**COOMET TECHNICAL COMMITTEE 1.8**

**“PHYSICO-CHEMISTRY”**

**Protocol for the Key Comparison:**

**COOMET.QM–K3.2019 (COOMET project № 864/RU/22)**

**Key comparison «Automotive exhaust gases»**

- October 2022 -

## 1 Background

COOMET key comparison COOMET.QM–K3.2019 is designed as linking to the appropriate CCQM comparison - CCQM-K3.2019 [1] and is intended to support CMCs of National Metrological Institutes of the countries - members of COOMET.

The CCQM‐K3.2019 was organized to support calibration and measurement capabilities (CMCs) for gas mixtures presenting little analytical challenge and is a key comparison on a 'core' gas mixture (Track A key comparison) [2].

**2 Participants**

VNIIM, Russia (coordinator)

KazStandart, Kazakhstan

BelGIM, Belarus

**3 Measurands**

Amount fractions of carbon monoxide, carbon dioxide, oxygen and propane (in a matrix of high-purity nitrogen)

# 4 Mixtures

A set of mixtures will be prepared gravimetrically and subsequently verified against other PSM, including PSMs used in CCQM -K3.2019. The mixtures will be prepared by the coordinating laboratory VNIIM using gravimetric method. The nominal composition of the mixtures is within the following ranges (Table 1):

Table 1: Nominal ranges of amount of substance fractions

|  |  |
| --- | --- |
| Component | Amount fraction x |
| Carbon monoxide | 0.5 % – 2 % |
| Carbon dioxide | 2 % – 5 % |
| Oxygen | 1 % – 4 % |
| Propane | 100 ppm – 300 ppm |
| Nitrogen | Balance |

The pressure in the cylinders will be approximately 10 MPa; cylinders of 5 dm3 nominal volume will be used. The amount-of-substance fractions as calculated from gravimetry and purity data will be used as key comparison reference value. Each cylinder will have its own reference value and associated expanded uncertainty.

**5 The task of the participants**

Participating laboratories are responsible for the calibration of their own equipment. For a proper evaluation of the data, it is necessary that the calibration method, as well as the way in which the calibration mixtures have been prepared is reported to the co-ordinator in sufficient detail to check the data for obvious omissions.

After the measurements, the participants have to return the cylinders with a sufficient amount of gas (pressure shall be at least 7 MPa) to VNIIM for re-analysis.

Transport of the cylinders to the participating laboratories and back to the coordinating laboratory will be arranged and paid for by the participants. The participants are also responsible for returning the cylinders promptly after completing the measurements.

The measurement report requires per cylinder at least three independent measurements,obtained under repeatability conditions. This is a strict requirement to come to proper statistical analysis of the reported data..

Participating laboratories are requested to specify in detail which analytical method(s) have been used and how the evaluation of measurement uncertainty was performed.

Additional measurement reports and additional information can be submitted jointly with the report forms to VNIIM and will be taken into consideration during the evaluation.

The measurement reports shall meet the standards that Metrologia applies for submitted papers. Furthermore, the following requirements are to be met:

Equations shall be typeset in the equation editor of Word 2007 or later.

Participating laboratories are to express the uncertainty on all results submitted, as expanded uncertainty. The evaluation of measurement uncertainty should be inaccordance to the “Guide to the expression of uncertainty in measurement”.

The participant should provide a detailed description of the uncertainty budget, including

* All data necessary for reproducing the measurement results and final result recorded in the reporting forms
* All models used for calculating intermediate and final results; models taken verbatim from international standards (e.g., ISO 6142-1, ISO 6143) should be given by reference
* Evaluation method of standard uncertainty (type A or type B), including as appropriate the (assumed) probability distribution

**6 Timetable**

|  |  |
| --- | --- |
| **Dates** | **Action** |
| November 2022 | Agreement of protocol |
| January 2023 | Registration of participants |
| July 2023 ‐ September 2023 | Preparation of mixtures and verification of their composition |
| October 2023 | Dispatch of mixtures |
| November 2023 ‐ January 2024 | Measurements at NMIs |
| February 2024 | Reports and cylinders arrived back at VNIIM |
| March 2024 – May 2024 | Re-verification of the mixtures |
| July 2024 | Draft A report available |

References:

[1] Adriaan M H van der Veen et al. International comparison CCQM-K3.2019 “Automotive exhaust gases”. [Metrologia](https://iopscience.iop.org/journal/0026-1394), [Volume 60](https://iopscience.iop.org/volume/0026-1394/60), [Number 1A](https://iopscience.iop.org/issue/0026-1394/60/1A)  (2023).

[2] Brewer PJ, van der Veen AMH. GAWG strategy for comparisons and CMC claims, CCQM Gas Analysis Working Group, (2016).

**Measurement report**

**Calibration standards**  
*Please provide a brief description of the calibration standards used, including  
• Method of preparation  
• Weighing data  
• Purity tables (composition) of the parent gases  
• Verification measures*

**Instrumentation**  
*Please provide a brief description of the particulars of the instrument(s) used in this key comparison*

**Calibration method and value assignment***Please provide a brief description how the equipment was calibrated and how the assigned value was  
calculated (including the necessary formula):*

**Uncertainty evaluation**  
Please provide a brief description of the evaluation of measurement uncertainty, including the expressions used:

**References**  
*Any literature references you may wish to refer to come here*

**Authorship**  
*Please provide the authorship of the measurement report (2-3 persons typically)*