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Stack Emissions Testing Report Commissioned by
Enovrt

Installation Name & Address

Enovrt
Tir John Landfill Site
Port Tennant
Swansea
SA1 8LN

EPR Permit: BP3738LS

Stack Reference
Jenbacher Engine

Dates of the Monitoring Campaign
10th August 2023

Job Reference Number
ERE-23296

Report Written by
Joshua Cunningham Technician MCERTS Level 1 MM 22 1702 -

Report Approved by
Darren Price Team Leader MCERTS Level 2 MM 03 176 TE1 TE2 TE3 TE4

Report Date
8th September 2023

Version
Version 1

Signature of Report Approver


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Executive Summary

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MONITORING OBJECTIVES

Enovert, Tir John Landfill Site
Jenbacher Engine
10th August 2023

Overall Aim of the Monitoring Campaign

Element were commissioned by Enovert to carry out stack emissions testing on the Jenbacher Engine at Tir John Landfill Site.

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values (ELVs) as specified in the Site's Permit.

Special Requirements

There were no special requirements.

Target Parameters

Total VOCs (as Carbon), Oxides of Nitrogen (as NO₂), Carbon Monoxide

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MONITORING RESULTS

Enovert, Tir John Landfill Site

Jenbacher Engine

10th August 2023

where MU = Measurement Uncertainty associated with the Result

Parameter	Concentration			
	Units	Result	MU +/-	Limit
Total VOCs (as Carbon)	¹ mg/m ³	1384	65.5	1750
Oxides of Nitrogen (as NO ₂)	¹ mg/m ³	198	10.0	650
Carbon Monoxide	¹ mg/m ³	704	35.2	1500
Oxygen	% v/v	Dry 6.6	0.28	
Water Vapour	% v/v	11.6	0.51	

¹ Reference Conditions (REF) are: 273K, 101.3kPa, dry gas, 5% oxygen.

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MONITORING DATE(S) & TIMES

Enovert, Tir John Landfill Site
Jenbacher Engine
10th August 2023

Parameter	Units	Concentration		Sampling Date(s)	Sampling Times	Duration mins
Total VOCs (as Carbon)	R1 mg/m ³	1384.4		10/08/2023	12:50 - 13:50	60
Oxides of Nitrogen (as NO ₂)	R1 mg/m ³	198.1		10/08/2023	12:50 - 13:50	60
Carbon Monoxide	R1 mg/m ³	704.0		10/08/2023	12:50 - 13:50	60
Oxygen	R1 % v/v	6.63		10/08/2023	12:50 - 13:50	60
Water Vapour	R1 % v/v	11.6		10/08/2024	12:50 - 13:50	60

All results are expressed at the respective reference conditions.

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PROCESS DETAILS

Enovert, Tir John Landfill Site
Jenbacher Engine
10th August 2023

Standard Operating Conditions

Parameter	Value
Process Status	Operating
Capacity (of 100%) and Tonnes / Hour	500KWe (MCR 650KWe)
Continuous or Batch Process	Continuous
Feedstock (if applicable)	N/A
Abatement System	None
Abatement System Running Status	N/A
Fuel	Landfill Gas
Plume Appearance	No visible plume

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MONITORING & ANALYTICAL METHODS

Enovert, Tir John Landfill Site

Jenbacher Engine

10th August 2023

Parameter	Monitoring				Analysis				Overall Status	LOD (Average)
	Standard	Technical Procedure	Sampling Status	Testing Lab	Analytical Procedure	Analytical Technique	Analysis Status	Analysis Lab		
Water Vapour	EN 14790	CAT-TP-05	MCERTS	EET	CAT-TP-05	Gravimetric	MCERTS	EET	MCERTS	0.10 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	MCERTS	EET	Flame Ionisation Detection by Signal 3010HM				MCERTS	0.32 mg/m ³
Oxides of Nitrogen (as NO ₂)	EN 14792	CAT-TP-21	MCERTS	EET	Chemiluminescence by Horiba PG-250				MCERTS	0.41 mg/m ³
Carbon Monoxide	EN 15058	CAT-TP-21	MCERTS	EET	NDIR by Horiba PG-250				MCERTS	0.71 mg/m ³
Oxygen	EN 14789	CAT-TP-21	MCERTS	EET	Dry Zirconia Cell by Horiba PG-250				MCERTS	0.1 %

ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Element (Stockport Lab - EET)	ISO 17025 Accreditation Number: 4279
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SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
All	All	There are no deviations associated with the sampling employed.

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.30
Width	m	-
Area	m ²	0.07
Port Depth	cm	10
Orientation of Duct	-	Angled
Number of Ports	-	1
Sample Port Size	-	1" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	On Ground
Inside / Outside	Inside

Platform Details

EA Technical Guidance Note M1 / EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	N/A
Platform has vertical base boards (approx. 0.25m high)	N/A
Platform has chains / self closing gates at top of ladders	N/A
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

Sampling Location / Platform Improvement Recommendations

Due to the nature of the access into the duct, it is not possible to conduct a full velocity profile, however no particulate phase sampling was required and all gaseous species were considered to be mixed sufficiently for the purposes of these tests. There is also no requirement to undertake a homogeneity test as per EN 15259 and as such the location cannot be compared against that or the criteria within TGN M1. The sampling location used in this instance has been approved for use by the Environment Agency.

EN 15259 Homogeneity Test Requirements

There is no requirement to perform a EN 15259 Homogeneity Test on this Stack.

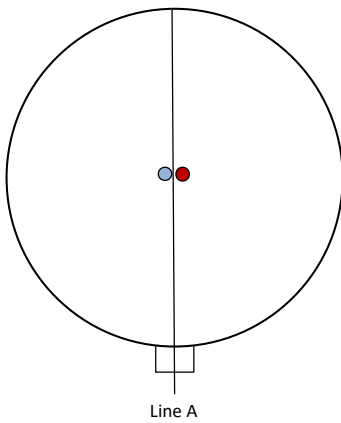
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PLANT PHOTOS

Photo 1



SAMPLE POINTS



- where** ○ = isokinetic point sampled at
 ● = isokinetic point not sampled at
 ● = combustion gases sample point
 ○ = non-isokinetic sample point

APPENDICES

APPENDIX CONTENTS

APPENDIX 1 - Stack Emissions Monitoring Personnel, List of Equipment & Methods and Technical Procedures Used

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

APPENDIX 1

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Darren Price	MCERTS Level 2	MM 03 176	TE1 TE2 TE3 TE4
Technician	Joshua Cunningham	MCERTS Level 1	MM 22 1704	-

LIST OF EQUIPMENT

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM (1)	-	Horiba PG-250	CAT 9.26	Digital Manometer (1)	-
Control Box DGM (2)	-	Horiba PG-250 SRM	-	Digital Manometer (2)	-
Box Thermocouples (1)	-	Servomex 5200 MP	-	Digital Temperature Meter	CAT 3.294
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	-
Umbilical (1)	-	ABB AO2020-URAS26	-	Barometer	-
Umbilical (2)	-	Testo 350 XL	-	Stack Thermocouple (1)	CAT 4.1676
Oven Box (1)	-	Signal 200SM	CAT 4.00168	Stack Thermocouple (2)	-
Oven Box (2)	-	Gasmet DX4000	-	Stack Thermocouple (3)	-
Heated Probe (1)	-	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	-	Signal 3010HM	CAT 8.50	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.168	1m Heated Line (3)	-
S-Pitot (1)	-	Mass Flow Controller (1)	-	5m Heated Line (1)	-
S-Pitot (2)	-	Mass Flow Controller (2)	-	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	CAT 25.106	20m Heated Line (1)	CAT 20.1023
Site Balance	CAT 17.82	Mass View (2)	CAT 25.107	20m Heated Line (2)	-
500g / 1Kg Check Weights	CAT 17.82	Squirrel 2020	CAT DL#04	Dual Channel Heater Controller	-
Last Impinger Arm	-	Easylogger EN-EL-12 Bit	-	Single Channel Heater Controller	CAT 20.1023
Callipers	-	Bioaerosols Temperature Logger	-	Laboratory Balance	-
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.144

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Water Vapour	EN 14790	CAT-TP-05
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20
Oxides of Nitrogen (as NO ₂)	EN 14792	CAT-TP-21
Carbon Monoxide	EN 15058	CAT-TP-21
Oxygen	EN 14789	CAT-TP-21

WATER VAPOUR: RESULTS SUMMARY

Enovert, Tir John Landfill Site
Jenbacher Engine

Sample Runs

Parameter	Units	Run 1	Mean
Concentration	% v/v	11.6	11.6
Uncertainty	±% v/v	0.51	0.51

General Sampling Information

Parameter	Value
Standard	EN 14790
Technical Procedure	CAT-TP-05

WATER VAPOUR: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1
Sampling Times	-	12:50 - 13:50
Sampling Dates	-	10/08/2024
Sampling Device	-	MFC / MV
Duration	mins	60
Volume Sampled (STP, Dry)	m ³	0.3520
Volume Sampled (STP, Wet)	m ³	0.3982
Sample Flow Rate	l/min	5.68
Liquid Trap Start Mass	g	2475.9
Liquid Trap End Mass	g	2501.4
Silica Trap Start Mass	g	919.8
Silica Trap End Mass	g	931.4
Total Mass Of Water Vapour	g	37.1
Calculated Water Vapour	% v/v	11.61

Where: MFC stands for Mass Flow Controller, MV stands for Mass View Flowmeter

WATER VAPOUR: QUALITY ASSURANCE

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	5.7	
Pre-Sampling Leak Rate	l/min	0.08	
Post-Sampling Leak Rate	l/min	0.08	
Allowable Leak Rate	l/min	0.11	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
Measurement Uncertainty	Units	Run 1	
Measurement Uncertainty (MU)	%	4.4	
Allowable MU	%	20.0	
MU Acceptable	%	Yes	
Silica Gel	Units	Run 1	
Less than 50% Faded	%	Yes	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	No	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	1	
There are no deviations associated with the sampling employed.	x	

WATER VAPOUR: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value		Standard uncertainty		
	Symbol	Run 1	Symbol	Units	Run 1
Sampled Volume (STP)	V _m	0.352	uV _m	m ³	0.007
Repeatability of Weighing	R _w	37.10	uR _w	g	0.12
Reading of Balance	R _b	37.10	uR _b	g	0.19
Leak	L	1.41		%	-

Measured Quantities	Uncertainty as a Percentage		Requirement of Standard
	Units	Run 1	
Sampled Volume (STP)	%	2.00	≤2%
Repeatability of Weighing	%	0.32	No Requirement
Reading of Balance	%	0.50	No Requirement
Leak	%	1.41	≤2%

Measured Quantities	Uncertainty in Measurement Units			Sensitivity Coefficient
	Symbol	Units	Run 1	
Sampled Volume (STP)	V _m	m ³	0.3520	32.98
Repeatability of Weighing	R _w	g	37.10	0.31
Reading of Balance	R _b	g	37.10	0.31
Leak	L	% v/v	0.09	1.00

Measured Quantities	Uncertainty in Result	
	Units	Run 1
Sampled Volume (STP)	% v/v	0.232
Repeatability of Weighing	% v/v	0.038
Reading of Balance	% v/v	0.058
Leak	% v/v	0.094

Parameter	Units	Run 1
Combined uncertainty	% v/v	0.26
Expanded uncertainty (95% confidence)	% v/v	0.51
Expanded uncertainty (95% confidence), estimated with Method Deviations	% v/v	0.51
Uncertainty if Water Droplets are present	% v/v	N/A
Reported Uncertainty	% v/v	0.51
Expanded uncertainty (95% confidence)	%	4.4
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	4.4
Uncertainty if Water Droplets are present	%	N/A
Reported Uncertainty	%	4.4

TOTAL VOCs (as CARBON): RESULTS SUMMARY

Enovert, Tir John Landfill Site
Jenbacher Engine

Sample Runs

Parameter	Units	Run 1	Mean
Concentration	mg/m ³	1384	1384
Uncertainty	±mg/m ³	65.5	65.5

General Sampling Information

Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Type	Propane In Synthetic Air (5 Grade)	
Span Gas Reference Number	12.0506	
Span Gas Expiry Date	19/01/2025	
Span Gas Start Pressure (bar)	5	
Gas Cylinder Concentration (ppm)	635	
Span Gas Set Point (ppm)	635.00	
Span Gas Uncertainty (%)	2	
Zero Gas Type	Synthetic Air (5 Grade)	
Number of Sampling Lines Used	1/1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1/1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

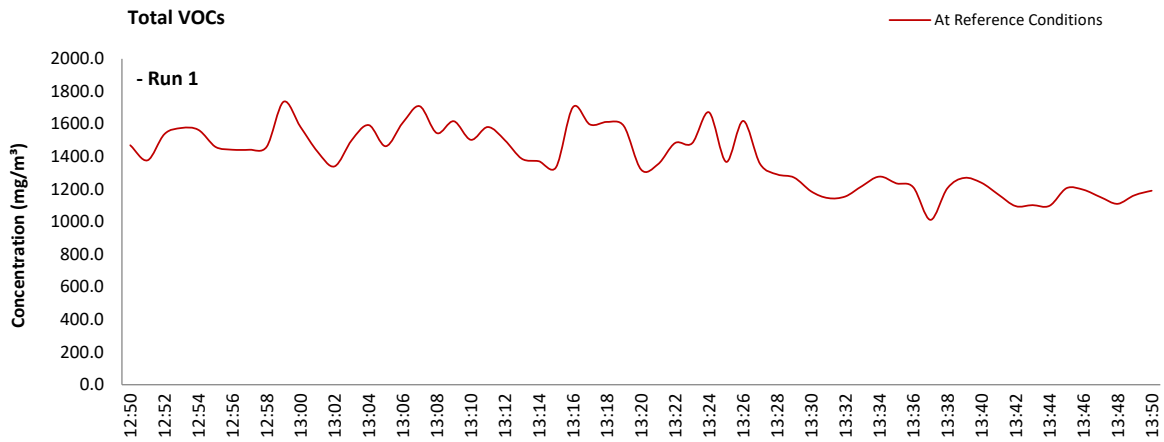
Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 5% oxygen.

APPENDIX 2

TOTAL VOCs (as CARBON): DATA TREND

Graphical Trend of Data



TOTAL VOCs (as CARBON): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1
Sampling Times	-	12:50 - 13:50
Sampling Dates	-	10/08/2023
Instrument Range	ppm	1000
Span Gas Value	ppm	635.0

Quality Assurance

Zero Drift		Units	Run 1
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.00
	Zero Down Sampling Line (Post)	ppm	0.00
	Zero Drift	ppm	0.00
	Zero Drift	%	0.00
	Drift Correction Applied	2-5%	No
	Allowable Zero Drift	± ppm	31.75
	Zero Drift Acceptable	-	Yes
Span Drift		Units	Run 1
CAL 1	Span Down Sampling Line (Pre)	ppm	637.00
	Span Down Sampling Line (Post)	ppm	615.00
	Span Drift	ppm	-22.00
	Span Drift	%	-3.45
	Drift Correction Applied	2-5%	Yes
	Allowable Span Drift	± ppm	31.75
	Span Drift Acceptable	-	Yes
Test Conditions		Units	Run 1
Run Ambient Temperature Range		°C	22 - 26

Method Deviations

Nature of Deviation	Run Number
(x = deviation applies to the associated run)	1
There are no deviations associated with the sampling employed.	x

TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1	Units
Limit value	1750.0	mg/m ³ (REF)
Allowable MU	15.0	%
Measured concentration	1243.55	mg/m ³ (STP, dry)
Range Used	1000.0	ppm
Range Used [A]	1606.1	mg/m ³
Cal gas conc.	635.0	ppm
Conversion	1.61	ppm to mg/m ³
MCERTS Range [B]	15.0	mg/m ³
Lower of [A] or [B]	15.0	mg/m ³
Cal gas conc.	1019.9	mg/m ³

Performance characteristics	RUN 1	Units
Response time	15	seconds
Number of readings in measurement	60	-
Repeatability at zero	0.15	% full scale
Repeatability at span level	0.80	% full scale
Deviation from linearity	0.10	% of value
Zero drift	0.00	% full scale
Span drift	0.00	% full scale
Volume or pressure flow dependence	2.00	% of full scale
Atmospheric pressure dependence	0.80	% of value/kPa
Ambient temperature dependence	1.00	% full scale/10K
Combined interference	1.20	% range
Dependence on voltage	0.10	% full scale/10V
Losses in the line (leak)	0.00	% of value
Uncertainty of calibration gas	2.00	% of value

Performance characteristic	RUN 1	Units
Standard deviation of repeatability at zero	use rep at span	mg/m ³
Standard deviation of repeatability at span level	0.10	mg/m ³
Lack of fit	0.01	mg/m ³
Drift	0.00	mg/m ³
Volume or pressure flow dependence	0.00	mg/m ³
Atmospheric pressure dependence	0.03	mg/m ³
Ambient temperature dependence	0.14	mg/m ³
Combined interference (from MCERTS Certificate)	0.10	mg/m ³
Dependence on voltage	0.01	mg/m ³
Losses in the line (leak)	0.00	mg/m ³
Uncertainty of calibration gas	14.36	mg/m ³

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		1243.55	mg/m ³
Expanded uncertainty	k = 1.96	14.36	mg/m ³
Expanded uncertainty		28.15	mg/m ³
Uncertainty corrected to std conds. (O ₂)		31.34	mg/m ³ (REF)

	RUN 1	Units
Expanded uncertainty (no O ₂) - at 95% Confidence	2.26	% of Value
Expanded uncertainty (no O ₂) - at 95% Confidence	1.61	% at ELV
Overall Allowable uncertainty (no O ₂) - at 95% Confidence	15.0	% at ELV
Result of Compliance with Uncertainty Requirement	N/A	-

	RUN 1	Units
Expanded uncertainty (with O ₂) - at 95% Confidence	4.73	% of Value
Expanded uncertainty (with O ₂) - at 95% Confidence	4.53	% at ELV
Overall Allowable uncertainty (with O ₂) - at 95% Confidence	15.6	% at ELV
Result of Compliance with Uncertainty Requirement	COMPLIANT	-

Requirement for SRM is that Uncertainty should be <15% of the value at the ELV, on a dry gas basis, or if O₂ correction is applied less than 15% + the uncertainty associated with the O₂ correction (using sqrt of sum squares to add uncertainty components).

OXIDES OF NITROGEN (as NO₂): RESULTS SUMMARY

Enovert, Tir John Landfill Site
Jenbacher Engine

Sample Runs

Parameter	Units	Run 1	Mean
Concentration	mg/m ³	198	198
Uncertainty	±mg/m ³	10.0	10.0

General Sampling Information

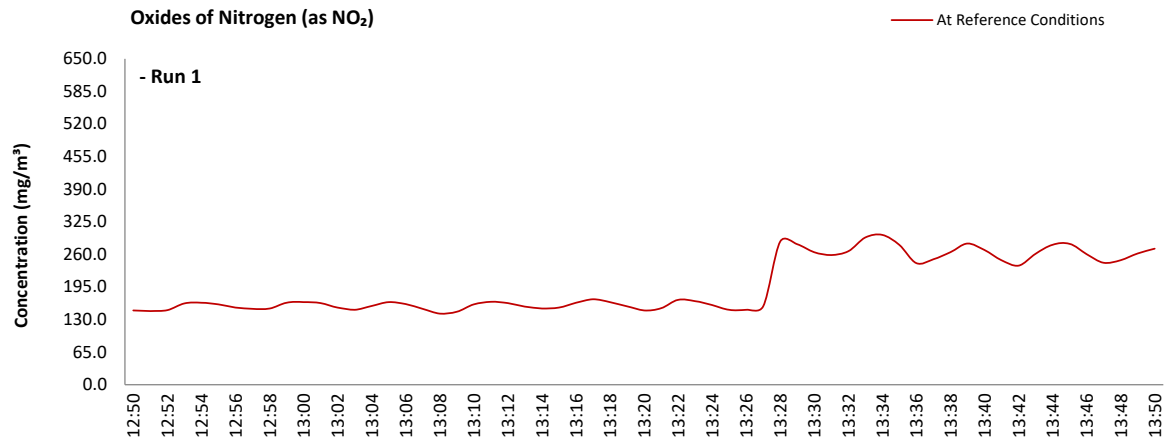
Parameter	Value	
Standard	EN 14792	
Technical Procedure	CAT-TP-21	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Date & Result of Last Converter Check	13/10/2022 - 95.5%	
Span Gas Type	Nitrogen Monoxide	
Span Gas Reference Number	12.0469	
Span Gas Expiry Date	21/09/2024	
Span Gas Start Pressure (bar)	10	
Gas Cylinder Concentration (ppm)	241.7	
Span Gas Uncertainty (%)	2	
Zero Gas Type	Nitrogen (5 Grade)	
Number of Sampling Lines Used	1/1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1/1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 5% oxygen.

OXIDES OF NITROGEN (as NO₂): DATA TREND

Graphical Trend of Data



APPENDIX 2

OXIDES OF NITROGEN (as NO₂): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1
Sampling Times	-	12:50 - 13:50
Sampling Dates	-	10/08/2023
Instrument Range	ppm	500
Span Gas Value	ppm	241.7

Quality Assurance

Conditioning Unit Temperature	Units	Run 1	
Average Temperature	°C	3.7	
Allowable Temperature	< °C	4.0	
Temperature Acceptable	-	Yes	
Zero Drift	Units	Run 1	
CAL 1	Zero at Analyser (Pre)	ppm	0.00
	Zero at Analyser (Post)	ppm	9.20
	Zero Drift	ppm	9.20
	Zero Drift	%	3.81
	Drift Correction Applied	2-5%	Yes
	Allowable Zero Drift	± %	5.00
	Zero Drift Acceptable	-	Yes
Span Drift	Units	Run 1	
CAL 1	Span at Analyser (Pre)	ppm	241.70
	Span at Analyser (Post)	ppm	244.00
	Span Drift	ppm	2.30
	Zero Adj. Span Drift	%	2.85
	Drift Correction Applied	2-5%	Yes
	Allowable Span Drift	± %	5.00
	Span Drift Acceptable	-	Yes
Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	22 - 26	

Method Deviations

Nature of Deviation	Run Number
(x = deviation applies to the associated run)	1
There are no deviations associated with the sampling employed.	x

OXIDES OF NITROGEN (as NO₂): MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1	Units
Limit value	650.0	mg/m ³ (REF)
Allowable MU	10.0	%
Measured concentration	177.96	mg/m ³ (STP, dry)
Ratio NO / NO ₂	5	%
Range Used	500.0	ppm
Range Used [A]	1026.1	mg/m ³
Cal gas conc.	241.7	ppm
Conversion	2.05	ppm to mg/m ³
MCERTS Range [B]	125.0	mg/m ³
Lower of [A] or [B]	125.0	mg/m ³
Cal gas conc.	496.0	mg/m ³

Performance characteristics	RUN 1	Units
Response time	60	seconds
Number of readings in measurement	60	-
Repeatability at zero	0.40	% full scale
Repeatability at span level	0.40	% full scale
Deviation from linearity	0.36	% of value
Zero drift	0.00	% full scale
Span drift	0.00	% full scale
Volume or pressure flow dependence	0.40	% of full scale
Atmospheric pressure dependence	0.30	% of value/kPa
Ambient temperature dependence	0.18	% full scale/10K
Combined interference	0.60	% range
Dependence on voltage	0.40	% full scale/10V
Converter efficiency	95.5	%
Losses in the line (leak)	0.00	% of value
Uncertainty of calibration gas blending	1.40	% of value
Uncertainty of calibration gas	2.00	% of value

Performance characteristic	RUN 1	Units
Standard deviation of repeatability at zero	use rep at span	mg/m ³
Standard deviation of repeatability at span level	0.05	mg/m ³
Lack of fit	0.26	mg/m ³
Drift	0.00	mg/m ³
Volume or pressure flow dependence	0.00	mg/m ³
Atmospheric pressure dependence	0.11	mg/m ³
Ambient temperature dependence	0.03	mg/m ³
Combined interference (from MCERTS Certificate)	0.43	mg/m ³
Dependence on voltage	0.05	mg/m ³
Converter efficiency	0.23	mg/m ³
Losses in the line (leak)	0.00	mg/m ³
Uncertainty of calibration gas blending	1.44	mg/m ³
Uncertainty of calibration gas	2.05	mg/m ³

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		177.96	mg/m ³
Expanded uncertainty		2.61	mg/m ³
Expanded uncertainty	k = 1.96	5.11	mg/m ³
Uncertainty corrected to std conds. (O ₂)		5.69	mg/m ³ (REF)

	RUN 1	Units
Expanded uncertainty (no O ₂) - at 95% Confidence	2.87	% of Value
Expanded uncertainty (no O ₂) - at 95% Confidence	0.79	% at ELV
Overall Allowable uncertainty (no O ₂) - at 95% Confidence	10.0	% at ELV
Result of Compliance with Uncertainty Requirement	N/A	-

	RUN 1	Units
Expanded uncertainty (with O ₂) - at 95% Confidence	5.05	% of Value
Expanded uncertainty (with O ₂) - at 95% Confidence	4.25	% at ELV
Overall Allowable uncertainty (with O ₂) - at 95% Confidence	10.8	% at ELV
Result of Compliance with Uncertainty Requirement	COMPLIANT	-

Requirement for SRM is that Uncertainty should be <10% of the value at the ELV, on a dry gas basis, or if O₂ correction is applied less than 10% + the uncertainty associated with the O₂ correction (using sqrt of sum squares to add uncertainty components).

APPENDIX 2

CARBON MONOXIDE: RESULTS SUMMARY

Enovert, Tir John Landfill Site
Jenbacher Engine

Sample Runs

Parameter	Units	Run 1	Mean
Concentration	mg/m ³	704	704
Uncertainty	±mg/m ³	35.2	35.2

General Sampling Information

Parameter	Value	
Standard	EN 15058	
Technical Procedure	CAT-TP-21	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Type	Carbon Monoxide	
Span Gas Reference Number	12.0469	
Span Gas Expiry Date	21/09/2024	
Span Gas Start Pressure (bar)	10	
Gas Cylinder Concentration (ppm)	1201.4	
Span Gas Uncertainty (%)	2	
Zero Gas Type	Nitrogen (5 Grade)	
Number of Sampling Lines Used	1/1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1/1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

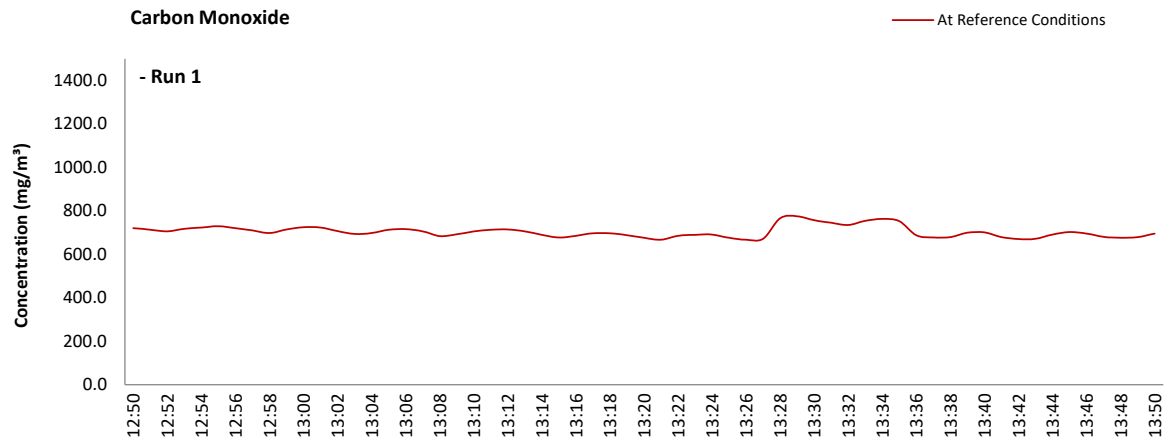
Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 5% oxygen.

APPENDIX 2

CARBON MONOXIDE: DATA TREND

Graphical Trend of Data



APPENDIX 2

CARBON MONOXIDE: SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1
Sampling Times	-	12:50 - 13:50
Sampling Dates	-	10/08/2023
Instrument Range	ppm	2000
Span Gas Value	ppm	1201.4

Quality Assurance

Conditioning Unit Temperature	Units	Run 1	
Average Temperature	°C	3.7	
Allowable Temperature	< °C	4.0	
Temperature Acceptable	-	Yes	
Zero Drift	Units	Run 1	
CAL 1	Zero at Analyser (Pre)	ppm	0.00
	Zero at Analyser (Post)	ppm	-1.00
	Zero Drift	ppm	-1.00
	Zero Drift	%	0.08
	Drift Correction Applied	2-5%	No
	Allowable Zero Drift	± %	5.00
	Zero Drift Acceptable	-	Yes
Span Drift	Units	Run 1	
CAL 1	Span at Analyser (Pre)	ppm	1201.00
	Span at Analyser (Post)	ppm	1157.00
	Span Drift	ppm	-44.00
	Zero Adj. Span Drift	%	3.58
	Drift Correction Applied	2-5%	Yes
	Allowable Span Drift	± %	5.00
	Span Drift Acceptable	-	Yes
Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	22 - 26	

Method Deviations

Nature of Deviation	Run Number
(x = deviation applies to the associated run)	1
There are no deviations associated with the sampling employed.	x

CARBON MONOXIDE: MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1	Units
Limit value	1500.0	mg/m ³ (REF)
Allowable MU	6.0	%
Measured concentration	632.37	mg/m ³ (STP, dry)
Range Used	2000.0	ppm
Range Used [A]	2498.4	mg/m ³
Cal gas conc.	1201.4	ppm
Conversion	1.25	ppm to mg/m ³
MCERTS Range [B]	95.0	mg/m ³
Lower of [A] or [B]	95.0	mg/m ³
Cal gas conc.	1500.8	mg/m ³

Performance characteristics	RUN 1	Units
Response time	60	seconds
Number of readings in measurement	60	-
Repeatability at zero	0.40	% full scale
Repeatability at span level	0.40	% full scale
Deviation from linearity	0.36	% of value
Zero drift	-0.08	% full scale
Span drift	0.00	% full scale
Volume or pressure flow dependence	0.40	% of full scale
Atmospheric pressure dependence	0.30	% of value/kPa
Ambient temperature dependence	0.05	% full scale/10K
Combined interference	0.73	% range
Dependence on voltage	0.40	% full scale/10V
Losses in the line (leak)	0.00	% of value
Uncertainty of calibration gas blending	1.40	% of value
Uncertainty of calibration gas	2.00	% of value

Performance characteristic	RUN 1	Units
Standard deviation of repeatability at zero	use rep at span	mg/m ³
Standard deviation of repeatability at span level	0.05	mg/m ³
Lack of fit	0.20	mg/m ³
Drift	0.00	mg/m ³
Volume or pressure flow dependence	0.00	mg/m ³
Atmospheric pressure dependence	0.08	mg/m ³
Ambient temperature dependence	0.01	mg/m ³
Combined interference (from MCERTS Certificate)	0.40	mg/m ³
Dependence on voltage	0.05	mg/m ³
Losses in the line (leak)	0.00	mg/m ³
Uncertainty of calibration gas blending	5.11	mg/m ³
Uncertainty of calibration gas	7.30	mg/m ³

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		632.37	mg/m ³
Expanded uncertainty		8.93	mg/m ³
Expanded uncertainty	k = 1.96	17.51	mg/m ³
Uncertainty corrected to std conds. (O ₂)		19.49	mg/m ³ (REF)

	RUN 1	Units
Expanded uncertainty (no O ₂) - at 95% Confidence	2.77	% of Value
Expanded uncertainty (no O ₂) - at 95% Confidence	1.17	% at ELV
Overall Allowable uncertainty (no O ₂) - at 95% Confidence	6.0	% at ELV
Result of Compliance with Uncertainty Requirement	N/A	-

	RUN 1	Units
Expanded uncertainty (with O ₂) - at 95% Confidence	4.99	% of Value
Expanded uncertainty (with O ₂) - at 95% Confidence	4.36	% at ELV
Overall Allowable uncertainty (with O ₂) - at 95% Confidence	7.3	% at ELV
Result of Compliance with Uncertainty Requirement	COMPLIANT	-

Requirement for SRM is that Uncertainty should be <6% of the value at the ELV, on a dry gas basis, or if O₂ correction is applied less than 6% + the uncertainty associated with the O₂ correction (using sqrt of sum squares to add uncertainty components).

APPENDIX 2

OXYGEN: RESULTS SUMMARY

Enovert, Tir John Landfill Site
Jenbacher Engine

Sample Runs

Parameter	Units	Run 1	Mean
Concentration	% v/v	6.6	6.6
Uncertainty	±% v/v	0.28	0.28

General Sampling Information

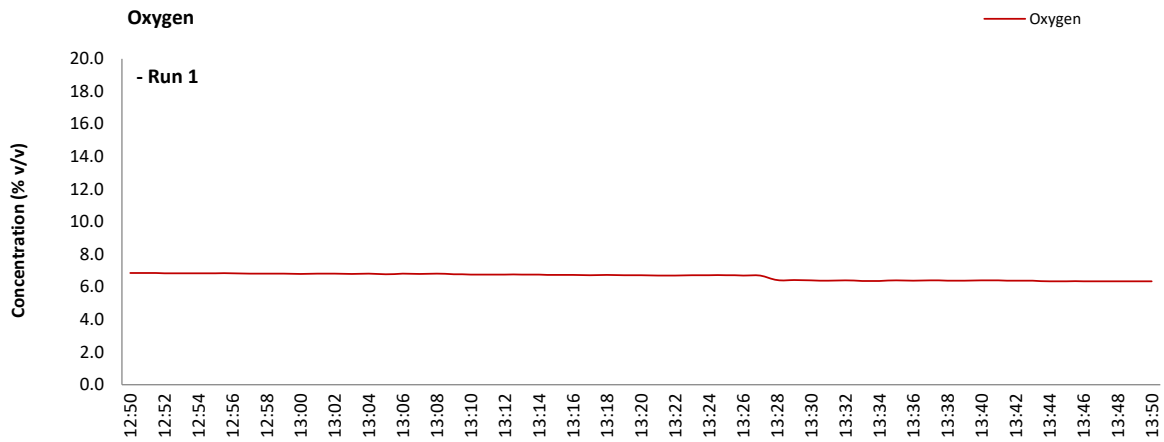
Parameter	Value
Standard	EN 14789
Technical Procedure	CAT-TP-21
Probe Material	Stainless Steel
Filtration Type / Size	0.1µm Glass Fibre
Heated Head Filter Used	Yes
Heated Line Temperature	180°C
Span Gas Type	Synthetic Air (5 Grade)
Span Gas Reference Number	SELECT
Span Gas Expiry Date	12/01/1900
Span Gas Start Pressure (bar)	SELECT
Gas Cylinder Concentration (% v/v)	8.39
Span Gas Uncertainty (%)	2
Zero Gas Type	Nitrogen (5 Grade)
Number of Sampling Lines Used	1/1
Number of Sampling Points Used	1/1
Sample Point I.D.'s	A1

FORMAT: Number Used / Number Required
FORMAT: Number Used / Number Required

APPENDIX 2

OXYGEN: DATA TREND

Graphical Trend of Data



APPENDIX 2

OXYGEN: SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1
Sampling Times	-	12:50 - 13:50
Sampling Dates	-	10/08/2023
Instrument Range	% v/v	25.0
Span Gas Value	% v/v	8.4

Quality Assurance

Conditioning Unit Temperature	Units	Run 1	
Average Temperature	°C	3.7	
Allowable Temperature	< °C	4.0	
Temperature Acceptable	-	Yes	
Zero Drift	Units	Run 1	
CAL 1	Zero at Analyser (Pre)	% v/v	0.00
	Zero at Analyser (Post)	% v/v	0.05
	Zero Drift	% v/v	0.05
	Zero Drift	%	0.60
	Drift Correction Applied	2-5%	No
	Allowable Zero Drift	± %	5.00
	Zero Drift Acceptable	-	Yes
Span Drift	Units	Run 1	
CAL 1	Span at Analyser (Pre)	% v/v	8.27
	Span at Analyser (Post)	% v/v	8.60
	Span Drift	% v/v	0.33
	Zero Adj. Span Drift	%	3.34
	Drift Correction Applied	2-5%	Yes
	Allowable Span Drift	± %	5.00
	Span Drift Acceptable	-	Yes
Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	22 - 26	

Method Deviations

Nature of Deviation	Run Number
(x = deviation applies to the associated run)	1
There are no deviations associated with the sampling employed.	x

OXYGEN: MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1	Units
Limit value	N/A	%vol
Allowable MU	6.0	%
Measured concentration	6.63	%vol
Range Used	25.0	%vol
Cal gas conc.	8.4	%vol

Performance characteristics	RUN 1	Units
Response time	60	seconds
Number of readings in measurement	60	-
Repeatability at zero	0.04	% full scale
Repeatability at span level	0.04	% full scale
Deviation from linearity	0.10	% of value
Zero drift	0.60	% full scale
Span drift	0.00	% full scale
Volume or pressure flow dependence	0.20	% of full scale
Atmospheric pressure dependence	0.30	% of value/kPa
Ambient temperature dependence	-0.07	% full scale/10K
Combined interference	0.56	% range
Dependence on voltage	0.02	% full scale/10V
Losses in the line (leak)	0.12	% of value
Uncertainty of calibration gas	2.00	% of value

Performance characteristic	RUN 1	Units
Standard deviation of repeatability at zero	use rep at span	%vol
Standard deviation of repeatability at span level	0.01	%vol
Lack of fit	0.01	%vol
Drift	0.00	%vol
Volume or pressure flow dependence	0.00	%vol
Atmospheric pressure dependence	0.02	%vol
Ambient temperature dependence	-0.01	%vol
Combined interference (from MCERTS Certificate)	0.08	%vol
Dependence on voltage	0.00	%vol
Losses in the line (leak)	0.00	%vol
Uncertainty of calibration gas	0.08	%vol

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		6.63	%vol
Expanded uncertainty	k = 1.96	0.28	%vol

	RUN 1	Units
Expanded uncertainty (no O ₂) - at 95% Confidence	4.16	% of Value
Result of Compliance with Uncertainty Requirement	COMPLIANT	-

Requirement for SRM is that Uncertainty should be 0.3% vol absolute or 6% relative whichever is the lower, on a dry gas basis. Source, EN 14789.

VERSION HISTORY

Version Number	Record of changes made within this version of the document
V1	The original document issued to the client