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GAS ANALYSIS PROFICIENCY TESTING SCHEMES DESCRIPTION

2026-2030

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Contents

1. INTRODUCTION

The NMISA Gas Analysis Section has been delivering PT and interlaboratory comparisons (ILCs) to the air quality, pollution and emission monitoring industry over the last 15 years.

Participation in Proficiency testing (PT) schemes provides participants with an objective evaluation of the laboratory's technical competence and analytical capabilities. Regular participation in PT is a requirement of ISO/IEC 17025. PT scheme reports can also be used to demonstrate laboratory and staff competence to both clients and accreditation bodies.

Gas PT samples are prepared by NMISA and provided in cylinders containing the target measurands as listed in Table 1. Planned PTs are run annually (Table 2), as communicated in this document, and on our website. Those PTs not planned under the 5-year schedule, may be arranged on request as a custom interlaboratory comparison (ILC) with NMISA.

Homogeneity and short-term stability of the NMISA PT gas mixtures are checked prior to shipment. After the PT deadline a confidential electronic PT result report is provided to all participants.

Table 1: PT scheme measurand, amount fraction range and expanded relative uncertainty (%REU) offered by the NMISA Gas Analysis Section

#	Description	Amount Fraction	%REU
1	Methane in nitrogen	0.1 to 10 % mol.mol^{-1}	1.3
2	Carbon dioxide in nitrogen	0.1 to 10 % mol.mol^{-1}	1.3
3	Carbon monoxide in nitrogen	100 to 10 000 µmol.mol^{-1}	1.3
4	Carbon monoxide in nitrogen	1 to 10 % mol.mol^{-1}	1.3
5	Sulphur dioxide in nitrogen	100 to 1000 µmol.mol^{-1}	1.3
6	Sulphur dioxide in nitrogen	10 to 100 µmol.mol^{-1}	1.3
7	Ozone	0 to 500 nmol.mol^{-1}	3
8	Hydrogen sulphide in nitrogen	100 to 1000 µmol.mol^{-1}	1.5
9	Hydrogen sulphide in nitrogen	10 to 100 µmol.mol^{-1}	3
10	Nitrogen dioxide in nitrogen	10 to 100 µmol.mol^{-1}	3.6
11	Nitrogen dioxide in nitrogen	100 to 1000 µmol.mol^{-1}	2.0
12	Ethanol in nitrogen	50 to 250 µmol.mol^{-1}	1.0
13	Ethanol in nitrogen	250 to 500 µmol.mol^{-1}	0.7
14	Nitrogen oxide in nitrogen	10 to 100 µmol.mol^{-1}	1

#	Description	Amount Fraction	%REU
15	Nitrogen oxide in nitrogen	100 to 10 000 µmol.mol^{-1}	0.5
16	Oxygen in nitrogen	1.5 to 20 % mol.mol-1	1.3
17	Propane in nitrogen	100 to 10 000 µmol.mol^{-1}	1.3
19	Hydrogen in nitrogen	1 to 10 % mol.mol^{-1}	1.0

Note: the gas analysis laboratory offers purity assignment of high purity gases and multicomponent proficiency testing schemes on request.

2. ACCREDITATION STATUS

The NMISA Gas Analysis Section is ISO/IEC 17025 and ISO 17034 accredited. The PTs are conducted according to the requirements of the ISO/IEC 17043 (2023) standard: conformity assessment – general requirements for proficiency testing. Unless otherwise indicated, all PT samples used in the scheme are ISO 17034 accredited certified reference materials.

3. COMMUNICATION

NMISA has appointed key personnel and management representatives responsible for delivering the PT schemes. Contact details of the PT coordinator, the logistics administrator and technical manager are given below. Where applicable alternative scheme coordinators are communicated for each PT.

Scheme coordinators

Ms Mudalo Jozela/ Ms Nompumelelo Leshabane/ Ms Portia Seemane/ Mr Mphara Mogale/ Ms Tshepiso Mphamo/ Mr Wilson Magobo

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Logistics administrator

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Technical manager

Dr Maria Fernandes-Whaley

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4. SCHEDULE

4.1. Shipment of PT samples

Shipment of the PT samples to and from the participant will be arranged by NMISA. NMISA will notify the participant when the cylinder is ready for shipment. The participants should indicate if they will require bullnose and nuts and if is required it should be returned with the PT sample. A participant may also opt for self-collection at NMISA premises, noting that cylinders will only be released to clients where vehicles meet the road transportation safety requirements. NMISA subcontracts the transportation of PT samples to qualified courier companies that meet safety and quality requirements. Participants are required to complete delivery notes and cylinder log sheet; these should be submitted to NMISA immediately upon receipt of the PT sample cylinders.

4.2. PT scheme schedule and registration

The cost for participation (single result submission) in planned NMISA PTs for 2026/27 are listed in **Table 2**. The cost includes delivery.

An additional 12- month cylinder rental fee will be levied for PT participants who wish to retain the PT sample until it is depleted. NMISA will issue a credit note for cylinders returned before the end of the 12-month period.

Participants not wishing to retain the PT sample will pay the fee as per Table 2. Requests for custom PT/ILC not planned in 2026/27 are priced on request. Registration is confirmed upon receipt of a Purchase Order or proof of payment received through the NMISA customer portal.

Table 2 Planned PT schemes and ILCs schedule for the 5 year cycle 2026 – 2030. Prices are indicated for 2026/27.

	Description	Amount Fraction	Registration deadline	Dispatch	Result submission deadline	Draft Report	Cost (Rands) 0% VAT
1.	H_2S in nitrogen	10 to 100 $\mu mol.mol^{-1}$	20 Sept 2026	31 Oct 2026	30 Nov 2026	20 Dec 2026	R 10 650
2.	SO_2 in nitrogen	10 to100 $\mu mol.mol^{-1}$	20 Sept 2026	31 Oct 2026	30 Nov 2026	20 Dec 2026	R 10 650
3.	SO_2 in nitrogen	100 to 1 000 $\mu mol.mol^{-1}$	20 Sept 2026	31 Oct 2026	30 Nov 2026	20 Dec 2026	R 10 650
4.	CH_4 in nitrogen	1 to 10 % $mol.mol^{-1}$	20 Oct 2026	30 Nov 2026	20 Dec 2026	20 Jan 2027	R 10 650
5.	CO_2 in nitrogen	1 to 10 % $mol.mol^{-1}$	20 Oct 2026	30 Nov 2026	20 Dec 2026	20 Jan 2027	R10 650
6.	CO_2 in nitrogen	10 to 20 % $mol.mol^{-1}$	July 2027	Aug 2027	Sept 2027	Sept 2027	TBC
7.	C_2H_5OH in nitrogen	140 to 240 $\mu mol.mol^{-1}$	Sept 2027	Oct 2027	Nov 2027	Dec 2027	TBC
8.	SO_2 in nitrogen	1000 to 10 000 $\mu mol.mol^{-1}$	Sept 2027	Oct 2027	Nov 2027	Dec 2027	TBC
9.	CO in nitrogen	100 to 1 000 $\mu mol.mol^{-1}$	Oct 2027	Nov 2027	Dec 2027	Jan 2028	TBC
10.	Ozone	0 to 500 $nmol.mol^{-1}$	Oct 2027	Nov 2027	Dec 2027	Jan 2028	TBC
11.	H_2S in nitrogen	100 to 1 000 $\mu mol.mol^{-1}$	July 2028	Aug 2028	Sept 2028	Sept 2028	TBC
12.	C_3H_8 in nitrogen	100 to 1 000 $\mu mol.mol^{-1}$	Sept 2028	Oct 2028	Nov 2028	Dec 2028	TBC
13.	C_3H_8 in nitrogen	1000 to 10 000 $\mu mol.mol^{-1}$	Sept 2028	Oct 2028	Nov 2028	Dec 2028	TBC
14.	NO_2 in nitrogen	100 to 1 000 $\mu mol.mol^{-1}$	Oct 2028	Nov 2028	Dec 2028	Jan 2029	TBC

	Description	Amount Fraction	Registration deadline	Dispatch	Result submission deadline	Draft Report	Cost (Rands) 0% VAT
15.	NO in nitrogen	10 to 100 $\mu mol.mol^{-1}$	Oct 2028	Nov 2028	Dec 2028	Jan 2029	TBC
16.	NO_2 in nitrogen	10 to 100 $\mu mol.mol^{-1}$	July 2029	Aug 2029	Sept 2029	Sept 2029	TBC
17.	NO in nitrogen	100 to 1 000 $\mu mol.mol^{-1}$	Sept 2029	Oct 2029	Nov 2029	Dec 2029	TBC
18.	O_2 in nitrogen	3 to 10 % $mol.mol^{-1}$	Sept 2029	Oct 2029	Nov 2029	Dec 2029	TBC
19.	CO in nitrogen	1 to 10 % $mol.mol^{-1}$	Oct 2029	Nov 2029	Dec 2029	Jan 2030	TBC
20.	CO in nitrogen	10 to 100 $\mu mol.mol^{-1}$	Oct 2029	Nov 2029	Dec 2029	Jan 2030	TBC
21.	O_2 in nitrogen	10 to 21 % $mol.mol^{-1}$	July 2030	Aug 2030	Sept 2030	Sept 2030	TBC
22.	CH_4 in nitrogen	1000 to 10 000 $\mu mol.mol^{-1}$	Sept 2030	Oct 2030	Nov 2030	Dec 2030	TBC
23.	C_2H_5OH in nitrogen	250 to 500 $\mu mol.mol^{-1}$	Sept 2030	Oct 2030	Nov 2030	Dec 2030	TBC

Please note that the ozone ILCs will be scheduled between October to December upon request (Cost: R 10 650).

5. PT SCHEME MIXTURES

5.1. Preparation method and homogeneity assessment

Cylinders containing gas mixtures of the measurand with similar nominal amount fractions will be prepared gravimetrically by NMISA according to ISO 6142-1 (2015). The mixtures will be verified against NMISA primary standard gas mixtures (PSGM). The pressure in a cylinder will be approximately 9.0 MPa at the time of dispatch for participants intending to retain the sample. A cylinder of 10 or 5 dm^3 nominal volume may be used.

5.2. Stability of mixtures

Stability is defined as the ability of a reference material, when stored under specified conditions, to maintain a stated property value within specified limits for specified period. The stability study of gas mixtures aims to determine the degree of instability of gas mixtures after preparation or to confirm the stability. Before the PT sample is sent to the participant the short-term stability of the

cylinder is assessed by verifying the mixtures for a minimum of three measurements over a month duration. According to our historical data our PT samples are stable for a minimum of twelve months.

5.3. Retention of Gas PT cylinders

NMISA PT participants will now be able to retain the PT cylinder for a maximum period of twelve months. The PT sample may be used for internal QC, staff training and any PT corrective actions. Cylinder rental will be applied for this period. NMISA will issue a credit note for any cylinders that are returned before the end of the 12-month period. Participants not wishing to retain the PT sample, will have their cylinders collected by NMISA upon result submission deadline.

6. REPORTING

6.1. Result submission

An electronic result report template is provided to participants. Participants are required to not make any modifications to the given template. The completed measurement result report must be submitted by the indicated deadline. Participants will be given a month to complete their measurements after the PT sample distribution date. Results received after the deadline will not be processed or included in the report. In case of foreseeable delays, participants are requested to report such delays to the scheme coordinator in advance, with the expected result submission date. New deadlines, if extension request is granted, will be communicated to all participants.

6.2. Measurement results

Laboratories will be required to submit results for at least three independent measurements taken from each cylinder, which is obtained under repeatability conditions with at least three independent calibrations, e.g., calibration − > measurement − > calibration − > measurement − > calibration − > measurement. This is required for proper statistical analysis of the reported data.

6.3. Measurement uncertainty

The reported amount fraction of the measurand should have uncertainty estimates. The measurement uncertainty should be evaluated according to the GUM (ISO/IEC GUIDE 98-3:2008). For example,

- method of evaluation (type A or Type B)
- (assumed) probability distribution
- standard uncertainties and sensitivity coefficients

The participant will be responsible for the calibration of their equipment according to the routine procedures applied in their own laboratory. To ensure a proper evaluation of the data, it is necessary

that the calibration method, as well as how the calibration mixtures are prepared, should be reported to the NMISA. This information is needed for the evaluation of the preparation facilities as an integral part of this comparison.

7. STORAGE AND HANDLING OF PT SAMPLES

Store the cylinder away from direct heat between temperatures of 10 to 40 °C in a well-ventilated area. More guidance on the use of calibration gas mixtures can be found in ISO 16664 (Gas Analysis – Handling of calibration gases and gas mixtures – Guidelines). PT measurements must be completed in a similar manner to routine measurements to allow accurate evaluation of participant measurement capabilities that are representative of daily operational performance.

8. SAFETY

The cylinder should be handled with care and by experienced personnel in a laboratory environment suitably equipped for the safe handling of gases materials. Participants collecting cylinders from NMISA premises are required to do so with vehicles that comply with safe road transportation requirements for gas cylinders.

9. PERFORMANCE EVALUATION

9.1. PT scheme reference value

The amount-of-substance fraction (in $mol.mol^{-1}$) for each individual mixture obtained from the weighing process and the purity verification of the parent gases will be provided by NMISA. The NMISA metrologically traceable gravimetric preparation value will be used as the PT scheme assigned reference value.

The uncertainty associated with the reference value is calculated by combining gravimetric uncertainty and verification uncertainty. The PT scheme uncertainty for each measurand will be calculated from the percentage relative expanded uncertainty. The percentage relative expanded uncertainty (% REU) is different for each measurand based on the NMISA's calibration and measurement capabilities for each component and amount fraction and are listed in **Table 1**.

9.2. Evaluation using En-score

The E_n numbers or normalised errors are used to determine the conformance and non-conformance of participating laboratories in proficiency schemes where the uncertainty in the measurement result from both the laboratory reported value and reference value are compared using the E_n equation below:

$$E_n = \frac{x_{lab} - x_{Ref}}{\sqrt{U_{lab}^2 + U_{Ref}^2}} \quad (1)$$

Where:

$E_n = the\ E_n\ score$

$x_{lab} = participant\ laboratory\ result$

$x_{Ref} = reference\ value$

$U_{lab} = is\ the\ expanded\ uncertainty\ of\ a\ participant's\ results\ (x)$

$U_{Ref} = is\ the\ expanded\ uncertainty\ of\ the\ reference\ laboratory's\ assigned\ value\ (x)$

I. |En| ≤ 1.0 the score indicates "satisfactory" performance.
II. |En| > 1.0 the score indicates "unsatisfactory" performance.

10. PT REPORT

An electronic confidential PT report will be provided within 1 month of the PT deadline. Where needed alternative timeframes may be communicated to participants. Unique codes will be allocated to each participant in the report to ensure confidentiality of the results.

11. APPEALS

Participants will be given an opportunity to review the draft report within 2 weeks for transcription errors. Thereafter the final report is issued. Participants who wish to appeal their results may direct their queries to the Scheme Coordinator within this period. If necessary, the appeal may be escalated to the technical manager. Where applicable a revised report may be issued.

12. REFERENCES

ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*

ISO/IEC 17043:2023 *Conformity assessment - General requirements for proficiency testing*

ISO/IEC Guide 98: 2008 Uncertainty of measurement - Part 3: Guide to the expression of uncertainty in measurement (GUM)

ISO 6142-1:2015 *Gas analysis - Preparation of calibration gas mixtures - Part 1: Gravimetric method for Class I mixtures*

Eurachem guide: Selection, use and interpretation of proficiency testing (PT) schemes. 2011. 2nd Edition.

ISO 16664:2017 Gas analysis – Handling of calibration gases and gas mixtures – Guidelines.