

Stack Emissions Monitoring Report

commissioned by Finning (UK) Ltd

Operator Name

Virtus Holdco Ltd | LON14 Data Centre

Operator Address

DC6 Prologis Park
West Drayton
UB7 9FN

Release Point

2-3 - CAT 3516 standby power unit

Monitoring Organisation Name & Address

Atesta Ltd
Unit 2, Asher Court, Lyncastle Way
Appleton, Warrington
WA4 4ST

Monitoring Report Written By

Andrew Shipley | Senior Team Leader
MCERTS Level 2 | MM 13 1243 | TE1 TE2 TE3 TE4 | expires on 31/07/2025

Monitoring Report Approved By

Matt Pendlebury | Technical Support Manager
MCERTS Level 2 | MM 04 535 | TE1 TE2 TE3 TE4 | expires on 31/03/2026



Job Reference: JOB-1422

Report Date | Version Number

03/02/2025 | Version 1

Dates of the Monitoring Campaign

28/01/2025

Atesta Ltd Primary Contact

Alastair Wolff | m: 07506 729 226
e: alastair.wolff@atesta.com



info@atesta.com

T: 0800 970 8945

atesta.com

Report Contents and Monitoring Objectives

Report Contents

- TITLE PAGE
- CONTENTS AND MONITORING OBJECTIVES
- PART 1: EXECUTIVE SUMMARY
 - Monitoring Results
 - Monitoring and Analytical Methods (incorporating Method Deviations if applicable)
 - Monitoring Location
 - Duct and Sampling Platform Information
 - Operating Information
- PART 2: SUPPORTING INFORMATION
 - Appendix 1 - Monitoring Personnel, Analysis Laboratories and Test Equipment Used
 - Appendix 2 - Results and Calculations

Monitoring Objective

The monitoring objective was to conduct stack emissions monitoring, as requested by the customer, for a number of prescribed pollutants.

Special Requirements

There were no special requirements for this monitoring campaign.

Opinions and Interpretations

Any opinions or interpretations contained within this test report are outside the scope of Atesta's MCERTS / ISO 17025 accreditation.

Part 1: Executive Summary - Monitoring Results Summary

Monitoring Results - Summary

test parameter	EXPRESSED AS A CONCENTRATION				EXPRESSED AS A MASS EMISSION				reference conditions	accreditation status
	result	uncertainty in result +/-	limit (ELV)	units	result	uncertainty in result +/-	limit (ELV)	units		
Total Particulate Matter	9.5	0.68		mg/m ³	202	14.4		g/hr	STP, dry, 15% O ₂	MCERTS
PM ₁₀	7.0	0.94		mg/m ³	151	20.7		g/hr	STP, dry, 15% O ₂	MCERTS
PM _{2.5}	6.7	0.94		mg/m ³	144	20.6		g/hr	STP, dry, 15% O ₂	MCERTS
Total VOCs (as Carbon)	0.53	0.043		mg/m ³	11.3	0.93		g/hr	STP, dry, 15% O ₂	MCERTS
Oxides of Nitrogen (as NO ₂)	6.9	0.38		mg/m ³	148	8.1		g/hr	STP, dry, 15% O ₂	MCERTS
Carbon Monoxide	100	5.8		mg/m ³	2158	123		g/hr	STP, dry, 15% O ₂	MCERTS
Carbon Dioxide	8.0	0.21		% v/v	1899	101		kg/hr	dry	MCERTS
Oxygen	10.3	0.31		% v/v					dry	MCERTS
Stack Gas Water Vapour	5.4	0.16		% v/v					actual	MCERTS
Stack Gas Temperature	428			°C					actual	MCERTS
Stack Gas Velocity	32.3	0.31		m/s					actual	MCERTS
Stack Gas Flow Rate (ACTUAL)	32837	1519		m ³ /hr					actual	MCERTS
Stack Gas Flow Rate (REF)	21450	992		m ³ /hr					STP, dry, 15% O ₂	MCERTS

The stack gas water vapour, temperature, velocity and flow rates in the above table are calculated as an average of all of the results recorded during this monitoring campaign

The uncertainty in the result is reported at a 95% Confidence Interval in the same units as the monitoring result. In practice, this means that 95 times out of 100, the true result will lie within the stated range.

Part 1: Executive Summary - Monitoring Results Further Details

Monitoring Results - Further Details

		EXPRESSED AS A CONCENTRATION				EXPRESSED AS A MASS EMISSION				sampling date times	run time (mins)	H ₂ O (% v/v)	reference conditions
test parameter	run	result	uncertainty in result +/-	limit (ELV)	units	result	uncertainty in result +/-	limit (ELV)	units				
Total Particulate Matter	R1	10.5	0.73		mg/m³	222	15.3		g/hr	28/01/2025 13:43 - 14:08	25	6.2	STP, dry, 15% O ₂
Total Particulate Matter	R2	8.5	0.63		mg/m³	182	13.5		g/hr	28/01/2025 14:26 - 14:51	25	4.3	STP, dry, 15% O ₂
PM ₁₀	R1	7.7	1.0		mg/m³	171	22.9		g/hr	28/01/2025 13:04 - 13:34	30	5.8	STP, dry, 15% O ₂
PM ₁₀	R2	6.2	0.87		mg/m³	131	18.5		g/hr	28/01/2025 15:02 - 15:32	30	5.3	STP, dry, 15% O ₂
PM _{2.5}	R1	7.2	1.0		mg/m³	159	22.7		g/hr	28/01/2025 13:04 - 13:34	30	5.8	STP, dry, 15% O ₂
PM _{2.5}	R2	6.1	0.87		mg/m³	128	18.4		g/hr	28/01/2025 15:02 - 15:32	30	5.3	STP, dry, 15% O ₂
Total VOCs (as Carbon)	R1	0.53	0.043		mg/m³	11.3	0.93		g/hr	28/01/2025 13:04 - 14:04	60		STP, dry, 15% O ₂
Oxides of Nitrogen (as NO ₂)	R1	6.9	0.38		mg/m³	148	8.1		g/hr	28/01/2025 13:04 - 14:04	60		STP, dry, 15% O ₂
Carbon Monoxide	R1	100	5.8		mg/m³	2158	123		g/hr	28/01/2025 13:04 - 14:04	60		STP, dry, 15% O ₂
Carbon Dioxide	R1	8.0	0.21		% v/v	1899	101		kg/hr	28/01/2025 13:04 - 14:04	60		dry
Oxygen	R1	10.3	0.31		% v/v					28/01/2025 13:04 - 14:04	60		dry
Velocity & Flow Rate Traverse	R1	31.0	0.30		m/s	31577	1461		m³/hr	28/01/2025 12:40 - 12:47			actual
Stack Gas Water Vapour		5.4	0.16		% v/v								actual
Stack Gas Temperature		428			°C								actual
Stack Gas Velocity		32.3	0.31		m/s								actual
Stack Gas Flow Rate (ACTUAL)		32837	1519		m³/hr								actual
Stack Gas Flow Rate (REF)		21450	992		m³/hr								STP, dry, 15% O ₂

The stack gas water vapour, temperature, velocity and flow rates in the above table are calculated as an average of all of the results recorded during this monitoring campaign

The uncertainty in the result is reported at a 95% Confidence Interval in the same units as the monitoring result. In practice, this means that 95 times out of 100, the true result will lie within the stated range.

Part 1: Executive Summary - Monitoring and Analytical Methods

Monitoring and Analytical Methods

where analysis required	MONITORING					ANALYSIS					
test parameter	laboratory	accreditation number	technical procedure	reference method	monitoring status	laboratory	accreditation number	analytical procedure	analytical technique	analysis status	accreditation status
Total Particulate Matter	ATA	10706	TP-01	EN 13284-1	MCERTS	ATA	10706	AP-01	Gravimetric	MCERTS	MCERTS
PM ₁₀	ATA	10706	TP-02	EN ISO 23210	MCERTS	ATA	10706	AP-02	Gravimetric	MCERTS	MCERTS
PM _{2.5}	ATA	10706	TP-02	EN ISO 23210	MCERTS	ATA	10706	AP-02	Gravimetric	MCERTS	MCERTS
Water Vapour	ATA	10706	TP-03	EN 14790	MCERTS	ATA	10706	TP-03	Gravimetric	MCERTS	MCERTS

where analysis not required	MONITORING						
test parameter	laboratory	accreditation number	technical procedure	reference method	monitoring status	measurement technique & equipment	accreditation status
Total VOCs (as Carbon)	ATA	10706	TP-21b	EN 12619	MCERTS	FID using iFID Mobile	MCERTS
Oxides of Nitrogen (as NO ₂)	ATA	10706	TP-22a	EN 14792	MCERTS	Chemiluminescence using Horiba PG-350E	MCERTS
Carbon Monoxide	ATA	10706	TP-22b	EN 15058	MCERTS	NDIR using Horiba PG-350E	MCERTS
Carbon Dioxide	ATA	10706	TP-22e	PD CEN TS 17405	MCERTS	NDIR using Horiba PG-350E	MCERTS
Oxygen	ATA	10706	TP-22d	EN 14789	MCERTS	Paramagnetism using Horiba PG-350E	MCERTS
Velocity & Flow Rate Traverse	ATA	10706	TP-04a	EN 16911-1 TR 17078	MCERTS	Pitot Tube, Thermocouple & Thermomanometer	MCERTS

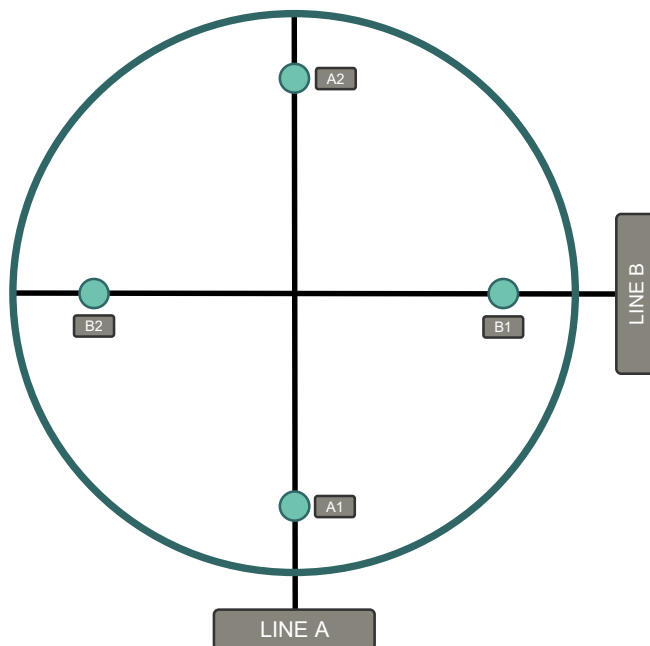
Summary of Monitoring Deviations (from Appendix 2)

test parameter	run	details of monitoring deviation
All	1	There were no deviations associated with the monitoring employed.

Monitoring Location Photos



refer to Appendix 2 - Raw Data to see how the points on this diagram relate to the points used for each test



Part 1: Executive Summary - Duct and Sampling Platform Information

Duct Characteristics | Sampling Ports

parameter	units	value	parameter	value	summary of all sample ports available
shape	-	Circular	primary sample port size	5" Flange	5" Flange
dimensions	-	Diameter = 0.60 m	primary sample port depth cm	45	
area	m²	0.28	primary sample ports number of sampling lines available	2	
orientation	-	Vertical			

Sampling Location General Information

general information	details
type location access	Permanent Outside with shelter available in nearby building Stairs

CEMS | Abatement Systems

parameter	details
abatement system/s	SCR
CEMS installed on the stack	N/A

Sampling Plane Validation Criteria Summary (EN 15259) from Stack Traverse/s

criteria in EN 15259	units	value	allowed	compliant
lowest differential pressure	Pa	331.0	> 5 Pa	Yes
lowest traverse velocity	m/s	30.1	-	-
highest traverse velocity	m/s	31.7	-	-
mean traverse velocity	m/s	31.0	-	-
ratio traverse velocities	: 1	1.05	< 3 : 1	Yes
angle of swirl compliance	°	< 15	< 15°	Yes
no local negative flow	-	Yes	-	Yes

Part 1: Executive Summary - Sampling Location and Operating Information

Process Details

process detail	details
plume appearance on day of monitoring	Not visible from the sampling location
type of process	Combustion
batch or continuous process	On Demand
fuel type	Diesel
feedstock	N/A
typical load / throughput of plant	6.9 MWth
details of any unusual process occurrences	None

Part 2: Supporting Information - Appendix 1: Monitoring Personnel, Analysis Laboratories and Test Equipment Used

Monitoring Personnel

name	position	MCERTS level number expiry	MCERTS technical endorsements
Andrew Shipley	Senior Team Leader	MCERTS Level 2 MM 13 1243 31/07/2025	TE1 TE2 TE3 TE4
Ashley Shipp	Technician	MCERTS Level 1 MM 21 1650 29/10/2026	TE1 TE2 TE4

Analysis Laboratories

laboratory	ISO 17025 accreditation number	laboratory short name	laboratory phone number
Atesta North West	10706	ATA	0800 970 8945

Test Equipment Used

equipment type	A-EQ ID
Source sampling console	405
Low flow sampling MFCs	
ThermoFID / iFID mobile	5
Horiba PG-350E multigas analyser	69
Gasmet DX4000 FTIR	
Gasmet PSS	
Protea AtmosFIR	
Protea PIB Pump	
Gasmet syringe calibrator	
M&C PSS5-C conditioning unit	61
Digital thermomanometer	116
Top pan balance kit	465

equipment type	A-EQ ID
Pitot	98 174
Calipers	44
Barometer	21
Timer	399
Tape measure	405
Heated head filter	63
Heated tee	
10m heated line	30
1.5m heated line	
Odour barrel	
Vacuum chamber	
Dilution probe	

equipment type	A-EQ ID
10m umbilical	89
30m umbilical	
Heated probe	288 76
Filter oven	284
Ambient thermocouple	
Stack thermocouple	342 255
Exit thermocouple	165
Condenser thermocouple	
Tubes kit thermocouple	
2-way heater controller	
Air sampling pump	
5-figure analytical balance	1

Part 2: Supporting Information - Appendix 2: Total Particulate Matter | Run 1

Results

reference conditions are: STP, dry, 15% O₂

parameter	units	result $\pm$ MU (95% CI)	units	result $\pm$ MU (95% CI)
Total Particulate Matter	mg/m ³	10.5 $\pm$ 0.73	g/hr	222 $\pm$ 15.3

Analytical Laboratory Information

parameter	details
name of analytical lab	ATA
lab analytical procedure	AP-01
lab analytical technique	Gravimetric Analysis Accreditation: MCERTS
date analysis completed	30/01/2025

General Information

parameter	details
sampling date	28/01/2025
sampling times	13:43 - 14:08
sampling duration testing team	25 minutes tested by: AS ASH
standard technical procedure	EN 13284-1 TP-01
nozzle / probe filter housing material	Titanium Borosilicate Glass
filter IDs	Sample: F-6079 Blank: F-6553

Quality Assurance

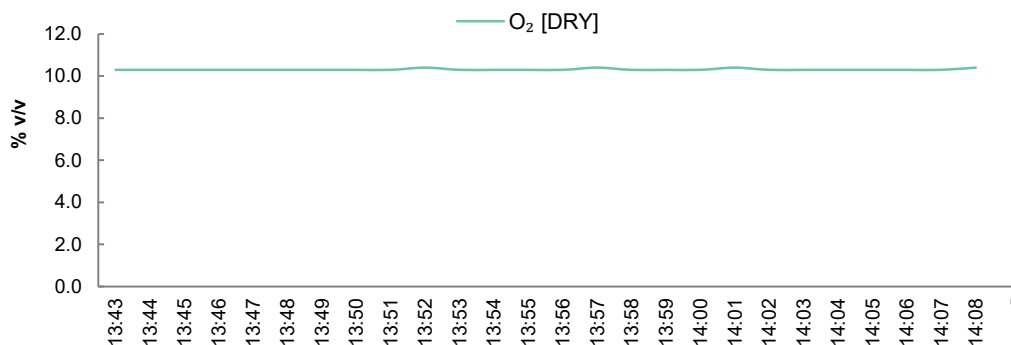
		sample run			blank (taken on 28/01/2025)		
QA parameter	units	value	allowable	result	value	allowable	result
maximum allowable blank	mg/m³	-	-	-	0.3	N/A	N/A
leak test	%	0.55	2.00	Pass	0.70	2.00	Pass
filter intact	-	Yes	-	Pass	-	-	-
filter no signs of water marks	-	Yes	-	Pass	-	-	-
maximum run filter temperature	°C	120	< 230	Pass	-	-	-
silica trap <50% faded	-	Yes	-	Pass	-	-	-
are water droplets present	-	No	-	-	-	-	-
water vapour MU	-	2.9	20.0	Pass	-	-	-
isokinetic variation	%	98.0	95 - 115	Pass	-	-	-

Breakdown of Results

reference conditions are: STP, dry, 15% O₂

parameter	sample volume [m³]	LOD [mg]	mass on filter [mg]	mass in rinse [mg]	mass total [mg]	LOD result [mg/m³]	result [mg/m³]	result reported [mg/m³]	mass emission [g/hr]
sample run <i>F-6079</i>	0.8869	0.10	6.79	2.54	9.33	0.11	10.5	10.5	222
blank <i>F-6553</i>	0.8869	0.10	-0.07	0.34	0.27	0.11	0.3	0.3	

Oxygen Data



parameter	details
pre-use filter conditioning temperature	250°C
filter size, material & location	47mm GF Out Stack heated to 120°C
number sampling lines available	2
number sampling lines used	2
number sampling points ideal per line	2
number sampling points used per line	2
sampling point IDs	A1, A2, B1 & B2
volume metering device	XC-53 Digital Source Sampling Console

Part 2: Supporting Information - Appendix 2: Total Particulate Matter | Run 1

Raw Data | Calculations

data	units	value
P _{bar}	mmHg	759.8
P _g	Pa	-54.0
ΔH _@	mmH ₂ O	47.8
P _m	mmHg	763.3
P _s	mmHg	759.4
V _m (DGM)	m ³	0.5151
Y _d	-	1.0076
C _{stp}	-	0.3592

data	units	value
T _m	°C	12.8
ΔH _{av}	Pa	508.8
ΔP _{av}	Pa	391.5
m _{wts}	g	26.6
M _w	g/mol	18.0
V _{mol}	m ³ /mol	0.0222
T _s	°C	434.7
R _{wv} (H ₂ O)	% v/v	6.2

data	units	value
%CO _{2d}	% v/v (est)	8.00
%O _{2d}	% v/v	10.32
%O _{2w}	% v/v	9.68
%N _{2d}	% v/v	81.68
%O _{2ref}	% v/v	15.0
O _{2facd}	-	0.56
O _{2facw}	-	0.53
C _p (pitot)	-	0.84

data	units	value
M _d	g/mol	29.69
M _s	g/mol	28.97
R	J/mol	8.314
K ₄	-	4.64E+06
A _s	m ²	0.28
D _n	mm	6.02
A _n	mm ²	28.43
θ (sample time)	mins	25

where (est) refers to an estimated value

data	value
f _{WA}	0.995

metered volume calculations	units	value
allow favourable O ₂ correction	-	Yes
vol actual stack conditions, V _{mTa} = (V _{mTstw})(T _s + 273) / (P _s) / (C _{stp})	m ³	1.3770
vol dry, V _{mstd} = (V _m)(Y _d)(C _{stp}) / ((P _{bar} + (ΔH _{av} / 9.80665 / 13.6)) / (T _m + 273))	m ³	0.4980
vol dry, V _{mSSstd} [from side stream sampling (if applicable)]	m ³	N/A
vol dry, V _{mTstd} [total volume metered]	m ³	0.4980
vol wet, V _{mTstw} = (V _{mTstd})(100 / (100 - R _{wv}))	m ³	0.5308
vol dry O ₂ , V _{mTstdO₂} = (V _{mTstd}) / (O _{2facd})	m ³	0.8869
vol wet O ₂ , V _{mTstwO₂} = (V _{mTstw}) / (O _{2facw})	m ³	1.0016

isokinetic calculations	units	value
isokinetic rate, %I _r = ((K ₄)(T _s)(V _{mTstd})) / ((P _s)(v _s)(A _n)(θ)(1 - (R _{wv} / 100)))	%	98.0

stack gas density velocity volume flow rate calculations	units	value
density of stack gas, ρ = ((Ms / 1000)(Ps)(0.133322)(1000)) / ((R)(Ts + 273))	kg/m ³	0.499
velocity of stack gas, v _s = (f _{WA})(C _p)√((2(ΔP _{av}) / (ρ)))	m/s	32.9
stack gas flow actual stack conditions, Q _a = (60)(60)(A _s)(v _s)	m ³ /hr	33514.7
stack gas flow dry, Q _{std} = (Q _a)(P _s)(C _{stp}) / (1 - (R _{wv} / 100)) / (T _s + 273)	m ³ /hr	12121.5
stack gas flow wet, Q _{stw} = (Q _a)(P _s)(C _{stp}) / (T _s + 273)	m ³ /hr	12919.1
stack gas flow dry O ₂ , Q _{stdO₂} = (Q _a)(P _s)(C _{stp})(1 - (R _{wv} / 100)) / ((T _s + 273)(O _{2facd}))	m ³ /hr	21585.6
stack gas flow wet O ₂ , Q _{stwO₂} = (Q _a)(P _s)(C _{stp}) / (T _s + 273)(O _{2facw})	m ³ /hr	24377.2

Part 2: Supporting Information - Appendix 2: Total Particulate Matter | Run 1

Measurement Uncertainty (MU) Calculations

parameter	units	value	standard MU	MU as %age	required standard	value	sens coeff.	MU mg/m³
DGM meter volume, V _m	m³	0.5151	0.0026	0.50	≤5%	-	-	-
DGM temperature, T _m	K	285.8	2.0	0.70	≤2%	-	-	-
DGM pressure, P _m	kPa	101.8	0.50	0.49	≤2%	-	-	-
DGM humidity, H _m	% v/v	0	1.0	1.00	≤2%	-	-	-
DGM volume STP, V _{mstd}	m³	-	-	-	-	0.4980	21.12	0.15
leak, L	% ¹ mg/m³ ²	0.53 ¹	-	0.53	≤2%	0.032 ²	1.00	0.032
mass of particulate, m	mg	9.33	0.20	-	-	9.33	1.13	0.23
uncollected mass, m _{uc}	mg	0	-	0	≤10% total mass	0	1.00	0
combined MU with O ₂ correction								0.37
expanded MU 95% CI with O ₂ correction (k = 1.96) including method deviations								0.73
expanded MU 95% CI with O ₂ correction (k = 1.96) as percentage of measured value								6.9%
expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission								6.9%

MU factor O ₂ correction
0.03
overall MU for O ₂ correction
4.7%
method deviation factor
1.00

method and sampling deviations
Sampling was performed in full compliance with the Standard, technical procedure and regulatory requirements.

Part 2: Supporting Information - Appendix 2: Total Particulate Matter | Run 2

Results reference conditions are: STP, dry, 15% O₂

parameter	units	result ± MU (95% CI)	units	result ± MU (95% CI)
Total Particulate Matter	mg/m³	8.5 ± 0.63	g/hr	182 ± 13.5

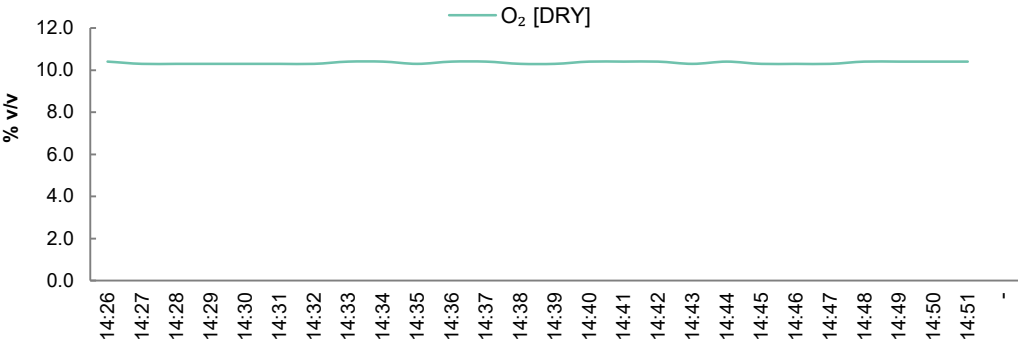
Analytical Laboratory Information

parameter	details
name of analytical lab	ATA
lab analytical procedure	AP-01
lab analytical technique	Gravimetric Analysis Accreditation: MCERTS
date analysis completed	30/01/2025

General Information

parameter	details
sampling date	28/01/2025
sampling times	14:26 - 14:51
sampling duration testing team	25 minutes tested by: AS ASH
standard technical procedure	EN 13284-1 TP-01
nozzle / probe filter housing material	Titanium Titanium
filter IDs	Sample: F-6241 Blank: F-6553

Oxygen Data



parameter	details
pre-use filter conditioning temperature	250°C
filter size, material & location	47mm GF Out Stack heated to 120°C
number sampling lines available	2
number sampling lines used	2
number sampling points ideal per line	4
number sampling points used per line	4
sampling point IDs	A1 - 2, B1 - 2
volume metering device	XC-53 Digital Source Sampling Console

Quality Assurance

QA parameter	units	sample run			blank (taken on 28/01/2025)		
		value	allowable	result	value	allowable	result
maximum allowable blank	mg/m³	-	-	-	0.3	N/A	N/A
leak test	%	0.60	2.00	Pass	0.70	2.00	Pass
filter intact	-	Yes	-	Pass	-	-	-
filter no signs of water marks	-	Yes	-	Pass	-	-	-
maximum run filter temperature	°C	120	< 230	Pass	-	-	-
silica trap <50% faded	-	Yes	-	Pass	-	-	-
are water droplets present	-	No	-	-	-	-	-
water vapour MU	-	3.0	20.0	Pass	-	-	-
isokinetic variation	%	97.2	95 - 115	Pass	-	-	-

Breakdown of Results

reference conditions are: STP, dry, 15% O₂

parameter	sample volume [m³]	LOD [mg]	mass on filter [mg]	mass in rinse [mg]	mass total [mg]	LOD result [mg/m³]	result [mg/m³]	result reported [mg/m³]	mass emission [g/hr]
sample run F-6241	0.9137	0.10	5.69	2.06	7.75	0.11	8.5	8.5	182
blank F-6553	0.9137	0.10	-0.07	0.34	0.27	0.11	0.3	0.3	

Part 2: Supporting Information - Appendix 2: Total Particulate Matter | Run 2

Raw Data | Calculations

data	units	value
P _{bar}	mmHg	759.8
P _g	Pa	-54.0
ΔH _@	mmH ₂ O	47.8
P _m	mmHg	763.3
P _s	mmHg	759.4
V _m (DGM)	m ³	0.5319
Y _d	-	1.0076
C _{stp}	-	0.3592

data	units	value
T _m	°C	12.7
ΔH _{av}	Pa	535.4
ΔP _{av}	Pa	417.8
m _{wts}	g	19.0
M _w	g/mol	18.0
V _{mol}	m ³ /mol	0.0222
T _s	°C	434.2
R _{wv} (H ₂ O)	% v/v	4.3

data	units	value
%CO _{2d}	% v/v (est)	8.00
%O _{2d}	% v/v	10.35
%O _{2w}	% v/v	9.90
%N _{2d}	% v/v	81.65
%O _{2ref}	% v/v	15.0
O _{2facd}	-	0.56
O _{2facw}	-	0.54
C _p (pitot)	-	0.83

data	units	value
M _d	g/mol	29.69
M _s	g/mol	29.19
R	J/mol	8.314
K ₄	-	4.64E+06
A _s	m ²	0.28
D _n	mm	6.02
A _n	mm ²	28.43
θ (sample time)	mins	25

where (est) refers to an estimated value

data	value
f _{WA}	0.995

metered volume calculations	units	value
allow favourable O ₂ correction	-	Yes
vol actual stack conditions, V _{mTa} = (V _{mTstw})(T _s + 273) / (P _s) / (C _{stp})	m ³	1.3951
vol dry, V _{mstd} = (V _m)(Y _d)(C _{stp}) / ((P _{bar} + (ΔH _{av} / 9.80665 / 13.6)) / (T _m + 273))	m ³	0.5147
vol dry, V _{mSSstd} [from side stream sampling (if applicable)]	m ³	N/A
vol dry, V _{mTstd} [total volume metered]	m ³	0.5147
vol wet, V _{mTstw} = (V _{mTstd})(100 / (100 - R _{wv}))	m ³	0.5381
vol dry O ₂ , V _{mTstdO₂} = (V _{mTstd}) / (O _{2facd})	m ³	0.9137
vol wet O ₂ , V _{mTstwO₂} = (V _{mTstw}) / (O _{2facw})	m ³	0.9956

isokinetic calculations	units	value
isokinetic rate, %I _r = ((K ₄)(T _s)(V _{mTstd})) / ((P _s)(v _s)(A _n)(θ)(1 - (R _{wv} / 100)))	%	97.2

stack gas density velocity volume flow rate calculations	units	value
density of stack gas, ρ = ((Ms / 1000)(Ps)(0.133322)(1000)) / ((R)(Ts + 273))	kg/m ³	0.503
velocity of stack gas, v _s = (f _{WA})(C _p)√((2(ΔP _{av}) / (ρ)))	m/s	33.6
stack gas flow actual stack conditions, Q _a = (60)(60)(A _s)(v _s)	m ³ /hr	34236.0
stack gas flow dry, Q _{std} = (Q _a)(P _s)(C _{stp}) / (1 - (R _{wv} / 100)) / (T _s + 273)	m ³ /hr	12632.0
stack gas flow wet, Q _{stw} = (Q _a)(P _s)(C _{stp}) / (T _s + 273)	m ³ /hr	13206.5
stack gas flow dry O ₂ , Q _{stdO₂} = (Q _a)(P _s)(C _{stp})(1 - (R _{wv} / 100)) / ((T _s + 273)(O _{2facd}))	m ³ /hr	22421.9
stack gas flow wet O ₂ , Q _{stwO₂} = (Q _a)(P _s)(C _{stp}) / (T _s + 273)(O _{2facw})	m ³ /hr	24432.4

Part 2: Supporting Information - Appendix 2: Total Particulate Matter | Run 2

Measurement Uncertainty (MU) Calculations

parameter	units	value	standard MU	MU as %age	required standard	value	sens coeff.	MU mg/m³
DGM meter volume, V _m	m³	0.5319	0.0027	0.50	≤5%	-	-	-
DGM temperature, T _m	K	285.7	2.0	0.70	≤2%	-	-	-
DGM pressure, P _m	kPa	101.8	0.50	0.49	≤2%	-	-	-
DGM humidity, H _m	% v/v	0	1.0	1.00	≤2%	-	-	-
DGM volume STP, V _{mstd}	m³	-	-	-	-	0.5147	16.48	0.12
leak, L	% ¹ mg/m³ ²	0.56 ¹	-	0.56	≤2%	0.027 ²	1.00	0.027
mass of particulate, m	mg	7.75	0.20	-	-	7.75	1.09	0.22
uncollected mass, m _{uc}	mg	0	-	0	≤10% total mass	0	1.00	0
combined MU with O ₂ correction								0.32
expanded MU 95% CI with O ₂ correction (k = 1.96) including method deviations								0.63
expanded MU 95% CI with O ₂ correction (k = 1.96) as percentage of measured value								7.5%
expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission								7.4%

MU factor O ₂ correction	0.03
overall MU for O ₂ correction	4.7%
method deviation factor	1.00

method and sampling deviations
Sampling was performed in full compliance with the Standard, technical procedure and regulatory requirements.

Part 2: Supporting Information - Appendix 2: PM₁₀ | Run 1

Results

reference conditions are: STP, dry, 15% O₂

parameter	units	result $\pm$ MU (95% CI)	units	result $\pm$ MU (95% CI)
PM ₁₀	mg/m ³	7.7 $\pm$ 1	g/hr	171 $\pm$ 22.9

Analytical Laboratory Information

parameter	details
name of analytical lab	ATA
lab analytical procedure	AP-02
lab analytical technique	Gravimetric Analysis Accreditation: MCERTS
date analysis completed	03/02/2025

General Information

parameter	details
sampling date	28/01/2025
sampling times	13:04 - 13:34
sampling duration testing team	30 minutes tested by: AS ASH
standard technical procedure	EN ISO 23210 TP-02
sizing device material orientation	3-Stage Cascade Impactor Titanium Horizontal
filter set IDs	Sample 134 Blank 142

Quality Assurance

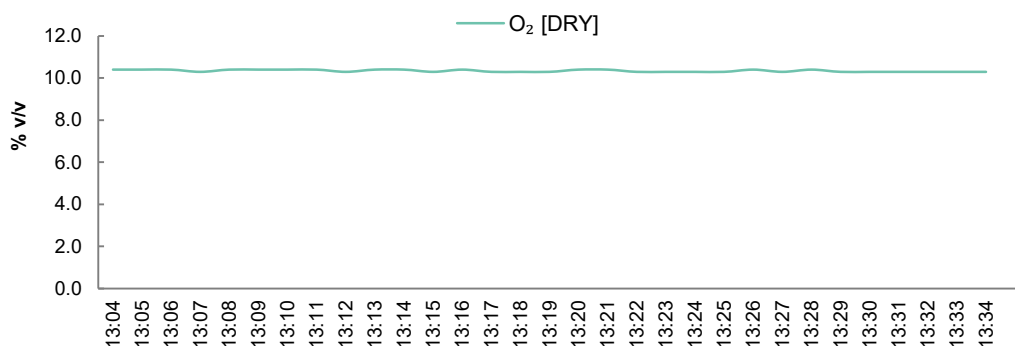
Quality Assurance		sample run			blank (taken on 28/01/2025)		
QA parameter	units	value	allowable	result	value	allowable	result
maximum allowable blank	mg/m³	-	-	-	0.096	N/A	N/A
leak test	%	0.13	2.00	Pass	1.60	2.00	Pass
filter intact	-	Yes	-	Pass	-	-	-
filter no signs of water marks	-	Yes	-	Pass	-	-	-
silica trap <50% faded	-	Yes	-	Pass	-	-	-
are water droplets present	-	No	-	-	-	-	-
water vapour MU	%	2.8	20.0	Pass	-	-	-
isokinetic variation	%	99.7	90 - 130	Pass	-	-	-
cut off diameter	µm	10.13	9 - 11	Pass	-	-	-

Breakdown of Results

reference conditions are: STP, dry, 15% O₂

parameter	sample volume [m³]	LOD [mg]	mass collected [mg]	LOD result [mg/m³]	result [mg/m³]	result reported [mg/m³]	mass emission [g/hr]
sample run <i>PM-134-SET</i>	1.0447	0.10	8.09	0.096	7.7	7.7	171
blank <i>PM-142-SET</i>	1.0447	0.10	-0.07	0.096	-0.067	0.096	

Oxygen Data



parameter	details
filter size, material & location	47mm QF In Stack heated to 424°C
number sampling lines available	2
number sampling lines used	1
number sampling points ideal per line	1
number sampling points used per line	1
sampling point IDs	1
volume metering device	XC-53 Digital Source Sampling Console

Part 2: Supporting Information - Appendix 2: PM₁₀ | Run 1

Raw Data | Calculations

data	units	value
P _{bar}	mmHg	759.8
P _g	Pa	-54.0
ΔH _@	mmH ₂ O	47.8
P _m	mmHg	763.3
P _s	mmHg	759.4
V _m (metered)	m ³	0.6063
Y _d	-	1.0076
C _{stp}	-	0.3592

data	units	value
T _m	°C	11.8
ΔH _{av}	Pa	499.9
ΔP _{av}	Pa	350.8
m _{wt}	g	29.3
M _w	g/mol	18.0
V _{mol}	m ³ /mol	0.0222
T _s	°C	407.5
R _{wv} (H ₂ O)	% v/v	5.8

data	units	value
%CO _{2d}	% v/v (est)	8.00
%O _{2d}	% v/v	10.35
%O _{2w}	% v/v	9.75
%N _{2d}	% v/v	81.65
%O _{2ref}	% v/v	15.0
O _{2facd}	-	0.56
O _{2facw}	-	0.53
C _p (pitot)	-	0.84

data	units	value
FR _{ma}	m ³ /hr	3.1152
M _d	g/mol	29.69
M _s	g/mol	29.02
R	J/mol	8.314
A _s	m ²	0.28
D _n	mm	6.02
A _n	mm ²	28.43
θ (sample time)	mins	30

where (est) refers to an estimated value

data	value
f _{WA}	0.995

isokinetic metered volume calculations	units	value
isokinetic rate, %I _r = ((v _n) / (v _s))(100)	%	99.7
allow favourable O ₂ correction	-	Yes
vol actual stack conditions, V _{ma} = (V _{mstw})(T _s + 273) / (P _s) / (C _{stp})	m ³	1.5576
vol dry, V _{mstd} = (V _m)(Y _d)(C _{stp}) / ((P _{bar} + (ΔH _{av} / 9.80665 / 13.6)) / (T _m + 273))	m ³	0.5883
vol wet, V _{mstw} = (V _{mstd})(100 / (100 - R _{wv}))	m ³	0.6244
vol dry O ₂ , V _{mstdO₂} = (V _{mstd}) / (O _{2facd})	m ³	1.0447
vol wet O ₂ , V _{mstwO₂} = (V _{mstw}) / (O _{2facw})	m ³	1.1710

stack gas density velocity volume flow rate calculations	units	value
density of stack gas, ρ = ((Ms / 1000)(Ps)(0.133322)(1000)) / ((R)(Ts + 273))	kg/m ³	0.519
velocity of stack gas, v _s = (f _{WA})(C _p)√((2(ΔP _{av}) / (ρ)))	m/s	30.5
velocity through nozzle, v _n = ((FR _{ma}) / (3600)) / ((A _n) / 1000000))	m/s	30.4
stack gas flow actual stack conditions, Q _a = (60)(60)(A _s)(v _s)	m ³ /hr	31086.2
stack gas flow dry, Q _{std} = (Q _a)(P _s)(C _{stp}) / (1 - (R _{wv} / 100)) / (T _s + 273)	m ³ /hr	11740.9
stack gas flow wet, Q _{stw} = (Q _a)(P _s)(C _{stp}) / (T _s + 273)	m ³ /hr	12461.3
stack gas flow dry O ₂ , Q _{stdO₂} = (Q _a)(P _s)(C _{stp}) / (1 - (R _{wv} / 100)) / ((T _s + 273)(O _{2facd}))	m ³ /hr	20849.6
stack gas flow wet O ₂ , Q _{stwO₂} = (Q _a)(P _s)(C _{stp}) / (T _s + 273)(O _{2facw})	m ³ /hr	23371.1

Measurement Uncertainty (MU) Calculations

parameter	units	value	standard MU	MU as %age	required standard	value	sens coeff.	MU mg/m ³
DGM meter volume, V _m	m ³	0.6063	0.0030	0.50	≤2%	-	-	-
DGM temperature, T _m	K	284.8	2.0	0.70	≤1%	-	-	-
DGM pressure, P _m	kPa	101.8	0.50	0.49	≤1%	-	-	-
DGM humidity, H _m	% v/v	0	1.0	1.00	≤1%	-	-	-
DGM volume STP, V _{mstd}	m ³	-	-	-	-	0.5883	13.16	0.11
leak, L	% ¹ mg/m ³ ²	0.2 ¹	-	0.20	≤2%	0.0088 ²	1.00	0.0088
mass of particulate, m	mg	8.09	0.20	-	-	8.09	0.96	0.19
uncollected mass, m _{uc}	mg	0	-	0	≤10% total mass	0	1.00	0
particle sizing, ps	% ¹ mg/m ³ ²	10 ¹	-	10	-	0.45 ²	1.00	0.45
combined MU with O ₂ correction								0.53
expanded MU 95% CI with O ₂ correction (k = 1.96) including method deviations								1
expanded MU 95% CI with O ₂ correction (k = 1.96) as percentage of measured value								13.5%
expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission								13.4%

MU factor O ₂ correction
0.03

overall MU for O ₂ correction
4.7%

method deviation factor
1.00

method and sampling deviations
Sampling was performed in full compliance with the Standard, technical procedure and regulatory requirements.

Part 2: Supporting Information - Appendix 2: PM₁₀ | Run 2

Results

reference conditions are: STP, dry, 15% O₂

parameter	units	result $\pm$ MU (95% CI)	units	result $\pm$ MU (95% CI)
PM ₁₀	mg/m ³	6.2 $\pm$ 0.87	g/hr	131 $\pm$ 18.5

Analytical Laboratory Information

parameter	details
name of analytical lab	ATA
lab analytical procedure	AP-02
lab analytical technique	Gravimetric Analysis Accreditation: MCERTS
date analysis completed	03/02/2025

General Information

parameter	details
sampling date	28/01/2025
sampling times	15:02 - 15:32
sampling duration testing team	30 minutes tested by: AS ASH
standard technical procedure	EN ISO 23210 TP-02
sizing device material orientation	3-Stage Cascade Impactor Titanium Horizontal
filter set IDs	Sample 121 Blank 142

Quality Assurance

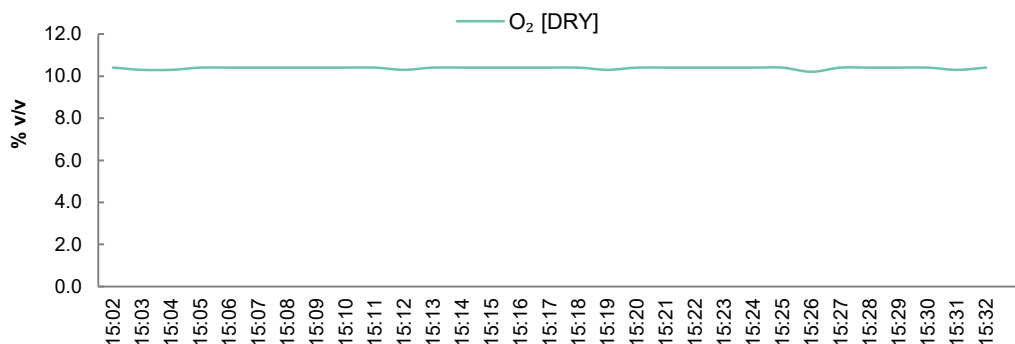
		sample run			blank (taken on 28/01/2025)		
QA parameter	units	value	allowable	result	value	allowable	result
maximum allowable blank	mg/m³	-	-	-	0.097	N/A	N/A
leak test	%	1.65	2.00	Pass	1.60	2.00	Pass
filter intact	-	Yes	-	Pass	-	-	-
filter no signs of water marks	-	Yes	-	Pass	-	-	-
silica trap <50% faded	-	Yes	-	Pass	-	-	-
are water droplets present	-	No	-	-	-	-	-
water vapour MU	%	3.4	20.0	Pass	-	-	-
isokinetic variation	%	93.6	90 - 130	Pass	-	-	-
cut off diameter	µm	10.13	9 - 11	Pass	-	-	-

Breakdown of Results

reference conditions are: STP, dry, 15% O₂

parameter	sample volume [m³]	LOD [mg]	mass collected [mg]	LOD result [mg/m³]	result [mg/m³]	result reported [mg/m³]	mass emission [g/hr]
sample run <i>PM-121-SET</i>	1.0257	0.10	6.35	0.097	6.2	6.2	131
blank <i>PM-142-SET</i>	1.0257	0.10	-0.07	0.097	-0.068	0.097	

Oxygen Data



parameter	details
filter size, material & location	47mm QF In Stack heated to 437°C
number sampling lines available	2
number sampling lines used	1
number sampling points ideal per line	1
number sampling points used per line	1
sampling point IDs	1
volume metering device	XC-53 Digital Source Sampling Console

Part 2: Supporting Information - Appendix 2: PM₁₀ | Run 2

Raw Data | Calculations

data	units	value
P _{bar}	mmHg	759.8
P _g	Pa	-54.0
ΔH _@	mmH ₂ O	47.8
P _m	mmHg	763.3
P _s	mmHg	759.4
V _m (metered)	m ³	0.6013
Y _d	-	1.0076
C _{stp}	-	0.3592

data	units	value
T _m	°C	14.0
ΔH _{av}	Pa	567.8
ΔP _{av}	Pa	398.5
m _{wt}	g	26.2
M _w	g/mol	18.0
V _{mol}	m ³ /mol	0.0222
T _s	°C	435.5
R _{wv} (H ₂ O)	% v/v	5.3

data	units	value
%CO _{2d}	% v/v (est)	8.00
%O _{2d}	% v/v	10.38
%O _{2w}	% v/v	9.83
%N _{2d}	% v/v	81.62
%O _{2ref}	% v/v	15.0
O _{2facd}	-	0.56
O _{2facw}	-	0.54
C _p (pitot)	-	0.84

data	units	value
FR _{ma}	m ³ /hr	3.1772
M _d	g/mol	29.70
M _s	g/mol	29.08
R	J/mol	8.314
A _s	m ²	0.28
D _n	mm	6.02
A _n	mm ²	28.43
θ (sample time)	mins	30

where (est) refers to an estimated value

data	value
f _{WA}	0.995

isokinetic metered volume calculations	units	value
isokinetic rate, %I _r = ((v _n) / (v _s))(100)	%	93.6
allow favourable O ₂ correction	-	Yes
vol actual stack conditions, V _{ma} = (V _{mstw})(T _s + 273) / (P _s) / (C _{stp})	m ³	1.5886
vol dry, V _{mstd} = (V _m)(Y _d)(C _{stp}) / ((P _{bar} + (ΔH _{av} / 9.80665 / 13.6)) / (T _m + 273))	m ³	0.5794
vol wet, V _{mstw} = (V _{mstd})(100 / (100 - R _{wv}))	m ³	0.6117
vol dry O ₂ , V _{mstdO₂} = (V _{mstd}) / (O _{2facd})	m ³	1.0257
vol wet O ₂ , V _{mstwO₂} = (V _{mstw}) / (O _{2facw})	m ³	1.1387

stack gas density velocity volume flow rate calculations	units	value
density of stack gas, ρ = ((Ms / 1000)(Ps)(0.133322)(1000)) / ((R)(Ts + 273))	kg/m ³	0.500
velocity of stack gas, v _s = (f _{WA})(C _p)√((2(ΔP _{av}) / (ρ)))	m/s	33.2
velocity through nozzle, v _n = ((FR _{ma}) / (3600)) / ((A _n) / 1000000))	m/s	31.0
stack gas flow actual stack conditions, Q _a = (60)(60)(A _s)(v _s)	m ³ /hr	33770.5
stack gas flow dry, Q _{std} = (Q _a)(P _s)(C _{stp}) / (1 - (R _{wv} / 100)) / (T _s + 273)	m ³ /hr	12316.2
stack gas flow wet, Q _{stw} = (Q _a)(P _s)(C _{stp}) / (T _s + 273)	m ³ /hr	13002.4
stack gas flow dry O ₂ , Q _{stdO₂} = (Q _a)(P _s)(C _{stp}) / (1 - (R _{wv} / 100)) / ((T _s + 273)(O _{2facd}))	m ³ /hr	21805.0
stack gas flow wet O ₂ , Q _{stwO₂} = (Q _a)(P _s)(C _{stp}) / (T _s + 273)(O _{2facw})	m ³ /hr	24206.6

Measurement Uncertainty (MU) Calculations

parameter	units	value	standard MU	MU as %age	required standard	value	sens coeff.	MU mg/m ³
DGM meter volume, V _m	m ³	0.6013	0.0030	0.50	≤2%	-	-	-
DGM temperature, T _m	K	287.0	2.0	0.70	≤1%	-	-	-
DGM pressure, P _m	kPa	101.8	0.50	0.49	≤1%	-	-	-
DGM humidity, H _m	% v/v	0	1.0	1.00	≤1%	-	-	-
DGM volume STP, V _{mstd}	m ³	-	-	-	-	0.5794	10.68	0.087
leak, L	% ¹ mg/m ³ ²	1.63 ¹	-	1.63	≤2%	0.058 ²	1.00	0.058
mass of particulate, m	mg	6.35	0.20	-	-	6.35	0.97	0.19
uncollected mass, m _{uc}	mg	0	-	0	≤10% total mass	0	1.00	0
particle sizing, ps	% ¹ mg/m ³ ²	10 ¹	-	10	-	0.36 ²	1.00	0.36
combined MU with O ₂ correction								0.45
expanded MU 95% CI with O ₂ correction (k = 1.96) including method deviations								0.87
expanded MU 95% CI with O ₂ correction (k = 1.96) as percentage of measured value								14.1%
expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission								14.1%

MU factor O ₂ correction
0.03

overall MU for O ₂ correction
4.7%

method deviation factor
1.00

method and sampling deviations
Sampling was performed in full compliance with the Standard, technical procedure and regulatory requirements.

Part 2: Supporting Information - Appendix 2: PM_{2.5} | Run 1

Results

reference conditions are: STP, dry, 15% O₂

parameter	units	result $\pm$ MU (95% CI)	units	result $\pm$ MU (95% CI)
PM _{2.5}	mg/m ³	7.2 $\pm$ 1	g/hr	159 $\pm$ 22.7

Analytical Laboratory Information

parameter	details
name of analytical lab	ATA
lab analytical procedure	AP-02
lab analytical technique	Gravimetric Analysis Accreditation: MCERTS
date analysis completed	03/02/2025

General Information

parameter	details
sampling date	28/01/2025
sampling times	13:04 - 13:34
sampling duration testing team	30 minutes tested by: AS ASH
standard technical procedure	EN ISO 23210 TP-02
sizing device material orientation	3-Stage Cascade Impactor Titanium Horizontal
filter set IDs	Sample 134 Blank 142

Quality Assurance

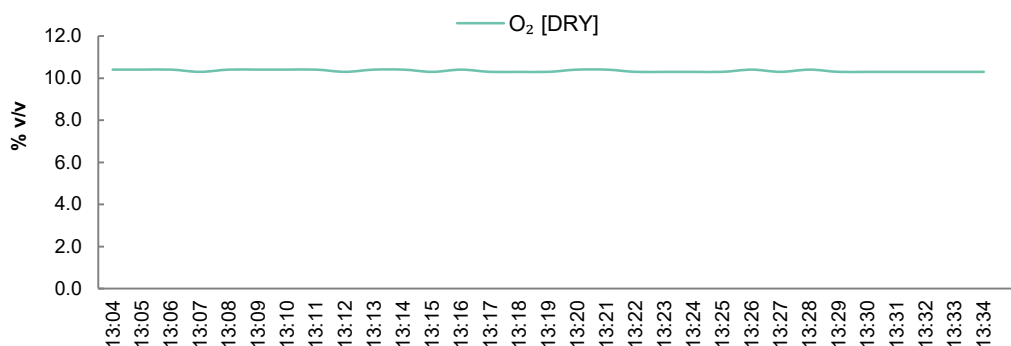
QA parameter		sample run			blank (taken on 28/01/2025)		
QA parameter	units	value	allowable	result	value	allowable	result
maximum allowable blank	mg/m³	-	-	-	0.067	N/A	N/A
leak test	%	0.13	2.00	Pass	1.60	2.00	Pass
silica trap <50% faded	-	Yes	-	Pass	-	-	-
are water droplets present	-	No	-	-	-	-	-
water vapour MU	%	2.8	20.0	Pass	-	-	-
isokinetic variation	%	99.7	90 - 130	Pass	-	-	-
cut off diameter	µm	2.47	2.25 - 2.75	Pass	-	-	-

Breakdown of Results

reference conditions are: STP, dry, 15% O₂

parameter	sample volume [m³]	LOD [mg]	mass collected [mg]	LOD result [mg/m³]	result [mg/m³]	result reported [mg/m³]	mass emission [g/hr]
sample run <i>PM-134-SET</i>	1.0447	0.07	7.52	0.067	7.2	7.2	159
blank <i>PM-142-SET</i>	1.0447	0.07	-0.21	0.067	-0.2	0.067	

Oxygen Data



parameter	details
filter size, material & location	47mm QF In Stack heated to 424°C
number sampling lines available	2
number sampling lines used	1
number sampling points ideal per line	1
number sampling points used per line	1
sampling point IDs	1
volume metering device	XC-53 Digital Source Sampling Console

Part 2: Supporting Information - Appendix 2: PM_{2.5} | Run 2

Results reference conditions are: STP, dry, 15% O₂

parameter	units	result ± MU (95% CI)	units	result ± MU (95% CI)
PM _{2.5}	mg/m ³	6.1 ± 0.87	g/hr	128 ± 18.4

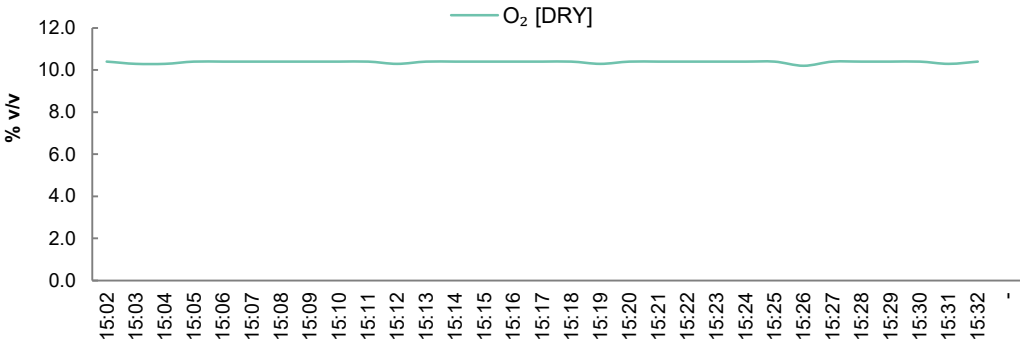
Analytical Laboratory Information

parameter	details
name of analytical lab	ATA
lab analytical procedure	AP-02
lab analytical technique	Gravimetric Analysis Accreditation: MCERTS
date analysis completed	03/02/2025

General Information

parameter	details
sampling date	28/01/2025
sampling times	15:02 - 15:32
sampling duration testing team	30 minutes tested by: AS ASH
standard technical procedure	EN ISO 23210 TP-02
sizing device material orientation	3-Stage Cascade Impactor Titanium Horizontal
filter set IDs	Sample 121 Blank 142

Oxygen Data



parameter	details
filter size, material & location	47mm QF In Stack heated to 437°C
number sampling lines available	2
number sampling lines used	1
number sampling points ideal per line	1
number sampling points used per line	1
sampling point IDs	1
volume metering device	XC-53 Digital Source Sampling Console

Quality Assurance

QA parameter	units	sample run			blank (taken on 28/01/2025)		
		value	allowable	result	value	allowable	result
maximum allowable blank	mg/m ³	-	-	-	0.068	N/A	N/A
leak test	%	1.65	2.00	Pass	1.60	2.00	Pass
silica trap <50% faded	-	Yes	-	Pass	-	-	-
are water droplets present	-	No	-	-	-	-	-
water vapour MU	%	3.4	20.0	Pass	-	-	-
isokinetic variation	%	93.6	90 - 130	Pass	-	-	-
cut off diameter	µm	2.47	2.25 - 2.75	Pass	-	-	-

Breakdown of Results reference conditions are: STP, dry, 15% O₂

parameter	sample volume [m ³]	LOD [mg]	mass collected [mg]	LOD result [mg/m ³]	result [mg/m ³]	result reported [mg/m ³]	mass emission [g/hr]
sample run <i>PM-121-SET</i>	1.0257	0.07	6.21	0.068	6.1	6.1	128
blank <i>PM-142-SET</i>	1.0257	0.07	-0.21	0.068	-0.2	0.068	

Part 2: Supporting Information - Appendix 2: Total VOCs (as Carbon) | Run 1

Results reference conditions are: STP, dry, 15% O₂

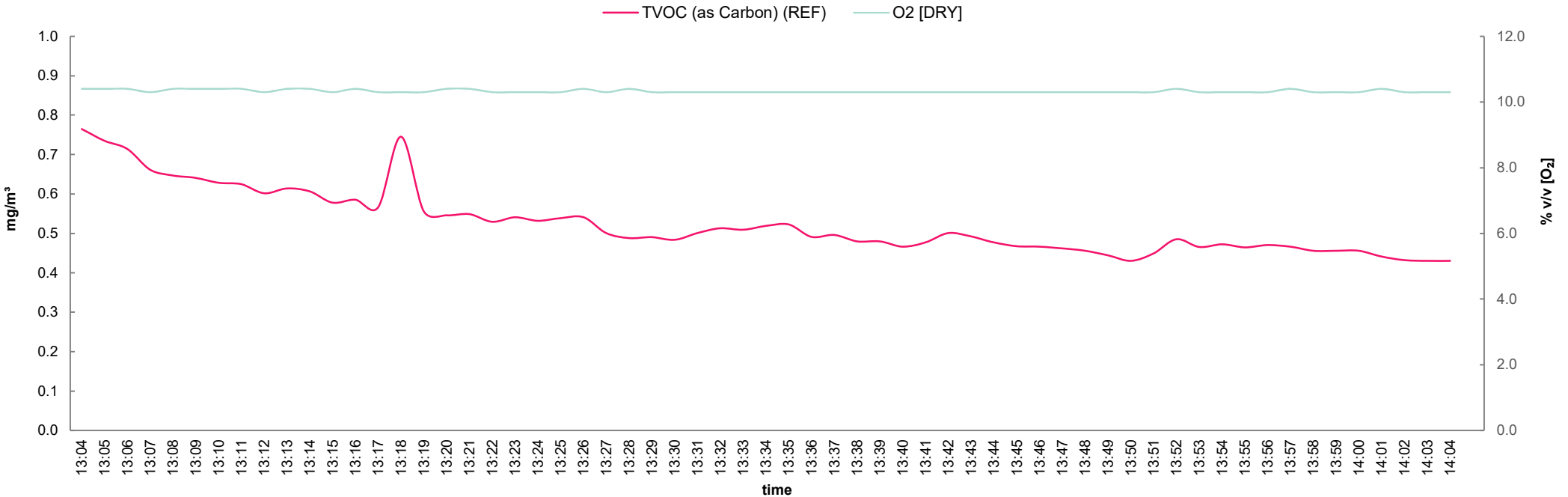
parameter	units	result ± MU (95% CI)	units	result ± MU (95% CI)
Total VOCs (as Carbon)	mg/m ³	0.53 ± 0.043	g/hr	11.3 ± 0.93

General Information

parameter	details
sampling start date & time	28/01/2025 13:04
sampling end date & time	28/01/2025 14:04
test time mins	60
testing team	AS ASH
standard technical procedure	EN 12619 TP-21b
analyser type	iFID Mobile
heated head & line temperature	180°C

parameter	details
probe material	Titanium
filter size, material & location	Filter Element GF Within Heated Head
number sampling lines available	2
number sampling lines used	1
number sampling points ideal per line	1
number sampling points used per line	1
sampling point IDs	A1

Plot of Emissions Over Time



Part 2: Supporting Information - Appendix 2: Total VOCs (as Carbon) | Run 1

Analyser Calibration Information with QA checks

where [A] = at analyser, [L] = down sampling line

	pre-test calibration events								post-test calibration events			quality assurance					
CAL ID	date & time	zero [A] [ppm]	span [A] [ppm]	zero [L] [ppm]	span [L] [ppm]	T ₉₀ [s]	leak [%]		date & time	zero [L] [ppm]	span [L] [ppm]	zero drift [%]		span drift [%]	allowable [%]	temp [°C]	
1	28/01/25 12:01	0.00	80.12	-0.15	79.40	43	0.9	P	28/01/25 15:47	-0.05	79.97	0.1	P	0.6	P	±5	9.0

Analyser Calibration Extended Information

CAL ID	performed by	drift corr. applied	log period [s]	CYL ID	CYL conc. [ppm]	CYL expiry	CYL MU [%]	zero gas type	span [CYL] gas type	span target [ppm]	range [ppm]	LOD [ppm]
1	AS	No	60	A-CYL-153	80.12	30/10/2029	1.1	Synthetic Air	5l 80ppm Propane in Air	80.12	AUTO	0.03

Part 2: Supporting Information - Appendix 2: Total VOCs (as Carbon) | Run 1

Measurement Uncertainty (MU) Calculations

general information	units	value
emission limit value (ELV) (REF)	mg/m³	N/A
measured concentration (REF)	mg/m³	0.53

MU budget			
parameter	units	min	max
ambient temp	°C	9.0	9.0
voltage	V	90.0	130.0

overall MU for O ₂ correction
4.7%

MU factor O ₂ correction
0.03

performance characteristics	MU budget input parameters				MU budget		
	symbol	units	value	source	symbol	units	value
repeatability at zero	rz	% of value	0.05	MCERTS certificate MC050062	U _{rz}	mg/m³	0.00026
repeatability at span	rs	% of value	0.08	MCERTS certificate MC050062	U _{rs}	mg/m³	0.00042
lack of fit	lof	% of value	2	maximum allowable	U _{lof}	mg/m³	0.0061
maximum short term zero drift (ABS) [after drift correction]	dz	% of value	0.12	day of testing	U _{dz}	mg/m³	0.00037
maximum short term span drift (ABS) [after drift correction]	ds	% of value	0.59	day of testing	U _{ds}	mg/m³	0.0018
influence of sample gas flow	f	% of value	-0.42	MCERTS certificate MC050062	U _f	mg/m³	-0.0013
influence of sample gas pressure	p	% of value	0	MCERTS certificate MC050062	U _p	mg/m³	0
influence of ambient temperature zero point (/ 35k)	tz	% of value	-2.4	MCERTS certificate MC050062	U _{tz}	mg/m³	0
influence of ambient temperature span point (/ 35k)	ts	% of value	-2.7	MCERTS certificate MC050062	U _{ts}	mg/m³	0
influence of supply voltage (/ 60V)	v	% of value	-0.46	MCERTS certificate MC050062	U _v	mg/m³	-0.00093
cross sensitivity at zero	iz	% of value	3.8	MCERTS certificate MC050062	U _{iz}	mg/m³	0.012
cross sensitivity at span	is	% of value	3.9	MCERTS certificate MC050062	U _{is}	mg/m³	0.012
maximum leak	L	% of value	0.9	day of testing	U _L	mg/m³	0.0027
uncertainty associated with calibration gas	adj	% of value	1.1	span gas calibration certificate	U _{adj}	mg/m³	0.0029
combined MU with O ₂ correction						mg/m³	0.022
expanded MU with O ₂ correction (k = 1.96)						mg/m³	0.043
expanded MU 95% CI with O ₂ correction (k = 1.96) as percentage of measured value						%	8.3
expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission						%	8.2

method and sampling deviations
Sampling was performed in full compliance with the Standard, technical procedure and regulatory requirements.

Part 2: Supporting Information - Appendix 2: Oxides of Nitrogen (as NO₂) | Run 1

Analyser Calibration Information with QA checks

where [A] = at analyser, [L] = down sampling line

	pre-test calibration events							post-test calibration events			quality assurance						
CAL ID	date & time	zero [A] [ppm]	span [A] [ppm]	zero [L] [ppm]	span [L] [ppm]	T ₉₀ [s]	leak [%]		date & time	zero [A] [ppm]	span [A] [ppm]	zero drift [%]		span drift [%]	allowable [%]	temp [°C]	
1	28/01/25 12:00	0.00	204.00	0.00	202.30	41	0.8	P	28/01/25 15:48	0.00	196.50	0.0	P	-3.7	P	±5	9.0

Analyser Calibration Extended Information

CAL ID	performed by	drift corr. applied	log period [s]	CYL ID	CYL conc. [ppm]	CYL expiry	CYL MU [%]	zero gas type	span [CYL] gas type	span target [ppm]	range [ppm]	LOD [ppm]
1	AS	Yes	60	A-CYL-115	204.00	26/06/2026	1.2	Nitrogen 5.2	5l 200ppm NO 160ppm CO 16% CO2 in Nitrogen	204.00	250	0.09

Part 2: Supporting Information - Appendix 2: Oxides of Nitrogen (as NO₂) | Run 1

Measurement Uncertainty (MU) Calculations

general information	units	value
emission limit value (ELV) (REF)	mg/m ³	N/A
measured concentration (REF)	mg/m ³	6.9

MU budget			
parameter	units	min	max
ambient temp	°C	9.0	9.0
voltage	V	90.0	130.0

overall MU for O ₂ correction
4.7%

MU factor O ₂ correction
0.03

performance characteristics	MU budget input parameters				MU budget		
	symbol	units	value	source	symbol	units	value
repeatability at zero	rz	% of value	0	MCERTS certificate MC130223	U _{rz}	mg/m ³	0
repeatability at span	rs	% of value	0.1	MCERTS certificate MC130223	U _{rs}	mg/m ³	0.0069
lack of fit	lof	% of value	2	maximum allowable	U _{lof}	mg/m ³	0.08
maximum short term zero drift (ABS) [after drift correction]	dz	% of value	0	day of testing	U _{dz}	mg/m ³	0
maximum short term span drift (ABS) [after drift correction]	ds	% of value	0	day of testing	U _{ds}	mg/m ³	0
influence of sample gas flow	f	% of value	0.1	MCERTS certificate MC130223	U _f	mg/m ³	0.004
influence of sample gas pressure	p	% of value	0	MCERTS certificate MC130223	U _p	mg/m ³	0
influence of ambient temperature zero point (/ 35k)	tz	% of value	0	MCERTS certificate MC130223	U _{tz}	mg/m ³	0
influence of ambient temperature span point (/ 35k)	ts	% of value	1.8	MCERTS certificate MC130223	U _{ts}	mg/m ³	0
influence of supply voltage (/ 60V)	v	% of value	0.4	MCERTS certificate MC130223	U _v	mg/m ³	0.011
cross sensitivity at zero	iz	% of value	0.63	MCERTS certificate MC130223	U _{iz}	mg/m ³	0.025
cross sensitivity at span	is	% of value	-0.52	MCERTS certificate MC130223	U _{is}	mg/m ³	-0.021
maximum leak	L	% of value	0.83	day of testing	U _L	mg/m ³	0.033
uncertainty associated with calibration gas	adj	% of value	1.2	span gas calibration certificate	U _{adj}	mg/m ³	0.041
combined MU with O ₂ correction						mg/m ³	0.19
expanded MU with O ₂ correction (k = 1.96)						mg/m ³	0.38
expanded MU 95% CI with O ₂ correction (k = 1.96) as percentage of measured value						%	5.5
expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission						%	5.5

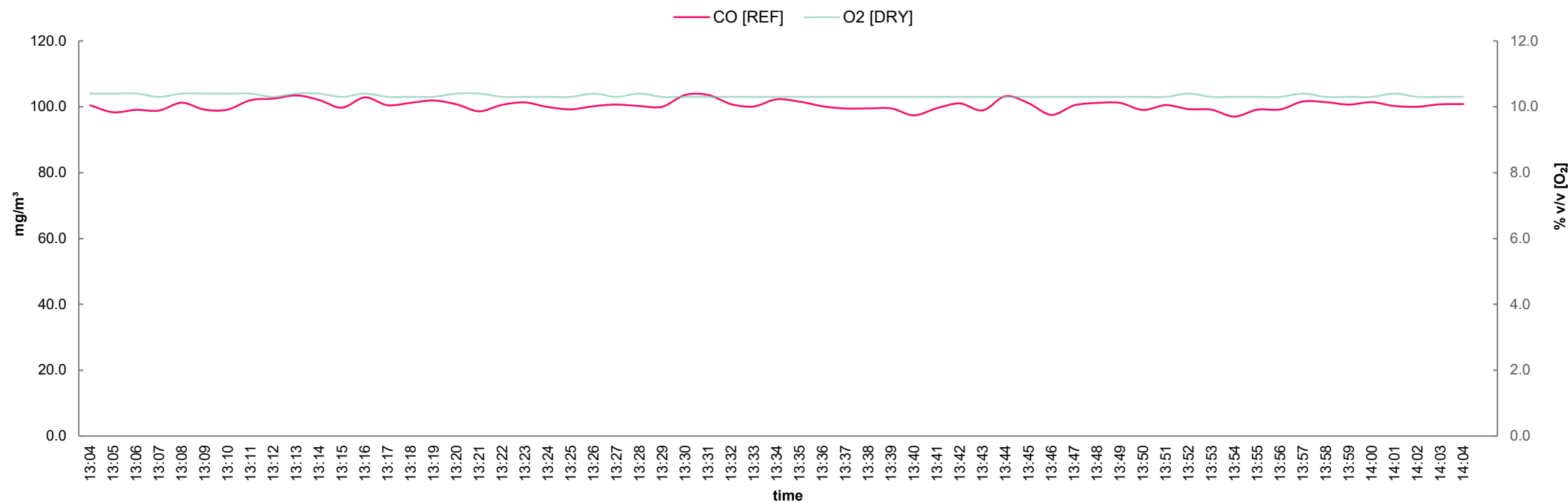
method and sampling deviations
Sampling was performed in full compliance with the Standard, technical procedure and regulatory requirements.

reference conditions are: STP, dry, 15% O₂

General Information

parameter	details
probe material	Stainless Steel
filter size, material & location	Filter Element GF Within Heated Head
number sampling lines available	2
number sampling lines used	1
number sampling points ideal per line	1
number sampling points used per line	1
sampling point IDs	A1

Plot of Emissions Over Time



Part 2: Supporting Information - Appendix 2: Carbon Monoxide | Run 1

Analyser Calibration Information with QA checks

where [A] = at analyser, [L] = down sampling line

	pre-test calibration events							post-test calibration events			quality assurance						
CAL ID	date & time	zero [A] [ppm]	span [A] [ppm]	zero [L] [ppm]	span [L] [ppm]	T ₉₀ [s]	leak [%]		date & time	zero [A] [ppm]	span [A] [ppm]	zero drift [%]		span drift [%]	allowable [%]	temp [°C]	
1	28/01/25 12:00	0.00	166.84	-0.60	164.20	41	1.6	P	28/01/25 15:48	0.00	160.50	-0.2	P	-3.6	P	±5	9.0

Analyser Calibration Extended Information

CAL ID	performed by	drift corr. applied	log period [s]	CYL ID	CYL conc. [ppm]	CYL expiry	CYL MU [%]	zero gas type	span [CYL] gas type	span target [ppm]	range [ppm]	LOD [ppm]
1	AS	Yes	60	A-CYL-115	166.84	26/06/2026	1.0	Nitrogen 5.2	5l 200ppm NO 160ppm CO 16% CO2 in Nitrogen	166.84	200	0.32

Part 2: Supporting Information - Appendix 2: Carbon Monoxide | Run 1

Measurement Uncertainty (MU) Calculations

general information	units	value
emission limit value (ELV) (REF)	mg/m ³	N/A
measured concentration (REF)	mg/m ³	100

MU budget			
parameter	units	min	max
ambient temp	°C	9.0	9.0
voltage	V	90.0	130.0

overall MU for O ₂ correction
4.7%

MU factor O ₂ correction
0.03

performance characteristics	MU budget input parameters				MU budget		
	symbol	units	value	source	symbol	units	value
repeatability at zero	rz	% of value	0.1	MCERTS certificate MC130223	U _{rz}	mg/m ³	0.1
repeatability at span	rs	% of value	0.2	MCERTS certificate MC130223	U _{rs}	mg/m ³	0.2
lack of fit	lof	% of value	2	maximum allowable	U _{lof}	mg/m ³	1.2
maximum short term zero drift (ABS) [after drift correction]	dz	% of value	0	day of testing	U _{dz}	mg/m ³	0
maximum short term span drift (ABS) [after drift correction]	ds	% of value	0	day of testing	U _{ds}	mg/m ³	0
influence of sample gas flow	f	% of value	0.1	MCERTS certificate MC130223	U _f	mg/m ³	0.058
influence of sample gas pressure	p	% of value	0	MCERTS certificate MC130223	U _p	mg/m ³	0
influence of ambient temperature zero point (/ 35k)	tz	% of value	-0.2	MCERTS certificate MC130223	U _{tz}	mg/m ³	0
influence of ambient temperature span point (/ 35k)	ts	% of value	2	MCERTS certificate MC130223	U _{ts}	mg/m ³	0
influence of supply voltage (/ 60V)	v	% of value	0.5	MCERTS certificate MC130223	U _v	mg/m ³	0.19
cross sensitivity at zero	iz	% of value	-0.48	MCERTS certificate MC130223	U _{iz}	mg/m ³	-0.28
cross sensitivity at span	is	% of value	-0.87	MCERTS certificate MC130223	U _{is}	mg/m ³	-0.5
maximum leak	L	% of value	1.6	day of testing	U _L	mg/m ³	0.92
uncertainty associated with calibration gas	adj	% of value	1	span gas calibration certificate	U _{adj}	mg/m ³	0.52
combined MU with O ₂ correction						mg/m ³	2.9
expanded MU with O ₂ correction (k = 1.96)						mg/m ³	5.8
expanded MU 95% CI with O ₂ correction (k = 1.96) as percentage of measured value						%	5.7
expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission						%	5.7

method and sampling deviations
Sampling was performed in full compliance with the Standard, technical procedure and regulatory requirements.

Part 2: Supporting Information - Appendix 2: Carbon Dioxide | Run 1

Results

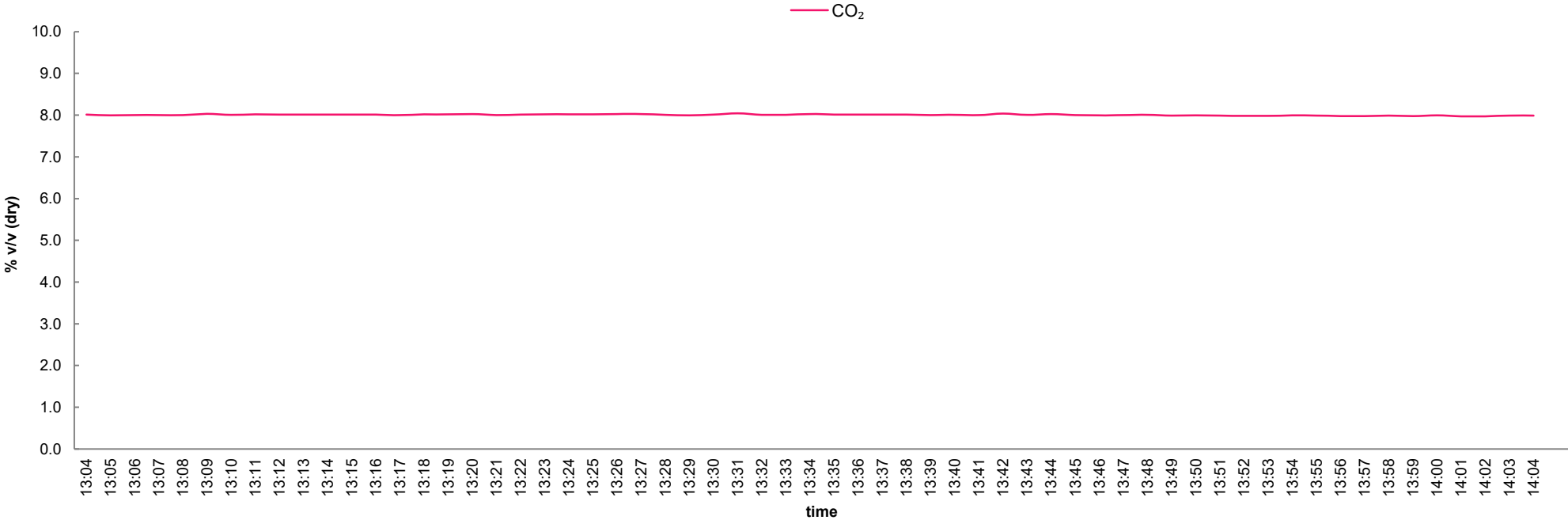
parameter	units	result ± MU (95% CI)	units	result ± MU (95% CI)
Carbon Dioxide	% v/v	8 ± 0.21	kg/hr	1899 ± 101

General Information

parameter	details
sampling start date & time	28/01/2025 13:04
sampling end date & time	28/01/2025 14:04
test time mins	60
testing team	AS ASH
standard technical procedure	PD CEN TS 17405 TP-22e
analyser type	Horiba PG-350E
heated head & line temperature	180°C

parameter	details
probe material	Stainless Steel
filter size, material & location	Filter Element GF Within Heated Head
number sampling lines available	2
number sampling lines used	1
number sampling points ideal per line	1
number sampling points used per line	1
sampling point IDs	A1

Plot of Emissions Over Time



Part 2: Supporting Information - Appendix 2: Carbon Dioxide | Run 1

Analyser Calibration Information with QA checks

where [A] = at analyser, [L] = down sampling line

	pre-test calibration events								post-test calibration events			quality assurance					
CAL ID	date & time	zero [A] [% v/v]	span [A] [% v/v]	zero [L] [% v/v]	span [L] [% v/v]	T ₉₀ [s]	leak [%]		date & time	zero [A] [% v/v]	span [A] [% v/v]	zero drift [%]		span drift [%]		allowable [%]	temp [°C]
1	28/01/25 12:00	0.00	16.08	0.01	16.03	41	0.3	P	28/01/25 15:48	0.04	16.52	0.1	P	2.6	P	±5	9.0

Analyser Calibration Extended Information

CAL ID	performed by	drift corr. applied	log period [s]	CYL ID	CYL conc. [% v/v]	CYL expiry	CYL MU [%]	zero gas type	span [CYL] gas type	span target [% v/v]	range [% v/v]	LOD [% v/v]
1	AS	Yes	60	A-CYL-115	16.08	26/06/2026	1.1	Nitrogen 5.2	5l 200ppm NO 160ppm CO 16% CO2 in Nitrogen	16.08	20	0.10

Part 2: Supporting Information - Appendix 2: Carbon Dioxide | Run 1

Measurement Uncertainty (MU) Calculations

general information	units	value
measured concentration (dry)	% v/v	8

MU budget			
parameter	units	min	max
ambient temp	°C	9.0	9.0
voltage	V	90.0	130.0

performance characteristics	MU budget input parameters				MU budget		
	symbol	units	value	source	symbol	units	value
repeatability at zero	rz	% of value	0	MCERTS certificate MC130223	U _{rz}	% v/v	0
repeatability at span	rs	% of value	0.1	MCERTS certificate MC130223	U _{rs}	% v/v	0.008
lack of fit	lof	% of value	2	maximum allowable	U _{lof}	% v/v	0.092
maximum short term zero drift (ABS) [after drift correction]	dz	% of value	0	day of testing	U _{dz}	% v/v	0
maximum short term span drift (ABS) [after drift correction]	ds	% of value	0	day of testing	U _{ds}	% v/v	0
influence of sample gas flow	f	% of value	0.1	MCERTS certificate MC130223	U _f	% v/v	0.0046
influence of sample gas pressure	p	% of value	0	MCERTS certificate MC130223	U _p	% v/v	0
influence of ambient temperature zero point (/ 35k)	tz	% of value	-0.2	MCERTS certificate MC130223	U _{tz}	% v/v	0
influence of ambient temperature span point (/ 35k)	ts	% of value	1	MCERTS certificate MC130223	U _{ts}	% v/v	0
influence of supply voltage (/ 60V)	v	% of value	0.4	MCERTS certificate MC130223	U _v	% v/v	0.012
cross sensitivity at zero	iz	% of value	0	MCERTS certificate MC130223	U _{iz}	% v/v	0
cross sensitivity at span	is	% of value	-0.55	MCERTS certificate MC130223	U _{is}	% v/v	-0.025
maximum leak	L	% of value	0.31	day of testing	U _L	% v/v	0.014
uncertainty associated with calibration gas	adj	% of value	1.1	span gas calibration certificate	U _{adj}	% v/v	0.044
combined MU						% v/v	0.11
expanded MU 95% CI (k = 1.96)						% v/v	0.21
expanded MU 95% CI (k = 1.96) as percentage of measured value						%	2.6
expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission						%	5.3

method and sampling deviations
Sampling was performed in full compliance with the Standard, technical procedure and regulatory requirements.

Part 2: Supporting Information - Appendix 2: Oxygen | Run 1

Results

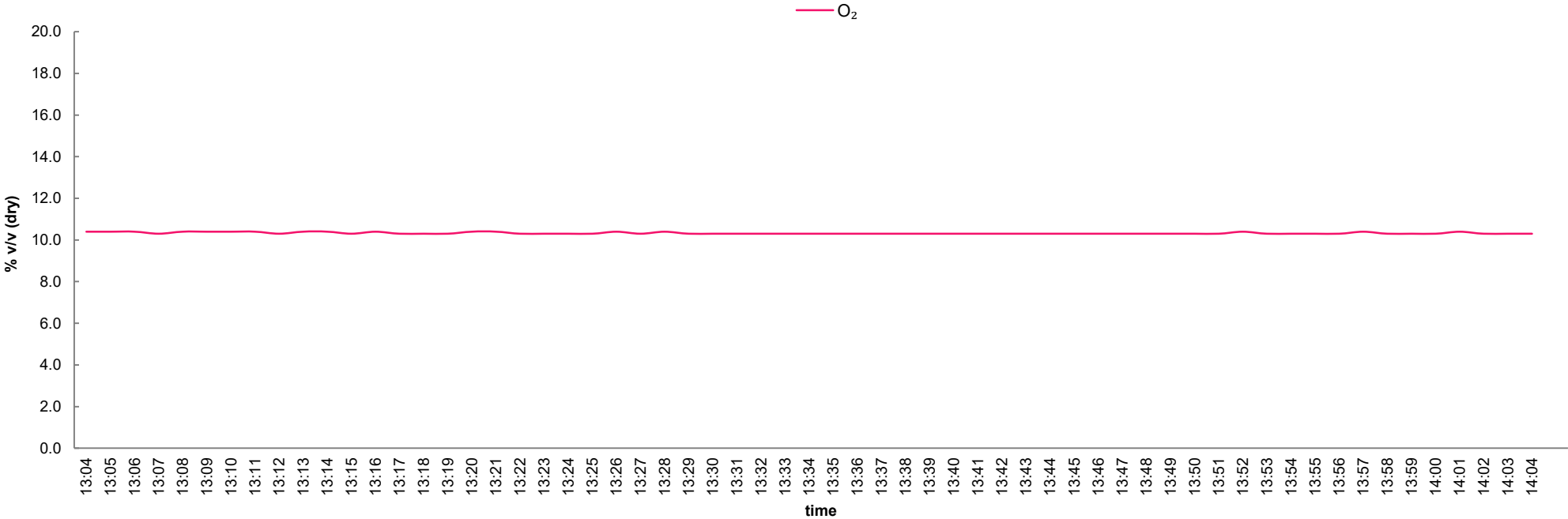
parameter	units	result ± MU (95% CI)
Oxygen	% v/v	10.3 ± 0.31

General Information

parameter	details
sampling start date & time	28/01/2025 13:04
sampling end date & time	28/01/2025 14:04
test time mins	60
testing team	AS ASH
standard technical procedure	EN 14789 TP-22d
analyser type	Horiba PG-350E
heated head & line temperature	180°C

parameter	details
probe material	Stainless Steel
filter size, material & location	Filter Element GF Within Heated Head
number sampling lines available	2
number sampling lines used	1
number sampling points ideal per line	1
number sampling points used per line	1
sampling point IDs	A1

Plot of Emissions Over Time



Part 2: Supporting Information - Appendix 2: Oxygen | Run 1

Analyser Calibration Information with QA checks

where [A] = at analyser, [L] = down sampling line

	pre-test calibration events							post-test calibration events			quality assurance						
CAL ID	date & time	zero [A] [% v/v]	span [A] [% v/v]	zero [L] [% v/v]	span [L] [% v/v]	T ₉₀ [s]	leak [%]		date & time	zero [A] [% v/v]	span [A] [% v/v]	zero drift [%]		span drift [%]	allowable [%]	temp [°C]	
1	28/01/25 12:00	0.00	21.14	0.14	20.88	39	1.2	P	28/01/25 15:48	0.10	21.09	0.2	P	-0.5	P	±5	9.0

Analyser Calibration Extended Information

CAL ID	performed by	drift corr. applied	log period [s]	CYL ID	CYL conc. [% v/v]	CYL expiry	CYL MU [%]	zero gas type	span [CYL] gas type	span target [% v/v]	range [% v/v]	LOD [% v/v]
1	AS	No	60	A-CYL-137	21.14	15/08/2029	1.2	Nitrogen 5.2	5l Synthetic Air	21.14	25	0.03

Part 2: Supporting Information - Appendix 2: Oxygen | Run 1

Measurement Uncertainty (MU) Calculations

general information	units	value
measured concentration (dry)	% v/v	10.3

MU budget			
parameter	units	min	max
ambient temp	°C	9.0	9.0
voltage	V	90.0	130.0

performance characteristics	MU budget input parameters				MU budget		
	symbol	units	value	source	symbol	units	value
repeatability at zero	rz	% of value	0.02	MCERTS certificate MC130223	U _{rz}	% v/v	0.0021
repeatability at span	rs	% of value	0.02	MCERTS certificate MC130223	U _{rs}	% v/v	0.0021
lack of fit	lof	% of value	2	maximum allowable	U _{lof}	% v/v	0.12
maximum short term zero drift (ABS) [after drift correction]	dz	% of value	0.24	day of testing	U _{dz}	% v/v	0.014
maximum short term span drift (ABS) [after drift correction]	ds	% of value	0.47	day of testing	U _{ds}	% v/v	0.028
influence of sample gas flow	f	% of value	-0.01	MCERTS certificate MC130223	U _f	% v/v	-0.0006
influence of sample gas pressure	p	% of value	0	MCERTS certificate MC130223	U _p	% v/v	0
influence of ambient temperature zero point (/ 35k)	tz	% of value	-0.4	MCERTS certificate MC130223	U _{tz}	% v/v	0
influence of ambient temperature span point (/ 35k)	ts	% of value	-0.15	MCERTS certificate MC130223	U _{ts}	% v/v	0
influence of supply voltage (/ 60V)	v	% of value	0.02	MCERTS certificate MC130223	U _v	% v/v	0.0008
cross sensitivity at zero	iz	% of value	0	MCERTS certificate MC130223	U _{iz}	% v/v	0
cross sensitivity at span	is	% of value	0	MCERTS certificate MC130223	U _{is}	% v/v	0
maximum leak	L	% of value	1.2	day of testing	U _L	% v/v	0.073
uncertainty associated with calibration gas	adj	% of value	1.2	span gas calibration certificate	U _{adj}	% v/v	0.062
combined MU						% v/v	0.16
expanded MU 95% CI (k = 1.96)						% v/v	0.31
expanded MU 95% CI (k = 1.96) as percentage of measured value						%	3

method and sampling deviations
Sampling was performed in full compliance with the Standard, technical procedure and regulatory requirements.

Part 2: Supporting Information - Appendix 2: Velocity & Flow Rate Traverse | Run 1

Supporting Information

General Information

Quality Assurance

parameter	units	value
barometric pressure	kPa	101.3
average wet density	kg/m³	0.503
average stack static pressure	Pa	-51.0
pitot tube coefficient, C _p	-	0.829

parameter	details
traverse date	28/01/2025
traverse times performed by	12:40 - 12:47 performed by: AS ASH
standard technical procedure	EN 16911-1 TR 17078 TP-04a
device used	S-type Pitot with KIMO MP 210 (500Pa module)

parameter	details
result of pitot stagnation test	Pass
result of pitot leak check (pre)	Pass
result of pitot leak check (post)	Pass
water droplets present	No

Limit of Detection (LOD) is 1 m/s for this device combination

ND = Not Detected

NM = Not Measured

		Line A					Line B				
		static pressure = -48 Pa					static pressure = -54 Pa				
Pt	Depth m	ΔP Pa	Temp °C	Vel m/s	Swirl °	ΔP Pa	Temp °C	Vel m/s	Swirl °		
1	0.09	386.0	412.0	31.9	< 15	331.0	436.9	30.1	< 15		
2	0.51	340.0	437.2	30.5	< 15	368.0	436.4	31.7	< 15		

Part 2: Supporting Information - Appendix 2: Velocity & Flow Rate Traverse | Run 1

Measurement Uncertainty (MU) Calculations

ND = Not Detected		
parameter	units	value
standard uncertainty on the coefficient of the pitot tube	-	0.0015
standard uncertainty associated with the mean local dynamic pressures	Pa	5.6
standard uncertainty associated with the molar mass of the gas	-	0.000034
standard uncertainty associated with the temperature	K	3.6
standard uncertainty associated with the absolute pressure in the duct	Pa	176
standard uncertainty associated with the density of the gas effluent	kg/m³	0.0028
standard uncertainty associated with the local velocities	m/s	0.26
standard uncertainty associated with the mean velocity	m/s	0.15

ND = Not Detected		
parameter	units	value
standard uncertainty associated with the mean velocity (95% CI)	m/s	0.3
standard uncertainty associated with the mean velocity (95% CI), relative	%	0.96
standard uncertainty associated with the volume flow rate @ actual (95% CI)	m³/hr	1461
standard uncertainty associated with the volume flow rate @ actual (95% CI), relative	%	4.6
standard uncertainty associated with the volume flow rate @ ref 1 (95% CI)	m³/hr	952
standard uncertainty associated with the volume flow rate @ ref 1 (95% CI), relative	%	4.6

method and sampling deviations
Sampling was performed in full compliance with the Standard, technical procedure and regulatory requirements.