INTERNATIONAL
DOCUMENT

OIML D 14

Edition 2004 (E)

Training and qualification of legal metrology personnel

Formation et qualification des personnels de métrologie légale

OIML D 14 Edition 2004 (E)

ORGANISATION INTERNATIONALE
DE MÉTROLOGIE LÉGALE

INTERNATIONAL ORGANIZATION
OF LEGAL METROLOGY

Contents

Foreword

The International Organization of Legal Metrology (OIML) is a worldwide, intergovernmental organization whose primary aim is to harmonize the regulations and metrological controls applied by the national metrological services, or related organizations, of its Member States.

The two main categories of OIML publications are:

- **International Recommendations (OIML R)**, which are model regulations that establish the metrological characteristics required of certain measuring instruments and which specify methods and equipment for checking their conformity; the OIML Member States shall implement these Recommendations to the greatest possible extent;
- **International Documents (OIML D)**, which are informative in nature and intended to improve the work of the metrology services.

OIML Draft Recommendations and Documents are developed by Technical Committees or Subcommittees which are formed by Member States. Certain international and regional institutions also participate on a consultation basis.

Cooperative agreements are established between OIML and certain institutions, such as ISO and the IEC, with the objective of avoiding contradictory requirements; consequently, manufacturers and users of measuring instruments, test laboratories, etc. may simultaneously apply OIML publications and those of other institutions.

International Recommendations and Documents are published in French (F) and English (E) and are subject to periodic revision.

This publication - reference OIML D 14 Edition 2004 (E) - was developed by Working Group 1 of the former OIML Development Council and was approved for final publication by CIML postal ballot in 2004. This edition supersedes the previous version dated 1989.

OIML Publications may be downloaded from the OIML web site in the form of PDF files. Additional information on OIML Publications may be obtained from the Organization's headquarters:

International Bureau of Legal Metrology
11, rue Turgot - 75009 Paris - France
Telephone: 33 (0)1 48 78 12 82
Fax: 33 (0)1 42 82 17 27
E-mail: biml@oiml.org
Internet: www.oiml.org

Training and qualification of legal metrology personnel

Introduction

The previous edition of Document D 14 *Training of legal metrology personnel – Qualification – Training programs* (1989) dealt with the training and qualification for both "metrology engineers" and "metrology technicians".

Discussions showed that there is a certain need for a specific training program for legal metrology officers who carry out verification, inspections and supervision in the field of legal metrology.

Experience proves that the majority of the staff in verification offices will need the qualification of "legal metrology officer" or a comparable qualification.

For certain tasks in this field, trained engineers might be necessary to fulfill the requirements. These engineers might for example work in central national institutions and deal with the implementation of OIML Recommendations, standards or with the general evaluation of measurement uncertainties.

Engineers with a university degree mainly perform highly specified tasks in science, industry or laboratories for type approval. Due to the fact that their number is relatively small in the field of legal metrology, this revision focuses on the training and qualification of legal metrology officers only.

1 Scope

The aim of this Document is to define the general outlines for the qualification of legal metrology officers and to suggest models for training programs for this profession.

The training and qualification is set up in a modular structure, which allows each country to arrange tailor-made training programs according to the preconditions and the specific needs (qualification on demand).

This Document is not concerned with technicians responsible for the metrological control of production in all industrial sectors, technicians in charge of maintenance of measuring instruments or technicians employed to help engineers and research workers in research laboratories and basic metrology laboratories, but it is evident that many of the subjects included in the study program could also be useful for such technicians.

2 Legal metrology officers

2.1 Definition

Legal metrology officers are agents appointed by the state or a local authority, or having a similar legal status, responsible for the execution of various tasks defined within the framework of the application of laws and regulations in the field of legal metrology.

2.2 Scope of tasks

The application of regulations and reference to categories of measuring instruments concerning legal metrology should refer to OIML D 1 *Elements for a law on metrology*. The table at the top of page 5 illustrates tasks and examples.

Tasks	Examples
Verification and technical inspection of measuring instruments:	• See list of measuring instruments relevant for legal metrology officers, Annex A
Inspection and supervision of:	• Net contents in prepackages • Measuring systems including software for data processing of measuring results • Manufacturers and importers of measuring instruments • Repair firms • Authorized bodies for verification • Medical laboratories
Special tasks:	• Assessment and accreditation of testing laboratories • Assessment, auditing and certification of quality management systems • Tasks as a member of a notified body

2.3 Recruitment

Legal metrology officers are usually recruited at university education level, generally in scientific and technological disciplines. They should have a good general knowledge of mathematics, physics and basic engineering.

When selecting legal metrology officers it is recommended to take into account not only scientific and technical knowledge but also general culture and human qualities.

3 Recommended qualifications for legal metrology officers

3.1 Knowledge

The legal metrology officer should have a good general knowledge of:

- The legal and administrative regulations concerning legal metrology;
- The principles of general metrology including the software used in measuring instruments and systems;
- The principles of construction and operation of the various instruments he or she has to verify as well as the regulations applicable to them; and
- The principles of quality management, accreditation and certification in the field of legal metrology.

3.2 Competence

The legal metrology officer should be able to:

- Identify breaches of the legal metrology laws and regulations and establish factual reports in certified statements;
- Carry out measurements of environmental conditions and at a given accuracy level;
- Carry out statistical calculations resulting from several measurements in control by sampling, and deduce the correct conclusions;
- Carry out calibrations while taking account of external conditions and of the level of accuracy required; and
- Identify the non-application of mandatory standards to finished products and their components.

Depending on the status of the institution, the requirements of ISO/IEC 17025 on personnel may apply.

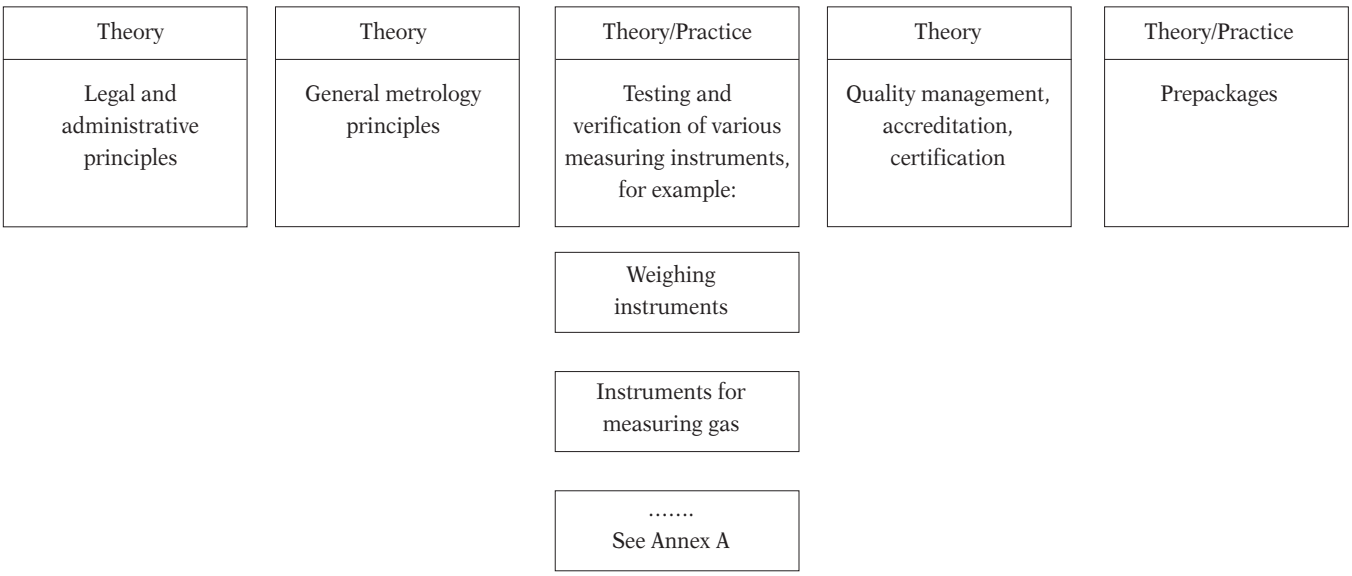
4 Basic training in legal metrology

4.1 Structure of training

4.1.1 Training modules

The contents of the training are set out in a modular structure according to the required qualification of legal metrology officers. Since this training is given with the objective of applying the legal metrology regulations within a given country, it should naturally be adapted to these regulations and may differ from one country to another. The contents of the training modules shall be independent of each other, so that certain modules can be carried out whenever the organizational or personnel conditions require additional knowledge (qualification on demand).

Training modules:



4.1.2 Documentation, final examination, mutual recognition

The contents and duration of lessons given in each training module should be documented. After each training module, there should be a final examination (theoretical and/or practical) to ensure that the participants have acquired the required qualification.

Provided that the contents of the training module and conditions of the final examination are documented transparently, the qualification acquired by the participants can be recognized on an international level.

4.1.3 Theoretical/practical parts

It is recommended to provide a period of theoretical training, given by a school or institute, and a practical training session in a verification office.

For examples of the duration of training modules, see Annex C.

4.2 Contents of training modules

4.2.1 Module "Legal and administrative principles"

Structures	Topics
Basic notions of national law	• Introduction to the legal system • Constitution, administrative/criminal law, criminal procedure and legal organization
International metrological institutions and issued documents	• OIML (Recommendations, Documents, Certificates) • ISO/IEC (Standards) • ➔ See also Annex B
Administrative relations	• National metrological infrastructures • National administrative structures
Specialized legislation	Studies of the general texts whose application is entrusted to the legal metrology service: • Law on metrology • Law on units and implementation in regulations • Laws and regulations concerning measuring instruments subject to state control • The various aspects of control (type approval, initial verification, in-service verification, supervision) • Associated legislation (economic legislation, fraud legislation, etc.) • Application of standards • Administrative offences and legal proceedings
Occupational safety	• Prevention of accidents, safety equipment and clothing, methods of first aid
Hygiene regulations	• Rules concerning staff working in sensitive areas

4.2.2 Module "General metrology principles"

Structures	Topics
Terminology, basic knowledge	• Quantities and units • Measurement standards • Metrological qualities of an instrument • Definition and metrological qualities of a measuring chain (examples of sensors and transducers) • Traceability • Calibration and control • Calibration chains
Statistics and probabilities	• Combinative analysis • Calculation of probabilities - laws of probabilities • Generalities on statistical variables • Reduction of data • Sampling schemes • Estimates
Mathematics and physics	• Error calculation • Importance and determination of measurement uncertainties by examples • Physical quantities related to mechanics of solids, liquids, gases, thermodynamics • Electricity, electrical metrology
Data processing	• General notions concerning data processing • Knowledge of the most common equipment • Training in the use of relevant software • Software testing and quality assurance • Measurement data processing • Measurement data transfer technology

4.2.3 Module "Testing and verification of various measuring instruments"

For the technical study of various measuring instruments (see also Annex A) and methods of measurement, it is advisable to follow the chronological order given below.

The module should be adapted to the specific properties of the given category of measuring instruments.

Structures		**Remarks**
Introduction to the category of measuring instrument	Practice	Witnessing a verification session on site (in service, in a laboratory or in a factory)
Principles of construction and operation of the measuring instruments	Theory	
International/national regulations concerning the category of measuring instruments	Theory	See also Annex B: Reference documents for basic training in legal metrology
Handling of the necessary standards and testing equipment	Theory/Practice	
Introduction to influence quantities and measurement uncertainties for the category of measuring instruments	Theory	
Introduction to the handling of software used in this category of measuring instruments	Theory	
Visit to a manufacturer	Practice	If possible
Practical experiments concerning handling	Practice	On site/on a test bench with "hands on" experience of the instruments

4.2.4 Module "Quality management, accreditation, certification"

Structures	Topics
Quality management	• Principles, terminology • Relevant standards (ISO 9000, ISO 17025, etc.) • The quality management system of the verification institution
Accreditation, certification	• Principles of accreditation and certification • The national and international accreditation and certification system • Conformity assessment • Quality management in testing or calibration laboratories • The accreditation procedure • Documentation

4.2.5 Module "Prepackages"

Structures		Remarks
Legal principles for the supervision of prepackages	Theory	• Relevant OIML Recommendations • Relevant national regulations and standards • Definitions
Checking the net contents	Theory/Practice	• Labeling of prepackages • Requirements for net contents • Test methods, sampling schemes • Determination of density • Standards and testing equipment for density, weight and volume
Controls by public authority	Practice	• On-site (importer/manufacturer)
Internal controls by the manufacturer	Theory/Practice	• On-site (manufacturer)
Measuring container bottles	Theory/Practice	• Testing by templates
Gravimetric and volumetric filling machines - checkweighers	Theory/Practice	• Verification and supervision

4.3 Organization of practical training

Trainees are allocated to verification offices, either singly or in small groups of two or three maximum.

In these offices and under the supervision of the head of the office or a qualified and experienced person, the trainees take part in all legal metrology operations, participate in, and then carry out on their own, the operations which correspond to their future positions.

They can thus build on the knowledge gained during the theoretical training period, combine this with the necessities of practical controls, see this confronted with difficulties related to human factors and gain the dexterity and experience they will require to further their career.

4.4 Follow-up training

Due to the rapid development of techniques in metrology, it will be necessary to complement the basic training described in this Document, by continued training consisting for instance of practical and theoretical courses of five to ten days per year.

Annex A - List of measuring instruments relevant for legal metrology officers

The measuring instruments subject to legal metrology differ from one country to another, therefore the relevant categories have to be adapted to the national regulations of the given country.

Category	Measuring instruments
Weighing	• General notions on levers and the oscillating beam • Nonautomatic weighing instruments (different classes) • Automatic weighing instruments • Strain gauge devices • Electronic devices • Weights
Dynamic measurement of liquids	• Main types of measuring equipment (with alternating movement, rotary, turbine, discontinuous distributors) • Water meters • Meters for milk and other liquid foods • Hydrocarbon meters • Liquefied gas meters • Temperature compensators
Static measurement of liquids	• Storage tanks • Measuring transport tanks • Proving tanks and gauging stations • Level measuring devices
Dimensional measurements	• Length • Area • Capacity
Measurement of gas	• Gas volume meters • Volume correctors • Manometers • Differential pressure meters
Measurement of electrical energy	• Single phase and three phase electricity meters • Measuring transformers
Measurement of thermal energy	• Measurement of temperatures • Thermal energy meters
Measurements in road traffic	• Taximeters • Chronotachographs • Tachometers • Speed meters (radar, laser) • Tire pressure gauges • Breath analyzers • Parking meters

Category	Measuring instruments
Health	• Medical thermometers • Blood pressure manometers • Medical glass measures • Sound level meters • Carbon monoxide analyzers • Dosimeters for ionizing radiation
Density measurement	• Density meters • Viscometers
Agricultural measurements	• Hectolitre mass of cereals • Moisture meters for cereals and oilseeds • Polarimetric saccharimeters and refractometers • Alcoholometers • Butyrometers

Annex B Reference documents for basic training in legal metrology

B.1 International regulations and standards

- OIML Recommendations
- OIML Documents
- ISO Standards
- IEC Standards

B.2 Regional regulations and standards

For example:

Europe	Southern African Development Community
• WELMEC Guides • EN Standards • EU Directives	• Harmonized technical regulations

B.3 National regulations and standards

- Law on metrology
- Law on units and implementation in regulations
- Laws and regulations concerning measuring instruments subject to state control
- Associated legislation (economic legislation, fraud legislation, etc.)
- National standards
- Regulations on administrative offences and legal proceedings

B.4 Additional documents

- Type approval certificates and documentation
- Manuals
- Training documents from manufacturers
- Service manuals from manufacturers
- Video films and interactive e-learning modules

Annex C Examples of curricula for training modules

The time needed for the lessons depends on the previous knowledge and experience of the participants and will therefore be subject to changes.

T = Theoretical part, **P** = Practical part

Example C.1 Training module on "Legal and administrative principles"

Subject	T/P	Hours
Introduction to the legal system: constitution, administrative/criminal law, criminal procedure and legal organization	T	2
International documents: OIML (Recommendations, Documents, Certificates), ISO/IEC (Standards)	T	2
National metrological and administrative infrastructures	T	1
Law on metrology	T	2
Law on units and implementation in regulations	T	1
Laws and regulations concerning measuring instruments subject to state control	T	2
The various aspects of control (type approval, initial verification, in-service verification, supervision)	T	4
Associated legislation (economic legislation, fraud legislation, etc.)	T	2
Application of standards	T	2
Administrative offences and legal proceedings	T	10
Prevention of accidents, safety equipment and clothing, methods of first aid	T	2
Rules concerning staff working in sensitive areas	T	2

Example C.2 Training module on "General metrology principles"

Subject	T/P	Hours
Terminology, basic knowledge		
Quantities and units	T	1
Measurement standards	T	2
Metrological qualities of an instrument	T	4
Definition and metrological qualities of a measuring chain (examples of sensors and transducers)	T	2
Traceability	T	2
Calibration and control	T	2
Calibration chains	T	2
Statistics and probabilities		
Combinative analysis	T	4
Calculation of probabilities - laws of probabilities	T	4
Generalities on statistical variables	T	4
Reduction of data	T	2
Sampling schemes	T	4
Estimates	T	2
Mathematics and physics		
Error calculation	T	12
Importance and determination of measuring uncertainties by examples	T	10
Physical quantities related to mechanics of solids, liquids, gases, thermodynamics	T	8
Electricity, electrical metrology	T	12
Data processing		
General notions concerning data processing	T	2
Knowledge of the most common equipment	T	4
Training in the use of the relevant software	T	8
Software testing and quality assurance	T	4
Measurement data processing	T	2
Measurement data transfer technology	T	2

Example C.3 Training module on "Testing and verification of various measuring instruments"

In this example, verification of weighing instruments

Subject	T/P	Hours
Basic weighing principles	T	2
Review of OIML requirements concerning nonautomatic weighing instruments	T	2
Information presented in a type approval certificate or in an OIML Certificate	T	1
Verification of nonautomatic weighing instruments	T	2
Verification of test weights	T	2
Load measuring devices and load cells	T	2
Electromagnetic compensation devices	T	2
Load cells - classification	T	2
Practice in the verification of class III retail scales	P	8
Practice in the calibration of heavy test weights - 20 kg to 500 kg	P	8
Types and characteristics of mechanical vehicle scales	T	2
Review of various types of vehicle scales verification equipment	T	2
Electronic static vehicle scales and hopper scales, characteristics and verification	T	2
Verification of a mechanical vehicle scale up to 40 t	T/P	16
Verification of class II mechanical and electronic scales used for pharmaceutical dispensing and jewellery trade	P	8
On-site verification of an electronic vehicle scale	P	8
Electronics in the construction of weighing machines, including retail electronic scales	T	2
Review of principles and requirements for automatic industrial scales including in-motion weighbridges and beltweighers	T	2

Example C.4 Training module on "Quality management, accreditation, certification"

Subject	T/P	Hours
Principles, terminology	T	2
Relevant standards (ISO 9000, ISO 17025, etc.)	T	4
Quality management system of the verification institution	T	4
Principles of accreditation and certification	T	2
National and international accreditation and certification system	T	2
Conformity assessment	T	2
Quality management in testing or calibration laboratories	T	4
Accreditation procedure	T	2
Documentation	T	4

Example C.5 Training module on "Prepackages"

Subject	T/P	Hours
Introduction to the relevant OIML Recommendations and national regulations/standards	T	2
Review of basic statistics	T	4
Prepackages - principles, definitions	T	2
Labeling of prepackages	T	2
Requirements for net contents	T	2
Test methods, sampling schemes	T	6
Prepackage controls by public authorities	T	2
Measuring containers/test by templates	T	2
Determination of density	T/P	8
Internal controls by the manufacturer	T/P	8
Prepackage control with importers/breweries	P	16
Prepackage controls at a verification office - testing of commodities	P	16
Presentation of weighing instruments and software for prepackage control with practical lectures	T/P	8

Annex D International training institutions in the field of legal metrology

The addresses of institutions offering training in the field of legal metrology, as well as links to their programs, will be presented on the OIML web site (www.oiml.org).