

STACK EMISSIONS MONITORING REPORT



Unit E Broadheath Network Centre
Atlantic Street, Altrincham
Cheshire
WA14 5EW
Tel: 0161 443 0980

Operator & Address:	
Jaguar Land Rover Halewood Liverpool L24 9BJ	
Permit Reference:	
EPR Permit: A2/0703/6.4/1	
Release Point:	
Recuperative RTO	
Sampling Date(s):	
19th November 2024	
SOCOTEC Job Number:	LNO 18976
Report Date:	13th December 2024
Version:	1
Report By:	Lawrence Mason
MCERTS Number:	MM 07 849
MCERTS Level:	MCERTS Level 2 - Team Leader
Technical Endorsements:	1, 2, 3 & 4
Report Approved By:	Johnathon Orley
MCERTS Number:	MM 08 983
Business Title:	MCERTS Level 2 - Team Leader
Technical Endorsements:	1, 2, 3 & 4
Signature:	



1015



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EXECUTIVE SUMMARY

MONITORING OBJECTIVES

Jaguar Land Rover operates a thermal oxidiser process at Halewood which is subject to EPR Permit A2/0703/6.4/1, under the Environmental Permitting Regulations 2016.

SOCOTEC UK LTD were commissioned by Jaguar Land Rover to carry out stack emissions monitoring to determine the release of prescribed pollutants from the following Plant under normal operating conditions.

The results of these tests shall be used to demonstrate compliance with a set of emission limit values for prescribed pollutants as specified in the Plant's EPR Permit, A2/0703/6.4/1.

Plant

Recuperative RTO

Operator

Jaguar Land Rover
Halewood
Liverpool
L24 9BJ

EPR Permit: A2/0703/6.4/1

Stack Emissions Monitoring Test House

SOCOTEC UK LTD- Altrincham Laboratory
Unit E Broadheath Network Centre
Atlantic Street, Altrincham
Cheshire
WA14 5EW
UKAS and MCERTS Accreditation Number: 1015

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

The results of this testing relate only to the emission release point(s) listed in the report.

MCERTS accredited results will only be claimed where both the sampling and analytical stages are MCERTS accredited.

This test report shall not be reproduced, except in full, without written approval of SOCOTEC UK LTD.

EXECUTIVE SUMMARY

EMISSIONS SUMMARY					
Parameter	Units	Result	Calculated Uncertainty +/-	Emission Limit Value (ELV)	Accreditation
Total Particulate Matter	mg/m ³	0.15	0.31	50	MCERTS
Particulate Emission Rate	g/hr	2.4	4.7	-	
Total Volatile Organic Compounds	mg/m ³	16	1.3	50	MCERTS
Total Volatile Organic Compounds Emission Rate	g/hr	248	20	-	
Oxides of Nitrogen (as NO ₂)	mg/m ³	83	2.5	100	MCERTS
Oxides of Nitrogen (as NO ₂) Emission Rate	g/hr	1268	38	-	
Carbon Monoxide	mg/m ³	16	1.9	100	MCERTS
Carbon Monoxide Emission Rate	g/hr	238	30	-	
Oxygen	% v/v	19.3	0.26	-	MCERTS
Moisture	%	1.54	0.05	-	MCERTS
Stack Gas Temperature	°C	275	-	-	MCERTS
Stack Gas Velocity	m/s	11.0	0.28	-	
Gas Volumetric Flow Rate (Actual)	m ³ /hr	30969	1608	-	
Gas Volumetric Flow Rate (STP, Wet)	m ³ /hr	15352	797	-	
Gas Volumetric Flow Rate (STP, Dry)	m ³ /hr	15116	785	-	
Gas Volumetric Flow Rate at Reference Conditions	m ³ /hr	15352	797	-	

ND = None Detected,

Results at or below the limit of detection are highlighted by bold italic text.

The above volumetric flow rate is calculated using data from the preliminary survey. Mass emissions for non isokinetic tests are calculated using these values. For all isokinetic testing the mass emission is calculated using test specific flow data and not the above values.

Reference conditions are 273K, 101.3kPa without correction for water vapour

EXECUTIVE SUMMARY

MONITORING TIMES			
Parameter	Sampling Date(s)	Sampling Times	Sampling Duration
Total Particulate Matter Run 1	19 November 2024	10:30 - 11:31	60 minutes
Total Volatile Organic Compounds Run 1	19 November 2024	10:30 - 11:30	60 minutes
Combustion Gases	19 November 2024	10:30 - 11:30	60 minutes
Preliminary Stack Traverse	19 November 2024	09:40	-

EXECUTIVE SUMMARY

PROCESS DETAILS	
Parameter	Process Details
Description of process	Thermal Oxidiser
Continuous or batch	Continuous
Product Details	Paint
Part of batch to be monitored (if applicable)	N/A
Normal load, throughput or continuous rating	Normal load
Fuel used during monitoring	Natural gas
Abatement	Thermal oxidiser
Plume Appearance	None visible

EXECUTIVE SUMMARY

Monitoring Methods

The selection of standard reference / alternative methods employed by SOCOTEC is determined, wherever possible by the hierarchy of method selection outlined in Environment Agency technical Guidance 'Monitoring stack emissions: techniques and standards for periodic monitoring'.

MONITORING METHODS							
Species	Method Standard Reference Method / Alternative Method	SOCOTEC Technical Procedure	UKAS Lab Number	Method Accreditation	Limit of Detection (LOD)	Calculated MU +/- % Result	Calculated MU +/- % ELV
Total Particulate Matter	SRM - BS EN 13284-1	AE 104	1015	MCERTS	0.15 mg/m ³	200%	0.62%
Total Volatile Organic Compounds	SRM - BS EN 12619:2013	AE 102	1015	MCERTS	0.06 mg/m ³	8.2%	2.6%
Oxides of Nitrogen	SRM - BS EN 14792:2017	AE 102	1015	MCERTS	0.2 mg/m ³	3.0%	2.5%
Carbon Monoxide	SRM - BS EN 15058:2017	AE 102	1015	MCERTS	0.27 mg/m ³	12%	1.9%
Oxygen	SRM - BS EN 14789:2017	AE 102	1015	MCERTS	0.01%	1.3%	N/A - No ELV
Moisture	BS EN 14790	AE 105	1015	MCERTS	0.01%	3.0%	N/A - No ELV
Velocity	SRM - EN ISO 16911-1	AE 154	1015	MCERTS	5 Pa	2.5%	N/A - No ELV
Volumetric Flow Rate	SRM - EN ISO 16911-1	AE 154	1015	MCERTS	-	5.2%	N/A - No ELV

BS EN 14790 has been validated over a range of 4 - 40%. It is however the preferred method of the Environment Agency for concentrations below 4%

EXECUTIVE SUMMARY

Analytical Methods

The following tables list the analytical methods employed together with the custody details. Unless otherwise stated the samples are archived at the analysis lab location.

SAMPLING METHODS WITH SUBSEQUENT ANALYSIS							
Species	Analytical Technique	Analytical Procedure	UKAS Lab Number	Analysis Accreditation	Analysis Lab	Analysis Report No. Date of Analysis	Archive Period
Total Particulate Matter	Gravimetric	AE 106	1015	MCERTS	SOCOTEC (Altrincham)	N/A	8 Weeks

ON-SITE TESTING							
Species	Analytical Technique	Analytical Procedure	UKAS Lab Number	Accreditation	Laboratory	Data Archive Location	Archive Period
Total Volatile Organic Compounds	Flame Ionisation Detection	AE 102	1015	MCERTS	SOCOTEC (Altrincham)	SOCOTEC (Altrincham)	5 years
Oxides of Nitrogen	Chemiluminescence	AE 102	1015	MCERTS	SOCOTEC (Altrincham)	SOCOTEC (Altrincham)	5 years
Carbon Monoxide	Non Dispersive Infra Red	AE 102	1015	MCERTS	SOCOTEC (Altrincham)	SOCOTEC (Altrincham)	5 years
Oxygen	Paramagnetism	AE 102	1015	MCERTS	SOCOTEC (Altrincham)	SOCOTEC (Altrincham)	5 years
Moisture	Gravimetric	AE 105	1015	MCERTS	SOCOTEC (Altrincham)	-	-

EXECUTIVE SUMMARY

SAMPLING LOCATION					
Sampling Plane Validation Criteria	Value	Units	Requirement	Compliant	Method
Lowest Differential Pressure	57	Pa	≥ 5 Pa	Yes	BS EN 15259
Lowest Gas Velocity	10.7	m/s	-	-	-
Highest Gas Velocity	11.1	m/s	-	-	-
Ratio of Gas Velocities	1.0	: 1	$< 3 : 1$	Yes	BS EN 15259
Mean Velocity	11.0	m/s	-	-	-
Maximum angle of flow with regard to duct axis	< 15	$^{\circ}$	$< 15^{\circ}$	Yes	BS EN 15259
No local negative flow	Yes	-	-	Yes	BS EN 15259

DUCT CHARACTERISTICS		
	Value	Units
Shape	Circular	-
Depth	1.00	m
Width	-	m
Area	0.79	m ²
Port Depth	90	mm

SAMPLING LINES & POINTS		
	Isokinetic	Non-Iso & Gases
Sample port size	4 inch BSP	4 inch BSP
Number of lines used	2	1
Number of points / line	2	1
Duct orientation	Vertical	Vertical
Filtration	-	Out stack
Filtration for TPM	In Stack	-

SAMPLING PLATFORM	
General Platform Information	
Permanent / Temporary Platform / Ground level / Floor Level / Roof	Roof
Inside / Outside	Outside

EA Guidance, Monitoring stack emissions: measurement locations.	
Is there a sufficient working area so work can be performed in a compliant manner	Yes
Platform has 2 levels of handrails (approximately 0.5 m & 1.0 m high)	Yes
Platform has vertical base boards (approximately 0.25 m high)	Yes
Platform has removable chains / self closing gates at the top of ladders	N/A
Handrail / obstructions do not hamper insertion of sampling equipment	Yes
Depth of Platform = $>$ Stack depth / diameter + wall and port thickness + 1.5m	Yes

Sampling Platform Improvement Recommendations (if applicable)

The sampling location meets all the requirements specified in EA Guidance, Monitoring stack emissions: measurement locations.

EXECUTIVE SUMMARY

Sampling & Analytical Method Deviations

In this instance there were no deviations from the sampling and analytical methods employed.

APPENDICES

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APPENDIX 1 - Monitoring Schedule, Calibration Checklist & Monitoring Team

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

APPENDIX 3 - Measurement Uncertainty Budget Calculations

APPENDIX 1 - Monitoring Schedule, Calibration Checklist & Monitoring Team

MONITORING SCHEDULE					
Species	Method Standard Reference Method / Alternative Method	SOCOTEC Technical Procedure	UKAS Lab Number	MCERTS Accredited Method	Number of Samples
Total Particulate Matter	SRM - BS EN 13284-1	AE 104	1015	MCERTS	1
Total Volatile Organic Compounds	SRM - BS EN 12619:2013	AE 102	1015	MCERTS	1
Oxides of Nitrogen	SRM - BS EN 14792:2017	AE 102	1015	MCERTS	1
Carbon Monoxide	SRM - BS EN 15058:2017	AE 102	1015	MCERTS	1
Oxygen	SRM - BS EN 14789:2017	AE 102	1015	MCERTS	1
Moisture	BS EN 14790	AE 105	1015	MCERTS	1
Velocity	SRM - EN ISO 16911-1	AE 154	1015	MCERTS	1

APPENDIX 1 - Monitoring Schedule, Calibration Checklist & Monitoring Team

CALIBRATEABLE EQUIPMENT CHECKLIST					
Extractive Sampling		Instrumental Analyser/s		Miscellaneous	
Equipment	Equipment I.D.	Equipment	Equipment I.D.	Equipment	Equipment I.D.
Control Box DGM	LNO 13-22	Horiba PG - 350E Analyser	LNO 21-44	Laboratory Balance	LNO 00-13, 00-33
Box Thermocouples	LNO 03-22	FT-IR	-	Tape Measure	LNO 24-LM
Meter In Thermocouple	LNO 03-22	FT-IR Oven Box	-	Stopwatch	-
Meter Out Thermocouple	LNO 03-22	Bernath 3006 FID	-	Protractor	-
Control Box Timer	LNO 17-22	Signal 3030 FID	-	Barometer	LNO 08-LM
Oven Box	-	Servomex	-	Digital Micromanometer	-
Probe	LNO 11-32	JCT Heated Head Filter	-	Digital Temperature Meter	-
Probe Thermocouple	LNO 10-32	Thermo FID	LNO 21-19	Stack Thermocouple	-
Probe	-	Stackmaster	-	Mass Flow Controller	-
Probe Thermocouple	-	FTIR Heater Box for Heated Line	-	MFC Display module	-
S-Pitot	LNO 06-LM	Anemometer	-	1m Heated Line (1)	-
L-Pitot	-	Ecophysics NOx Analyser	-	1m Heated Line (2)	-
Site Balance	LNO 14-LM	Chiller (JCT/MAK 10)	LNO 21-104	1m Heated Line (3)	-
Last Impinger Arm	-	Heated Line Controller (1)	LNO 03-56	5m Heated Line (1)	-
Dioxins Cond. Thermocouple	-	Heated Line Controller (2)	-	10m Heated Line (1)	-
Callipers	LNO 31-LM	Site temperature Logger	-	10m Heated Line (2)	-
Small DGM	-			15m Heated Line (1)	-
Heater Controller	-			20m Heated Line (1)	LNO 18-136
Inclinometer (Swirl Device)	LNO 23-LM			20m Heated Line (2)	-

NOTE: If the equipment I.D is represented by a dash (-), then this piece of equipment has not been used for this test.

CALIBRATION GASES					
Gas (traceable to ISO 17025)	Cylinder I.D Number	Supplier	ppm	%	Analytical Tolerance +/- %
Oxygen	Fresh Air	BOC	-	20.9	2.0
Propane	HPC 2226	BOC	10.09	-	2.0
Nitric Oxide	HPC 2325	BOC	79.4	-	2.0
Carbon Monoxide	HPC_LNO_4	BOC	81.9	-	2.0

STACK EMISSIONS MONITORING TEAM

MONITORING TEAM								
Personnel	MCERTS Number	MCERTS		TE / H&S Qualifications and Expiry Date				
		Level	Expiry	TE1	TE2	TE3	TE4	H&S
Lawrence Mason	MM 07 849	MCERTS Level 2	Sep-25	Jun-28	Dec-25	Sep-26	Sep-25	Jun-27
Joe Stephens	MM 24 1838	MCERTS Trainee	Mar-29	-	-	-	-	Mar-29

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

TOTAL PARTICULATE MATTER SUMMARY					
Parameter	Sampling Times	Concentration mg/m ³	Uncertainty mg/m ³	ELV mg/m ³	Emission Rate g/hr
Run 1	10:30 - 11:31 19 November 2024	0.15	0.31	50	2.4
Blank	-	0.58	-	-	-

Reference conditions are 273K, 101.3kPa without correction for water vapour

Acetone Blank Value mg/l	Acceptable Value mg/l
0.3	1.0

FILTER INFORMATION

SAMPLES								
Test	Filter & Probe Rinse Number	Filter Start Weight	Filter End Weight	Mass Gained on Filter	Probe Rinse Start Weight	Probe Rinse End Weight	Mass Gained on Probe	Combined Total Mass Gained
		g	g	g	g	g	g	g
Run 1	G6797	0.10809	0.09731	-0.01078	74.27310	74.27850	0.00540	0.00020

If total mass gained is less than the LOD then the LOD is reported

BLANKS								
Test	Filter & Probe Number	Filter Start Weight	Filter End Weight	Mass Gained Filter	Probe Start Weight	Probe End Weight	Mass Gained Probe	Combined Total Mass Gained
		g	g	g	g	g	g	g
Run 1	G6796	0.10827	0.10832	0.00005	74.42230	74.42300	0.00070	0.00075

If total mass gained is less than the LOD then the LOD is reported

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

ISOKINETIC SAMPLING EQUATIONS - RUN 1				TPM
Absolute pressure of stack gas, P_s			Molecular weight of dry gas, M_d	
Barometric pressure, P _b	Kpa	100.7	CO ₂	% 0.98
Stack static pressure, P _{static}	pa	100.0	O ₂	% 19.30
P _s = P _b + P _{static}	Kpa	100.8	Total	% 20.28
			N ₂ (100 - Total)	% 79.72
Vol. of water vapour collected, V_{wstd}			M _d = 0.44(%CO ₂)+0.32(%O ₂)+0.28(%N ₂)	28.93
Moisture trap weight increase, V _{lc}	g	16.0	Molecular weight of wet gas, M_s	
V _{wstd} = (0.001246)(V _{lc})	m ³	0.019936	M _s = M _d (1 - B _{wo}) + 18(B _{wo})	g/gmol 28.76
Volume of gas metered dry, V_{mstd}			Actual flow of stack gas, Q_a	
Volume of gas sample through gas meter, V _m		1.213	Area of stack, A _s	m ² 0.79
Gas meter correction factor, Y _d		1.084	Q _s = (60)(A _s)(V _s)	m ³ /min 517.1
Mean dry gas meter temperature, T _m		281	Total flow of stack gas, Q	
Mean pressure drop across orifice, DH mmH ₂ O		38.029	Conversion factor (K/mm.Hg)	0.3592
V _{mstd} = $\frac{(0.3592)(V_m)(P_b + (DH/13.6))(Y_d)}{T_m}$	m ³	1.275	Q _{std} = $\frac{(Q_a)P_s(0.3592)(1-B_{wo})}{(T_s)}$	Dry 252.1
Volume of gas metered wet, V_{mstw}			Q _{stdO2} = $\frac{(Q_a)P_s(0.3592)(1-B_{wo})(O_2REF)}{(T_s)}$	@O ₂ ref No O2 Ref
V _{mstw} = V _{mstd} + V _{wstd}	m ³	1.2946	Q _{stw} = $\frac{(Q_a)P_s(0.3592)}{(T_s)}$	Wet 256.04
Vol. of gas metered at O₂ Ref. Cond., V_{mstd@X%O2}			Percent isokinetic, %I	
Is the process burning hazardous waste? (If yes, no favourable oxygen correction)	No		Nozzle diameter, D _n	mm 8.89
% oxygen measured in gas stream, act%O ₂	19.3		Nozzle area, A _n	mm ² 62.13
% oxygen reference condition	21		Total sampling time, q	min 60
O ₂ Reference O ₂ Ref = 21.0 - act%O ₂	No O2 Ref		%I = $\frac{(4.6398E6)(T_s)(V_{mstd})}{(P_s)(V_s)(A_n)(q)(1-B_{wo})}$	% 106.5
Factor 21.0 - ref%O ₂	No O2 Ref		Acceptable isokinetic range 95% to 115%	Yes
V _{mstd@X%oxygen} = (V _{mstd}) (O ₂ Ref)	m ³	No O2 Ref	Particulate Concentration, C	
Moisture content, B_{wo}			Mass collected on filter, M _f	g -0.01078
B _{wo} = $\frac{V_{wstd}}{V_{mstd} + V_{wstd}}$	%	0.0154	Mass collected in probe, M _p	g 0.00540
		1.54	Total mass collected, M _n	g 0.00020
Moisture by FTIR	%	-	C _{wet} = $\frac{M_n}{V_{mstw}}$	mg/m ³ 0.154
Velocity of stack gas, V_s			C _{dry} = $\frac{M_n}{V_{mstd}}$	mg/m ³ 0.157
Velocity pressure coefficient, C _p		0.80	C _{dry@X%O2} = $\frac{M_n}{V_{mstd@X\%oxygen}}$	mg/m ³ No O2 Ref
Mean of velocity heads, DP _{avg}	Pa	59.21	Particulate Emission Rates, E	
Mean stack gas temperature, T _s	K	548	E = $\frac{[(C_{wet})(Q_{stw})(60)]}{1000}$	2.37
Gas density (wet, ambient), p	kg/m ³	0.636		
p = (M _s *P _s)/(8.314*T _s)				
Stack Velocity, V _s = $\frac{\sum_{i=1}^n V_i}{n}$	m/s	10.97		

As the total mass gained was less than the LOD, the LOD has been reported

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

TOTAL PARTICULATE MATTER QUALITY ASSURANCE CHECKLIST

LEAK RATE						
Run	Mean Sampling Rate litre/min	Pre-sampling Leak Rate litre/min	Post-sampling Leak Rate litre/min	Maximum Vacuum mm Hg	Acceptable Leak Rate litre/min	Leak Tests Acceptable?
Run 1	21.90	0.13	-	-381	0.44	Yes

In BS EN 13284-1:2017 a post sampling leak check is not required.

ISOKINETICITY		
Run	Isokinetic Variation %	Acceptable Isokineticity
Run 1	106.55	Yes

Acceptable isokinetic range 95% to 115%

WEIGHING BALANCE UNCERTAINTY			
Run	Result mg/m ³	5% ELV mg/m ³	LOD < 5% ELV
Run 1	0.15	2.5	Yes

The above is based on both the Filter and rinse uncertainty

BLANK VALUE				
Run	Overall Blank Value mg/m ³	Daily Emission Limit Value mg/m ³	Acceptable Blank Value mg/m ³	Overall Blank Acceptable mg/m ³
Blank 1	0.58	50	5.0	Yes

FILTERS					
Run	Filter Material	Filter Size mm	Max Filtration Temperature °C	Pre-use Filter Conditioning Temperature °C	Post-use Filter Conditioning Temperature °C
Run 1	Glass Fibre	47	276	180	160

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

TOTAL VOLATILE ORGANIC COMPOUNDS SUMMARY

Test	Sampling Times	Concentration mg/m³	LOD mg/m³	ELV mg/m³	Emission Rate g/hr
Run 1	10:30 - 11:30 19 November 2024	16	0.06	50	248

Reference conditions are 273K, 101.3kPa without correction for water vapour

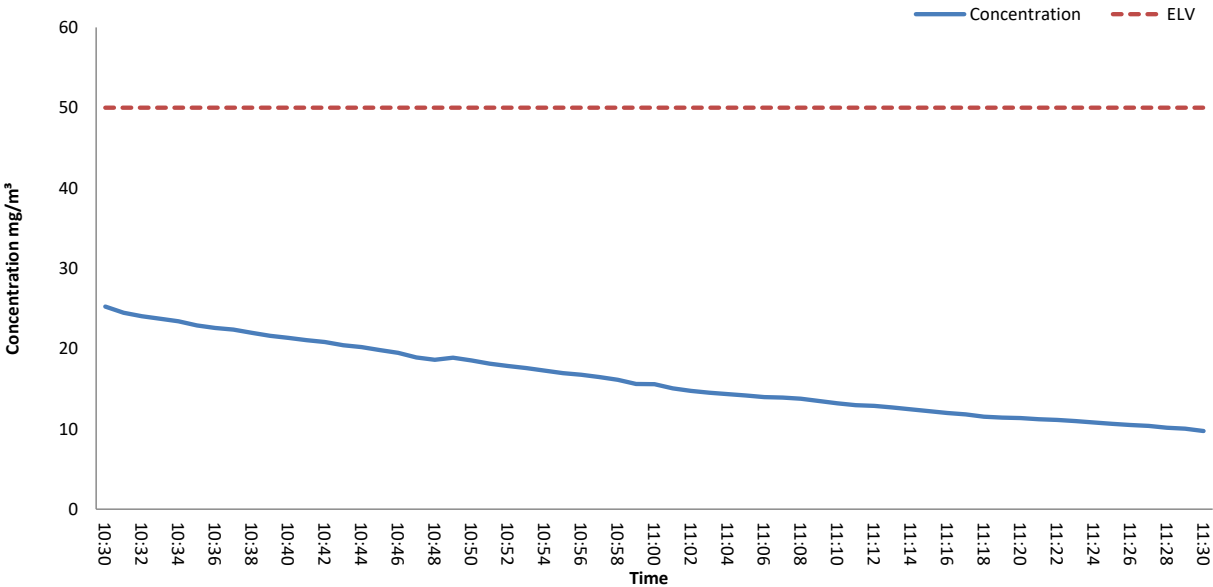
INSTRUMENTAL SPAN & ZERO CHECKS

PRE-SAMPLING CALIBRATION CHECKS								
Date	19 November 2024							
Start Time	10:00							
End Time	10:15							
Gas	Gas Conc (ppm)	Range	Instrument Zero Reading	Instrument Span Reading	Instrument Zero Reading	Zero Down line reading	Span down line reading	Leak Rate (%)
Propane	10.1	100	0.20	10.1	0.20	0.10	10.0	0.89

Zero and Span gas contained 10% Oxygen

POST-SAMPLING CALIBRATION CHECKS								
Date	19 November 2024							
Start Time	11:33							
End Time	11:40							
Gas	Mean Raw Value ppm	Zero down line reading	Span down line reading	Zero Drift (%)	Span Drift (%)	Corrected for Zero Drift	Corrected for Span Drift	Corrected Values ppm / %
Propane	10.06	0.10	10.0	0.00	0.00	x	x	N/A - not corrected

TOTAL VOLATILE ORGANIC COMPOUNDS EMISSIONS CHART



Reference conditions are 273K, 101.3kPa without correction for water vapour

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

COMBUSTION GASES SUMMARY

Test	Sampling Time and Date	Concentration mg/m ³	LOD mg/m ³	ELV mg/m ³	Emission Rate g/hr
Oxides of Nitrogen	10:30 - 11:30 19 November 2024	83	0.20	100	1268
Carbon Monoxide	10:30 - 11:30 19 November 2024	16	0.27	100	238

Test	Sampling Time and Date	Concentration %	LOD %
Oxygen	10:30 - 11:30 19 November 2024	19.4	0.01

Reference conditions are 273K, 101.3kPa without correction for water vapour

PRE-SAMPLING CALIBRATION DATA

Date	19 November 2024
Start Time	10:00
End Time	10:20

Chiller Temperature (°C)	2.3
Requirement	< 4°C
Compliant	Yes

Gas	Range (ppm / %)	Zero Reading at analyser	Span Reading at analyser	Zero Check at analyser	Zero Check down line	Span Check down line	Response Time (Secs)	Leak Rate %
Nitric Oxide	100	0.00	79.4	0.10	0.10	79.5	80	-0.13
Carbon Monoxide	200	0.00	81.9	0.10	0.20	81.5	75	0.49
Oxygen	25	0.00	20.90	0.00	0.01	20.91	75	-0.05

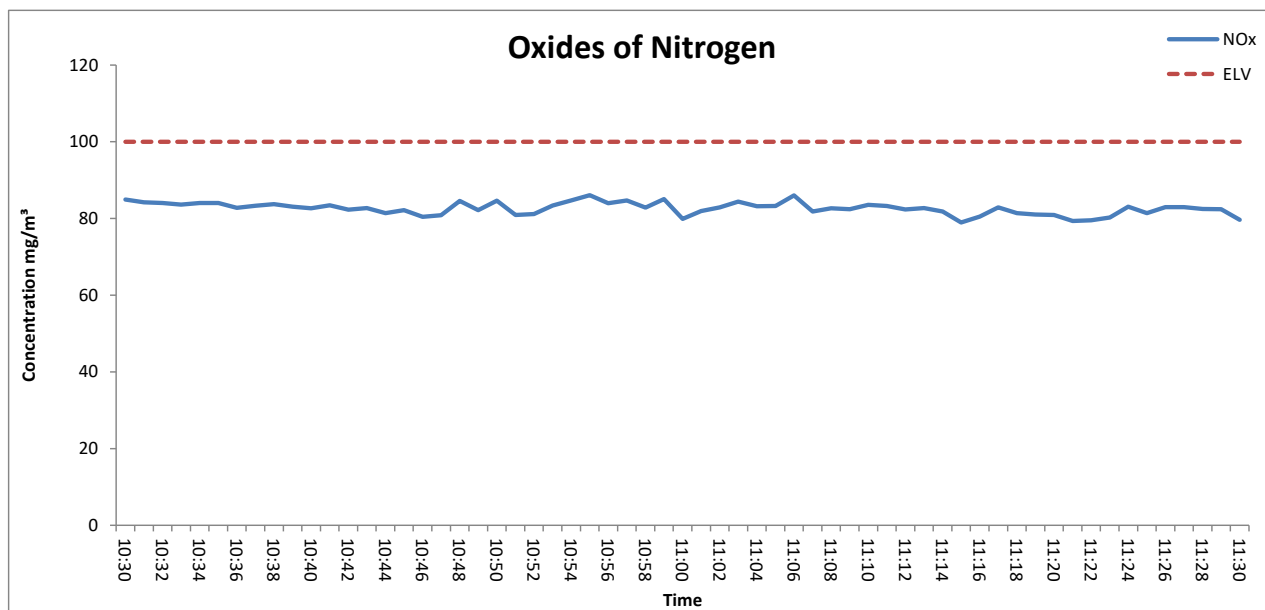
POST-SAMPLING CALIBRATION DATA

Date	19 November 2024
Start Time	11:33
End Time	11:46

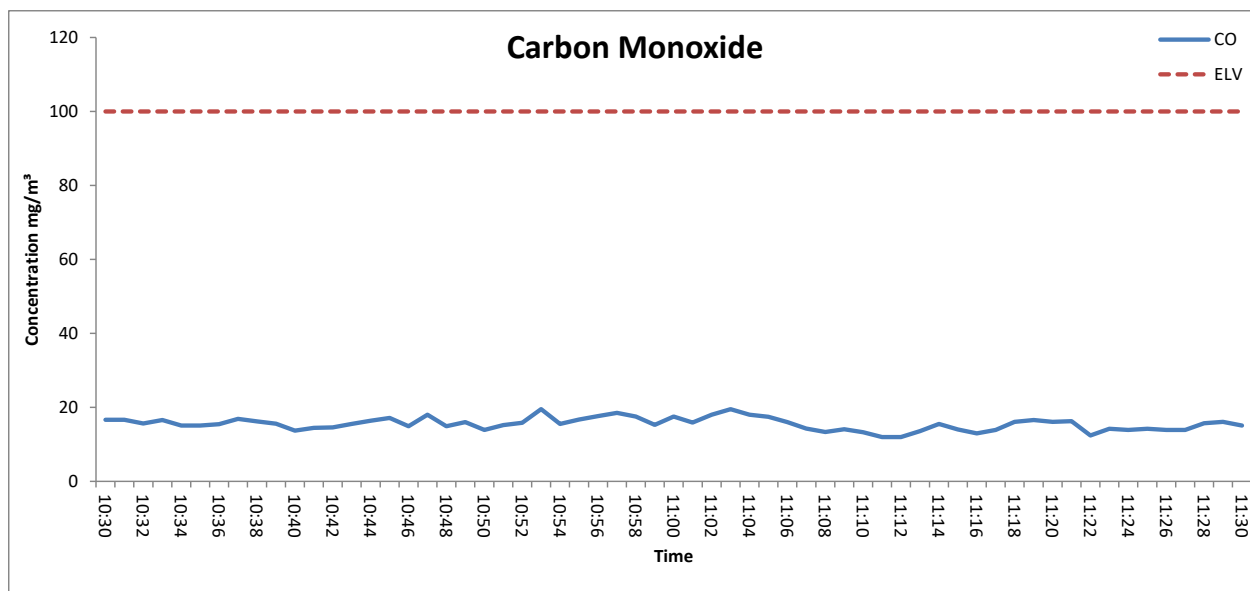
Chiller Temperature (°C)	2.1
Requirement	< 4°C
Compliant	Yes

Gas	Zero Check at Analyser	Span Check at Analyser	Zero Drift (% of Span Gas)	Span Drift (% of Span Gas)	Corrected for Zero Drift	Corrected for Span Drift	Corrected Values ppm / %
Nitric Oxide	0.20	79.3	0.13	-0.25	x	x	N/A - not corrected
Carbon Monoxide	0.30	81.3	0.25	-0.98	x	x	N/A - not corrected
Oxygen	0.02	20.92	0.10	0.00	x	x	N/A - not corrected

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts
OXIDES OF NITROGEN (as NO₂) EMISSIONS CHART

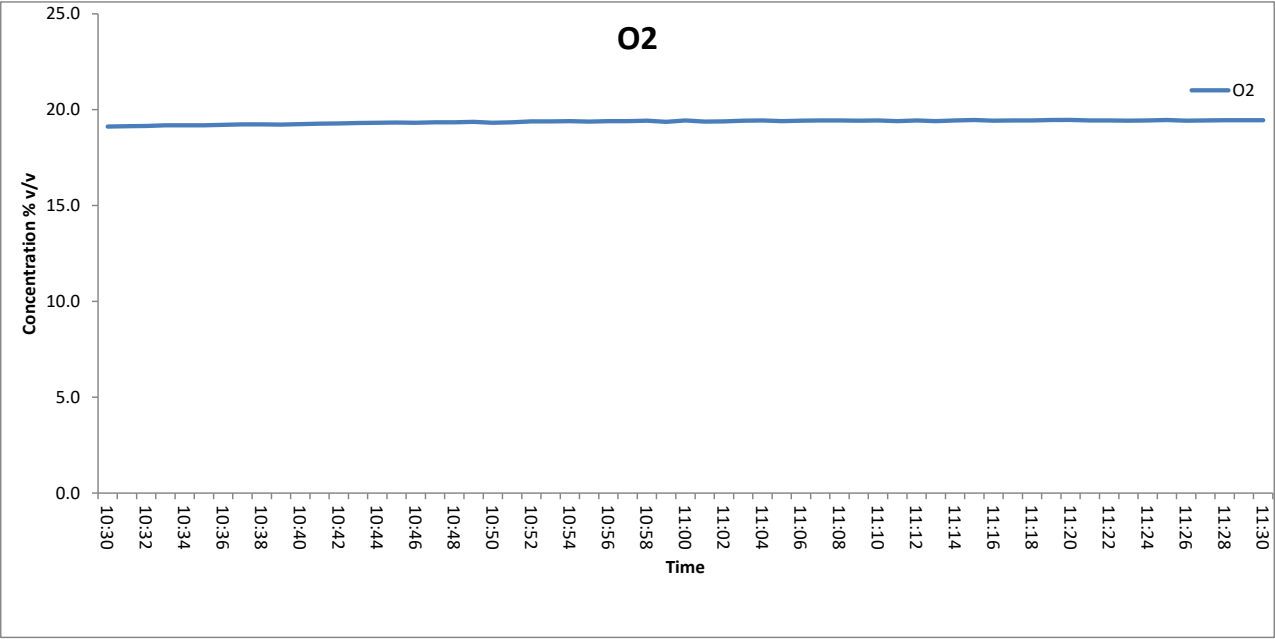


CARBON MONOXIDE EMISSIONS CHART



APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

OXYGEN EMISSIONS CHART



APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

MOISTURE CALCULATIONS

Moisture Determination - Isokinetic							
Test Number	Sampling Time and Date	Start Weight	End Weight	Total gain	Concentration	LOD	Uncertainty
		kg	kg	kg	%	%	%
Run 1	10:30 - 11:31 19 November 2024	3.4620	3.4780	0.0160	1.5	0.0096	3.0

Moisture Quality Assurance							
Test Number	Sampling Duration	Total Volume Sampled	Sampling Rate	Start Leak Rate	End Leak Rate	Acceptable Leak Rate	Leak Tests Acceptable?
	mins	l	l/min	l/min	l/min	l/min	
Run 1	60	1295	21.9	0.13	-	0.44	Yes

PRELIMINARY STACK SURVEY

Stack Characteristics		
Stack Diameter / Depth, D	1.00	m
Stack Width, W	-	m
Stack Area, A	0.79	m ²
Average stack gas temperature	275	°C
Stack static pressure	0.1	kPa
Barometric Pressure	100.7	kPa

Stack Gas Composition & Molecular Weights								
Component	Molar Mass M	Density kg/m ³ p	Conc Dry % Vol	Dry Volume Fraction r	Dry Conc kg/m ³ pi	Conc Wet % Vol	Wet Volume Fraction r	Wet Conc kg/m ³ pi
CO ₂	44	1.963059	0.979524	0.009795	0.019229	0.964440	0.009644	0.018933
O ₂	32	1.427679	19.343154	0.193432	0.276158	19.045289	0.190453	0.271906
N ₂	28	1.249219	79.677322	0.796773	0.995344	78.450373	0.784504	0.980017
H ₂ O	18	0.803070	-	-	-	1.539898	0.015399	0.012366

Where: $p = M / 22.41$ $pi = r \times p$

Calculation of Stack Gas Densities		
Determinand	Result	Units
Dry Density (STP), P_{STD}	1.2907	kg/m ³
Wet Density (STP), P_{STW}	1.2832	kg/m ³
Dry Density (Actual), P_{Actual}	0.6398	kg/m ³
Average Wet Density (Actual), $P_{ActualW}$	0.636	kg/m ³

Where:

P_{STD} = sum of component concentrations, kg/m³ (not including water vapour)

$P_{STW} = (P_{STD} + pi \text{ of H}_2\text{O}) / (1 + (pi \text{ of H}_2\text{O} / 0.8036))$

$P_{Actual} = P_{STD} \times (Ts / Ps) \times (Pa / Ta)$

$P_{ActualW} = P_{STW} \times (Ts / Ps) \times (Pa / Ta)$

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

PRELIMINARY STACK SURVEY

TRAVERSE 1

Date of Survey	19 November 2024
Time of Survey	09:40
Velocity Measurement Device:	S-Type Pitot

Sampling Line A								
Traverse Point	Distance into duct (m)	DP pt Pa (average of 3 readings)	DP pt mmH ₂ O (average of 3 readings)	Temp °C	Velocity m/s	Volumetric Flow Rate (actual) m ³ /s	O ₂ % Vol	Angle of Swirl °
1	0.15	60.8	6.2	275	11.1	8.7	-	<15
2	0.85	59.8	6.1	275	11.0	8.7	-	<15
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
Mean	-	60.3	6.2	275	11.1	8.7	-	-

Sampling Line B								
Traverse Point	Distance into duct (m)	DP pt Pa (average of 3 readings)	DP pt mmH ₂ O (average of 3 readings)	Temp °C	Velocity m/s	Volumetric Flow Rate (actual) m ³ /s	O ₂ % Vol	Angle of Swirl °
1	0.15	58.8	6.0	275	10.9	8.6	-	<15
2	0.85	56.8	5.8	275	10.7	8.4	-	<15
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
Mean	-	57.8	5.9	275	10.8	8.5	-	-

PRELIMINARY STACK SURVEY QUALITY ASSURANCE CHECKLIST

PITOT LEAK CHECK								
Run	Pre Traverse Leak Rate				Post Traverse Leak Rate			
	Start Value mmH ₂ O	End Value mmH ₂ O	Difference %	Outcome	Start Value mmH ₂ O	End Value mmH ₂ O	Difference %	Outcome
Run 1	133	130	2.3	Pass	135	134	0.7	Pass

To complete a compliant pitot leak check a pressure of over 80 mmH₂O (or 800 Pa) is applied and the pressure drop monitored over 5 mins. A drop of less than 5% must be observed.

S-Type Pitot Stagnation Check				
Run	Stagnation (Pa)	Reference (Pa)	Difference (Pa)	Outcome (Permitted +/- 10 Pa)
Run 1	100	100	0.0	Pass

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

PRELIMINARY STACK SURVEY (CONTINUED)

Sampling Plane Validation Criteria				
EA Technical Guidance Note (Monitoring) M1	Result	Units	Requirement	Compliant
Lowest Average Differential Pressure	57	Pa	>= 5 Pa	Yes
Lowest Gas Velocity	10.7	m/s	-	-
Highest Gas Velocity	11.1	m/s	-	-
Ratio of Gas Velocities	1.0	-	< 3 : 1	Yes
Maximum angle of flow with regard to duct axis	<15	°	< 15°	Yes
No local negative flow	Yes	-	-	Yes

Calculation of Stack Gas Velocity, V		
Velocity at Traverse Point, $V = K_{pt} \times (1-e) \times \sqrt{2 \times DP_{pt} / P_{ActualW}}$		
Where: K_{pt} = Pitot tube calibration coefficient (1-e) = Compressibility correction factor, assumed at a constant 0.998		
Average Stack Gas Velocity, V_a	11.0	m/s

Calculation of Stack Gas Volumetric Flowrate, Q			
Duct gas flow conditions	Actual	Reference	Units
Temperature	275	0	°C
Total Pressure	100.8	101.3	kPa
Oxygen	19.3	21	%
Moisture	1.54	1.54	%
Pitot tube calibration coefficient, K_{pt}	0.80		

Gas Volumetric Flowrate	Result	Units
Average Stack Gas Velocity (V_a)	10.95	m/s
Stack Area (A)	0.79	m ²
Gas Volumetric Flowrate (Actual), Q_{Actual}	30969.41	m ³ /hr
Gas Volumetric Flowrate (STP, Wet), Q_{STP}	15352.04	m ³ /hr
Gas Volumetric Flowrate (STP, Dry), $Q_{STP,Dry}$	15115.63	m ³ /hr
Gas Volumetric Flowrate (REF), Q_{Ref}	15352.04	m ³ /hr

Where:

$$Q_{Actual} = V_a \times A \times 3600$$

$$Q_{STP} = Q (Actual) \times (T_s / T_a) \times (P_a / P_s) \times 3600$$

$$Q_{STP,Dry} = Q (STP) / (100 - (100 / Ma)) \times 3600$$

$$Q_{Ref} = Q (STP) \times ((100 - Ma) / (100 - Ms)) \times ((21 - O_{2a}) / (21 - O_{2s}))$$

Nomenclature:

T_s = Absolute Temperature, Standard Conditions, 273 K

P_s = Absolute Pressure, Standard Conditions, 101.3 kPa

T_a = Absolute Temperature, Actual Conditions, K

P_a = Absolute Pressure, Actual Conditions, kPa

Ma = Water vapour, Actual Conditions, % Vol

Ms = Water vapour, Reference Conditions, % Vol

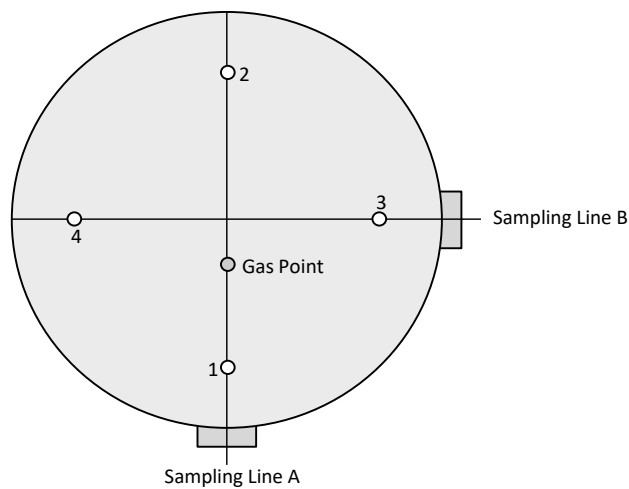
O_{2a} = Oxygen, Actual Conditions, % Vol

O_{2s} = Oxygen, Reference Conditions, % Vol

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

STACK DIAGRAM

	Value	Units
Stack Depth	1.00	m
Stack Width	-	m
Area	0.79	m ²



- Isokinetic sampling point
- Isokinetic sampling points not used
- Non Isokinetic/Gases sampling point

Non-Isokinetic/Gases Sampling			
Sampling Point	Distance (% of Depth)	Distance into Stack	Units
A	40	0.40	m

Isokinetic Sampling			
Sampling Point	Distance (% of Depth)	Distance into Stack (m)	Swirl °
1	14.6	0.15	< 15
2	85.4	0.85	< 15
3	14.6	0.15	< 15
4	85.4	0.85	< 15
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

SAMPLING LOCATION



APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - TOTAL PARTICULATE MATTER

Run	Sampled Volume m ³	Sampled Gas Temp K	Sampled Gas Pressure kPa	Sampled Gas Humidity % by volume	Oxygen Content % by volume	Limit of Detection % by mass	Leak %	Uncollected Mass mg
MU required	≤ 2%	≤ 2%	≤ 1%	≤ 1%	≤ 10%	≤ 5% of ELV	≤ 2%	≤ 10% of ELV
Run 1	0.003	2.0	0.50	1.0	N/A	0.20	-	-
as a %	0.20	0.36	0.50	1.0	N/A	0.31	0.59	0.001
compliant?	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes

Run	Volume (STP) m ³	Mass of particulate mg	O ₂ Correction -	Leak mg/m ³	Uncollected Mass mg	Combined uncertainty
Run 1	0.63	0.2000	1.0	0.0005	0.0004	-
MU as mg/m ³	0.002	0.1545	-	0.0005	0.0003	0.15
MU as %	1.24	100.0000	-	0.343	0.2165	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	0.31	mg/m³	200.02	% Result	0.62	% ELV
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(k is a coverage factor which gives a 95% confidence in the quoted figures)

Reference – SOCOTEC Technical Procedure AE150 Estimation of Uncertainty of Measurement

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - MOISTURE

Run	Sampled Volume m ³	Sampled Gas Temp K	Sampled Gas Pressure kPa	Sampled Gas Humidity % by volume	Oxygen Content % by volume	Leak %
MU required	≤ 2%	≤ 2%	≤ 1%	≤ 1%	≤ 10%	≤ 2%
Run 1	0.003	2.0	0.50	1.0	N/A	-
as a %	0.20	0.36	0.50	1.0	N/A	0.59
compliant?	Yes	Yes	Yes	Yes	N/A	Yes

Run	Volume (STP) m ³	Mass Gained mg	O ₂ Correction -	Leak mg/m ³	Uncollected Mass mg	Combined uncertainty
Run 1	0.63	16000	1.0	43.01	58	-
MU as % v/v	0.0196	0.0099	-	0.0054	0.0057	0.0234
MU as %	1.24	0.62	-	0.34	0.36	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	0.05	% v/v	2.95	%
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APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - VOLATILE ORGANIC COMPOUNDS RUN 1

Measured Concentration	16.2	mg/m ³
Limit	50	mg/m ³
Calibration Gas Concentration	16.144	mg/m ³
Range	160	mg/m ³

Performance characteristics	Value	Units	specification	MU Met?
Response time	75	seconds	<180	Yes
Logger sampling interval	60	seconds	-	-
Measurement period	60	minutes	-	-
Number of readings in measurement	60	-	-	-
Repeatability at zero	0.25	% full scale	<1 % range	Yes
Repeatability at span level	0.15	% full scale	<2 % range	Yes
Deviation from linearity	0.70	% of value	<2 % range	Yes
Zero drift	0.0000	% full scale	<5% range / 24hr	Yes
Span drift	0.0000	% full scale	<5% range / 24hr	Yes
volume or pressure flow dependence	0.02	% of full scale/3 kPa	<2 % / 3 kPa	Yes
atmospheric pressure dependence	0.80	% of full scale/2 kPa	<3% / 2 kPa	Yes
ambient temperature dependence	0.01	% full scale/10K	<3% range / 10 K	Yes
dependence on voltage	0.10	% full scale/10V	< 0.1%vol / 10 volt	Yes
losses in the line (leak)	0.89	% of value	< 2% of span gas value	Yes
Uncertainty of calibration gas	1.0	% of value	< 2% of value	Yes

Performance characteristic	Uncertainty	Value of uncertainty quantity
Standard deviation of repeatability at zero	ur0	0.02
Standard deviation of repeatability at span level	urs	0.02
Lack of fit	ufit	0.65
Drift	u0dr	0.00000
volume or pressure flow dependence	uspres	0.0006
atmospheric pressure dependence	uapres	0.04
ambient temperature dependence	utemp	0.00001
Dependence on voltage	uvolt	0.14
losses in the line (leak)	uleak	0.08
Uncertainty of calibration gas	ucalib	0.09
Uncertainty in factor	uf	0.00000

Measurement uncertainty Measured Concentration	16.16	mg/m ³
Combined uncertainty	0.67	mg/m ³
Expanded uncertainty	1.32	mg/m ³

Expanded uncertainty expressed with a level of confidence of 95%	2.64	% ELV
Expanded uncertainty expressed with a level of confidence of 95%	1.32	mg/m ³
Expanded uncertainty expressed with a level of confidence of 95%	8.18	% value

Reference – SOCOTEC Technical Procedure AE150 Estimation of Uncertainty of Measurement

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - OXIDES OF NITROGEN

Limit value	100	mg/m ³
Concentration @ Ref conditions	82.6	mg/m ³
Cal gas conc	163	mg/m ³
Analyser Full Scale	205	mg/m ³

	Value	Units	specification	MU Met?
Response time	80	seconds	180	Yes
Logger sampling interval	60	seconds	-	-
Measurement period	60	minutes	-	-
Number of readings in measurement	60	-	-	-
Repeatability at zero	0.11	% full scale	<1 % range	Yes
Repeatability at span level	0.1	% full scale	<2 % range	Yes
Deviation from linearity	-0.40	% of value	<2 % range	Yes
Zero drift	0.13	% full scale	<5% range / 24hr	Yes
Span drift	-0.25	% full scale	<5% range / 24hr	Yes
volume or pressure flow dependence	0.1	% of full scale/3 kPa	<2 % / 3 kPa	Yes
atmospheric pressure dependence	0.10	% of full scale/2 kPa	<3% / 2 kPa	Yes
ambient temperature dependence zero / span	0.0000	% full scale/10K	<3% range / 10 K	Yes
Combined interference	-0.01	% range	<4% of Range	Yes
dependence on voltage	0.03	% full scale/10V	< 0.1%vol /10 volt	Yes
Influence of Vibration	N/A	% of upper limit of Cal range	<2%	-
losses in the line (leak)	0.03	% of value	< 2% of value	Yes

Performance characteristic	Uncertainty	Value of uncertainty quantity
repeatability	$U_r = S_r$	0.0037
lack of fit	U_{lof}	-0.2309
short term zero drift	$U_{d,z}$	0.0732
short term span drift	$U_{d,s}$	-0.1454
influence of Ambient Temp at Zero	$U_{t,z}$	0.000000
influence of Ambient Temp at Span	$U_{t,s}$	0.9454
influence of sample gas pressure	U_p	0.000000
influence of sample gas flow	U_{fit}	0.0693
influence of supply voltage	U_v	0.0361
Combined Interference	U_i	-0.0018
Uncertainty of Cal gas	U_{adj}	0.7940

Measurement uncertainty (Concentration Measured)	82.62	mg/m ³
Combined uncertainty	1.27	mg/m ³
Expanded at a 95% confidence interval	2.49	mg/m ³

Expanded uncertainty expressed with a level of confidence of 95%	2.49	% ELV
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Expanded uncertainty expressed with a level of confidence of 95%	2.5	mg/m ³
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Expanded uncertainty expressed with a level of confidence of 95%	3.0	% value
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Reference – SOCOTEC Technical Procedure AE150 Estimation of Uncertainty of Measurement

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - CARBON MONOXIDE

Limit value	100	mg/m ³
Concentration @ Ref conditions	15.5	mg/m ³
Cal gas conc	102.4	mg/m ³
Analyser Full Scale	250	mg/m ³

Performance characteristics	Value	Units	specification	MU Met?
Response time	75	seconds	180	Yes
Logger sampling interval	60	seconds	-	-
Measurement period	60	minutes	-	-
Number of readings in measurement	60	-	-	-
Repeatability at zero	0.1	% full scale	<1 % range	Yes
Repeatability at span level	0.2	% full scale	<2 % range	Yes
Deviation from linearity	0.61	% of value	<2 % range	Yes
Zero drift	0.25	% full scale	<5% range / 24hr	Yes
Span drift	-0.98	% full scale	<5% range / 24hr	Yes
volume or pressure flow dependence	0.2	% of full scale/3 kPa	<2 % / 3 kPa	Yes
atmospheric pressure dependence	0.44	% of full scale/2 kPa	<3% / 2 kPa	Yes
ambient temperature dependence zero / span	-0.8	% full scale/10K	<3% range / 10 K	Yes
Combined interference	-0.01	% of Range	<4% of Range	Yes
dependence on voltage	-0.06	% full scale/10V	< 0.1%vol /10 volt	Yes
Influence of Vibration	N/A	% of upper limit of Cal range	<2%	N/A
losses in the line (leak)	0.005	% of value	< 2% of value	Yes
Uncertainty of calibration gas	1.00	% of value	< 2% of value	Yes

N/A - Horiba's are not effected by Vibration

Performance characteristic	Uncertainty	Value of uncertainty quantity
repeatability	$U_r = S_r$	0.003
lack of fit	U_{lof}	0.12
short term zero drift	U_{dz}	0.35
short term span drift	U_{ds}	0.14
influence of Ambient Temp zero	U_{tz}	-0.13
influence of Ambient Temp span	U_{ts}	0.19
influence of sample gas pressure	U_p	0.0000
influence of sample gas flow	U_{fit}	0.14
influence of supply voltage	U_v	-0.09
Combined Interference	U_i	-0.75
Uncertainty of Cal gas	U_{adj}	0.41

Measurement uncertainty (Concentration Measured)	15.8	mg/m ³
Combined uncertainty	1.0	mg/m ³
Expanded uncertainty	1.9	mg/m ³

Expanded uncertainty expressed with a level of confidence of 95%	1.9	% ELV
Expanded uncertainty expressed with a level of confidence of 95%	1.9	mg/m ³
Expanded uncertainty expressed with a level of confidence of 95%	12.5	% value

Reference – SOCOTEC Technical Procedure AE150 Estimation of Uncertainty of Measurement

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - OXYGEN

Reference	N/A	%vol
Reported Concentration	19.36	%vol
Calibration gas	20.9	%vol
Analyser Full Scale	25	%vol

	Value	Units	specification	MU Met?
Response time	75	seconds	180	Yes
Logger sampling interval	60	seconds	-	-
Measurement period	60	minutes	-	-
Number of readings in measurement	60	-	-	-
Repeatability at zero	0.25	% full scale	<1 % range	Yes
Repeatability at span level	0.15	% full scale	<2 % range	Yes
Deviation from linearity	0.13	% of value	<2 % range	Yes
Zero drift	0.10	% full scale	<5% range / 24hr	Yes
Span drift	0.00	% full scale	<5% range / 24hr	Yes
volume or pressure flow dependence	0.03	% of full scale/3 kPa	<2 % / 3 kPa	Yes
atmospheric pressure dependence	0.05	% of full scale/2 kPa	<3% / 2 kPa	Yes
ambient temperature dependence	-0.05	% full scale/10K	<3% range / 10 K	Yes
Combined interference	0.01	% range	<4% of Range	Yes
dependence on voltage	0.0005	% full scale/10V	< 0.1%vol / 10 volt	Yes
losses in the line (leak)	0.01	% of value	< 2% of value	Yes
Uncertainty of calibration gas	0.005	% of value	< 2% of value	Yes

Performance characteristic	Uncertainty	Value of uncertainty quantity
repeatability	$U_r = S_r$	0.0083
lack of fit	U_{lof}	0.0751
short term zero drift	U_{dz}	0.0115
short term span drift	U_{ds}	0.000000
influence of Ambient Temp at Zero	U_{tz}	0.0003
influence of Ambient Temp at Span	U_{ts}	-0.0024
influence of sample gas pressure	U_p	0.000000
influence of sample gas flow	U_{fit}	0.0173
influence of supply voltage	U_v	0.0001
Combined Interference	U_i	0.0017
Uncertainty of Cal gas	U_{adj}	0.1045

Measurement uncertainty (Concentration Measured)	19.36	% vol
Combined uncertainty	0.13	% vol
Expanded uncertainty	0.26	% vol

Expanded uncertainty expressed with a level of confidence of 95%	0.26	% vol
Expanded uncertainty expressed with a level of confidence of 95%	1.32	% value

Maximum permissible uncertainty is 6% of value or 0.3% by volume.

Reference – SOCOTEC Technical Procedure AE150 Estimation of Uncertainty of Measurement

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - VELOCITY & VOLUMETRIC FLOW RATE

Measured Velocity at Actual Conditions	11.0	m/s
Measured Volumetric Flow rate at Actual Conditions	30969	m ³ /hr

Performance Characteristics & Source of Value	Units	Values	Requirement	Compliant
Uncertainty of Local Gas Velocity Determination	-	0.010		
Uncertainty of pitot tube coefficient	-	0.62		
Uncertainty of mean local dynamic pressures	-	0.591	minimum 3	Yes
Factor loading, function of the number of measurements.	3 readings	1000		
Range of measurement device	pa	1.00		
Resolution	pa	10.47	<1% of Value or 20 Pa whichever is greater	Yes
Calibration uncertainty	pa	0.10		
Drift	% range	0.06	<2% of value	Yes
Linearity	% range	0.00002		
Uncertainty of gas density determination	kg/mol	2.80	<1% of value	Yes
Uncertainty of molar mass determination	K	514		
Uncertainty of temperature measurement	pa	0.007		
Uncertainty of absolute pressure in the duct	kg/m ³	0.0002		
Uncertainty associated with the calculation of density	-	0.0002		
Uncertainty associated with the measurement of local velocity	-	0.0002		
Uncertainty associated with the measurement of mean velocity	-	0.0002		

Measurement Uncertainty - Velocity	m/s
Combined uncertainty	0.14
Expanded uncertainty at a 95% Confidence Interval	0.28

Note - The expanded uncertainty uses a coverage factor of $k = 2$.

Expanded Measurement Uncertainty of Velocity at a 95% Confidence Interval	%
Expressed as a % of the Measured Velocity	1.3
Expanded uncertainty at a 95% Confidence Interval	2.5

Measurement Uncertainty Volumetric Flow Rate	m ³ /hr
Combined uncertainty	820
Expanded uncertainty at a 95% Confidence Interval	1608

Note - The expanded uncertainty uses a coverage factor of $k = 2$.

Expanded Measurement Uncertainty of Volumetric Flow Rate at a 95% Confidence Interval	%
Expressed as a % of the Measured Volumetric Flow Rate	2.6
Expanded uncertainty at a 95% Confidence Interval	5.2

Reference – SOCOTEC Technical Procedure AE150 Estimation of Uncertainty of Measurement

END OF REPORT

Thank you for choosing SOCOTEC for your environmental monitoring needs. We hope our services have met your requirements and that you are fully satisfied with your experience of working with us, we really do value your custom and would welcome your feedback. We would appreciate it if you could take a moment to complete a short online questionnaire so that we can improve our operations and address any areas that have not met with your expectations, by clicking on the following

https://www.surveymonkey.co.uk/r/CAE_customer_feedback_weblink