



German Academy of Metrology

Basic and advanced training of legal metrology personnel in Germany



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Foreword

An efficient metrology and verification system supports trade and industry and consumers as well and is an indispensable element of a social market economy. In view of today's rapid technical development and the structural change in legal metrology, training and advanced training have gained great importance. Qualified staff are the supporting column to fulfil the high demands.

The German Academy of Metrology (Deutsche Akademie für Metrologie - DAM) is the common institution for basic and advanced training of technical staff of the verification authorities of all States of the Federal Republic of Germany.

On the basis of an agreement concluded by the Federal States the DAM was established at the Bavarian State Office of Weights and Measures in Munich on 25 May 1961.

The EC Single Market subdues trade and industry as well as the verification authorities to international competition. To prepare the verification officers for new tasks and services for trade, industry and consumers, the DAM offers advanced training courses in the field of quality management and quality assurance.

In close cooperation with the verification administrations of the Federal States, the Physikalisch-Technische Bundesanstalt (PTB), the Organisation Internationale de Métrologie Légale (OIML) and manufacturers and users of measuring instruments, the Academy has developed to a nationally and internationally appreciated institution for training and advanced training.

Thus, the concept of DAM-training was also the model for the OIML-document OIML D14 "Training and qualification of legal metrology personnel".

This brochure gives a general account of the training and advanced training of legal metrology personnel in Germany.



1 Scope of tasks of legal metrology officers in Germany

Task	Example
Verification and technical inspection of measuring instruments	<ul style="list-style-type: none"> - All measuring instruments subject to verification
Inspection and supervision	<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 Necessary qualifications for legal metrology officers in Germany

2.1 Knowledge

The legal metrology officers 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 measuring instruments as well as the regulations applicable to them; and
- the principles of quality management, accreditation and certification in the field of legal metrology.



2.2 Competence

The legal metrology officers 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.

3 Recruitment

Legal metrology officers are usually recruited by the local verification authorities, where they also serve the preparatory service (= practical training). When selecting legal metrology officers, not only scientific and technical knowledge is to be taken into account, but also general culture and human qualities.

Certain prerequisites must be fulfilled for a candidate to be admitted to the preparatory training for one of these careers. The relevant prescriptions as

- civil service code
- admission regulations
- training regulations

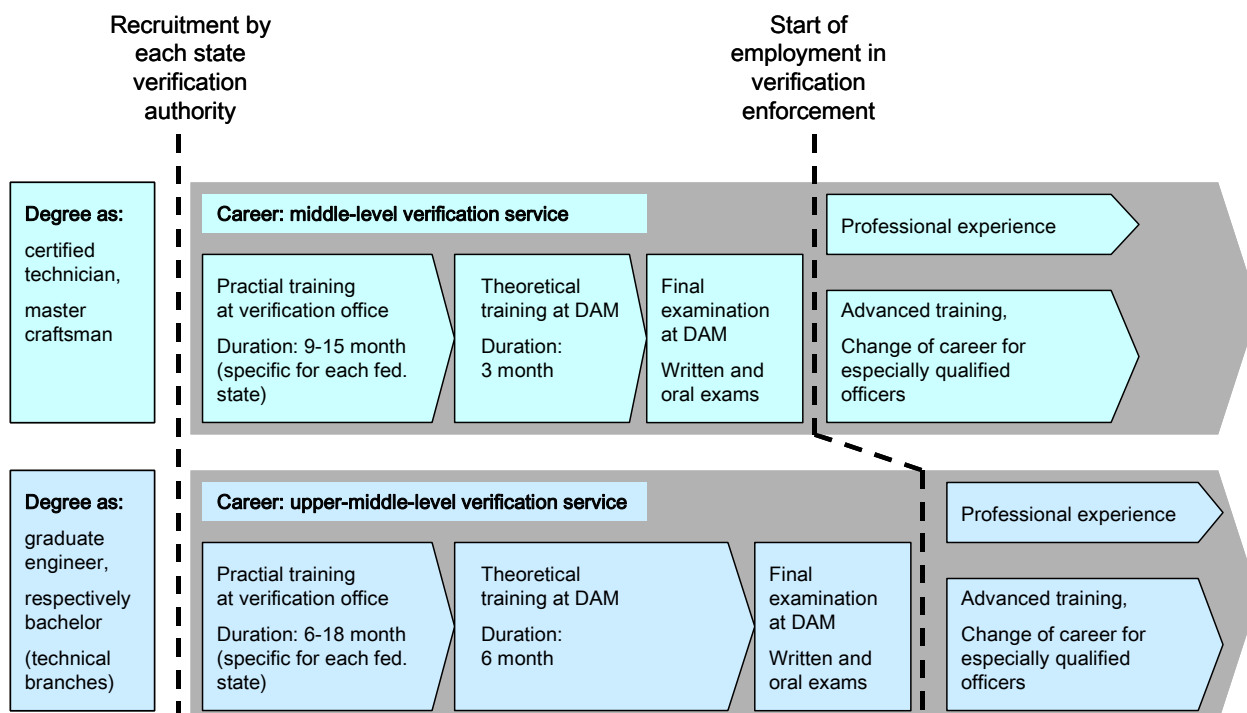
are similar in all Federal States and include the following conditions:

upper-middle-level verification service	middle-level verification service
<ul style="list-style-type: none"> - graduate engineer, respectively - bachelor degree <p>in a technical branch</p>	<ul style="list-style-type: none"> - certified technician - certified master craftsman - journeyman's examination and practical experience of 5 years



4 Basic training for legal metrology officers

4.1 Structure of basic training



4.2 Practical training at the local verification authority

During their preparatory service at the local verification authority (duration specific for each federal state), verification officers have to work through an intensive practical training on all measuring instruments subject to verification.

The 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.

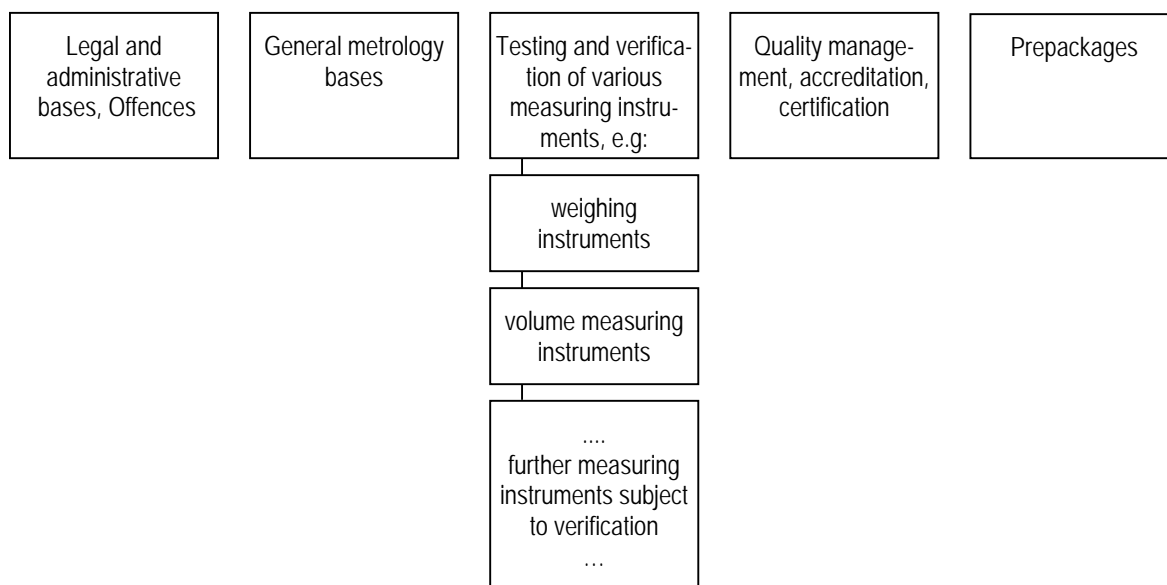
They can thus build on the knowledge gained during the theoretical training period, combine this with the necessities of practical controls, see this confronted with difficulties related to human factors and gain the dexterity and experience they will require to further their career.



4.3 Theoretical training at DAM

The training contents is set up in a modular structure according to the necessary qualification of legal metrology officers. The contents of the training modules are independent of each other, so that certain modules can be carried out whenever the organizational or personnel conditions require additional knowledge (qualification on demand, e.g. for brushing-up of knowledge).

Training modules:



Final examination

Immediately after the courses the candidates have to undergo an examination.

Subjects of the examinations are:

- verification techniques for different kinds of measuring instruments and control of the filling quantities of prepackaged goods
- mathematics and physics with special respect of technical applicabilities in the field of metrology
- legal prescriptions such as Metrology and Verification Act, Verification Ordinance, Units Act, technical rules and standards etc.
- basic concepts of public and private law, administrative offences and legal proceedings

The examination comprises written and oral parts.

The written examination for the middle-level verification service comprises six tasks to be answered within two hours each; for the upper-middle-level verification service there are nine tasks to be answered within eighteen hours.

The oral part (with five examiners) lasts half an hour.



5 Advanced training

Besides the regular courses, the academy holds technical seminars for the advanced training of verification officers from all Federal States to prepare them for new tasks and fields of work.

In view of the rapid technical development of measuring instruments and the changing tasks to be performed on account of the new Metrology and Verification Act and Verification Ordinance and in view of the EC Single Market, the DAM offers a steadily increasing number of technical seminars with topical subjects in this field.

- new legal prescriptions (national and European)
- technical developments of measuring instruments
- training courses for verification officers in leading positions (management skills)
- intensive courses for technical English
- didactic courses for DAM trainers
- qualification for Quality Assurance and Auditors of Quality Systems (ISO 9000, ISO 17025)

DAM also offers online tutorials for verification officers (E-learning, Blended learning).

6 Organizational background

6.1 Legal base, infrastructure, personnell

Legal base of the DAM is the state-agreement of 25 May 1961, which was last amended in 1992 including now the States of the former German Democratic Republic (GDR). This agreement regulates subjects such as uniform practical and theoretical training of candidates for employment, responsibilities of the DAM, appointment of the examination board and financing of the DAM (Academy Agreement, Annex B).

Once a year, the representatives of the Federal States meet in Munich to decide upon the budget and questions of training.

As the DAM is affiliated to the Bavarian State Office of Weights and Measures, it has the organizational status of a section. The whole infrastructure of the LMG is at the DAM's disposal.

The steadily increasing number of tasks necessitated the establishment of a permanent management and a secretariat. The permanent staff of the DAM consists of five persons.



DAM is accommodated in the building of the LMG in immediate vicinity of the Munich Verification Office, one of Germany's most versatile verification offices. The equipment allows all kinds of metrological tests to be carried out.

Determination of mass, pressure and volume and tape measures

- verification of velocimeters used by the police
- verification of clinical measuring instruments
- verification of dosimeters and sound level meters
- support of accredited test centers for gas, water, electricity and thermal energy located in Munich

Two lecture rooms, one room for practical training offices and storage rooms for instruction material are at the disposal of the DAM. State-of-the-art technical equipment completes the facilities.

6.2 Trainers

For a high-quality qualification programme high importance is attached to the trainers. Their education, professional experience, special knowledge, which must always be up-to-date, and their personal qualities, in particular pedagogic and didactic capabilities are summarised in the table below.

The Academy's trainers, about 30, are practitioners from the verification service. As such, they are able to instill life into theoretical subjects and show their relevance to practice. Depending on the subject and demand, lecturers from PTB, OIML and trade and industry are ready to give lectures.

Requirements for DAM-trainers		
Requirements	special criteria by Quality Management system	fulfilment by DAM
Education	- university - technical college	physicians, bachelors and masters of engineering, lawyers, verification officers
	branch of study	training on specialised subjects as required
Professional experience	adequate experience	practicians from respective fields of work
	experience in giving lectures	participation in didactics courses
	knowledge of English to be able to understand directives, standards etc.	English language courses on technical subjects
Special knowledge	- general knowledge of teaching subjects	knowledge based on the work of the trainers
	- technique of presentation - technique of interviewing - behavior training	special on-the-job training at the DAM
	psychologic and pedagogic abilities	special on-the-job courses at the DAM
Actualisation of knowledge	participation in exchange of experience	Regular advanced training measures, participation in exchange of experience, in particular in special working groups



7 Further information on DAM-activities

During the last 50 years, DAM has continually improved its training concepts. The Academy has also steadily extended its activities. In addition to basic and advanced training for legal metrology officers, DAM offers also:

- workshops for trade and industry
- organization of seminars for employees of foreign authorities and metrological institutes
- supply of verification authorities with technical/legal rules (central services)
- brochures for partners and citizens
- administration of the Internet/Extranet-Servers of the German verification authorities
- office of the Working Group Metrology and Verification (AGME)

For further information, please visit:

www.dam-germany.de



Annex A

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 A 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) - WELMEC-Guides - EC-Directives und Guides	T	6
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
Market surveillance according to European Directives	T	12



Example A 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 A 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 force 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 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 A 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 A 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 and their documentation	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 B

Agreement on uniform training and examination in the field of legal metrology

-Academy Agreement-

of 30 June 1992

The signatory governments of the States of the Federal Republic of Germany conclude the following agreement:

§ 1

- (1) The competent State authorities of the contracting States lay down utmost corresponding regulations on training for the higher intermediate and intermediate verification service.
- (2) Specialized practical and theoretical training in the verification administration will be supplemented by courses and concluded by examinations. For this purpose the German Academy of Metrology (hereinafter called Academy) with its seat in Munich will be established at the Bavarian State Office of Weights and Measures.
- (3) Courses and lectures will be held for specialized advanced training of verification officers
- (4) If required additional projects will be organized for training and advanced training in the field of legal metrology.
- (5) Participation in courses, lectures and examinations as well as in projects under section 4 may also be allowed to other persons, who are occupied with metrology and verification, upon closer arrangement between the competent institutions and the head of the Academy.
- (6) As joint information agency the Academy, on behalf of the States, will carry out central services.

§ 2

- (1) Courses and examinations for the verification service will be held at the Academy.
- (2) Examinations will be performed on the basis of the examination regulations for the intermediate and higher intermediate verification service laid down by the Bavarian State Ministry of Economics and Transport.
- (3) The Bavarian State Ministry of Economics and Transport will lay down and amend examination regulations under section 2 only with approval of the supreme State authorities responsible for metrology and verification of the States concerned.

§ 3

- (1) According to the provisions of section 2 and 3 an examining board will be established at the Academy to perform the examinations.
- (2) The examining board will consist of the chairman and 4 assessors.
 - a) Chairman will be the head of the Bavarian State Office of Weights and Measures, in case of absence his deputy.
 - b) Assessors will be:
 1. The head of the Academy or, in case he has to preside the examination or is absent, an official of the executive verification service,
 2. an official of the higher intermediate verification service,
 3. an official of the higher intermediate administration service,
 4. an official or employee of the executive verification service or an official of the higher intermediate verification service - salary bracket A13.- if there is no official or employee of the executive verification service available in that State.



(3) The assessors under section 2 b, Nos. 1 and 3 and their deputies will be made available and appointed by the Bavarian State Office of Weights and Measures. The assessors under section 2 b, Nos. 2 and 4 and their deputies will be nominated by the contracting States. The States will provide assessors and deputies by turns in alphabetical order. A separate order has to be observed for assessors under section 2 b, No. 2 as well as No. 4 and for examinations for the higher intermediate and the intermediate service respectively.

Deputies will be nominated by the State following next in the list. If a State renounces the appointment the next State in alphabetical order will take its place. In case of absence of an assessor and his deputy under section 2 b, Nos. 2 and 4 the Bavarian State Office of Weights and Measures will nominate the assessor and his deputy.

(4) A right of presence have:

a) One member each of the Bavarian Civil Service Committee and comparable institutions of the other States or an official authorized by those institutions, in all examinations.

b) One representative each of the Physikalisch-Technische Bundesanstalt and the competent State authorities in oral examinations.

c) One member each of the civil service council responsible for the examination candidate, in oral examinations if provided by State law.

They are authorized to look through the graded examination papers, members of a civil service council, however, only as far as prescribed by State law.

(5) Only members of the examination board are authorized to participate in deliberation. The presence of other persons is excluded if not provided by State law.

§ 4

(1) Costs arising from the implementation of this Agreement will be shared by the contracting parties. Excluded are projects in the sense of § 1 section 4, which have to be financed by participation fees or other contributions by third parties.

(2) To this purpose the contracting parties will annually assess the total amount of the means to be raised to cover these costs.

(3) The Free State of Bavaria will bear one tenth of the basic amount. The remainder will be apportioned to the signatory States or the respective partners of the Agreement according to the proportion of their tax returns and their population figure. The proportion of the tax returns will be relevant for two thirds of the amount and that of the population figure for one third.

Tax returns are the tax returns of the States taken as a basis in the State financial adjustment. The tax returns will be raised or reduced by the amounts which the States, within the scope of the State financial adjustment, receive from or pay to other States. Relevant are the tax returns and the population figure established by the Federal Statistical Office for 30th June, of the budgetary year preceeding the current budgetary year by two years.

(4) Until 31 December 1994 the tax returns for the financing share of the States of Brandenburg, Mecklenburg-Vorpommern, Sachsen, Sachsen-Anhalt and Thüringen as well as the Eastern part of Berlin will be assessed at zero.

§ 5

Participation in the Agreement may be cancelled by any contracting party in compliance with a term of notice of six months for the end of the budgetary year.

§ 6

The present Agreement will come into force on 1 January 1992 after signature by all contracting parties. At the same time the Agreement on uniform training and examination for the higher intermediate and intermediate verification service of 2 December 1976 will become invalid.



Annex C

Literature, sources

- OIML D14 “Training and qualification of legal metrology personnel”
(www.oiml.org)
- POEich
(examination regulations for the upper-middle-level and the middle-level verification service)
- Glossary of Metrology (German)
www.dam-germany.de
- ISO/IEC 17025:2005
(General requirements for the competence of testing and calibration laboratories)
- ISO 29990:2010
Learning services for non-formal education and training - Basic requirements for service providers