

STACK EMISSIONS MONITORING REPORT



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Operator & Address:

Conrad Energy
Hawarden Industrial Park
Clwyd Close
Broughton
Deeside
Flintshire
CH5 3PZ

Permit Reference:


EPR Permit: PAN-010150

Release Point:

Engine 1

Sampling Date(s):

19th December 2023

SOCOTEC Job Number:	LNO 18280
Report Date:	4th January 2024
Version:	1
Report By:	Mark Derbyshire
MCERTS Number:	MM 07 824
MCERTS Level:	MCERTS Level 2 - Team Leader
Technical Endorsements:	1, 2, 3 & 4
Report Approved By:	Lawrence Mason
MCERTS Number:	MM 07 849
Business Title:	MCERTS Level 2 - Team Leader
Technical Endorsements:	1, 2, 3 & 4
Signature:	



1015



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EXECUTIVE SUMMARY

MONITORING OBJECTIVES

Conrad Energy operates a natural gas engines process at Hawarden which is subject to EPR Permit PAN-010150, under the Environmental Permitting Regulations 2010.

SOCOTEC LTD were commissioned by Conrad Energy 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, PAN-010150.

Plant

Engine 1

Operator

Conrad Energy
Hawarden Industrial Park
Clwyd Close
Broughton
Deeside
Flintshire
CH5 3PZ

Stack Emissions Monitoring Test House

SOCOTEC - Stockport Laboratory
Unit 5 Crown Industrial Estate
Kenwood Road
Stockport
SK5 6PH
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 LTD.

EXECUTIVE SUMMARY

EMISSIONS SUMMARY					
Parameter	Units	Result	Calculated Uncertainty +/-	Emission Limit Value (ELV)	Accreditation
Oxides of Nitrogen (as NO ₂)	mg/m ³	91	1.8	95	MCERTS
Carbon Monoxide	mg/m ³	367	1.4	-	MCERTS
Oxygen	% v/v	10.5	0.02	-	MCERTS
Stack Gas Temperature	°C	512	-	-	-

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, dry gas 15% Oxygen.

EXECUTIVE SUMMARY

MONITORING TIMES			
Parameter	Sampling Date(s)	Sampling Times	Sampling Duration
Combustion Gases	19 December 2023	11:28 - 12:28	60 minutes

EXECUTIVE SUMMARY

PROCESS DETAILS

Parameter	Process Details
Description of process	Natural Gas Engines
Continuous or batch	Continuous
Product Details	Electricity
Part of batch to be monitored (if applicable)	Whilst running
Normal load, throughput or continuous rating	2500kw (max load 2500kw)
Fuel used during monitoring	Natural Gas
Abatement	None
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
Oxides of Nitrogen	SRM - BS EN 14792:2017	AE 102	1015	MCERTS	0.23 mg/m ³	2.0%	1.93%
Carbon Monoxide	SRM - BS EN 15058:2017	AE 102	1015	MCERTS	0.39 mg/m ³	0.37%	N/A - No ELV
Oxygen	SRM - BS EN 14789:2017	AE 102	1015	MCERTS	0.01%	0.19%	N/A - No ELV

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
-	-	-	-	-	-	-	-

ON-SITE TESTING							
Species	Analytical Technique	Analytical Procedure	UKAS Lab Number	Accreditation	Laboratory	Data Archive Location	Archive Period
Oxides of Nitrogen	Chemiluminescence	AE 102	1015	MCERTS	SOCOTEC (Stockport)	SOCOTEC (Stockport)	5 years
Carbon Monoxide	Non Dispersive Infra Red	AE 102	1015	MCERTS	SOCOTEC (Stockport)	SOCOTEC (Stockport)	5 years
Oxygen	Paramagnetic	AE 102	1015	MCERTS	SOCOTEC (Stockport)	SOCOTEC (Stockport)	5 years

EXECUTIVE SUMMARY

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

DUCT CHARACTERISTICS		
	Value	Units
Shape	Circular	-
Depth	0.25	m
Width	-	m
Area	0.05	m ²
Port Depth	0	mm

SAMPLING LINES & POINTS		
	Isokinetic	Non-Iso & Gases
Sample port size	N/A	1 Inch BSP
Number of lines used	N/A	1
Number of points / line	N/A	1
Duct orientation	N/A	Vertical
Filtration	N/A	Out Stack

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

M1 Platform requirements	
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)	N/A
Platform has vertical base boards (approximately 0.25 m high)	N/A
Platform has removable chains / self closing gates at the top of ladders	N/A
Handrail / obstructions do not hamper insertion of sampling equipment	No
Depth of Platform = \geq Stack depth / diameter + wall and port thickness + 1.5m	Yes

Sampling Platform Improvement Recommendations (if applicable)

The sampling location meets all the requirements as specified in EA Guidance Note M1.

EXECUTIVE SUMMARY

Sampling & Analytical Method Deviations

Mass Emissions

Due to the restrictive access of the sample port a flow traverse could not be measured, therefore a mass emission rate cannot not be calculated.

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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
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

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	-	Horiba PG - 350 Analyser	LNO 21-58	Laboratory Balance	LNO 00-13/33
Box Thermocouples	-	FT-IR	-	Tape Measure	LNO 24-MD
Meter In Thermocouple	-	FT-IR Oven Box	-	Stopwatch	LNO 17-MD
Meter Out Thermocouple	-	Bernath 3006 FID	-	Protractor	-
Control Box Timer	-	Signal 3030 FID	-	Barometer	LNO 08-MD
Oven Box	-	Servomex	-	Digital Micromanometer	LNO 01-MD
Probe	-	JCT Heated Head Filter	-	Digital Temperature Meter	LNO 03-MD
Probe Thermocouple	-	Thermo FID	-	Stack Thermocouple	LNO 10-MD
Probe	-	Stackmaster	-	Mass Flow Controller	-
Probe Thermocouple	-	FTIR Heater Box for Heated Line	-	MFC Display module	-
S-Pitot	LNO 06-MD	Anemometer	-	1m Heated Line (1)	-
L-Pitot	-	Ecophysics NOx Analyser	-	1m Heated Line (2)	-
Site Balance	LNO 14-MD	Chiller (JCT/MAK 10)	LNO 21-39	1m Heated Line (3)	-
Last Impinger Arm	-	Heated Line Controller (1)	LNO 03-110	5m Heated Line (1)	-
Dioxins Cond. Thermocouple	-	Heated Line Controller (2)	-	10m Heated Line (1)	-
Callipers	LNO 31-MD	Site temperature Logger	-	10m Heated Line (2)	-
Small DGM	-			15m Heated Line (1)	-
Heater Controller	-			20m Heated Line (1)	LNO 18-91
Inclinometer (Swirl Device)	LNO 25-MD			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	HPC 2357	BOC	-	9.88	2.0
Nitric Oxide	HPC 2334	BOC	79.9	-	2.0
Carbon Monoxide	HPC 2236	BOC	163	-	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
Mark Derbyshire	MM 07 824	MCERTS Level 2	Nov-26	Nov-26	Apr-27	May-28	Jul-27	Feb-25
Mark Strachan	MM 23 1861	MCERTS Trainee	Oct-28	-	-	-	-	Oct-28

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	11:28 - 12:28 19 December 2023	91	0.23	95	-
Carbon Monoxide	11:28 - 12:28 19 December 2023	367	0.39	-	-

Test	Sampling Time and Date	Concentration %	LOD %
Oxygen	11:28 - 12:28 19 December 2023	10.5	0.01

Reference conditions are 273K, 101.3kPa, dry gas 15% Oxygen.

PRE-SAMPLING CALIBRATION DATA

Date	19 December 2023
Start Time	09:55
End Time	10:05

Chiller Temperature (°C)	2.2
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	200	0.00	79.9	0.06	0.07	79.8	20	0.13
Carbon Monoxide	500	0.00	163.0	0.10	0.11	162.1	20	0.55
Oxygen	25	0.00	9.88	0.02	0.05	9.88	20	0.00

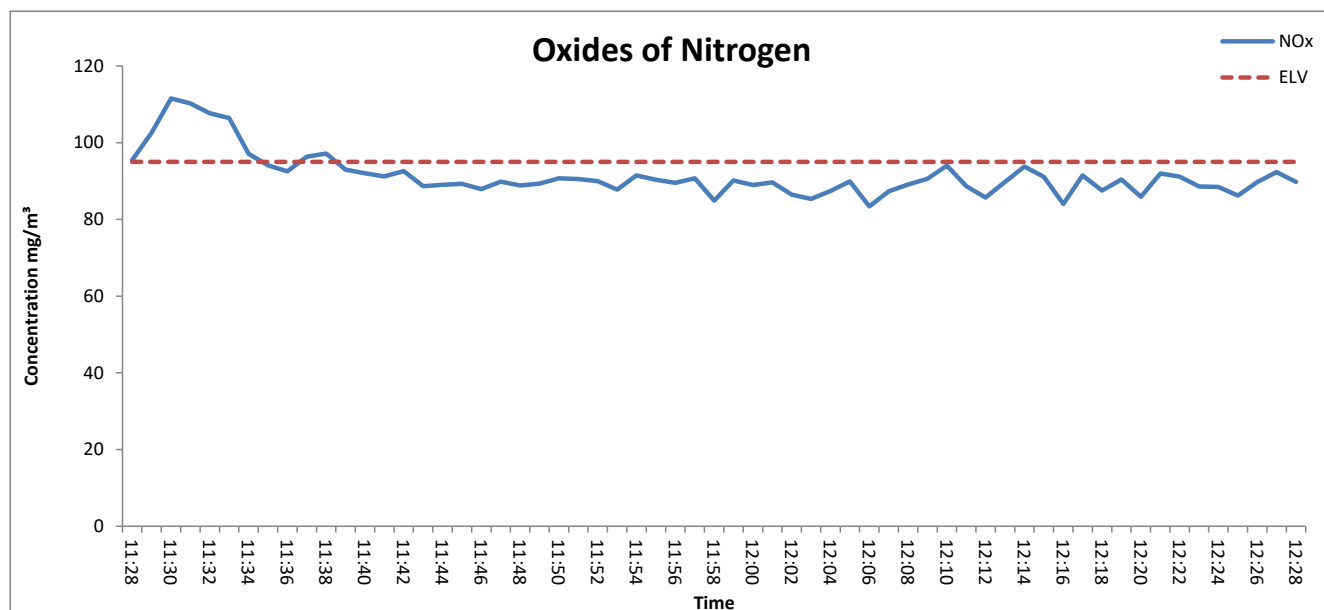
POST-SAMPLING CALIBRATION DATA

Date	19 December 2023
Start Time	12:35
End Time	12:43

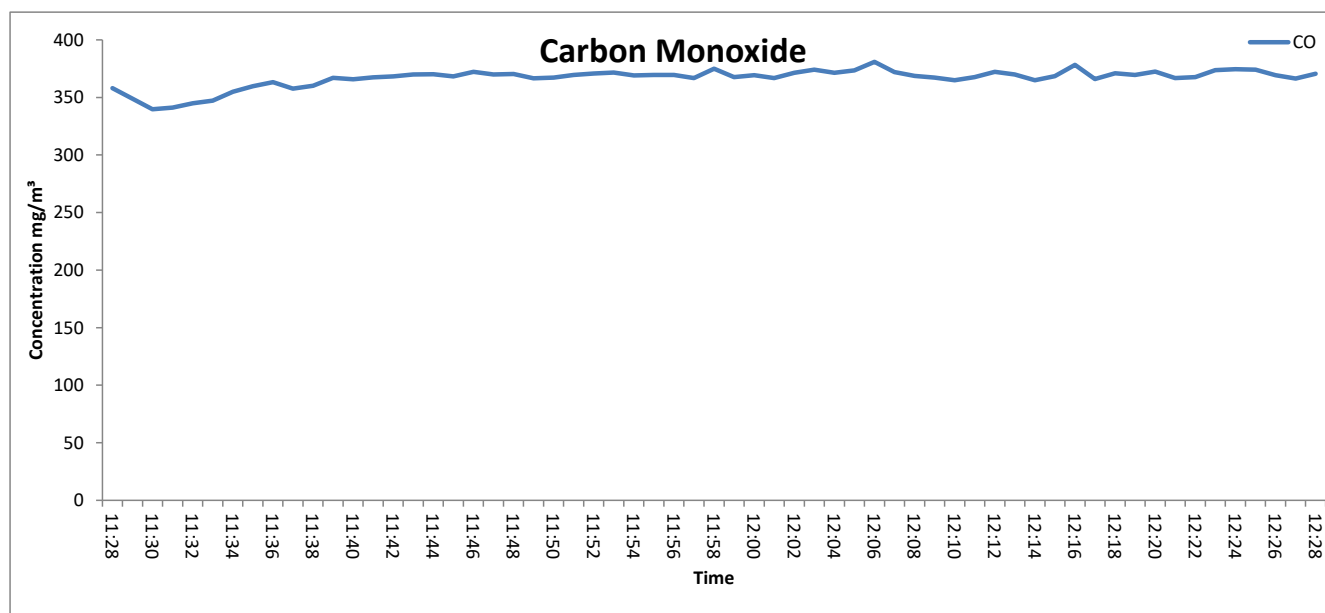
Chiller Temperature (°C)	2.1
Requirement	< 4°C
Compliant	Yes

Gas	Zero Check at Analyser	Span Check at Analyser	Zero Drift (%)	Span Drift (%)	Corrected for Zero Drift	Corrected for Span Drift	Corrected Values ppm / %
Nitric Oxide	0.10	79.8	0.05	-0.20	x	x	N/A - not corrected
Carbon Monoxide	0.13	162.3	0.02	-0.45	x	x	N/A - not corrected
Oxygen	0.06	9.87	0.04	-0.05	x	x	N/A - not corrected

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

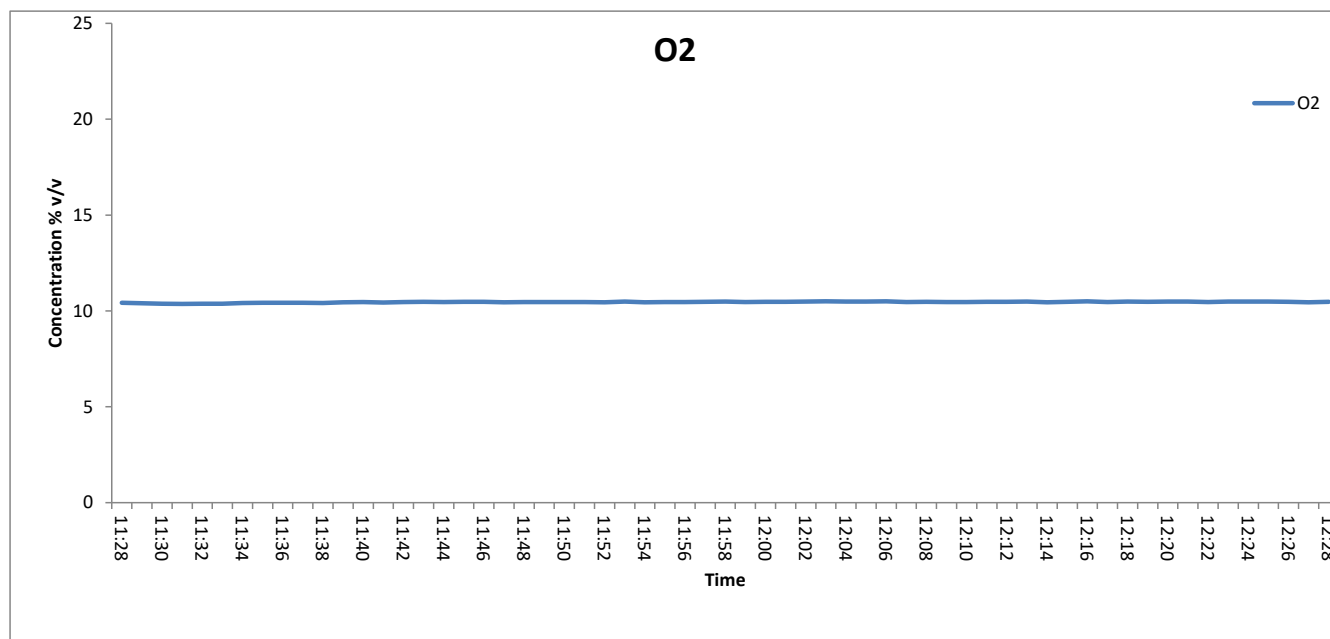


CARBON MONOXIDE EMISSIONS CHART



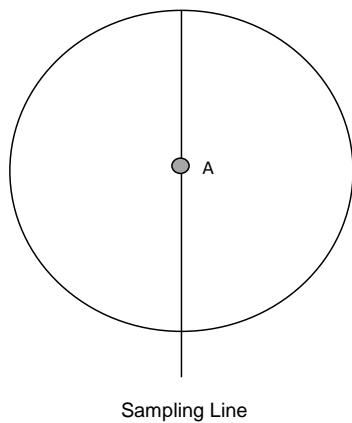
APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

OXYGEN EMISSIONS CHART



STACK DIAGRAM

	Value	Units
Stack Depth	0.25	m
Stack Width	-	m
Area	0.05	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	50	0.13	m

[illegible]

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - OXIDES OF NITROGEN

Limit value	95	mg/m ³
Concentration @ Ref conditions	91.4	mg/m ³
Cal gas conc	164	mg/m ³
Analyser Full Scale	410	mg/m ³

	Value	Units	specification	MU Met?
Response time	20	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	0.05	% full scale	<5% range / 24hr	Yes
Span drift	-0.20	% 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	0.20	% of full scale/2 kPa	<3% / 2 kPa	Yes
ambient temperature dependence zero / span	0.00	% full scale/10K	<3% range / 10 K	Yes
Combined interference	-1.04	% 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%	-
losses in the line (leak)	0.06	% 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	$U_{d,z}$	0.0291
short term span drift	$U_{d,s}$	-0.1156
influence of Ambient Temp at Zero	$U_{t,z}$	0.00
influence of Ambient Temp at Span	$U_{t,s}$	0.3600
influence of sample gas pressure	U_p	0.00
influence of sample gas flow	U_{fit}	0.1386
influence of supply voltage	U_v	0.1383
Combined Interference	U_i	-0.0018
Uncertainty of Cal gas	U_{adj}	0.7990

Measurement uncertainty (Concentration Measured)	91.43	mg/m ³
Combined uncertainty	0.93	mg/m ³
Expanded at a 95% confidence interval	1.83	mg/m ³

Expanded uncertainty expressed with a level of confidence of 95%	1.9	% ELV
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Expanded uncertainty expressed with a level of confidence of 95%	1.8	mg/m ³
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Expanded uncertainty expressed with a level of confidence of 95%	2.0	% value
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Developed for the STA by R Robinson, NPL

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - CARBON MONOXIDE

Limit value	-	mg/m ³
Concentration @ Ref conditions	366.8	mg/m ³
Cal gas conc	203.8	mg/m ³
Analyser Full Scale	625	mg/m ³

Performance characteristics	Value	Units	specification	MU Met?
Response time	20	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	0.02	% full scale	<5% range / 24hr	Yes
Span drift	-0.45	% full scale	<5% range / 24hr	Yes
volume or pressure flow dependence	0.5	% of full scale/3 kPa	<2 % / 3 kPa	Yes
atmospheric pressure dependence	1.1	% of full scale/2 kPa	<3% / 2 kPa	Yes
ambient temperature dependence zero / span	-2	% full scale/10K	<3% range / 10 K	Yes
Combined interference	-0.01	% of Range	<4% of Range	Yes
dependence on voltage	-0.16	% 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)	0.01	% 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	$U_{d,z}$	0.35
short term span drift	$U_{d,s}$	0.01
influence of Ambient Temp zero	$U_{t,z}$	-0.03
influence of Ambient Temp span	$U_{t,s}$	0.09
influence of sample gas pressure	U_p	0.00
influence of sample gas flow	U_{fit}	0.35
influence of supply voltage	U_v	-0.57
Combined Interference	U_i	-0.50
Uncertainty of Cal gas	U_{adj}	0.82

Measurement uncertainty (Concentration Measured)	644.3	mg/m ³
Combined uncertainty	1.2	mg/m ³
Expanded uncertainty	2.4	mg/m ³

Expanded uncertainty expressed with a level of confidence of 95%	-	% ELV
Expanded uncertainty expressed with a level of confidence of 95%	2.4	mg/m ³
Expanded uncertainty expressed with a level of confidence of 95%	0.37	% value

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Reference – SOCOTEC Technical Procedure AE150 Estimation of Uncertainty of Measurement

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - OXYGEN

Reference	15	%vol
Reported Concentration	10.46	%vol
Calibration gas	9.88	%vol
Analyser Full Scale	25	%vol

	Value	Units	specification	MU Met?
Response time	20	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	0.04	% full scale	<5% range / 24hr	Yes
Span drift	-0.05	% 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	0.0	% 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	$U_{d,z}$	0.0233
short term span drift	$U_{d,s}$	-0.0289
influence of Ambient Temp at Zero	$U_{t,z}$	0.0001
influence of Ambient Temp at Span	$U_{t,s}$	0.0005
influence of sample gas pressure	U_p	0.000
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}	0.0494

Measurement uncertainty (Concentration Measured)	10.46	%
Combined uncertainty	0.10	%
Expanded uncertainty	0.19	%

Expanded uncertainty expressed with a level of confidence of 95%	0.2	%
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Expanded uncertainty expressed with a level of confidence of 95%	1.86	% vol
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APPENDIX 3 - Measurement Uncertainty Budget Calculations

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