Protocol APMP.QM-K3.2019

Automotive emission gases

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March 13, 2023

Table of contents

Table of contents II

Background 1

Measurands 1

Mixtures 1

Supported claims 2

Participants 2

Schedule 2

Coordinator 2

Measurement report 3

- Report form 3
- Calibration standards 4
- Instrumentation 4
- Calibration method and value assignment 4
- Uncertainty evaluation 4
- References 5
- Authorship 5

Background

To support calibration and measurement capabilities (CMCs) for gas mixtures presenting little analytical challenge, a key comparison on a 'core' gas mixture is organised.

Measurands

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

Mixtures

A set of mixtures will be prepared gravimetrically and subsequently verified against other PSMs. The mixtures will be prepared by the coordinating laboratory KRISS. The nominal composition of the mixtures is within the following ranges:

Table 1: Nominal ranges of amount of substance fractions

Component	Amount fraction x
Carbon monoxide	(0.5 – 2) cmol/mol
Carbon dioxide	(2 – 5) cmol/mol
Oxygen	(1 – 4) cmol/mol
Propane	(100 – 300) µmol/mol
Nitrogen	Balance

The pressure in the cylinders will be approximately 10 MPa; cylinders of 10 L nominal volume will be used. The amount 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.

Please note that:

1. 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 coordinator in sufficient detail to check the data for obvious omissions.
2. After the measurements, the participants have to return the cylinders with a sufficient amount of gas (pressure shall be at least 5 MPa) to KRISS for second verification analysis.
3. Transport of the cylinders from coordinating laboratory (KRISS) to the participating laboratories will be paid for by the KRISS and back to the coordinating laboratory (KRISS) will be paid for by the participants. The participants are also responsible for returning the cylinders promptly after completing the measurements.
4. 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.
5. Participating laboratories are requested to specify in detail which analytical method(s) have been used and how the evaluation of measurement uncertainty was performed.
6. Additional measurement reports and additional information can be submitted jointly with the report forms to KRISS and will be taken into consideration during the evaluation.

Supported claims

This key comparison can be used to support CMC claims for mixtures of propane in nitrogen, propane in air, and mixtures falling into the category of "core gas mixtures".

Participants

Participants: KRISS (coordinating laboratory), NIM, NMIM, NMC/A*STAR, NIMT, NMIJ, NMIA, CMS/ITRI, NPLI, CENAM, and CERI

Schedule

The schedule for this key comparison reads as follows

Table 2: Key comparison schedule

Date	Event
March 2023	Agreement of protocol
April 2023	Registration of participants
October 2023	Preparation and verification of mixtures
November 2023	Dispatch of mixtures
March 2024	Reports and cylinders arrived back at KRISS
May 2024	Re-verification of the mixtures
September 2024	Draft A report available
March 2025	Draft B report available

Coordinator

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Measurement report

Report form

Laboratory name:

Cylinder number:

Measurement 1[#]

Component	Date (dd/mm/yy)	Result (cmol/mol)	Standard deviation (% relative)	Number of replicates
CO				
CO_2				
O_2				
C_3H_8				

Measurement 2[#]

Component	Date (dd/mm/yy)	Result (cmol/mol)	Standard deviation (% relative)	Number of replicates
CO				
CO_2				
O_2				
C_3H_8				

Measurement 3[#]

Component	Date (dd/mm/yy)	Result (cmol/mol)	Standard deviation (% relative)	Number of replicates
CO				
CO_2				
O_2				
C_3H_8				

Measurement X#

Component	Date (dd/mm/yy)	Result (cmol/mol)	Standard deviation (% relative)	Number of replicates
CO				
CO_2				
O_2				
C_3H_8				

Results

Component	Result (cmol/mol)	Expanded uncertainty (cmol/mol)	Coverage factor
CO			
CO_2			
O_2			
C_3H_8			

Calibration standards

Please provide a brief description of the calibration standards used

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 formulae):

Uncertainty evaluation

Please provide a brief description of the evaluation of measurement uncertainty.

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)