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	Review "National educational systems in the field of metrology in the COOMET member-countries"	
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This information source was developed as a result of implementation COOMET project 270/BY-a/03 "National Educational Systems in the Field of Metrology in the COOMET Member-States", within its' framework the system of base education obtaining, the system of personnel training, professional development, retraining and a system of a highly skilled scientific personnel preparation were analyzed.

SYSTEM OF OBTAINING BASIC EDUCATION

	Belarus	Germany	Kazakhstan	Kyrgyzstan	Lithuania	Moldova	Russia	Ukraine
The educational system offer training of the following:								
technicians	✔	✔	-	-	-	✔	✔	✔
holders of a bachelor's degree	✔	✔	✔	✔	✔	✔	✔	✔
engineers with a diploma	✔	✔	✔	✔	✔	✔	✔	✔
holders of a master's degree	✔	✔	✔	-	✔	✔	✔	✔
other								

SYSTEM OF TRAINING, SHORT TERM TRAINING ON ADJACENT PROFESSIONS AND CONTINUOUS IMPROVEMENT OF PROFESSIONAL SKILLS

	Belarus	Germany	Kazakhstan	Kyrgyzstan	Lithuania	Moldova	Russia	Ukraine
Specialised training on the following professions:								
verification officers	▼	▼	-	▼	▼	▼	▼	▼
calibration officers	▼	▼	-	▼	▼	▼	▼	▼
other	Expert-auditor	-	-	Expert	-	-	Expert	-
Short term training on adjacent professions and continuous improvement of professional skills is offered by the following:								
institutions of higher education	▼	-	▼	-	▼	-	▼	▼
specialised courses offered by postgraduates educational centers	▼	-	▼	▼	-	-	▼	▼
specialised courses in the framework of NMI(s)	-	▼	▼	-	-	▼	-	▼
other	on training seminars						on target seminars	by ministries' and departments' metrological services

SYSTEM OF TRAINING FOR YOUNG SCIENTISTS AND PERSONNEL OF HIGHER SKILLS

	Belarus	Germany	Kazakhstan	Kyrgyzstan	Lithuania	Moldova	Russia	Ukraine
Postgraduate studies and doctor's degree studies are available:								
in the framework of institutions of higher education	▼	▼	-	-	▼	▼	▼	▼
in the framework of NMI(s)		-	-	-	-	-	▼	▼

INFORMATION ABOUT NATIONAL EDUCATIONAL SYSTEMS IN THE FIELD OF METROLOGY

BELARUS

A complex approach to a construction of an education system in the field of metrology, providing for professional training of experts from lower to higher level, is realized in the Republic of Belarus.

The educational system's infrastructure in the field of metrology includes secondary and higher professional educational institutions, refresher courses, applied educational centres etc.

Secondary and higher educational institutions are engaged in training of secondary school graduates and provide them corresponding technical education on specialization «Metrology. Standardization and certification».

Specialized secondary education can be gotten in Grodno and Minsk polytechnics.

There is also an opportunity to get the *higher education* in institutes of higher education of Minsk and Grodno (Belorussian National Technology University (BNTU), Belorussian State University of Informatics and Radioelectronics (BSUIR), Gomel State University (GSU)). 40 to 60 interns get the higher education in the field of metrology annually. A specialists' educational system without work interruption (night classes) implemented in addition to daytime classes.

The system of manpower training includes a *professional development* for key personnel and for technical and engineering employees of the state metrological service and metrological services, it also includes *training and retraining* of specialists having higher education in other fields. This work is under way since 1989 in the Training Center of the Gosstandart of the Republic of Belarus on the base of Professional Development and Personnel Retraining (inline with technics and technology development) Institute (PDPRI) of the Ministry of Education, as well as in the Professional Development and Personnel Retraining Institute of the Gosstandart (BelPDI), established in 2000.

The Training Center of PDPRI, widely uses a technical and methodological BelGIM base and invites leading experts of Gosstandart and BNTU's and Academy of Metrology «Belaya Rus» teaching staff. Lecturers undergo an attestation within the system of the Gosstandart and have corresponding licenses and certificates. A number of trained specialists amounts to about 700 persons annually. To conduct the training a list of 20 specializations, curriculums and educational plans as well as a structure chart of communications between organizations with an aim to take into account operational experience are developed, taking into consideration interests of 16 regions and of 20 ministries and departments of the Republic. Graduate students are given with professional development licenses as well as certificates, confirming their qualification required for conducting works in accordance with acquired specialization. Apprenticeship amounts to from 2 weeks to 1 month, studying is conducted with work interruption. An automatized system of professional development process control is elaborated in the Training Center to increase manpower development effectiveness. The stuff accumulated during 10 years (there is information about more than 6 000 specialists having metrological specialization, 1 500

enterprises of 16 regions, 20 ministries and departments) is a representative sample of the entire departmental and governmental metrological services cadre aggregate. The analysis of this statistical material enables reliable image obtaining of metrology manpower development situation in the Republic of Belarus as well as metrological service composition overview depending on sex, age, length of service, educational attainment and row of other factors.

Professional Development and Personnel Retraining Institute (Gosstandart BelPDI) realizes the leading employee and specialists professional development on 45 study directions and conducts specialists' skill conversion in different branches of economic complex to «Metrology and metrological support» specialization giving qualification of metrology engineer.

The training of higher qualification specialists (candidates and doctors of science) is realized in postgraduate studying and doctor's degree studies of several Republic institutes of higher education.

The academic council of BNTU for rendering support in defending dissertations on technical sciences academic degree competition of following specializations:

- 05.11.15 Metrology and metrological support
- 05.02.23 Standardization and product quality management

is established. This combination of specializations creates appropriate conditions for scientific works defending throughout the whole specter of metrology, standardization and certification problems. Besides, specialist having higher education can improve their educational and scientific qualification, while studying in the magistrates attached to «Standardization, metrology and information systems» chair of BNTU.

KAZAKHSTAN

The system of obtaining the basic education

1. The specialists' training and retraining in the field of metrology is realized in 16 higher educational institutions in the Republic of Kazakhstan.
2. The education in the field of metrology is realized for specializations:
 - Metrology and metrological support – 2 institutes of higher education;
 - Standardization, certification and metrology (baccalaureates) – 14 institutes of higher education.
3. A number of specialists trained by (graduated from) this institutes of higher education amounts to 60 persons per annum.

System of training, short term training on adjacent professions and continuous improvement of professional skills

1. The activity coordination on personnel training, professional development and retraining activities in the field of metrology is realized by the Ministry of Education and Science of the Republic of Kazakhstan as well as Standardization, Metrology and Certification Committee of the Industry and Trade Ministry of the Republic of Kazakhstan.

2. Metrology engineer training and retraining is conducted by Karaganda State University and North-Kazakh State University, staff professional development in the field of metrology is conducted by RSE (Republic State Enterprise) «Kazakh Metrology Institute»

(RSE «KazMetrInst»), public corporation «National Centre of expertise and certification» (public corporation «NatExC»), public corporation «National Accreditation Centre» (public corporation «NAC»), the Energetics and Communications Institute of Alma-Ata.

3. Primary directions of personnel training and retraining are the students' education in institutes of higher education and personnel training on a base of higher education with an aim to obtain a second higher education: primary directions of staff professional development is training on metrologist and verification officer courses.

4. The number of graduated specialists trained on this professional development courses is equal to 200 – 300 metrologists and verification officers per annum.

System of training for young scientists and personnel of higher skills

1. There is no post-graduate courses nor doctoral courses for «Metrology and metrological support» specialization.

2. Academic councils for dissertation defending are not established.

3. Specialization for academic degree competition – 05.11.15 « Metrology and metrological support».

KYRGYZSTAN

System of obtaining basic education

Institute of higher education – Basalygin Kyrgyz National University (KNU) implements training for "Standardization, certification and metrology" specialization.

System of training, short term training on adjacent professions and continuous improvement of professional skills

Bodies realizing the activity coordination on personnel training, professional development and retraining are listed below:

- *The Ministry of Education and Culture of the Kyrgyz Republic*
- *Kyrgyz branch establishment of the Standardization Metrology and Certification Academy (CMCA) of the Gosstandart of the Russian Federation (educational)*

Personnel training and retraining are realized as well as personnel professional development.

The number of graduated specialist is equal to:

CMCA – 130 persons

KNU – 10 persons

per annum.

LITHUANIA

System of obtaining basic education

Institute of Metrology at Kaunas technology university is the only institution offering higher education in the respective field. It offers the following profession courses: engineer metrologist and master of science in measurement engineering. Number of graduates in the respective field per year is approximately 80.

System of training, short term training on adjacent professions and continuous improvement of professional skills

Institute of Metrology at Kaunas technology university is a body performing co-ordination of training activities for the purpose of improvement of professional skills.

The major fields in which training is actively offered:

- ✓ training and short term training on adjacent professions,
- ✓ continuous improvement of professional skills

Number of graduates in the respective field per year is 80.

System of training for young scientists and personnel of higher skills

Postgraduate studies and doctor's degree studies are carried out in Institute of Metrology at Kaunas technology university. Councils for rendering support in defending dissertations is located at Kaunas technology university. Profession courses (including their description) that assume further postgraduate studies.

MOLDOVA

System of obtaining basic education

The training of specialists in the field of metrology in the Moldova Republic is carried out in 4 institutes of higher education (Technical University of Moldova, State University of Moldova, Real Sciences Institute, Applied Integrated Knowledge Institute) for the specialization "Metrology, standardization, control and certification".

The annual number of graduated specialists in the field of metrology amounts to about 50 persons.

System of training, short term training on adjacent professions and continuous improvement of professional skills

The activity coordination of personnel training, professional development and retraining activities in the field of metrology is realized by the National Body for Metrology (Standardization and metrology department).

In accordance with the Regulation № 932 of the Republic Moldova Government of 6 September 2001, Standardization and Metrology Department is entrusted with finding solutions for problems concerning the specialists' knowledge improvement in the field of metrology. It is made by means of courses establishing and of other forms of professional training. Direct operations for specialists' professional development are realized by the Personnel Certification Body of the Standardization and Metrology Department.

About 70 persons pass this metrology field professional development courses per annum.

System of training for young scientists and personnel of higher skills

The post university education is realized at post-graduate courses and doctoral courses, established at the Technical University of Moldova. Annual magisters' graduates' number is equal to about 8 persons on average. Councils for dissertation defending are established in Technical University of Moldova.

RUSSIA

In accordance with the "Education Law" of the Russian Federation (accepted by State Duma on 12 June 1995), following levels of professional education in the field of metrology are realized in the Russian Federation:

1. **Professional primary education** is organized in sectorial destination vocational schools (VS). It has an aim of training skilled workers and employees who have certain (base) knowledge, skills and practices for exploitation, repairing, verification and calibration of measuring instruments. 30 000 such professional oriented workers are graduated annually.

2. **Professional secondary education** has an aim of middle echelon certificated specialists training (metrology technician) on a base of primary general or primary professional education. It is realized in specialized secondary educational institutions (SSEI) (technical schools, liceums or colleges) on specializations: "Mechanical measurements", "Electro-thermal-technical measurements", "Radiotechnical measurements". Thus up to 500 technician-metrologists in two SSEIs of Russia GosStandard (Moscow Engineering School of Metrology and Quality, Middle-Ural College of Metrology and Quality) are trained and graduated annually for mentioned above specializations (verification officers SI).

3. **Higher professional education** has an aim of training and retraining of highly skilled metrology engineers on a base of general secondary (complete) education and professional secondary education. This is realized in engineering oriented institutes of higher education having graduating chairs for specializations «Metrology and metrological support». There is about 20 such chairs and institutes of higher education in Russia in total, with annual number of graduates of 500 metrology engineers.

In several institutes of higher education engineers of other specializations are retrained into metrology engineers (up to 50 persons per annum).

General skill criteria for specialists having either professional secondary or professional higher education are laid down in Educational State Standards (ESSs), they contain minimum requirements list for professional training of specialists, who have given level and specialization (on discipline cycles). ESSs' development, approval and introduction order is defined by the Government of the Russian Federation. All kinds of ESSs are developed on competitive basis and adjusted on the same basis not often than once per 10 years at that.

4. **Additional education** is realized within the bounds of every professional education level with an aim of continual professional development of technical and engineering employees (TEE) in a view of continual improvement of educational standards. In general the professional development for TEE in the field of metrology is realized in the SMC Academy of GosStandard and in its' branches (about 5 000 persons per annum), as well as in training centres and on special courses, having corresponding licences (up to 1 500 persons per annum).

5. **The professional post-university education** is realized at post-graduate courses and at doctoral courses established both in institutes of higher education and in scientific metrological centres, where academic councils are organized for following specializations: "Devices and measuring procedures (on types of measurements)", "Data-measuring and data-controlling systems (on branches)", "Metrology and metrological support". 3 to 5 Ph.D. theses and 1 to 2 doctoral theses in this councils in the field of metrology are defended annually.

UKRAINE

System of obtaining basic education

There are institutes of higher education in the Ukraine realizing education in the field of metrology.

There are 4 institutes of higher education realizing education on «Metrology» specialization in Kharkov alone. There is a metrology chair on a base of National Scientific Centre «the Metrology Institute» (NSC "MI"), at which students of National Aerospace University «KAI» and of Kharkov National University of Radioelectronics pass education for specialization «Metrology, certification and quality». There are analogous institutes of higher education in the capital of Ukraine (Kiev) and in great region centres (Dnepropetrovsk, Donetsk, Odessa and others).

Specializations for which education is realized:

- Metrology;
- Certification;
- Quality.

The number of graduated specialists is equal to about 200 persons per year.

System of training, short term training on adjacent professions and continuous improvement of professional skills

1) Body realizing coordination of personnel training, professional development and retraining activities:

There is the Ukrainian Scientific-Research and Training Centre of Standardization, Certification and Quality Problems in the structure of GosPotrebStandard.

2) Other organizations realizing personnel training, professional development and retraining:

- NSC "MI", other NMI, territorial bodies of Ukrainian GosPotrebStandard;
- Metrological services of ministries and departments.

3) Primary directions in which:

✓ *Personnel training and retraining are realized:*

- Ukrainian Scientific-Research and Training Centre of Standardization, Certification and Quality Problems conducts personnel training and retraining for following specializations: metrology, standardization, certification and quality;
- NSC "IM", other NMIs – in the field of metrology;
- territorial bodies of Ukrainian GosPotrebStandard – in the field of metrology and standardization;
- metrological services of ministries and departments – in the field of metrology and quality.

✓ *professional development are realized:*

- The Ukrainian Scientific-Research and Training Centre of Standardization, Certification and Quality Problems conducts personnel professional development for following specializations metrology, standardization, certification and quality;

System of training for young scientists and personnel of higher skills

1) Availability of post-graduate courses and doctoral courses: attached to NSC "IM".

2) Availability of councils for dissertation defending: attached to NSC "IM".

3) Specializations for academic degree competition, and their content:

05.11.08 «Radio metering devices».

05.11.15 «Metrology and metrological support»

05.04.03 «Radiophysics»

05.11.01 «Measuring instruments and methods for mechanical quantities measurements».

05.11.04 « Measuring instruments and methods for thermal quantities measurements»

05.11.05 « Measuring instruments and methods for electric and magnetic quantities measurements»