

OIML D 14**TRAINING AND QUALIFICATION OF LEGAL METROLOGY OFFICERS**

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Contents*Foreword*

1	Scope	
2	Legal metrology officers	
2.1	Definitions	
2.2	Fields of tasks	
2.3	Recruitment	
3	Recommended qualification for legal metrology officers	
3.1	Knowledge	
3.2	Competence	
4	Basic training in legal metrology	
4.1	Structure of training	
4.1.1	Training modules	
4.1.2	Documentation, final examination, mutual recognition	
4.1.3	Theoretical/practical parts	
4.2	Contents of training modules	
4.2.1	Module "Legal and administrative bases"	
4.2.2	Module "General metrology bases"	
4.2.3	Modules "Testing and verification of various measuring instruments"	
4.2.4	Module "Quality management, accreditation, certification"	
4.2.5	Module "Prepackages"	
4.3	Organization of practical training	
4.4	Follow-up training	
Annex A	List of measuring instruments relevant for legal metrology officers	
Annex B	Reference documents for basic training in legal metrology	
Annex C	Examples for curricula of training modules	
Annex D	International training institutions in the field of legal metrology	

Foreword

The former Document D 14; “TRAINING OF LEGAL METROLOGY PERSONNEL QUALIFICATION - TRAINING PROGRAMMES” (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 programme 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 a legal metrology officer or a comparable qualification.

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

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

1 Scope

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

The training and qualification is set up in a modular structure. This shall allow each country to arrange tailor-made training programmes according to the preconditions and the specific needs (qualification on demand).

This Document is not concerned with the technicians responsible for metrological control of production in all the 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 programme can 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 Field of tasks

The application of regulations and categories of measuring instruments concerning legal metrology should refer to OIML D1, "Law on metrology".

Task	Example
Verification and technical inspection of measuring instruments	<ul style="list-style-type: none"> ▪ see list of measuring instruments relevant for Legal metrology officers, Annex A
Inspection and supervision of	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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 an educational level corresponding to university entry, in science and technology.

They should have a 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 qualification 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 bases and principles of general metrology including the software used in measuring instruments and systems
- The principles of the construction and operation as well as the particular regulations relative to the various instruments he has to verify
- The bases of quality management, accreditation and certification in the field of legal metrology

3.2 Competence

The Legal metrology officer should be able to:

- spot breaches of the laws and regulations of legal metrology and establish reports of the facts in certified statements,
- carry out measurements in 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 the level of accuracy demanded,
- spot the non-application of mandatory standards on finished products and their components.

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

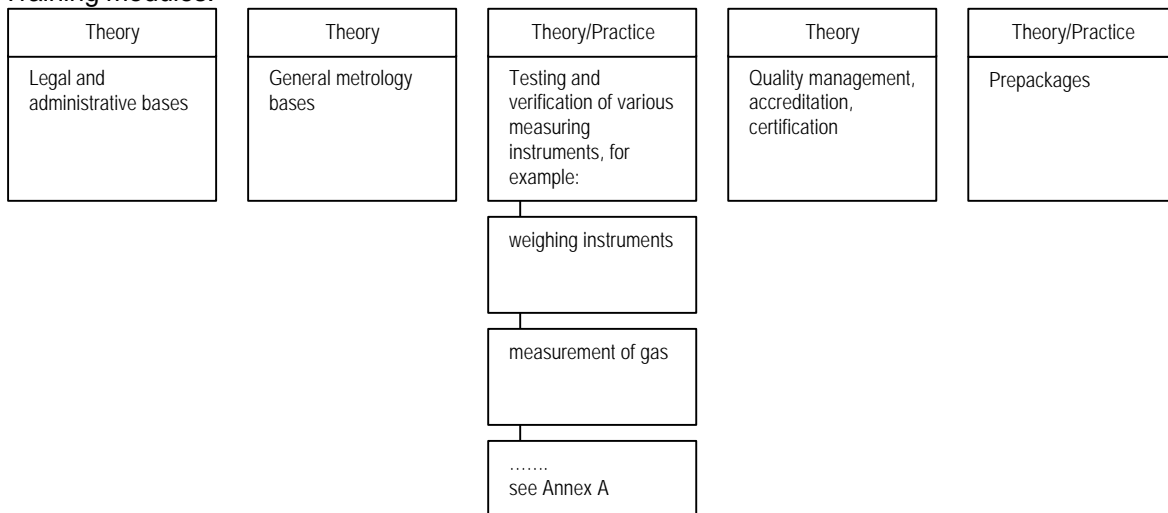
4 Basic training in legal metrology

4.1 Structure of training

4.1.1 Training modules

The training contents is set up in a modular structure according to the necessary qualification of legal metrology officers. Since this training is given with the scope of applying the legal metrology regulations proper to the 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 gained the required qualification.

Provided that the contents of the training module and conditions of the final examination are documented transparently, the gained qualification of 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 for the duration of training modules, see Annex C

4.2 Contents of training modules

4.2.1 Module "Legal and administrative bases"

Structure	Topics
Basic notions of national law	<ul style="list-style-type: none"> ▪ Introduction to the legal system ▪ constitution, administrative/criminal law, criminal procedure and legal organization
International metrological institutions and the issued documents	<ul style="list-style-type: none"> ▪ OIML (recommendations, documents, certificates) ▪ ISO/IEC (standards) ▪ → see also Annex B
Administrative relations	<ul style="list-style-type: none"> ▪ National metrological infrastructure ▪ National administrative structures
Specialized legislation	<p>Studies of the general texts whose application is entrusted to the legal metrology service:</p> <ul style="list-style-type: none"> ▪ Law on metrology ▪ Units act and implementing regulation ▪ laws and regulations concerning measuring instruments subject to state control ▪ the various aspects of control (pattern approval, initial verification, in-service verification, supervision) ▪ affinitive legislation (economic legislation, fraud legislation, etc.) ▪ application of standards ▪ administrative offences and legal proceedings
Occupational safety	<ul style="list-style-type: none"> ▪ Prevention against accidents, safety equipment and clothing, methods of first aid.
Hygiene regulations	<ul style="list-style-type: none"> ▪ rules concerning staff working in sensitive areas

4.2.2 Module “General metrology bases”

Structure	Topics
Terminology, basic knowledge	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ combinative analysis ▪ calculation of probabilities - laws of probabilities ▪ generalities on statistical variables ▪ reduction of data ▪ sampling schemes ▪ estimates
Mathematics and physics	<ul style="list-style-type: none"> ▪ error calculation ▪ importance and determination of measuring uncertainties by examples ▪ physical quantities related to mechanics of solids, liquids, gases, thermodynamics ▪ electricity, electrical metrology
Data processing	<ul style="list-style-type: none"> ▪ 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 Modules “Testing and verification of various measuring instruments”

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

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

Structure		Remark
Introduction to the category of measuring instruments	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 the influence quantities and the measuring 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 of the instruments	Practice	on site/on a test bench with “hands on”

4.2.4 Module “Quality management, accreditation, certification”

Structure	Topics
Quality management	<ul style="list-style-type: none"> ▪ bases, terminology ▪ relevant standards (ISO 9000, ISO 17025,..) ▪ the quality management system of the verification institution
Accreditation, certification	<ul style="list-style-type: none"> ▪ bases of accreditation and certification ▪ the national and international accreditation and certification system ▪ conformity assessment ▪ quality management in testing or calibration laboratories ▪ ISO 9000 ▪ the accreditation procedure ▪ documentation

4.2.5 Module “Prepackages”

Structure		Remark
Legal bases for the supervision of Prepackages	Theory	<ul style="list-style-type: none"> ▪ relevant OIML-Recommendations ▪ relevant national regulations and standards ▪ definitions
Checking the net contents in Prepackages	Theory/Practice	<ul style="list-style-type: none"> ▪ labelling 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	<ul style="list-style-type: none"> ▪ on-site (importer/manufacturer)
Internal controls by the manufacturer	Theory/Practice	<ul style="list-style-type: none"> ▪ on-site (manufacturer)
Measuring container bottles	Theory/Practice	<ul style="list-style-type: none"> ▪ test by templates
Gravimetric and volumetric filling machines - checkweighers.	Theory/Practice	<ul style="list-style-type: none"> ▪ verification and supervision

4.3 Organization of practical training

Trainees are allocated, either single or in small groups of two or three maximum, to verification offices. In these offices and under the supervision of the head of the office or a qualified and experienced person, they 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, within the framework of continued training consisting for instance of practical and theoretical courses of 5 to 10 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. The relevant categories naturally have to be adapted to the national regulations of the given country.

Category	measuring instruments
Weighing	<ul style="list-style-type: none"> ▪ general notions on levers and the oscillating beam ▪ non-automatic weighing instruments (different classes) ▪ automatic weighing machines ▪ strain gauge devices ▪ electronic devices ▪ weights
Dynamic measurement of liquids	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ storage tanks ▪ measuring transport tanks ▪ proving tanks and gauging stations ▪ level measuring devices.
Dimensional measurements	<ul style="list-style-type: none"> ▪ length ▪ area ▪ capacity
Measurement of gas	<ul style="list-style-type: none"> ▪ gas volume meters ▪ volume correctors ▪ manometers ▪ differential pressure meters
Measurement of electrical energy	<ul style="list-style-type: none"> ▪ single phase and three phase electricity meters ▪ measuring transformers.
Measurement of thermal energy	<ul style="list-style-type: none"> ▪ measurement of temperatures ▪ thermal energy meters
Measurements in road traffic	<ul style="list-style-type: none"> ▪ taximeters ▪ chronotachographs ▪ tachometers ▪ speed meters (radar, laser) ▪ tyre pressure gauges ▪ breath analysers ▪ parking meters.
Health	<ul style="list-style-type: none"> ▪ medical thermometers ▪ blood pressure manometers ▪ medical glass measures ▪ sound level meters ▪ carbon monoxide analysers ▪ dosimeters for ionizing radiation.
Density measurement	<ul style="list-style-type: none"> ▪ density meters ▪ viscometers
Agricultural measurements	<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none">▪ WELMEC-Guides▪ EN-Standards▪ EU-Directives

Southern Africa Development Council
<ul style="list-style-type: none">▪ Harmonised technical regulations

B 3 National regulations and standards

- Law on Metrology
- Units act and Implementing Regulation
- laws and regulations concerning measuring instruments subject to state control
- affinitive legislation (economic legislation, fraud legislation, etc.)
- national standards
- Regulations on administrative offences and legal proceedings

B 4 Additional documents

- type approvals
- manuals
- training documents from manufacturers
- service manuals from manufacturers
- pattern approval documents
- video films and interactive e-learning modules

Annex C Examples for curricula of training modules

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

T = Theoretical Part, **P** = Practical Part

Example C 1

Training module on "Legal and administrative bases"	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 infrastructure	T	1
Law on metrology	T	2
Units act and Implementing Regulation	T	1
Laws and regulations concerning measuring instruments subject to state control	T	2
The various aspects of control (pattern approval, initial verification, in-service verification, supervision)	T	4
Affinitive legislation (economic legislation, fraud legislation, etc.)	T	2
Application of standards	T	2
Administrative offences and legal proceedings	T	10
Prevention against 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 bases”	T/P	hours
<i>Terminology, basic knowledge</i>		
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
<i>Statistics and probabilities</i>		
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
<i>Mathematics and physics</i>		
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
<i>Data processing</i>		
General notions concerning data processing	T	2
Knowledge of the most common equipment	T	4
Training in the use of 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”, here: Verification of weighing instruments	T/P	hours
Basic weighing principles	T	2
Review of OIML-Requirements concerning non-automatic weighing instruments	T	2
Information presented in a pattern approval certificate or in an OIML certificate	T	1
Verification of non-automatic 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 to 500 kg	P	8
Types and characteristics of mechanical vehicle scales	T	2
Review of various types of verification equipment of vehicle scales	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”	T/P	hours
Bases, terminology	T	2
Relevant standards (ISO 9000, ISO 17025,..)	T	4
Quality management system of the verification institution	T	4
Bases 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”	T/P	hours
Introduction to the relevant OIML-Recommendations	T	2
Review of basic statistics	T	4
Prepackages - bases, definitions	T	2
Labelling 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 - test 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

Information on addresses and programmes of international training institutions in the field of legal metrology will be presented at

www.oiml.org