour alcool (Moniteur belge du 21-9-1978)

Arrêté royal du 9-8-1978 relatif aux tables alcoométriques (M.b. du 21-9-1978)

DANEMARK

— Justervaesenet

Lov om aendring al Lov om mal og vaegt nr. 246 af 12-5-1976

Justerreglement af 1-3-1950 (àjourfort 1-1-1978)

Bekendtgorelse om aendring af bekendtgorelse angaende justerreglement nr. 363 af 17-7-1978

Bekendtgorelse om indforelse af det internationale enhedssystem (SI) for mal og vaegt nr. 320 af 21-6-1977 + traduction en anglais

TDIR nr. 10.00.1-01 (09-1976) : System for tekniske direktiver

TDIR nr. 10.00.1-02 (09-1977) : Index for tekniske direktiver

TDIR nr. 10.01.4-01 (12-1976) : Jv Tilsynsmaerkat — Tilsyn

TDIR nr. 20.00.1-01 (01-1978) : Maleinstrumenter med elektronik — Godkendelse og justering — Forelobige almindelige bestemmelser + trad. en anglais

TDIR nr. 21.05.1-01 (05-1977) : Stalmaleband — Justering og tilsyn — Almindelige bestemmelser

TDIR nr. 21.05.1-02 (05-1977) : Stalmaleband — Supplerende almindelige bestemmelser for justering

TDIR nr. 21.21.1-01 (08-1977) : Laengdemalemaskiner — Almindelige bestemmelser

TDIR nr. 22.07.1-01 (08-1977) : Halvautomatiske spiritusmalere — Almindelige bestemmelser

TDIR nr. 24.11.1-01 (10-1978) : Ikke-automatiske vaegte — National typegodkendelse og justering — Almindelige bestemmelser

Vejledning til SI — Storrelser og enheder Det internationale enhedssystem SI (Marts 1979)

ESPAGNE

— Junta de Energia Nuclear

Nuevas Unidades en Radiologia (A. Brosed Serreta 1978)

FINLANDE

— Technical Inspectorate

Notice on Technical Inspectorate — 1978

FRANCE

— Réglementation métrologique

Arrêté n° 78-89/P du 9-8-1978 relatif au prix du pain

Décision ministérielle n° 78.1.06.900.0.0 du 11-9-1978 : Appareils de mesure de la qualité de poussière émises à l'atmosphère

Circulaire n° 78.1.01.620.0.0 du 21-9-1978 : Instruments de pesage industriel munis de capteurs à jauges de contrainte

Décret n° 78-975 du 26-9-1978 modifiant le décret n° 72-937 du 12-10-1972 portant application de la loi du 1-8-1905 sur la répression des fraudes : produits alimentaires et étiquetage des préemballages

Circulaire n° 78.1.01.100.0.0 du 13-11-1978 relative à l'assiette des taxes et redevances

Décret n° 79-200 du 5-3-1979 portant règlement d'administration publique en ce qui concerne les alcoomètres, les aréomètres pour alcool et les tables alcoométriques + Annexes

— Commission Interministérielle des Appareils électriques et électroniques de mesure (CIAME)

Essais d'évaluation des capteurs de pression (Janvier 1976)

Essais d'évaluation des capteurs de température — Méthodes et procédures (Mai 1978)

Essais d'évaluation des capteurs de force et de pesage — Méthodes et procédures (Mai 1978)

— Association Française de Normalisation — AFNOR

Catalogue des Normes Françaises, 1979

POLOGNE

— Polski Komitet Normalizacji i miar

Dziennik Normalizacji i miar
Nr. 15, 18 à 23/1978

Katalog Polskich Norm — 1978

Katalog Norm Branzowych — 1978

ROUMANIE

— Réglementation métrologique

Legea metrologiei din 3-11-1978 + Anexa : unitati de masura si alte unitati de masura legale, multipli si submultipli de large utilizare in Republica Socialista Romania

URSS

— Gosudarstvennyj Komitet Standartov Soveta Ministrov SSSR

State System for ensuring the uniformity of measurements :

Gost 8.322-78 : Measuring signal generators. Methods and means for verification within the range of 0,03 ; 17,44 GHz

Gost 8.323-78 : Standard time and frequency signals radiated by specialized radio stations of the state time service. Main parameters

Gost. 8.324-78 : Gas meters. Verification methods and means

Gost 8.326-78 : Metrological ensurance of elaboration, production and exploitation of non-standardized measurement means principle statements

Gost 8.330-78 : The telescopes of total radiation pyrometers. Methods and means of verification

RECOMMANDATIONS INTERNATIONALES

de la

CONFERENCE INTERNATIONALE DE METROLOGIE LEGALE

R.I. N°		SECRETARIATS	Année d'édition
—	Vocabulaire de métrologie légale (termes fondamentaux) (édition bilingue français/anglais)	**Pologne**	**— 1978**
1 —	Poids cylindriques de 1 gramme à 10 kilogrammes (de la classe de précision moyenne)	**Belgique**	**— 1973**
2 —	Poids parallélépipédiques de 5 à 50 kilogrammes (de la classe de précision moyenne)	**Belgique**	**— 1973**
3 —	Réglementation métrologique des instruments de pesage à fonctionnement non automatique	**R.F. d'Allemagne et France**	**— 1978**
4 —	Fioles jaugées (à un trait) en verre	**Gde Bretagne**	**— 1970**
5 —	Compteurs de volume de liquides (autres que l'eau) à chambres mesureuses	**R.F. d'Allemagne et France**	**— 1970**
6 —	Prescriptions générales pour les compteurs de volume de gaz	**Pays-Bas et R.F. d'Allemagne**	**— 1978**
7 —	Thermomètres médicaux à mercure, en verre, avec dispositif à maximum	**R.F. d'Allemagne**	**— 1978**
8 —	Méthode étalon de travail destinée à la vérification des instruments de mesurage du degré d'humidité des grains	**R.F. d'Allemagne**	**— 1970**
9 —	Vérification et étalonnage des blocs de référence de dureté Brinell	**Autriche**	**— 1970**
10 —	de dureté Vickers		
11 —	de dureté Rockwell B		
12 —	de dureté Rockwell C		
13 —	Symbole de correspondance	**B.I.M.L.**	**— 1970**
14 —	Saccharimètres polarimétriques	**R.F. d'Allemagne**	**— 1978**

15 —	Instruments de mesure de la masse à l'hectolitre des céréales	**R.F. d'Allemagne**	— **1970**
16 —	Manomètres des instruments de mesure de la tension artérielle	**Autriche**	— **1970**
17 —	Manomètres - manovacuomètres - vacuomètres « indicateurs » à éléments récepteurs élastiques à indications directes par aiguille et échelle graduée (catégorie instruments de travail)	**U.R.S.S.**	— **1970**
18 —	Pyromètres optiques à filament disparaissant	**U.R.S.S.**	— **1970**
19 —	Manomètres - manovacuomètres - vacuomètres « enregistreurs » à éléments récepteurs élastiques à enregistrements directs par style et diagramme (catégorie instruments de travail)	**U.R.S.S.**	— **1970**
20 —	Poids des classes de précision E_1 E_2 F_1 F_2 M_1 de 50 kg à 1 mg	**Belgique**	— **1973**
21 —	Taximètres	**R.F. d'Allemagne**	— **1973**
22 —	Alcoométrie	**France**	— **1973**
—	Tables alcoométriques	**France**	— **1975**
23 —	Manomètres pour pneumatiques	**U.R.S.S.**	— **1973**
24 —	Mètre étalon rigide pour Agents de Vérification	**Inde**	— **1973**
25 —	Poids étalons pour Agents de vérification	**Inde**	— **1977**
26 —	Seringues médicales	**Autriche**	— **1973**
27 —	Compteurs de volume de liquides autres que l'eau — Dispositifs complémentaires	**R.F. d'Allemagne et France**	— **1973**
28 —	Réglementation « technique » des instruments de pesage à fonctionnement non-automatique	**R.F. d'Allemagne et France**	— **1973**
29 —	Mesures de capacité de service	**Suisse**	— **1973**
30 —	Mesures de longueur à bouts plans	**U.R.S.S.**	— **1973**
31 —	Compteurs de volume de gaz à parois déformables	**Pays-Bas**	— **1973**
32 —	Compteurs de volume de gaz à pistons rotatifs et compteurs de volume de gaz à turbine	**R.F. d'Allemagne**	— **1973**
33 —	Valeur conventionnelle du résultat des pesées dans l'air	**B.I.M.L.**	— **1973**
34 —	Classes de précision des instruments de mesurage	**U.R.S.S.**	— **1974**

35 —	Mesures matérialisées de longueur pour usages généraux	**Belgique et Hongrie**	**— 1977**
36 —	Vérification des pénétrateurs des machines d'essai de dureté	**Autriche**	**— 1977**
37 —	Vérification des machines d'essai de dureté système Brinell	**Autriche**	**— 1977**
38 —	Vérification des machines d'essai de dureté système Vickers	**Autriche**	**— 1977**
39 —	Vérification des machines d'essai de dureté système Rockwell B,F,T — C,A,N	**Autriche**	**— 1977**
40 —	Pipettes étalons pour Agents de vérification	**Inde**	**— 1977**
41 —	Burettes étalons pour Agents de vérification	**Inde**	**— 1977**
42 —	Poinçons de métal pour Agents de vérification	**Inde**	**— 1977**
43 —	Fioles étalons graduées en verre pour Agents de vérification	**Inde**	**— 1977**
44 —	Alcoomètres et aréomètres pour alcool	**France**	**— 1977**
45 —	Tonneaux et futailles	**Autriche**	**— 1977**
46 —	Compteurs d'énergie électrique active à branchement direct	**France**	**— 1978**
47 —	Poids étalons pour le contrôle des instruments de pesage de portée élevée	**R.F. d'Allemagne et France**	**— 1978**
48 —	Lampes à ruban de tungstène pour l'étalonnage des pyromètres optiques	**U.R.S.S.**	**— 1978**
49 —	Compteurs d'eau (destinés au mesurage de l'eau froide)	**Gde-Bretagne**	**— 1977**

DOCUMENTS INTERNATIONAUX

adoptés par le
Comité International de Métrologie Légale

D.I. N°

1 —	Loi de métrologie	**BIML**	**— 1975**
2 —	Unités de mesures légales	**BIML**	**— 1978**
3 —	Qualification légale des instruments de mesurage	**BIML**	**— 1979**

Note - Recommandations internationales et Documents internationaux peuvent être acquis au Bureau International de Métrologie Légale.

ORGANISATION INTERNATIONALE DE MÉTROLOGIE LÉGALE

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AUSTRALIE.
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Mr T.J. PETRY, Executive Officer.
National Standards Commission,
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N° d'inscription à la commission paritaire des Publications et Agences de presse : 38245

Grande Imprimerie de Troyes, 130, rue Général-de-Gaulle, 10000 Troyes

Dépôt légal n° 5881 - 2e trim. 1979