	COOMET Recommendation	**COOMET R/GM/31:2016**
	Calibration techniques. General requirements	
Approved at 26th meeting of the COOMET Committee (Erevan ,Armenia 20-21 April 2016)		

1. Introduction

This document specifies main requirements for the structure, drafting, layout and contents of calibration techniques. The Recommendation has been developed taking into account the requirements of ISO/IEC 17025-2005, COOMET Recommendations R/GM/21:2011 [3] and R/GM/15:2007 [4], and Publication Reference EA-4/02 M: 2013 [6].

The “International vocabulary of metrology – Basic and general concepts and associated terms”, third edition (2007) [1] has been adopted as the main reference document for concepts and terminology.

This Recommendation is developed under the COOMET project 422/RU-a/08. The recommendations set forth in this document are intended for use in legal and applied metrology.

2 Scope

This Recommendation is applicable to calibration techniques developed and used by national metrology institutes and other national metrology organizations.

Calibration techniques (CTs) may be developed as separate documents or as parts of documents for measurement standards or measuring instruments. CTs may apply to groups of measurement standards or measuring instruments of different types as well as to individual types of measurement standards or measuring instruments. Standardized CTs or CTs of other organizations, with established uncertainties (uncertainty calculation algorithms) may also be used for calibration. In that case it is necessary to confirm that the use of such CTs is valid before using them in calibration. Assessment of the validity of calibration techniques should be conducted in accordance with the requirements specified in section 5.4 of ISO/IEC 17025-2005.

It is recommended that the provisions of this document be also applied to all kinds of documents, scientific-technical, educational and reference literature on metrology that fall within the area of work on standardization and (or) use results of this work.

3 Normative references

The following documents are referenced in this Recommendation:

ISO/IEC 17025-2005 “General requirements for the competence of testing and calibration laboratories”;

JCGM 200:2008 (E/F) “International vocabulary of metrology – Basic and general concepts and associated terms (VIM)”;

International Document OIML D 5 “Principles for the establishment of hierarchy schemes for measuring instruments”

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 CIPM MRA”.

4 Abbreviations

BIPM	International Bureau of Weights and Measures;
COOMET	Euro-Asian Cooperation of National Metrological Institutions
NMI	National Metrology Institute;
DI	Designated Institute;
CT	calibration technique;
PC	personal computer;
MI	measuring instrument;

5. Basic terms and definitions

The terms and definitions used in this Recommendation are those given in [1], taking into account comments in [3].

6 Main requirements for the structure, drafting, layout, and content of calibration techniques

6.1 Recommendations for the structure and content of the title and the main part of CT:

6.1.1 The title page may contain:

- the spelled-out name of the NMI or DI;
- the approval signature of a responsible official;
- the name and type designation of the measuring instrument (group of measuring instruments of the same type) to be calibrated, and the name of the object of regulation, i.e. “Calibration technique”.
- the identification number of CT (for example, it can consist of letters indicating the status of the document, numbers representing the code of the structural subdivision as assigned to it within the NMI/DI, the number of the laboratory that developed the technique, preceded with a slash, and also numbers indicating the chronological number of the given

document type, preceded with a hyphen, and numbers of the year of approval (signing) of the document (separated by a hyphen).

6.1.2 Introduction

The Introduction section shall include the scope of CT, its purpose, calibration method, groups of measuring instruments to be calibrated, and also references to international and national normative documents used in the development of this CT.

6.1.3 CT shall have the main part subdivided into sections arranged in the following order:

- calibration operations;
- calibration instruments;
- requirements for the qualification of persons performing calibration (if there are special requirements);
- safety requirements;
- calibration conditions;
- handling of the unit under calibration;
- preparations for calibration;
- calibration;
- processing of measurement results and calculation of the uncertainty of measurements in calibration;
- documentation of calibration results;
- information data.

In justified cases, combining or omitting individual sections is allowed.

1) The section “Calibration operations” shall list the names of operations performed during the calibration. The operations should be arranged as a vertical list.

2) The section “Calibration instruments” shall list main and auxiliary calibration instruments, reference materials, equipment and materials, for which reference numbers of the normative documents that regulate the metrological and main technical characteristics of these means shall be indicated. The list may be given as Table 1.

Table 1

CT item number	Name and type (designation) of a main or auxiliary calibration instrument; reference number of the normative document that regulates the technical requirements and (or) metrological and main technical characteristics of the calibration instrument

This section shall include an indication of the possibility of using means other than those listed but which ensure the determination of the metrological characteristics of the measuring instruments to be calibrated with required accuracy.

3) The section “Requirements for the qualification of persons performing calibration” shall contain information about the level of qualification (profession, education, practical experience etc.) of such persons. The section may additionally include a list of reference numbers and names of normative documents, knowledge of which is essential for conducting the calibration.

4) The section “Safety requirements” shall contain requirements ensuring occupational safety, industrial sanitation, and environmental protection when performing the calibration. This section shall include an indication of the need for the calibration process to be classified as work involving harmful or especially harmful working conditions.

5) The section “Calibration conditions” shall contain a list of quantities that affect the metrological characteristics of the measuring instruments to be calibrated, together with nominal values of the influence quantities and permissible deviations from the nominal values (limits of the nominal area).

6) The section “Handling of the unit under calibration” shall describe a procedure for the application of identification marks on the unit under calibration on its receipt from the customer, requirements for the handling, movement, transportation and storage of the unit under calibration. The section may include a reference to a documented procedure of the NMI/ DI, if any.

7) The section “Preparations for calibration” shall contain a list of work to be carried out before calibration and ways of doing it.

8) The section “Calibration” shall have the following subsections:

- visual inspection;
- functional check;
- determination of metrological characteristics.

The subsection “Visual inspection” shall list requirements for the completeness of delivery and appearance of the measuring instruments to be calibrated.

The subsection “Functional check” shall list and describe operations that need to be carried out to check how the measuring instrument to be calibrated works, and how its individual parts and elements work and interact (including its insulation strength and resistance, hermeticity, etc.).

The subsection “Determination of metrological characteristics” shall describe the operations listed in the section “Calibration operations” and specify most appropriate methods for determining (monitoring) the metrological characteristics of the measuring instrument to be calibrated.

The description of each operation shall appear as a separate item in the sequence indicated in the section “Calibration operations”.

The description of an operation shall contain the calibration name and method, connection diagrams, drawings, a statement of the order of the operations, formulas, graphs, tables explaining the symbols used in them.

If it is necessary during calibration to record the results of measurements in a measurement report (report) in a particular from, this fact shall be indicated and the report form shall be given in an annex, specifying how much detail is to be included in the report.

Note 2: If no particular form is required for the report, this should be indicated

9) The section “Processing of measurement results and calculation of the uncertainty of measurements in calibration” shall be included in CT if there are complicated ways of processing measurements results. In any case it is mandatory to describe an algorithm for determining the expanded uncertainty of measurement results in calibration, taking into account that this uncertainty is not a metrological characteristic of the measuring instrument being calibrated. If the ways of processing measurement results are set forth in a normative document, in a section (subsection), a reference to that document shall be included.

10) The section “Documentation of calibration results” shall contain requirements for documenting calibration results.

A calibration certificate is drawn up in accordance with the 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 CIPM MRA” [4, 5]. If a calibration cannot be performed, an NMI/DI informs the customer of this fact, with an indication of the reasons.

6.2 The following may be included as annexes to CT:

- an algorithm for processing measurement results on a PC;
- a form for recording measurement results, uncertainty of measurements;
- a calibration hierarchy scheme (taking into account the requirements in [2]);
- examples of calculations involved in the processing of measurement results, tables of calculated values, curves and other calculated data;
- explanations of terms;
- procedures for preparing certified mixtures and sampling;
- a scientific-technical justification of requirements for CT parameters (number of calibration points, number of measurements at each calibration point etc.);
- technical descriptions of auxiliary devices.

6.3 CT must be updated periodically and also when there has been a change in the set of applied equipment and/or national and international standards.

Bibliography

[1] JCGM 200:2008 (E/F)	International vocabulary of metrology – Basic and general concepts and associated terms (VIM)
[2] International Document OIML D 5	Principles for the establishment of hierarchy schemes for measuring instruments
[3] COOMET Recommendation R/GM/21:2011	Use of concepts “error of measurement” and “uncertainty of measurement”. General principles
[4] 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 CIPM MRA
[5] CIPM MRA	Mutual recognition arrangement on national measurement standards and calibration and measurement certificates issued by national metrology institutes, Paris, 14 October 1999
[6] EA-4/02 M: 2013	Evaluation of the Uncertainty of Measurement In Calibration

Information data

1. Coordinating organisation: All-Russian Research Institute for Physico-Technical and Radio-Technical Measurements (VNIIFTRI).

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2. COOMET project 422/RU-a/08.

3. The document was approved at __ meeting of the COOMET Committee.

4. Information on the application of the document by COOMET members.

This Recommendation is developed taking into account the requirements of the COOMET Publication D4/2014 “COOMET Publications. Classification, development, approval and registration. General provisions”, ISO/IEC 17025-2006, 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 CIPM MRA”, COOMET Recommendation R/GM/21:2011 “Use of concepts ‘error of measurement’ and ‘uncertainty of measurement’. General principles”, Mutual Recognition Arrangement on national measurement standards and calibration and measurement certificates issued by National Metrology Institutes (CIPM MRA) and also based on various publications.

The recommended general requirements are intended primarily for use by National Metrology Institutes (NMI) in developing calibration techniques corresponding to calibration and measurement capabilities within the framework of the CIPM MRA.

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