

Stack Emissions Monitoring Report

commissioned by Mr Edward Vaughan

Operator Name

Mr Edward Vaughan | Sychtyn

Operator Address

Llanerfyl
Welshpool, Powys
SY21 0JF
EPR Permit EPR/AB3091ZZ

Release Point

AD Plant Engine Exhaust

Monitoring Organisation Name & Address

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

Monitoring Report Written By

Sam Copping | Team Leader
MCERTS Level 2 | MM 21 1653 | TE1 TE2 TE3 TE4 | expires on 25/02/2027

Monitoring Report Approved By

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



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Report Date | Version Number

03/03/2025 | Version 1

Dates of the Monitoring Campaign

24/02/2025

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Report Contents and Monitoring Objectives

Report Contents

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Monitoring Objective

The monitoring objective was to conduct stack emissions monitoring to demonstrate compliance against a set of emission limit values (ELVs) as specified in the Site's Environmental Permit.

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		
Sulphur Dioxide	42.3	3.6	350	mg/m ³	31.7	2.9		g/hr	STP, dry, 5% O ₂	MCERTS
Total VOCs (as Carbon) †	1116	446	1000	mg/m ³	843	337		g/hr	STP, dry, 5% O ₂	MCERTS
Oxides of Nitrogen (as NO ₂) †	475	143	500	mg/m ³	359	108		g/hr	STP, dry, 5% O ₂	MCERTS
Carbon Monoxide †	860	172	1400	mg/m ³	649	130		g/hr	STP, dry, 5% O ₂	MCERTS
Oxygen	7.8	0.20		% v/v					dry	MCERTS
Stack Gas Water Vapour	13.3	0.16		% v/v					actual	MCERTS
Stack Gas Temperature	402			°C					actual	MCERTS
Stack Gas Velocity	36.0	0.60		m/s					actual	MCERTS
Stack Gas Flow Rate (ACTUAL)	2603	126		m ³ /hr					actual	MCERTS
Stack Gas Flow Rate (REF)	757	36.5		m ³ /hr					STP, dry, 5% 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.

† The uncertainties stated above are those specified in Table 4.7 (in Section 4.6.1) of EA LFTGN08 v2 2010, and are the “Assumed maximum values for total uncertainty to be applied when assessing compliance of emissions from [landfill gas] engines”. See Appendix 2 of this report for more information.

Part 1: Executive Summary - Monitoring Results Further Details

Monitoring Results - Further Details

test parameter	run	EXPRESSED AS A CONCENTRATION				EXPRESSED AS A MASS EMISSION				sampling date times	run time (mins)	H ₂ O (% v/v)	reference conditions
		result	uncertainty in result +/-	limit (ELV)	units	result	uncertainty in result +/-	limit (ELV)	units				
Sulphur Dioxide	R1	42.3	3.6	350	mg/m ³	31.7	2.9		g/hr	24/02/2025 12:55 - 13:55	60	13.3	STP, dry, 5% O ₂
Total VOCs (as Carbon) †	R1	1116	446	1000	mg/m ³	843	337		g/hr	24/02/2025 12:55 - 13:55	60		STP, dry, 5% O ₂
Oxides of Nitrogen (as NO ₂) †	R1	475	143	500	mg/m ³	359	108		g/hr	24/02/2025 12:55 - 13:55	60		STP, dry, 5% O ₂
Carbon Monoxide †	R1	860	172	1400	mg/m ³	649	130		g/hr	24/02/2025 12:55 - 13:55	60		STP, dry, 5% O ₂
Oxygen		7.8	0.20		% v/v					N/A - Concurrent Testing			dry
Velocity & Flow Rate Traverse	R1	36.0	0.60		m/s	2603	126		m ³ /hr	24/02/2025 11:52 - 11:57			actual
Stack Gas Water Vapour		13.3	0.16		% v/v								actual
Stack Gas Temperature		402			°C								actual
Stack Gas Velocity		36.0	0.60		m/s								actual
Stack Gas Flow Rate (ACTUAL)		2603	126		m ³ /hr								actual
Stack Gas Flow Rate (REF)		757	36.5		m ³ /hr								STP, dry, 5% 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.

† The uncertainties stated above are those specified in Table 4.7 (in Section 4.6.1) of EA LFTGN08 v2 2010, and are the "Assumed maximum values for total uncertainty to be applied when assessing compliance of emissions from [landfill gas] engines". See Appendix 2 of this report for more information.

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
Sulphur Dioxide	ATA	10706	TP-10	EN 14791	MCERTS	RPS	0605	C27	IC	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
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.

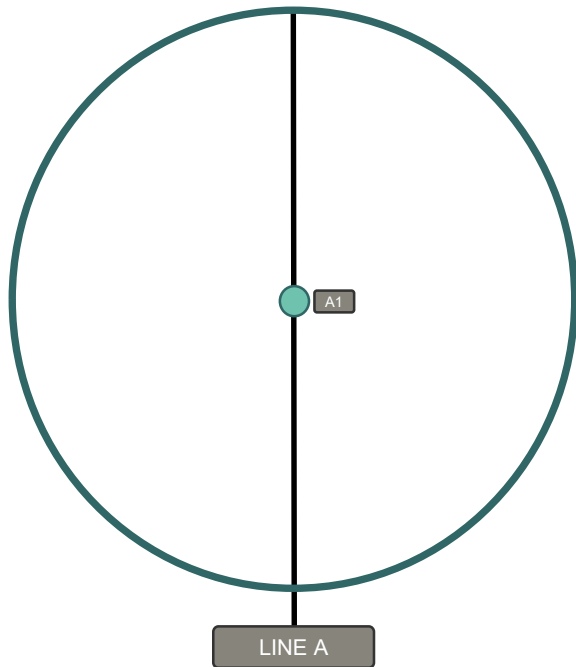
Part 1: Executive Summary - Monitoring Location

Monitoring Location Photos



Identification of Sampling Points on a Duct Diagram

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
shape	-	Circular
dimensions	-	Diameter = 0.16 m
area	m ²	0.02
orientation	-	Horizontal

parameter	value
primary sample port size	1" BSP
primary sample port depth cm	10
primary sample ports number of sampling lines available	1

summary of all sample ports available
1" BSP

Sampling Location General Information

general information	details
type location access	On the Ground Inside On Ground Level

CEMS | Abatement Systems

parameter	details
abatement system/s	N/A
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	486.0	> 5 Pa	Yes
lowest traverse velocity	m/s	36.0	-	-
highest traverse velocity	m/s	36.0	-	-
mean traverse velocity	m/s	36.0	-	-
ratio traverse velocities	: 1	1.00	< 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	No visible plume
type of process	Anaerobic Digester Engine
batch or continuous process	Continuous
fuel type	Biogas
feedstock	N/A
typical load / throughput of plant	Normal Operation - 250kW
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
Sam Copping	Team Leader	MCERTS Level 2 MM 21 1653 25/02/2027	TE1 TE2 TE3 TE4
Mike Gormley	Trainee	MCERTS Level 1 MM 23 1823 22/01/2029	-

Analysis Laboratories

laboratory	ISO 17025 accreditation number	laboratory short name	laboratory phone number
Atesta North West	10706	ATA	0800 970 8945
RPS Laboratories Salford	0605	RPS	0161 872 2443

Test Equipment Used

equipment type	A-EQ ID
Source sampling console	
Low flow sampling MFCs	389
ThermoFID / iFID mobile	
Horiba PG-350E multigas analyser	388
Gasmet DX4000 FTIR	
Gasmet PSS	
Protea AtmosFIR	
Protea PIB Pump	
Gasmet syringe calibrator	
M&C PSS5-C conditioning unit	411
Digital thermomanometer	387
Top pan balance kit	466

equipment type	A-EQ ID
Pitot	443
Calipers	
Barometer	240
Timer	399
Tape measure	488
Heated head filter	62
Heated tee	
10m heated line	473
1.5m heated line	406
Odour barrel	
Vacuum chamber	
Dilution probe	

equipment type	A-EQ ID
10m umbilical	
30m umbilical	
Heated probe	
Filter oven	
Ambient thermocouple	275
Stack thermocouple	275
Exit thermocouple	
Condenser thermocouple	
Tubes kit thermocouple	
2-way heater controller	
Air sampling pump	
5-figure analytical balance	1

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

Results

reference conditions are: STP, dry, 5% O₂

parameter	units	result ± MU (95% CI)	units	result ± MU (95% CI)
Sulphur Dioxide	mg/m ³	42.3 ± 3.6	g/hr	31.7 ± 2.9

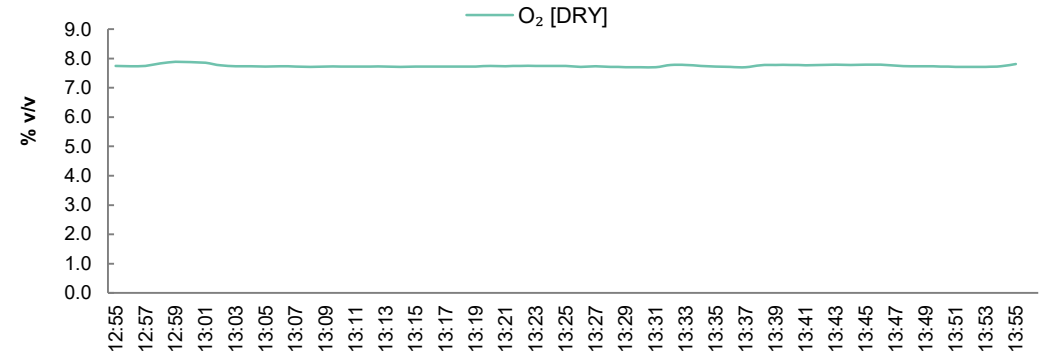
Analytical Laboratory Information

parameter	details
name of analytical lab	RPS
lab analytical procedure	C27
lab analytical technique	IC Analysis Accreditation: MCERTS
date analysis completed	28/02/2025

General Information

parameter	details
sampling date	24/02/2025
sampling times	12:55 - 13:55
sampling duration testing team	60 minutes tested by: SC MG
standard technical procedure	EN 14791 TP-10
probe filter housing material	Titanium Stainless Steel Heated Head
impinger material capture media	Borosilicate Glass 0.3% H ₂ O ₂
set flow rate	4 l/min

Oxygen Data



parameter	details
filter size, material & location	Heated Head Filter Element PTFE Within Heated Head heated to 180°C
number sampling lines available	1
number sampling lines used	1
number sampling points ideal per line	1
number sampling points used per line	1
sampling point IDs	A1
volume metering device	Mass Flow Controller

Quality Assurance

QA parameter	units	sample run			blank (taken on 24/02/2025)		
		value	allowable	result	value	allowable	result
maximum allowable blank	mg/m ³	-	-	-	0.15	35	Pass
leak test	%	0.40	2.00	Pass	0.20	2.00	Pass
absorption efficiency	%	99.7	95	Pass	-	-	-
silica trap <50% faded	-	Yes	-	Pass	-	-	-
are water droplets present	-	No	-	-	-	-	-
water vapour MU	%	1.2	20.0	Pass	-	-	-

Breakdown of Results

reference conditions are: STP, dry, 5% O₂

parameter	sample volume [m ³]	LOD [mg]	impingers [front back] [mg/l]	impinger volume [front back] [ml]	mass total [mg]	LOD result [mg/m ³]	result [mg/m ³]	result reported [mg/m ³]	mass emission [g/hr]
sample run	0.1974	0.019	30.3 0.2	275 110	8.4	0.098	42.3	42.3	31.7
blank	0.1974	0.016	0.09	325	0.029	0.082	0.15	0.15	

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

Raw Data | Calculations

data	units	value
P _{bar}	mmHg	756.1
P _g	Pa	-93.0
P _s	mmHg	755.4
V _m (metered)	m ³	0.2384
C _{stp}	-	0.3592

data	units	value
m _{wts}	g	29.6
M _w	g/mol	18.0
V _{mol}	m ³ /mol	0.0222
T _s	°C	403.9
R _{wv} (H ₂ O)	% v/v	13.3

data	units	value
%CO _{2d}	% v/v (est)	12.00
%O _{2d}	% v/v	7.75
%O _{2w}	% v/v	6.72
%N _{2d}	% v/v	80.25
%O _{2ref}	% v/v	5.0
O _{2facd}	-	1.21
O _{2facw}	-	1.12

data	units	value
M _d	g/mol	30.23
M _s	g/mol	28.61
A _s	m ²	0.02
θ (sample time)	mins	60

where (est) refers to an estimated value

metered volume calculations	units	value
allow favourable O ₂ correction	-	Yes
vol actual stack conditions, V _{ma} = (V _{mstw})(T _s + 273) / (P _s) / (C _{stp})	m ³	0.6857
vol dry, V _{mstd} = V _m	m ³	0.2384
vol wet, V _{mstw} = (V _{mstd})(100 / (100 - R _{wv}))	m ³	0.2749
vol dry O ₂ , V _{mstdO₂} = (V _{mstd}) / (O _{2facd})	m ³	0.1974
vol wet O ₂ , V _{mstwO₂} = (V _{mstw}) / (O _{2facw})	m ³	0.2453

velocity volume flow rate calculations	units	value
velocity of stack gas, v _s = average of all velocity measurements	m/s	36.0
stack gas flow actual stack conditions, Q _a = average of all flow rate measurements	m ³ /hr	2603.3

Measurement Uncertainty (MU) Calculations

parameter	units	value	standard MU	MU as %age	required standard	value	sens coeff.	MU mg/m ³
MFC meter volume, V _m	m ³	0.2384	0.0012	0.50	≤2%	-	-	-
MFC volume STP, V _{mstd}	m ³	-	-	-	-	0.2	178	0.21
leak, L	% ¹ mg/m ³ ²	0.5 ¹	-	0.50	≤2%	0.12 ²	1.00	0.12
laboratory result, L _r	% ¹ mg/m ³ ²	3.9 ¹	-	3.9	-	1.6 ²	1.00	1.6
<i>combined MU with O₂ correction</i>								1.8
<i>expanded MU 95% CI with O₂ correction (k = 1.96) including method deviations</i>								3.6
<i>expanded MU 95% CI with O₂ correction (k = 1.96) as percentage of measured value</i>								8.5%
<i>expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission</i>								9%
<i>expanded MU 95% CI with O₂ correction (k = 1.96) as percentage of ELV [allowable 20.4%]</i>								1%

MU factor O₂ correction	0.05
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overall MU for O₂ correction	3.8%
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method deviation factor	1.00
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result	Pass
---------------	------

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 VOCs (as Carbon) | Run 1

Results

reference conditions are: STP, dry, 5% O₂

parameter	units	result ± MU (95% CI)	units	result ± MU (95% CI)
Total VOCs (as Carbon) †	mg/m ³	1116 ± 446	g/hr	843 ± 337

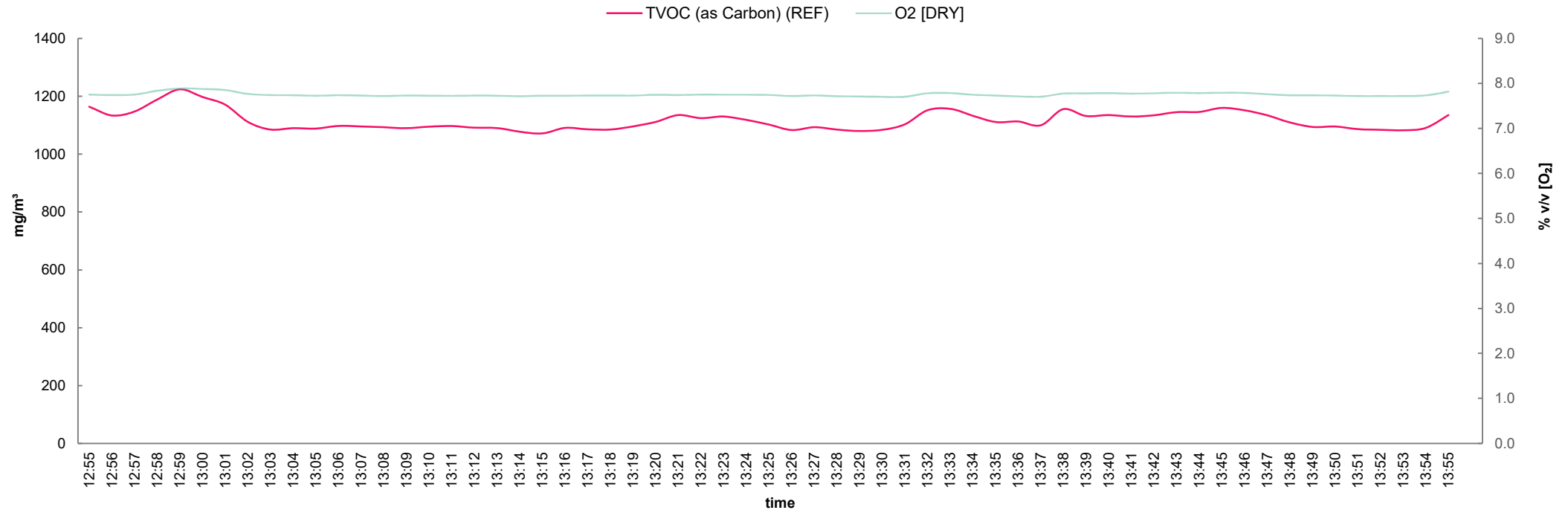
† LFTGN08 maximum value for total uncertainty (40% of measured value) applied to the results

General Information

parameter	details
sampling start date & time	24/02/2025 12:55
sampling end date & time	24/02/2025 13:55
test time mins	60
testing team	SC MG
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 PTFE Within Heated Head
number sampling lines available	1
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

CAL ID	pre-test calibration events							post-test calibration events			quality assurance						
	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	24/02/25 12:20	0.00	791.01	-0.10	792.00	10	0.0	P	24/02/25 14:07	-0.91	764.00	-0.1	P	-3.4	P	±5	10.0

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	SC	Yes	60	A-CYL-32	791.01	11/10/2025	0.9	Synthetic Air	10l 800ppm Propane in Air	791.01	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/m ³	1000
measured concentration (REF)	mg/m ³	1116

MU budget			
parameter	units	min	max
ambient temp	°C	10.0	10.0
voltage	V	90.0	130.0

overall MU for O ₂ correction
3.8%

MU factor O ₂ correction
0.05

performance characteristics	MU budget input parameters				MU budget			result			
	symbol	units	value	source	symbol	units	value				
repeatability at zero	rz	% of value	0.05	MCERTS certificate MC050062	U _{rz}	mg/m ³	0.56				
repeatability at span	rs	% of value	0.08	MCERTS certificate MC050062	U _{rs}	mg/m ³	0.89				
lack of fit	lof	% of value	2	maximum allowable	U _{lof}	mg/m ³	12.9				
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	-0.42	MCERTS certificate MC050062	U _f	mg/m ³	-2.7				
influence of sample gas pressure	p	% of value	0	MCERTS certificate MC050062	U _p	mg/m ³	0				
influence of ambient temperature zero point (/ 35k)	tz	% of value	-2.4	MCERTS certificate MC050062	U _{tz}	mg/m ³	0				
influence of ambient temperature span point (/ 35k)	ts	% of value	-2.7	MCERTS certificate MC050062	U _{ts}	mg/m ³	0				
influence of supply voltage (/ 60V)	v	% of value	-0.46	MCERTS certificate MC050062	U _v	mg/m ³	-2				
cross sensitivity at zero	iz	% of value	3.8	MCERTS certificate MC050062	U _{iz}	mg/m ³	24.5				
cross sensitivity at span	is	% of value	3.9	MCERTS certificate MC050062	U _{is}	mg/m ³	25.1				
maximum leak	L	% of value	0	day of testing	U _L	mg/m ³	0				
uncertainty associated with calibration gas	adj	% of value	0.9	span gas calibration certificate	U _{adj}	mg/m ³	5				
† This MU budget calculates the measurement uncertainty (MU) based upon the equipment used and the Standard followed. The reported MU is that specified in Table 4.7 (in Section 4.6.1) of EA LFTGN08 v2 2010, and is the "Assumed maximum value for total uncertainty to be applied when assessing compliance of emissions from [landfill gas] engines" which is 40% for Total VOCs.							combined MU with O ₂ correction		mg/m ³	43.5	
							expanded MU with O ₂ correction (k = 1.96)		mg/m ³	85.3	
							expanded MU 95% CI with O ₂ correction (k = 1.96) as percentage of measured value		%	7.6	
							expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission		%	8.2	
							expanded MU with O ₂ correction (k = 1.96) as percentage of ELV [allowable 15.5%]		%	8.5	N/A [>ELV]

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

Results

reference conditions are: STP, dry, 5% O₂

parameter	units	result ± MU (95% CI)	units	result ± MU (95% CI)
Oxides of Nitrogen (as NO ₂) †	mg/m ³	475 ± 143	g/hr	359 ± 108

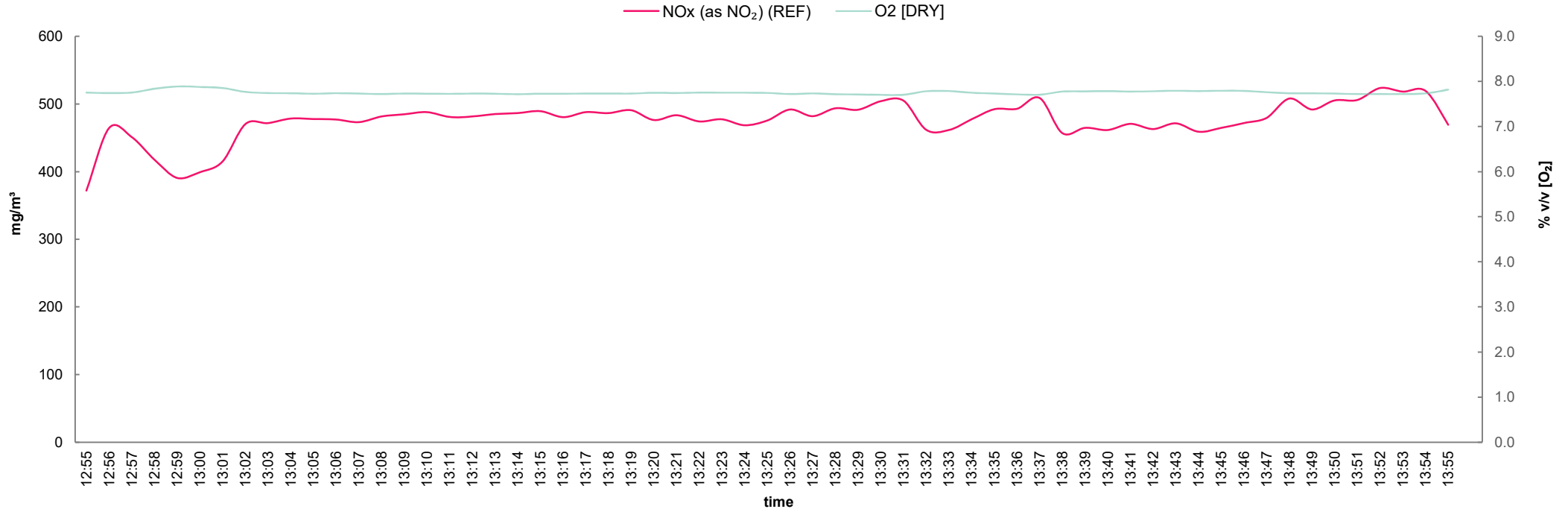
† LFTGN08 maximum value for total uncertainty (30% of measured value) applied to the results

General Information

parameter	details
sampling start date & time	24/02/2025 12:55
sampling end date & time	24/02/2025 13:55
test time mins	60
testing team	SC MG
standard technical procedure	EN 14792 TP-22a
analyser type	Horiba PG-350E
heated head & line temperature	180°C

parameter	details
probe material	Titanium
filter size, material & location	Filter Element PTFE Within Heated Head
number sampling lines available	1
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: Oxides of Nitrogen (as NO₂) | Run 1

Analyser Calibration Information with QA checks

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

CAL ID	pre-test calibration events							post-test calibration events			quality assurance						
	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	24/02/25 12:07	0.00	431.92	2.50	424.00	21	1.8	P	24/02/25 14:13	0.60	425.00	-0.1	P	-1.5	P	±5	11.5

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	SC	No	60	A-CYL-117	431.92	07/09/2026	1.3	Nitrogen 5.2	10l 400ppm NO 1600ppm CO 16% CO2 in Nitrogen	431.92	1000	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	500
measured concentration (REF)	mg/m ³	475

MU budget			
parameter	units	min	max
ambient temp	°C	11.0	12.0
voltage	V	90.0	130.0

overall MU for O ₂ correction	3.8%
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MU factor O ₂ correction	0.05
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performance characteristics	MU budget input parameters				MU budget			result																
	symbol	units	value	source	symbol	units	value																	
repeatability at zero	rz	% of value	0	MCERTS certificate MC130223	U _{rz}	mg/m ³	0	<table border="1"> <tr> <td>combined MU with O₂ correction</td> <td>mg/m³</td> <td>13.1</td> <td rowspan="5">Pass</td> </tr> <tr> <td>expanded MU with O₂ correction (k = 1.96)</td> <td>mg/m³</td> <td>25.6</td> </tr> <tr> <td>expanded MU 95% CI with O₂ correction (k = 1.96) as percentage of measured value</td> <td>%</td> <td>5.4</td> </tr> <tr> <td>expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission</td> <td>%</td> <td>6.2</td> </tr> <tr> <td>expanded MU with O₂ correction (k = 1.96) as percentage of ELV [allowable 10.7%]</td> <td>%</td> <td>5.1</td> </tr> </table>	combined MU with O ₂ correction	mg/m ³	13.1	Pass	expanded MU with O ₂ correction (k = 1.96)	mg/m ³	25.6	expanded MU 95% CI with O ₂ correction (k = 1.96) as percentage of measured value	%	5.4	expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission	%	6.2	expanded MU with O ₂ correction (k = 1.96) as percentage of ELV [allowable 10.7%]	%	5.1
combined MU with O ₂ correction	mg/m ³	13.1	Pass																					
expanded MU with O ₂ correction (k = 1.96)	mg/m ³	25.6																						
expanded MU 95% CI with O ₂ correction (k = 1.96) as percentage of measured value	%	5.4																						
expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission	%	6.2																						
expanded MU with O ₂ correction (k = 1.96) as percentage of ELV [allowable 10.7%]	%	5.1																						
repeatability at span	rs	% of value	0.1	MCERTS certificate MC130223	U _{rs}	mg/m ³	0.48																	
lack of fit	lof	% of value	2	maximum allowable	U _{lof}	mg/m ³	5.5																	
maximum short term zero drift (ABS) [after drift correction]	dz	% of value	0.14	day of testing	U _{dz}	mg/m ³	0.38																	
maximum short term span drift (ABS) [after drift correction]	ds	% of value	1.5	day of testing	U _{ds}	mg/m ³	4																	
influence of sample gas flow	f	% of value	0.1	MCERTS certificate MC130223	U _f	mg/m ³	0.27																	
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	0.081																	
influence of supply voltage (/ 60V)	v	% of value	0.4	MCERTS certificate MC130223	U _v	mg/m ³	0.73																	
cross sensitivity at zero	iz	% of value	0.63	MCERTS certificate MC130223	U _{iz}	mg/m ³	1.7																	
cross sensitivity at span	is	% of value	-0.52	MCERTS certificate MC130223	U _{is}	mg/m ³	-1.4																	
maximum leak	L	% of value	1.8	day of testing	U _L	mg/m ³	5																	
uncertainty associated with calibration gas	adj	% of value	1.3	span gas calibration certificate	U _{adj}	mg/m ³	3.1																	

† This MU budget calculates the measurement uncertainty (MU) based upon the equipment used and the Standard followed. The reported MU is that specified in Table 4.7 (in Section 4.6.1) of EA LFTGN08 v2 2010, and is the "Assumed maximum value for total uncertainty to be applied when assessing compliance of emissions from [landfill gas] engines" which is 30% for Oxides of Nitrogen (as NO₂).

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 Monoxide | Run 1

Results

reference conditions are: STP, dry, 5% O₂

parameter	units	result ± MU (95% CI)	units	result ± MU (95% CI)
Carbon Monoxide †	mg/m ³	860 ± 172	g/hr	649 ± 130

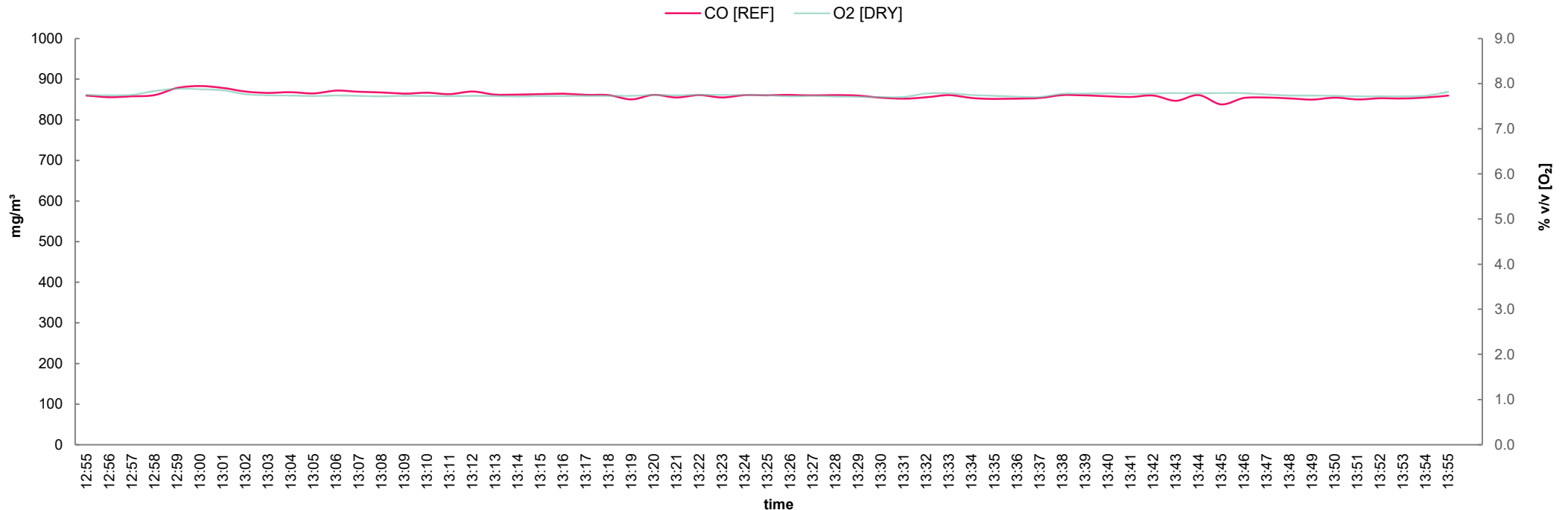
† LFTGN08 maximum value for total uncertainty (20% of measured value) applied to the results

General Information

parameter	details
sampling start date & time	24/02/2025 12:55
sampling end date & time	24/02/2025 13:55
test time mins	60
testing team	SC MG
standard technical procedure	EN 15058 TP-22b
analyser type	Horiba PG-350E
heated head & line temperature	180°C

parameter	details
probe material	Titanium
filter size, material & location	Filter Element PTFE Within Heated Head
number sampling lines available	1
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

CAL ID	pre-test calibration events							post-test calibration events			quality assurance						
	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	24/02/25 12:07	0.00	1707.83	1.00	1684.00	21	1.4	P	24/02/25 14:13	1.00	1682.00	-0.1	P	-1.5	P	±5	11.5

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	SC	No	60	A-CYL-117	1707.83	07/09/2026	1.1	Nitrogen 5.2	10l 400ppm NO 1600ppm CO 16% CO2 in Nitrogen	1707.83	2000	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	1400
measured concentration (REF)	mg/m ³	860

MU budget			
parameter	units	min	max
ambient temp	°C	11.0	12.0
voltage	V	90.0	130.0

overall MU for O ₂ correction
3.8%

MU factor O ₂ correction
0.05

performance characteristics	MU budget input parameters				MU budget			result			
	symbol	units	value	source	symbol	units	value				
repeatability at zero	rz	% of value	0.1	MCERTS certificate MC130223	U _{rz}	mg/m ³	0.86				
repeatability at span	rs	% of value	0.2	MCERTS certificate MC130223	U _{rs}	mg/m ³	1.7				
lack of fit	lof	% of value	2	maximum allowable	U _{lof}	mg/m ³	9.9				
maximum short term zero drift (ABS) [after drift correction]	dz	% of value	0.058	day of testing	U _{dz}	mg/m ³	0.29				
maximum short term span drift (ABS) [after drift correction]	ds	% of value	1.5	day of testing	U _{ds}	mg/m ³	7.2				
influence of sample gas flow	f	% of value	0.1	MCERTS certificate MC130223	U _f	mg/m ³	0.5				
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	-0.016				
influence of ambient temperature span point (/ 35k)	ts	% of value	2	MCERTS certificate MC130223	U _{ts}	mg/m ³	0.16				
influence of supply voltage (/ 60V)	v	% of value	0.5	MCERTS certificate MC130223	U _v	mg/m ³	1.7				
cross sensitivity at zero	iz	% of value	-0.48	MCERTS certificate MC130223	U _{iz}	mg/m ³	-2.4				
cross sensitivity at span	is	% of value	-0.87	MCERTS certificate MC130223	U _{is}	mg/m ³	-4.3				
maximum leak	L	% of value	1.4	day of testing	U _L	mg/m ³	6.9				
uncertainty associated with calibration gas	adj	% of value	1.1	span gas calibration certificate	U _{adj}	mg/m ³	4.7				
† This MU budget calculates the measurement uncertainty (MU) based upon the equipment used and the Standard followed. The reported MU is that specified in Table 4.7 (in Section 4.6.1) of EA LFTGN08 v2 2010, and is the "Assumed maximum value for total uncertainty to be applied when assessing compliance of emissions from [landfill gas] engines" which is 20% for Carbon Monoxide.							combined MU with O ₂ correction		mg/m ³	22.9	
							expanded MU with O ₂ correction (k = 1.96)		mg/m ³	44.9	
							expanded MU 95% CI with O ₂ correction (k = 1.96) as percentage of measured value		%	5.2	
							expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission		%	6	result
							expanded MU with O ₂ correction (k = 1.96) as percentage of ELV [allowable 7.1%]		%	3.2	Pass

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 | QA Concurrent Testing

Results

parameter	units	result ± MU (95% CI)
Oxygen	% v/v	7.8 ± 0.2

General Information

parameter	details
sampling start date & time	N/A - Concurrent Testing
sampling end date & time	N/A - Concurrent Testing
testing team	SC MG

parameter	details
standard technical procedure	EN 14789 TP-22d
analyser type	Horiba PG-350E

Analyser Calibration Information with QA checks

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

CAL ID	pre-test calibration events							post-test calibration events			quality assurance			
	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	24/02/25 12:07	0.00	21.35	0.24	21.24	23	0.5	24/02/25 14:13	0.14	21.41	0.3	0.0	±5	11.5

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	SC	No	60	A-CYL-129	21.35	25/06/2029	1.2	Nitrogen 5.2	10l Synthetic Air	21.35	25	0.03

Part 2: Supporting Information - Appendix 2: Oxygen | QA Concurrent Testing

Measurement Uncertainty (MU) Calculations

general information	units	value
measured concentration (dry)	% v/v	7.8

MU budget			
parameter	units	min	max
ambient temp	°C	11.0	12.0
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	0.0016
repeatability at span	rs	% of value	0.02	MCERTS certificate MC130223	U _{rs}	% v/v	0.0016
lack of fit	lof	% of value	2	maximum allowable	U _{lof}	% v/v	0.089
maximum short term zero drift (ABS) [after drift correction]	dz	% of value	0.33	day of testing	U _{dz}	% v/v	0.015
maximum short term span drift (ABS) [after drift correction]	ds	% of value	0.047	day of testing	U _{ds}	% v/v	0.0021
influence of sample gas flow	f	% of value	-0.01	MCERTS certificate MC130223	U _f	% v/v	-0.00045
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	-0.0003
influence of ambient temperature span point (/ 35k)	ts	% of value	-0.15	MCERTS certificate MC130223	U _{ts}	% v/v	-0.00011
influence of supply voltage (/ 60V)	v	% of value	0.02	MCERTS certificate MC130223	U _v	% v/v	0.0006
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	0.52	day of testing	U _L	% v/v	0.023
uncertainty associated with calibration gas	adj	% of value	1.2	span gas calibration certificate	U _{adj}	% v/v	0.047
<i>combined MU</i>						% v/v	0.1
<i>expanded MU 95% CI (k = 1.96)</i>						% v/v	0.2
<i>expanded MU 95% CI (k = 1.96) as percentage of measured value</i>						%	2.6

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

parameter	units	value
barometric pressure	kPa	101.2
average wet density	kg/m ³	0.517
average stack static pressure	Pa	153.0
pitot tube coefficient, C _p	-	0.834

ND = Not Detected

NM = Not Measured

Line A

static pressure = 153 Pa

Pt	Depth m	ΔP Pa	Temp °C	Vel m/s	Swirl °
1	0.08	486.0	401.0	36.0	< 15

General Information

parameter	details
traverse date	24/02/2025
traverse times performed by	11:52 - 11:57 performed by: SC MG
standard technical procedure	EN 16911-1 TR 17078 TP-04a
device used	S-type Pitot with KIMO MP 210 (2500Pa module)

Limit of Detection (LOD) is 2.5 m/s for this device combination

Quality Assurance

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

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	7.7
standard uncertainty associated with the molar mass of the gas	-	0.000064
standard uncertainty associated with the temperature	K	3.4
standard uncertainty associated with the absolute pressure in the duct	Pa	176
standard uncertainty associated with the density of the gas effluent	kg/m ³	0.003
standard uncertainty associated with the local velocities	m/s	0.31
standard uncertainty associated with the mean velocity	m/s	0.31

ND = Not Detected

parameter	units	value
standard uncertainty associated with the mean velocity (95% CI)	m/s	0.6
standard uncertainty associated with the mean velocity (95% CI), relative	%	1.7
standard uncertainty associated with the volume flow rate @ actual (95% CI)	m ³ /hr	126
standard uncertainty associated with the volume flow rate @ actual (95% CI), relative	%	4.8
standard uncertainty associated with the volume flow rate @ ref 1 (95% CI)	m ³ /hr	36.5
standard uncertainty associated with the volume flow rate @ ref 1 (95% CI), relative	%	4.8

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