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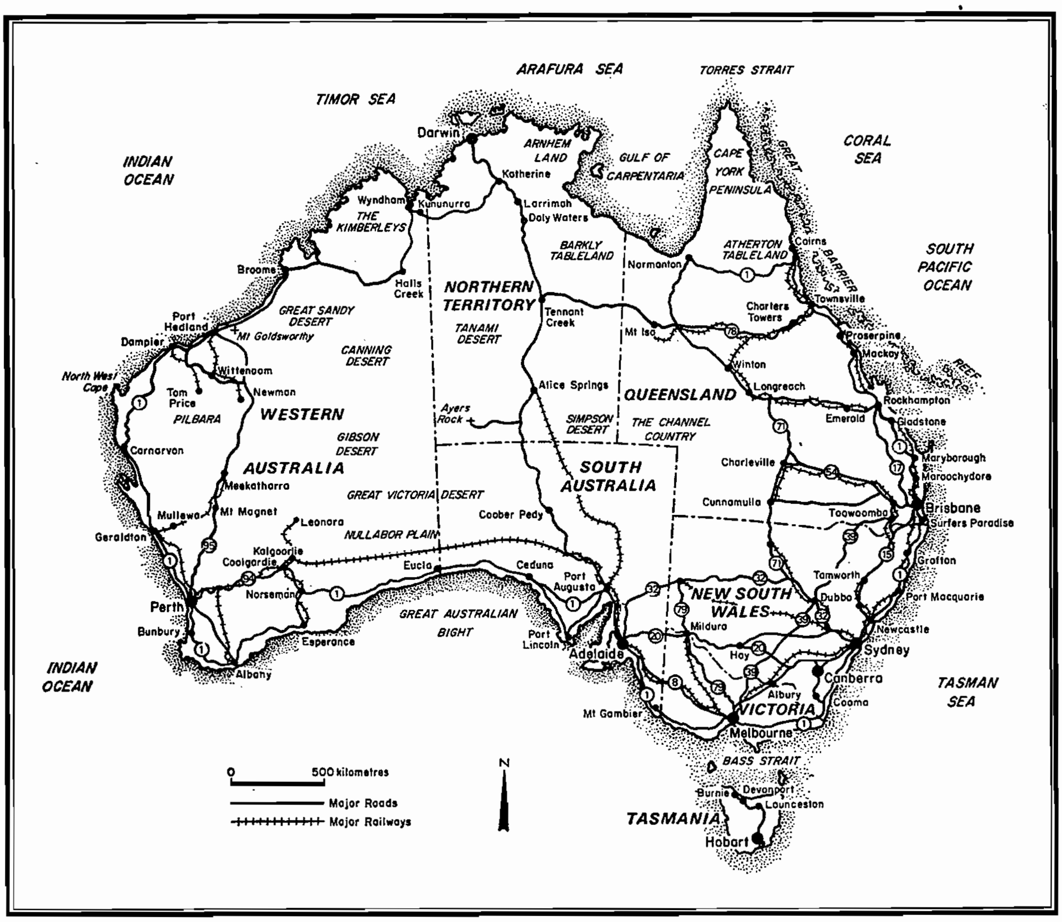

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AUSTRALIE 88

Le Lecteur aura certainement remarqué que le planisphère qui orne habituellement la couverture de notre Bulletin a été remplacé par une carte de l'Australie.

C'est qu'en effet la 8e Conférence Internationale de Métrologie Légale se déroulera à Sydney, du 24 au 28 octobre prochain. Les commémorations du bicentenaire de l'installation européenne en Australie trouveront ainsi leur composante « métrologique », venue fort à propos puisque, simultanément on fêtera le cinquantenaire de la création du National Measurement Laboratory.

Mais l'OIML ne sera pas la seule à se réunir aux antipodes de la vieille Europe. La Conférence Internationale d'Accréditation des Laboratoires d'Essais, ILAC, se tiendra en effet du 17 au 21 octobre à Auckland, en Nouvelle-Zélande, et nombreux seront les experts qui assisteront consécutivement aux deux réunions. C'est là certainement une marque de reconnaissance de l'importance croissante, sur les plans démographique, politique, économique et autres, de cette vaste région dite d'Asie-Pacifique, qui s'étend du nord de la Chine au sud de la Nouvelle-Zélande, et qui comprend tout à la fois le pays le plus peuplé du monde et de petits états de quelques milliers d'habitants ou encore des pays hautement industrialisés et d'autres qui franchissent juste les premiers pas du développement.

Métrologiquement parlant, cette région « existe » : un important programme de coopération créé à l'origine par le « Commonwealth Science Council » mais maintenant autonome, l'Asia-Pacific Metrology Programme (APMP), permet en effet aux pays les plus industrialisés de la région, en collaboration avec les institutions internationales concernées, dont l'OIML, d'aider les pays moins développés à établir les bases métrologiques et à former les spécialistes dont ils ont besoin.

La 8e Conférence Internationale de Métrologie Légale sera bien sûr l'occasion pour de nombreux métrologues du monde entier de découvrir ou de retrouver le continent australien, et d'établir de nombreux contacts, mais elle sera surtout une étape importante dans la vie de l'OIML.

De nouvelles réglementations métrologiques internationales seront en effet soumises à l'adoption dans des domaines aussi variés que le pesage, les préemballages, le contrôle de la vitesse des véhicules, la médecine ou encore le mesurage des pollutions.

La certification des instruments de mesure fera peut-être quelques progrès décisifs à cette occasion, mais bien d'autres questions seront également débattues, telles que planification des travaux de l'OIML, problèmes particuliers aux pays en développement, liaison avec d'autres Institutions Internationales, etc.

Enfin c'est la Conférence qui décidera du budget de l'Organisation pour les quatre prochaines années.

Mais nous laissons la parole à Monsieur J. Birch, le représentant de l'Australie auprès de l'OIML, qui décrira le fonctionnement du système national de la métrologie dans son pays.

Vous trouverez également dans ce numéro deux articles techniques d'un intérêt tout particulier pour l'OIML, écrits par les collaborateurs de Monsieur Birch.

AUSTRALIA

AUSTRALIA 88

Our readers will certainly have noticed that the planisphere usually reproduced on the cover of our Bulletin has in this issue been replaced by a map of Australia.

The reason is the Eighth International Conference of Legal Metrology which will take place in Sydney, 24-28 October, this year. The commemoration of the bicentenary of European Settlement in Australia will thus have a metrological component ; it also happens to coincide with the 50th anniversary of the creation of the National Measurement Laboratory.

However, OIML is not alone in organizing meetings at the antipodes of old Europe. The International Conference on Accreditation of Testing Laboratories (ILAC) will also meet, 17-21 October, in Auckland, New Zealand and a number of experts will attend both meetings. This fact is certainly a mark of recognition of the increasing demographic, political and economic importance of this vast Asia-Pacific region, which extends from the north of China to the south of New Zealand and which comprises, on one hand, the most populated country in the world as well as small states with a few thousand inhabitants and, on the other hand, highly industrialized countries and others which have just taken the initial steps towards development.

From the metrological point of view this region is already very active : it has an important cooperative programme, originally launched by the Commonwealth Science Council but now autonomous, called the Asia-Pacific Metrology Programme. The APMP coordinates the help given by the most industrialized countries in cooperation with international institutions like OIML, in establishing the metrological foundations and in training the necessary specialists for the less developed countries.

The Eighth International Conference of Legal Metrology will, of course, be an opportunity for many metrologists from all over the world to make or to renew acquaintance with the Australian continent and to establish numerous contacts, but it will also constitute an important step for OIML.

New international metrological regulations will in fact be submitted for adoption in several quite different fields such as weighing, prepackage control, vehicle speed control, health and pollution control.

There may also be some positive progress towards the certification of measuring instruments on this occasion, and a number of other questions such as the planning of OIML work, particular problems of developing countries, connections with other international institutions, etc., will be debated.

Finally it is the Conference which will decide the budget of the Organization for the next four years.

However, let us leave the word to Mr J. Birch, the Australian representative at OIML who will describe the development of the national measurement system of his country.

You will also find in this issue two technical papers of special interest to OIML written by his colleagues.

AUSTRALIE

The AUSTRALIAN NATIONAL MEASUREMENT SYSTEM

by **John A. BIRCH**
Executive Director National Standards Commission

Australia - the Land and its People

Australia is an ancient island continent in the Southern Hemisphere bounded in the east by the Pacific Ocean and on the west by the Indian Ocean. With an area of 7 682 000 square kilometers it is about the same size as the USA without Alaska and about 50 % greater than Europe (excluding USSR). It is the lowest, flattest and (apart from Antartica) the driest of the continents.

The original inhabitants of Australia were nomadic Aboriginal tribes that migrated from South East Asia at least fifty thousand years ago. At the time of the first European settlement in Australia in 1788 there was an estimated 300 000 Aboriginals in Australia divided into some 500 tribes.

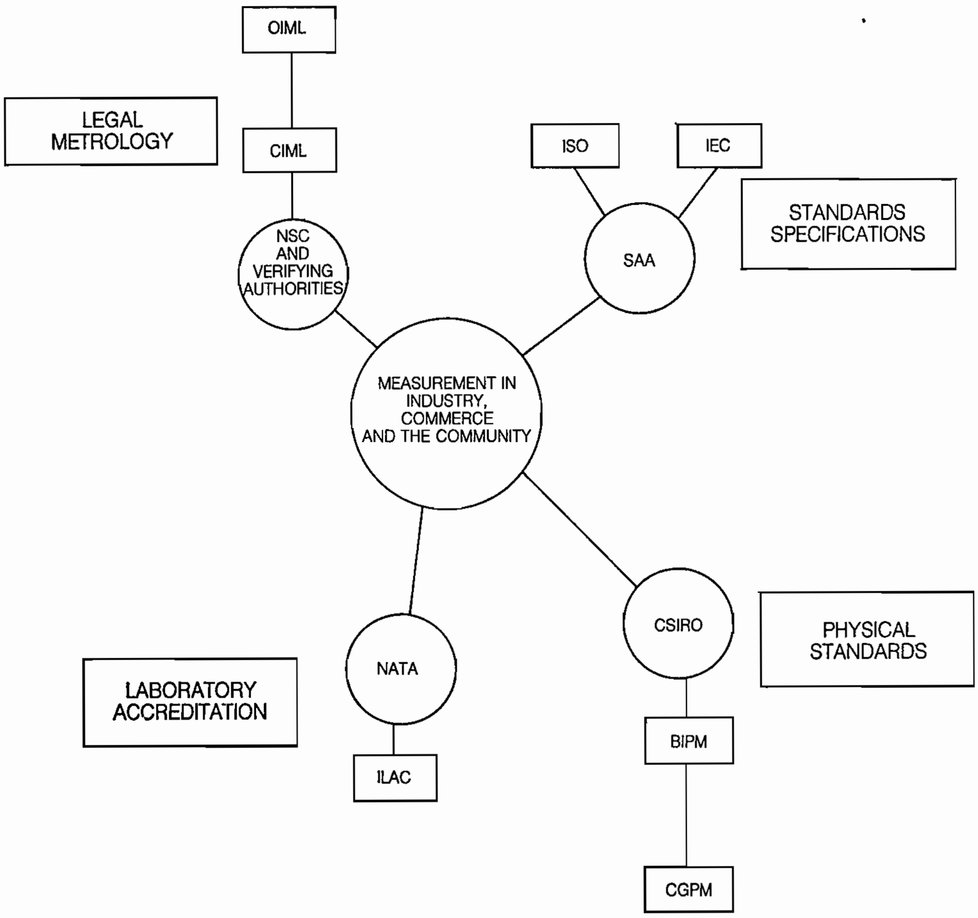

FIGURE 1 — International affiliations of Australian standards - related organisations

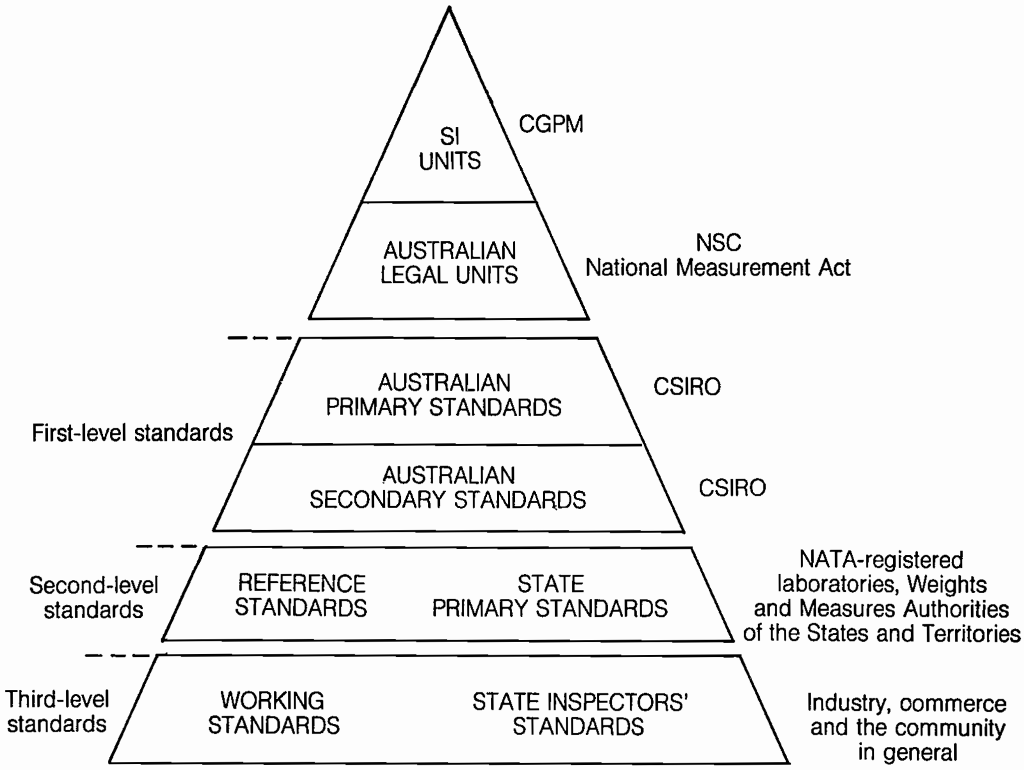

FIGURE 2 — Australia's hierarchy of physical units and standards

The first European settlement was a British penal colony established in 1788 in Sydney. During the nineteenth century immigration to Australia was principally from Britain. After World War II there was a surge of European migration followed in the last two decades by increased migration from Asia. The current population of Australia is about 16 500 000 of whom about 3 500 000 live in Sydney.

During the nineteenth century British colonies were established around the coast of Australia at Melbourne, Hobart, Brisbane, Perth and Adelaide and were granted self-government by Britain as States of Australia. Due to climatic factors the population is concentrated on the coastal fringe of the continent with the inland areas being desert or used for land extensive grazing and agriculture.

In 1901 the six States of New South Wales, Victoria, Queensland, South Australia, Western Australia and Tasmania (joined in 1978 by the Northern Territory) federated as the Commonwealth of Australia. The national capital is Canberra 250 km south west of Sydney within the Australian Capital Territory.

The National Measurement System

Prior to Federation in 1901 Weights and Measures legislation and administration was the responsibility of the State Governments. Each State maintained its own standards of measurement traceable back to Britain and the administration was based on the British model. At Federation the Australian Constitution transferred responsibility for weigths and measures from the State Governments to the Commonwealth Government. However, it was not until 1938 that the Commonwealth Government began to exercise these powers by establishing the Australian National Standards Laboratory (since renamed the National Measurement Laboratory - NML) within the Commonwealth Scientific and Industrial Research Organisation (CSIRO), to maintain Australia's standards of physical measurement. In 1947 Australia became a signatory to the Treaty of the Metre and in 1948 the Commonwealth Government enacted the

National Standards (Weights & Measures) Act which defined the national standards of measurement and established the National Standards Commission (NSC) to advise the Government on all aspects of legal metrology.

This action by the Australian Government prior and subsequent to World War II had been stimulated by the demands of an expanding manufacturing industry. In 1922 industry with the support of Government established the Australian Commonwealth Engineering Standards Association which in 1929 was to become the Standards Association of Australia (SAA) with the aim of formulating standard specifications. In 1947 industry was also instrumental in establishing the National Association of Testing Authorities (NATA) to coordinate testing and calibration facilities throughout Australia.

The relationship of these four peak Australian standards related organisations and their international affiliations is shown in Figure 1 and the hierarchy of Australia's physical units and standards is shown in Figure 2.

Legislation

The National Standards (Weights and Measures) Act of 1948 was replaced by the National Measurement Act 1960. This Act provides the legal basis for a national system of units and standards of measurement of physical quantities and clarifies the responsibilities of the Commonwealth and State and Territory Governments. The Act also provides for the establishment of a National Standards Commission to advise the Commonwealth Government on all aspects of the National Measurement System. Amendments to the Act in 1964 transferred responsibility for pattern approval from the States to the National Standards Commission and a further amendment in 1984 gave the National Standards Commission responsibility for completing metrication in Australia.

The units prescribed under the Regulations of the National Measurement Act are the sole legal units of measurement of physical quantities in Australia. The Act requires CSIRO, through the National Measurement Laboratory, to maintain the physical standards of measurement for all the Australian legal units of measurement. It is the responsibility of the National Standards Commission to determine, revoke and vary the recognised-value standards of measurement.

The Act requires that measurement of physical quantities expressed in a contract shall be in Australian legal units. If this is not the case the contract is void. This provision does not apply to real estate contracts or contracts made in connection with import or export transactions.

Apart from units and standards of measurement and pattern approval, trade measurement legislation is still the responsibility of the State and Territory Governments. Each State and Territory Government has its own Weigths and Measures Legislation administered by a State inspectorate, the exception to this being Victoria where the administration is shared between the State Government and Local Government Authorities.

The State and Territory legislation covers verification and reverification of trade instruments measuring mass, volume, length and area and prepacked articles sold by measure, but does not cover gas, water, electricity, taxi or telephone meters which are controlled by other specialist agencies.

To overcome the over-regulation and inefficiency caused by having eigth separate and different Weights and Measures Acts in Australia considerable effort has gone into bringing about legislation and administrative uniformity. A Model Trade Measurement Act has been developed and should be enacted in 1988/89 by State and Territory Governments. This model legislation proposes changing from cyclical reverification to variable reverification and makes provision for instruments to be certified for use for trade by the holder of a servicing licence.

National Standards Commission

The National Standards Commission was established in 1948 as a Commonwealth Government Statutory Authority to advise the Minister with respect to weights and measures. The 1984 amendments to the National Measurement Act defined more fully and precisely the powers and functions of the National Standards Commission as :

(a) to furnish advice to the Minister on matters relating to the administration of this Act ;

(b) to promote and coordinate the use in Australia of a uniform system of units and standards of measurement of physical quantities ;

(c) to consult and cooperate with appropriate State and Territory authorities on matters relating to legal metrology and the use of units of measurement in the packaging of articles for sale ;

(d) to consult and cooperate with the International Organization of Legal Metrology and other appropriate international organisations on matters relating to legal metrology ;

(e) to examine and approve patterns of instruments ;

(f) to promote the adoption in the States and Territories of uniform legislation relating to :

  (i) patterns of instruments for use in trade ; and

  (ii) the use of units of measurement in the packaging of articles for sale ;

(g) to provide information relating to units of measurement and standards of measurement ; and

(h) to bring about progressively the use of the metric system of measurement in Australia as the sole system of measurement of physical quantities.

In 1948 the Commission comprised five part-time Commissioners with expertise in science and technology and no support staff. In 1988 the Commission comprises a part-time Chairman and six part-time Commissioners with expertise in science and technology and drawn from Federal and State Government Authorities, Universities, NATA, private industry and consumer organisations and the Commission's Executive Director as an eighth ex officio Commissioner. The Commission has a staff of thirty-two scientists, engineers, technical officers and administrators.

Arising from its responsibility to coordinate the National Measurement System, the Commission in recent years has organised a series of conferences on measurement topics. These have dealt with electromagnetic distance measurement, traceability of foreign standards, microwave standards and calibration, precise time measurement, measurement of ionising radiation and gas and liquid flow.

Australia was a signatory ot the International Convention of Legal Metrology in October 1955 and has been represented by the National Standards Commission on the International Committee of Legal Metrology since that date. Subject to the constraints of distance (Paris to Sydney is 17 000 km) the Commission has actively participated in the technical secretariats of OIML and this year has accepted responsibility for the Reporting Secretariat SP 5S-Sr 12 « Static direct mass measurement of quantities of liquids ». In October 1988 Australia will host the Eighth International Conference of Legal Metrology at Manly, a seaside suburb of Sydney.

In 1964 responsibility for the examination and approval of patterns of measuring instruments was transferred to the National Standards Commission. Prior to this pattern approval was an independent undertaking of each of the State and Territory weights and measures authorities. This had resulted in a lack of uniformity in pattern requirements and created severe problems for the trade measurement industry.

The specifications of instruments in use for trade are contained in the Pattern Approval Manuals developed by the Commission and based on OIML Recommendations. Manuals have been published for non-automatic weighing machines, liquid measuring systems, liquor dispensers, length measuring instruments, area measuring instruments, farm milk tanks, load cells, weighing-in-motion systems and belt conveyor weighers.

In 1976 the Commission moved to its present premises at North Ryde where the increased area enabled the expansion of facilities for pattern approval. This included an automated load cell test machine (Figure 3), designed and constructed by the Commission, with a capacity of 50 tonnes and incorporating a temperature controlled test chamber. This machine has recently been used by the Commission in an international intercomparison of load cell tests with USA, United Kingdom, the Netherlands and Federal Republic of Germany. Facilities have also been established for the examination of industrial flowmeters and for humidity testing of electronic weighing instruments.

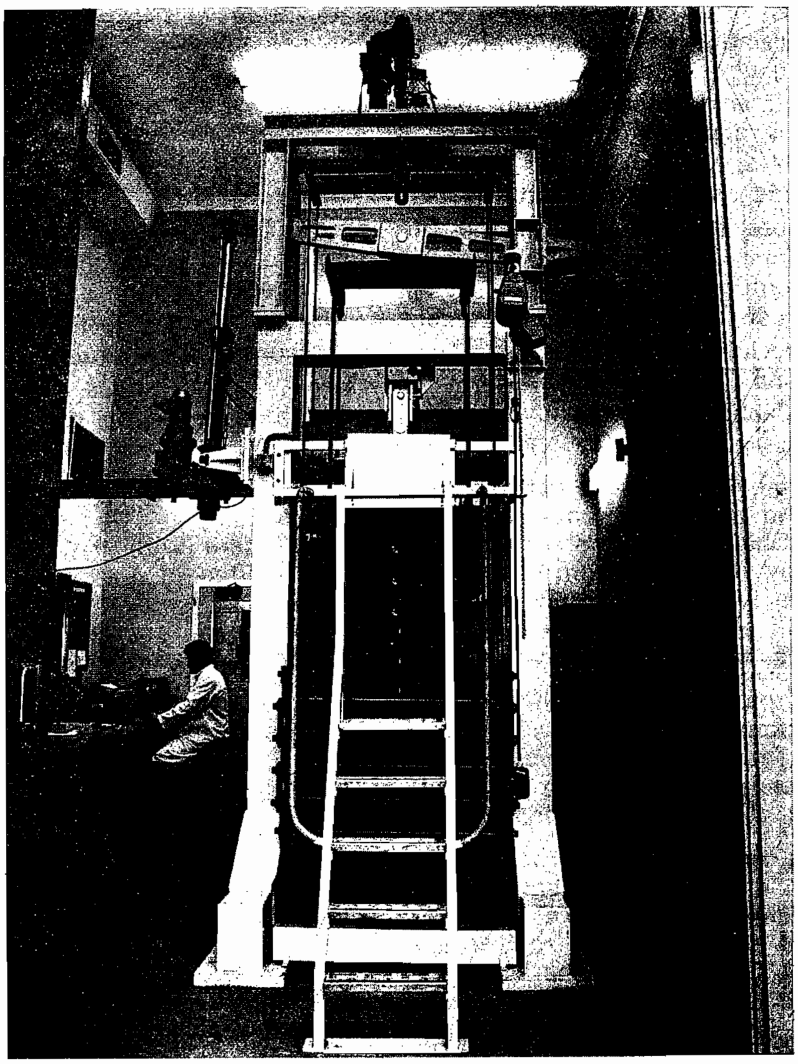

FIGURE 3 — 50 t load cell testing apparatus at the National Standards Commission

Submittors' fees charged by the Commission for pattern approval currently recover 75 % of the cost of examination and issuing Certificates of Approval. It is expected that full cost recovery will be achieved in 1990.

Since its establishment the Commission has been active in promoting greater uniformity in weights and measures legislation and administration in Australia. The Commission has provided the Chairman and secretariat for the Working Party that has developed Model Trade Measurement Legislation and also chairs the Standing Committee on Trade Measurement that brings together senior weights and measures officers from the State and Territory authorities to discuss uniform administration of weights and measures. An observer from the New Zealand Weights and Measures Authority attends these meetings as part of the program of closer economic cooperation between Australia and New Zealand. The Commission is also participating in a Working Party on Uniform Inspection procedures.

Since 1981 the Commission has organised training courses and consultations on weights and measures topics for neighbouring countries in the Asia/Pacific region. Officers from twelve countries have participated in these courses which have covered training of weights and measures inspectors, standards laboratory techniques, weighing-in-motion and metrication. The Commission has been greatly assisted in these activities by the State Weights and Measures Authorities and the National Measurement Laboratory. Commission staff have also assisted nations in the region in the development of weights and measures legislation.

State & Territory Weights and Measures Authorities

Each of the six States and two Territories maintain their own Weights and Measures legislation and administration. The State and Territory Authorities employ about 200 inspectors who are responsible for testing (verification and re-verification) of trade measurement instruments and prepacked articles sold by measure. In the State of Victoria the Weights and Measures administration is a two tier system with the State Government Authority responsible for wholesale activities and Local Government administration responsible for retail weights and measures activities.

In recent years most of the State and Territory Authorities have been incorporated into the Ministries of Consumer Affairs and priority has been given to consumer protection aspects of weights and measures. As part of a general policy of deregulation the authorities are moving towards a greater degree of industry self-regulation and the replacement of regular inspection of measuring instruments with variable inspection.

All weights and measures inspectors are accredited by a National Accreditation Board. The Board was established in 1984 to promote the uniform training of weights and measures inspectors and it has developed a national correspondence course for inspectors.

National Measurement Laboratory

The National Measurement Laboratory was established in 1938 within the Commonwealth Scientific & Industrial Research Organisation (CSIRO). This Laboratory is currently part of the CSIRO Division of Applied Physics. The Laboratory maintains all the legal physical standards of measurement, except for ionising radiation which is maintained by other specialist agencies, as well as maintaining standards for many other physical quantities including those related to hardness and hygrometry.

The National Measurement Laboratory provides a top level calibration service to ensure that measurements in industry, commerce and the community are traceable to the national standards. Second level and routine calibrations have been devolved to other laboratories, particularly those registered by the National Association of Testing Authorities.

The National Measurement Laboratory was originally sited in the grounds of the University of Sydney. In 1977 it moved to its present site in Lindfield in the northern suburbs of Sydney. The laboratory at Lindfield (Figure 4) was specifically designed as an advanced measurement standards laboratory, with maximum isolation from electromagnetic and mechanical vibration interference. The Laboratory has a number of major facilities including a 550 kN dead weight force standard machine, a computer numerically controlled coordinate measurement machine, acoustic and microwave anechoic chambers and a 60 m precision length measuring facility.

FIGURE 4 — The National Measurement Laboratory photographed against Sydney's skyline

At the international level the National Measurement Laboratory collaborates closely with the BIPM and other international laboratories. The present Director of NML is member of the International Committee for Weights and Measures (CIPM). The laboratory has participated in a large number of international comparisons of standards, and in recent years agreements recognising the equivalence of standards have been exchanged by the National Measurement Laboratory with the national standards laboratories of the United Kingdom, USA, Canada and New Zealand.

Since its establishment in 1938 the National Measurement Laboratory has made significant contributions to international standards. In 1955 scientists at the Laboratory invented a calculable standard capacitor which enabled capacitance to be determined to an accuracy of 1 part in 10^7 from the measurement of single length. More recently the Laboratory has completed a determination of the absolute volt to an accuracy of 1 part in 10^6 using a novel absolute liquid electrometer. The Laboratory has also made significant contributions to the international re-definition of the candela, the metre and the new International Temperature Scale.

The National Measurement Laboratory has developed a number of innovative measuring instruments which include an A C resistance bridge, a precision electronic voltage standard, the World Meteorological Organisation Reference Psychrometer and systems using critical flow nozzles as standards for the calibration of gas flow meters.

Through its membership of the Asia/Pacific Metrology Program the Laboratory has provided a wide range of training opportunities for standards staff from neighbouring countries.

National Association of Testing Authorities

The National Association of Testing Authorities (NATA) was established in 1947 as a non-profit making incorporated company responsible for the accreditation and registration of calibration and testing laboratories. As such it was the first national laboratory accreditation system established anywhere in the world. The Association's Head Office is in Sydney with offices in Melbourne, Brisbane, Adelaide and Perth. The Association itself does not operate a laboratory but relies on the services of over one thousand voluntary expert assessors drawn from industry, Government organisations and universities to assess laboratories and to make recommendations concerning registration.

At 30 June 1987 the total number of registered laboratories was 1 578 covering the industry classifications of mining, manufacturing, electricity, gas and water, construction, wholesale and retail trade, transport, communications, technical services, public administration and defence, and community services. Laboratories are registered for mechanical, chemical, non-destructive, biological and medical testing as well as in the fields of metrology, heat and temperature, acoustics and vibration, and optics and radiometry. In each field of testing NATA has established a technically expert Registration Advisory Committee which review the criteria against which laboratories are assessed. NATA provides the Australian representation on the International Laboratory Accreditation Conference (ILAC) and has signed mutual recognition agreements with its counterpart organisations in the United Kingdom, the United States and New Zealand. NATA also provides advisory and consultative services to nations in the Asia/Pacific region.

Standards Association of Australia

The Standards Association of Australia (SAA) is the organisation in Australia responsible for specification standards. It is an independent body, formed in 1922 and incorporated by Royal Charter in 1950. The Association has a staff of 240 located at its headquarters in Sydney and has offices or sales outlets in Melbourne, Brisbane, Adelaide, Perth, Hobart, Canberra, Darwin and Newcastle. The SAA has no legal power to enforce adoption of its standards, adoption is normally voluntary or through ordinances or regulations administered by other bodies. The SAA has a registered AS trademark which it permits manufacturers to use under licence on products satisfying specified requirements on safety, reliability and performance.

SAA has more than 3 800 current Australian Standards covering most areas of community endeavour including industrial applications, the environment, consumer goods and services and safety of the community. Some 1 255 of these standards have been made mandatory through adoption in Government legislation and regulations. More than 2 300 standards are presently under preparation involving the work of more than 1 600 technical committees.

SAA is the Australian member body of the International Organisation for Standardization (ISO) and the International Electrotechnical Commission (IEC).

Metrication

In 1947 Australia signed the Treaty of the Metre which made metric units legal for use in Australia. In 1970 following a Parliamentary Enquiry the Australian Government decided to enact legislation to make the metric system the sole system of legal measurement in Australia. A Metric Conversion Board was established by the Australian Government to plan, guide and facilitate the change to the metric system.

Metric Conversion was carried out voluntarily on an industry by industry basis through a system of industry and community based advisory committees.

By the time the Metric Conversion Board was dissolved in 1981 their task could be regarded as complete apart from a few specialist areas that had not been converted. These included the real estate industry and engineering spare parts and components.

In 1984 the National Standards Commission was given responsibility for the final stages of metrication and in December 1987 legislation was enacted converting real estate contracts to metric units.

Conclusion

Australia has developed the institutions and infrastructure necessary to support the measurement and standards requirements of an advanced industrial society. In addition it has made a significant contribution to international measurement and standards development.

However technological change, demands for improved quality in Australian manufacturing, development of large scale resource projects, defence purchases of state-of-the-art equipment and increased community requirements in the areas of health, safety and environmental protection are all placing major demands on the system.

These demands are occurring at a time of budgetary restraint by the Australian Government, with limited funds available for the development of measurement and calibration facilities. The Australian National Measurement System will only be able to continue to make its contribution to Australian industrial development and community protection if the Australian Government recognises the continuing importance of measurement standards and provides the funds for investment in new facilities and the development of expertise. The Eighth International Conference of Legal Metrology to be held in Sydney in October this year should make a significant contribution to increasing the awareness within Australia of the importance of measurement standards.

AUSTRALIE

PATTERN APPROVAL TESTING of LOAD CELLS FITTED to WEIGHING INSTRUMENTS in USE for TRADE in AUSTRALIA

by **Ian HOERLEIN** and **Ian BENTLEY**

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SUMMARY — The procedure, within Australia, for the pattern approval testing of load cells fitted to weighing instruments in use for trade is outlined. The performance requirements of load cells are indicated and the maximum permissible load cell errors are then specified for each characteristic. These errors are considered together when fitting load cell performance characteristics to the allowable error limits. An analysis is then made of 156 load cell test reports to discover whether overall performance trends exist for load cells tested by the National Standards Commission. The most significant factor affecting the performance of load cells was found to be temperature on sensitivity, minimum dead load output and minimum dead load output return.

1. Introduction

Within Australia the National Standards Commission has as one of its responsibilities the approval of the pattern (design) of instruments used for trade purposes. This process involves the examination and testing of a sample instrument and the issuing of a certificate of approval. The instruments are tested to design specifications issued by the Commission which are based on requirements of the International Organisation of Legal Metrology (OIML).

The majority of instruments examined by the Commission are those used for weighing, e.g. laboratory balances, shop scales, weighbridges, belt conveyor weighers and train weighing-in-motion weighbridges.

The last decade has seen a change in instruments from mechanical lever systems with spring or pendulum-resistant mechanisms to instruments utilising load cells as the force transducer and a microprocessor-based digital indicator giving the indication of mass. One of the effects of this change is the additional testing that has to be carried out on instruments because of the susceptibility of electronic instruments to influence factors such as temperature, supply voltage variation, humidity, barometric pressure and electromagnetic interference. All instruments in use for trade are expected to continue to perform within the prescribed error limits under all practical variations of working conditions over a period of up to two years.

2. Method of testing instruments

Normally for small instruments up to 30 kg capacity the whole instrument is tested. However as it is impractical to test a 100 t weighbridge for effects of temperature variation under laboratory conditions, the procedure of testing each component separately has been developed. Hence load cells are tested in dead

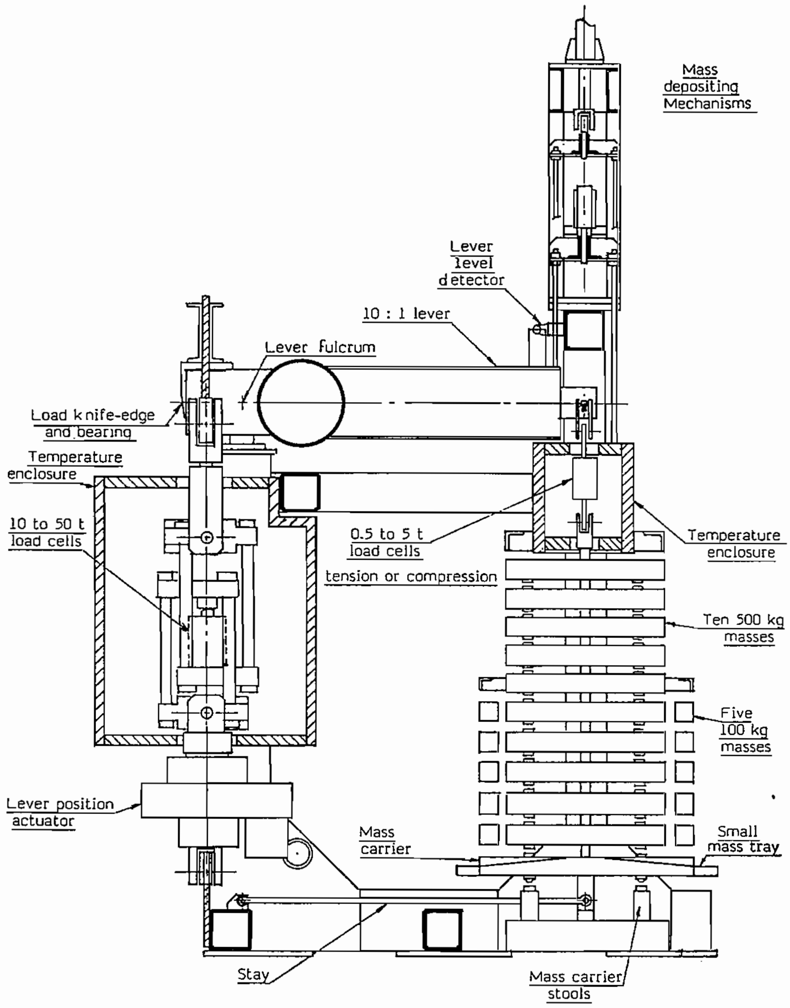

Figure 1 — The Commission's 50 t load cell test machine

weight test machines fitted with temperature enclosures and indicators are tested in a separate temperature enclosure. The Commission's 50 t test machine (see Figure 1) was designed specifically to test load cells under varying temperature conditions, and the enclosures include not only the load cell but also the loading plates and fixtures to avoid temperature gradients across the load cell.

Australian requirements for load cells [1] are based on OIML International Recommendation No 60, Metrological Regulations for Load Cells [2].

The requirements for load cells are based on the principle that several load cell errors must be considered together when fitting load cell performance characteristics to the overall allowable error limits, rather than the more common method of specifying individual error limits. It is therefore possible to have low non-linearity and hysteresis errors and moderate temperature errors, or conversely to have moderate non-linearity and hysteresis errors and low temperature errors, provided the overall error envelope fits within the prescribed error limits (see Figures 2 and 3).

3. Classification of load cells

As the required performance of weighing instruments has been established for some time, the requirements for load cells closely follow those for weighing instru-

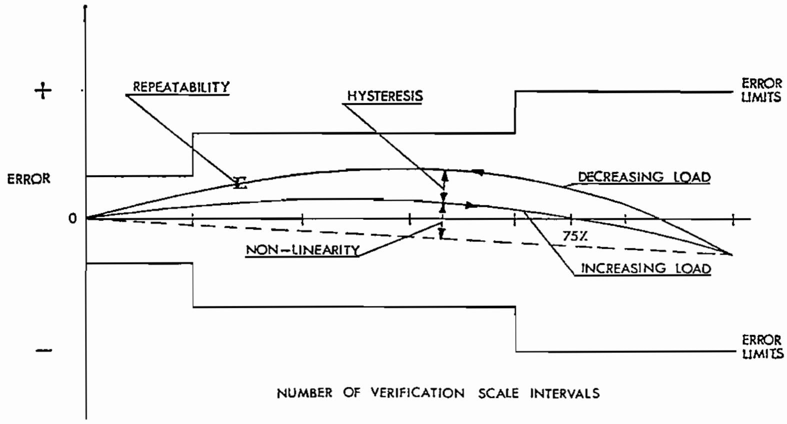

Figure 2 — Load cell errors and error limits

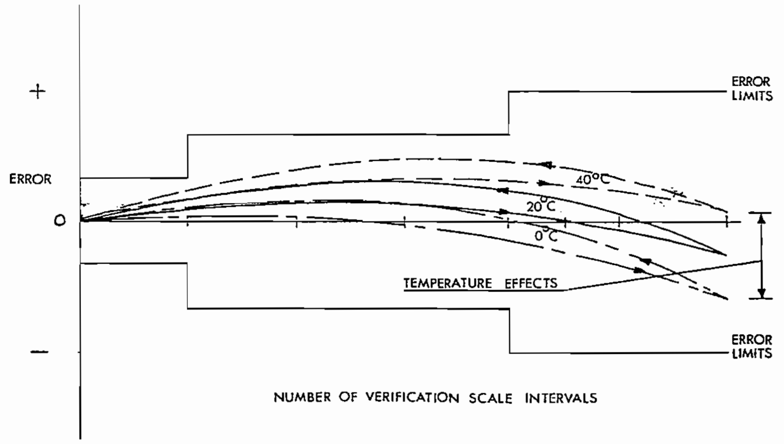

Figure 3 — Load cell errors and error limits with variation in temperature

ments. Hence the cells are divided into four accuracy classes A, B, C and D, with A being the most accurate, e.g. for laboratory balances, and D the least accurate, e.g. for personal weighers and baggage scales.

This classification does not prohibit the use of a lower grade load cell in a higher grade instrument if compensation techniques are used in the instrument. Class C is the most commonly used classification for normal trade instruments.

The performance requirements for weighing instruments and load cells are based on the value of the scale interval (called the verification scale interval) and hence the maximum number of scale intervals determined by the maximum capacity. This concept prevents the use of over-fine scale intervals with a perceived higher accuracy than that of which the instrument is capable.

Hence in specifying the outer limits of performance for which a load cell is suitable, two values are stated : the maximum number of verification scale intervals and the minimum verification scale interval. Therefore within the stated capacity of the load cell, a variety of measuring ranges may be utilised.

As an example, a class C load cell with a maximum capacity of 30 t, a maximum number of verification scale intervals of 3 000 and a minimum verification scale interval of 2 kg may be used for measuring ranges of :

(a) 1 t × 2 kg (500 scale intervals) ;
(b) 20 t × 10 kg (2 000 scale intervals) ;
(c) 15 t × 5 kg (3 000 scale intervals) ; and
(d) 25 t × 20 kg (1 250 scale intervals).

Note : The 30 t maximum capacity consists of dead load as well as live load.

Load cells are also classified depending on the method of load, i.e. tension, compression, beam (shear or bending) or universal.

4. Maximum permissible errors for load cells

The tests described in clauses 4.1 to 4.4 determine the maximum number of verification scale intervals as the tests are carried out over the full measuring range, whilst the tests outlined in clauses 4.5 to 4.6 determine the minimum verification scale interval and are carried out at minimum dead load.

4.1. Non-linearity, hysteresis and temperature effect on sensitivity

The maximum permissible errors for load cells are related to the errors for weighing instruments. As the load cell is only one component of a weighing instrument and errors can arise from other parts, the maximum permissible errors for load cells are specified as 70 % of the maximum permissible errors for the weighing instruments (see Table 1). The errors are specified in terms of the value of the scale interval (v) and apply over specified ranges of scale intervals for each class as shown in Table 2.

TABLE 1 — MAXIMUM PERMISSIBLE ERRORS FOR LOAD CELLS AS 70 % OF THAT FOR WEIGHING INSTRUMENTS

Weighing instrument	Load cell
0.5e	0.35 v
1.0e	0.7 v
1.5e	1.05 v

TABLE 2 — MAXIMUM PERMISSIBLE LOAD CELL ERRORS

Errors on pattern evaluation and initial verification	Load			
	Class A	Class B	Class C	Class D
0.35 v	0 to 50 000 v	0 to 5 000 v	0 to 500 v	0 to 50 v
0.7 v	over 50 000 v up to 200 000 v	over 5 000 v up to 20 000 v	over 500 v up to 2 000 v	over 50 v up to 200 v
1.05 v	over 200 000 v	over 20 000 v up to 100 000 v	over 2 000 v up to 10 000 v	over 200 v up to 1 000 v

These errors apply to the combined effects of non-linearity, hysteresis and temperature effect on sensitivity with the output of the load cell adjusted to zero at minimum dead load and for increasing and decreasing load. To standardise the performance of load cells, the curves are referenced to a straight line passing through zero and the load cell output for a load of 75 % of the measuring range taken on ascending load at 20 °C (see Figure 2).

Other characteristics are determined separately and therefore the maximum permissible error for each characteristic is specified separately.

4.2. Repeatability

Each load test is repeated a number of times and the maximum variation of results should not exceed the absolute value of the errors specified for non-linearity, hysteresis and temperature.

4.3. Creep

A load of 90 to 100 % of maximum capacity is applied to the load cell for 4 h. The maximum difference between the initial reading after the load is applied and any reading during the next 4 h must not exceed 1.5 times the value of the errors specified for non-linearity, hysteresis and temperature. The factor 1.5 brings the error back to that for the whole weighing instrument as only the load cell is susceptible to creep errors (see Figure 4).

4.4. Minimum dead load output return

Minimum dead load output return is a test for creep recovery at minimum dead load (zero indication) due to a load of 90 to 100 % maximum capacity being placed on the load cell for 30 min. The difference in zero reading before and after the application of the load must not exceed half of the verification scale interval (see Figure 5).

4.5. Temperature effect on minimum dead load output

An allowance of 0.7 minimum verification scale interval is made for a change in output at minimum dead load for a temperature change of 5 °C.

4.6. Barometric pressure effect on minimum dead load output

An allowance of 1.0 minimum verification scale interval is made for a change in output at minimum dead load for a barometric pressure change of 10 hPa.

The allowance for temperature effect is less than for barometric effect as other components of the instrument would suffer from temperature changes but not barometric changes. These error allowances are aligned with those required for weighing instruments.

5. Test conditions

5.1. Time limits

As characteristics of load cells such as creep and hysteresis are time related, the time to apply the load and read the output has been standardised to obtain uniformity. The times specified in Table 3 allow approximately half the time for applying the load and the other half for stabilisation before a reading is taken.

TABLE 3 — TIME INTERVAL FOR INITIAL READING OF LOAD APPLICATION OR REMOVAL

Load (kg)		Time
Greater than	To and including	(s)
0	10	10
10	100	15
100	1 000	20
1 000	10 000	30
10 000	100 000	50
100 000	—	60

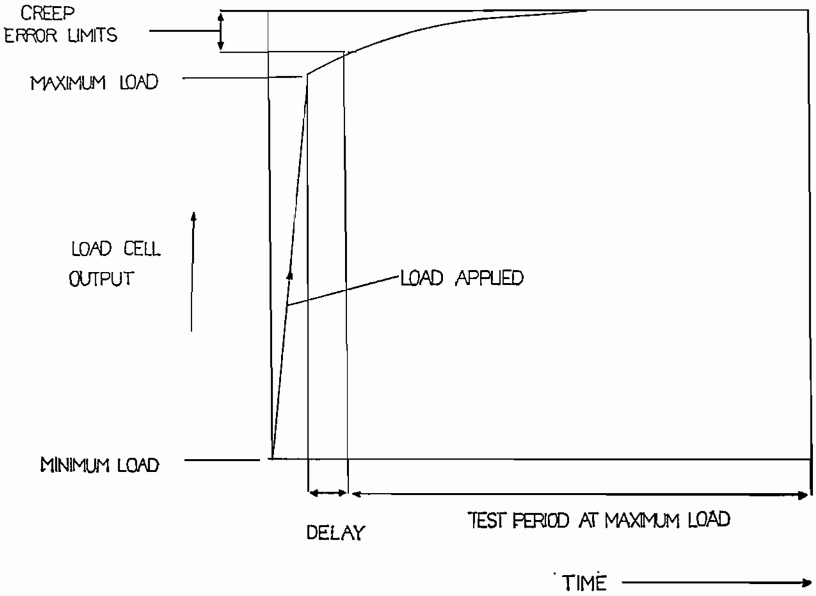

Figure 4 — Load cell creep errors and error limits

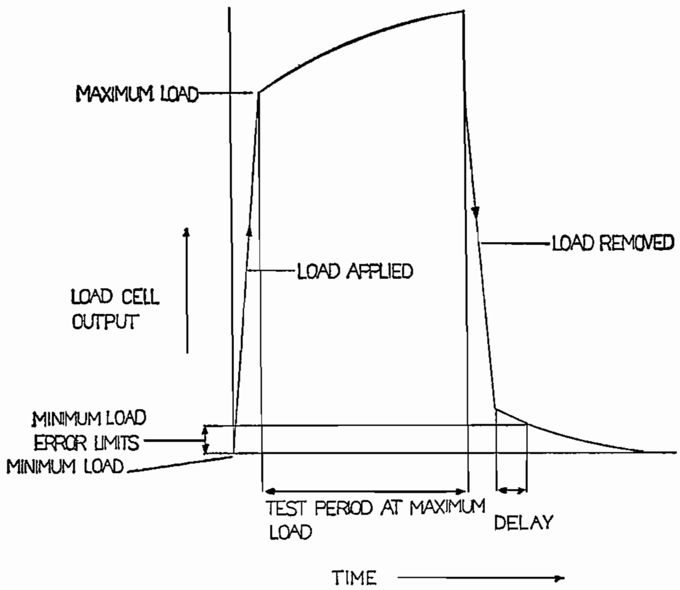

Figure 5 — Load cell minimum load errors and error limits

5.2. Temperature limits

The performance of the load cell should remain within the maximum permissible errors over specified temperature ranges of :

(a) class A and B + 10 to + 30 °C ; and (b) class C and D — 10 to + 40 °C.

Therefore for class C which is the most common class of instruments, the Commission tests cells at 20, 40 and 0 °C and then repeats the 20 °C test. Commission equipment was not designed for testing at — 10 °C as this was not considered necessary for Australian conditions. However attempts are being made to test as close as possible to — 10 °C in order to be comparable with other test authorities. The 20 °C repeat test is carried out to ensure that no permanent shift has occurred in the load cell due to temperature cycling. All tests except for barometric pressure are carried out at each temperature.

5.3. Test procedure

Within Australia a standard test procedure is included in the requirements for pattern approval of load cells to ensure that the results obtained for different load cells and by different test organisations are comparable [1].

The load cells are tested in dead weight test machines fitted with temperature enclosures and the power supply and reading of the output from the load cell is provided by a standard reference instrument kept at a uniform 20 °C.

As the method of mounting and loading a load cell can affect its performance, the load cell is usually tested with the fittings provided by the manufacturer and used when fitted to a weighing instrument.

Careful consideration is given to ensuring that the load cell, its cable and all fittings in contact with it, have stabilised at the test temperature. This may take up to 12 h for some of the larger load cells.

As some load cells can be affected by changes in barometric pressure, this is recorded and adjustments are made to the results of the 4 h creep test if necessary.

5.4. Tests results

The load cell is stabilised at 20 °C and the output adjusted so that at minimum dead load the indication is zero and at 75 % maximum capacity the indication is a suitable number of scale intervals, typically 75 % of 200 000. For all subsequent tests the zero changes are noted and then the instrument is reset to zero before each new test. The span adjustment at 200 000 is not touched for the remainder of the tests.

The tests at each temperature are carried out in the following sequence after three exercise runs :

(a) three load tests (Table 4) ;

(b) minimum dead load output return test (Table 5) ; and

(c) creep test (Table 6).

The temperature effect on minimum dead load output is determined when changing from one test temperature to another (see Table 4).

The load tests are carried out with increasing and decreasing loads with at least five test points. The timing for each load application and recording of output is as close as possible to that shown in Table 3. The repeatability error is determined from the three load tests.

The test temperatures are set in the following sequence : 20, 40, 0 and 20 °C. The load cell test machines are automated so that a complete test cycle can be performed and the results are recorded automatically. A typical test cycle for one load cell takes two days operating 24 h per day. Four load cells of each type are tested to ensure good quality control by the manufacturer.

TABLE 4 — LOAD TEST RESULT SHEET

Model : —
Capacity : 25 t
Minimum dead load : 1.6 t
Serial no. : —
Date : 17 February 1987
Start time : 0756 h
Time interval : 30 s
Load cell temperature : 39.2 °C
Indicator temperature : 21.0 °C
Pressure : 1 015 hPa

Minimum dead load output at 21.2 °C = 20/200 000
Pressure : 1 011 hPa
Soak time : 14 h

Minimum dead load output at 39.2 °C = — 3/200 000
Pressure : 1 015 hPa

∴ Temperature effect on minimum dead load output = — 0.315/10 000 v/5 °C

Load (t)	Error (parts/200 000) Run 1	Run 2	Run 3	Error (parts/10 000) Repeatability	Average
0	0	0	0	0.00	0.00
5	11	12	10	0.10	0.55
10	20	20	18	0.10	0.97
15	16	15	16	0.05	0.78
20	— 1	0	— 3	0.15	— 0.07
25	— 37	— 36	— 37	0.05	— 1.83
20	— 12	— 12	— 15	0.15	— 0.65
15	4	3	2	0.10	0.15
10	12	13	12	0.05	0.62
5	5	6	6	0.05	0.28
0	— 1	0	— 1	0.05	— 0.03

After test
Load cell temperature : 39.2 °C
Indicator temperature : 21.0 °C
Pressure : 1 015 hPa

After the tests are completed in the test machine, the load cell is removed and placed in a chamber in which the pressure can be varied from 950 to 1 050 hPa. The variations in output at zero dead load are recorded (see Table 7).

The results of tests for linearity, hysteresis and temperature effect on sensitivity are plotted on a graph together with the appropriate error limits for the maximum number of verification scale intervals (Figure 6). All results are reduced to the equivalent error for 10 000 scale intervals for uniformity in comparing the performance of all load cells.

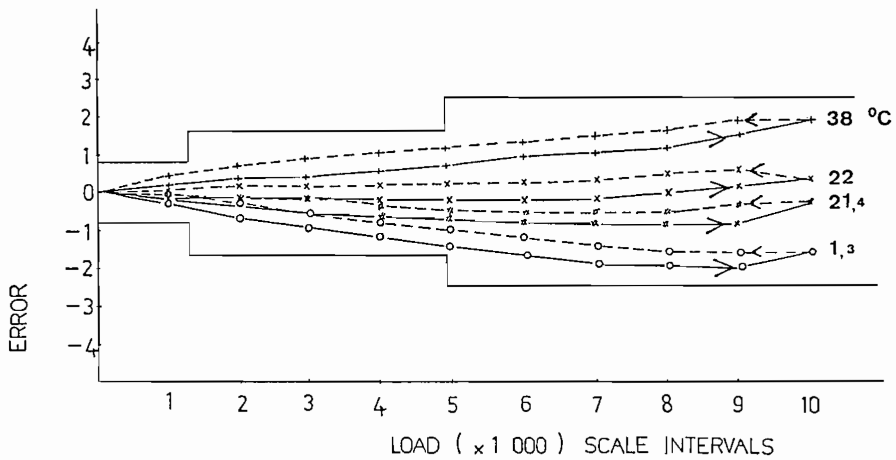

Figure 6 — Error graph for a 4 500 v load cell, capacity 90 kg, for increasing and decreasing load at various temperatures. Results are reduced to the equivalent error for 10 000 v for comparison purposes.

TABLE 5 — MINIMUM DEAD LOAD OUTPUT RETURN TEST

Model :	—
Capacity :	450 kg
Minimum dead load :	25 kg
Serial no. :	—
Date :	13 April 1987
Start time :	0519 h
Time interval :	83 s
Load cell temperature :	— 0.2 °C
Initial zero :	13/180 000

Full load after :		Return to zero after :	
0 s	180026	0 s	32
5 s	180026	5 s	32
10 s	180027	10 s	31
15 s	180027	15 s	31
20 s	180027	20 s	30
30 s	180028	25 s	30
40 s	180029	30 s	29
50 s	180029	35 s	30
60 s	180030	40 s	29
2 min	180032	45 s	30
3 min	180033	50 s	30
4 min	180034	55 s	30
5 min	180033	60 s	30
10 min	180036		
15 min	180038		
20 min	180040		
25 min	180043		
30 min	180044		

30 min creep error = 0.94/10 000

Minimum dead load output return error = 0.94/10 000

TABLE 6 — CREEP TEST

Model :	—
Capacity :	20 000 kg
Minimum dead load :	1 600 kg
Serial no. :	—
Date :	11 September 1985
Start time :	1 300 h
Time interval :	84 s
Load cell temperature :	20.5 °C
Indicator temperature :	21.7 °C
Pressure :	1 005 hPa

Full load after :		
0 s	200035	
5 s	200014	
10 s	200009	
15 s	200003	
20 s	200002	
30 s	200001	
40 s	200000	
50 s	199999	
60 s	199997	
2 min	199994	
3 min	199992	
4 min	199991	
5 min	199988	
10 min	199985	
15 min	199983	
20 min	199981	
25 min	199980	
30 min	199979	
1 h	199976	Pressure : 1 005 hPa
2 h	199971	Pressure : 1 006 hPa
3 h	199968	Pressure : 1 008 hPa
4 h	199965	Pressure : 1 008 hPa

4 h creep error = — 1.85/10 000

After test : Load cell temperature : 20.3 °C
Indicator temperature : 21.3 °C

TABLE 7 — BAROMETRIC PRESSURE TEST

Model :	—
Capacity :	20 000 kg
Minimum dead load :	0 kg
Serial no. :	—
Date :	13 September 1987
Start time :	1 330 h
Load cell temperature :	22.1 °C
Indicator temperature :	22.1 °C

Minimum dead load output	Parts/200 000
1 000 hPa	1
1 050 hPa	31
1 030 hPa	19
1 010 hPa	7
1 000 hPa	1
950 hPa	— 28
970 hPa	— 16
990 hPa	— 5
1 000 hPa	1

After test : Load cell temperature : 22.3 °C
Indicator temperature : 22.3 °C

Pressure effect on minimum dead load/10 hPa = 0.3/10 000

6. Trends in load cell performance

An analysis of 156 load cell test reports was carried out in an effort to discover whether overall performance trends existed for load cells tested by the Commission. The sample included the following types and capacities :

(a) 109 beam cells (bending and shear) from 11.4 to 3 000 kg capacity ;
(b) 4 double-ended beam cells of 22 700 kg capacity ;
(c) 18 compression cells from 20 000 to 50 000 kg capacity ;
(d) 21 S-type cells from 68 to 500 kg capacity ; and
(e) 4 tension cells of 1 130 kg capacity.

The Commission issues supplementary certificates of approval to cover the pattern of a component of a measuring instrument, e.g. a load cell or digital indicator. This component may then be used in other complete measuring instrument patterns. Four cells of each capacity need to be submitted to gain approval and the number of verification scale intervals awarded for each capacity of the cell is based on the worst performance of the four cells. Figure 7 shows the range of the number of load cells presently approved for different numbers of scale intervals (v) under the supplementary approval system.

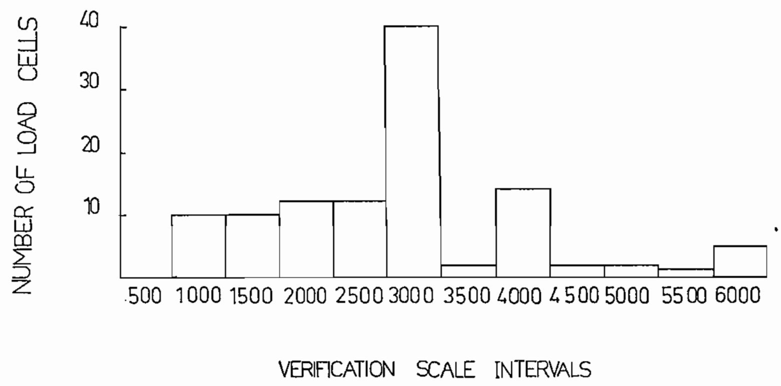

Figure 7 — Verification scale intervals for approved load cells

The performance of the four cells can vary significantly (up to 4 000 v). In fact, of 34 groups of four cells analysed only three had all four cells gaining the same number of verification scale intervals. On average the difference between the best and worst cell was 1 600 v so testing just one cell which may be specially selected by the manufacturer would clearly not give an indication of the quality of the production cells. Comparing the worst cell to the next worst cell led to a significant difference in 17 of the 34 groups, with the average difference being 1 100 v. This would seem to justify the test of at least four load cells.

7. Limiting factors from test results

When the results of a load cell test are analysed, one of the eight parameters listed below is the limiting factor in determining the maximum number of scale intervals. The percentage of the sample limited by each of the eight parameters is also shown :

(a) non-linearity 8 % ;
(b) hysteresis 12 % ;
(c) temperature effect on sensitivity 20 % ;
(d) repeatability 1 % ;
(e) creep 1 % ;
(f) minimum dead load output return 34 % ;
(g) temperature effect on minimum dead load output 24 % ; and
(h) barometric pressure effect on minimum dead load output 0 %.

7.1. Non-linearity, hysteresis and temperature effect on sensitivity

The combined effect of non-linearity, hysteresis and temperature effect on sensitivity was the limiting factor in 40 % of the load cells tested. The individual effects were :

(a) 20 % were limited by temperature effect on sensitivity ;

(b) 12 % were limited by hysteresis ; and

(c) 8 % were limited by non-linearity.

No definite trend was evident as :

(a) 51 % had negative, 48 % positive non-linearity ;

(b) 35 % had negative, 60 % positive hystereris ;

(c) 46 % had negative, 33 % positive shift in sensitivity at 40 °C ; and

(d) 54 % had negative, 44 % positive shift in sensitivity at 0 °C.

7.2. Repeatability

Only 1 % of cells were limited by repeatability errors and in no cases was it the limiting factor of a group of four load cells. In the experience of the Commission, poor repeatability is a result of either friction in the cells load fittings or in the test machine itself, or due to exposed compensation elements having a different thermal response to the strain gauges and reacting to minor changes in the temperature chamber due to heaters cutting in at different times during the load test.

7.3. Creep

Based on an earlier investigation where it was found that the creep test was not a limiting factor in any of the reports surveyed and that the error after 4 h was less than double the error after 30 min, the Commission decided only to monitor creep during the 30 min minimum dead load output return test. If doubling this error was going to be a limiting factor then a full creep test would be carried out at that temperature. The latest research shows that the 4 h creep test is a limiting factor in only 1 % of cases analysed.

Comparing the 30 min creep errors to the 30 min minimum dead load output return errors it became apparent that they are of the same magnitude, with small differences probably due to the creep rate when loaded not matching the rate of recovery when the load is removed. The absolute average difference was only 0.35 parts in 10 000 with 23 % having the same error, 45 % with the minimum dead load output return error larger than the creep error and 32 % with it smaller.

For cells with a rating greater than 2 000 v the maximum permissible error for creep (1.5 v) is three times the minimum dead load output return maximum permissible error (0.5 v) and as the 4 h creep error is approximately twice the 30 min minimum dead load output return error the latter will obviously be more likely to be the limiting factor (which is reflected in the above results, i.e. 34 % compared to 1 %).

Initial creep may occur during a load test while each load is being applied ; thus, the timing of load applications can be important when trying to compare test results to those of the manufacturers or other laboratories. If this initial creep is excessive, it may be reflected in the load cell graph as excessive non-linearity or hysteresis. Figure 8 shows a cell that had excessive initial creep, especially at 0 °C, thus non-linearity and hysteresis are much worse at that temperature.

This was an exaggerated case as it was subsequently found that the label, which was used as a cover for the strain gauges and which had been added after the manufacturer had tested the cell, was causing the initial creep. Figure 9 shows the cell after the load cell was modified with a new cover over the strain gauges and fixed before testing.

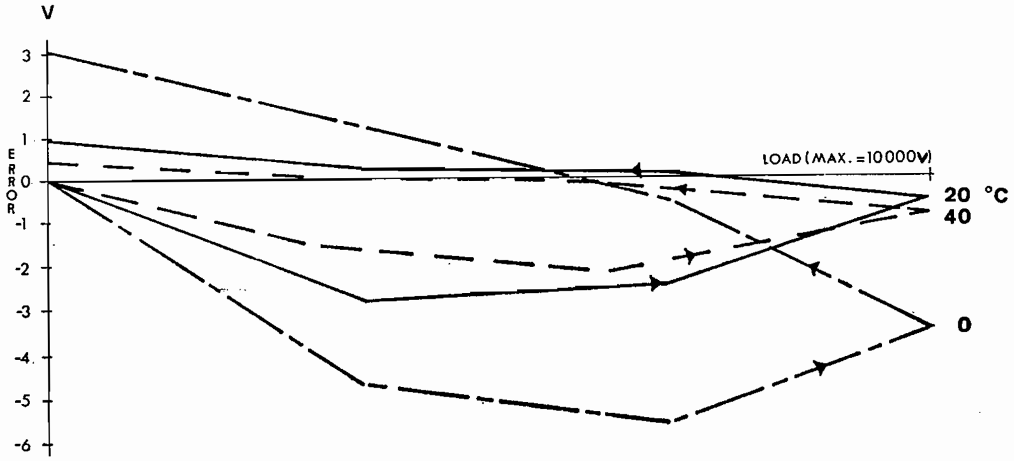

Figure 8 — Performance of a load cell with excessive non-linearity and hysteresis

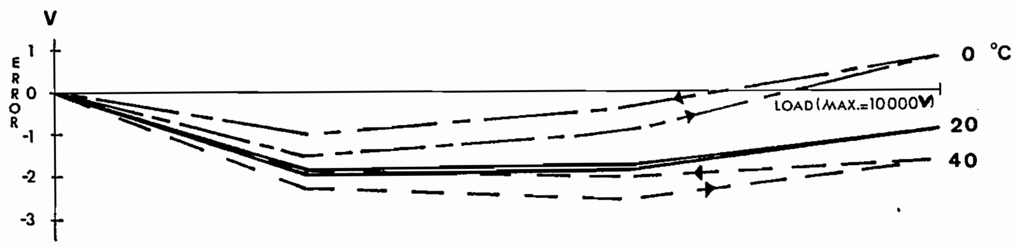

Figure 9 — Performance of a load cell after modification

7.4. Minimum dead load output return

The test for minimum dead load output return is carried out at 40, 0 and 20 °C. In all cases where minimum dead load output return was a limiting factor the largest error was at 40 or 0 °C. Minimum dead load output return was the limiting factor in 34 % of cases, with the 40 °C test alone accounting for 27 %. The effect of this test was to derate the performance of the cells by 25 % (1 000 v) compared to all other factors and to derate by 35 % (1 700 v) compared to the performance expressed only by non-linearity, hysteresis and temperature effect on sensitivity.

7.5. Temperature effect on minimum dead load output

Temperature effect on minimum dead load output sets the size of the minimum verification scale interval : if it is large the maximum number of verification scale intervals may have to be reduced so that the product of the two is less than the maximum capacity of the cell.

In the past this factor had led to a large reduction in the approved number of verification scale intervals for some load cells. Of the load cells analysed 24 % were affected by this factor. With the widespread use of digital indicators with automatic zero track devices, such an error would normally be compensated for by such a device. Thus the Commission issues certificates with approvals covering :

(a) instrument with automatic zero track - multi-cell applications ;

(b) instrument with automatic zero track - single-cell applications ;

(c) instruments without automatic zero track - multi-cell applications ; and

(d) instruments without automatic zero track - single-cell applications.

The multi-cell figure allows for the addition of errors before rounding up to multiples of 1, 2 or 5 for determining the scale interval of a complete instrument.

The introduction of these four figures has increased the number of scale intervals awarded to cells affected by temperature at minimum dead load by an average of 62 % (1 600 v) when fitted with an automatic zero track device.

7.6. Barometric pressure effect on minimum dead load output

The effect of barometric pressure on minimum dead load output varies depending on the construction of the load cell. For example a sealed compression type load cell which had a diaphragm attached to its load column had an error of 0.30/10 000, while a sealed beam-type load cell had an error of 0.05/10 000. The effect of barometric pressure has not yet been applied to many load cells so at this stage it has not been the limiting factor for any of the load cells in the sample.

7.7. Load cell mounting

It has been found that the rigidity of the mounting rig to which a beam-type load cell is fitted in the test machine can be critical. Figure 10 shows the graphs

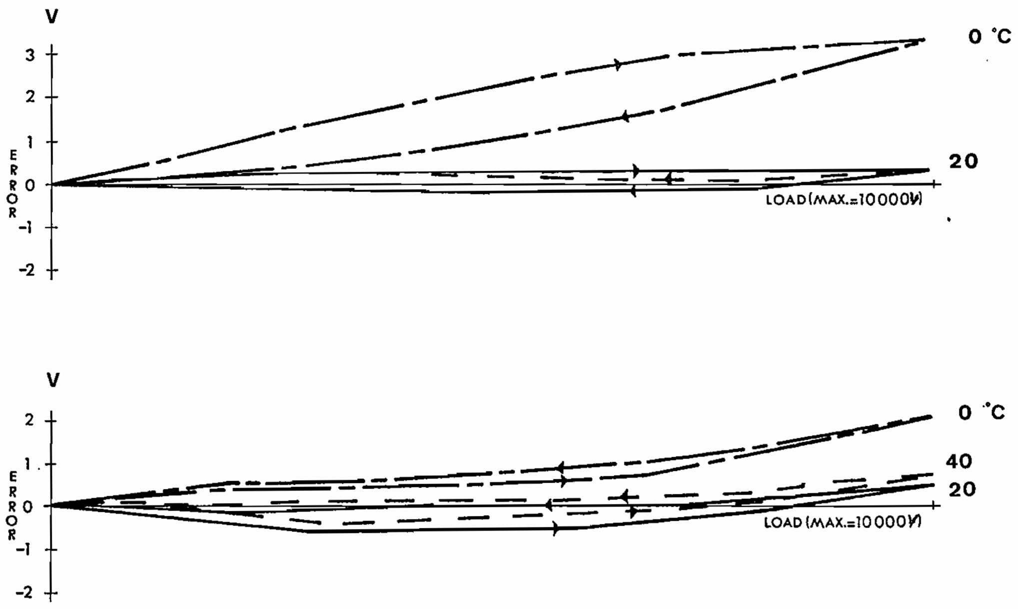

Figure 10 — Performance of a load cell showing the difference between more rigid (lower graph) and less rigid (upper graph) mounting rigs

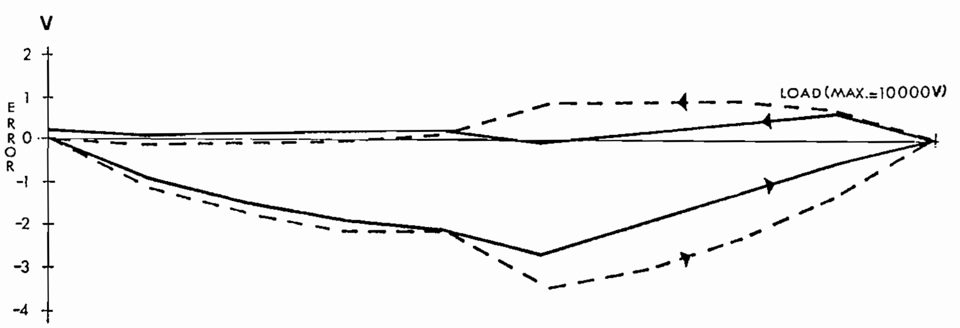

Figure 11 — Performance of a load cell with correct (plain lines) and incorrect (dashed lines) mounting bolt torque at 20 °C

of a cell using different mounting rigs. A significant difference in hysteresis at 0 °C occurred between the two rigs with the more rigid one giving the best performance.

The torque applied to mounting bolts has an effect on some beam-type load cells and the Commission asks the manufacturer to specify the torque. Figure 11 shows the improvement in hysteresis when the correct torque was applied to a load cell.

8. Conclusions

The most significant factor affecting the performance of load cells is the effect of extremes of temperature on the sensitivity, the minimum dead load output and the minimum dead load output return, with the last being the worst effect. Although the worst cases are often at 40 °C it is common for load cells located under weighbridges to be working at 40 °C on a sunny summer day. Therefore testing for performance over a range of temperatures is important.

The necessity of testing for the effects of full load creep over a loading period of 4 h is questionable from the point of view of whether it represents practical usage and from the fact that very few load cells are limited by this factor. A 30 min period would be quite adequate.

The fact that the maximum permissible error for minimum dead load output return is less than that required for full load creep, even though the load cell errors are comparable for the same loading period, means that designers have to concentrate on this feature at the extreme temperature limits to obtain the best approval conditions for their load cells. It is also obvious that this test is more important than the full load creep test.

The variation obtained between different load cells of the same type means that it is imperative that more than one load cell is tested. The Commission has always tested four cells and any less would not give a true indication of the performance of that type of load cell.

The mounting of the load cells in the test machine and adhering to the specified loading times are important if a repeatable true performance of the load cell is to be obtained.

References

(1) Pattern Approval Manual No 7 — Pattern Approval Manual for Load Cells for Trade Weighing Instruments (August 1981), National Standards Commission.

(2) OIML International Recommendation 60 — Metrological Regulations for Load Cells.

AUSTRALIE

VERIFICATION of LIQUEFIED PETROLEUM GAS FLOWMETERS *

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SUMMARY — Liquefied petroleum gas flowmetering instruments pattern approved by the National Standards Commission for trade purposes in Australia are verified by the State or Territory Weights and Measures Authorities. A description is given of the testing facility and the techniques used by the National Standards Commission for pattern approval of liquefied petroleum gas flowmeters. Also a description is given of the experiences with the various methods used by the Weights and Measures Authorities for verification of pattern approved liquefied petroleum gas flowmetering systems in field installations.

1. Introduction

The National Standards Commission is a Commonwealth Statutory Authority with the responsibility for pattern approval of measuring instruments used for trade purposes in Australia. The Commonwealth of Australia is a Federation of six States and two Territories, each of which makes its own provision for the verification of pattern approved instruments. Instruments submitted for testing and approved by the Commission are issued with a NSC approval number ; this allows the submittor of the pattern to install instruments purporting to comply with the Commission approved pattern. In most cases the installed instruments are adjusted for optimum performance by authorised firms and/or contractors before the verification is carried out by the State or Territory Weights and Measures Authority. The process of verification includes identification of the instrument with the approved pattern and a procedure to ascertain that the installed measuring instrument is calibrated and performs within the permissible tolerance.

In Australia the calibration of liquefied petroleum gas (LPG) flowmetering instruments is performed by using the volumetric, gravimetric or the master flowmeter method. The selection of a particular method in each State or Territory was determined by the resources available and previously acquired experience. The National Standards Commission has adopted the volumetric method in a fixed installation whereas the various State and Territory Authorities have a variety of portable equipment including volumetric provers, master flowmeters and gravimetric provers.

2. NSC Testing Facility

The National Standards Commission (NSC) performs testing of liquefied petroleum gas (LPG) flowmeters using the volumetric method (Fig. 1). The testing facility

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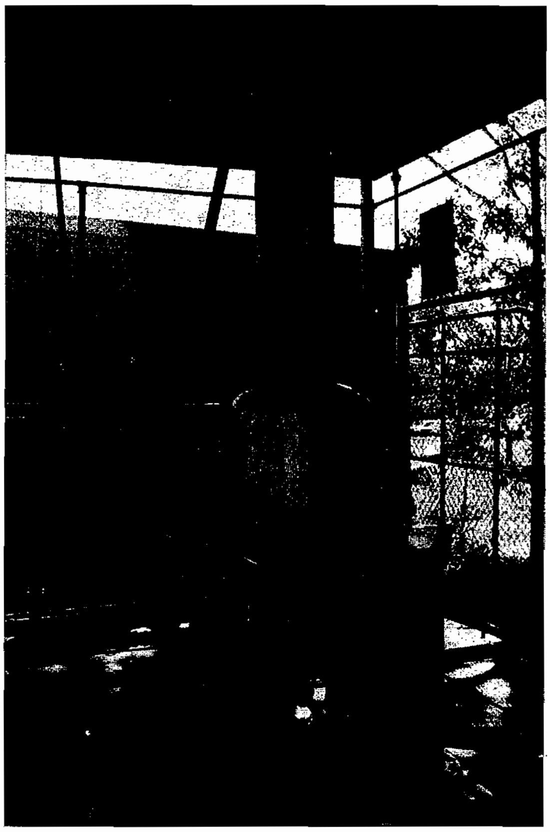
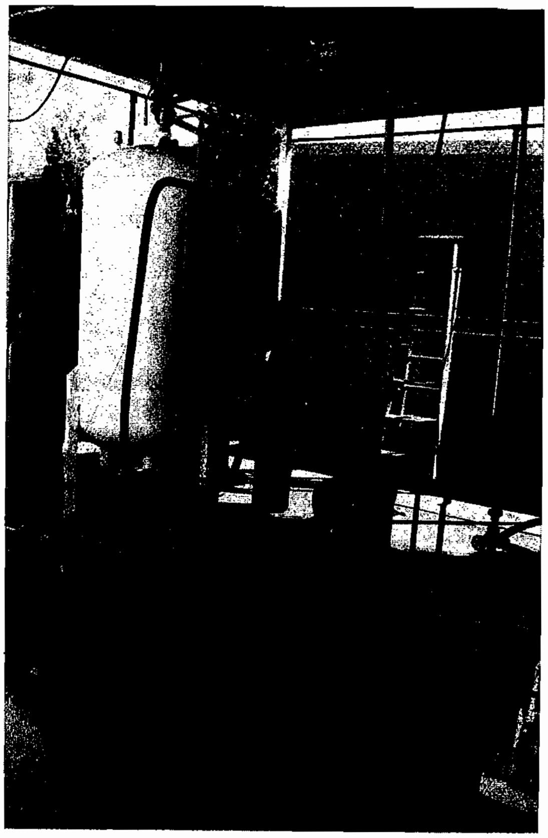
* Presented at the OIML seminar on Calibration of Liquid Volume Measuring Installations, Arles, France, 11-15 May 1987.





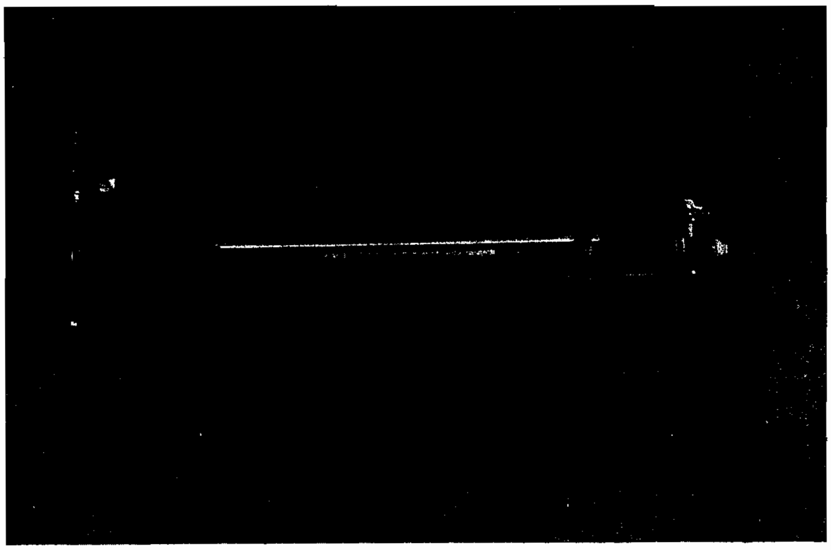


Figure 1 — NSC volumetric testing facility

is a fixed installation which comprises two supply tanks, a variable speed positive displacement pump, a 200 litre volumetric proving measure together with associated pipework and valves. A vapour return line connecting the volumetric prover and the supply tank is used during the proving test runs to maintain constant flowrate and equilibrium conditions.

Recent upgrading of the LPG testing facility included the installation of the second supply tank and the replacement of a fixed speed positive displacement pump with the variable speed pump. The former has enabled NSC to carry out testing of gas separators which are required on all LPG driveway flowmeters. The variable speed pump eliminates overheating problems of the liquid at low flow rates. Previously, the fixed speed pump controlled the low flow rate by by-passing the liquid back to the supply tank which caused non-equilibrium conditions to exist in the system. It is further proposed to upgrade the efficiency of the system by installing a second pump for the sole purpose of returning the LPG back to the supply tanks. At present the flowrate of a proving test run is set by the single pump and at low flow rate (15 L/min), pumping the LPG back to the supply tank through the same pump becomes a time consuming process.

An LPG flowmeter is tested by the Commission for linearity and repeatability over a 5:1 turndown in flowrate with the temperature compensator deactivated and then with the temperature compensator activated. The results are recorded on a standard test sheet shown in Appendix 1. Before commencing the 5 test runs at each flowrate, an initial run is carried out to establish the rate of flow through the meter and to wet the volumetric prover. After each 200 L delivery, valves are used to re-direct the flow and return the LPG in the prover back to the supply tank. The testing is completed by performing the gas separation test at maximum flowrate using the « empty compartment » technique. This is done by using valves to switch from the bulk supply tank to the small volume supply. When the tank is emptied the bulk supply is re-connected and the delivery is allowed to be completed into the 200 litre volumetric prover. The gas separation error is then the difference between the error obtained for the delivery with the supply tank running dry and the error for the delivery without introducing vapour ; the maximum permissible error for this difference is 0.5 %.

During the upgrading of the LPG testing facility, the volumetric prover was mounted on three load cells fixed to a tri-pod type stand to enable gravimetric testing to be performed for comparison against the volumetric method. The aim was to compare the results obtained volumetrically with the vapour return line open and gravimetrically with the vapour return line closed. Unfortunately the exercise was largely unsuccessful because the flow rate could not be maintained constant when the vapour return line was closed. Even using the « spray filling » technique to reduce the rate of pressure build-up, the shape of the volumetric prover restricts the effective spraying area and hence does not lend itself to be used with the vapour return line closed.

The NSC continues to test LPG driveway flowmeters using the volumetric proving method and has found the system a satisfactory method for determining the performance characteristics of LPG flowmeters provided simple precautions are taken to maintain temperature/pressure equilibrium between the prover and the supply tank thereby avoiding the possibility of changes in the liquid/vapour states.

3. Verification Methods

As distinct from pattern approval examinations performed by the NSC under controlled conditions, the problems associated with the verification of field installed LPG driveway flowmeters are quite evident as described in the following calibration methods presented.

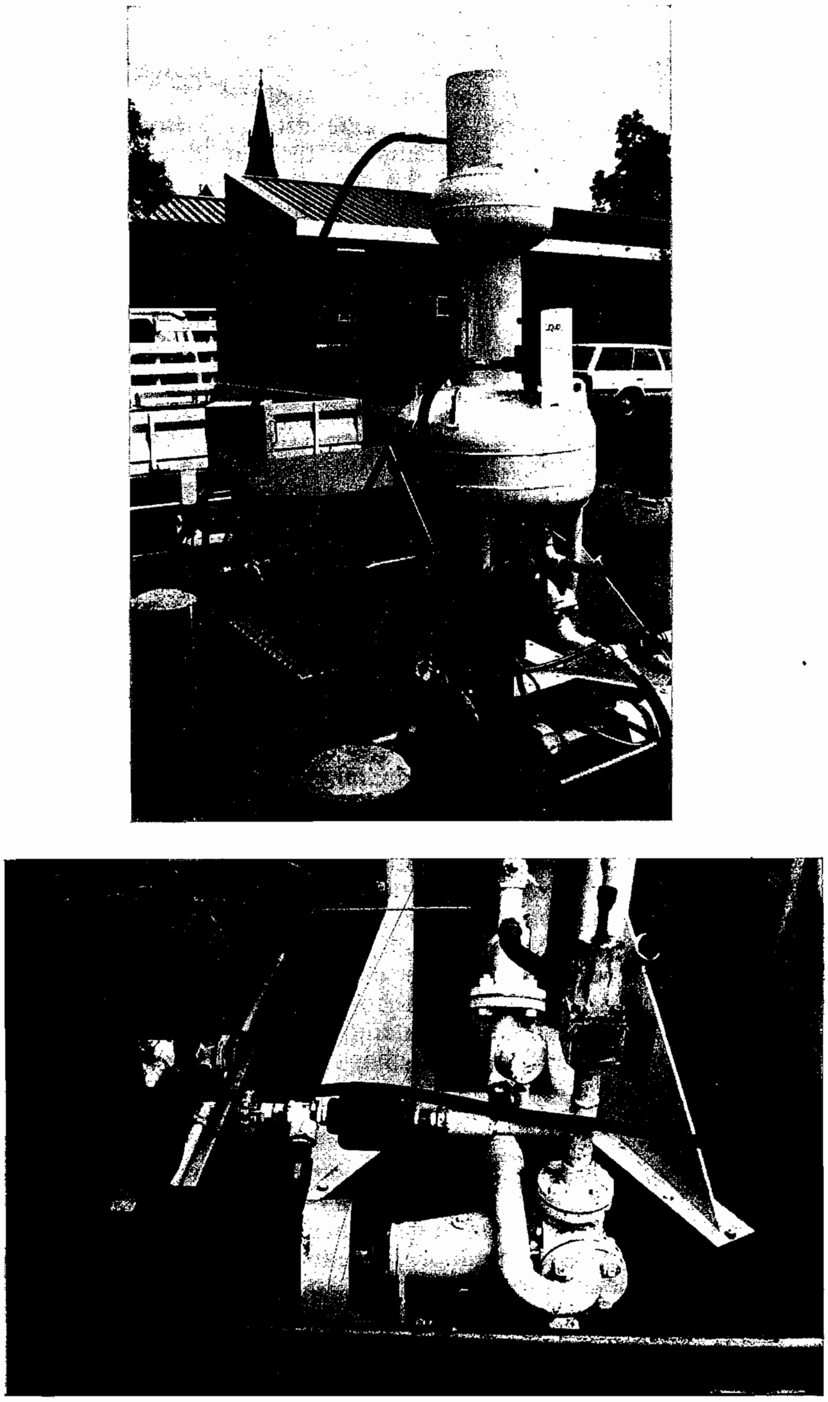


Figure 2 — Victorian State Weights & Measures Authority LPG volumetric proving system

Volumetric Method

A volumetric proving system used by one of the State Authorities for verification of LPG driveway flowmeters is similar to that used by the NSC except that the testing apparatus is mobile (Fig. 2). The system is mounted on a trailer and basically comprises a 200 litre volumetric prover with temperature and pressure sensors and a pump for returning the LPG from the prover back to the supply tank. The prover has a « spray-fill » inlet and because of inadequate provisions for the measurement of the vapour space parameters the prover is required to be used with the vapour return line connected to the vapour space of the supply tank.

Although the procedure for using the system is straight forward, it is the site installation conditions that dictate the ease of performing the calibration and as such, the experiences encountered with the volumetric proving system indicate that it is not a very successful method for verifying LPG driveway flowmeters in Australia. The most significant downfall experienced with the volumetric method is the long distances encountered between the driveway flowmeter and the supply tank, which can be up to 100 metres. This creates difficulties not only for pumping the prover volume back to the supply tank but also for maintaining equilibrium conditions between the prover and the supply tank via a long vapour return line.

The use of the volumetric method for calibrating LPG dispensers is further disadvantaged by :

— The fixed 200 litre test deliveries in conjunction with the abovementioned difficulties often results in a fewer number of test runs performed than recommended.

— Transportation problems associated with the volumetric prover mounted on a trailer.

— The need to level the prover at each test location.

— The time consuming computations to correct the volumetric reading to reference conditions.

The significance of the abovementioned factors has brought about a modification to the volumetric method of proving. On a trial basis a turbine flowmeter has been installed upstream of the prover inlet to allow three or four runs to be made before pumping the LPG back to the supply tank and the prover is then used only to check the calibration of the turbine flowmeter at regular intervals. The main advantage of this arrangement is that the signal from the turbine meter allows a series of electronic indicators to be used for displaying the volume delivered, the rate of flow and even a temperature compensated delivery. As mentioned in the master flowmeter section of this paper a similar concept has already been in use for some time now, the performance of which has been satisfactory.

Master Flowmeter Method

In Australia, prior to the recent introduction of turbine flowmeters, master flowmeters used for the calibration of LPG driveway flowmeters were typical positive displacement LPG meters manufactured to tighter tolerances than usual. The closed loop system with the master flowmeter connected between the driveway flowmeter and the supply tank, allows the volume delivered and the rate of flow to be controlled without having to re-arrange the system set-up and as such is considered to be a quick system of calibration with minimum inconvenience to both the examiner and the proprietor.

Although requiring some corrections for temperature and pressure, the indicator reading of a calibrated master flowmeter can be used directly to determine the initial meter factor of an LPG driveway, flowmeter. However, from a verification point of view, the State Weights and Measures Authorities are hesitant to use the master flowmeter method as the only source of calibrating LPG driveway flowmeters mainly because of the necessity to regularly check the calibration of the master flowmeter. Furthermore to maintain the integrity of the master flowmeter a rather more expensive primary standard or some other traceable system is required. Without such facilities the master flowmeter would need to be sent somewhere to be checked and with

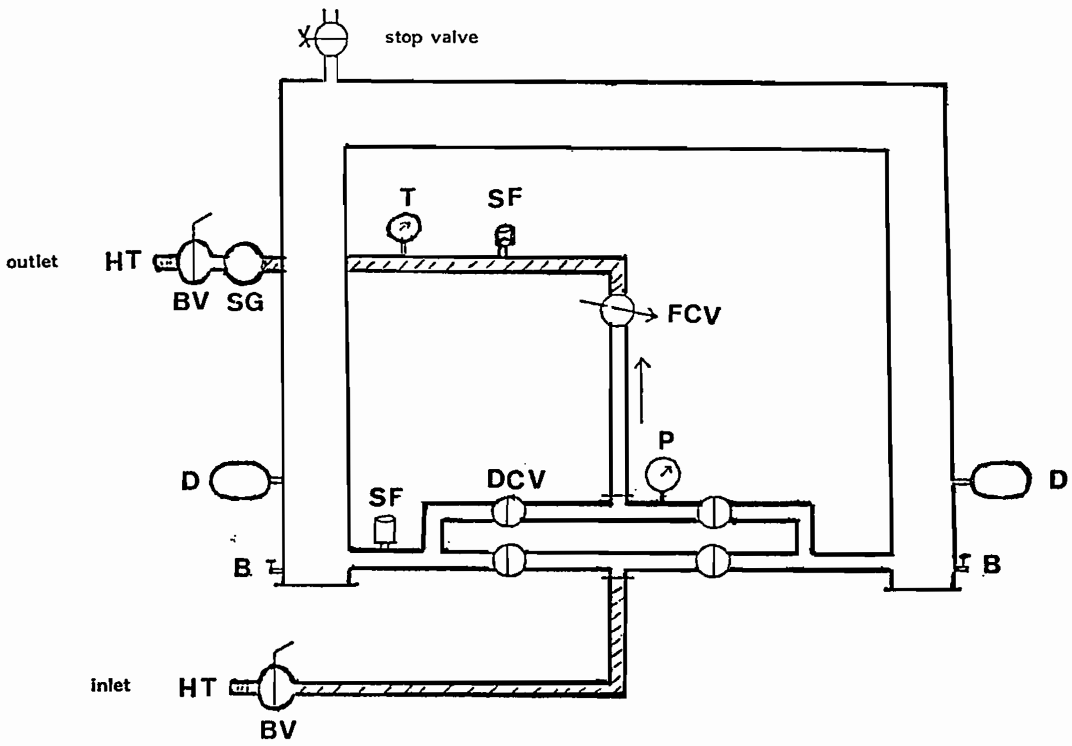


Figure 3 — Schematic Diagram of the South Australian Loop Prover Unit

BV	— Ball Valves	B	— Bleed Valves
HT	— Hose Thread Connections	DCV	— Direction Changing Valves
SG	— Sight Glass	D	— Detectors
FCV	— Flow Control Valve	SF	— Safety Valves
P	— Pressure Gauge	T	— Temperature Gauge

the lack of testing facilities, long time delays are inevitable. To overcome this situation and provide a continual calibration service, the common practice is to have a second master flowmeter as back-up.

The recent introduction of turbine flowmeters in trade applications has influenced some verifying authorities to upgrade their existing facility by using the turbine flowmeter as an auxillary calibrating method. The ease of using a turbine flowmeter for verifying LPG driveway flowmeters has not only improved the efficiency of verification but also provides an economical way of increasing the number of test units as the need arises. This has been proven feasible by one of the State Weights and Measures Authorities who have installed a 1" (25.4 mm) turbine meter in series with their bi-directional loop prover (refer to figures 3 and 4). The prover is basically a loop of stainless steel pipe mounted on a trailer. Inside the pipe is a elastomer sphere which travels with the flow and triggers the mechanically operated switches located at each end of the loop. The total bi-directional volume of the loop prover is 245.06 litres and was determined by using the water draw calibration method. The turbine flowmeter was used in series with the loop prover until confidence in the results has enabled the method to be used on its own. The entire turbine master flowmeter system (refer to figures 5 and 6) is mounted on a trailer together with fittings for connecting the nozzle of a driveway flowmeter directly to the inlet of the system and the outlet, in the form of a nozzle at the end of a hose reel, is used to reach the supply tank and complete the closed loop system. The turbine meter is installed with flow straighteners upstream and downstream of the meter and provisions are made for the measurement of temperature and pressure. In addition, connections are provided for the interfacing of the loop prover to check the

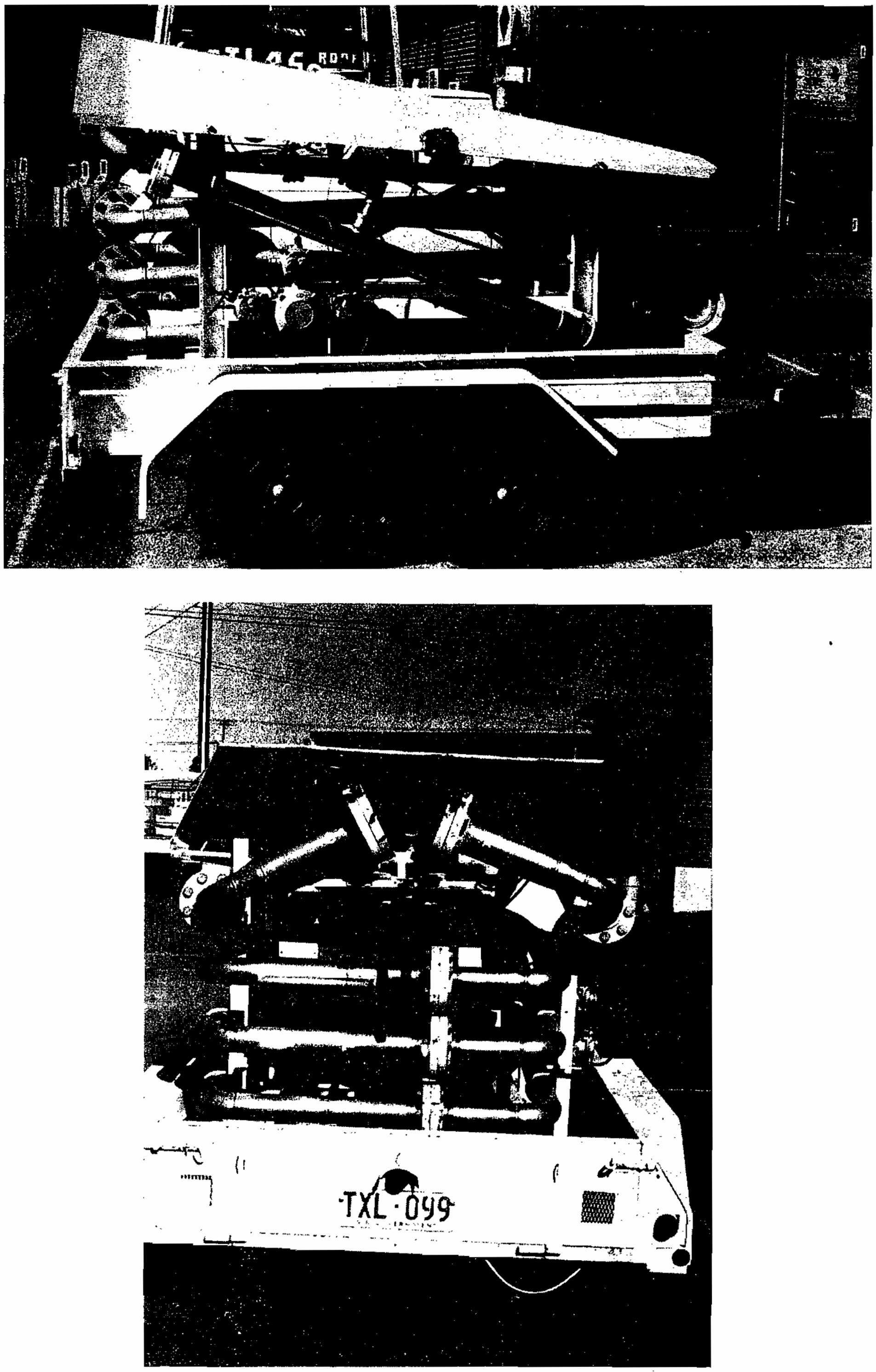


Figure 4 — South Australian Weights & Measures LPG Loop Prover

calibration factor of the turbine flowmeter which is carried out three to four times a year.

Further improvements are planned with respect to the calibration of the turbine master meter, by purchasing a supply tank and a pump for the loop prover to provide a fixed self-sufficient turbine master flowmeter calibrating facility. Overall, the master flowmeter method in conjunction with the facility to check its calibration is found by the verification Authorities as not only a versatile and portable system for calibrating LPG driveway flowmeters but also extends itself to high flowrate applications (220 L/min) such as vehicle mounted bulk delivery LPG flowmetering systems.

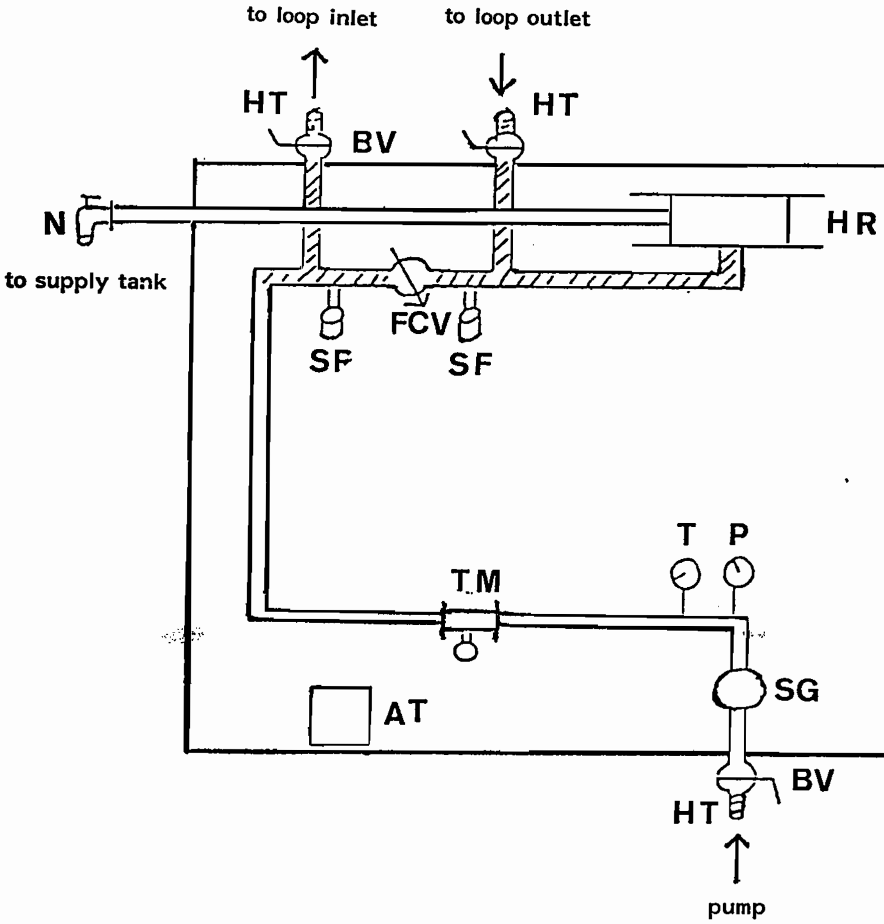


Figure 5 — Schematic Diagram of the South Australian LPG Master Meter Unit

BV	— Ball Valve		
HT	— Hose Thread Connection	N	— Nozzle
T	— Temperature Gauge	FCV	— Flow Control Unit
TM	— Turbine Meter	SF	— Safety Valves
AT	— Acme Totaliser	SG	— Sight Glass
HR	— Hose Reel	P	— Pressure Gauge

Gravimetric Method

The gravimetric method is used by manufacturers and two State Authorities for the calibration of LPG driveway flowmeters (Fig. 7). The main reasons for selecting this method are :

— its simplicity, and

— its operation which is similar to filling an LPG car tank.

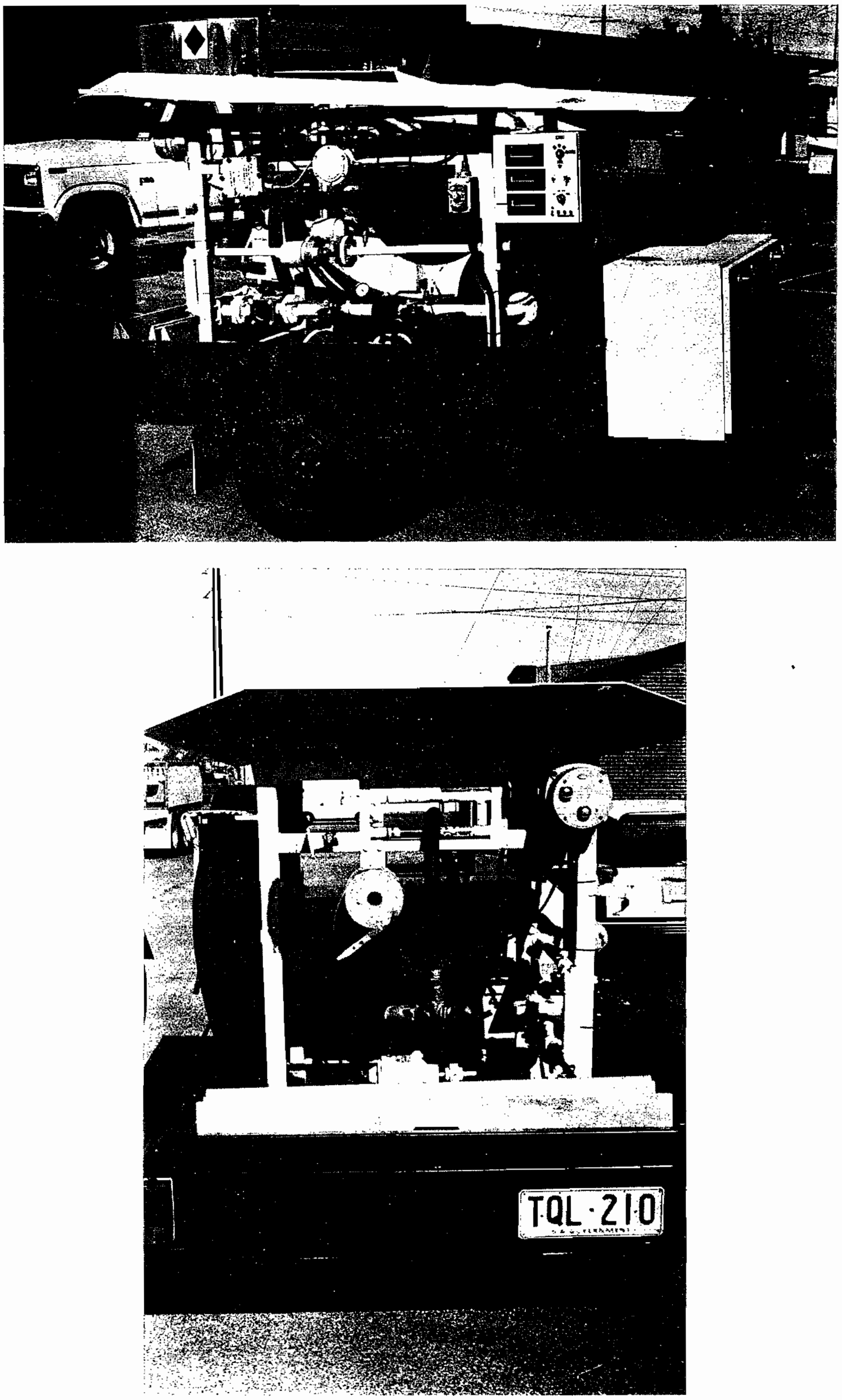


Figure 6 — South Australian Weight & Measures Authority Master Meter Unit

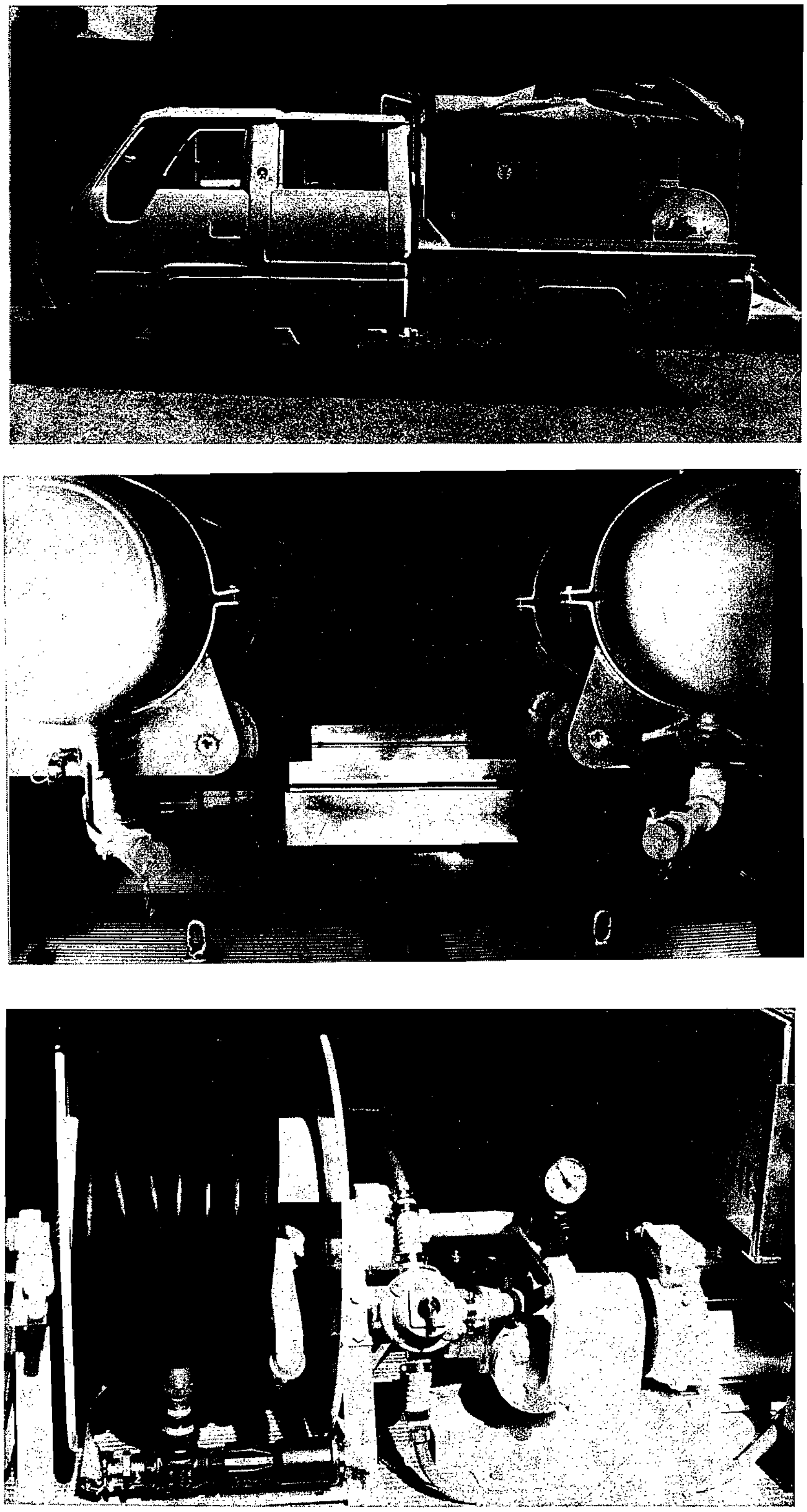


Figure 7 — New South Wales Weights & Measures gravimetric proving system

Equipment as used by the State Authorities is fitted on a trailer or a vehicle and comprises two LPG vehicle tanks, a hose reel and a pump for returning the LPG back to the supply tank, a weighing platform with a remote electronic indicator and provision for leveling the weighing platform. Each tank has a capacity of approximately 75 litres and is fitted on a trolley which enables the tank to be rolled onto the weighing platform. The inlet of the LPG tank is such that the nozzle of an LPG driveway flowmeter can be directly connected and allow spray filling into the tanks. Also the LPG tank has an outlet to which the hose is connected for returning the product back to the supply tank. In addition to the system, the following are required :

— a hydrometer for determining the density of LPG,

— a thermometer for measuring the temperature of the product, and

— weights of known mass for checking the weighing instrument.

The principle of operation of the gravimetric method involves the filling of the fixed capacity LPG tank, weighing it and determining the density of LPG at reference conditions. The delivered volume is then obtained by calculation and may be compared with the compensated indicator of the LPG driveway flowmeter. When the two LPG tanks are filled, the LPG is returned to the supply tank usually by tapping into the vapour return line at the driveway flowmeter. The consequences of the latter have not yet been assessed. Although the weighing instrument is selected to give negligible error, the main limitation of the gravimetric method is the inability to readily measure the density of LPG with high degree of accuracy. In Australia the density of LPG can be anything from 0.500 kg/L to 0.540 kg/L depending on the butane/propane ratio and therefore it is necessary to determine the actual density at each site location. With the available instruments, a reading error of one scale interval on the hydrometer introduces an error of 0.2 % in the calculated volume. This error is further increased by systematic errors due to

— the discrepency between using the volume reduction tables and the density reduction tables, and

— the assumption that the value of specific gravity as indicated by the hydrometer is the same as the value of density.

An example of this is given in Appendix 2.

Although the gravimetric method has its share of limitations, it is nevertheless considered as the most practical way of calibrating LPG driveway flowmeters not only because the testing procedure is performed in the same manner as filling the LPG tank of a vehicle, but also because the calibration and traceability of the equipment is simple and direct with minimum requirements for performing on site calculations.

Conclusion

As presented in this paper, there are several verification methods used throughout Australia. Given the difficult nature of LPG, the calibration of LPG driveway flowmeters is performed by each State or Territory Weights and Measures Authority using the most practical and available proving method suited to their needs and financial resources. However there is a need to compare the different methods used by the verifying Authorities with the volumetric testing facility used by the National Standards Commission. So far a preliminary comparison between one State Authority's gravimetric equipment and the Commission's volumetric equipment has been made and indicates substantial agreement.

Acknowledgement

In concluding this paper I wish to thank the NSC staff involved with the LPG testing facility in particularly Mr J. Bonnici and Mr I. Hoerlein, as well as the staff of industries and State Weights and Measures Authorities for their co-operation and contributions to this paper.

CALIBRATION REPORT

LPG DRIVEWAY FLOWMETER USING A VOLUMETRIC PROVER

Volumetric Prover (VP)
Make :
Serial No :
Volume at Reference Conditions :
Calibration Certificate Date :
  Calibrated by :
  Certificate No :
Drain Time :
Material of Construction :
Owner :

DFM under Test (DFM)
Make & Type :
Serial No :
NSC No :
Flow Rate Range :
Indicator Units :
Totaliser Reading :
Owner :
Location :

Liquid
Type :
Viscosity :
Density (at 15 °C) :
Test Conditions
Storage Tank Pressure :
Storage Tank Temperature :
Ambient Temperature :

Units
Volume : Litres
Temperature : °C
Pressure : kPa
Flow Rate : L/min
Reference Temperature : 15 °C
Reference Pressure = Atmospheric : 101.3 kPa
Density : kg/L

Description	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
1. Flow Rate						
2. VP Volume Reading						
3. VP Temperature						
4. VP Pressure						
5. Cts (VP) (Table)						
6. Ctl (VP) (Table)						
7. Cps (VP) (Table)						
8. Cpl (VP) (Table)						
9. VP Volume Corrected (2 × 5 × 6 × 7 × 8)						
10. DFM Volume Reading (compensated or uncompensated)						
11. DFM Temperature (1/3 delivery)						
12. DFM Temperature (2/3 delivery)						
13. DFM Average Temperature						
14. DFM Pressure						
15. Ctl (DFM) (Table 54)						
16. Cpl (DFM) (Table)						
17. Uncompensated DFM Volume Corrected (10 × 15 × 16)						
18. Uncompensated DFM Error % $\left(\frac{9 - 17}{9}\right) 100$						
19. Compensated DFM Volume Corrected (10 × 16)						
20. Compensated DFM Error % $\left(\frac{9 - 19}{9}\right) 100$						
21. Compensator Error % (20 — 18)						

Notes : (a) Temperature and Pressure readings are average, corrected values of observed readings.
Average Uncompensated Meter Error .... % at .. L/min
Repeatability (Max — Av) Error .... %
Average Compensated Meter Error ...... % at .. L/min
Repeatability (Max — Av) Error .... %

Signed .... Date ....

Checked .... Date ....

SYSTEMATIC ERRORS IN GRAVIMETRIC METHOD

EXAMPLE 1

Given that the density of LPG at 15 °C = 0.518 kg/L, and for a typical test run,

— the driveway flowmeter indication = 59.00 L (uncompensated)

— the corresponding weighed LPG delivered = 30.00 kg

— the observed temperature of LPG = 20 °C

Method (a)

From the ASTM-IP volume reduction table 54, a reduction factor of 0.986 is obtained and used to correct the uncompensated indicator of the driveway flowmeter to 15 °C and the result is compared with the volume obtained gravimetrically, that is :

59.00*0.986 = 58.174 L, and

30.00/0.518 = 57.915 L

this gives an error of — 0.45 %, whereas

Method (b)

Using the density reduction table 53, the density of 0.518 kg/L at 15 °C becomes an equivalent value of 0.510 kg/L at 20 °C which is used to divide into the value of mass and is then compared directly with the driveway flowmeter indicator as follows :

30.0/0.510 = 58.82 L and driveway flowmeter indication = 59.00 L

this gives an error of — 0.30 %

Hence the difference between Method (a) and Method (b) introduces an error of 0.15 %.

Although there is no documentation stating which method should be used, the verifying Authorities use Method (b), simply because only table 53 is required to perform all necessary calculations.

EXAMPLE 2

It is common practice to assume the value of specific gravity to be the same as density because ;

— the difference between specific gravity and density is considered to be negligible, and

— converting the specific gravity, as indicated by the hydrometer, involves using additional tables.

The error introduced due to this assumption is obtained as follows :

Given that the specific gravity as indicated by the hydrometer is 0.500 at 77 °F (25 °C)

Using the ASTM-IP table 23, the equivalent specific gravity at 60/60 °F gives a value of 0.514.

Now using table 21 to convert the 0.514 specific gravity at 60/60 °F to density at 15 °C, gives a value of 0.5143 kg/L.

However if the specific gravity of 0.500 is assumed to be the density and directly using the metric addition of the ASTM-IP table 53, the value of 0.500 at 25 °C gives a corresponding value of 0.515 density at 15 °C.

Hence the difference between 0.5143 and 0.515 gives an error of 0.14 %.

TRAVAUX de l'OIML — WORK of OIML

1987-1988

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

Dans cette liste ne sont pas inclus les sujets dont les travaux ont donné lieu à des publications définitives parues avant 1987.

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

This list does not include work which has been subject to final publication before 1987.

LEGENDES

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

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publi-cation *Status*	Etat de préparation *Stage of preparation* 1987	 1988
SP 1	TERMINOLOGIE *TERMINOLOGY*			
Sr 1	Vocabulaire de métrologie légale (revision) *Vocabulary of legal metrology*		Vote CIML	Publication
Sr 2, Sr 3	Conformité terminologique *Conformity of terminology*		Activité permanente	
SP 2	METROLOGIE LEGALE, GENERALITES *LEGAL METROLOGY, GENERAL*			
Sr 2	Unités de mesure légales (revision DI 2) *Legal units of measurement*	DI	Préparation	1 AP
Sr 5	Utilisation des méthodes statistiques de vérification *Application of statistics in verification procedures*	DI	1 AP	2 AP
Sr 6	Exigences générales pour les instruments électroniques (révision DI 11) *General requirements for electronic instruments*	DI	Préparation	1 AP
SP 4	MESURES DE LONGUEURS, SURFACES, ANGLES *MEASUREMENT OF LENGTH, AREA, ANGLE*			
Sr 1	Mesures à traits de haute précision *High precision line measures of length*	RI	P	P
	Calibres à bouts plans (revision RI 30) *End measures of length*	RI	2 AP	P
Sr 4	Schéma de hiérarchie, mesures de longueur *Hierarchy scheme for length measuring instruments*	DI	4 AP	P
Sr 5	Schéma de hiérarchie, mesures d'angle *Hierarchy scheme for angle measuring instruments*	DI	3 AP	P
	Méthodes de reproduction d'unités d'angle plan *Methods of reproduction of plane angle units*	DI	Etude SP	Etude SP
Sr 6	Appareils de mesure de la superficie des peaux *Instruments measuring the area of hides*	RI	2 AP	3 AP
Sr 7	Terminologie utilisée en métrologie dimensionnelle *Terminology used in dimensional metrology*	DI	4 AP	P
SP 5S	MESURE STATIQUE DES QUANTITES DE LIQUIDES *STATIC MEASUREMENT OF QUANTITIES OF LIQUIDS*			
Sr 2	Schémas de hiérarchie *Hierarchy schemes*	DI	4 AP	P
Sr 3	Pipettes automatiques en verre *Glass delivery measures (Automatic pipettes)*	RI	P	Etude SP

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publi-cation *Status*	Etat de préparation *Stage of preparation* 1987	1988
SP 5S	MESURE STATIQUE DES QUANTITES DE LIQUIDES (suite)			
Sr 4	Seringues hypodermiques stériles, non réutilisables *Sterile hypodermic syringes for single use*	RI	Préparation	3 AP
	Seringues pour insuline, non réutilisables *Insuline syringes for single use*	RI	Préparation	
	Seringues médicales (revision RI 26) *Medical syringes*	RI	3 AP	
Sr 5	Bouteilles récipients-mesures *Measuring container bottles*	RI	P	Vote CIML
Sr 7	Tonneaux et futailles (revision RI 45) *Casks and barrels*	RI		1 AP
Sr 9	Camions et wagons citernes *Road and rail tankers*	RI	Vote CIML	Conférence
Sr 10	Citernes de bateaux *Ship tanks*	RI	P	Vote CIML
Sr 11	Mesure automatique des niveaux de liquides *Automatic measurement of the level of liquid in tanks*	RI	Vote CIML	Conférence
Sr 12	Mesurage statique de masses de liquides *Static direct mass measurement of liquids*	RI		1 AP
SP 5D	MESURE DYNAMIQUE DES QUANTITES DE LIQUIDES *DYNAMIC MEASUREMENT OF QUANTITIES OF LIQUIDS*			
Sr 1	Ensembles de mesure - Dispositions particulières *Measuring assemblies - Special provisions*	RI		Conférence
	Ensembles de mesure installés sur oléoduc *Measuring assemblies in pipelines*	RI	Préparation	3 AP
	Compteurs turbines *Turbine meters*	RI	Préparation	3 AP
	Compteurs routiers de GPL *LPG dispensers*	RI	Préparation	1 AP
Sr 2	Compteurs cryogéniques *Meters for cryogenic liquids*	RI	CIML	Conférence
Sr 3	Compteurs d'eau froide (revision RI 49) *Cold water meters*	RI	1 AP	Etude Sr
	Vérification par échantillonnage des compteurs d'eau *Statistical testing of water meters*	DI	Préparation	Préparation
Sr 4	Compteurs à tambour pour alcool *Drum meters for alcohol*	RI		Conférence

Note: in the 1988 column, "3 AP" is printed once with a brace covering the three Sr 4 rows (Seringues hypodermiques, Seringues pour insuline, Seringues médicales).

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation* 1987	1988
SP 5D	MESURE DYNAMIQUE DES QUANTITES DE LIQUIDES (suite)			
Sr 6	Dispositifs électroniques des ensembles de mesure de liquides *Electronic devices in measuring assemblies for liquids*	RI	2 AP	3 AP
Sr 7	Etalons de volume utilisés pour la vérification des ensembles de mesure *Standard volume measures used for verification of measuring assemblies*	RI		P
	Tubes étalons utilisés pour la vérification des ensembles de mesure *Pipe provers used for verification of measuring assemblies*	RI	Préparation	2 AP
	Méthodes d'essai de compteurs routiers de carburant liquide *Testing procedures for liquid fuel dispensers*	DI	Préparation	1 AP
Sr 8	Compteurs électromagnétiques *Electromagnetic meters*	RI	Préparation	1 AP
Sr 9	Compteurs vortex *Vortex meters*	RI	Préparation	1 AP
Sr 10	Compteurs massiques *Direct mass-flow measuring instruments*	RI		1 AP
SP 6	MESURE DES GAZ *MEASUREMENT OF GAS*			
Sr 1	Prescriptions générales pour compteurs de volume de gaz (revision RI 6) *General prescriptions for gas volume meters*	RI	4 AP, P	Vote CIML, Conférence
	Compteurs de gaz à parois déformables *Diaphragm gas meters* (revision RI 31)	RI	4 AP, P	Vote CIML, Conférence
Sr 2	Compteurs de gaz à pistons rotatifs et à turbine (revision RI 32) *Rotary piston gas meters and turbine gas meters*	RI	3 AP, P	Vote CIML, Conférence
Sr 4	Mesure des hydrocarbures gazeux distribués par pipeline *Measurement of hydrocarbon gases distributed by pipeline*	DI	Préparation	2 AP
Sr 5	Etalonnage des compteurs à l'aide de tuyères à col sonique *Calibration of gas meters by critical flow Venturi nozzles*	DI		1 AP
Sr 9	Correcteurs de volume de gaz *Correctors of gas volumes*	RI	Préparation	1 AP
Sr 11	Calculateurs incorporés dans des ensembles de mesure de gaz *Calculators incorporated in gas measuring systems*	RI		1 AP
Sr 12	Utilisation des gaz de calibrage calorimétriques *Use of calorimetric calibration gases*	RI	Préparation	2 AP

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publi-cation *Status*	Etat de préparation *Stage of preparation* 1987	1988
SP 7	MESURE DES MASSES *MEASUREMENT OF MASS*			
Sr 2	Instruments de pesage électroniques (RI 74) *Electronic weighing instruments*	RI		Conférence
Sr 3	Instruments de pesage pour étalonnage et vérification *Weighing instruments used for calibration and verification*	DI		1 AP
Sr 4	Instruments de pesage non automatiques (révision RI 3 et RI 28) *Non-automatic weighing instruments (revision RI 3 and RI 28)*	RI	2 AP, P	Vote CIML, Conférence
Sr 5	Instruments de pesage totalisateurs continus (revision RI 50) *Continuous totalising weighing machines*	RI	1 AP	2 AP
	Instruments de pesage totalisateurs discontinus *Discontinuous totalising weighing machines*	RI	4 AP	P
	Ponts-bascules ferroviaires à fonctionnement automatique *Automatic rail-weighbridges*	RI	3 AP, 4 AP	P
Sr 7	Contrôle en service des instruments de pesage *In-service control procedures of weighing instruments*	DI		1 AP
Sr 8	Réglementation métrologique des cellules de pesée (revision RI 60) *Metrological regulations for load cells*	RI		1 AP
SP 8	POIDS *WEIGHTS*			
Sr 1	Spécifications métrologiques pour les poids (compilation) *Metrological specifications for weights (collation)*	DI	Préparation	1 AP
Sr 2	Vérification des poids *Verification of weights*	DI		1 AP
SP 9	MESURE DE MASSES VOLUMIQUES *MEASUREMENT OF DENSITY*			
Sr 3	Aréomètres pour usages spécifiques *Hydrometers for specific uses*	RI	Etude SP	P
Sr 9	Terminologie *Terminology*	DI	2 AP	P

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publi-cation *Status*	Etat de préparation *Stage of preparation* 1987	1988
SP 10	INSTRUMENTS DE MESURE POUR VEHICULES *MEASURING INSTRUMENTS FOR VEHICLES*			
Sr 1	Cinémomètres radar pour trafic routier *Radar speed control meters*	RI	P	Vote CIML, Conférence
Sr 2	Instruments de mesure de vitesse et distance dans les véhicules (revision RI 55) *Speed and distance measuring instruments for vehicles*	RI	Enquête	1 AP
Sr 3	Taximètres (revision RI 21, extension aux taximètres électroniques) *Taximeters*	RI	Préparation	2 P
SP 11	MESURE DES PRESSIONS *MEASUREMENT OF PRESSURE*			
	Terminologie *Terminology*	DI	Préparation	1 AP
Sr 2	Schémas de hiérarchie *Hierarchy schemes*	DI		3 AP
Sr 3	Manomètres à piston *Pressure balances*	RI	Etude SP	Etude SP
Sr 4	Méthodes de vérification de manomètres indicateurs *Verification methods for indicating pressure gauges*	RI	Vote CIML	Conférence
	Méthodes de vérification de manomètres enregistreurs *Verification methods for recording pressure gauges*	RI	Vote CIML	Conférence
	Manomètres de référence à éléments élastiques *Reference manometers with elastic sensors*	RI	2 AP	3 AP
	Révision des RI 17 et RI 19 *Revision of RI 17 and RI 19*	RI	P	Etude SP
Sr 5	Manomètres pour la pression artérielle (revision RI 16) *Manometers for instruments measuring blood pressure*	RI	1 AP	2 AP
Sr 7	Baromètres *Barometers*	RI	P	Vote CIML
SP 12	MESURE DES TEMPERATURES ET DE L'ENERGIE CALORIFIQUE *MEASUREMENT OF TEMPERATURE AND HEAT*			
Sr 3	Thermomètres électriques à résistance métallique *Metallic electrical resistance thermometers*	RI		Conférence
	Thermomètres à résistance métallique à étendue de mesure accrue *Metallic electrical resistance thermometers with extended range*	RI	1 AP	2 AP

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation* 1987	 1988
SP 12	MESURE DES TEMPERATURES (suite)			
Sr 5	Thermocouples, tables de f.e.m. et tolérances *Thermocouples, tables of EMF and tolerances*	RI	Préparation	2 AP
Sr 6	Pyromètres optiques à filament disparaissant (révision RI 18) *Optical pyrometers - Disappearing filament type*	RI		Conférence
	Pyromètres à radiation totale *Total radiation pyrometers*	RI	1 P	2 P
	Classification des pyromètres à radiation *Classification of radiation pyrometers*	DI	1 P	2 P
	Lampes à ruban de tungstène pour l'étalonnage de pyromètres optiques (revision RI 48) *Tungsten ribbon lamps for calibration of optical pyrometers*	RI	Enquête	1 AP
Sr 7	Thermomètres électriques médicaux à maximum *Clinical electrical thermometers with maximum device*	RI	2 AP	P
	Thermomètres électriques médicaux pour mesures continues *Clinical electrical thermometers for continuous measurement*	RI	4 AP	P
Sr 8	Compteurs d'énergie thermique (RI 75) *Heat meters*	RI		Conférence
Sr 9	Méthodes de vérification des thermocouples étalons *Methods for verification of reference and ordinary thermocouples*	RI	2 P	Etude SP
SP 13	MESURES ELECTRIQUES ET MAGNETIQUES *MEASUREMENT OF ELECTRICAL AND MAGNETIC QUANTITIES*			
Sr 5	Instruments de mesure de courant, tension et fréquence *Indicating measuring instruments for current, voltage and frequency*	RI	P	Etude SP
SP 14	ACOUSTIQUE ET VIBRATIONS *ACOUSTICS AND VIBRATION*			
Sr 1	Sonomètres intégrateurs *Integrating sound level meters*	RI	Vote CIML	Conférence
	Etalonneurs acoustiques *Sound calibrators*	RI	Préparation	1 AP
Sr 2	Audiomètres à son pur *Pure tone audiometers*	RI	Préparation	1 AP
Sr 3	Instruments de mesure de vibrations *Measuring instruments for response to vibration*	RI		1 AP

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation*	
			1987	1988
SP 15	OPTIQUE *OPTICS*			
Sr 1	Dioptrimètres *Focimeters*	RI	P	Vote CIML
Sr 2	Illuminancemètres *Illuminancemeters*	RI	Préparation	1 AP
SP 16	*RAYONNEMENTS IONISANTS* *IONIZING RADIATION*			
Sr 2	Laboratoires secondaires d'étalonnage en dosimétrie *Secondary standard dosimetry laboratories for the calibration of dosemeters*	DI	P	Vote CIML
SP 17	MESURE DES POLLUTIONS *MEASUREMENT OF POLLUTION*			
Sr 1	Instruments de mesure des gaz d'échappement *Exhaust emission measuring instruments*	RI	4 AP, P	Vote CIML
Sr 2	Chromatographes à spectromètre de masse pour l'analyse des polluants de l'eau *Gas chromatograph-mass spectrometer for analysis of organic pollutants in water*	RI		Conférence
	Spectrophotomètres à absorption atomique pour la mesure des polluants métalliques dans l'eau *Atomic absorption spectrophotometers for measuring metal pollutants in water*	RI	2 AP	P
Sr 4	Chromatographes pour l'analyse de la pollution due aux pesticides et substances toxiques *Gas chromatographs for measuring pesticides and toxic substances pollution*	RI		Conférence
	Chromatographes à phase liquide de hautes performances pour la mesure de pesticides et autres substances toxiques *High performance liquid chromatographs for measuring pesticide and toxic substances pollution (HPLC)*	RI	2 AP	3 AP
Sr 5	Instruments portables pour la mesure des polluants de l'air provenant des déchets dangereux *Portable instruments for assessing airborne pollutants arising from hazardous wastes*	DI	2 AP	P
SP 18	MESURE DES CARACTERISTIQUES DES PRODUITS ALIMENTAIRES *MEASUREMENT OF CHARACTERISTICS OF FOOD PRODUCTS*			
Sr 3	Saccharimètres polarimétriques (revision RI 14) *Polarimetric saccharimeters*	RI	1 AP	P
Sr 6	Réfractomètres automatiques pour la mesure de la teneur en sucre des moûts de raisin *Automatic refractometers for the measurement of the sugar content of grape musts*	RI	1 AP	2 AP
Sr 7	Réfractomètres pour la mesure de la teneur en sucre des jus de fruits *Refractometers for measuring the sugar content of fruit juices*	RI	P	Etude SP

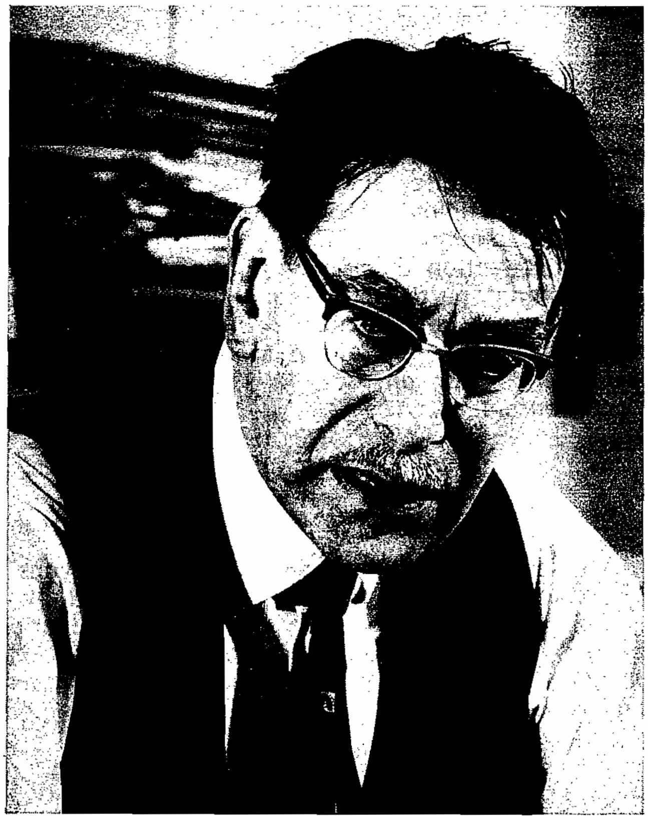
Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation* 1987	 1988
SP 19	MESURE DES CARACTERISTIQUES DES MATERIAUX *MEASUREMENT OF CHARACTERISTICS OF MATERIALS*			
Sr 3	Dureté (blocs de référence et machines d'essai) *Hardness (reference blocks and testing machines) (revision RI 9, 10, 37, 38)*	RI	Préparation	Enquête
Sr 4	Intercomparaison des étalons de dureté *Intercomparison of hardness standards*		Préparation	3e étape
Sr 6	Vocabulaire de dureté *Hardness testing dictionary*	DI	Vote CIML	Publication
SP 20	PRODUITS PREEMBALLES *PREPACKAGED PRODUCTS*			
Sr 1	Contenu informatif de l'étiquetage *Information on package labels*	RI	Vote CIML	Conférence
Sr 2	Vérification des quantités contenues dans les emballages *Verification of net contents in packages*	RI	P	Vote CIML, Conférence
SP 21	NORMALISATION DES CARACTERISTIQUES METROLOGIQUES DES INSTRUMENTS DE MESURE *METROLOGICAL CHARACTERISTICS OF MEASURING INSTRUMENTS*			
Sr 1	Caractéristiques métrologiques générales à normaliser *General metrological characteristics subject to standardization*	DI		Publication envisagée
	Caractéristiques à normaliser pour un modèle déterminé d'instrument de mesure *Metrological characteristics to be standardized for a particular pattern of measuring instruments*	DI	P	Etude SP
Sr 2	Caractéristiques métrologiques des propriétés dynamiques à normaliser *Metrological characteristics of dynamic properties subject to standardization*	DI		Publication envisagée
	Principes de détermination expérimentale des caractéristiques dynamiques des instruments de mesure linéaires *Principles of experimental determination of dynamic characteristics of linear measuring instruments*	DI	P	Etude SP
Sr 4	Principes de spécification des caractéristiques métrologiques des systèmes de mesure *Principles of specifying the metrological characteristics of measuring systems*	DI	Vote CIML	Publication envisagée

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation*	
			1987	1988
SP 21	CARACTERISTIQUES METROLOGIQUES (suite)			
Sr 5	Exigences pour les méthodes de contrôle des caractéristiques métrologiques des instruments de mesure *Requirements for the methods of control of metrological characteristics of measuring instruments*	DI	P	Etude SP
Sr 6	Détermination expérimentale des caractéristiques métrologiques des voies de mesure des systèmes *Experimental determination of metrological characteristics of measuring channels of systems*	DI	P	Vote CIML
	Certification métrologique des systèmes de mesure *Metrological certification of measuring systems*	DI	Préparation	1 AP
SP 22	PRINCIPES DU CONTROLE METROLOGIQUE *PRINCIPLES OF METROLOGICAL CONTROL*			
Sr 3	Evaluation de modèle et approbation de modèle *Pattern evaluation and approval*	DI	Vote CIML	
Sr 4	Vérification primitive et ultérieure *Initial and subsequent verification*	DI	Vote CIML	
Sr 5	Expertise métrologique *Metrological expertise*	DI	Préparation	2 AP
SP 23	METHODES ET MOYENS D'ATTESTATION DES DISPOSITIFS DE VERIFICATION *METHODS AND MEANS USED FOR CERTIFICATION OF VERIFICATION DEVICES*			
Sr 1	Principes du choix et de l'expression des caractéristiques métrologiques des étalons *Principles for the selection and expression of metrological characteristics of measurement standards*	DI	Préparation	1 AP
Sr 4	Principes du contrôle métrologique des dispositifs de vérification *Principles for metrological control of devices used for verification*	DI	1 P	Etude SP, Vote CIML
SP 26	INSTRUMENTS DE MESURE UTILISES DANS LE DOMAINE DE LA SANTE *MEASURING INSTRUMENTS USED IN THE FIELD OF HEALTH*			
Sr 3	Tubes Westergren pour la mesure de la vitesse de sédimentation du sang *Westergren tubes for the measurement of erythrocyte sedimentation rate*	RI		Conférence

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation* 1987	 1988
SP 26	INSTRUMENTS DE MESURE UTILISES DANS LE DOMAINE DE LA SANTE (suite)			
Sr 4	Electroencéphalographes *Electroencephalographs*	RI	Vote CIML	Conférence
	Electrocardiographes (ECG) *Electrocardiographs*	RI	Vote CIML	Conférence
	Electrocardioscopes (Appendice 1 à ECG)	RI	2 AP	3 AP
	Electrocardioscopes et électrocardiographes numériques (Appendice 2 à ECG) *Digital electrocardioscopes and electrocardiographs*	RI	2 AP	3 AP
	Représentation des caractéristiques des instruments de mesure bio-médicaux *Presentation of metrological characteristics of bio-electrical measuring instruments*	DI	2 AP	P
	Electrodes pour cardiographes et encéphalographes *Electrodes for cardiographs and encephalographs*	RI	2 AP	3 AP
	Amplificateurs bioélectriques *Bio-electric amplifiers*	RI	1 AP	2 AP
	Enregistreurs et oscilloscopes à usage médical *Recorders and oscilloscopes for medical use*	RI	1 AP	2 AP
Sr 5	Matériaux de référence pour l'étalonnage de compteurs de globules sanguins *Reference materials for calibrating blood counters*	RI	Préparation	1 AP
SP 27	PRINCIPES GENERAUX D'UTILISATION DES MATERIAUX DE REFERENCE *GENERAL PRINCIPLES FOR THE USE OF REFERENCE MATERIALS*			
Sr 3,4,5	Principes généraux d'utilisation des matériaux de référence certifiés *General principles for the application of certified reference materials*	DI	Publication DI 18	
Sr 3	Methodes d'essai d'homogénéité des matériaux de référence poudreux et solides certifiés *Methods of testing the homogeneity of powdered and solid certified reference materials*	DI	1 AP	2 AP
Sr 4	Principes généraux de la certification des matériaux de référence de propriétés *General principles of certification of reference materials of properties*	DI	Préparation	1 AP
Sr 5	Evaluation des méthodes de mesure à l'aide de matériaux de référence certifiés *Assessment of measurement procedures by means of certified reference materials*	DI	Préparation	1 AP
	Utilisation des matériaux de référence certifiés pour l'étalonnage des spectrophotomètres *Use of certified reference materials for spectrophotometer calibration*	DI	Préparation	1 AP

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publi-cation *Status*	Etat de préparation *Stage of preparation* 1987	1988
SP 30	MESURES PHYSICO-CHIMIQUES *PHYSICO-CHEMICAL MEASUREMENTS*			
Sr 1	Echelle de pH des solutions aqueuses (revision RI 54) *pH scale for aqueous solutions*	RI	1 AP	2 AP
	pH-métrie et ionométrie. Méthodes de mesurage *pH and ion measurements. Measuring methods*	RI	1 AP	2 AP
Sr 2	Méthodes de mesure de la conductivité des électrolytes *Methods of conductivity measurement of electrolytic solutions*	RI	3 AP	P
	Schéma de hiérarchie en conductométrie *Hierarchy scheme of conductometry*	DI	1 AP	2 AP
Sr 3	Echelle d'humidité relative de l'air utilisant des solutions salines saturées *Scale of relative humidity of air using saturated salt solutions*	RI	P	Etude SP
	Tables psychrométriques universelles *Universal psychrometric tables*	RI	Préparation	5 AP
Sr 4	Hygromètres pour bois. Méthodes de vérification *Wood moisture meters. Verification methods*	RI	Vote CIML	Conférence
	Vérification des dispositifs thermogravimétriques pour la mesure de l'humidité des solides *Verification of thermogravimetric devices for measuring the moisture content of solids*	RI	2 AP	P
Sr 6	Schéma de hiérarchie des instruments de mesure de l'humidité des gaz *Hierarchy scheme for instruments measuring the humidity of gases*	DI	4 AP	P
	Méthodes et moyens d'essai des psychromètres *Methods and means for testing psychrometers*	RI	2 AP	3 AP
Sr 9	Schéma de hiérarchie des instruments de mesure de la viscosité des liquides *Hierarchy scheme for instruments measuring the viscosity of liquids*	DI	Publication DI 17	
	Liquides étalons pour l'étalonnage de viscosimètres *Standard liquids used for the calibration of viscometers*	RI	P	Etude SP
	Viscosimètres à bille. Méthodes d'étalonnage *Falling-ball viscometer. Calibration methods*	RI	2 AP	3 AP
Sr 10	Méthodes et moyens pour la vérification des instruments de mesure de la teneur pondérale des polluants dans l'air *Methods and means for the verification of instruments measuring the mass concentration of pollutants in air*	RI	2 AP	3 AP
Sr 12	Explosimètres *Explosimeters*	RI		2 AP
Sr 13	Ethylomètres *Breath testers*	RI	1 AP	2 AP

Secrétariat	Titres abrégés des sujets *Short-form titles of subjects*	Forme de publication *Status*	Etat de préparation *Stage of preparation* 1987	1988
SP 31	ENSEIGNEMENT DE LA METROLOGIE *TEACHING OF METROLOGY*			
Sr 1	Programme des Cours de Métrologie de Base *Programme of the Basic Metrology Course*	DI	P	Vote CIML
	Programme des Cours de Mesures Mécaniques *Programme of the Mechanical Measurement Course*	DI	1 AP	2 AP
	Programme des Cours de Mesures Electriques *Programme of the Electrical Measurement Course*	DI	1 AP	2 AP
Sr 2	Programme de formation de techniciens en métrologie légale *Training programme for legal metrology technicians*	DI	4 AP	P



Hans KÖNIG

1904-1988

Le Prof. Dr. Hans KÖNIG, Membre d'Honneur du Comité International de Métrologie Légale, est décédé le 17 février 1988.

Directeur du Bureau Fédéral des Poids et Mesures de Suisse, Monsieur KÖNIG participa activement à la création de l'OIML en étroite collaboration avec ses collègues d'autres pays, en particulier Monsieur VIEWEG de République Fédérale d'Allemagne, Monsieur STULLA-GÖTZ d'Autriche, Monsieur JACOB de Belgique, Monsieur COSTAMAGNA de la France, Monsieur BOURDOUN d'URSS. En 1952, Monsieur KÖNIG fut nommé Vice-Président du Comité International Provisoire de Métrologie Légale.

De 1956, date de la Première Conférence Internationale de Métrologie Légale, à 1970, époque de sa retraite, Monsieur KÖNIG fut de toutes les réunions OIML : Conférences, Comités, Conseils de la Présidence, et participa aux travaux des nombreux Secrétariats techniques dont le Bureau Fédéral était responsable.

A sa retraite, Monsieur KÖNIG fut nommé Membre d'Honneur du CIML en reconnaissance de son active contribution au développement de l'OIML.

INFORMATIONS

MEMBRES DU COMITE

URSS — Monsieur L.K. ISSAEV, Chef du Département de Métrologie au GOSSTANDART et Vice-Président du Comité International de Métrologie Légale, a été appelé à d'autres fonctions à compter du 1er janvier 1988. Il quitte donc ses fonctions au sein du CIML auquel il participait depuis huit ans. Monsieur ISSAEV a joué un grand rôle dans le développement de l'OIML, en particulier avec la participation active de son Pays à l'introduction d'une planification des travaux de l'Organisation. Monsieur ISSAEV a également participé personnellement aux travaux des nombreux Secrétariats dont l'U.R.S.S. est responsable ; citons par exemple les instruments de mesure bio-électriques. Nous souhaitons à Monsieur L.K. ISSAEV un plein succès dans ses nouvelles fonctions. Par ailleurs, le nouveau Représentant de l'URSS au CIML sera désigné ultérieurement.

R.P. de CHINE

Deux manifestations dans le domaine de la métrologie vont être organisées à Beijing en mai 1989, l'une est un symposium international du 9 au 12 mai sur la métrologie dans le domaine du contrôle de la qualité de production, intitulé ISMQC/IMEKO 89 et l'autre un symposium international sur les matériaux de référence certifiés, intitulé ISCRM' 89. Des renseignements concernant ces deux symposia peuvent être obtenus en s'adressant à Chinese Society for Measurement, P.O. Box 1413, Beijing.

FRANCE

Le Laboratoire National d'Essais LNE a édité une nouvelle brochure illustrant l'ampleur de ses activités dont environ 18 % sont consacrés à la métrologie pratique et industrielle dans les domaines de mesures de longueurs, masses, forces, pressions ainsi que dans la thermométrie et l'hygrométrie. Rappelons que ce laboratoire a dernièrement pu s'agrandir considérablement par l'adjonction des nouveaux bâtiments situés à Trappes près de Paris. La brochure ainsi que le rapport d'activité du LNE résument également les actions du LNE pour les pays en développement. Ces publications peuvent être obtenues en s'adressant à LNE, 1, rue Gaston Boissier, 75015 Paris, tél. (1) 45 30 60 00.

Le congrès « Métrologie 87 » organisé du 6 au 8 octobre 1987 par deux associations françaises dans le domaine de la qualité a suscité un grand intérêt et rassemblé 250 visiteurs français et étrangers. Les principaux sujets traités : formation, métrologie dimensionnelle, capteurs, automatisation en métrologie, forces, électricité, pressions, débits, thermométrie et radiométrie, ont fait l'objet d'une publication de plus de 250 pages, qui peut être achetée en s'adressant à l'Association française des qualiticiens, 19, rue Blanche, 75009 Paris.

INDE

La création de Metrological Society of India, en janvier 1985 était sans doute une excellente initiative qui a notamment donné naissance à une revue trimestrielle : MAPAN-Journal of the Metrological Society of India. Le numéro inaugural était imprimé déjà en octobre 1985. Les numéros suivants pour 1986-87 contiennent des articles très intéressants écrits par des scientifiques indiens ou étrangers et traitant de sujets divers du domaine de la thermométrie et des mesures électriques et acoustiques. Il y a également des articles traitant les mesures dimensionnelles et les mesures précises de masses.

L'abonnement pour les pays étrangers s'élève à US $ 20 par an et peut être demandé à Member Secretary, Publications Committee, Metrology Society of India, c/o National Physical Laboratory, Dr K.S. Krishnan Road, New Dehli-110012.

METRAPLIQ

La première Conférence internationale METRAPLIQ s'est tenue à Karlovy Vary en Tchécoslovaquie du 8 au 10 décembre 1987. Elle était organisée par la Section métrologique centrale du Comité sur la qualité de la Société tchécoslovaque scientifique et technique en coordination avec l'Office de Normalisation et des Mesures tchécoslovaque.

A la Conférence ont participé plus de 220 experts, dont 30 de l'étranger. Un nombre très important d'exposés (55) ont été présentés dans des domaines les plus divers, ce qui a posé quelques problèmes d'organisation du fait qu'il n'a pas été possible de tenir deux séances parallèles comme cela avait été prévu à l'origine.

Le thème de la Conférence était le domaine de la métrologie appliquée en liaison avec les problèmes de la métrologie placée sous l'autorité d'Etat, autrement dit la métrologie légale.

Il y a eu deux exposés d'ouverture ayant un grand intérêt : M. P. Giacomo, Directeur du BIPM, a présenté un exposé exhaustif sur la métrologie scientifique contemporaine et M. B. Athané, Directeur du BIML, a traité en détail l'évolution présente de l'OIML et ses tâches, et notamment la tendance pour les années à venir.

Des questions relatives à la métrologie légale nationale ont été traitées par les délégués de la Grande-Bretagne, de la République Démocratique Allemande, de la Pologne, de l'Union Soviétique et de la Tchécoslovaquie. Ces questions ont aussi pu être débattues d'une façon amicale lors d'une réception le jour de l'ouverture ainsi que le jour suivant quand on a organisé avec succès une soirée de discussion thématique.

D'une façon générale on peut dire que la Conférence METRAPLIQ 1987 a été couronnée de succès et les organisateurs espèrent que la deuxième Conférence, prévue pour l'année 1990, rassemblera au moins autant de participants.

EMC

Un séminaire sur la compatibilité électromagnétique (EMC) s'est tenu à Paris du 14 au 16 décembre 1987. Il était organisé par le Comité Electrotechnique français à la demande du comité de coordination de la CEI intitulé ACEC (Advisory Committee on Electromagnetic Compatibility) dont le Président est Mr R.M. Showers (USA).

Le but de ce séminaire à très large participation (plus de 200 personnes) était de :

— faciliter les problèmes de coordination en matière d'activités de normalisation dans le domaine de EMC,
— définir les besoins urgents de nouvelles normes,
— établir des liens de coordination avec les organisations en dehors de la CEI,
— déterminer des procédures et calendrier de publication de la documentation nécessaire.

L'OIML avait été invitée à présenter un bref exposé sur ses travaux et besoins dans le domaine de l'EMC.

En conclusion de ce séminaire il semble qu'il y a encore beaucoup de travail urgent à effectuer par les différents comités d'études de la CEI. Le choix fait par l'OIML de suivre, dans le DI 11, de près les travaux du CE 65 semble cependant être le bon, mais il faut revoir notamment les essais à effectuer pour les variations de la tension d'alimentation en cours d'élaboration par le CE 77. Il convient également de conseiller les secrétariats-rapporteurs de l'OIML d'effectuer un choix plus approprié de degrés de sévérité.

La compatibilité électromagnétique suscite actuellement un très grand intérêt dans le monde et de nombreux symposia de caractère plus ou moins international sont fréquemment organisés. Nous avons par exemple noté les réunions suivantes à venir :

28-30 juin 1988	— EMC Symposium à Wroclaw, Pologne Informations : Box 2141, PL 51 645 Wroclaw 12, Pologne
2-4 août 1988	— International Symposium on Electromagnetic Compatibility Informations : Donald Weber, 131 SW 156th Street, Seattle, USA
12-15 septembre 1988	— 6th International Conference on Electromagnetic Compatibility, York, Royaume-Uni Informations : Conference secretariat IERE, 99 Grower Street, London WC1E 6AZ, U.K.
7-9 mars 1989	— 8th International Symposium and Exhibition on EMC Informations : ETH Zentrum - IKT 8092 Zurich, Suisse

INFORMATION

COMMITTEE MEMBERS

USSR — Mr L.K. ISSAEV, Head of the Department of Metrology at GOSSTANDART and Vice President of the International Committee of Legal Metrology, has been called to other duties as from 1st January 1988. He therefore ceases his activities in the CIML, in which he has taken part for eight years. Mr ISSAEV has played an important role in the development of OIML, particularly with the active participation of his country in the introduction of a work plan for the Organization. Mr ISSAEV has also contributed personally to the work of the numerous Secretariats for which the USSR is responsible ; we might cite, for example, Bio-electrical Measuring Instruments. We wish Mr ISSAEV every success in his new duties. The new Representative of the USSR will be nominated later.

CHINA

Two international events in the field of metrology will take place in Beijing in May 1989 : a Symposium on Metrology for Quality Control in Production ISMQC/IMEKO 89 and the other an International Symposium on Certified Reference Materials ISCRM' 89. For information write to Chinese Society for Measurement, P.O. Box 1413, Beijing.

FRANCE

The French national testing laboratory, Laboratoire National d'Essais LNE has edited a new brochure illustrating the wide extent of its activities whereof about

18 % is devoted to practical and industrial metrology in the field of length, mass, force and pressure measurements as well as in thermometry and hygrometry. The laboratory buildings have recently been extended considerably by the addition of new premises located at Trappes, near Paris. The brochure as well as the yearly activity report also summarize the LNE technical assistance to developing countries. These publications can be obtained from LNE, 1, rue Gaston Boissier, 75015 Paris, tel. (1) 45 30 60 00.

The Conference « Métrologie 87 » organized 6-8 October 1987 by two French associations in the field of quality control was attended by more than 250 French and foreign participants. The main subjects concerned training, dimensional metrology, sensors, automation in metrology and force, electrical, pressure, flow measurement as well as thermometry and radiometry. These presentations are collected in one volume of 250 pages which can be procured from Association française des qualiticiens, 19, rue Blanche, 75009 Paris.

INDIA

The creation of the Metrological Society of India in January 1985 is no doubt an excellent initiative which materialized in a quarterly technical publication : MAPAN - Journal of the Metrology Society of India. An inaugural issue was printed already in October 1985. The following issues for 1986-1987 contain many interesting papers written by Indian and foreign scientists on various subjects in the field of electrical, thermal and acoustic measurements. Other papers deal with dimensional and precision mass measurements.

The annual subscription rate for foreign countries is US $ 20 and can be ordered from Member Secretary, Publications Committee, Metrology Society of India, c/o National Physical Laboratory, Dr K.S. Krishnan Road, New Delhi - 110012.

METRAPLIQ

The first international conference METRAPLIQ was held in Karlovy Vary in Czechoslovakia, 8-10 December 1987. It was organized by the Central metrology section of the Committee for Quality of the Czech Scientific and Technical Society in coordination with the Office of Standardization and Metrology.

More than 220 experts participated whereof 30 from abroad. There were a very large number of presentations (55) in the most varying fields.

The theme of the Conference was applied metrology in connection with problems related to metrology controlled by the State or in other words legal metrology.

There were two opening presentations of great interest : Mr P. Giacomo, Director of BIPM, made a complete survey of the contemporary scientific metrology and Mr B. Athané, Director of BIML, explained in detail the present evolution of OIML.

Questions pertaining to national legal metrology were discussed in presentations by delegates from United Kingdom, German Democratic Republic, Poland, USSR and Czechoslovakia. These subjects were also debated in a friendly manner at a reception on the opening day and on the following day at a special discussion evening.

Generally speaking we can say that the Conference METRAPLIQ 1987 was a success and the organizers hope that the second Conference planned for 1990 will bring together at least the same amount of participants.

EMC

A seminar on electromagnetic compatibility (EMC) took place in Paris 14-16 December 1987, organized by the French Electrotechnical Committee at the request of the special coordination committee of IEC called ACEC (Advisory Committee on Electromagnetic Compatibility) under the Presidency of Mr R.M. Showers, USA.

This seminar was attended by more than 200 participants from various countries and had as a scope to

— facilitate coordination in EMC standardization activities

— define urgent needs for new EMC standards

— establish any additional requirements for coordination with organizations outside IEC

— determine procedures and schedules for publication of necessary documentation.

The OIML was invited to present a brief survey of its activities and needs in the field of EMC.

As a conclusion of this seminar it seems that there is still a great amount of urgent work to be done for the IEC technical committees concerned. The choice made by OIML to follow, in DI 11, closely the work of IEC TC 65 was probably the best. However, the tests concerning mains voltage variations should be revised in light of the drafts presently being elaborated by TC 77. OIML Reporting Secretariats should also be advised to make a more appropriate choice of severity levels in some cases.

There is presently a very great interest for the subject all over the world and a great number of more or less international symposia are frequently organized on EMC. We have thus noted the following meetings to come :

28-30 June 1988	— EMC Symposium in Wroclaw, Poland Information : Box 2141, PL 51 645 Wroclaw 12, Poland
2-4 August 1988	— International Symposium on Electromagnetic Compatibility Information : Donald Weber, 131 SW 156th Street, Seattle, USA
12-15 September 1988	— 6th International Conference on Electromagnetic Compatibility, York, United Kingdom Information : Conference secretariat IERE, 99 Gower Street, London WC1E 6AZ, U.K.
7-9 March 1989	— 8th International Symposium and Exhibition on EMC Information : ETH Zentrum-IKT 8092 Zurich, Switzerland

REUNIONS OIML

	Groupes de travail	Dates	Lieux
SP 31	Enseignement de la métrologie	11-15 avril 1988	LA HAVANE CUBA
SP 31 - Sr 1	Formation des ingénieurs en métrologie		
SP 31 - Sr 2	Formation des techniciens en métrologie et des agents de vérification		
Réunion du Conseil de Développement			
Séminaire sur la métrologie			
SP 7 - Sr 8	Cellules de pesée	13-15 avril 1988	TEDDINGTON ROYAUME-UNI
SP 7 - Sr 5	Instruments de pesage à fonctionnement automatique	18-22 avril 1988	TEDDINGTON ROYAUME-UNI
SP 12 - Sr 7	Thermomètres médicaux	3-6 mai 1988	BERLIN-OUEST
SP 5D - Sr 3	Compteurs d'eau	5-6 mai 1988	BIML PARIS
SP 17 - Sr 1	Mesure des pollutions de l'air	9-11 mai 1988	BERLIN-OUEST
SP 2 - Sr 6	Instruments électroniques	16-20 mai 1988	COPENHAGUE DANEMARK
SP 7 - Sr 2	Mesure des masses. Dispositifs électroniques		
SP 19 - Sr 4	Base internationale de référence de dureté	9-10 juin 1988	PRAGUE TCHECOSLOVAQUIE
SP 5D - Sr 7	Méthodes et dispositifs de vérification des instruments de mesure de liquides	21-23 juin 1988	BORÅS SUEDE
SP 5D - Sr 8	Compteurs électromagnétiques	4e trimestre 1988 *(provisoire)*	BRAUNSCHWEIG R.F.A.

Huitième Conférence Internationale de Métrologie Légale et 23e Réunion du CIML	24-28 octobre 1988	SYDNEY AUSTRALIE

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

PUBLICATIONS

— Vocabulaire de métrologie légale
Vocabulary of legal metrology

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

RECOMMANDATIONS INTERNATIONALES

INTERNATIONAL RECOMMENDATIONS

RI N°

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

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

3 — Réglementation métrologique des instruments de pesage à fonctionnement non automatique
Metrological regulations for non automatic weighing instruments

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

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

6 — Prescriptions générales pour les compteurs de volume de gaz
General specifications for volumetric gas meters

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

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

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

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

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

14 — Saccharimètres polarimétriques
Polarimetric saccharimeters

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

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

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

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

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

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

21 — Taximètres
Taximeters

22 — Tables alcoométriques internationales
International alcoholometric tables

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

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

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

26 — Seringues médicales
Medical syringes

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

28 — Réglementation technique des instruments de pesage à fonctionnement non-automatique
Technical regulations for non-automatic weighing machines

29 — Mesures de capacité de service
Capacity serving measures

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

45 — Tonneaux et futailles
Casks and barrels

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

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

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

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

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

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

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

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

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

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

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

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

58 — Sonomètres
Sound level meters

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

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

61 — Doseuses pondérales à fonctionnement automatique
Automatic gravimetric filling machines

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

63 — Tables de mesure du pétrole
Petroleum measurement tables

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

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

66 — Instruments mesureurs de longueurs
Length measuring instruments

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

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

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

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

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

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

73 — Prescriptions pour les gaz purs CO, CO_2, CH_4, H_2, O_2, N_2 et Ar destinés à la préparation des mélanges de gaz de référence
Requirements concerning pure gases CO, CO_2, CH_4, H_2, O_2, N_2 and Ar intended for the preparation of reference gas mixtures

74 — Instruments de pesage électroniques (*)
Electronic weighing instruments (*)

75 — Compteurs d'énergie thermique (*)
Heat meters (*)

DOCUMENTS INTERNATIONAUX

INTERNATIONAL DOCUMENTS

DI N°

1 — Loi de métrologie
Law on metrology

2 — Unités de mesure légales
Legal units of measurement

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

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

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

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

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

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

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(*) Projet à sanctionner par la Huitième Conférence Internationale de Métrologie Légale - octobre 1988
Draft to be sanctioned by the Eighth International Conference of Legal Metrology - October 1988.

9 — Principes de la surveillance métrologique
Principles of metrological supervision

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

11 — Exigences générales pour les instruments de mesure électroniques
General requirements for electronic measuring instruments

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

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

14 — Qualification du personnel en métrologie légale
Qualification of legal metrology personnel

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

16 — Principes d'assurance du contrôle métrologique
Principles of assurance of metrological control

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

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

Note — Ces publications peuvent être acquises au / *These publications may be purchased from* Bureau International de Métrologie Légale, 11, rue Turgot, 75009 PARIS.

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TP = telephone

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TG = telegramme TX = telex

Pour tout télex ou télégramme, il est nécessaire d'indiquer le nom de la personne et sa qualité.

For all telex or telegrams it is necessary to indicate name of person and occupation.

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