



EffecTech

Global Leaders in Gas Measurement



Stack Emissions Proficiency Testing Scheme (SEPTS)

Presentation of Results

Round 2026

EffecTech is accredited by the United Kingdom Accreditation Service (UKAS) to provide this Proficiency Testing Scheme in accordance with the requirements of ISO/IEC 17043 : 2023

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Revisions History

Issue	Date	Author(s)	Comments
1	27 August 2026	Dr Joey Walker	<i>Final report</i>

Statement of Confidentiality

EffectTech keeps all data regarding the performance of individual participants strictly confidential. Results and performance data are protected, stored and backed up on storage network disks and folders to which access is restricted to the scheme coordinator and the technical authority only.

The relationship between results and the laboratories that submitted them will never be disclosed. The laboratory alone is granted access to its performance through the assigned participant code and through issue of a confidential Certificate of Participation.

Checked by



Harvey Grills
Scheme Coordinator

Approved by



Dr Joey Walker
Technical Authority

1. Introduction

EffecTech provides and organises the Stack Emissions Proficiency Testing Scheme (SEPTS). This report presents data on the reference mixtures in cylinders and the results of the participants for Round 2026 (June - July 2026).

The SEPTS scheme provides an objective way of assessing the performance of each participant by a series of annual inter-laboratory comparisons. The scheme is aimed at laboratories/testing organisations working in the field of continuous emissions monitoring (CEM) of stationary sources often in waste incineration or large combustion plant processes.

In this round participants were given the opportunity of analysing up to eight (8) different measurands in seven (7) gas mixtures. The composition range of each measurand in each mixture is shown in the tables below.

Table 1: Composition range by gas mixture type

measurand	range
sulphur dioxide (SO ₂) in nitrogen	10 to 200 µmol/mol
propane (C ₃ H ₈) in 10% oxygen / nitrogen	5 to 50 µmol/mol
nitric oxide (NO) in nitrogen	10 to 500 µmol/mol
carbon monoxide (CO) in nitrogen	20 to 500 µmol/mol
oxygen (O ₂) in nitrogen	2 to 14 %mol/mol
carbon dioxide (CO ₂) in nitrogen	1 to 10 %mol/mol
nitric oxide (NO) and nitrogen oxides (NO _x) in nitrogen	20 to 400 µmol/mol 25 to 500 µmol/mol

Note: all units used in this report are in the SI unit of amount of substance fraction (mol/mol) or in metric prefixes thereof.
500 µmol/mol is equivalent to 500×10^{-6} mol/mol
10 %mol/mol is equivalent to 10 dmol/mol is equivalent to 10×10^{-2} mol/mol

Gas mixture preparation, reference value assignment and the assessment of participants' results are all carried out by designated operators and approved signatories within EffecTech and in accordance with our ISO/IEC 17043 accredited processes.

In addition, all logistics management and preparation of shipping documentation is also carried out by designated approved personnel within EffecTech. All shipping, freight forwarding and proficiency testing item distribution is supplied by specialist transport providers.

A total of twenty-two (22) laboratories signed up to participate in this round. Twenty-two (22) laboratories to whom items were distributed, submitted results for one or more of the measurands assessed in the scheme.

2. Mixture preparation and reference value assignment

2.1 Procedure

Preparation of mixture batches

For each mixture type, a single large volume parent mixture was prepared by a gravimetric method in accordance with ISO 6142-1. A batch of mixtures of each type was then produced by decanting the parent mixture into a batch of lower volume pre-prepared and evacuated daughter cylinders. The parent mixture and daughter mixtures were then calibrated.

Mixture calibration

All parent mixtures were calibrated using a two-point calibration design with bracketing (TPC), with the exception of the carbon dioxide measurand which was calibrated using a single-point through origin calibration (SPO). Both of these calibration methods are in accordance with ISO 12963 for which EffecTech is accredited to ISO/IEC 17025 and ISO 17034 by UKAS.

Every single decant mixture was calibrated by a single point exact matching technique (SPEM) also in accordance with ISO 12963 by the comparison of the decant mixture with its nominally identical parent mixture. A selective batch calibration technique was not used. All mixtures despatched to participants were calibrated individually to provide ultimate assurance in the assigned reference values.

The uncertainty on amount fraction of each measurand in the mixtures resulting from this calibration is termed the characterisation uncertainty, u_{char} (ISO 33405).

All calibrations are performed in accordance with EffecTech's ISO/IEC 17025 accredited calibration methods (in-house methods TM014, TM025 or TM026). These can be found in our scope of accreditation published on the United Kingdom Accreditation Service (UKAS) website (www.ukas.com).

Reference mixture traceability

An analytical comparison method is used for the calibration of all mixtures in this scheme. In-house primary reference gas mixtures (PRGM) are used for calibration which are traceable by verification to the National Physical Laboratory (NPL, UK) or to the Van Swinden Laboratorium (VSL, NL). Parent mixtures are calibrated either by direct comparison with PRGMs (SPO) or, where diluted, with reference gas mixtures generated dynamically in accordance with ISO 6145-7 (TPC). This process ensured that the values assigned to the mixtures in this scheme are metrologically traceable to international standards, through an unbroken chain of comparisons, and ultimately to the amount of substance (mole) defined in the SI (International System of Units).

Homogeneity assessment

Statistical analysis of the spread of reference values obtained for each batch of mixtures (derived through calibration above) is used to assess the homogeneity between the set of decant mixtures to be distributed to each participant. The dispersion of the amount fraction of each component due to batch inhomogeneity is known as the between-bottle standard deviation (s_{bb}). The uncertainty arising from this is the between-bottle uncertainty (u_{bb}). The statistical procedure used for the determination of $u_{\text{bb}}=s_{\text{bb}}$ can be found in ISO 33405.

The uncertainty associated with within-bottle heterogeneity u_{wb} is assumed to be zero; EffectTech has conducted numerous measurements and intercomparisons that demonstrate that for well mixed gas mixtures, samples used for analysis are homogenous with the gas mixture within the cylinder. Hence the standard uncertainty associated with heterogeneity $u_{hom} = u_{bb}$. This uncertainty should be less than or equal to the characterisation uncertainty, u_{char} , in order to accept the batch. This condition was met for all components in all mixtures produced for all participants in this round.

Reference value assignment

For all measurands, each component was assigned a reference value, x_{ref} , calculated from the average (simple arithmetic mean) of those determined in the calibration stage (see section above).

The initial combined uncertainty determined for each reference value was calculated from the equation below (ISO 33405 – section 10.2).

$$u_c^2 = u_{char}^2 + u_{hom}^2$$

This combined uncertainty, u_c , is dominated in all cases by the calibration uncertainty, u_{char}

Following this calculation, the expanded uncertainty, $k \cdot u_c$, ($k=2$), was compared to the Calibration and Measurement Capability (CMC) for which EffectTech is accredited to ISO/IEC 17025. If U_{CMC} ($k=2$) was greater than $k \cdot u_c$ ($k=2$) then the uncertainty on the reference value was assigned to that stated in our published CMC in accordance with accepted practice such that

$$U_{ref} = \max (U_{CMC}, 2u_c)$$

The use of a coverage factor of $k=2$ in the assignment of U_{ref} provides a level of confidence of approximately 95%.

The individual calibration data for each suite of decant mixtures is not shown in this report. However, this data is available to all participants on request from EffectTech.

Stability statement

Over several years EffectTech has built up a history of intercomparisons of mixture types featured in this PT scheme. Data from these intercomparisons show clearly that all mixtures remain stable within their stated uncertainty for a minimum of 12 months.

Hence, the stability of each mixture is guaranteed for a period of 12 months. Within this time period there is no additional uncertainty ascribed to the reference values resulting from the long or short term stability of the mixtures. This is valid providing the mixtures are not used beyond this stability period.

The majority of these mixtures will be stable (within their stated uncertainty) for considerably longer but this period has not been determined.

2.2 Assigned reference values

The table below show the reference values assigned to the measurands in the mixtures in cylinders distributed to participants of this scheme.

Table 2: Reference values assigned following batch homogeneity assessment

measurand	units	x_{ref}	$U(x_{\text{ref}})$	$u_c / \%$	$u_{\text{char}} / \%$	$u_{\text{bb}} / \%$
sulphur dioxide	$\mu\text{mol/mol}$	194.9	1.9	0.48	0.47	0.096
propane	$\mu\text{mol/mol}$	29.71	0.28	0.32	0.31	0.038
nitric oxide	$\mu\text{mol/mol}$	194.13	0.97	0.25	0.20	0.14
carbon monoxide	$\mu\text{mol/mol}$	387.6	3.1	0.25	0.25	0.0044
oxygen	$\%\text{mol/mol}$	4.765	0.029	0.080	0.073	0.032
carbon dioxide	$\%\text{mol/mol}$	3.239	0.017	0.20	0.19	0.053
nitric oxide (NO/NO ₂ mix)	$\mu\text{mol/mol}$	78.18	0.62	0.39	0.33	0.21
nitrogen oxides (NO/NO ₂ mix)	$\mu\text{mol/mol}$	90.12	0.80	0.45	0.39	0.21

3. Results

3.1 Reported results

There were twenty-seven (27) laboratories/organisations signed up for participation in this round of the scheme. Consignments containing up to seven (7) different mixture types were shipped to those participating.

The tables below show participation and whether results were submitted for the mixtures shipped.

Table 3: Participant laboratories and reported results

Participant id	sulphur dioxide		propane		nitric oxide		carbon monoxide	
	participation	results	participation	results	participation	results	participation	results
P01			✓	✓	✓	✓		
P02							✓	✗
P03	✓	✓	✓	✓	✓	✓	✓	✓
P04	✓	✓	✓	✓	✓	✓	✓	✓
P05			✓	✓	✓	✓	✓	✓
P06	✓	✓	✓	✓	✓	✓	✓	✓
P07	✓	✓			✓	✓	✓	✓
P08	✓	✓	✓	✓	✓	✓	✓	✓
P09	✓	✓	✓	✓	✓	✓	✓	✓
P10	✓	✓	✓	✓			✓	✓
P11	✓	✓	✓	✓	✓	✓	✓	✓
P12	✓	✓	✓	✓	✓	✓	✓	✓
P13			✓	✓				
P14	✓	✓	✓	✓	✓	✓	✓	✓
P15	✓	✓	✓	✓	✓	✓	✓	✓
P16								
P17	✓	✓	✓	✓			✓	✓
P18			✓	✓	✓	✓		
P19			✓	✓	✓	✓	✓	✓
P20			✓	✗				
P21	✓	✓	✓	✓			✓	✓
P22							✓	✓

Participant id	oxygen		carbon dioxide		nitric oxide (NO/NO2 mix)		nitrogen oxides (NO/NO2 mix)	
	participation	results	participation	results	participation	results	participation	results
P01								
P02	✓	✓	✓	✓	✓	✗	✓	✗
P03	✓	✓	✓	✓	✓	✓	✓	✓
P04	✓	✓	✓	✓				
P05	✓	✓	✓	✓	✓	✓	✓	✓
P06	✓	✓	✓	✓	✓	✓	✓	✓
P07	✓	✗	✓	✓	✓	✓	✓	✓
P08	✓	✓	✓	✓	✓	✓	✓	✓
P09	✓	✓	✓	✓	✓	✓	✓	✓
P10	✓	✓	✓	✓	✓	✓	✓	✓
P11	✓	✓	✓	✓	✓	✓	✓	✓
P12	✓	✓	✓	✓	✓	✓	✓	✓
P13								
P14	✓	✓	✓	✓	✓	✓	✓	✓
P15	✓	✓	✓	✓				
P16					✓	✓	✓	✓
P17	✓	✓	✓	✓	✓	✓	✓	✓
P18	✓	✓						
P19	✓	✓	✓	✓	✓	✓	✓	✓
P20	✓	✓	✓	✓				
P21	✓	✓	✓	✓	✓	✓	✓	✓
P22	✓	✓	✓	✓	✓	✓	✓	✓

To enable the calculation of E_n numbers, the laboratory is required to submit an estimate of the uncertainty placed on their measured amount fractions. The majority of participants submitted estimates of measurement uncertainty on the measurands for which they reported a value.

3.2 Measures of performance

z-score

The evaluation of performance was carried out by means of a z-score, which gives the relative deviation of the participant's result from the reference value.

The z-score is calculated with the following general formula

$$z = \frac{x_{meas} - x_{ref}}{\sigma} \quad (1)$$

where x_{meas} is the measured result reported by the laboratory

x_{ref} is the assigned reference value and

σ is the absolute standard deviation used for performance assessment (SDPA) which can be calculated from the contributions $S_{PT,rel}$ and $S_{PT,abs}$ by

$$\sigma = \frac{S_{PT,rel}}{100} \cdot x_{ref} + S_{PT,abs} \quad (2)$$

If there is concern that the estimation of the z-score may be biased due to the magnitude of the uncertainty of the assigned reference value in the case when $u_{ref} > 0.3\sigma$ then the use of a modified z'-score shall be used to evaluation performance for that component failing this condition.

The z'-score is calculated with the following general formula.

$$z' = \frac{x_{meas} - x_{ref}}{\sqrt{\sigma^2 + u_{ref}^2}} \quad (3)$$

The standard deviation for performance assessment used for calculating the z-scores has been fixed for all components by EffectTech and based upon a reasonable expectation of the performance capabilities that should be demonstrated by each laboratory for the direct measurement of a gas mixture in a cylinder.

These are given in the tables below.

Table 4: Standard deviation for performance assessment

measurand	$S_{PT,rel}$	$S_{PT,abs}$
sulphur dioxide	2.5 % relative	
propane	5.0 % relative	
nitric oxide	2.5 % relative	
carbon monoxide	1.5 % relative	
oxygen	1.0 % relative	0.01 %mol/mol
carbon dioxide	1.0 % relative	0.01 %mol/mol
nitric oxide (NO/NO2 mix)	2.5 % relative	
nitrogen oxides (NO/NO2 mix)	2.5 % relative	

The qualification of the z-scores is given in table 5 below

Table 5: Relationship between z-score and quality of result

z-score	quality of result
$ z \leq 2$	satisfactory result
$2 < z < 3$	questionable result
$ z \geq 3$	unsatisfactory result

E_n number

In addition, an E_n number is calculated which assesses the difference in the reference and measured (reported) values relative to their respective uncertainties. The calculation of E_n numbers is dependent upon the laboratory estimates of uncertainties associated with their measurement results.

The E_n number is calculated with the following general formula

$$E_n = \frac{x_{meas} - x_{ref}}{\sqrt{U_{meas}^2 + U_{ref}^2}} \quad (4)$$

where x_{meas} is the measured result reported by the laboratory

x_{ref} the assigned reference value and

U_{meas} and U_{ref} their respective uncertainties (using a coverage factor $k=2$)

The qualification of the E_n number is given in table 6 below

Table 6: Relationship between E_n -number and quality of result

E_n number	quality of result
$ E_n \leq 1$	satisfactory result
$ E_n > 1$	unsatisfactory result

Evaluation of the performance of a laboratory based on E_n numbers requires a reported estimate of their measurement uncertainty, U_{meas} . In addition, it is important that the reported uncertainties are in the same order of magnitude as the uncertainties on the reference values. Due to the nature of the formula used to calculate the E_n number, high reported uncertainties are much more likely to result in very low E_n numbers.

3.3 Evaluation of results

The results of the evaluation of z-scores based upon the expectation SDPA are shown in the table below.

Table 7 - Summary of z-scores

<i>z-scores</i>								
participant id	sulphur dioxide	propane	nitric oxide	carbon monoxide	oxygen	carbon dioxide	nitric oxide (NO/NO ₂ mix)	nitrogen oxides (NO/NO ₂ mix)
P01		-0.68	0.22					
P02					1.13	-0.92		
P03	0.87	-1.46	0.14	-0.63	-0.05	-0.75	-0.09	-1.83
P04	-0.21	-2.19	0.61	-0.52	0.95	3.84		
P05		1.08	0.54	-2.44	-0.57	1.75	-0.10	-1.93
P06	0.05	0.14	-0.38	-0.17	0.36	0.10	-0.52	-2.96
P07	-0.18		0.94	0.48		3.80	0.32	-1.34
P08	-0.34	0.62	0.53	1.43	0.19	-0.67	0.34	-1.47
P09	-1.05	-0.44	-0.67	0.38	-0.03	-1.13	3.77	2.32
P10	1.38	-2.81		1.30	-0.05	-0.73	-1.01	-2.50
P11	0.26	0.21	-0.01	0.41	0.09	-0.58	-0.46	-2.99
P12	-2.37	0.23	-1.48	4.93	1.65	-1.60	1.34	0.25
P13		0.17						
P14	0.54	-0.12	0.59	-0.18	-0.21	-1.09	-0.26	-0.86
P15	1.07	0.13	1.60	-2.57	-0.06	-0.04		
P16							0.26	-1.08
P17	1.37	-1.35		0.49	0.33	-0.87	0.50	-4.86
P18		0.33	0.15		0.12			
P19		2.11	0.82	-0.66	-1.39	4.08	0.38	-2.01
P20					0.35	0.68		
P21	-0.10	-0.72		0.47	-0.12	2.69	-1.81	-2.03
P22				-0.41	0.67	-0.55	0.16	-1.05

These results show a generally good performance from the pool of participants.

Eight (8) laboratories (**P01, P02, P03, P08, P13, P14, P16, and P22**) achieved satisfactory results for all measurands for which they reported a result.

Performance based upon the E_n -numbers are given in the table below.

Table 8 - Summary of E_n -numbers

E_n -numbers

participant id	sulphur dioxide	propane	nitric oxide	carbon monoxide	oxygen	carbon dioxide	nitric oxide (NO/NO ₂ mix)	nitrogen oxides (NO/NO ₂ mix)
P01		-2.18	0.45					
P02					0.13	-0.08		
P03	0.70	-0.89	0.12	-0.63	-0.10	-1.74	-0.05	-1.13
P04	-0.04	-0.67	0.12	-0.08	0.15	0.39		
P05		3.63	0.84	-2.10	-0.59	2.16	-0.15	-1.90
P06	0.02	0.08	-0.18	-0.08	0.07	0.02	-0.16	-0.80
P07	-0.03		0.22	0.06			0.08	
P08	-0.10	0.34	0.23	0.44	0.04	-0.37	0.24	-1.08
P09	-0.72	-0.10	-0.52	0.39	-0.01	-0.27	1.38	0.75
P10	2.08	-4.34		1.30	-0.02	-0.12	-0.50	-1.28
P11	0.12	0.12	0.00	0.18	0.02	-0.13	-0.15	-0.82
P12	-1.15	0.10	-0.78	1.29	0.39	-0.48	0.65	0.12
P13		0.06						
P14	0.31	-0.18	1.06	-0.16	-0.05	-0.22	-0.33	-0.58
P15	1.54	0.28	2.60	-1.85	-0.06	-0.06		
P16							0.31	-1.26
P17	1.24	-2.20		0.33	0.00	-0.14	0.33	-5.31
P18		1.21	0.34		0.12			
P19		6.87	1.27	-0.56	-1.45	4.93	0.55	-1.98
P20					0.12	0.15		
P21	-0.19	-1.83		0.46	-0.05	0.44	-1.01	-1.14
P22				-0.03	0.06	-0.06	0.02	-0.13

For the laboratories submitting estimates of uncertainty for their measurements, the corresponding E_n -numbers show fewer satisfactory result to those for z-scores.

Propane represented the most challenging measurand, with several participants reporting $E_n > 1$, including some substantially greater than 2. This indicates that, for these participants, the difference from the assigned value was large relative to the combined stated measurement uncertainties.

The largest absolute E_n -numbers were observed for **P19** for propane ($E_n=6.87$), **P17** for the nitrogen oxides mixture ($E_n=5.31$), **P19** for carbon dioxide ($E_n=6.87$), and **P10** for propane ($E_n=4.34$). These results warrant particular investigation as the reported deviations are considerably greater than would be expected from the stated measurement uncertainties.

Excellent performance was demonstrated by participant **P22**, who reported results for four or more measurands and achieved 100% satisfactory performance based on both z-scores and -numbers.

Annex A - Detailed results by measurand

Detailed results for all measurands in all mixtures are shown in subsequent charts.

In each chart, the reported results are shown with the dots in terms of a relative difference (in percent) from the assigned reference value. The reported uncertainties (where supplied) are shown as “error bars” on the reported values.

In each chart the bound limit lines surrounding the zero relative difference signify

- the percentage relative uncertainty on the reference value, $\%U(x_{\text{ref}})$ $k=2$ (in blue)
- the $|z|=2$ satisfactory limit (in green)
- the $|z|=3$ unsatisfactory limit (in red)

This annex also includes additional statistics presenting consensus values from the pool of laboratories on the basis of raw data and correct data (following the removal of outlying reported values).

Additional tables also show repeatability standard deviation (s_r), between laboratory standard deviation (s_L) and reproducibility standard deviation (s_R) on the basis of raw and corrected data. The data has been calculated in accordance with the robust statistical methods in ISO 5725 Parts 1 and 2. The detailed calculations made to derive these results are outside the scope of this report but will be provided to participants on request from the scheme coordinator.

Measurand/
Mixture

sulphur dioxide

Reference

x_{ref}	$U(x_{\text{ref}}) k=2$	σ
194.9	1.9 $\mu\text{mol/mol}$	4.9 $\mu\text{mol/mol}$

Reported data

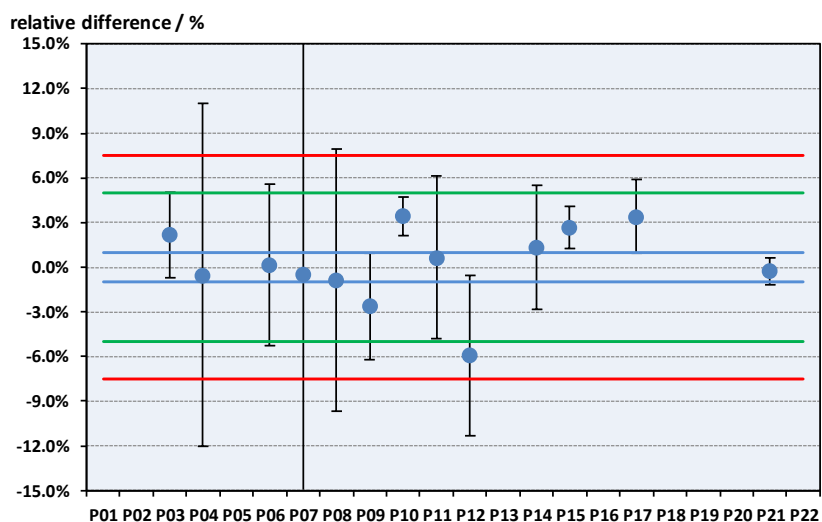
id	value ($\mu\text{mol/mol}$)	$U(k=2)$ ($\mu\text{mol/mol}$)	relative difference	z-score	E_n -number
P01					
P02					
P03	199.1	5.7	2.17%	0.87	0.70
P04	193.9	22.3	-0.51%	-0.21	-0.04
P05					
P06	195.2	10.6	0.13%	0.05	0.02
P07	194.0	32.9	-0.46%	-0.18	-0.03
P08	193.2	17.0	-0.86%	-0.34	-0.10
P09	189.8	6.9	-2.63%	-1.05	-0.72
P10	201.6	2.6	3.45%	1.38	2.08
P11	196.2	10.7	0.66%	0.26	0.12
P12	183.3	9.9	-5.93%	-2.37	-1.15
P13					
P14	197.5	8.2	1.34%	0.54	0.31
P15	200.1	2.8	2.68%	1.07	1.54
P16					
P17	201.6	5.0	3.41%	1.37	1.24
P18					
P19					
P20					
P21	194.4	1.7	-0.26%	-0.10	-0.19
P22					

Consensus values (raw data)

m	195.5	
s_r	0.7	0.34%
s_L	5.4	2.78%
s_R	5.5	2.80%
p	13	

Consensus values (corrected)

m	196.7	
s_r	0.7	0.36%
s_L	3.9	1.98%
s_R	4.0	2.02%
p	12	



Reference

x_{ref}	$U(x_{\text{ref}}) \ k=2$	σ
29.71	0.28	1.49

μmol/mol

μmol/mol

Reported data

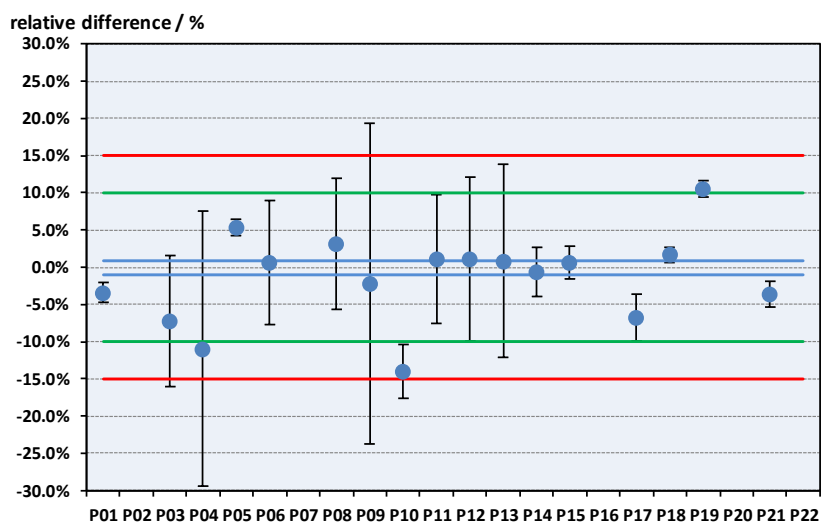
id	value (μmol/mol)	U (k=2) (μmol/mol)	relative difference	z -score	E _n -number
P01	28.69	0.37	-3.42%	-0.68	-2.18
P02					
P03	27.54	2.43	-7.30%	-1.46	-0.89
P04	26.45	4.89	-10.97%	-2.19	-0.67
P05	31.32	0.34	5.42%	1.08	3.63
P06	29.91	2.50	0.69%	0.14	0.08
P07					
P08	30.63	2.70	3.09%	0.62	0.34
P09	29.06	6.25	-2.18%	-0.44	-0.10
P10	25.54	0.92	-14.05%	-2.81	-4.34
P11	30.02	2.60	1.04%	0.21	0.12
P12	30.05	3.31	1.15%	0.23	0.10
P13	29.96	3.89	0.83%	0.17	0.06
P14	29.53	0.97	-0.61%	-0.12	-0.18
P15	29.91	0.66	0.67%	0.13	0.28
P16					
P17	27.70	0.87	-6.77%	-1.35	-2.20
P18	30.21	0.30	1.67%	0.33	1.21
P19	32.85	0.36	10.57%	2.11	6.87
P20					
P21	28.64	0.52	-3.61%	-0.72	-1.83
P22					

Consensus values (raw data)

m	29.23	
s_r	0.11	0.38%
s_L	1.89	6.48%
s_R	1.90	6.49%
p	17	

Consensus values (corrected)

m	29.23	
s_r	0.11	0.37%
s_L	1.38	4.72%
s_R	1.38	4.74%
p	15	



Reference

x_{ref}	$U(x_{\text{ref}}) \ k=2$		σ	
194.13	0.97	$\mu\text{mol/mol}$	4.85	$\mu\text{mol/mol}$

Reported data

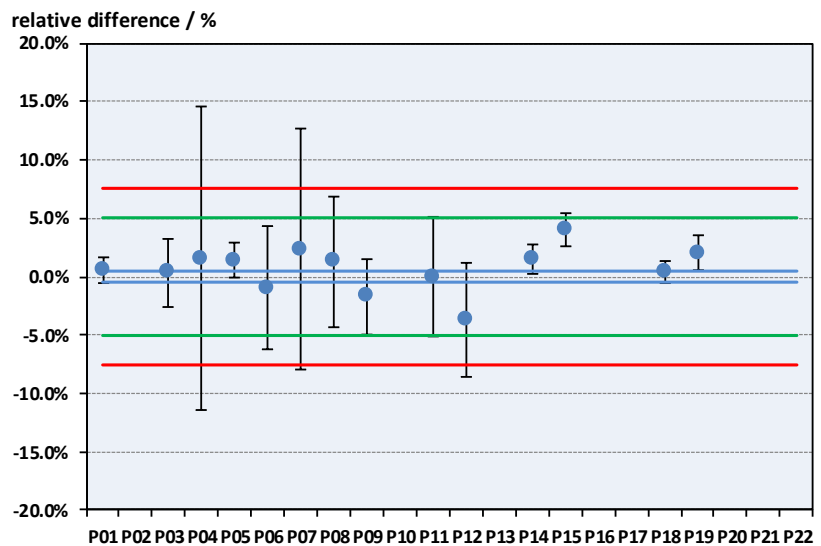
id	value ($\mu\text{mol/mol}$)	U (k=2) ($\mu\text{mol/mol}$)	relative difference	z-score	E_n -number
P01	195.20	2.15	0.55%	0.22	0.45
P02					
P03	194.80	5.71	0.35%	0.14	0.12
P04	197.10	25.60	1.53%	0.61	0.12
P05	196.75	2.95	1.35%	0.54	0.84
P06	192.28	10.18	-0.95%	-0.38	-0.18
P07	198.70	20.64	2.35%	0.94	0.22
P08	196.72	11.02	1.34%	0.53	0.23
P09	190.88	6.14	-1.67%	-0.67	-0.52
P10					
P11	194.10	10.02	-0.02%	-0.01	0.00
P12	186.97	9.16	-3.69%	-1.48	-0.78
P13					
P14	196.99	2.53	1.47%	0.59	1.06
P15	201.90	2.83	4.00%	1.60	2.60
P16					
P17					
P18	194.88	1.95	0.38%	0.15	0.34
P19	198.09	2.97	2.04%	0.82	1.27
P20					
P21					
P22					

Consensus values (raw data)

m	195.22	
s_r	1.85	0.95%
s_L	3.83	1.96%
s_R	4.25	2.18%
p	14	

Consensus values (corrected)

m	196.07	
s_r	1.94	0.99%
s_L	2.80	1.43%
s_R	3.40	1.74%
p	13	



Reference

x_{ref}	$U(x_{\text{ref}}) k=2$	σ
387.6	3.1	5.8

μmol/mol

μmol/mol

Reported data

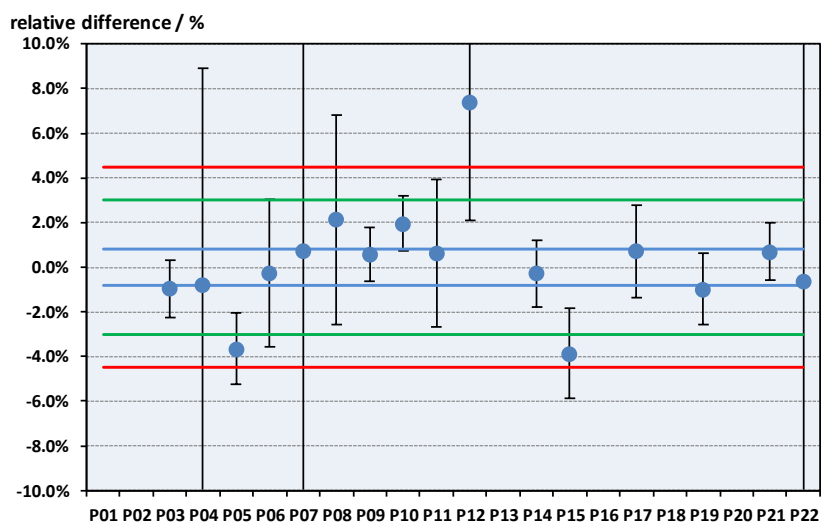
id	value (μmol/mol)	U (k=2) (μmol/mol)	relative difference	z-score	E_n -number
P01					
P02					
P03	383.9	4.9	-0.95%	-0.63	-0.63
P04	384.6	37.3	-0.77%	-0.52	-0.08
P05	373.4	6.0	-3.65%	-2.44	-2.10
P06	386.6	12.8	-0.26%	-0.17	-0.08
P07	390.4	50.0	0.72%	0.48	0.06
P08	395.9	18.6	2.14%	1.43	0.44
P09	389.8	4.7	0.56%	0.38	0.39
P10	395.2	4.9	1.95%	1.30	1.30
P11	390.0	12.9	0.62%	0.41	0.18
P12	416.3	22.1	7.40%	4.93	1.29
P13					
P14	386.5	5.7	-0.27%	-0.18	-0.16
P15	372.7	7.5	-3.86%	-2.57	-1.85
P16					
P17	390.4	8.1	0.73%	0.49	0.33
P18					
P19	383.8	6.1	-0.99%	-0.66	-0.56
P20					
P21	390.3	5.1	0.70%	0.47	0.46
P22	385.2	69.3	-0.61%	-0.41	-0.03

Consensus values (raw data)

m	388.3	
s_r	1.2	0.32%
s_L	10.3	2.66%
s_R	10.4	2.68%
p	16	

Consensus values (corrected)

m	386.2	
s_r	1.3	0.34%
s_L	6.9	1.79%
s_R	7.0	1.82%
p	15	



Reference

x_{ref}	$U(x_{\text{ref}}) \ k=2$		σ	
4.765	0.029	%mol/mol	0.058	%mol/mol

Reported data

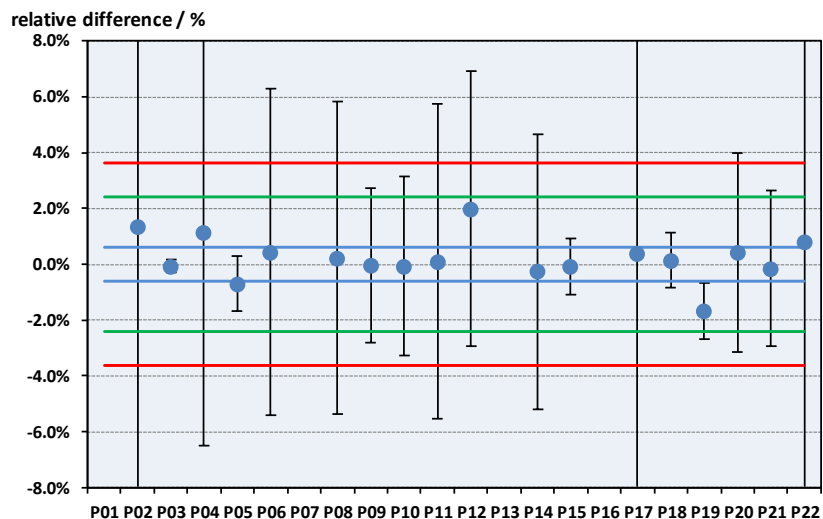
id	value (%mol/mol)	U (k=2) (%mol/mol)	relative difference	z -score	E_n -number
P01					
P02	4.830	0.500	1.36%	1.13	0.13
P03	4.762	0.012	-0.06%	-0.05	-0.10
P04	4.820	0.370	1.15%	0.95	0.15
P05	4.732	0.047	-0.69%	-0.57	-0.59
P06	4.786	0.280	0.43%	0.36	0.07
P07					
P08	4.776	0.267	0.23%	0.19	0.04
P09	4.763	0.132	-0.04%	-0.03	-0.01
P10	4.762	0.152	-0.06%	-0.05	-0.02
P11	4.770	0.270	0.10%	0.09	0.02
P12	4.860	0.240	1.99%	1.65	0.39
P13					
P14	4.753	0.234	-0.25%	-0.21	-0.05
P15	4.761	0.048	-0.07%	-0.06	-0.06
P16					
P17	4.784	3.900	0.40%	0.33	0.00
P18	4.772	0.048	0.14%	0.12	0.12
P19	4.685	0.047	-1.68%	-1.39	-1.45
P20	4.785	0.170	0.42%	0.35	0.12
P21	4.758	0.133	-0.15%	-0.12	-0.05
P22	4.804	0.624	0.81%	0.67	0.06

Consensus values (raw data)

m	4.776	
s_r	0.022	0.46%
s_L	0.040	0.83%
s_R	0.046	0.95%
p	18	

Consensus values (corrected)

m	4.776	
s_r	0.023	0.48%
s_L	0.026	0.53%
s_R	0.034	0.72%
p	16	



Reference

x_{ref}	$U(x_{\text{ref}}) k=2$		σ	
3.239	0.017	%mol/mol	0.042	%mol/mol

Reported data

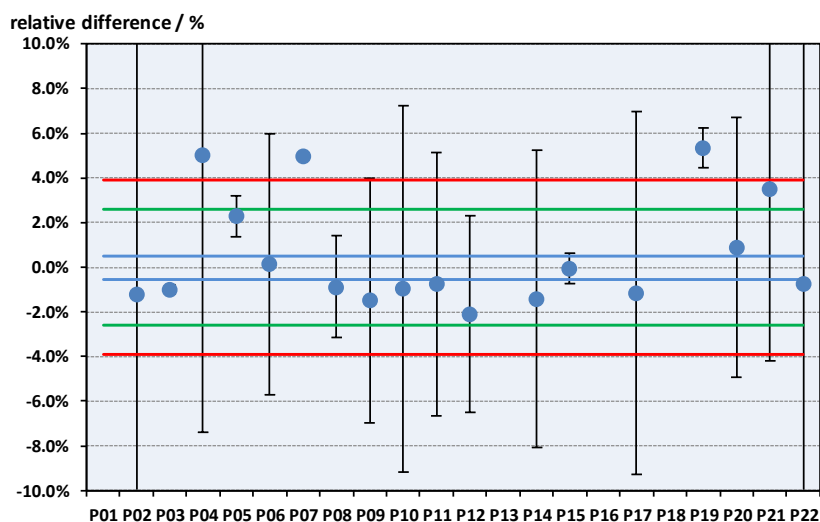
id	value (%mol/mol)	U (k=2) (%mol/mol)	relative difference	z -score	E_n -number
P01					
P02	3.200	0.500	-1.20%	-0.92	-0.08
P03	3.207	0.007	-0.99%	-0.75	-1.74
P04	3.402	0.422	5.03%	3.84	0.39
P05	3.313	0.030	2.28%	1.75	2.16
P06	3.243	0.190	0.13%	0.10	0.02
P07	3.400	0.000	4.97%	3.80	
P08	3.211	0.074	-0.87%	-0.67	-0.37
P09	3.191	0.175	-1.48%	-1.13	-0.27
P10	3.208	0.263	-0.96%	-0.73	-0.12
P11	3.214	0.190	-0.76%	-0.58	-0.13
P12	3.171	0.140	-2.10%	-1.60	-0.48
P13					
P14	3.193	0.212	-1.42%	-1.09	-0.22
P15	3.237	0.023	-0.06%	-0.04	-0.06
P16					
P17	3.202	0.260	-1.14%	-0.87	-0.14
P18					
P19	3.412	0.031	5.34%	4.08	4.93
P20	3.268	0.190	0.90%	0.68	0.15
P21	3.353	0.258	3.52%	2.69	0.44
P22	3.216	0.418	-0.72%	-0.55	-0.06

Consensus values (raw data)

m	3.251	
s_r	0.013	0.40%
s_L	0.077	2.36%
s_R	0.078	2.39%
p	18	

Consensus values (corrected)

m	3.251	
s_r	0.013	0.40%
s_L	0.077	2.36%
s_R	0.078	2.39%
p	18	



Measurand/
Mixture

nitric oxide
(NO/NO₂ mix)

Reference

x_{ref}	$U(x_{\text{ref}}) \ k=2$	σ
78.18	0.62	1.95

μmol/mol μmol/mol

Reported data

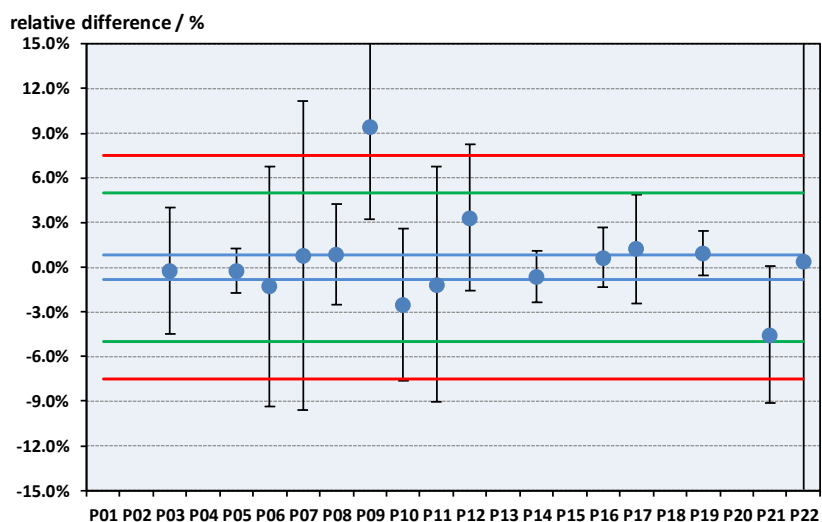
id	value (μmol/mol)	U (k=2) (μmol/mol)	relative difference	z -score	E _n -number
P01					
P02					
P03	78.00	3.32	-0.23%	-0.09	-0.05
P04					
P05	77.98	1.17	-0.26%	-0.10	-0.15
P06	77.17	6.20	-1.29%	-0.52	-0.16
P07	78.80	8.19	0.79%	0.32	0.08
P08	78.85	2.68	0.86%	0.34	0.24
P09	85.55	5.31	9.43%	3.77	1.38
P10	76.20	3.89	-2.54%	-1.01	-0.50
P11	77.29	6.10	-1.14%	-0.46	-0.15
P12	80.79	3.96	3.34%	1.34	0.65
P13					
P14	77.68	1.36	-0.64%	-0.26	-0.33
P15					
P16	78.70	1.57	0.66%	0.26	0.31
P17	79.15	2.90	1.24%	0.50	0.33
P18					
P19	78.92	1.18	0.95%	0.38	0.55
P20					
P21	74.64	3.43	-4.53%	-1.81	-1.01
P22	78.50	16.48	0.40%	0.16	0.02

Consensus values (raw data)

m	78.62	
s_r	0.44	0.56%
s_L	2.58	3.29%
s_R	2.62	3.33%
p	15	

Consensus values (corrected)

m	78.03	
s_r	0.46	0.58%
s_L	1.56	2.00%
s_R	1.63	2.08%
p	14	



Reference

x_{ref}	$U(x_{\text{ref}}) k=2$	σ
90.12	0.80	2.25

μmol/mol

μmol/mol

Reported data

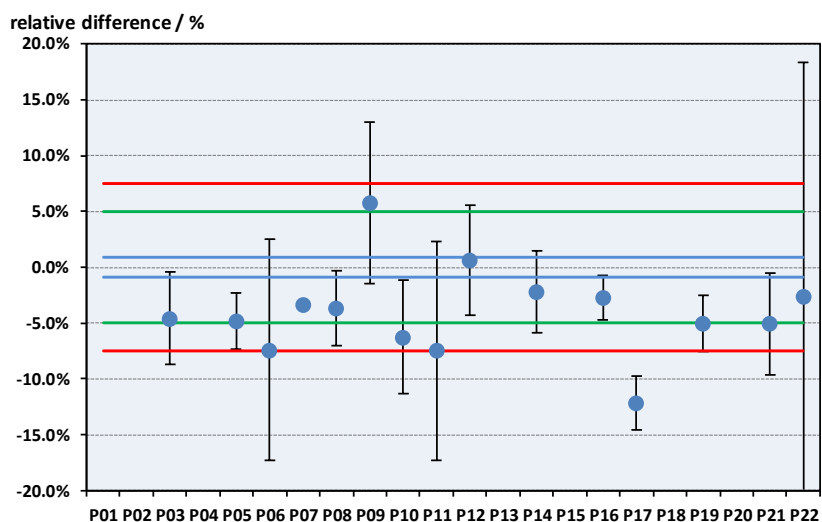
id	value (μmol/mol)	U (k=2) (μmol/mol)	relative difference	z -score	E _n -number
P01					
P02					
P03	86.01	3.56	-4.56%	-1.83	-1.13
P04					
P05	85.77	2.14	-4.83%	-1.93	-1.90
P06	83.46	8.31	-7.39%	-2.96	-0.80
P07	87.10	0.00	-3.35%	-1.34	
P08	86.81	2.95	-3.67%	-1.47	-1.08
P09	95.34	6.88	5.79%	2.32	0.75
P10	84.49	4.31	-6.24%	-2.50	-1.28
P11	83.38	8.18	-7.48%	-2.99	-0.82
P12	90.68	4.44	0.62%	0.25	0.12
P13					
P14	88.18	3.24	-2.15%	-0.86	-0.58
P15					
P16	87.69	1.75	-2.69%	-1.08	-1.26
P17	79.17	1.90	-12.15%	-4.86	-5.31
P18					
P19	85.59	2.14	-5.03%	-2.01	-1.98
P20					
P21	85.55	3.94	-5.07%	-2.03	-1.14
P22	87.76	18.43	-2.62%	-1.05	-0.13

Consensus values (raw data)

m	86.59	
s_r	0.45	0.52%
s_L	3.81	4.41%
s_R	3.84	4.44%
p	15	

Consensus values (corrected)

m	86.46	
s_r	0.48	0.56%
s_L	2.01	2.32%
s_R	2.07	2.39%
p	13	



Annex B - Converter efficiency

If the reported nitric oxide (NO) measurement of the NO/NO₂ mixture, for each participant, is subtracted from that of their reported nitrogen oxides (NO_x) result, then the nitrogen dioxide (NO₂) result from their measurements can be directly calculated. This derived NO₂ measurement result can be used to calculate the converter efficiency of their analyser where appropriate.

The table below gives the derived results for nitrogen dioxide and the calculated converter efficiencies for each reporting participant. Their uncertainties have been calculated by adding the uncertainties of their NO and NO_x reported results in quadrature.

**Component/
Mixture**nitrogen dioxide (NO₂)**Reference**

x_{ref}	$U(x_{\text{ref}}) k=2$
11.9	1.0

μmol/mol

Reported data

id	value (μmol/mol)	U (k=2) (μmol/mol)	difference (μmol/mol)	converter efficiency (%)	E_n -number
P01					
P02					
P03	8.0	4.9	-3.9	67.1%	-0.79
P04					
P05	7.8	2.4	-4.1	65.3%	-1.57
P06	6.3	10.4	-5.6	52.7%	-0.54
P07	8.3	8.2	-3.6	69.6%	-0.44
P08	8.0	4.0	-4.0	66.7%	-0.97
P09	9.8	8.7	-2.1	82.0%	-0.25
P10	8.3	5.8	-3.6	69.5%	-0.62
P11	6.1	10.2	-5.8	51.1%	-0.57
P12	9.9	5.9	-2.0	82.9%	-0.34
P13					
P14	10.5	3.5	-1.4	88.0%	-0.39
P15					
P16	9.0	2.4	-2.9	75.4%	-1.14
P17	0.0	3.5	-11.9	0.1%	-3.30
P18					
P19	6.7	2.4	-5.3	55.9%	-1.99
P20					
P21	10.9	5.2	-1.0	91.5%	-0.19
P22	9.3	24.7	-2.7	77.7%	-0.11

For appropriate measurement of nitrogen dioxide by the conversion of NO₂ to NO using a converter and subsequent measurement by chemiluminescence, the efficiency of the converter should be above 95% (in accordance with BS EN 14792).