	<b>COOMET Recommendation</b>	<b>COOMET R/IT/24:2014</b>
	<b>Educational programs and practical training programs of experts of National Metrological Institutes cooperating in COOMET</b>	
<p><i>Approved at the 24<sup>th</sup> COOMET Committee Meeting (Yekaterinburg, Russia, 16–17 April 2014)</i></p>		

## 1. Field of application

1.1 This Recommendation contains general provisions on the execution and content of training programs and professional development programs of specialists of National Metrological Institutes (NMIs), collaborating in COOMET, and establishes a procedure for their development and their agreement.

## 2. Normative References

International Standard ISO / IEC 17025 “General requirements for the competence of testing and calibration laboratories”.

COOMET document D2/2013 “COOMET Rules of Procedure”.

## 3. Abbreviations

**ILAC** - International Laboratory Accreditation Cooperation

**CC** - Consultative Committee CIPM

**COOMET** - Euro-Asian Cooperation of State metrological Institutions

**CIPM** - The International Committee for Weights and Measures

**BIPM** - International Bureau of Weights and Measures

**OIML** - International Organization of Legal Metrology

**NMI** - National Metrological Institute

**RMO** - Regional Metrology Organization

**QMS** - Quality Management System

**Terms of CIPM MRA** - Mutual Recognition Arrangement (CIPM MRA) for national measurement standards and for calibration and measurement certificates issued by NMIs

**TC** - Technical Committee COOMET

**JCRB** - Joint BIPM and RMO

## 4. General Terms

4.1 These recommendations are developed to work on the organization of training and professional development of NMIs specialists cooperating in the framework of COOMET and participating in the works on realization of the Mutual Recognition Arrangement for national measurement standards and for calibration and measurement certificates (CIPM MRA).

4.2 Specialists training and professional development in the framework of COOMET takes the form of workshops and training in the NMIs (workshops and training may be combined).

4.3 Training and professional development are conducted by education programs and specialists training (hereinafter the Programs), implemented in the form of a lecture course (theoretical workshops) and/or training (practical workshops on skills and experience assimilation). Requirements on the design and content of the Programs are given in the Appendices A and B.

4.4 Programs are developed in the thematic areas of cooperation of COOMET by Technical Committees:

- acoustics, ultrasound, vibration;
- electricity and magnetism;
- flow measurement;
- ionizing radiation and radioactivity;
- length and angle;
- mass and related quantities;
- photometry and radiometry;
- physical chemistry;
- thermometry and thermal physics;
- time and frequency;
- reference materials;
- common measurement issues (general metrology);
- legal metrology;
- quality management system;
- information and information technologies

4.5 Upon completion of the course of lectures and/or practical training the learners' assimilation of knowledge is checked with an individualized assessment of each with the point-based system. The knowledge testing is performed by a commission formed of teachers and organizers of the training. The testing is a test exam, a library-research paper, participation in a colloquium or a business game, etc., with the establishment of a passing grade.

4.6 The specialists who passed a course of lectures and/or practical training and successfully passed the test of knowledge will receive a certificate indicating the subject matter (program) and the time required for their training.

## **5. Procedure for the development and coordination of the Programs**

5.1 The development of each Program is based on an included in the Work Program and the COOMET database agreed COOMET project.

5.2 The theme proposer directs to the COOMET Secretariat a form in accordance with the "Rules of Procedure", to which he applies an explanatory note describing the purpose, objectives and content of the Program which is proposed to be developed.

5.3 The proposed theme is negotiated in the TC 4 "Information and Training", which is responsible for training and professional development of specialists, and defines the responsible person of its committee in the Working Group on the development of the Program. If the negotiations in TC 4 lead to a positive result, the agreement is included in the COOMET Work Program.

5.4 The draft of the Program is presented by the theme Coordinator in TC 4 for its consideration and approval. If there are any comments the draft is returned to the Coordinator for a revision. If there are no comments on the draft the TC 4 takes the approval decision on the Program, which serves as the basis for the preparation of the Final Report on the topic.

## **the Programs and the practical trainings of specialists cooperating in the framework of COOMET**

The program is designed in accordance with the following requirements to its structure, content and design.

### **A.1. The structure of the Program.**

The program consists of the following sections:

- Introduction;
- The content of thematic lectures (theoretical seminars);
- The content of practical training (workshops);
- Check of the assimilation of knowledge;
- Recommended literature.

### **A.2. The content of the Program.**

A.2.1 The “Introduction” section provides an overview of the purpose and objectives of the Program, the relevance of the subject matter of the Program in solving common (special, global) metrological problems, the scope and methodology of education and/or practical training, as well as the verification of the assimilation of knowledge. This section sets out the requirements for learners: their formation, their work experience in the field of the subject matter, their practical skills, including independent work with documents and technical literature.

A.2.2 The “The content of thematic lectures (theoretical seminars)” section includes the names of specific topics, with sections logically aligned from basic concepts to the explanation of the essence of each of the considered topics’ matters. For each topic must be specified the amount of curriculum hours, including the demonstration of educational material (films, slides) and reference is made to the literature for independent preparation.

A.2.3 The section “The content of the practical trainings (workshops)” includes the topic names and describes the final objectives of each workshop, their form and location, the scope of the workshop program (in hours), the workplaces and the assistive technology used during the workshops, the office equipment, training manuals and a list recommended literature. The procedure of the workshop must be exposed, as well as the learners’ measures in achieving their goals and the evaluation criteria of positive results in educational material assimilation.

A.2.4 The section “Check of the assimilation of knowledge” includes a description of the form and methods of testing and assessment (test exam, prom library-research paper, participation in a colloquium or a business role-playing game, etc.) resulting from the course of studies and/or practical training in the framework of a particular Program. Assessment criteria include questions to test the knowledge and evaluative scores for each one of them. A general passing grade is established, which determines those specialists who have successfully passed the check of the assimilation of knowledge.


A.2.5 The section “Recommended literature” is a list of international documents, technical literature, special methodological manuals, articles in periodicals, etc., recommended to the specialists for their individual preparation. Each item has its own number that can be referenced in the text of the Program.

### **A.3 Program’s layout**

The full name of the Program, as well as the information on the coordinator and members of the Working Group who have developed the Program, and its approval at the TC 4 meeting (see Appendix B) must be on the front page.

The text is typed in the MS WORD (doc) format, font - Times New Roman, normal, basic text font size - 14, line spacing - 1.5, the text must be vertically aligned, indented line - 1.25 cm. Headings are typed in bold, horizontally aligned. Page Setup: 210 × 297 (margins: top - 1,5 cm, bottom - 2.0 cm, left - 2.5 cm, right - 1,0 cm).

Examples of writing informative part of programs is attached in Appendix C.

	<b>COOMET Recommendation</b>	<b>COOMET R/IT/__:20__</b>
	<b>Educational Program (and/or practical training Program) of experts of National Metrological Institutes cooperating in COOMET, on subject:</b> < _____ _____ _____ >	

Developed by members of the Working Group on the subject number \_\_\_\_\_:  
 Working Group coordinator - \_\_\_\_\_ (first name, last name, name of the coordinator's NMI):

\_\_\_\_\_ -person in charge from TC 4  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

COOMET Secretariat  
 20\_\_

## Examples of Programs

### **B.1 Educational and/or training Program “Main provisions of the CIPM MRA and the mechanism of its realization”**

The educational and/or training programs in this field should include the following:

- B.1.1 Goals and objectives of the CIPM MRA.
- B.1.2 Members to the CIPM MRA.
- B.1.3 The mechanism of realization of the CIPM MRA.
- B.1.4 Role of the CIPM, BIPM and JCRB in the realization of the CIPM MRA.
- B.1.5 Databases published on the BIPM web site in accordance with the CIPM MRA.
- B.1.6 RMOs participation in the realization of the CIPM MRA.
- B.1.7 Procedures for internal and inter-regional inspections of measurement and calibration capabilities of the CIPM MRA members.
- B.1.8 Functions of COOMET structural bodies in the realization of the CIPM MRA.
- B.1.9 OIML and ILAC participation in the realization of principles regulated by the CIPM MRA.
- B.1.10 The possibility of realization of principles regulated by the CIPM MRA by calibration and measurement laboratories that can't be party to this agreement.

### **B.2 Educational and/or training Program “Comparisons of measurement standards”**

The educational and/or training programs in this field should include the following:

- B.2.1 The objectives of comparisons of measurement standards.
- B.2.2 Types of comparisons of measurement standards and methods of their realization.
- B.2.3 The form, role and importance of the Technical Protocol
- B.2.4 Procedure for determining the degree of equivalence of the measurement standard.
- B.2.5 Procedure for processing and presentation of comparison results.
- B.2.6 JCRB flowchart of the process of key comparisons, bilateral comparisons and supplementary comparisons.
- B.2.7 The role and function of TC, CC, CIPM and JCRB in the ongoing comparisons;
- B.2.8 Methodology of regional and inter-regional examination of the NMI's CMC;
- B.2.9 QMS auditors and COOMET technical experts in the field of types of measurements;
- B.2.10 Monitoring of the impact of the key and supplementary comparisons results on the stated CMC.
- B.2.11 Assessment of the data of key and supplementary comparisons conducted by COOMET.
- B.2.12 Registration of results (reports) of key and supplementary comparisons.
- B.2.13 Procedure for registration of the comparisons results in COOMET and BIPM databases.
- B.2.14 Registration form of key and supplementary comparisons regulated by JCRB.
- B.2.15 Rules of formation, management and updating of the COOMET Program of comparisons.

### **B.3 Educational and/or training Program “Calibration of measuring instruments”**

The educational and/or training programs in this field should include the following:

- B.3.1 The set of procedures performed during calibration of measuring instruments.
- B.3.2 Main requirements of the calibration methods of measuring instruments.
- B.3.3 Main provisions of the Manual on the expression of uncertainty of measurement.
- B.3.4 General principles of use of the terms “measurement uncertainty”.
- B.3.5 Traceability of the results of measurements calibration to the measurement standards, who have been recognized in accordance with the CIPM MRA.
- B.3.6 Order of execution of calibration certificates issued by NMIs in the framework of CIPM MRA.

- B.3.7 Accreditation for calibration of measuring instruments.
- B.3.8 Control forms on the activity of laboratories accredited for calibration.

**B.4 Educational and/or training Program “Implementation, maintenance and evaluation of the NMIs QMS effectiveness”**

The educational and/or training programs in this field should include the following:

- B.4.1 General requirements for quality management systems of calibration laboratories, regulated by the international standard ISO/IEC 17025.
- B.4.2 General requirements for the quality management systems of certified reference materials manufacturers, set by the ISO Guide 34.
- B.4.3 Method and procedure for the NMIs quality management system evaluation, established by the CIPM and COOMET.
- B.4.4 Main JCRB principles in RMOs monitoring and reporting on the NMIs QMS state.
- B.4.5 Functions of the COOMET Quality Forum and its Technical Committee.
- B.4.6 Requirements for written and oral presentations of the NMIs QMS.
- B.4.7 Structure and content requirements for the NMIs QMS documentation, and for the records management, which regulates the operation of the QMS.
- B.4.8 NMIs reporting procedure on the effectiveness of their QMS.
- B.4.9 Organization and content of internal and external audits of NMIs QMS.
- B.4.10 Criteria for selection of technical experts and QMS auditors, and the procedure for their training. The content of the questionnaires for the technical experts and QMS auditors.
- B.4.11 COOMET requirements to the scientists-custodians of national measurement standards.

**Literature reference**

1. CIPM document – CIPM/2005-06REV “Mutual recognition of national measurement standards and of calibration and measurement certificates issued by national metrology institutes – CIPM MRA” (2005 interpretation);
2. CIPM document – CIPM MRA-G-01 “Guide to the implementation of the CIPM MRA”;
3. CIPM document – CIPM MRA-D-02 “Use of the CIPM MRA logo and certificates statement”;
4. CIPM document – CIPM MRA-P-01 “Procedure for approval of the entry of a new RMO to the JCRB”;
5. CIPM guide – CIPM MRA-D-04 “Calibration and Measurement Capabilities in the context of the CIPM MRA”;
6. Classification of services in the field of measurements, published on the website of BIPM;
7. CIPM guide – CIPM/2009-24 “Traceability in the CIPM MRA”;
8. CIPM document – CIPM MRA-D-01 “Rules of procedure for the JCRB”;
9. CIPM guide – CIPM MRA-G-03 “Guidelines for the review of CMCs and the monitoring and reporting of the operation of quality systems by international intergovernmental organizations who are signatories of the CIPM MRA”;
10. CIPM guide – CIPM/2005-09 “Subcontracting of measurements under the CIPM MRA”;
11. CIPM guide – CIPM MRA-G-05 “Comparisons in the context of the CIPM MRA”;
12. JCRB guide – JCRB-9/9(1) “Key and supplementary comparison registration form”;
13. CIPM document – CIPM MRA-G-03 “Guidelines for the review of CMCs and the monitoring and reporting of the operation of quality systems by international intergovernmental organizations who are signatories of the CIPM MRA”;
14. CIPM document – CIPM/2007-25 “Recommendations for on-site visits by peers and selection criteria for on-site visit peer reviewers”;
15. CIPM document – CIPM/2005-05 “Services available to Associates States and Economies of the CGPM and their participation in the CIPM MRA”;
16. CIPM document – CIPM MRA/2005-07 “NMIs and other Designated Institutes”;
17. Common (BIPM, OIML, ILAC) statement and declaration on the relevance of various international agreements on metrology to trade, legislation and standardization (23 January 2006);
18. Joint ILAC-CIPM communication regarding the accreditation of calibration and measurement services of national metrology institutes (7 March 2012);
19. “Calibration and measurement capabilities” – A paper by the joint BIPM/ILAC working group – CIPM/2007-11;
20. COOMET recommendation R/GM/7:2006 “Procedure of inner inter-regional reviewing of measurement and calibration capabilities of COOMET national metrological institutes and interregional reviewing of the institutes of other regional metrological organizations”;
21. JCRB document – JCRB-11/7(a) “Monitoring the Impact of Key and Supplementary Comparison Results on CMC Claims”;
22. JCRB document – JCRB-10/7\_rev “A Note on Supplementary comparisons”;
23. JCRB document – JCRB-11/8(5)\_rev “Supplementary comparisons – definition”;
24. JCRB document – JCRB-20/6 “Flowcharts of the processes for key comparisons, bilateral comparisons, and supplementary comparisons”;
25. COOMET recommendation R/GM/12:2007 “Rules of maintaining of foregoing COOMET Program of comparisons”;
26. COOMET Recommendation R/GM/11:2010 “REGULATIONS for comparison of measurement standards from the national metrological institutes of COOMET”;

27. COOMET Recommendation R/GM/14:2006 “Guidelines for data evaluation of COOMET key comparison”;
28. COOMET Recommendation R/GM/19:2008 “Guideline on COOMET supplementary comparison evaluation”;
29. “*Guide to the Expression of Uncertainty in Measurement*”, traduction by “D.I. Mendeleyev Institute for Metrology (VNIIM)”, Saint-Petersburg, 1999;
30. JCRB document – JCRB-8/9 “Uncertainty contributions of the device under calibration or measurement”;
31. COOMET Recommendation R/GM/21:2011 “Use of concepts “error of measurement” and “uncertainty of measurement”. General principles materials”;
32. COOMET Informational Material I/GM/4:2006 “Analysis of the problem of introduction of the “Guide to the expression of Uncertainty in Measurement” in COOMET state-members”;
33. COOMET Recommendation R/GM/15:2007 “The rules of completion of the form of calibration certificates issued by National Metrology Institutes within the scope of the CIPM MRA”;
34. International standard ISO/IEC 17025 “General requirements for the competence of testing and calibration laboratories”;
35. ISO guide 34 “General requirements for the competence of reference material producers”;
36. COOMET Recommendation R/AQ/9:2010 “Recommendation on the Evaluation of Quality Management System of National Metrology Institutes”;
37. COOMET Recommendation R/AQ/13:2010 “The Rules and Procedure for the Evaluation of Quality Management Systems In National Metrology Institutes”;
38. CIPM document – CIPM MRA-G-02 “JCRB guidelines for the monitoring and reporting of the operation of quality systems by RMOs”;
39. Informational material COOMET I/TR/6: 2005 “Review "National educational systems in the field of metrology in the COOMET member-countries”.