Traceability of Measurements

ILAC-G2:1994

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PREAMBLE

During the ILAC 88 Conference in Auckland the following resolution was adopted:

"Standing Committee 2 should:
9. Further study of the needs for traceability of measurement to primary standards to develop practical policies for laboratory accreditation bodies in countries not having direct access to primary standards of measurement"

During its meeting of 9 and 10 February 1989 in Lisbon, ILAC Committee 2 on Accreditation Practice decided to organize an enquiry on the availability of resources for traceable measurements. The enquiry resulted in a report, published in August 1990. The results of 25 countries were incorporated. During the Turin meeting in 1990 it was agreed to continue the project.

The enquiry and the draft document on the concept of traceability were distributed in July 1993, asking for replies before 15 December. After two reminders, 33 countries sent in their replies. Hardly any comments were received on the document.

Part A of this report contains the text of the WECC Technical Guideline on the traceability of measuring and test equipment to national standards. Part B contains the results of the enquiry and gives a survey of the traceability available in 33 countries.

PURPOSE

This document gives guidance and assistance to organisations on how to comply with the traceability requirements in relevant quality assurance standards such as the standards in the EN 29000 and EN 45000 series. It is intended for all organisations where supervision of measuring and test equipment is an important part of quality assurance. It may be used by organisations involved with industrial production processes (development, manufacture, installation, final inspection) and by calibration and testing laboratories.

The document may also be used by assessors of testing laboratories and inspection bodies and assessors of quality systems of organisations which perform measurements. At Appendix 1 a checklist is added which is intended to be used for internal quality audits or by assessors.

AUTHORSHIP

This document was prepared by a Working Group of ILAC Committee 2 (Accreditation Practice) and was endorsed for publication as an ILAC document by Resolution No 10/94 of ILAC 94. The convenor of the Working Group was Dr P J H A M van de Leemput.

PART A
TRACEABILITY OF MEASURING AND TEST EQUIPMENT TO NATIONAL STANDARDS

1. CONTROL, CALIBRATION AND MAINTENANCE IN PRODUCTION AND IN TESTING LABORATORIES

Customer expectations of product quality are getting higher all the time. This means that *assuring product quality* is important for every company, especially in view of the need to strengthen the company's economic position in the European single internal market.

High quality requirements for a product mean that there must be an adequate quality assurance (QA) system. Requirements for QA systems are for example laid down in the ISO 9000 series of standards, which are identical to the EN 29 000 series of European standards[1]. The *"control, calibration and maintenance of measuring and test equipment"* is a major part of the QA content of these standards. Control, calibration and maintenance of measuring and test equipment ensures that measurements are "correct" in all production processes. To this end, all measurement results must be "traceable to national standards"[1,2].

This document assists organisations that are building up a QA system by explaining the concept of "control, calibration and maintenance of measuring and test equipment" and what that means in practice. It is therefore addressed primarily to staff members responsible for quality in industry.

However, the calibration of measuring and test equipment and the traceability of the measurements to national standards are also important requirements for the operation of calibration and testing laboratories and are prerequisites for their accreditation in accordance with European standards of the EN 45000 series (2). This document is therefore also addressed to the operators of calibration and testing laboratories and those who assess them as part of the accreditation procedure.

2. CALIBRATION AND TRACEABILITY

Calibration means determining and documenting the deviation of the indication of a measuring instrument (or the stated value of a material measure) from the conventional "true" value of the measurand.

The term *traceability* means a process whereby the indication of a measuring instrument (or a material measure) can be compared with a national standard for the measurand in question in one or more stages.

In each of these stages a calibration has been performed with a standard, the metrological quality of which has already been determined by calibration with a higher level standard. We thus have a *calibration hierarchy*, as shown in *Figure 1*. The figure illustrates in particular how an in-house calibration system (right hand side of the diagram) may interact with the existing metrological infrastructure (left hand side of the diagram).

3. WHY ARE CALIBRATION AND TRACEABILITY NECESSARY?

For companies, traceability of measuring and test equipment to national standards by means of calibration is necessitated by the growing national and international demand that manufactured parts be interchangeable: supplier firms that make products and customers which install them with other parts must measure with the "same measure".

But there are legal as well as technical reasons. The relevant laws and regulations have to be complied with just as much as the contractual provisions agreed with the purchaser of the product (guarantee of product quality) and the obligations to put into circulation only products whose safety is not affected by defects if they are used properly.

(NOTE: If binding requirements for the accuracy of measuring and test equipment have been stipulated, failure to meet these requirements means the absence of a warranted quality with considerable consequent liability.)

Demonstrating that adequate measuring and test equipment has been chosen and is in proper working order for controlling the product is very important for producer liability. This is because systematic and fully documented control of measuring and test equipment together with detailed proof that the equipment has been used correctly is essential if it becomes necessary to prove absence of liability.

There are similar technical and legal reasons why calibration and testing laboratory operators should have consistent control of measuring and test equipment in the manner described.

4. ELEMENTS OF TRACEABILITY

Traceability is characterized by a number of essential elements:

- an unbroken chain of comparisons going back to a standard acceptable to the parties, usually a national or international standard;

- measurement uncertainty; the measurement uncertainty for each step in the traceability chain must be calculated according to defined methods and must be stated so that an overall uncertainty for the whole chain may be calculated;

- documentation; each step in the chain must be performed according to documented and generally acknowledged procedures; the results must equally be documented;

- competence; the laboratories or bodies performing one or more steps in the chain must supply evidence for their technical competence (e.g. by demonstrating that they are accredited);

- reference to SI units; the "appropriate" standards must be primary standards for the realization of the SI units;

- recalibrations; calibrations must be repeated at appropriate intervals; the length of these intervals depends on a number of variables, (e.g. uncertainty required, frequency of use, way of use, stability of the equipment).

5. LEVELS IN THE CALIBRATION HIERARCHY

5.1 International

At the international level, decisions concerning the International System of Units (SI) and the realization of the primary standards are taken by the Conférence Générale des Poids et Mesures (CGPM). The Bureau International des Poids et Mesures (BIPM) is in charge with coordinating the development and maintenance of primary standards and organizes intercomparisons on the highest level.

5.2 National Metrology Institutes

The National Metrology Institutes are the highest authorities in metrology in almost all countries. In most cases they maintain the "national standards" of the country which are the sources of traceability for the associated physical quantity in that country. If the National Metrology Institute has facilities to realize the corresponding SI unit of measurement (the term SI units includes all derived units), the national standard is identical to or directly traceable to the *primary standard* realizing the unit. If the Institute does not have this facility, it has to ensure that the measurements are traceable to a primary standard maintained in another country. The National Metrology Institutes ensure that the primary standards themselves are internationally comparable. They are responsible for disseminating the units of measurement to users, be these scientists, public authorities, laboratories or industrial enterprises. So they are the top level of the calibration hierarchy in a country. The Western European National Metrology Institutes cooperate in EUROMET.

5.3 Accredited calibration laboratories

Calibration Laboratory Accreditation Bodies accredit calibration laboratories in industry and other organisations, according to well established criteria. For Western Europe these criteria are laid down in EN 45001. Internationally the criteria of ISO/IEC Guide 25 are often used. The documents are almost identical. For some aspects WECC has developed interpretation documents. Accreditation is generally given for specified measurands and for the smallest uncertainties that can be achieved with the suitable measuring devices available in the respective calibration laboratory ("best measurement capability").

Accredited laboratories are often at the top of a firm's internal calibration hierarchy. Their task is then to compare, at appropriate intervals, the firm's own working standards (factory standards) with reference standards which are calibrated by a National Metrology Institute or an accredited laboratory with a suitable best measurement capability.

Many accredited laboratories carry out calibrations for third parties on request, (eg for firms that do not have calibration measurement facilities with suitable equipment and for private test laboratories working in the field of product certification).

(NOTE: If an accredited laboratory is to be engaged for a particular calibration task, the client must ensure that the measurement uncertainty achieved is small enough for the intended use of the measuring instrument to be calibrated).

The calibration results are documented in a (calibration) certificate.

The Western European Calibration Laboratory Accreditation Bodies cooperate in the Western European Calibration Cooperation (WECC). The main goal of WECC is to ensure that certificates issued by an accredited laboratory are accepted in the other countries. This implies that the laboratories and the Accreditation Bodies have to operate in a compatible way. An evaluation of the Accreditation Bodies and

the results of interlaboratory comparisons have resulted in a WECC Multilateral Agreement on the mutual acceptance of certificates. This means that official certificates (containing the logo of the accreditation scheme) issued by a laboratory, accredited by one of the signatories of the Multilateral Agreement, are equivalent with the certificates issued by laboratories accredited by any of the other signatories.

5.4 In-house calibration laboratories (factory calibration laboratories)

The task for in-house calibration laboratories is to calibrate regularly the measuring and test equipment used in a company against its reference standards that are traceably calibrated at an accredited calibration laboratory or a National Metrology Institute. The in-house calibration may be documented by a factory calibration certificate, a calibration label or some other suitable method. The calibration data must be retained for a prescribed period of time.

The nature and scope of the metrological control of in-house calibration laboratories are at the discretion of the company concerned. They must be adapted to the particular applications so that the results obtained with the measuring and test equipment are sufficiently accurate and reliable. However, accreditation of these laboratories is not necessary to satisfy the requirements of the EN 29000 series of standards for internal purposes.

The hierarchy of standards and a resulting metrological organizational structure for tracing measurement and test results within a company to national standards are shown in *Figure 2* and demonstrated by examples in *Figures 3, 4* and *5*. The user of the standard or of the measuring and test equipment is given for each level of the hierarchy, together with his or her functions within the structure and the metrological basis and the result of his or her activity (documentation).

6. TERMINOLOGY IN THE HIERARCHY OF STANDARDS

The following definitions apply to the hierarchy of standards[3]:

Primary standard: A standard that is designated or widely acknowledged as having the highest metrological qualities and whose value is accepted without reference to other standards of the same quality.

International standard: A standard recognized by an international agreement to serve internationally as the basis for assigning values to other standards of the quality concerned.

National standard: A standard recognized by a national decision to serve, in a country, as the basis for assigning values to other standards of the quantity concerned.

Reference standard: A standard, generally having the highest metrological quality available at a given location or in a given organization, from which the measurements made there are derived.

Transfer standard: A standard used as an intermediary to compare standards.

Travelling standard: A standard, sometimes of special construction, intended for transport between different locations.

Working standard: A standard which is usually calibrated against a reference standard and is used routinely to calibrate or check material measures or measuring instruments. Working standards may also at the same time be reference standards. This is particularly the case for working standards directly calibrated against the standards of a national standards laboratory.

Certified reference material (CRM): A reference material, accompanied by a certificate, one or more of whose property values are certified by a procedure which establishes traceability to an accurate realization of the unit in which the property values are expressed, and for which each certified value is accompanied by an uncertainty at a stated level of confidence.

(NOTES:

1 CRMs are generally prepared in batches for which the property values are determined within stated uncertainty limits by measurements on samples representative of the whole batch.

2 The certified properties of certified reference materials are sometimes conveniently and reliably realized when the material is incorporated into a specially fabricated device, (e.g. a substance of known optical density into a transmission filter, spheres of uniform particle size mounted on a microscope slide). Such devices may also be considered as CRMs.

3 All CRMs lie within the definition of "measurement standards" or "étalons" given in the 'International vocabulary of basic and general terms in metrology'.

4 Some RMs and CRMs have properties which, because they cannot be correlated with an established chemical structure or for other reasons, cannot be determined by exactly defined physical and chemical measurement methods. Such materials include certain biological materials such as vaccines to which an International unit has been assigned by the World Health Organisation.)

Reference material (RM): Material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

(NOTE: A reference material may be in the form of a pure or mixed gas, liquid or solid. Examples are water for the calibration of viscometers, sapphire as a heat-capacity calibrant in calorimetry, and solutions used for calibration in chemical analysis).

(GENERAL NOTE: The value of any standard has an uncertainty. In the calibration hierarchy, the higher ranking standard has a smaller uncertainty. Each additional subordinate level therefore leads to an increase in the uncertainty of measurements).

7. REFERENCES

1 ISO 9000 *Quality management and quality assurance standards - Guidelines for selection and use*

ISO 9001 *Quality systems - Model for quality assurance in design/development, production, installation and servicing*

ISO 9002 *Quality systems - Model for quality assurance in production and installation*

ISO 9003 *Quality systems - Model for quality assurance in final inspection and test*

ISO 9004 *Quality management and quality system alements - Guidelines*

2 EN 45001 *General criteria for the operation of testing laboratories*

EN 45002 *General criteria for the assessment of testing laboratories*

EN 45003 *General criteria for laboratory accreditation bodies*

3 *International vocabulary of basic and general terms in metrology (VIM)*, ISO/IEC/OIML/ BIPM.

APPENDIX 1
CHECKLIST FOR THE ASSESSMENT OF THE CALIBRATION AND TRACEABILITY OF MEASURING AND TEST EQUIPMENT.

(Cautional note: only positive answers may not be sufficient).

1. GENERAL REMARKS

- The assessor for measuring equipment must have sufficient knowledge in the fields of metrology and calibration.

- The assessment refers only to the testing activities for which the laboratory is to be accredited; it does not refer to the operation of a pure calibration laboratory already accredited by another body.

2. APPROPRIATE CALIBRATION OF MEASURING EQUIPMENT

2.1 Is an appropriate calibration prescribed for all measuring instruments:
- appropriate with respect to the measurement uncertainty of the measuring equipment?
- appropriate with respect to the influence of the measured quantity on the test result?

2.2 Is an appropriate functional test determined for such measuring instruments which are based on natural constants (e.g. defined wave lengths)?

3. BODIES PERFORMING CALIBRATION OF MEASURING EQUIPMENT

3.1 Is the calibration carried out by an external body generally responsible for calibrations or by a body accredited or accepted for that purpose?

3.1.1 By a National Metrology Institute?

3.1.2 By an accredited calibration laboratory?

3.2 Is the calibration carried out internally or externally by a laboratory not falling into the categories mentioned in 3.1.1 and 3.1.2:

3.2.1 By a competent internal body of the institute operating the test laboratory?

3.2.2 By a competent staff group or single person in the test laboratory?

3.2.3 By the user of the measuring equipment himself?

4. CALIBRATION FACILITIES

This paragraph is only applicable the answer is yes on one of the questions of 3.2

4.1 Are internal reference standards and, if appropriate, working standards, available for all measuring and test instruments and measured quantities which are relevant for the measurement and test results?

4.2 Are the standards, directly or indirectly, in any case by an unbroken chain and documented by certificates, linked to national standards and labelled accordingly by a calibration label?

4.3 Are all instruments being part of the calibration equipment properly identified?

4.4 Is each calibration described in a procedure, (e.g. by switching diagrams or flow charts)?

4.5 Is the calibration procedure described step by step?

4.6 Are defined environmental conditions ensured during calibrations?

4.7 Are relevant environmental conditions recorded during calibrations?

4.8 Are procedures for the calculation of the measurement uncertainty of the calibration equipment specified and are they followed?

4.9 Are recalibration intervals fixed in accordance with the intended use and the properties of the equipment and are there programmes for regular recalibrations?

5. EVALUATION AND DOCUMENTATION OF RESULTS

5.1 Are the calibration results and the associated uncertainties documented?

5.2 Is the observance of fixed recalibration intervals supervised?

5.3 In the case where calibrations have to be performed before each measurement, are these cases clearly identified? Are the measuring instruments labelled accordingly?

5.4 Are the results of calibrations - including environmental conditions, if applicable - documented and filed ? Are they available to the user of the measuring instrument?

5.5 Is a calibration label used as a visible indication of an established confirmation system for the measuring equipment?

5.6 Are controls for calibration and adjustment sealed which should not be affected by the user?

6. SPECIFIED CALIBRATION PROCEDURES

6.1 Is the measuring equipment of a “self-calibration” type?

6.1.1 Is the internal reference calibrated?

6.1.2 Is the process of “self-calibration” checked?

6.2 Does the measuring equipment include an internal calibration of a less stable component by means of an internal reference?

6.2.1 Is the internal reference calibrated?

6.2.2 Is the procedure of internal calibration checked?

6.2.3 Is the internal calibration performed regularly, (e.g. before each use of the measuring equipment)?

6.3 Is the complete measuring system calibrated as a whole?

6.3.1 Are the single components of the measuring system adjusted, especially with respect to zero setting?

6.3.2 How is the labelling performed for a complete measuring system?

6.4 Is each single component of a measuring system calibrated?

6.4.1 Are the calibration parameters for the complete measuring system determined from the values of the single components?

6.5 What is done in the case of disposable measuring devices which cannot be calibrated individually (e.g. strain gauge transducers)?

6.5.1 Are samples calibrated? Is continuous sample testing practiced?

6.5.2 Which body is performing sample testing?

6.5.3 Does the body according to 5.5.2 fulfil the requirements of EN 45001 or ISO/IEC Guide 25 respectively?

6.5.4 Is the body accredited according to EN 45001 or ISO/IEC Guide 25?

6.6 Are reference materials used for the calibration?

6.6.1 Are the reference materials certified?

6.7 Are the calibrations computer-aided?

6.7.1 Is the software validated?

6.7.2 By which method?

7. RESPONSIBILITIES ADMINISTRATIVE ASPECTS OF CALIBRATION OF MEASURING EQUIPMENT

7.1 Is each user of measuring equipment aware that he is himself responsible for the calibration status of his measuring equipment?

7.2 Is each new measuring equipment calibrated before use?

7.3 Are those measuring instruments of which the validity period is expired brought to recalibration by a confirmation system?

7.4 Are there regulations concerning the responsibility for the internal reference standards, for their traceable calibration and for the working standards?

7.5 Are there regulations concerning the responsibility for the reliability of calibration software?

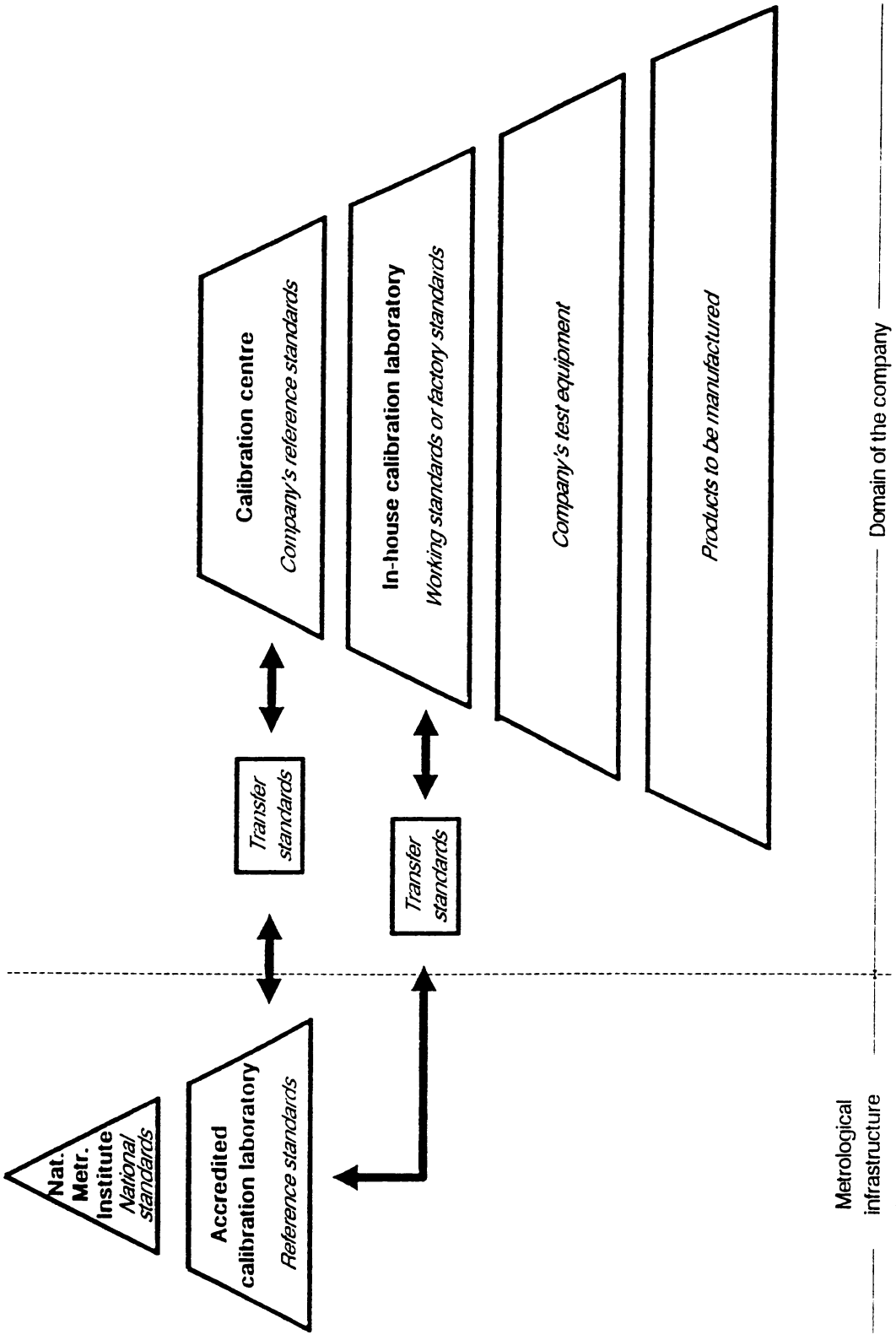

Figure 1. Calibration hierarchy from the national standard to the finished product

Standard (test equipment)	*Responsible*	*Tasks*	*Basis for the calibration or measurement*	*Documentation of the calibration or measurement*
National standard	National Metrology Institute	To maintain and disseminate the national standards	Statutory duty to represent SI units and ensure international comparability	Calibration certificate for reference standard
Reference standard	Accredited calibration laboratories	To safeguard the metrological infrastructure of a country	Calibration certificate from Nat. Metrology Institute or another accredited laboratory	Calibration certificate for working standard or factory standard
Working standard Factory standard	In-house calibration laboratories	Supervision of test equipment for in-house purposes	Calibration certificate from National Metrology Institute or an accredited laboratory	Factory calibration certificate, calibration mark or the like for test equipment
Test equipment	all sections of a company	Measurements and tests as part of quality assurance measures	Factory calibration certificate, calibration mark or the like	Test mark or the like

Figure 2. Organisational structure for tracing test results within a company to national standards

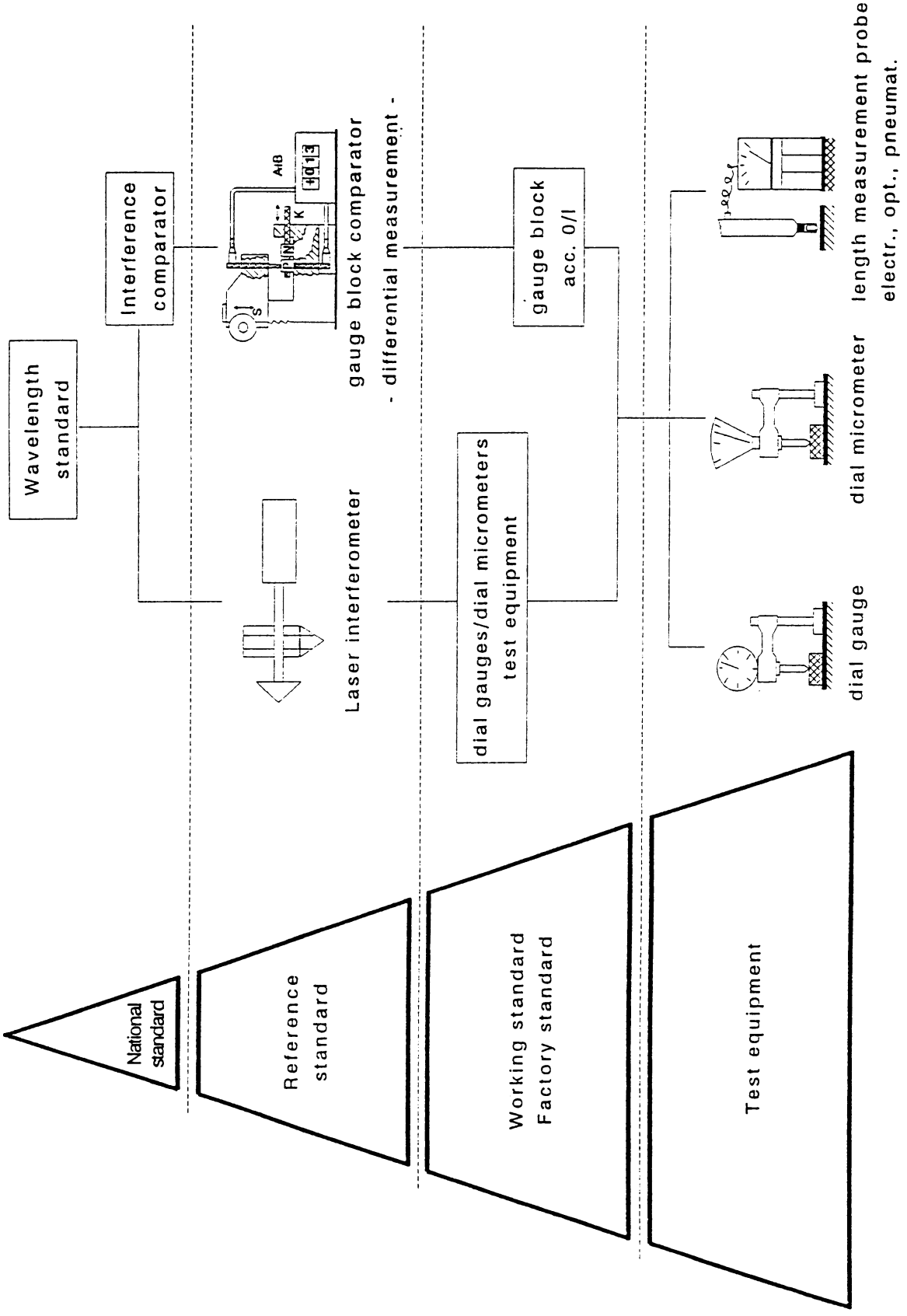

Figure 3. Levels of the calibration hierarchy for displacement transducers (example)

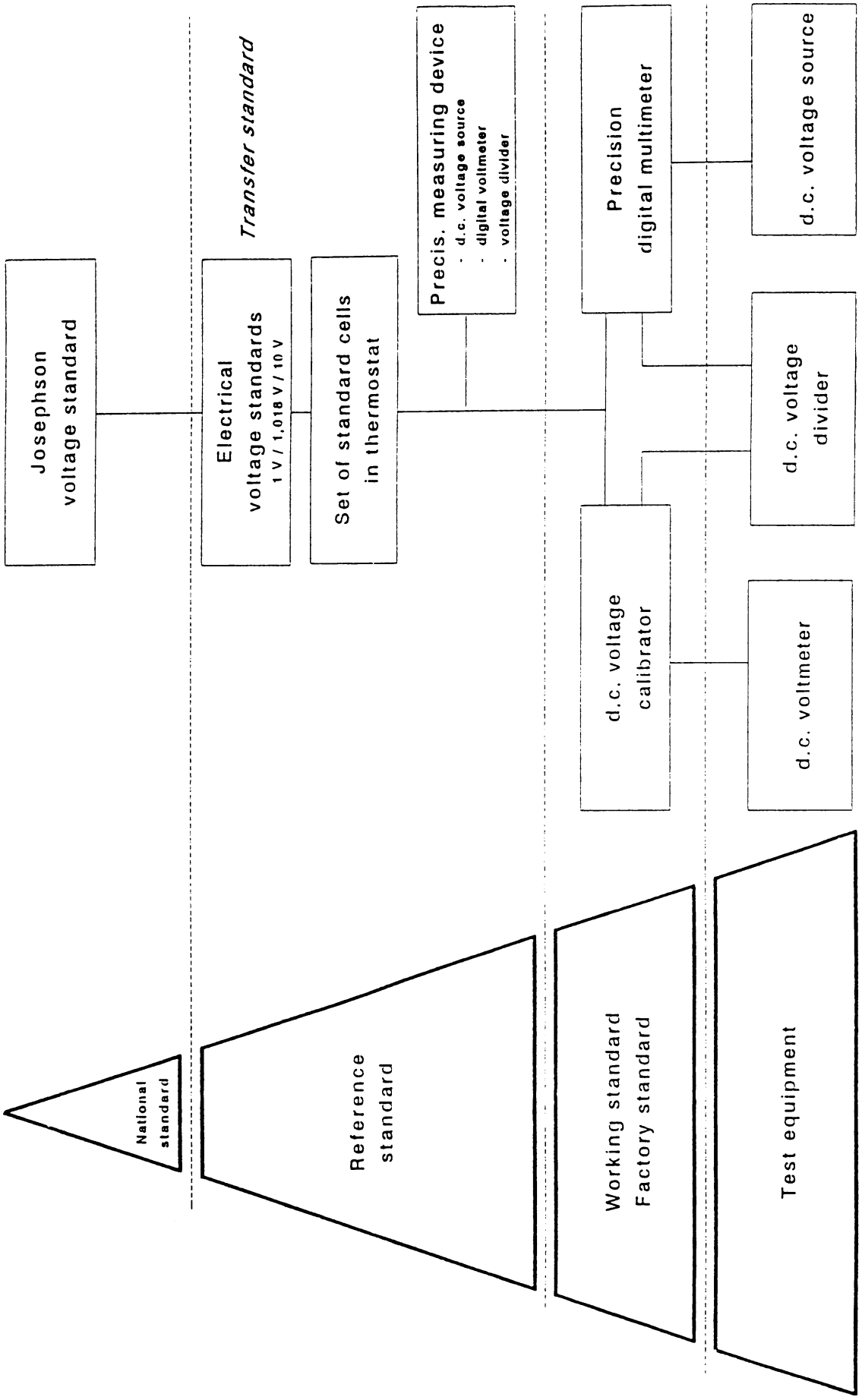

Figure 4. Levels of the calibration hierarchy for d.c. voltage measuring instruments (example)

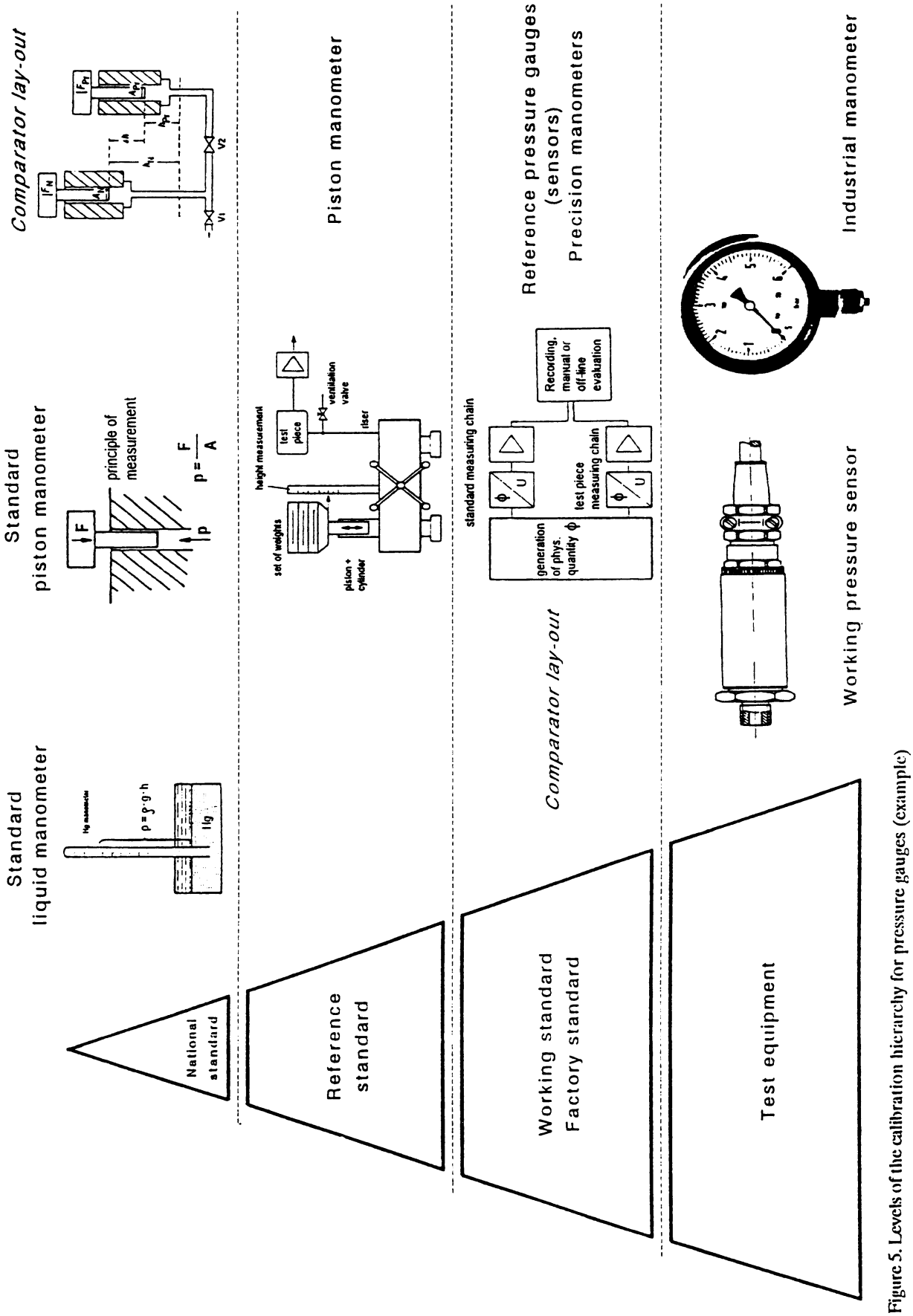

Figure 5. Levels of the calibration hierarchy for pressure gauges (example)

PART B

RESULTS OF THE ILAC ENQUIRY ON THE TRACEABILITY OF MEASUREMENTS

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+82 042 861 1494

MX Director de Servicios Tecnológicos
Centro Nacional de Metrología
K.m. 4.5. Carr. a Los Cués,
El Marqués Qro. México
A.P. 1-100 Centro, 76000
Tel: +52 91 42 153784/ 153902
Fax: +52 91 42 162626

MY Standards and Industrial Research Institute of Malaysia
P.O. Box 7035
40911 Shah Alam
Selangor Darul Ehsan, Malaysia
Tel: +60 3 5592601/5591630
Fax: +60 3 5508095

NL NMi Van Swinden Laboratorium (NMi VSL)
P.O. Box 654
2600 AR Delft, The Netherlands
Tel: +31 15 69 1500
Fax: +31 15 61 2971

NO National Standards Laboratory
(Laboratoriet for nasjonale normaler)
P.O. Box 6832, St. Olavs Plass
N-0130 Oslo, Norway
Tel: +47 22 200226
Fax: +47 22 207772

NZ Measurement Standards Laboratory
Industrial Research Limited
P.O. Box 31310
Lower Hutt, New Zealand

SA SASO, National Metrology Laboratory
P.O. Box 3437
Riyadh 11471, Saudi Arabia
Tel: +966 1 4489369
Fax: +966 1 4489235

SE Sveriges Provnings- och Forskningsinstitut AB, SP
P.O. Box 857
501 15 Borås, Sweden
Tel: +46 33 16 50 00
Fax: +46 33 13 55 02

Flygtekniska försöksanstalten
P.O. Box 11021
161 11 Bromma, Sweden
Tel: +46 8 634 10 00
Fax: +46 8 25 87 34

Telia Research AB
Validering
136 80 Haninge, Sweden
Tel: +46 8 707 54 00
Fax: +46 8 707 51 25

FFV AEROTECH AB
Riksmätplats, Avd AM 57
732 81 Arboga, Sweden
Tel: +46 589 80 000
Fax: +46 589 17 642

Statens Strålskyddsinstitut
P.O. Box 60204
104 01 Stockholm, Sweden
Tel: +46 8 729 71 00
Fax: +46 8 729 71 08

SG National Metrology Centre
Singapore Institute of Standards and Industrial Research (SISIR)
1 Science Park Drive
0511 Singapore
Tel: +65 77 29527
Fax: +65 77 83798

SK Slovak Institute of Metrology /SMÚ/
Karlovaská 63
842 55 Bratislava, Slovakia - SK
Tel: +42 7 726 208
Fax: +42 7 729 592

TH Metrology Development Programme,
Department of Science Service
Ratchathewi District
Bangkok 10400, Thailand
Tel: +66 2 2460065, ext. 338, 316
Fax: +66 2 2480119

Industrial Metrology and Testing
Service Centre
Thailand Institute of Scientific and
Technological Research
196 Phahonyothin Road, Chatuchak
Bangkok 10900, Thailand
Tel: +66 2 5795515
Fax: +66 2 5798592

TW Center for Measurement Standards,
Industrial Technology Research Institute
321, Sec. 2, Kuang FU Rd., Hsinchu, Taiwan.
Tel: +886 35 712564
Fax: +886 35 727841

Telecommunication Laboratories
Ministry of Transportation and Communication
P.O. Box 71
Chung-Li, Taiwan.
Tel: +886 3 4244200
Fax: +886 3 4244208

Institute of Nuclear Energy Research, Health Physics Division
P.O. Box 3-10
Lung-Tan, Taiwan.
Tel: +886 3 4711214
Fax: +886 3 4711214

2. CALIBRATION LABORATORIES ACCREDITATION BODIES

Calibration laboratory accreditation is fully integrated in a testing and calibration laboratory accreditation body.

Code	Accreditation Body	Body open for labs from abroad
AU	NATA 7 Leeds Street NSW 2138 Rhodes, AUstralia Tel: +61 2 7368222 Fax: +61 2 7435311 Contact person: Mr. J. Gilmour	Yes, unconditionally
CA	Standards Council of Canada 1200 - 45 O'Connor Street Ottawa, Ontario K1P 6N7, Canada Tel: +1 613 2383222 Fax: +1 613 9954564 Contact person: Manager Conformity Assessment Division	No
CH	SCS Swiss Federal Office of Metrology Lindenweg 50 CH-3084 Wabern, Switzerland Tel: Fax: Contact person: Mr. F. Landolt	No
CZ	Czech Accreditation Institute Václavské nám. 19 113 47 Prahal, Czech Republic Tel: +42 2 24 22 94 05 Fax: +42 2 24 22 94 05 Contact person: Jiří Růžička	Yes, unconditionally
DK	DANAK Tagensvej 137 DK-2200 Copenhagen N, Denmark Tel: +45 31 851066 Fax: +45 31 817068 Contact person: Ms. K. Munk Dorph	No
ES	RELE Avda. de Concha Espina, 65, 2^0 E-28016 Madrid, Spain Tel: +34 1 5649687 Fax: +34 1 5630454 Contact person: Beatriz Rivera Romero	Yes, unconditionally

Code	Accreditation Body	Body open for labs from abroad
FI	Centre for Metrology and Accreditation P.O. Box 239 00181 Helsinki, Finland Tel: +358 0 61671 Fax: +358 0 6167 467 Contact person: Dr. Tuulikki Hattula	Yes, unconditionally
GB	NAMAS Queens Road Teddington, Middlesex TW11 0LW, England Tel: +44 81 9436311 Fax: +44 81 9437134 Contact person: Mr. P.J. Key	Yes, depends on accreditation arrangements in other country
HK	Hong Kong Laboratory Accreditation Scheme (HOKLAS) 36/F, Immigration Tower 7 Gloucester Road, Wanchai, Hong Kong Tel: +852 829 4838 Fax: +852 824 1302 Contact person: Dr. L.H. Ng	Yes, applications are considered on their merits
IE	ILAB Glasvenin Dublin 9, Ireland Tel: +353 1 370101 Fax: +353 1 368738 Contact person: Mr. J. Gregan	No
IN	National Calibration Service Programme Cell National Physical Laboratory Dr. K.S. Krishnan Marg New Delhi-110012, India Tel: +91 11 5784479 Fax: +91 11 5752678 Contact person: Dr. Mahesh Chander	Yes, unconditionally
IS	Icelandic Bureau of Legal Metrology National Accreditation Scheme P.O. Box 8114 IS-128 Reykjavik, Iceland Tel: +354 1 681122 Fax: +354 1 685998 Contact person: Mr. A. Thorteinsson	No
MY	SAMM Secretariat Accreditation Unit Standards and Industrial Institute of Malaysia (SIRIM) P.O. Box 7035 40911 Shah Alam Selangor Darul Ehsan, Malaysia Tel: (603) 5592495 Contact person: Mr. Chin Miew Lim	Yes, however these laboratories are encouraged to apply to their respective country's accreditation body first

Code	Accreditation Body	Body open for labs from abroad
NO	Norwegian Accreditation P.O. Box 6832, St. Olavs Pl. N-0130 Oslo, Norway Tel: +47 22 200226 Fax: +47 22 207772 Contact person: Ms. C. Laake	Yes, unconditionally
NZ	Laboratory Accreditation Programme Telarc New Zealand Private Bag 28901, Remuera Auckland, New Zealand 1136 Tel: +64 9 5250100 Fax: +64 9 5251900 Contact person: Lynne Forster	Yes, if no other national accreditation body is available (e.g. Pacific Islands)
SA	SASO P.O. Box 3437 RIYADH 11471 Saudia Arabia Tel: +966 1 4464622 Fax: +966 1 4489235 Contact person: Mr. Mohammed Ayash	No
SE	SWEDAC P.O. Box 878 S-501 15 Borås, Sweden Tel: +46 33 177700 Fax: +46 33 101392 Contact person: Dr. H. Ots	Yes, unconditionally
SG	Singapore Institute of Standards and Industrial Research (SISIR) 1 Science Park Drive 0511 Singapore Tel: +65 7729527 Fax: +65 7783798 Contact person: Lam Kong Hong	No
SK	Slovak Office of Standards, Metrology and Testing /UNMS/ Trnavská 13 814 39 Bratislava Slovakia Tel: +427 493 524 Fax: +427 491 050 Contact person: Mr. Dušan Gábriš	Yes, when fulfilment of all accreditation criteria specified in EN 45001

Code	Accreditation Body	Body open for labs from abroad
US	NVLAP NIST Bldg. 411, Room A162 Gaithersburg, Md. 20899 Tel: +1 301 9754017 Fax: +1 301 9262884 Contact person: Al Tholen	Yes (accreditation for full range of calibration parameters is under development and expected to be oprational in early 1994)
TW	Center for Measurement Standards Industrial Technology Research Institute Building 8, 321 Sec. 2, Kuang Fu Rd. Hsinchu 300, Taiwan R.O.C. Tel: +886 35 721321 Fax: +886 35 716231 Contact person: Mr. Nigel Jou	Yes, under the following conditions: 1. The standards of the laboratories are traceable to international standards. 2. The service is only opened to those countries which have trade relationship with R.O.C.

Calibration laboratory accreditation and testing laboratory accreditation is dealt with by one organisation but are seperate activities

Code	Accreditation body	Body open for labs from abroad
AT	Bundesministerie für Wirtschaftl. Aangelegenh., Dept IX/7 Landstr. Hauptstrassa 55-57 A-1031 Wien, Austria Tel: +43 1 71102248 Fax: +43 1 7143582 Contact person: Mr. Freistetter	Yes, under certain conditions
KR	Korea Calibration Service (KOCAS) Industrial Advancement Administration (IAA) 2 Chungang-dong, Kwacheon-City, Kyonggi-do 427-010, The Republic of Korea Tel: +82 2 5037929 Fax: +82 2 5032515 Contact person: Kyu-whan Ma	Yes, under certain conditions
MX	DGN-SECOFI Puente de Tecamachalco no. 6 Col. Lomas de Tecamachalco Secc. Fuentes de Tecamachalco 53950 Naucalpan, Edo. de Mexico Tel: +52 91 5899343 Fax: +52 91 5405153 Contact person: Ing. A.L. Lopez	No
NL	NKO/STERIN/STERLAB P.O. Box 29152 3001 GD Rotterdam, The Netherlands Tel: +31 10 4136011 Fax: +31 10 4133557 Contact person: Dr. P.J.H.A.M. van de Leemput	Yes, depends on accreditation arrangements in other country

There is a seperate organisation for calibration laboratory accreditation

Code	Accreditation Body	Body open for labs abroad
BE	Algemene Inspectie van de Metrologie De Motstraat 24-26 B-1040 Bruxelles, Belgium Tel: +32 2 2336111 Fax: +32 2 2308300 Contact person: Dr. C. Deckers	No
DE	Physikalisch-Techn. Bundesanst. DKD Postfach 33 45 D-38023 Braunschweig Tel: +49 531 5928320 Fax: +49 531 5929292 Contact person: Mr. E. Fay	Yes, under conditions for cross-border accreditation agreed upon among WECC members (full information of the foreign accreditation body)
FR	BNM/FRETAC 22 Rue Monge 75005 Paris, France Tel: +33 1 43195051 Fax: +33 1 43195080 Contact person: Mr. Luc Erard	Yes, if there is no accreditation system for calibration laboratory in the country
IL	Ministry of Tradeand Industry ISRAEL Danciger A. Bldg. Hebrew University Campus Givat-Ram, Jerusalem 91904, ISRAEL Tel: +972 2 661856 / +972-2-635698 Fax: +972 2 520797 Contact person: Dr. A. Shenhar	Yes, unconditionally
IT	SIT - Servizio di Taratura in Italia Strada delle Cacce, 91 10135 Torino, Italy Tel: +39 11 34889 33 Fax: +39 11 346 384 Contact person: Prof. P. Soardo	Yes, if there is no accreditation body present in the country

Other

Code	Country	Comments
JP	IIII 2-49-10 Nishihara Shibuya-Ku, Tokyo, Japan 151 Tel: +81 3 34811921 Fax: +81 3 34811937 Contact person: Mr. T. Nakadate	There is only calibration laboratory accreditation sheme and no testing in Japan
TH	Thai Industrial Standards Institute Rama IV Street, Ratchathewi District Bangkok 10400, Thailand Tel: +66 2 2457802 Fax: +66 2 2464327 Contact person: Ms. K. Sinsakul	There is a proposed calibration laboratory accreditation scheme in the country
TK	Turkish Standards Institute Necatibev cad. No. 112 Ankara, Turkey Tel: +90 312 4254101 Fax: +90 312 4254399 Contact person: Mr. A. Kurter	There is no calibration laboratory accreditation scheme in the country

3. OTHER NATIONALLY RECOGNISED LABORATORIES WHICH CAN PROVIDE TRACEABILITY

AU various

CH GD PTT
Forschung und Entwicklung
Technisches Zentrum VM 4
3000 Bern 29, Switzerland

CZ Úre Av Čr (Institute of Radioelectronics, Czech Academy of Sciences)
Chaberská 57
180 00 Praha 8, Czech Republic
Tel: +42 2 6641 01 44
Fax: +42 2 6641 02 22

Ezú (Electrotechnical Testing Institute)
Pod Lisem 129
171 02 Praha 8, Czech Republic
Tel: +42 2 6641 00 77
Fax: +42 2 6641 00 37

DE list available on request from PTB and DAR

ES CEM, Centro Español de Metrología
Puogono Industrial Tres Cantos
c/ACFAR,s/n
E-28760
Tel: +34 1 8074700

FI Technical Inspection Centre
P.O. Box 204
00181 Helsinki, Finland
Tel: +358 0 61671
Fax: +358 0 6167467

Finnish Centre for Radiation and Nuclear Safety
P.O. Box 268
00101 Helsinki, Finland
Tel: +358 0 70821
Fax: +358 0 7082295

GB National Engineering Laboratory
Flow Centre
East Kilbride, Glasgow
Scotland 975 0QU
Tel: +44 3552 20222
Fax: +44 3552 72536

IN Radiation Standard Section
Bhabha Atomic Research Centre
Anushakti Nagar, Bombay, India
Telex: 011-71017 BARC IN

KR Korea Academy of Industrial Technology (KAITECH)

National Industrial Technology Institute (NITI)

MY Weights and Measures Department, Enforcement Division, Ministry of Domestic Trade and Consumer Affairs
11 Floor, Wisma PKNS,
Jalan Raja Laut
50622 Kuala Lumpur,
Malaysia
Tel: 603 292455 / 2924741
Fax: 603 2924148

NO Oslo justerkammer
Nordahl Brunsgt. 18
P.O. Box 6832, St. Olavs plass
N-0130 Oslo, Norway

Kristiansand justerkammer
Barstølvn. 29
N-4636 Kristiansand,
Norway

Stavanger justerkammer
Myrvangveien 6
P.O. Box 1121 Hillevåg
N-4004 Stavanger, Norway

Bergen justerkammer
Spelhaugen 12
P.O. Box 3630
N-5033 Tyllingsdalen

Ålesund justerkammer
Myrabakken Næringssenter
N-6010 Ålesund

Bodø justerkammer
Moloveien 20
P.O. Box 256
N-8001 Bodø, Norway

Trondheim justerkammer
Østre Rosten 80
N-7075 Tiller, Norway

Tromsø justerkammer
Tromsøysundveien 266
N-7075 Tomasjord, Norway

Hamar justerkammer
Kristin Lavransdattersv. 18
N-2300 Hamar, Norway

SK 29 Legal Metrology Laboratories
27 Centres of Calibration Service

TH Central Bureau of Weights and Measures, Department of Commercial Registration, Ministry of Commerce
Rama VI Street, Phaya Thai District
Bangkok 10400, Thailand
Tel: 662 2796220
Fax: 662 2799941

The Thai Airways International Ltd., Engineering Department,
Bangkok Airport
Bangkok 10210, Thailand
Tel: 662 5638320
Fax: 662 5311913

The Technological Promotion Association (Thai-Japan)
Industrial Instruments Calibration Center
5-7 Sukhumvit Soi 29
Bangkok 10110, Thailand
Tel: 662 2580320, 2599160
Fax: 662 2586440

TK Turkish Standard Institution

4 Type of Quantities for Which Countries can Provide Traceability to a National Standard

National Laboratories	AT	AU	BE	CA	CH	CZ	DE	DK	ES	FI	FR	GB	HK	IE	IL	IN	IS
1. Electricity																	
1.1 DC and Low frequency (<1MHz) quantities																	
voltage	X	X	X	X	X	X	X	X	X	X	X	X	P	X		X	X
current	X	X	X	X	X	X	X		X	X	X	X	X	X		X	
voltage ration	X	X	X	X	X	X	X		X		X	X	X	X		X	
AC/DC transfer (voltage and current)	X	X	X	X	X	X	X		X	X	X	X	X	X			
power and energy	X	X	X	X	X	X	X		X	X	X	X	X			X	
resistance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
capacitance	X	X	X	X	X	X	X		X		X	X	X	X		X	
inductance	X	X	X	X	X	X	X		X		X	X	X	X	X	X	
dissipation factor	X	X	X	X			X		X			X			X	X	
1.2 High Frequency Quantities																	
voltage		X		X		X	X	X	X	X	X	X	X		X	X	
impendance (reflection factor)		X		X			X	X	X	(X)	X	X	X			X	
power		X	X	X		X	X	X	X	X	X	X	X			X	
attenuation		X	X	X			X	X	X	X	X	X	X			X	
noise		X		X			X				X	X					
electric/ magentic field quantities		X	X				X		X		X	X			X		
2. Magnetic quantities																	
magnetic flux density		X				X	X		X		X	X					
magnetic material properties		X				X	X		X			X					
3. Time and Frequency																	
time interval	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	
frequency	X	X	X	X	X	X	X		X	X	X	X	P	X	X	X	

National Laboratories	IT	JP	KR	MX	MY	NL	NO	NZ	SA	SE	SG	SK	TH	TK	TW	US
1. Electricity																
1.1 DC and Low frequency (<1MHz) quantities																
voltage	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
current	X	X	X	X	X	X		X	X	X	X	X	X		X	X
voltage ration	X	X	X		X	X		X	X	X	X	X			X	X
AC/DC transfer (voltage and current)	X	X	X	X	X	X		X	X	X	X	X			X	X
power and energy	X	X	X		X	X		X	X	X	X	X	X		X	X
resistance	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
capacitance	X	X	X	X	X	X		X		X	X	X	X		X	X
inductance	X	X	X	X	X	X		X		X	X		X		X	X
dissipation factor			X		X	X				X						X
1.2 High Frequency Quantities																
voltage	X	X	X		X			X		X	X	X			X	X
impendance (reflection factor)		X	X		X	X		X		X	X	X			X	X
power	X	X	X		X	X		X		X	X	X			X	X
attenuation	X	X	X		X	X		X		X	X	X			X	X
noise			X		X	X				X	X				X	X
electric/ magentic field quantities	X		X	X		X										X
2. Magnetic quantities																
magnetic flux density	X		X								X				X	X
magnetic material properties	X		X								X				X	X
3. Time and Frequency																
time interval	X		X	X	X	X		X	X	X	X	X			X	X
frequency	X		X	X	X	X		X	X	X	X	X			X	X

Accredited Laboratories	AT	AU	BE	CA	CH	CZ	DE	DK	ES	FI	FR	GB	HK	IE	IL	IN	IS
1. Electricity																	
1.1 DC and Low frequency (<1MHz) quantities																	
voltage	X	X	X	X	X	X	37	X	X	X	X	X	X	X		26	
current	X	X	X	X	X	X	30	X	X	X	X	X	X	X		32	
voltage ration	X	X	X	X		X	4	X	X	X	X	X				02	
AC/DC transfer (voltage and current)	X	X	X	X	X	X	7	X	X	X	X	X	X				
power and energy	X	X	X	X	X		8	X	X	X	X	X		X		1	
resistance	X	X	X	X	X	X	33	X	X	X	X	X	X	X		28	
capacitance	X	X	X	X	X	X	8	X	X	X	X	X				22	
inductance		X	X	X	X	X	5	X	X		X	X				22	
dissipation factor		X	X						X			X				01	
1.2 High Frequency Quantities																	
voltage		X		X		X	6	X	X		X	X		X		3	
impendance (reflection factor)		X		X		X	2	X	X		X	X		X		1	
power		X		X		X	3	X	X		X	X		X		2	
attenuation		X		X			4	X	X		X	X		X		2	
noise		X					1				X	X					
electric/ magentic field quantities		X							X			X					
2. Magnetic quantities																	
magnetic flux density		X				X			X			X					
magnetic material properties		X				X			X			X					
3. Time and Frequency																	
time interval	X	X			X	X	7	X	X	X	X	X	X	X			
frequency	X	X		X	X	X	12	X	X	X	X	X	X	X		2	

Accredited Laboratories	IT	JP	KR	MX	MY	NL	NO	NZ	SA	SE	SG	SK	TH	TK	TW	US
1. Electricity														X		
1.1 DC and Low frequency (<1MHz) quantities														X	X	
voltage	X	X	X		X	X	X	X		X		2		X	X	
current	X	X	X		X	X	X	X		X		2		X		
voltage ration	X	X	X		X	X	X	X		X				X		
AC/DC transfer (voltage and current)		X	X		X	X		X						X	X	
power and energy	X	X	X		X	X	X	X		X					X	
resistance	X	X	X		X	X	X	X		X		2		X	X	
capacitance	X	X	X		X	X	X	X		X					X	
inductance	X	X	X		X	X	X	X		X						
dissipation factor						X		X								
1.2 High Frequency Quantities																
voltage		X	X					X		X						
impendance (reflection factor)		X	X			X		X		X					X	
power	X	X	X		X	X				X						
attenuation	X	X	X			X		X		X						
noise																
electric/ magentic field quantities																
2. Magnetic quantities																
magnetic flux density			X													
magnetic material properties			X													
3. Time and Frequency														X		
time interval			X		X	X		X		X				X		
frequency	X		X		X	X		X		X				X		

Other Laboratories	AT	AU	BE	CA	CH	CZ	DE	DK	ES	FI	FR	GB	HK	IE	IL	IN	IS
1. Electricity																	
1.1 DC and Low frequency (<1MHz) quantities									X								
voltage						X			X								
current						X											
voltage ration						X											
AC/DC transfer (voltage and current)						X											
power and energy						X	182		X								
resistance						X											
capacitance						X											
inductance						X											
dissipation factor																	
1.2 High Frequency Quantities																	
voltage					X	X											
impendance (reflection factor)					X	X											
power					X	X	182										
attenuation					X	X											
noise					X	X											
electric/ magentic field quantities																	
2. Magnetic quantities																	
magnetic flux density						X											
magnetic material properties						X											
3. Time and Frequency																	
time interval						X											
frequency						X											

Other Laboratories	IT	JP	KR	MX	MY	NL	NO	NZ	SA	SE	SG	SK	TH	TK	TW	US
1. Electricity																
1.1 DC and Low frequency (<1MHz) quantities																
voltage			X		X							10	X		X	
current			X		X							9	X		X	
voltage ration			X		X							1	X		X	
AC/DC transfer (voltage and current)			X										X		X	
power and energy			X		X							8	X		X	
resistance			X		X							10	X		X	
capacitance			X		X							2	X		X	
inductance			X		X							2	X		X	
dissipation factor					X											
1.2 High Frequency Quantities																
voltage			X									1	X			
impendance (reflection factor)			X									1				
power			X		X								X		X	
attenuation			X										X		X	
noise															X	
electric/ magentic field quantities															X	
2. Magnetic quantities																
magnetic flux density			X												X	
magnetic material properties			X												X	
3. Time and Frequency																
time interval			X		X							5	X		X	
frequency			X		X							7	X		X	

National Laboratories	AT	AU	BE	CA	CH	CZ	DE	DK	ES	FI	FR	GB	HK	IE	IL	IN	IS
4 Dimensional quantities																	
4.1 length									X								
laser wavelength	X	X	X	X	X	X	X		X		X	X	X			X	
length gauges	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
line scales, distances	X	X		X	X		X		X	X	X	X	X	X		X	
length measuring instruments	X	X	X	X	X		X		X	X	X	X	X	X	X	X	
diameter	X	X	X		X		X		X	X	X	X	X	X	X	X	
form error		X			X		X		X	X	X	X	X	X			
roughness		X	X		X		X		X	(X)	X		X	X		X	
thread quantities		X			X		X		X		X	X					
coordinate measuring machines		X		X	X		X		X		X	X		X		X	
machine tools, work pieces	X	X			X		X		X	X			X	X		X	
4.2 angle																	
angle gauges		X		X	X	X	X		X	X	X	X	X	X	X	X	
index tables		X		X	X	X	X		X		X	X	X	X	X	X	
clinometers		X		X	X	X	X		X		X		X	X		X	
5 mechanical quantities (except dimensional)																	
force	X	X	X	X	X	X	X	X	X		X	X		X		X	
mass (mass and density of mass standards)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
weighing instruments	X	X	X		X	X	X		X	X			X	X	?	X	X
pressure	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
vacuum quantities		X	X	X	X		X		X	X	X	X	X	X	X	X	
torque		X		X	X	X	X		X		X		X	X		X	
acceleration		X		X	X	X	X	X	X		X						
6 acoustical quantities		X		X	X	X	X	X	X		X	X		X		X	

National Laboratories	IT	JP	KR	MX	MY	NL	NO	NZ	SA	SE	SG	SK	TH	TK	TW	US
4 Dimensional quantities																
4.1 length																
laser wavelength	X	X	X			X		X	X	X	X	X				X
length gauges	X	X	X	X	X	X		X	X	X	X	X	X		X	X
line scales, distances	X		X	X	X	X		X	X	X	X	X	X			X
length measuring instruments	X		X	X	X	X		X	X	X	X		X		X	
diameter	X		X	X	X	X		X	X	X	X		X		X	X
form error	X		X			X		X			X		X		X	X
roughness	X		X			X		X			X	X			X	X
thread quantities	X		X	X		X		X		X	X		X		X	X
coordinate measuring machines	X		X		X	X		X			X		X		X	X
machine tools, work pieces	X		X		X			X			X		X			
4.2 angle																
angle gauges	X		X	X	X	X			X		X	X	X		X	X
index tables	X		X	X		X					X	X	X		X	X
clinometers	X		X			X					X	X	X		X	X
5 mechanical quantities (except dimensional)																
force	X		X	X	X	X			X	X	X		X		X	X
mass (mass and density of mass standards)	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
weighing instruments	X		X	X	X	X	X	X	X	X	X	X	X		X	
pressure	X		X	X	X	X		X	X	X	X	X	X		X	X
vacuum quantities	X		X		X			X			X	X			X	X
torque	X		X			X		X			X		X			
acceleration	X		X	X		X				X	X				X	X
6 acoustical quantities	X		X	X	X					X		X	X		X	X

Accredited Laboratories	AT	AU	BE	CA	CH	CZ	DE	DK	ES	FI	FR	GB	HK	IE	IL	IN	IS
4 Dimensional quantities																	
4.1 length									X								
laser wavelength									X								
length gauges	X	X	X	X	X	X	20	X	X	X	X	X					
line scales, distances	X	X		X	X	X	3	X	X	(X)	X	X					
length measuring instruments	X	X	X	X			1	X	X	X	X	X	X	X		10	
diameter	X	X			X		5	X	X	X	X	X					
form error		X					7	X	X	X	X	X					
roughness		X			X		7	X	X		X	X					
thread quantities		X			X		2	X	X		X	X					
coordinate measuring machines		X					3		X	(X)	X	X					
machine tools, work pieces		X			X			X	X	X		X		X			
4.2 angle																	
angle gauges		X					2		X		X	X				4	
index tables		X			X		1		X		X	X					
clinometers		X			X		1		X		X	X					
5 mechanical quantities (except dimensional)																	
force	X	X	X	X			9	X	X	X	X	X	X	X			
mass (mass and density of mass standards)	X	X			X	X	5	X	X	X	X	X	X			3	
weighing instruments	X	X						X	X	X	X	X	X	X			
pressure	X	X	X	X	X	X	27	X	X	X	X	X	X			5	
vacuum quantities		X					3	X	X			X				1	
torque		X			X		4		X		X	X	X	X			
acceleration		X					5		X		X	X					
6 acoustical quantities		X		X			2	X	X		X	X	X				

Accredited Laboratories	IT	JP	KR	MX	MY	NL	NO	NZ	SA	SE	SG	SK	TH	TK	TW	US
4 Dimensional quantities																
4.1 length																
laser wavelength		X				X		X								
length gauges	X	X	X	X	X	X	X	X		X		3			X	
line scales, distances	X		X		X	X	X	X		X						
length measuring instruments	X		X	X	X	X	X	X		X		3				
diameter	X		X	X	X	X	X	X		X		3			X	
form error	X		X			X	X	X				3				
roughness	X		X			X	X	X							X	
thread quantities	X		X	X		X	X			X		2				
coordinate measuring machines	X		X			X				X						
machine tools, work pieces	X		X		X	X		X		X						
4.2 angle																
angle gauges	X		X			X	X			X						
index tables	X		X			X										
clinometers	X		X			X										
5 mechanical quantities (except dimensional)																
force	X		X	X		X		X		X				X	X	
mass (mass and density of mass standards)	X	X	X			X		X		X					X	
weighing instruments	X		X		X	X	X	X		X				X		
pressure	X		X		X	X		X		X		3		X	X	
vacuum quantities			X									2			X	
torque	X		X					X		X		1				
acceleration	X		X	X								2				
6 acoustical quantities	X		X									1			X	

Other Laboratories	AT	AU	BE	CA	CH	CZ	DE	DK	ES	FI	FR	GB	HK	IE	IL	IN	IS
4 Dimensional quantities																	
4.1 length									X								
laser wavelength						X				X							
length gauges						X				X							
line scales, distances						X				X							
length measuring instruments						X				X							
diameter						X											
form error						X											
roughness						X											
thread quantities						X											
coordinate measuring machines						X											
machine tools, work pieces						X											
4.2 angle																	
angle gauges						X											
index tables						X											
clinometers						X											
5 mechanical quantities (except dimensional)																	
force						X											
mass (mass and density of mass standards)		X				X			X	X							
weighing instruments		X				X	16			X							
pressure						X											
vacuum quantities						X											
torque						X											
acceleration						X											
6 acoustical quantities						X											

Other Laboratories	IT	JP	KR	MX	MY	NL	NO	NZ	SA	SE	SG	SK	TH	TK	TW	US
4 Dimensional quantities																
4.1 length																
laser wavelength													X			
length gauges			X									13	X		X	
line scales, distances			X		X							4	X		X	
length measuring instruments			X									14	X		X	
diameter			X									4	X		X	
form error			X									1	X		X	
roughness			X									1			X	
thread quantities			X									3			X	
coordinate measuring machines			X										X		X	
machine tools, work pieces			X										X		X	
4.2 angle																
angle gauges			X									3			X	
index tables			X									2			X	
clinometers			X									2			X	
5 mechanical quantities (except dimensional)																
force			X									6	X		X	
mass (mass and density of mass standards)			X		X							5	X		X	
weighing instruments			X		X							13	X		X	
pressure			X									13	X		X	
vacuum quantities			X										X		X	
torque			X									1				
acceleration			X												X	
6 acoustical quantities			X												X	

National Laboratories	AT	AU	BE	CA	CH	CZ	DE	DK	ES	FI	FR	GB	HK	IE	IL	IN	IS
7 Fluid quantities																	
gas and liquid flow rate	X	X	X		X		X					X					
volume of flowing gases and liquids		X	X		X	X	X	X				X					X
velocity of gases	X				X		X										
mass, volume and density of gases and liquids	X	X	X	X	X		X			(X)	X	X	X			X	
viscosity	X	X	X		X		X				X					X	
8 Optical quantities																	
radiometric quantities	X	X		X	X		X		X		X	X			?	X	
photometric quantities	X	X		X	X	X	X		X		X	X			?	X	
optical system quantities		X		X			X		X		X	X			?	X	
9 Ionising radioation and radioactivity																	
radiometric quantities	X	X		X		X	X		X		X					X	
dosimetric quantities	X	X		X		X	X		X		X	X				X	
radioprotection quantities	X	?		X		X	X		X		X	X				X	
activity of radioactive sources	X	X		X		X	X		X		X	X				X	
10 Temperature, humidity and thermophysical properties																	
resistance thermometers	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
thermocouples	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
liquid-in-glass thermometers	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
radioation thermometers	X	X		X		X	X		X	X	X	X				X	
humidity		X	X	X	X		X		X		X	X	X				
thermophysical properties		X		X			X		X		X	X				X	
11 Chemical analysis, reference materials																	
amount of substance							X				X		X		X	X	
gas mixtures					X						X	X				X	
pH measuring equipment							X	X							X	X	
hardness		X				X					X		X		X		

National Laboratories	IT	JP	KR	MX	MY	NL	NO	NZ	SA	SE	SG	SK	TH	TK	TW	US
7 Fluid quantities																
gas and liquid flow rate	X		X	X	X	X				X		X	X		X	X
volume of flowing gases and liquids	X		X	X	X	X	X			X		X	X		X	X
velocity of gases			X	X									X			X
mass, volume and density of gases and liquids	X		X	X	X	X	X	X		X	X	X	X		X	X
viscosity	X		X	X		X			X			X	X		X	
8 Optical quantities																
radiometric quantities		X	X	X	X	X		X		X	X	X	X		X	X
photometric quantities	X	X	X	X		X		X		X	X	X	X		X	X
optical system quantities	X		X	X				X		X					X	X
9 Ionising radioation and radioactivity																
radiometric quantities	X	X	X		X	X				X					X	X
dosimetric quantities	X	X	X		X	X				X		X			X	X
radioprotection quantities	X		X		X	X						X			X	X
activity of radioactive sources			X		X	X									X	X
10 Temperature, humidity and thermophysical properties																
resistance thermometers	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
thermocouples	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
liquid-in-glass thermometers	X	X	X	X	X	X		X	X	X	X	X	X		X	X
radioation thermometers	X	X	X		X	X		X		X	X	X	X		X	X
humidity	X		X		X	X			X		X	X			X	X
thermophysical properties	X		X									X				
11 Chemical analysis, reference materials																
amount of substance		X							X			X				X
gas mixtures		X		X		X										X
pH measuring equipment									X			X			X	X
hardness	X		X			X			X		X					X

Accredited Laboratories	AT	AU	BE	CA	CH	CZ	DE	DK	ES	FI	FR	GB	HK	IE	IL	IN	IS
7 Fluid quantities																	
gas and liquid flow rate	X	X					7	X		X	X	X			1		
volume of flowing gases and liquids		X				X	6	X			X	X			1		
velocity of gases								X			X						
mass, volume and density of gases and liquids		X						X			X	X					
viscosity							1					X					
8 Optical quantities																	
radiometric quantities		X					4	X			X	X					
photometric quantities		X									X	X			1		
optical system quantities		X					1								1		
9 Ionising radioation and radioactivity																	
radiometric quantities									X		X				3		
dosimetric quantities							2	X	X		X	X			3		
radioprotection quantities						X	2		X		X	X			2		
activity of radioactive sources							1				X	X			3		
10 Temperature, humidity and thermophysical properties																	
resistance thermometers	X	X	X	X	X	X	15	X	X	X	X	X	X		1		
thermocouples	X	X	X	X	X	X	13	X	X	X	X	X	X		1		
liquid-in-glass thermometers	X	X	X	X	X	X	1	X	X	X	X	X	X		1		
radioation thermometers									X		X	X					
humidity				X	X						X	X					
thermophysical properties		X							X			X					
11 Chemical analysis, reference materials																	
amount of substance								X					X				
gas mixtures		X			X			X				X					
pH measuring equipment								X						X			
hardness		X				X	1	X				X		X			

Accredited Laboratories	IT	JP	KR	MX	MY	NL	NO	NZ	SA	SE	SG	SK	TH	TK	TW	US
7 Fluid quantities																
gas and liquid flow rate			X			X	X					1				
volume of flowing gases and liquids			X			X		X				1				
velocity of gases																
mass, volume and density of gases and liquids			X			X	X	X		X						
viscosity			X													
8 Optical quantities																
radiometric quantities		X	X							X						
photometric quantities	X	X	X	X		X				X					X	
optical system quantities			X			X										
9 Ionising radioation and radioactivity																
radiometric quantities	X	X														
dosimetric quantities	X	X	X									1			X	
radioprotection quantities	X		X													
activity of radioactive sources			X													
10 Temperature, humidity and thermophysical properties																
resistance thermometers	X	X	X			X	X	X		X		2		X	X	
thermocouples	X	X	X		X	X	X	X		X		2		X		
liquid-in-glass thermometers	X	X	X		X	X	X	X		X		1		X		
radioation thermometers	X	X	X			X				X				X		
humidity			X			X										
thermophysical properties								X								
11 Chemical analysis, reference materials																
amount of substance		X														
gas mixtures		X				X		X								
pH measuring equipment																
hardness			X			X		X								

Other Laboratories	AT	AU	BE	CA	CH	CZ	DE	DK	ES	FI	FR	GB	HK	IE	IL	IN	IS
7 Fluid quantities																	
gas and liquid flow rate		X				X	182			X							
volume of flowing gases and liquids		X				X				X							
velocity of gases						X						X					
mass, volume and density of gases and liquids		X				X				X							
viscosity						X											
8 Optical quantities																	
radiometric quantities						X				X							
photometric quantities			X			X				X				X			
optical system quantities																	
9 Ionising radioation and radioactivity																	
radiometric quantities						X				X				X			
dosimetric quantities			X			X				X				X			
radioprotection quantities						X				X							
activity of radioactive sources						X				X				X			
10 Temperature, humidity and thermophysical properties																	
resistance thermometers						X								X			
thermocouples						X				X				X			
liquid-in-glass thermometers						X	6			X				X			
radioation thermometers						X											
humidity						X				X				X			
thermophysical properties						X											
11 Chemical analysis, reference materials																	
amount of substance						X											
gas mixtures						X											
pH measuring equipment						X											
hardness						X				X							

Other Laboratories	IT	JP	KR	MX	MY	NL	NO	NZ	SA	SE	SG	SK	TH	TK	TW	US
7 Fluid quantities																
gas and liquid flow rate			X									6				
volume of flowing gases and liquids			X		X							14				
velocity of gases																
mass, volume and density of gases and liquids			X									26				
viscosity			X									2				
8 Optical quantities																
radiometric quantities			X												X	
photometric quantities			X												X	
optical system quantities			X												X	
9 Ionising radioation and radioactivity																
radiometric quantities															X	
dosimetric quantities			X												X	
radioprotection quantities			X												X	
activity of radioactive sources			X									13			X	
10 Temperature, humidity and thermophysical properties																
resistance thermometers			X									2	X		X	
thermocouples			X									6	X		X	
liquid-in-glass thermometers			X									5			X	
radioation thermometers			X												X	
humidity			X									1	X		X	
thermophysical properties				X								7				
11 Chemical analysis, reference materials																
amount of substance												1				
gas mixtures												2				
pH measuring equipment												2			X	
hardness			X									2				

Part B Requirements for Traceability

	AT	AU	BE	CA	CH	CZ	DE	DK	ES	FI	FR	GB	HK	IE	IL	IN	IS
1. Testing laboratory accreditation body requires traceability for all measurements and tests having an effect on the accuracy or validity of tests	X	X				X	X		X		X	X	X	X		X	
Testing laboratory accreditation body requires traceability for those measurements and tests for which traceability is applicable and available			X	X	X			X		X					X		X
Testing laboratory accreditation body does not require traceability																	
2. Calibration certificates to demonstrate traceability are accepted:																	
- only by the national standards laboratory(ies) of that country to demons.		X		X								X		X		X	
- by the national standards laboratories form those countries which participate in the work of CIPM	X		X	X	X	X	X			X		X		X	X	X	X
- by all other national standards laboratories							X			X							
- by the national standards body called up in the national test specification being used									X								
- by accredited calibration laboratories from the calibration laboratory accreditation body in the country	X	X	X	X		X	X	X	X	X	X	X	X	X		X	X
- by accredited calibration laboratories accredited by a body with which your calibration laboratory has an agreement of equivalence		X		X	X		X	X	X	X	X	X	X	X			
- by accredited calibration laboratories from all other calibration laboratory accreditation bodies							X			X						X	
3. The testing laboratory accreditation body requires laboratories to obtain calibration certificates that contain a statement of measurement uncertainty and the measuring of this statement	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y
Calibration certificates are acceptable for the testing laboratory accreditation body which state a compliance with a certain defined specification	Y	Y	N	Y	Y	N	Y	Y	Y	Y	N	Y	N	N		N	N
4. The calibration laboratory accreditation body has agrements of equivalence with other organisations		@2			@1		@1	@1	@1	@1	@1	@1,2	@2	@1	NIST		

		IT	JP	KR	MX	MY	NL	NO	NZ	SA	SE	SG	SK	TH	TK	TW	US
1.	Testing laboratory accreditation body requires traceability for all measurements and tests having an effect on the accuracy or validity of tests	X		X	X	X	X		X			X		X			
	Testing laboratory accreditation body requires traceability for those measurements and tests for which traceability is applicable and available							X		X	X		X		X	X	X
	Testing laboratory accreditation body does not require traceability		n.a.														
2.	Calibration certificates to demonstrate traceability are accepted :																
-	only by the national standards laboratory(ies) of that country to demons.				X			X									
-	by the national standards laboratories form those countries which participate in the work of CIPM	X		X		X	X	X	X	X	X	X	X	X	X	X	
-	by all other national standards laboratories													X			
-	by the national standards body called up in the national test specification being used			X	X	X											X
-	by accredited calibration laboratories from the calibration laboratory accreditation body in the country	X		X		X	X	X	X	X	X	X	X			X	X
-	by accredited calibration laboratories accredited by a body with which your calibration laboratory has an agreement of equivalence	X		X			X		X		X	X	X		X	X	X
-	by accredited calibration laboratories from all other calibration laboratory accreditation bodies							X		X				X			
3.	The testing laboratory accreditation body requires laboratories to obtain calibration certificates that contain a statement of measurement uncertainty and the measuring of this statement	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
	Calibration certificates are acceptable for the testing laboratory accreditation body which state a compliance with a certain defined specification	N		Y		Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y
4.	The calibration laboratory accreditation body has agreements of equivalence with other organisations	@1					@1	@1	@2		@1						

FOOTNOTES PART B

@1 WECC Mulitlateral Agreement and South Africa @2 NAMAS, HOKLAS, TELARC, NATA

The International Laboratory Accreditation Cooperation (ILAC) is the principal international forum for the exchange of ideas and information on laboratory accreditation.

Established in the late 1970s, ILAC membership has grown rapidly and includes representatives from the world's major laboratory accreditation systems in Europe, Asia, North America, Australia and the Pacific. Countries that are developing their own laboratory accreditation systems are also welcome to participate and contribute.

ILAC operates a series of committees which investigate issues such as the harmonisation of international laboratory accreditation practices, the effectiveness of mutual recognition agreements in facilitating trade and the promotion of the aims and awareness of laboratory accreditation around the world.

There are regular meetings of individual ILAC committees as well as a major plenary meeting of all ILAC members.

The activities of ILAC affect a diverse range of areas including standardisation, accreditation, certification, testing, calibration, and regulation in both the public and private sectors.

ILAC Publications Currently Available

Information Documents (I Series)

ILAC-I1:1994	Legal Liability in Testing
ILAC-I2:1994	Testing, Quality Assurance, Certification and Accreditation
ILAC-I3:1996	The Role of Testing and Laboratory Accreditation in International Trade
ILAC-I4:1996	Guidance Documents for the Preparation of Laboratory Quality Manuals

Guidance Documents (G Series)

ILAC-G2:1994	Traceability of Measurement
ILAC-G3:1994	Guidelines for Training Courses for Assessors
ILAC-G4:1994	Guidelines on Scopes of Accreditation
ILAC-G7:1996	Accreditation Requirements and Operating Criteria for Horseracing Laboratories
ILAC-G8:1996	Guidelines on Assessment and Reporting of Compliance with Specification
ILAC-G9:1996	Guidelines for the Selection and Use of Certified Reference Materials
ILAC-G10:1996	Harmonised Procedures for Surveillance & Reassessment of Accredited Laboratories
ILAC-G11:1998	Guidelines on Assessor Qualification and Competence
ILAC-G12:2000	Guidelines for the Requirements for the Competence of Reference Material Producers
ILAC-G13:2000	Guidelines for the Requirements for the Competence of Providers of Proficiency Testing Schemes
ILAC-G14:2000	Guidelines for the Use of Accreditation Body Logos and for Claims of Accreditation Status
ILAC-G15:2001	Guidance for Accreditation to ISO/IEC 17025

Secretariat Documents (S Series)

ILAC-S1:2000	Guidelines for the Preparation, Layout and Numbering of ILAC Publications
ILAC-S2:1998	Rules

Procedural Documents (P Series)

ILAC-P1:2000	ILAC Mutual Recognition Arrangement (Arrangement): Requirements for Evaluation of Accreditation Bodies
ILAC-P2: 2000	ILAC Mutual Recognition Arrangement (Arrangement): Procedures for the Evaluation of Regional Cooperation Bodies for the Purpose of Recognition