

Site Visit Report

The site visit process is a sample on a particular day of an installation's compliance with some of its licence conditions. Where non-compliance against a particular condition has not been reported, this should not be construed to mean that there is full compliance with that condition of the licence.

Instructions and actions arising from the visit shall be addressed, or where applicable noted, by the licensee in order to ensure compliance, to improve the environmental performance of the installation and to provide clarification on certain issues.

The licensee shall take the actions specified to close out the non-compliances and observations raised in this Site Visit Report.

The licensee may also be requested to provide a response to the Environmental Protection Agency (hereafter referred to as the Agency) in relation to the site visit report findings.

Licensee	
Name of Installation	Irish Cement Limited (Limerick)
Licensee	Irish Cement Limited
Licence Register No.	P0029-06
CRO Number	9212
Site Address	Castlemungret, Limerick
Site Visit Reference No.	SV26250

Report Detail	
Issue Date	19/02/2024
Prepared By	Caroline Kelly

Site Visit Detail			
Date Of Inspection	24/10/2023		
Time In	09:00	Time Out	18:00
EPA Inspector(s)			
Additional Visitors	Socotec UK Limited		
Licensee Personnel and Role	n/a		

> Summary

This site visit was conducted as part of the Agency's routine air emissions monitoring programme. The monitoring report is attached.

The licensee was found to be in compliance with its licence in relation to the emission point sampled inspected during this site visit.

> Site Areas Inspected

See report

> Documents Inspected

N/A

STACK EMISSIONS MONITORING REPORT



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Kelvin South Business Park
East Kilbride
G75 0YF
Tel: 01355 246 730

Your contact at SOCOTEC LTD

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Operator & Address:

Irish Cement Limited
Castlemungret
Limerick
Co. Limerick
-

Permit Reference:

IE Licence: P0029-06

Release Point:

A2-01

Sampling Date(s):

24 - 25 October 2023

SOCOTEC Job Number:	P0029-06CAR23-01 (LEK 14098)
Report Date:	06-Dec-23
Version:	1
Report By:	Brian Walsh
MCERTS Number:	MM 17 1414
MCERTS Level:	MCERTS Level 2 - Team Leader
Technical Endorsements:	1, 2, 3 & 4
Report Approved By:	Enda Flood
MCERTS Number:	MM 12 1170
Business Title:	MCERTS Level 2 - Team Leader
Technical Endorsements:	1, 2, 3 & 4
Signature:	



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EXECUTIVE SUMMARY

MONITORING OBJECTIVES

Irish Cement Limited operates a cement kiln/coal mill process at Irish Cement Limerick which is subject to IE Licence P0029-06, under the EPA Act 1992.

SOCOTEC LTD were commissioned by Environmental Protection Agency 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 IE Licence, P0029-06.

Plant

A2-01

Operator

Irish Cement Limited
Castlemungret
Limerick
Co. Limerick
-

Stack Emissions Monitoring Test House

SOCOTEC - East Kilbride Laboratory
2-4 Langlands Place
Kelvin South Business Park
East Kilbride
G75 0YF
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
Total Particulate Matter	mg/m ³	0.75	1.51	10	MCERTS
Particulate Emission Rate	g/hr	229.71	459.42	-	
Dioxins & Furans - UPPER Limits					
Dioxins & Furans (NATO I-TEQ)	ng/m ³	0.0016	0.0049	0.1	MCERTS
Dioxins & Furans (NATO I-TEQ) Emission Rate	µg/hr	0.4121	1.2957	-	
Dioxins & Furans (WHO TEQ Humans / Mammals)	ng/m ³	0.0017	0.0055	-	MCERTS
Dioxins & Furans (WHO TEQ H / M) Emission Rate	µg/hr	0.4608	1.4486	-	
Dioxins & Furans (WHO TEQ Fish)	ng/m ³	0.0016	0.0052	-	MCERTS
Dioxins & Furans (WHO TEQ Fish) Emission Rate	µg/hr	0.4339	1.3641	-	
Dioxins & Furans (WHO TEQ Birds)	ng/m ³	0.0046	0.0143	-	MCERTS
Dioxins & Furans (WHO TEQ Birds) Emission Rate	µg/hr	1.2051	3.7890	-	
Dioxins & Furans - LOWER Limits					
Dioxins & Furans (NATO I-TEQ)	ng/m ³	0.0004	0.0013	-	MCERTS
Dioxins & Furans (NATO I-TEQ) Emission Rate	µg/hr	0.1072	0.3369	-	
Dioxins & Furans (WHO TEQ Humans / Mammals)	ng/m ³	0.0004	0.0013	-	MCERTS
Dioxins & Furans (WHO TEQ H / M) Emission Rate	µg/hr	0.1062	0.3340	-	
Dioxins & Furans (WHO TEQ Fish)	ng/m ³	0.0002	0.0007	-	MCERTS
Dioxins & Furans (WHO TEQ Fish) Emission Rate	µg/hr	0.0589	0.1852	-	
Dioxins & Furans (WHO TEQ Birds)	ng/m ³	0.0031	0.0099	-	MCERTS
Dioxins & Furans (WHO TEQ Birds) Emission Rate	µg/hr	0.8318	2.6151	-	
Cadmium & Thallium	mg/m ³	0.0014	0.0024	0.05	MCERTS
Cadmium & Thallium Emission Rate	g/hr	0.3628	0.6109	-	
Heavy Metals	mg/m ³	0.0631	0.0100	0.5	MCERTS
Heavy Metals Emission Rate	g/hr	15.8971	2.5276	-	
Mercury	mg/m ³	0.0089	0.0014	0.05	MCERTS
Mercury Emission Rate	g/hr	2.4265	0.3907	-	
Hydrogen Chloride	mg/m ³	0.17	0.02	10	MCERTS
Hydrogen Chloride Emission Rate	g/hr	49.28	6.60	-	
Hydrogen Fluoride	mg/m ³	0.42	0.05	1	MCERTS
Hydrogen Fluoride Emission Rate	g/hr	122.45	15.92	-	
Sulphur dioxide	mg/m ³	3.29	0.39	50	MCERTS
Sulphur dioxide Emission Rate	g/hr	963.24	113.66	-	
Ammonia	mg/m ³	28.00	3.39	50	MCERTS
Ammonia Emission Rate	g/hr	8537.31	1033.01	-	
Total Volatile Organic Compounds	mg/m ³	6.31	1.31	25	MCERTS
Total Volatile Organic Compounds Emission Rate	g/hr	1767.37	365.85	-	
Oxides of Nitrogen (as NO ₂)	mg/m ³	436.9	7.1	500	MCERTS
Oxides of Nitrogen (as NO ₂) Emission Rate	g/hr	127688.0	2076.6	-	
Carbon Monoxide	mg/m ³	306.5	2.1	1500	MCERTS
Carbon Monoxide Emission Rate	g/hr	89604.4	606.0	-	
Oxygen Day 1	% v/v	10.3	0.03	-	MCERTS
Oxygen Day 2	% v/v	10.8	0.03	-	MCERTS
Moisture	%	8.6	0.3	-	MCERTS
Stack Gas Temperature	°C	143.5	-	-	MCERTS
Stack Gas Velocity	m/s	24.5	0.6	-	
Gas Volumetric Flow Rate (Actual)	m ³ /hr	505192.4	25973.9	-	
Gas Volumetric Flow Rate (STP, Wet)	m ³ /hr	329639.0	16948.0	-	
Gas Volumetric Flow Rate (STP, Dry)	m ³ /hr	301412.0	15496.8	-	
Gas Volumetric Flow Rate at Reference Conditions	m ³ /hr	292449.0	15036.0	500000	

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 10% Oxygen.

EXECUTIVE SUMMARY

MONITORING TIMES			
Parameter	Sampling Date(s)	Sampling Times	Sampling Duration
Total Particulate Matter Run 1	25 October 2023	11:34 - 12:38	64 minutes
Dioxins & Furans Run 1	24 October 2023	10:50 - 16:50	360 minutes
Cadmium & Thallium Run 1	25 October 2023	10:14 - 11:18	64 minutes
Heavy Metals Run 1	25 October 2023	10:14 - 11:18	64 minutes
Mercury Run 1	25 October 2023	12:40 - 13:44	64 minutes
Hydrogen Chloride Run 1	24 October 2023	16:01 - 16:31	30 minutes
Hydrogen Fluoride Run 1	24 October 2023	14:30 - 15:00	30 minutes
Sulphur dioxide Run 1	24 October 2023	15:27 - 15:57	30 minutes
Ammonia Run 1	25 October 2024	11:34 - 12:38	64 minutes
Total Volatile Organic Compounds Run 1	25 October 2023	11:30 - 12:30	60 minutes
Combustion Gases	24 October 2023	13:15 - 14:15	60 minutes
Oxygen Day 2	25 October 2023	10:17 - 11:17	60 minutes
Preliminary Stack Traverse	24 October 2023	10:30	-

EXECUTIVE SUMMARY

PROCESS DETAILS

Parameter	Process Details
Description of process	Cement Kiln/Coal Mill
Continuous or batch	Continuous (On demand)
Product Details	Cement
Part of batch to be monitored (if applicable)	N/A
Normal load, throughput or continuous rating	TBC
Fuel used during monitoring	Per Coke
Abatement	Bag Filter and SNCR System
Plume Appearance	No plume Visible

EXECUTIVE SUMMARY

Monitoring Methods

Declaration: Unless otherwise stated as a deviation, work has been completed to conform to the specific requirements of the Irish EPA's monitoring guidance notes; AG1, AG2, and the index of preferred methods.

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 - EN 13284-1	AE 104	1015	MCERTS	0.75 mg/m ³	200%	15.07%
Dioxins & Furans	SRM - EN 1948 - Part 1	AE 109	1015	MCERTS	0.0012 ng/m ³	314.4%	4.9%
Cadmium & Thallium	SRM - EN 14385	AE 108	1015	MCERTS	0.00119 mg/m ³	168.4%	4.8%
Heavy Metals	SRM - EN 14385	AE 108	1015	MCERTS	0.004 mg/m ³	15.9%	2%
Mercury	SRM - EN 13211 / MID 14385	AE 107	1015	MCERTS	0.0005 mg/m ³	16.1%	2.9%
Hydrogen Chloride	SRM - EN 1911	AE 111	1015	MCERTS	0.003 mg/m ³	13.4%	0.23%
Hydrogen Fluoride	CEN/TS 17340	AE 113	1015	MCERTS	0.006 mg/m ³	13%	5.44%
Sulphur dioxide	SRM - EN 14791	AE 112	1015	MCERTS	0.053 mg/m ³	11.8%	0.78%
Ammonia	SRM - BS EN ISO 21877	AE 115	1015	MCERTS	0.0034 mg/m ³	12.1 %	6.8 %
Total Volatile Organic Compounds	SRM - EN 12619:2013	AE 102	1015	MCERTS	0 mg/m ³	20.7%	5.2%
Oxides of Nitrogen	SRM - EN 14792:2017	AE 102	1015	MCERTS	0.53 mg/m ³	1.6%	1.42%
Carbon Monoxide	SRM - EN 15058:2017	AE 102	1015	MCERTS	0.28 mg/m ³	0.7%	0.1%
Oxygen	SRM - EN 14789:2017	AE 102	1015	MCERTS	0.01%	0.3%	N/A - No ELV
Moisture	SRM - EN 14790	AE 105	1015	MCERTS	0.02%	3.3%	N/A - No ELV
Velocity	SRM - EN ISO 16911-1	AE 154	1015	MCERTS	5 Pa	2.4%	N/A - No ELV
Volumetric Flow Rate	SRM - EN ISO 16911-1	AE 154	1015	MCERTS	-	5.1%	3.01%

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 (East Kilbride)	N/A	8 Weeks
Dioxins and Furans	Gas Chromatography - High Resolution Mass Spectrometry	2002a	1668	MCERTS	Marchwood	23-62214 15/11/23-	8 Weeks
Cadmium & Thallium	Inductively coupled Plasma - Mass Spectrometry	ASC/SOP/117	1252	MCERTS	SOCOTEC (Bretby)	ASC/60331 09 Nov 2023	8 Weeks
Heavy Metals	Inductively coupled Plasma - Mass Spectrometry	ASC/SOP/117	1252	MCERTS	SOCOTEC (Bretby)	ASC/60331 09 Nov 2023	8 Weeks
Mercury	Inductively coupled plasma - mass spectrometry / Cold vapour - atomic fluorescence spectroscopy	ASC/SOP/112	1252	MCERTS	SOCOTEC (Bretby)	ASC/60331 09 Nov 2023	8 Weeks
Hydrogen Chloride	Ion Chromatography	ASC/SOP/110	1252	MCERTS	SOCOTEC (Bretby)	ASC/60332	8 Weeks
Hydrogen Fluoride	Ion Chromatography	ASC/SOP/110	1252	MCERTS	SOCOTEC (Bretby)	ASC/60332	8 Weeks
Sulphur dioxide	Ion Chromatography	ASC/SOP/110	1252	MCERTS	SOCOTEC (Bretby)	ASC/60332	8 Weeks
Ammonia	Ion Chromatography	ASC/SOP/108	1252	MCERTS	SOCOTEC (Bretby)	ASC/60332	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 (East Kilbride)	SOCOTEC (East Kilbride)	5 years
Oxides of Nitrogen	Chemiluminescence	AE 102	1015	MCERTS	SOCOTEC (East Kilbride)	SOCOTEC (East Kilbride)	5 years
Carbon Monoxide	Non Dispersive Infra Red	AE 102	1015	MCERTS	SOCOTEC (East Kilbride)	SOCOTEC (East Kilbride)	5 years
Oxygen	Paramagnetic	AE 102	1015	MCERTS	SOCOTEC (East Kilbride)	SOCOTEC (East Kilbride)	5 years
Moisture	Gravimetric	AE 105	1015	MCERTS	SOCOTEC (East Kilbride)	-	-

EXECUTIVE SUMMARY

SAMPLING LOCATION					
Sampling Plane Validation Criteria	Value	Units	Requirement	Compliant	Method
Lowest Differential Pressure	226	Pa	$\geq 5 \text{ Pa}$	Yes	EN 15259
Lowest Gas Velocity	19.4	m/s	-	-	-
Highest Gas Velocity	27.6	m/s	-	-	-
Ratio of Gas Velocities	1.4	: 1	$< 3 : 1$	Yes	EN 15259
Mean Velocity	24.5	m/s	-	-	-
Maximum angle of flow with regard to duct axis	< 15	$^{\circ}$	$< 15^{\circ}$	Yes	EN 15259
No local negative flow	Yes	-	-	Yes	EN 15259

DUCT CHARACTERISTICS		
	Value	Units
Shape	Circular	-
Depth	2.70	m
Width	-	m
Area	5.73	m ²
Port Depth	90	mm

SAMPLING LINES & POINTS		
	Isokinetic	Non-Iso & Gases
Sample port size	4" BSP	4" BSP
Number of lines used	2	1
Number of points / line	10	1
Duct orientation	Vertical	Vertical
Filtration	In Stack	In Stack
Filtration for TPM	In Stack	In Stack

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

AG1 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)	Yes
Platform has vertical base boards (approximately 0.25 m high)	Yes
Platform has removable chains / self closing gates at the top of ladders	Yes
Handrail / obstructions do not hamper insertion of sampling equipment	Yes
Depth of Platform = $> \text{Stack depth / diameter} + \text{wall and port thickness} + 1.5\text{m}$	Yes

Sampling Platform Improvement Recommendations (if applicable)

Increase platform depth to 50% of stack diameter plus 1.5 m. Install a second port on each line @ 180 degrees.

EXECUTIVE SUMMARY

Sampling & Analytical Method Deviations

Sampling points

Due to reduced work area and the platform not meeting all requirements outlined in AG1/EN 15259 it was no possible to sample at all points on both lines.

Calculated maximum uncertainties

The Calculated Maximum Uncertainties as a % of the result for several of the parameters (TPM, Dioxin, Cadmium/Thallium) were above the upper levels suggested in EPA Guidance Note AG2 Section 5.2. This is typically due to the low measured values, often at or around the Limit's of Detection. It should be noted that the MU's based on the Emission Limit Values are all below the AG2 levels.

Isokinetic sampling Nozzle

Due to high stack velocities a nozzle less than the recommended 6mm size was used in order to achieve the isokinetic sampling rate.

Absorbion efficiency

The absorbion efficiency of the HF impingers was less than the required 95%

APPENDICES

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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
Total Particulate Matter	SRM - EN 13284-1	AE 104	1015	MCERTS	1
Dioxins & Furans	SRM - EN 1948 - Part 1	AE 109	1015	MCERTS	1
Cadmium & Thallium	SRM - EN 14385	AE 108	1015	MCERTS	1
Heavy Metals	SRM - EN 14385	AE 108	1015	MCERTS	1
Mercury	SRM - EN 13211 / MID 14385	AE 107	1015	MCERTS	1
Hydrogen Chloride	SRM - EN 1911	AE 111	1015	MCERTS	1
Hydrogen Fluoride	CEN/TS 17340	AE 113	1015	MCERTS	1
Sulphur dioxide	SRM - EN 14791	AE 112	1015	MCERTS	1
Ammonia	SRM - BS EN ISO 21877	AE 115	1015	MCERTS	1
Total Volatile Organic Compounds	SRM - EN 12619:2013	AE 102	1015	MCERTS	1
Oxides of Nitrogen	SRM - EN 14792:2017	AE 102	1015	MCERTS	1
Carbon Monoxide	SRM - EN 15058:2017	AE 102	1015	MCERTS	1
Oxygen	SRM - EN 14789:2017	AE 102	1015	MCERTS	1
Moisture	SRM - EN 14790	AE 105	1015	MCERTS	2
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	LEK 9.49 / 9.44	Horiba PG - 350 Analyser	LEK 12.18	Laboratory Balance	LEK 15.21
Box Thermocouples	LEK 9.50 / 9.46	FT-IR	-	Tape Measure	LEK 20.2
Meter In Thermocouple	LEK 9.50 / 9.46	FT-IR Oven Box	-	Stopwatch	-
Meter Out Thermocouple	LEK 9.50 / 9.46	Bernath 3006 FID	LEK 8.4	Protractor	-
Control Box Timer	LEK 17.27 / 17.25	Signal 3030 FID	-	Barometer	LEK 16.13
Oven Box	LEK 13.25	Servomex	-	Digital Micromanometer	LEK 1.20
Probe	LEK 6.21	JCT Heated Head Filter	LEK 13.32a	Digital Temperature Meter	LEK 2.11
Probe Thermocouple	LEK 3.21	Thermo FID	-	Stack Thermocouple	-
Probe	LEK 6.17	Stackmaster	-	Mass Flow Controller	-
Probe Thermocouple	LEK 3.17	FTIR Heater Box for Heated Line	-	MFC Display module	-
S-Pitot	LEK 6.21	Anemometer	-	1m Heated Line (1)	-
L-Pitot	-	Ecophysics NOx Analyser	-	1m Heated Line (2)	-
Site Balance	LEK 23.24	Chiller (JCT/MAK 10)	LEK 12.12	1m Heated Line (3)	-
Last Impinger Arm	LEK 3.109	Heated Line Controller (1)	LEK 8.49	5m Heated Line (1)	-
Dioxins Cond. Thermocouple	LEK 3.209	Heated Line Controller (2)	-	10m Heated Line (1)	-
Callipers	LEK 15.1X	Site temperature Logger	-	10m Heated Line (2)	-
Small DGM	-			15m Heated Line (1)	-
Heater Controller	-			20m Heated Line (1)	LEK 8.49
Inclinometer (Swirl Device)	LEK 24.15			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	-	20.95	-
Propane	LEK 232	BOC	82.8	-	2.0
Nitric Oxide	LEK 293	BOC	207	-	2.0
Carbon Monoxide	LEK 293	BOC	157	-	2.0
Carbon Dioxide	LEK 293	BOC	-	16.4	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
Brian Walsh	MM 17 1414	MCERTS Level 2	Nov-23	Dec-27	Nov-23	Nov-23	May-28	May-25
Aidan Whitney	MM 20 1603	MCERTS Level 2	Sep-25	Mar-27	-	Mar-28	May-27	Sep-25

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	11:34 - 12:38 25 October 2023	0.75	1.51	10	229.71
Blank	-	0.70	-	-	-

Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

Acetone Blank Value mg/l	Acceptable Value mg/l
0.3	10

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	AQ 5126	0.14045	0.13973	-0.00072	55.65740	55.65721	-0.00019	0.00059

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	AQ 5102	0.14238	0.14238	0.00000	55.76344	55.76340	-0.00004	0.00059

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

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	101.0	CO ₂	% 18.85
Stack static pressure, P _{static}	pa	-450.0	O ₂	% 10.78
P _s = P _b + P _{static}	Kpa	100.6	Total	% 29.63
			N ₂ (100 -Total)	% 70.37
Vol. of water vapour collected, V_{wstd}			Molecular weight of wet gas, M_s	
Moisture trap weight increase, V _{lc}	g	H ₂ O by Non Iso	M _d = 0.44(%CO ₂)+0.32(%O ₂)+0.28(%N ₂)	31.45
V _{wstd} = (0.001246)(V _{lc})	m ³	-	M _s = M _d (1 - B _{wO}) + 18(B _{wO})	g/gmol 30.30
Volume of gas metered dry, V_{mstd}			Actual flow of stack gas, Q_a	
Volume of gas sample through gas meter, V _m		0.895	Area of stack, A _s	m ² 5.73
Gas meter correction factor, Y _d		1.049	Q _a = (60)(A _s)(V _s)	m ³ /min 9186.4
Mean dry gas meter temperature, T _m		304	Total flow of stack gas, Q	
Mean pressure drop across orifice, DH	mmH ₂ O	21.898	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	0.843	Q _{std} = $\frac{(Q_a)P_s(0.3592)(1-B_{wO})}{(T_s)}$	Dry 5469.7
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 5082.54
V _{mstw} = V _{mstd} + V _{wstd}	m ³	0.9219	Q _{stw} = $\frac{(Q_a)P_s(0.3592)}{(T_s)}$	Wet 5981.89
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 3.98
% oxygen measured in gas stream, act%O ₂		10.8	Nozzle area, A _n	mm ² 12.46
% oxygen reference condition		10	Total sampling time, q	min 64
O ₂ Reference O ₂ Ref = 21.0 - act%O ₂		0.93	%I = $\frac{(4.6398E6)(T_s)(V_{mstd})}{(P_s)(V_s)(A_n)(q)(1-B_{wO})}$	% 110.6
Factor $\frac{21.0 - ref\%O_2}{21.0 - act\%O_2}$			Acceptable isokinetic range 95% to 115%	Yes
V _{mstd@X%oxygen} = (V _{mstd}) (O ₂ Ref)	m ³	0.7833	Particulate Concentration, C	
Moisture content, B_{wO}			Mass collected on filter, M _f	g -0.00072
B _{wO} = $\frac{V_{wstd}}{V_{mstd} + V_{wstd}}$	%	8.56	Mass collected in probe, M _p	g -0.00019
Moisture by FTIR			Total mass collected, M _n	g 0.00059
			C _{wet} = $\frac{M_n}{V_{mstw}}$	mg/m ³ 0.640
Velocity of stack gas, V_s			C _{dry} = $\frac{M_n}{V_{mstd}}$	mg/m ³ 0.700
Velocity pressure coefficient, C _p		0.84	C _{dry@X%O₂} = $\frac{M_n}{V_{mstd@X\%oxygen}}$	mg/m ³ 0.753
Mean of velocity heads, DP _{avg}	Pa	446.51	Particulate Emission Rates, E	
Mean stack gas temperature, T _s	K	416	E = $[(C_{wet})(Q_{stw})(60)] / 1000$	229.71
Gas density (wet, ambient), ρ	kg/m ³	0.881		
ρ = (M _s *P _s)/(8.314*T _s)				
Stack Velocity, V _s	$V_s = \frac{\sum_{i=1}^n V_i}{n}$	m/s 26.74		

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

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	14.66	0.12	-	-406.4	0.29	Yes

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

ISOKINETICITY		
Run	Isokinetic Variation %	Acceptable Isokineticity
Run 1	110.63	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	0.75	0.5	No

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	0.70	10	1.0	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	47	QF	143	180	160

DIOXINS & FURANS SUMMARY - UPPER LIMIT

NATO I-TEQ					
Test	Sampling Times	Concentration ng/m ³	LOD ng/m ³	ELV ng/m ³	Emission Rate µg/hr
Run 1	10:50 - 16:50 24 October 2023	0.0016	0.0012	0.1	0.41
Field Blanks Run 1	-	0.003115	0.00295	-	-

WHO TEQ (Humans / Mammals)					
Test	Sampling Times	Concentration ng/m ³	LOD ng/m ³	ELV ng/m ³	Emission Rate µg/hr
Run 1	10:50 - 16:50 24 October 2023	0.0017	0.0014	-	0.46
Field Blanks Run 1	-	0.00353	0.00336	-	-

WHO TEQ (Fish)					
Test	Sampling Times	Concentration ng/m ³	LOD ng/m ³	ELV ng/m ³	Emission Rate µg/hr
Run 1	10:50 - 16:50 24 October 2023	0.0016	0.0015	-	0.43
Field Blanks Run 1	-	0.00374	0.00366	-	-

WHO TEQ (Birds)					
Test	Sampling Times	Concentration ng/m ³	LOD ng/m ³	ELV ng/m ³	Emission Rate µg/hr
Run 1	10:50 - 16:50 24 October 2023	0.0046	0.0020	-	1.21
Field Blanks Run 1	-	0.00553	0.00385	-	-

Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

DIOXINS & FURANS SUMMARY - LOWER LIMIT

NATO I-TEQ					
Test	Sampling Times	Concentration ng/m ³	LOD ng/m ³	ELV ng/m ³	Emission Rate µg/hr
Run 1	10:50 - 16:50 24 October 2023	0.0004	-	0.1	0.11
Field Blanks Run 1	-	0.0001944	-	-	-

WHO TEQ (Humans / Mammals)					
Test	Sampling Times	Concentration ng/m ³	LOD ng/m ³	ELV ng/m ³	Emission Rate µg/hr
Run 1	10:50 - 16:50 24 October 2023	0.0004	-	-	0.11
Field Blanks Run 1	-	0.00019319	-	-	-

WHO TEQ (Fish)					
Test	Sampling Times	Concentration ng/m ³	LOD ng/m ³	ELV ng/m ³	Emission Rate µg/hr
Run 1	10:50 - 16:50 24 October 2023	0.0002	-	-	0.06
Field Blanks Run 1	-	0.000096326	-	-	-

WHO TEQ (Birds)					
Test	Sampling Times	Concentration ng/m ³	LOD ng/m ³	ELV ng/m ³	Emission Rate µg/hr
Run 1	10:50 - 16:50 24 October 2023	0.0031	-	-	0.83
Field Blanks Run 1	-	0.00192652	-	-	-

Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

DIOXINS & FURANS ANALYSIS SUMMARY - RUN 1

NATO I-TEQ & WHO TEQ (Humans / Mammals)							
Congener	Result ng	NATO I-TEQ ng	WHO TEQ Humans / Mammals ng	Extraction Recovery		Sampling Recovery	
				Actual %	Permitted %	Actual %	Permitted %
Dioxins							
2,3,7,8 Tetra CDD	< 0.00386	0.0039	0.0039	100	50% - 130%		
1,2,3,7,8 Penta CDD	< 0.00241	0.0012	0.0024	80	50% - 130%		
1,2,3,4,7,8 Hexa CDD	< 0.00105	0.0001	0.0001	86	50% - 130%		
1,2,3,6,7,8 Hexa CDD	< 0.00127	0.0001	0.0001	79	50% - 130%		
1,2,3,7,8,9 Hexa CDD	< 0.0012	0.0001	0.0001		-		
1,2,3,4,6,7,8 Hepta CDD	0.014	0.0001	0.0001	75	40% - 130%		
OCDD Octa CDD	0.0196	0.0000	0.0000	80	40% - 130%		
Total -Dioxins	0.04339	0.0056	0.0068				
Furans							
2,3,7,8 Tetra CDF	0.0163	0.0016	0.0016	82	50% - 130%		
1,2,3,7,8 Penta CDF	< 0.00099	0.0000	0.0000		-	108	>=50
2,3,4,7,8 Penta CDF	< 0.00096	0.0005	0.0003	80	50% - 130%		
1,2,3,4,7,8 Hexa CDF	< 0.00058	0.0001	0.0001	81	50% - 130%		
1,2,3,6,7,8 Hexa CDF	< 0.00057	0.0001	0.0001	79	50% - 130%		
2,3,4,6,7,8 Hexa CDF	0.00281	0.0003	0.0003	83	50% - 130%		
1,2,3,7,8,9 Hexa CDF	< 0.00044	0.0000	0.0000		-	72	>=50
1,2,3,4,6,7,8 Hepta CDF	0.00695	0.0001	0.0001	70	40% - 130%		
1,2,3,4,7,8,9 Hepta CDF	< 0.00043	0.0000	0.0000		-	100	>=50
OCDF Octa CDF	0.00696	0.0000	0.0000	69	40% - 130%		
Total -Furans	0.03699	0.0027	0.0025				
Mean Recoveries (%)				80		93	
Total Isomers	0.08038	0.0083	0.0092				
Total ITEQ (<LOD = 0)		0.0021	0.0021				

NOTE: The Total Isomers result includes all isomers below the limit of detection. This gives a "worst case" Dioxins & Furans result.

DIOXINS & FURANS ANALYSIS SUMMARY - RUN 1

WHO TEQ (Fish) & WHO TEQ (Birds)							
Congener	Result ng	WHO TEQ Fish ng	WHO TEQ Birds ng	Extraction Recovery		Sampling Recovery	
				Actual %	Permitted %	Actual %	Permitted %
Dioxins							
2,3,7,8 Tetra CDD	< 0.00386	0.0039	0.0039	100	50% - 130%		
1,2,3,7,8 Penta CDD	< 0.00241	0.0024	0.0024	80	50% - 130%		
1,2,3,4,7,8 Hexa CDD	< 0.00105	0.0005	0.0001	86	50% - 130%		
1,2,3,6,7,8 Hexa CDD	< 0.00127	0.0000	0.0000	79	50% - 130%		
1,2,3,7,8,9 Hexa CDD	< 0.0012	0.0000	0.0000		-		
1,2,3,4,6,7,8 Hepta CDD	0.014	0.0000	0.0000	75	40% - 130%		
OCDD Octa CDD	0.0196	-	-	80	40% - 130%		
Total -Dioxins	0.04339	0.0068	0.0064				
Furans							
2,3,7,8 Tetra CDF	0.0163	0.0008	0.0163	82	50% - 130%		
1,2,3,7,8 Penta CDF	< 0.00099	0.0000	0.0000		-	108	>=50
2,3,4,7,8 Penta CDF	< 0.00096	0.0005	0.0010	80	50% - 130%		
1,2,3,4,7,8 Hexa CDF	< 0.00058	0.0001	0.0001	81	50% - 130%		
1,2,3,6,7,8 Hexa CDF	< 0.00057	0.0001	0.0001	79	50% - 130%		
2,3,4,6,7,8 Hexa CDF	0.00281	0.0003	0.0003	83	50% - 130%		
1,2,3,7,8,9 Hexa CDF	< 0.00044	0.0000	0.0000		-	72	>=50
1,2,3,4,6,7,8 Hepta CDF	0.00695	0.0001	0.0001	70	40% - 130%		
1,2,3,4,7,8,9 Hepta CDF	< 0.00043	0.0000	0.0000		-	100	>=50
OCDF Octa CDF	0.00696	0.0000	0.0000	69	40% - 130%		
Total -Furans	0.03699	0.0019	0.0178				
Mean Recoveries (%)				80		93	
Total Isomers	0.08038	0.0087	0.0241				
Total ITEQ (<LOD = 0)		0.0012	0.0167				

NOTE: The Total Isomers result includes all isomers below the limit of detection. This gives a "worst case" Dioxins & Furans result.

DIOXINS & FURANS ANALYSIS SUMMARY - FIELD BLANK RUN 1

NATO I-TEQ & WHO TEQ (Humans / Mammals)							
Congener	Result ng	NATO I-TEQ ng	WHO TEQ Humans / Mammals ng	Extraction Recovery		Sampling Recovery	
				Actual %	Permitted %	Actual %	Permitted %
Dioxins							
2,3,7,8 Tetra CDD	< 0.0074	0.007400	0.007400	94	50% - 130%		
1,2,3,7,8 Penta CDD	< 0.006	0.003000	0.006000	80	50% - 130%		
1,2,3,4,7,8 Hexa CDD	< 0.0042	0.000420	0.000420	88	50% - 130%		
1,2,3,6,7,8 Hexa CDD	< 0.0045	0.000450	0.000450	92	50% - 130%		
1,2,3,7,8,9 Hexa CDD	< 0.0042	0.000420	0.000420		-		
1,2,3,4,6,7,8 Hepta CDD	< 0.005	0.000050	0.000050	86	40% - 130%		
OCDD Octa CDD	0.0095	0.000010	0.000003	95	40% - 130%		
TOTAL 2,3,7,8-Dioxins	0.0408	0.0117	0.0147				
Furans							
2,3,7,8 Tetra CDF	0.0102	0.001020	0.001020	76	50% - 130%		
1,2,3,7,8 Penta CDF	< 0.0037	0.000185	0.000111		-	106	>=50
2,3,4,7,8 Penta CDF	< 0.0036	0.001800	0.001080	78	50% - 130%		
1,2,3,4,7,8 Hexa CDF	< 0.0045	0.000450	0.000450	88	50% - 130%		
1,2,3,6,7,8 Hexa CDF	< 0.0042	0.000420	0.000420	89	50% - 130%		
2,3,4,6,7,8 Hexa CDF	< 0.0044	0.000440	0.000440	79	50% - 130%		
1,2,3,7,8,9 Hexa CDF	< 0.0037	0.000370	0.000370		-	77	>=50
1,2,3,4,6,7,8 Hepta CDF	< 0.0025	0.000025	0.000025	80	40% - 130%		
1,2,3,4,7,8,9 Hepta CDF	< 0.003	0.000030	0.000030		-	98	>=50
OCDF Octa CDF	< 0.0039	0.000004	0.000001	85	40% - 130%		
TOTAL 2,3,7,8-Furans	0.0437	0.0047	0.0039				
Mean Recoveries (%)				85		94	
Total Isomers	0.0845	0.0165	0.0187				
Total ITEQ (<LOD = 0)		0.0010295	0.0010229				

NOTE: The Total Isomers result includes all isomers below the limit of detection. This gives a "worst case" Dioxins & Furans result.

DIOXINS & FURANS ANALYSIS SUMMARY - FIELD BLANK RUN 1

Congener	WHO TEQ (Fish) & WHO TEQ (Birds)						
	Result	WHO TEQ Fish	WHO TEQ Birds	Extraction Recovery		Sampling Recovery	
				Actual	Permitted	Actual	Permitted
ng	ng	ng	%	%	%	%	
Dioxins							
2,3,7,8 Tetra CDD	< 0.0074	0.007400	0.007400	94	50% - 130%		
1,2,3,7,8 Penta CDD	< 0.006	0.006000	0.006000	80	50% - 130%		
1,2,3,4,7,8 Hexa CDD	< 0.0042	0.002100	0.000210	88	50% - 130%		
1,2,3,6,7,8 Hexa CDD	< 0.0045	0.000045	0.000045	92	50% - 130%		
1,2,3,7,8,9 Hexa CDD	< 0.0042	0.000042	0.000042	-	-		
1,2,3,4,6,7,8 Hepta CDD	< 0.005	0.000005	0.000005	86	40% - 130%		
OCDD Octa CDD	0.0095	-	-	95	40% - 130%		
TOTAL 2,3,7,8-Dioxins	0.0408	0.0156	0.0137				
Furans							
2,3,7,8 Tetra CDF	0.0102	0.000510	0.010200	76	50% - 130%		
1,2,3,7,8 Penta CDF	< 0.0037	0.000185	0.000037		-	106	>=50
2,3,4,7,8 Penta CDF	< 0.0036	0.001800	0.003600	78	50% - 130%		
1,2,3,4,7,8 Hexa CDF	< 0.0045	0.000450	0.000450	88	50% - 130%		
1,2,3,6,7,8 Hexa CDF	< 0.0042	0.000420	0.000420	89	50% - 130%		
2,3,4,6,7,8 Hexa CDF	< 0.0044	0.000440	0.000440	79	50% - 130%		
1,2,3,7,8,9 Hexa CDF	< 0.0037	0.000370	0.000370		-	77	>=50
1,2,3,4,6,7,8 Hepta CDF	< 0.0025	0.000025	0.000025	80	40% - 130%		
1,2,3,4,7,8,9 Hepta CDF	< 0.003	0.000030	0.000030		-	98	>=50
OCDF Octa CDF	< 0.0039	0.000000	0.000000	85	40% - 130%		
TOTAL 2,3,7,8-Furans	0.0437	0.0042	0.0156				
Mean Recoveries (%)				85		94	
Total Isomers	0.0845	0.0198	0.0293				
Total ITEQ (<LOD = 0)		0.0005100	0.0102000				

NOTE: The Total Isomers result includes all isomers below the limit of detection. This gives a "worst case" Dioxins & Furans result.

ISOKINETIC SAMPLING EQUATIONS - RUN 1			Dioxins & Furans		
Absolute pressure of stack gas, P_s			Molecular weight of dry gas, M_d		
Barometric pressure, P _b	kPa	100.10	CO ₂	%	18.85
Stack static pressure, P _{static}	Pa	-450.00	O ₂	%	10.33
P _s = P _b + (P _{static})	kPa	99.65	Total	%	29.18
			N ₂ (100 -Total)	%	70.82
			M _d = 0.44(%CO ₂)+0.32(%O ₂)+0.28(%N ₂)		31.43
Vol. of water vapour collected, V_{wstd}			Molecular weight of wet gas, M_s		
Moisture trap weight increase, V _{lc}	g	H ₂ O by Non Iso	M _s = M _d (1 - B _{wO}) + 18(B _{wO})	g/gmol	30.28
V _{wstd} = (0.001246)(V _{lc})	m ³	-	Velocity of stack gas, V_s		
Volume of gas metered dry, V_{mstd}			Velocity pressure coefficient, C _p		
Volume of gas sample through gas meter, V _m	m	6.43	Mean of velocity heads, DP _{avg}	Pa	0.84
Gas meter correction factor, Y _d		0.95	Mean stack gas temperature, T _s	K	310.88
Mean dry gas meter temperature, T _m		303.19	Gas density (wet, ambient), ρ		
Mean pressure drop across orifice, DH	mmH ₂ O	38.15	ρ = (M _s *P _s)/(8.314*T _s)	kg/m ³	0.873
V _{mstd} = (0.3592)(V _m)(P _b +(DH/13.6))(Y _d)	m ³	5.46	Stack Velocity, V _s	$V_s = \frac{\sum_{i=1}^n V_i}{n}$	m/s
					22.38
Volume of gas metered wet, V_{mstw}			Actual flow of stack gas, Q_a		
V _{mstw} = V _{mstd} + V _{wstd}	m ³	5.9678	Area of stack, A _s	m ²	5.73
Vol. of gas metered at O₂ Ref. Cond., V_{mstd@X%O2}			Q _a = (60)(A _s)(V _s)		
Is the process burning hazardous waste? (If yes, no favourable oxygen correction)	No		Q _a = (60)(A _s)(V _s)	m ³ /min	7690.1
% oxygen measured in gas stream, act%O ₂	10.33		Total flow of stack gas, Q		
% oxygen reference condition	10		Conversion factor (K/mm.Hg)		
O ₂ Reference	21.0 - act%O ₂	0.97	Q _{std} = $\frac{(Q_a)P_s(0.3592)(1-B_{wO})}{(T_s)}$	Dry	4539.3
Factor	21.0 - ref%O ₂		Q _{stdO2} = $\frac{(Q_a)P_s(0.3592)(1-B_{wO})(O_2REF)}{(T_s)}$	@O2ref	4404
V _{mstd@X%oxygen} = (V _{mstd}) (O ₂ Ref)	m ³	5.29	Q _{stw} = $\frac{(Q_a)P_s(0.3592)}{(T_s)}$	Wet	4964
Moisture content, B_{wO}			Percent isokinetic, %I		
B _{wO} = $\frac{V_{wstd}}{V_{mstd} + V_{wstd}}$	%	0.0856	Nozzle diameter, D _n	mm	5.0
		8.56	Nozzle area, A _n	mm ²	19.6
Moisture by FTIR			Total sampling time, q		
	%	-	%I = $\frac{(4.6398E6)(T_s)(V_{mstd})}{(P_s)(V_s)(A_n)(q)(1-B_{wO})}$	%	97.8
			Acceptable isokinetic range 95% to 115%		
					Yes

DIOXINS & FURANS QUALITY ASSURANCE CHECKLIST

Leak Test Results	Mean Sampling Rate litre/min	Pre-sampling Leak Rate litre/min	Post-sampling Leak Rate litre/min	Maximum Vacuum mm Hg	Leak Tests Acceptable litre/min	Acceptable Leak Rate litre/min	Leak Tests Acceptable litre/min
Run 1	16.98	0.41	0.39	-381	Yes	0.85	Yes

Isokinetic Criterion Compliance	Isokinetic Variation %	Acceptable Isokineticity %
Run 1	97.8	Yes

Acceptable isokinetic range 95% to 115%

Filtration	Filter Material	Filter Size mm	Maximum Filtration Temperature °C
Run 1	Glass Fibre	47	120

Critical Sampling Requirement	Maximum Temperature at Condenser / Adsorber °C	Acceptable Temperature?	Temperature during storage / transit <25°C
Run 1	16	Yes	Yes
Acceptance Criteria	< 20°C	-	< 25°C

HEAVY METALS SOLID & VAPOUR PHASES COMBINED

CADMIUM & THALLIUM COMBINED					
Test	Sampling Times	Concentration mg/m ³	LOD mg/m ³	ELV mg/m ³	Emission Rate g/hr
Run 1	10:14 - 11:18 25 October 2023	0.0014	0.0012	0.05	0.36
Field Blank	-	0.0012	-	-	-

TOTAL HEAVY METALS COMBINED					
Test	Sampling Times	Concentration mg/m ³	LOD mg/m ³	ELV mg/m ³	Emission Rate g/hr
Run 1	10:14 - 11:18 25 October 2023	0.063	0.0038	0.5	15.9
Field Blank	-	0.0054	-	-	-

Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

INDIVIDUAL METALS SUMMARY - SOLID & VAPOUR PHASES COMBINED

Metals	LOD mg/m ³	Concentration mg/m ³	Emission Rate g/hr	Uncertainty %	UKAS Accredited
Cadmium	0.00055	0.00076	0.191	137%	✓
Thallium	0.00066	0.00068	0.172	183%	✓
Cadmium & Thallium	0.00119	0.00144	0.363	168.4%	-

Metals	LOD mg/m ³	Concentration mg/m ³	Emission Rate g/hr	Uncertainty %	UKAS Accredited
Arsenic	0.00045	0.00047	0.118	177%	✓
Antimony	0.00045	0.00051	0.128	164%	✓
Chromium	0.00034	0.03749	9.448	24%	✓
Cobalt	0.00024	0.00026	0.065	162%	✓
Copper	0.00055	0.01759	4.433	15%	✓
Lead	0.00055	0.00268	0.674	40%	✓
Manganese	0.00045	0.00153	0.386	55%	✓
Nickel	0.00045	0.00205	0.516	45%	✓
Vanadium	0.00034	0.00051	0.129	123%	✓
Sum of Heavy Metals (Excluding Cd / Tl)	0.00381	0.06308	15.897	15.9%	-

Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

HEAVY METALS - RUN 1 SUMMARY

Metals	PARTICULATE PHASE			VAPOUR PHASE		
	Stack LOD mg/m ³	Laboratory Result ug	Concentration mg/m ³	Stack LOD mg/m ³	Laboratory Result ug	Concentration mg/m ³
Cadmium	0.00053	0.50	0.00053	0.00002	0.22	0.00023
Thallium	0.00063	0.60	0.00063	0.00002	0.05	0.00005
Cadmium & Thallium	0.00116	1.10	0.00116	0.00002	0.26	0.00028
Volume Sampled m ³			0.9465			0.9465

Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

Metals	PARTICULATE PHASE			VAPOUR PHASE		
	Stack LOD mg/m ³	Laboratory Result ug	Concentration mg/m ³	Stack LOD mg/m ³	Laboratory Result ug	Concentration mg/m ³
Arsenic	0.00042	0.40	0.00042	0.00002	0.04500	0.00005
Antimony	0.00042	0.40	0.00042	0.00002	0.07950	0.00008
Chromium	0.00032	1.00	0.00106	0.00002	34.48500	0.03643
Cobalt	0.00021	0.20	0.00021	0.00002	0.04500	0.00005
Copper	0.00053	15.00	0.01585	0.00002	1.65000	0.00174
Lead	0.00053	1.00	0.00106	0.00002	1.53300	0.00162
Manganese	0.00042	0.80	0.00085	0.00002	0.64950	0.00069
Nickel	0.00042	1.00	0.00106	0.00002	0.93900	0.00099
Vanadium	0.00032	0.30	0.00032	0.00002	0.18300	0.00019
Sum of Heavy Metals	0.00359	20.10	0.02124	0.00021	39.60900	0.04185
Volume Sampled m ³			0.9465			0.9465

Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

HEAVY METALS - BLANK SUMMARY

Metals	PARTICULATE PHASE			VAPOUR PHASE		
	Stack LOD mg/m ³	Laboratory Result ug	Concentration mg/m ³	Stack LOD mg/m ³	Laboratory Result ug	Concentration mg/m ³
Cadmium	0.00053	0.50	0.00053	0.00002	0.04	0.00004
Thallium	0.00053	0.60	0.00063	0.00002	0.04	0.00004
Cadmium & Thallium	0.00106	1.10	0.00116	0.00002	0.07	0.00007
Volume Sampled m ³		0.9465			0.9465	

Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

Metals	PARTICULATE PHASE			VAPOUR PHASE		
	Stack LOD mg/m ³	Laboratory Result ug	Concentration mg/m ³	Stack LOD mg/m ³	Laboratory Result ug	Concentration mg/m ³
Arsenic	0.00042	0.40	0.00042	0.00002	0.04	0.00004
Antimony	0.00042	0.60	0.00063	0.00002	0.04	0.00004
Chromium	0.00032	0.70	0.00074	0.00002	0.25	0.00026
Cobalt	0.00021	0.20	0.00021	0.00002	0.04	0.00004
Copper	0.00053	0.50	0.00053	0.00002	0.07	0.00007
Lead	0.00053	0.40	0.00042	0.00002	0.04	0.00004
Manganese	0.00042	0.90	0.00095	0.00002	0.07	0.00007
Nickel	0.00042	0.50	0.00053	0.00002	0.04	0.00004
Vanadium	0.00032	0.30	0.00032	0.00002	0.04	0.00004
Sum of Heavy Metals	0.00359	4.50	0.00475	0.00021	0.60	0.00063
Volume Sampled m ³		0.9465			0.9465	

Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

ISOKINETIC SAMPLING EQUATIONS RUN 1			Heavy Metals	
Absolute pressure of stack gas, P_s			Molecular weight of dry gas, M_d	
Barometric pressure, P _b	kPa	100.20	CO ₂	% 18.85
Stack static pressure, P _{static}	Pa	-450.00	O ₂	% 10.78
P _s = P _b + (P _{static})	kPa	99.75	Total	% 29.63
			N ₂ (100 -Total)	% 70.37
			M _d = 0.44(%CO ₂)+0.32(%O ₂)+0.28(%N ₂)	31.45
Vol. of water vapour collected, V_{wstd}			Molecular weight of wet gas, M_s	
Moisture trap weight increase, V _{lc}	g	H ₂ O by Non Iso	M _s = M _d (1 - B _{w0}) + 18(B _{w0})	g/gmol 30.30
V _{wstd} = (0.001246)(V _{lc})	m ³	-		
Volume of gas metered dry, V_{mstd}			Velocity of stack gas, V_s	
Volume of gas sample through gas meter, V _m	m ³	1.20	Velocity pressure coefficient, C _p	0.84
Gas meter correction factor, Y _d		0.95	Mean of velocity heads, DP _{avg}	Pa 305.03
Mean dry gas meter temperature, T _m		304.31	Mean stack gas temperature, T _s	K 413.00
Mean pressure drop across orifice, DH	mmH ₂ O	37.32	Gas density (wet, ambient), ρ	
			ρ = (M _s *P _s)/(8.314*T _s)	kg/m ³ 0.880
			Stack Velocity, V _s = $\frac{\sum_{i=1}^n V_i}{n}$	m/s 22.11
V _{mstd} = $\frac{(0.3592)(V_m)(P_b+(DH/13.6))(Y_d)}{T_m + 273}$	m ³	1.02	Actual flow of stack gas, Q_a	
			Area of stack, A _s	m ² 5.73
Volume of gas metered wet, V_{mstw}			Q _a = (60)(A _s)(V _s)	
V _{mstw} = V _{mstd} + V _{wstd}	m ³	1.1140	m ³ /min 7596.8	
Vol. of gas metered at O₂ Ref. Cond., V_{mstd@X%O2}			Total flow of stack gas, Q	
Is the process burning hazardous waste? (If yes, no favourable oxygen correction)		No	Conversion factor (K/mm.Hg)	
% oxygen measured in gas stream, act%O ₂		10.78	Q _{std} = $\frac{(Q_a)P_s(0.3592)(1-B_{w0})}{(T_s)}$	Dry 4519.8
% oxygen reference condition		10	Q _{stdO2} = $\frac{(Q_a)P_s(0.3592)(1-B_{w0})(O_2REF)}{(T_s)}$	@O2ref 4200
O ₂ Reference		0.93	Q _{stw} = $\frac{(Q_a)P_s(0.3592)}{(T_s)}$	Wet 4943
Factor			Percent isokinetic, %I	
V _{mstd@X%oxygen} = (V _{mstd}) (O ₂ Ref)	m ³	0.95	Nozzle diameter, D _n	mm 5.0
Moisture content, B_{w0}			Nozzle area, A _n	mm ² 19.4
B _{w0} = $\frac{V_{wstd}}{V_{mstd} + V_{wstd}}$	%	0.0856	Total sampling time, q	min 64.0
		8.56	%I = $\frac{(4.6398E6)(T_s)(V_{mstd})}{(P_s)(V_s)(A_n)(q)(1-B_{w0})}$	% 103.8
Moisture by FTIR			Acceptable isokinetic range 95% to 115%	
	%	-	Yes	

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

HEAVY METALS QA CHECKLIST

Leak Test Results	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 litre/min
Run 1	17.9	0.24	-	-406.4	0.36	Yes

Isokinetic Criterion Compliance	Isokinetic Variation %	Acceptable Isokineticity
Run 1	103.8	Yes

Filtration / Temp	Filter Material	Filter Size mm	Maximum Filtration Temperature °C	Temperature during storage / transit <25°C
Run 1	Quartz Fibre	47	160	Yes

Metals	Type of Absorbers - Metals	Absorption Solutions - Metals
Run 1	Glass	3.3% Nitric Acid, 1.5% Hydrogen Peroxide

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

HEAVY METALS ABSORPTION EFFICIENCY

Parameter		Total ug	3rd Absorber ug	Absorption Efficiency (%)	Required %	Pass / Fail
Cadmium	Run 1	0.71750	ND	100	90	N/A <30% ELV
Thallium	Run 1	0.64500	ND	100	90	N/A <30% ELV
Arsenic	Run 1	0.44500	ND	100	90	N/A <30% ELV
Antimony	Run 1	0.47950	ND	100	90	N/A <30% ELV
Chromium	Run 1	35.48500	1.37	96	90	N/A <30% ELV
Cobalt	Run 1	0.24500	ND	100	90	N/A <30% ELV
Copper	Run 1	16.65000	0.06	100	90	N/A <30% ELV
Lead	Run 1	2.53300	0.08	97	90	N/A <30% ELV
Manganese	Run 1	1.44950	0.06	96	90	N/A <30% ELV
Nickel	Run 1	1.93900	0.04	98	90	N/A <30% ELV
Vanadium	Run 1	0.48300	ND	100	90	N/A <30% ELV

MERCURY SUMMARY - PARTICULATE & VAPOUR PHASES COMBINED

MERCURY COMBINED					
Test	Sampling Times	Concentration mg/m ³	LOD mg/m ³	ELV mg/m ³	Emission Rate g/hr
Run 1	12:40 - 13:44 25 October 2023	0.0089	0.0005	0.05	2.43
Field Blank	-	0.0006	-	-	-

Mercury	PARTICULATE PHASE			VAPOUR PHASE		
	Stack LOD mean mg/m ³	Lab Result ug	Concentration mg/m ³	Stack LOD mean mg/m ³	Lab Result ug	Concentration mg/m ³
Run 1	0.00052	0.50	0.0005	0.00002	8.05	0.0084
Volume Sampled m ³		0.9599			0.9599	
Field Blank	-	0.50	0.0005	-	0.04	0.0000
Volume Sampled m ³		0.9599			0.9599	

ISOKINETIC SAMPLING EQUATIONS RUN 1			Mercury
Absolute pressure of stack gas, P_s			Molecular weight of dry gas, M_d
Barometric pressure, P _b	kPa	100.20	CO ₂ % 18.85
Stack static pressure, P _{static}	Pa	-450.00	O ₂ % 10.78
P _s = P _b + (P _{static})	kPa	99.75	Total % 29.63
			N ₂ (100 -Total) % 70.37
			M _d = 0.44(%CO ₂)+0.32(%O ₂)+0.28(%N ₂) 31.45
Vol. of water vapour collected, V_{wstd}			Molecular weight of wet gas, M_s
Moisture trap weight increase, V _{lc}	g	H ₂ O by Non Iso	M _s = M _d (1 - B _{w0}) + 18(B _{w0}) g/gmol 30.30
V _{wstd} = (0.001246)(V _{lc})	m ³	-	
Volume of gas metered dry, V_{mstd}			Velocity of stack gas, V_s
Volume of gas sample through gas meter, V _m	m ³	1.22	Velocity pressure coefficient, C _p 0.84
Gas meter correction factor, Y _d		0.95	Mean of velocity heads, DP _{avg} Pa 358.56
Mean dry gas meter temperature, T _m		304.65	Mean stack gas temperature, T _s K 415.00
Mean pressure drop across orifice, DH	mmH ₂ O	43.70	Gas density (wet, ambient), ρ
			ρ = (M _s *P _s)/(8.314*T _s) kg/m ³ 0.876
			Stack Velocity, V _s $V_s = \frac{\sum_{i=1}^n V_i}{n}$ m/s 24.02
V _{mstd} = $\frac{(0.3592)(V_m)(P_b + (DH/13.6))(Y_d)}{T_m + 273}$	m ³	1.03	Actual flow of stack gas, Q_a
			Area of stack, A _s m ² 5.73
Volume of gas metered wet, V_{mstw}			Q _a = (60)(A _s)(V _s) m ³ /min 8252.7
V _{mstw} = V _{mstd} + V _{wstd}	m ³	1.1297	Total flow of stack gas, Q
			Conversion factor (K/mm.Hg)
Vol. of gas metered at O₂ Ref. Cond., V_{mstd@X%O2}			Q _{std} = $\frac{(Q_a)P_s(0.3592)(1-B_{w0})}{(T_s)}$ Dry 4886.3
Is the process burning hazardous waste? (If yes, no favourable oxygen correction)	No		Q _{stdO2} = $\frac{(Q_a)P_s(0.3592)(1-B_{w0})(O_2REF)}{(T_s)}$ @O2ref 4541
% oxygen measured in gas stream, act%O ₂	10.78		Q _{stw} = $\frac{(Q_a)P_s(0.3592)}{(T_s)}$ Wet 5344
% oxygen reference condition	10		
O ₂ Reference Factor	0.93		Percent isokinetic, %I
Factor			Nozzle diameter, D _n mm 5.0
V _{mstd@X%oxygen} = (V _{mstd}) (O _{2 Ref})	m ³	0.96	Nozzle area, A _n mm ² 19.4
			Total sampling time, q min 64.0
Moisture content, B_{w0}			%I = $\frac{(4.6398E6)(T_s)(V_{mstd})}{(P_s)(V_s)(A_n)(q)(1-B_{w0})}$ % 97.4
B _{w0} = $\frac{V_{wstd}}{V_{mstd} + V_{wstd}}$	%	8.56	
Moisture by FTIR		%	-
			Acceptable isokinetic range 95% to 115% Yes

MERCURY QA CHECKLIST

Leak Test Results	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 litre/min
Run 1	18.1	0.14	-	-482.6	0.36	Yes

Isokinetic Criterion Compliance	Isokinetic Variation %	Acceptable Isokineticity
Run 1	97.4	Yes

Filtration / Temp	Filter Material	Filter Size mm	Maximum Filtration Temperature °C	Temperature during storage / transit <25°C
Run 1	Quartz Fibre	47	180	Yes

Mercury	Type of Absorbers - Mercury	Absorption Solutions - Mercury
Run 1	Glass	4% Potassium Dichromate, 20% Nitric Acid

Parameter		Total ug	Final Absorber ug	Absorption Efficiency	Required	Pass / Fail
Mercury	Run 1	8.55	ND	100	95	N/A <30% ELV

HYDROGEN CHLORIDE SUMMARY					
Test	Sampling Times	Concentration mg/m ³	LOD mg/m ³	ELV mg/m ³	Emission Rate g/hr
Run 1	16:01 - 16:31 24 October 2023	0.17	0.003	10	49
Field Blank	-	0.011	-	-	-

Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

HYDROGEN CHLORIDE QUALITY ASSURANCE CHECKLIST

	Barometric Pressure Kpa	Average Oxygen Value for Referencing %	Total Sample Volume @ ref Conditions m ³	Mean Sampling Rate l/min	Pre Sampling Leak Rate l/min	Post Sampling Leak Rate l/min	Acceptable Leak Rate l/min	Leak Tests Acceptable?
Run 1	100.2	10.3	0.346	11.9	0.12	0.14	0.24	Yes

	Filter Material	Filter Size mm	Max. Filtration Temp. °C	Temperature during storage / transit <25°C	Type of Absorbers	Absorption Solutions
Run 1	Glass Fibre	47	143	N/A	Glass	HPLC Water

HYDROGEN CHLORIDE ABSORPTION EFFICIENCY

Parameter	Total ug	IMP C ug	Absorption Efficiency %	Acceptable Absorption Efficiency %	Absorption Efficiency Acceptable ?
Run 1	58.326	3.796	93	95	N/A - <30% ELV

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

HYDROGEN FLUORIDE SUMMARY					
Test	Sampling Times	Concentration mg/m ³	LOD mg/m ³	ELV mg/m ³	Emission Rate g/hr
Run 1	14:30 - 15:00 24 October 2023	0.42	0.01	1	122.5
Field Blank	-	0.17	-	-	-

Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

HYDROGEN FLUORIDE QUALITY ASSURANCE CHECKLIST

	Barometric Pressure Kpa	Average Oxygen Value for Referencing %	Total Sample Volume @ ref Conditions m ³	Mean Sampling Rate l/min	Pre Sampling Leak Rate l/min	Post Sampling Leak Rate l/min	Acceptable Leak Rate l/min	Leak Tests Acceptable?
Run 1	100.1	10.3	0.406	14.0	0.13	0.10	0.28	Yes

	Filter Material	Filter Size mm	Max. Filtration Temp. °C	Temperature during storage / transit <25°C	Type of Absorbers	Absorption Solutions
Run 1	Quartz Fibre	47	142	N/A	PE	0.1N Sodium Hydroxide

HYDROGEN FLUORIDE ABSORPTION EFFICIENCY

Parameter	Total ug	IMP C ug	Absorption Efficiency %	Acceptable Absorption Efficiency %	Absorption Efficiency Acceptable ?
Run 1	170.02	159.9	6	95	Fail

ND - None Detected

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

SULPHUR DIOXIDE SUMMARY					
Test	Sampling Times	Concentration mg/m ³	LOD mg/m ³	ELV mg/m ³	Emission Rate g/hr
Run 1	15:27 - 15:57 24 October 2023	3.29	0.05	50	963.24
Field Blank	-	0.10	-	-	-

Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

SULPHUR DIOXIDE QUALITY ASSURANCE CHECKLIST

	Barometric Pressure Kpa	Average Oxygen Value for Referencing %	Total Sample Volume @ ref Conditions m ³	Mean Sampling Rate l/min	Pre Sampling Leak Rate l/min	Post Sampling Leak Rate l/min	Acceptable Leak Rate l/min	Leak Tests Acceptable?
Run 1	100.1	10.3	0.346	11.9	0.13	0.13	0.24	Yes

	Filter Material	Filter Size mm	Max. Filtration Temp. °C	Temperature during storage / transit <25°C	Type of Absorbers	Absorption Solutions
Run 1	Quartz Fibre	47	140	N/A	Glass	0.3% Hydrogen Peroxide

SULPHUR DIOXIDE ABSORPTION EFFICIENCY

Parameter	Total ug	IMP C ug	Absorption Efficiency %	Acceptable Absorption Efficiency %	Absorption Efficiency Acceptable ?
Run 1	1138.3	ND	100	95	Yes

ND - None Detected

AMMONIA SUMMARY					
Test	Sampling Times	Concentration mg/m ³	LOD mg/m ³	ELV mg/m ³	Emission Rate g/hr
Run 1	11:34 - 12:38 25 October 2024	28.00	0.003	50	8537.31
Field Blank	-	0.01	-	-	-

Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

AMMONIA QUALITY ASSURANCE CHECKLIST

Leak Test Results	Barometric Pressure Kpa	Average Oxygen Value for Referencing %	Total Sample Volume @ ref Conditions m ³	Mean Sampling Rate l/min	Pre Sampling Leak Rate l/min	Post Sampling Leak Rate l/min	Acceptable Leak Rate l/min	Leak Tests Acceptable?
Run 1	101.0	10.8	0.8	13.978	0.12	0.12	0.28	Yes

	Filter Material	Filter Size mm	Max. Filtration Temp. °C	Temperature during storage / transit <25°C	Type of Absorbers	Absorption Solutions
Run 1	Quartz Fibre	47	143	N/A	PE	0.05M Sulphuric Acid

AMMONIA ABSORPTION EFFICIENCY

Parameter	Total ug	IMP C ug	Absorption Efficiency %	Acceptable Absorption Efficiency %	Absorption Efficiency Acceptable ?
Run 1	21865.44	76.44	99.65040722	95	Yes

ISOKINETIC SAMPLING EQUATIONS 1			Ammonia	
Absolute pressure of stack gas, P_s			Velocity of stack gas, V_s	
Barometric pressure, P _b	kPa	101	Velocity pressure coefficient, C _p	0.84
Stack static pressure, P _{static}	Pa	-450	Mean of velocity heads, DP _{avg}	Pa
P _s = P _b + (P _{static})	kPa	100.55	Mean stack gas temperature, T _s	K
Vol. of water vapour collected, V_{wstd}			Gas density (wet, ambient), ρ	kg/m ³
Moisture trap weight increase, V _{lc}	g	H ₂ O by Non Iso	$\rho = (M_s \cdot P_s) / (8.314 \cdot T_s)$	0.881
V _{wstd} = (0.001246)(V _{lc})	m ³	-	Stack Velocity, V _s	m/s
Volume of gas metered dry, V_{mstd}			$V_s = \frac{\sum_{i=1}^n V_i}{n}$	26.74
Volume of gas sample through gas meter, V _m	m ³	0.8946	Actual flow of stack gas, Q_a	
Gas meter correction factor, Y _d		1.049	Area of stack, A _s	m ²
Mean dry gas meter temperature, T _m	K	304.44	Q _a = (60)(A _s)(V _s)	m ³ /min
Mean pressure drop across orifice, DH	mmH ₂ O	21.82	Dry total flow of stack gas, Q_{std}	
$V_{mstd} = \frac{(0.3592)(V_m)(P_b + (DH/13.6))(Y_d)}{T_m}$	m ³	0.84	Conversion factor (K/mm.Hg)	0.3592
Volume of gas metered wet, V_{mstw}			Q _{std} = (Q _a)P _s (0.3592)(1-B _{w0})	m ³ /min
V _{mstw} = V _{mstd} + V _{wstd}	m ³	0.9192	(T _s)	5470
Vol. of gas metered at O₂ Ref. Cond., V_{mstd@X%O₂}			Wet total flow of stack gas, Q_{stw}	
Is the process burning hazardous waste? (If yes, no favourable oxygen correction)	No		Q _{stw} = $\frac{(Q_a)P_s(0.3592)}{(T_s)}$	m ³ /min
% oxygen measured in gas stream, act%O ₂	10.78		Dry total flow of stack gas at X% O₂, Q_{stdO₂}	
% oxygen reference condition	10		Q _{stdO₂} = $\frac{(Q_a)P_s(0.3592)(1-B_{w0})(O_2REF)}{(T_s)}$	m ³ /min
O ₂ Reference	O ₂ Ref = 21.0 - act%O ₂	0.93	Percent isokinetic, %I	
Factor	$\frac{21.0 - ref\%O_2}{21.0 - act\%O_2}$		Nozzle diameter, D _n	mm
V _{mstd@X%oxygen} = (V _{mstd}) (O ₂ Ref)	m ³	0.7810	Nozzle area, A _n	mm ²
Moisture content, B_{w0}			Total sampling time, q	min
B _{w0} = $\frac{V_{wstd}}{V_{mstd} + V_{wstd}}$	%	0.0856	%I = $\frac{(4.6398E6)(T_s)(V_{mstd})}{(P_s)(V_s)(A_n)(q)(1-B_{w0})}$	%
Moisture by FTIR		-	Acceptable isokinetic range 95% to 115%	
Molecular weight of dry gas, M_d			Hydrogen Chloride Concentration, C	
CO ₂	18.85		Mass collected, M	ug
O ₂	10.78		C _{wet} = $\frac{M_n}{V_{mstw}}$	mg/m ³
Total	29.63		C _{dry} = $\frac{M_n}{V_{mstd}}$	mg/m ³
N ₂ (100 - Total)	70.37		C _{dry@X%O₂} = $\frac{M_n}{V_{mstd@X\%oxygen}}$	mg/m ³
M _d = 0.44(%CO ₂)+0.32(%O ₂)+0.28(%N ₂)	31.45		Hydrogen Chloride Emission Rates, E	
Molecular weight of wet gas, M_s			E = [(C _{wet})(Q _{stw})(60)] / 1000	g/hr
M _s = M _d (1 - B _{w0}) + 18(B _{w0})	g/gmol	30.3	8537.31	

TOTAL VOLATILE ORGANIC COMPOUNDS SUMMARY

Test	Sampling Times	Concentration mg/m ³	LOD mg/m ³	ELV mg/m ³	Emission Rate g/hr
Run 1	11:30 - 12:30 25 October 2023	6.3	0.40	25	1767.37

Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

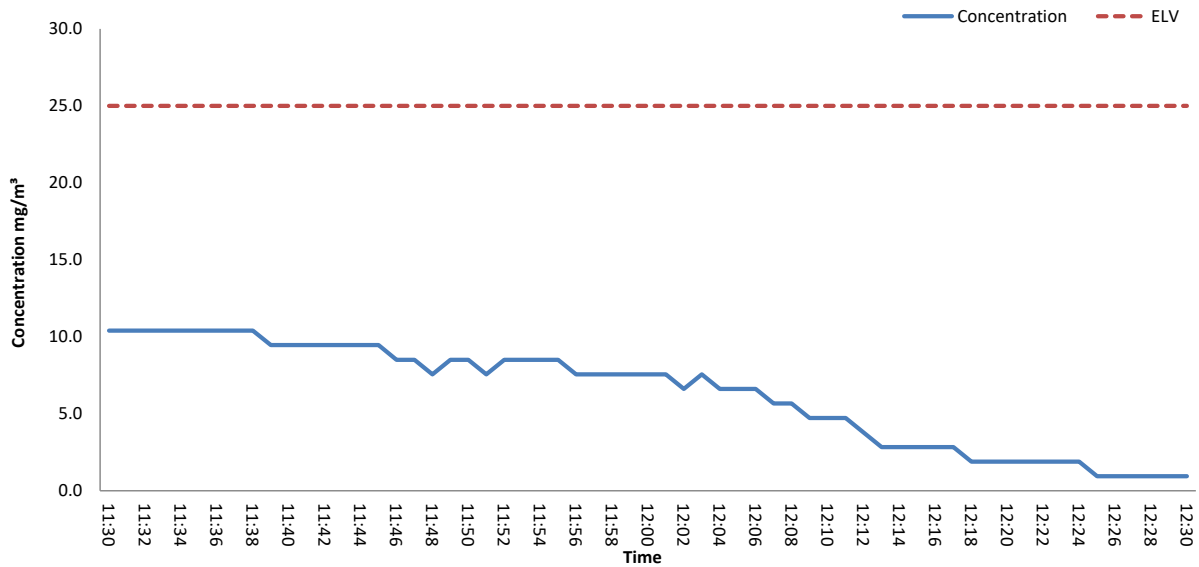
INSTRUMENTAL SPAN & ZERO CHECKS

PRE-SAMPLING CALIBRATION CHECKS								
Date	25 October 2023							
Start Time	08:51							
End Time	09:01							
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	82.8	100	0.02	82.5	0.60	0.90	83.3	-0.97

Zero and Span gas contained 20.27% Oxygen

POST-SAMPLING CALIBRATION CHECKS								
Date	25 October 2023							
Start Time	13:00							
End Time	13:10							
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	3.34	0.90	82.6	0.00	-0.85	x	x	N/A - not corrected

TOTAL VOLATILE ORGANIC COMPOUNDS EMISSIONS CHART



Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

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	13:15 - 14:15 24 October 2023	436.9	0.53	500	127688
Carbon Monoxide	13:15 - 14:15 24 October 2023	306.5	0.28	1500	89604.45

Test	Sampling Time and Date	Concentration %	LOD %
Oxygen	13:15 - 14:15 24 October 2023	10.33	0.01

Reference conditions are 273K, 101.3kPa, dry gas 10% Oxygen.

PRE-SAMPLING CALIBRATION DATA

Date	24 October 2023
Start Time	12:45
End Time	13:05

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	250	0.03	201.9	0.03	0.04	202.0	45	-0.05
Carbon Monoxide	200	0.10	163.5	0.10	0.20	163.9	45	-0.24
Oxygen	25	0.00	20.95	0.00	0.00	20.95	40	0.00

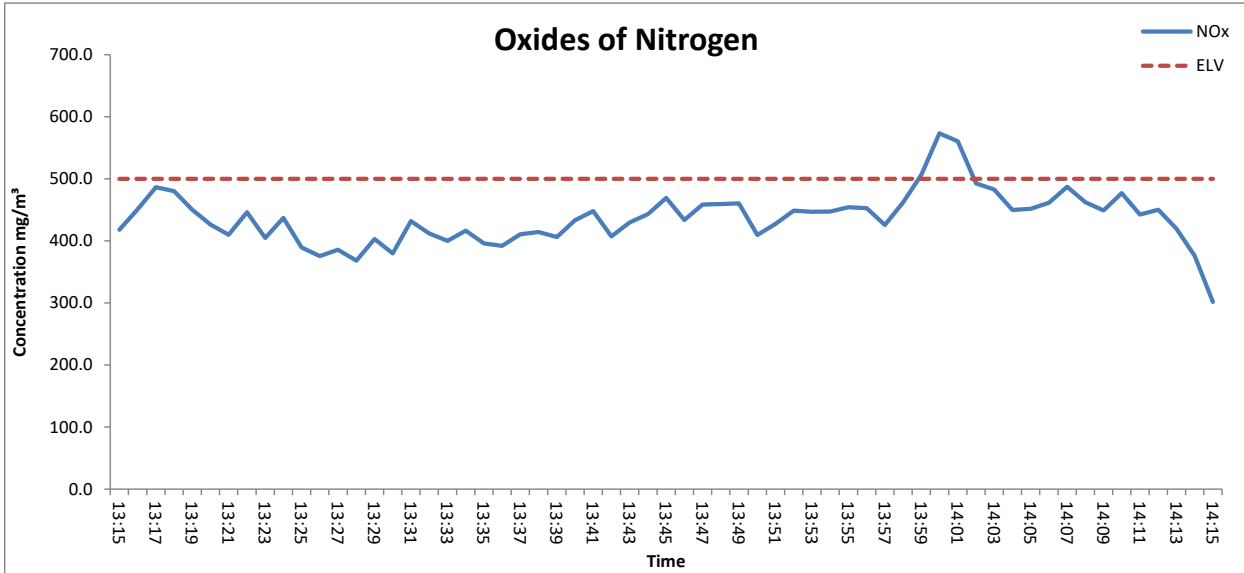
POST-SAMPLING CALIBRATION DATA

Date	24 October 2023
Start Time	16:30
End Time	16:45

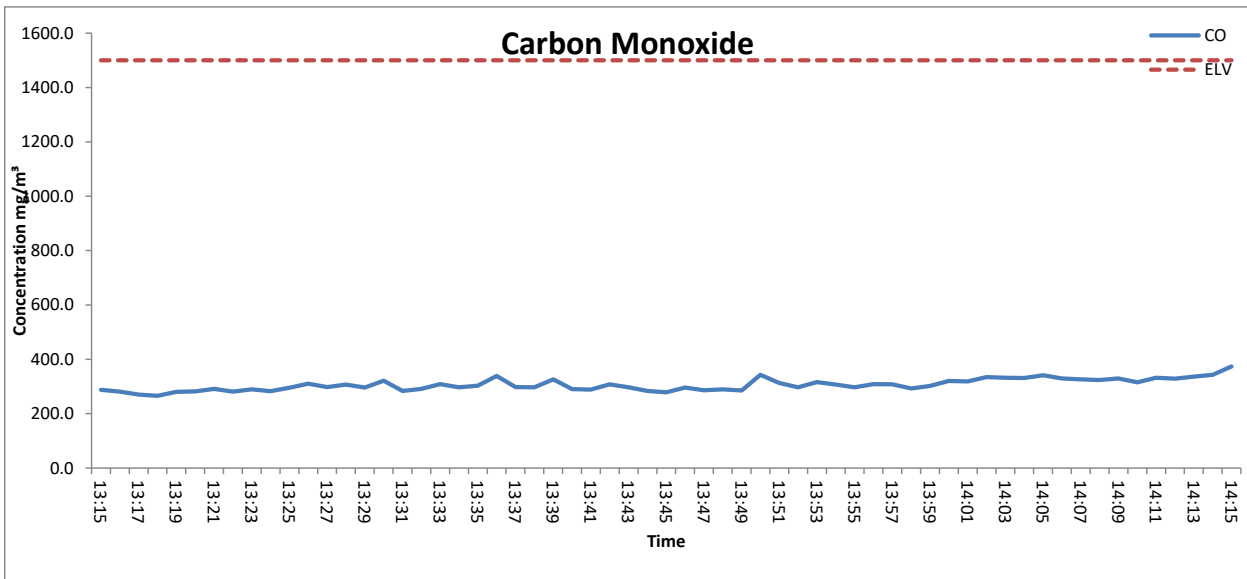
Chiller Temperature (°C)	2.3
Requirement	< 4°C
Compliant	Yes

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	0.06	202.3	0.01	0.18	×	×	N/A - not corrected
Carbon Monoxide	0.20	164.0	0.06	0.25	×	×	N/A - not corrected
Oxygen	0.02	20.95	0.10	-0.10	×	×	N/A - not corrected

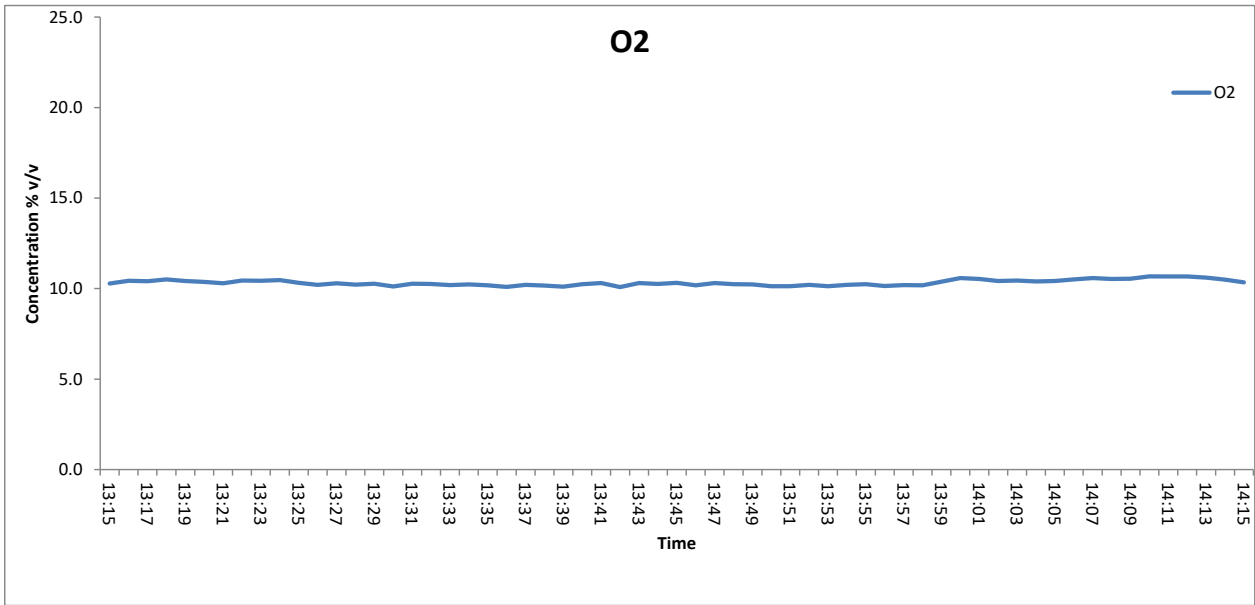
APPENDIX 2 - Summaries, Calculations, Raw Data and Charts
OXIDES OF NITROGEN (as NO₂) EMISSIONS CHART



CARBON MONOXIDE EMISSIONS CHART



OXYGEN EMISSIONS CHART



DAILY OXYGEN SUMMARY

Sampling Times	Concentration %	LOD %
10:17 - 11:17 25 October 2023	10.78	0.01

PRE SAMPLING CALIBRATION DATA

Date	Time of Analyser Checks	Range (%)	Zero Reading at analyser	Span Reading at analyser	Zero Check at analyser	Zero Check down line	Span Check down line	Leak Rate %
25 October 2023	09:45 - 10:15	25	0.02	20.95	0.02	0.03	20.95	0.00

POST SAMPLING CALIBRATION DATA

Date	Time of Analyser Checks	Zero Check down line	Span Check down line	Zero Drift (%)	Span Drift (%)
25 October 2023	00:00 - 11:40	0.04	20.95	0.10	-0.10

MOISTURE CALCULATIONS

Moisture Determination - Non Isokinetic							
Test Number	Sampling Time and Date	Start Weight	End Weight	Total gain	Concentration	LOD	Uncertainty
		kg	kg	kg	%	%	%
Run 1	16:01 - 16:31 24 October 2023	1.6838	1.7188	0.0350	9.9	0.03	3.3
Run 2	11:34 - 12:28 25 October 2023	1.7228	1.7818	0.0590	7.3	0.01	3.3

Moisture Quality Assurance							
Test Number	Sampling Duration mins	Total Volume Sampled l	Sampling Rate l/min	Start Leak Rate l/min	End Leak Rate l/min	Acceptable Leak Rate l/min	Leak Tests Acceptable?
Run 1	30	399	13.3	0.12	0.14	0.27	Yes
Run 2	64.0000	938.4354	14.7	0.14	0.12	0.29	Yes

PRELIMINARY STACK SURVEY

Stack Characteristics		
Stack Diameter / Depth, D	2.70	m
Stack Width, W	-	m
Stack Area, A	5.73	m ²
Average stack gas temperature	144	°C
Stack static pressure	-0.4575	kPa
Barometric Pressure	101.3	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	18.853835	0.188538	0.370112	17.239383	0.172394	0.338419
O ₂	32	1.427679	10.327106	0.103271	0.147438	9.442797	0.094428	0.134813
N ₂	28	1.249219	70.819060	0.708191	0.884685	64.754832	0.647548	0.808930
H ₂ O	18	0.803070	-	-	-	8.562988	0.085630	0.068767

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

Calculation of Stack Gas Densities		
Determinand	Result	Units
Dry Density (STP), P_{STD}	1.4022	kg/m ³
Wet Density (STP), P_{STW}	1.3509	kg/m ³
Dry Density (Actual), P_{Actual}	0.9150	kg/m ³
Average Wet Density (Actual), $P_{ActualW}$	0.881	kg/m ³

Where:

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

$P_{Actual} = P_{STD} \times (T_s / P_s) \times (P_a / T_a)$

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

$P_{ActualW} = P_{STW} \times (T_s / P_s) \times (P_a / T_a)$

PRELIMINARY STACK SURVEY**TRAVERSE 1**

Date of Survey	24 October 2023
Time of Survey	10:30
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	0.07	235.2	24.0	143	19.4	111.1	10.3	<15
2	0.22	248.3	25.3	143	19.9	114.1	-	<15
3	0.40	277.7	28.3	143	21.1	120.7	-	<15
4	0.61	329.9	33.7	143	23.0	131.6	-	<15
5	0.92	405.1	41.3	143	25.5	145.8	-	<15
6	1.78	431.2	44.0	143	26.3	150.4	-	<15
7	2.09	408.3	41.7	143	25.6	146.4	-	<15
8	2.30	418.1	42.7	143	25.9	148.1	-	<15
9	2.48	450.8	46.0	143	26.9	153.8	-	<15
10	2.63	421.4	43.0	143	26.0	148.7	-	<15
Mean	-	362.6	37.0	143	23.9	137.1	10.3	-

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	0.07	352.8	36.0	144	23.8	136.1	-	<15
2	0.22	320.1	32.7	144	22.6	129.6	-	<15
3	0.40	329.9	33.7	144	23.0	131.6	-	<15
4	0.61	346.3	35.3	144	23.5	134.8	-	<15
5	0.92	392.0	40.0	144	25.0	143.4	-	<15
6	1.78	365.9	37.3	144	24.2	138.6	-	<15
7	2.09	437.7	44.7	144	26.5	151.6	-	<15
8	2.30	467.1	47.7	144	27.3	156.6	-	<15
9	2.48	476.9	48.7	144	27.6	158.2	-	<15
10	2.63	460.6	47.0	144	27.2	155.5	-	<15
Mean	-	394.9	40.3	144	25.1	143.6	-	-

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	145	144	0.7	Pass	128	127	0.8	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	-154	-149	-5.0	Pass

PRELIMINARY STACK SURVEY (CONTINUED)

Sampling Plane Validation Criteria				
EA Technical Guidance Note (Monitoring) M1	Result	Units	Requirement	Compliant
Lowest Average Differential Pressure	235	Pa	>= 5 Pa	Yes
Lowest Gas Velocity	19.4	m/s	-	-
Highest Gas Velocity	27.6	m/s	-	-
Ratio of Gas Velocities	1.4	-	< 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, $V = K_{pt} \times (1-e) \times \sqrt{2 * DP_{pt} / P_{ActualW}}$		
Where:		
K_{pt} = Pitot tube calibration coefficient		
(1-e) = Compressibility correction factor, assumed at a constant 0.998		
Average Stack Gas Velocity, Va	24.5	m/s

Calculation of Stack Gas Volumetric Flowrate, Q			
Duct gas flow conditions	Actual	Reference	Units
Temperature	144	0	°C
Total Pressure	100.8425	101.3	kPa
Oxygen	10.3	10	%
Moisture	8.56	0.00	%
Pitot tube calibration coefficient, K_{pt}	0.84		

Gas Volumetric Flowrate	Result	Units
Average Stack Gas Velocity (Va)	24.51	m/s
Stack Area (A)	5.73	m ²
Gas Volumetric Flowrate (Actual), Q_{Actual}	505192.36	m ³ /hr
Gas Volumetric Flowrate (STP, Wet), Q_{STP}	329638.99	m ³ /hr
Gas Volumetric Flowrate (STP, Dry), $Q_{STP,Dry}$	301412.04	m ³ /hr
Gas Volumetric Flowrate (REF), Q_{Ref}	292448.98	m ³ /hr

Where:

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

$$Q_{STP} = Q (Actual) \times (Ts / Ta) \times (Pa / Ps) \times 3600$$

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

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

Nomenclature:

Ts = Absolute Temperature, Standard Conditions, 273 K

Ps = Absolute Pressure, Standard Conditions, 101.3 kPa

Ta = Absolute Temperature, Actual Conditions, K

Pa = Absolute Pressure, Actual Conditions, kPa

Ma = Water vapour, Actual Conditions, % Vol

Ms = Water vapour, Reference Conditions, % Vol

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

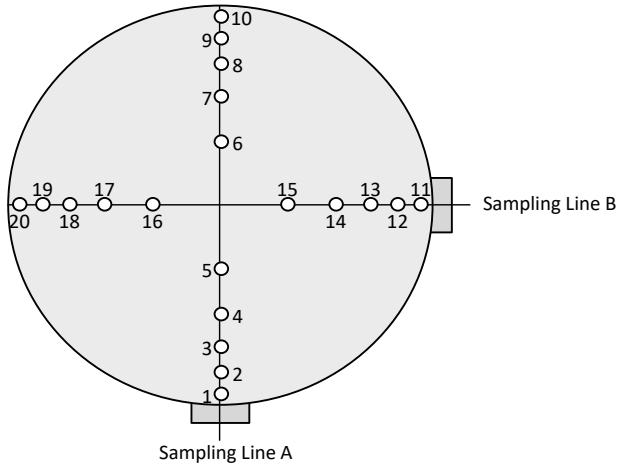
O_{2s} = Oxygen, Reference Conditions, % Vol

STACK DIAGRAM

	Value	Units
Stack Depth	2.70	m
Stack Width	-	m
Area	5.73	m ²

Non-Isokinetic/Gases Sampling			
Sampling Point	Distance (% of Depth)	Distance into Stack	Units
A	50	1.35	m

Isokinetic Sampling			
Sampling Point	Distance (% of Depth)	Distance into Stack (m)	Swirl °
1	2.6	0.07	< 15
2	8.2	0.22	< 15
3	14.6	0.40	< 15
4	22.6	0.61	< 15
5	34.2	0.92	< 15
6	65.8	1.78	< 15
7	77.4	2.09	< 15
8	85.4	2.30	< 15
9	91.8	2.48	< 15
10	97.4	2.63	< 15
11	2.6	0.07	< 15
12	8.2	0.22	< 15
13	14.6	0.40	< 15
14	22.6	0.61	< 15
15	34.2	0.92	< 15
16	65.8	1.78	< 15
17	77.4	2.09	< 15
18	85.4	2.30	< 15
19	91.8	2.48	< 15
20	97.4	2.63	< 15



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

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	0.002	2.0	0.50	1.0	0.1	0.5900	-	-
as a %	0.20	0.48	0.50	1.0	0.93	7.53267	0.82	0.006
compliant?	Yes	Yes	Yes	Yes	Yes	No	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	0.55	0.5900	1.1	0.0036	0.0003	-
MU as mg/m ³	0.01	0.7533	0.01	0.0036	0.0004	0.75
MU as %	1.25	100.0000	-	0.472	0.0577	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	1.51	mg/m³	200.03	% Result	15.07	% 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 - DIOXINS & FURANS

Run	Sampled Volume m ³	Sampled Gas Temp K	Sampled Gas Pressure kPa	Sampled Gas Humidity % by volume	Oxygen Content % by volume	Leak %	Uncollected Mass ng/m ³
MU required	≤ 2%	≤ 2%	≤ 1%	≤ 1%	≤ 10%	≤ 5%	≤ 10% ELV
Run 1	0.011	2.0	0.50	1.0	0.1	-	0.00312
as a %	0.20	0.7	0.50	1.0	0.97	2.41	3.12
compliant?	Yes	Yes	Yes	Yes	Yes	Yes	N/A

Run	Volume (STP) m ³	O2 Correction	Mass of Dioxin & Furan ng	Leak ng/m ³	Uncollected Mass ng/m ³	Laboratory analysis	Combined uncertainty
Run 1	4.7109	1.0	0.0804	0.00002	0.00180	-	-
MU as ng/m ³	0.0000	0.0000	0.0013	0.00002	0.0020742	0.0001	0.0025
MU as %	1.3173	-	83.4660	1.3942	133.0054	7.40	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	0.0049	ng/m³	314.4	% Result	4.90	% 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

MEASUREMENT UNCERTAINTY BUDGET - CADMIUM & THALLIUM

Run	Sampled Volume m ³	Sampled Gas Temp K	Sampled Gas Pressure kPa	Sampled Gas Humidity % by volume	Oxygen Content % by volume	Concentration in impinger mg	Leak %
MU required	<=2%	<2.5 k	<=1%	<=1%	<=5%	<5%	<=2%
Run 1	0.002	2.0	0.50	1.0	0.1	0.000018	-
as a %	0.20	0.7	0.50	1.0	0.93	3.00	1.34
compliant?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Run	Volume (STP) m ³	O2 Correction -	Mass of Cadmium & Thallium mg	Leak mg/m ³	Lab Uncertainty mg	Combined uncertainty
Run 1	0.8399	1.0762	1.3625	0.000011	-	-
MU as mg	0.00002	0.00001	0.0012	0.000011	0.00007	0.0012
MU as %	1.3160	0.9783	84.0367	0.7751	4.85417	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	0.002	mg/m³	168.39	% Result	4.85	% 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 - HEAVY METALS

Run	Sampled Volume m ³	Sampled Gas Temp K	Sampled Gas Pressure kPa	Sampled Gas Humidity % by volume	Oxygen Content % by volume	Concentration in impinger mg	Leak %
MU required	<=2%	<2.5 k	<=1%	<=1%	<=5%	<5%	<=2%
Run 1	0.002	2.0	0.50	1.0	0.10	0.00	-
as a %	0.20	0.73	0.50	1.0	0.93	3.00	1.34
compliant?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Run	Volume (STP) m ³	O2 Correction -	Mass of Heavy Metals mg	Leak mg/m ³	Lab Uncertainty mg	Combined uncertainty
Run 1	0.9362	1.0762	59.7090	0.0005	-	-
MU as mg/m ³	0.0009	0.0006	0.0038	0.0005	0.00306	0.0050
MU as %	1.3515	0.9783	6.0334	0.7751	4.85417	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	0.010	mg/m³	15.92	% Result	2.01	% 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 - MERCURY

Run	Sampled Volume m ³	Sampled Gas Temp K	Sampled Gas Pressure kPa	Sampled Gas Humidity % by volume	Oxygen Content % by volume	Concentration in impinger mg	Leak %
MU required	<=2%	<2.5 k	<=1%	<=1%	<=5%	<5%	<=2%
Run 1	0.002	2.0	0.50	1.0	0.10	0.00066	-
as a %	0.20	0.7	0.50	1.0	0.93	3.00	0.77
compliant?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Run	Volume (STP) m ³	O2 Correction -	Mass of Mercury mg	Leak mg/m ³	Lab Uncertainty mg	Combined
Run 1	0.8508	1.0762	8.5493	0.000040	-	-
MU as mg/m ³	0.00012	0.00009	0.0005	0.000040	0.00045	0.0007
MU as %	1.3156	0.9783	6.0627	0.4456	5.00000	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	0.00143	mg/m³	16.08	% Result	2.86	% 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

MEASUREMENT UNCERTAINTY BUDGET - NON-ISOKINETIC HYDROGEN CHLORIDE

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 %
MU required	<=2%	<2.5 k	<=1%	<=1%	<=5%	≤ 5% of ELV	<=2%
Run 1	0.000	2.000	0.500	1.000	0.100	0.004	-
as a %	0.069	0.669	0.499	1.000	0.968	0.073	1.177
compliant?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Run	Volume (STP) m ³	Mass of Hydrogen Chloride mg	O2 Correction -	Leak mg/m ³	Lab Uncertainty mg	Combined uncertainty
Run 1	0.3126	0.0878	1.0306	0.0011	-	-
MU as mg/m ³	0.0022	0.0073	0.0016	0.0011	0.0081	0.011
MU as %	1.3047	4.3557	0.9370	0.6797	4.8	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	0.023	mg/m³	13.42	% Result	0.23	% 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

MEASUREMENT UNCERTAINTY BUDGET - NON-ISOKINETIC HYDROGEN FLUORIDE

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 %
MU required	<=2%	<2.5 k	<=1%	<=1%	<=5%	≤ 5% of ELV	<=2%
Run 1	0.00028	2.000	0.500	1.000	0.100	0.008	-
as a %	0.069	0.669	0.500	1.000	0.968	0.635	0.717
compliant?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Run	Volume (STP) m ³	Mass of Hydrogen Fluoride mg	O2 Correction -	Leak mg/m ³	Lab Uncertainty mg	Combined uncertainty
Run 1	0.3664	0.5038	1.0306	0.0017	-	-
MU as mg/m ³	0.0055	0.0063	0.0039	0.0017	0.0255	0.0272
MU as %	1.3049	1.5160	0.9370	0.4139	6.1	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	0.05	mg/m³	13.00	% Result	5.44	% 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 - NON-ISOKINETIC SULPHUR DIOXIDE

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 %
MU required	<=2%	<2.5 k	<=1%	<=1%	<=5%	≤ 5% of ELV	<=2%
Run 1	0.0002	2.000	0.500	1.000	0.100	0.054	-
as a %	0.069	0.667	0.500	1.000	0.968	0.194	1.095
compliant?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Run	Volume (STP) m ³	Mass of Sulphur dioxide mg	O2 Correction -	Leak mg/m ³	Lab Uncertainty mg	Combined uncertainty
Run 1	0.3108	1.8190	1.0306	0.0208	-	-
MU as mg/m ³	0.0429	0.0971	0.0309	0.0208	0.1581	0.194
MU as %	1.3038	2.9471	0.9370	0.6322	4.8	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	0.39	mg/m³	11.78	% Result	0.78	% 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

MEASUREMENT UNCERTAINTY BUDGET - ISOKINETIC AMMONIA

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 %
MU required	<=2%	<2.5 k	<=1%	<=1%	<=5%	≤ 5% of ELV	<=2%
Run 1	0.781031702	304.44	96.5	1.0	10.77854459	34.63325	-
as a %	0.13	0.66	0.52	1.0	0.93	0.13	0.86
compliant?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Run	Volume (STP) m ³	Mass of Ammonia mg	O2 Correction -	Leak mg/m ³	Lab Uncertainty mg	Combined uncertainty
Run 1	0.6672	34.6333	1.0762	0.1388	-	-
MU as mg/m ³	0.3674	0.0662	0.2739	0.1388	1.6237	1.6942
MU as %	1.3124	0.2366	0.9783	0.4956	5.8	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	3.39	mg/m³	12.10	% Result	6.78	% 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

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	0.000	2.0	0.50	1.0	0.1	-
as a %	0.07	0.48	0.50	1.0	0.97	0.90
compliant?	Yes	Yes	Yes	Yes	Yes	Yes
Run 2	0.000293261	2.0	0.50	1.0	0.1	-
as a %	0.03	0.48	0.50	1.0	0.97	0.95
compliant?	Yes	Yes	Yes	Yes	Yes	Yes

Run	Volume (STP) m ³	Mass Gained mg	O2 Correction -	Leak mg/m ³	Uncollected Mass mg	Combined uncertainty
Run 1	0.3	35000	1.0	457.8	58	-
MU as % v/v	0.13	0.03	0.01	0.06	0.02	0.15
MU as %	1.2	0.3	0.94	0.5	0.2	-
Run 2	0.61	59000	1.0	347	58	-
MU as % v/v	0.10	0.0134	0.00	0.044	0.01	0.11
MU as %	1.2	0.1695	0.9	0.551	0.10	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	0.30	% v/v	3.31	%
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R2 - Uncertainty expressed at a 95% confidence level (where k = 2)	0.21	% v/v	3.29	%
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Reference – SOCOTEC Technical Procedure AE150 Estimation of Uncertainty of Measurement

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - VOLATILE ORGANIC COMPOUNDS RUN 1

Measured Concentration	6.3	mg/m ³
Limit	25	mg/m ³
Calibration Gas Concentration	132.48	mg/m ³
Range	160	mg/m ³

Performance characteristics	Value	Units	specification	MU Met?
Response time	45	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	0.00	% full scale	<5% range / 24hr	Yes
Span drift	-0.85	% 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)	-0.97	% 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	-0.02
volume or pressure flow dependence	uspres	0.00
atmospheric pressure dependence	uapres	0.04
ambient temperature dependence	utemp	0.00
Dependence on voltage	uvolt	0.14
losses in the line (leak)	uleak	-0.04
Uncertainty of calibration gas	ucalib	0.04
Uncertainty in factor	uf	0.02

Measurement uncertainty Measured Concentration	6.31	mg/m ³
Combined uncertainty	0.67	mg/m ³
Expanded uncertainty	1.30	mg/m ³

Expanded uncertainty expressed with a level of confidence of 95%	5.22	% ELV
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Expanded uncertainty expressed with a level of confidence of 95%	1.30	mg/m³
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Expanded uncertainty expressed with a level of confidence of 95%	20.67	% value
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Reference – SOCOTEC Technical Procedure AE150 Estimation of Uncertainty of Measurement

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - OXIDES OF NITROGEN

Limit value	500	mg/m ³
Concentration @ Ref conditions	436.9	mg/m ³
Cal gas conc	424	mg/m ³
Analyser Full Scale	513	mg/m ³

	Value	Units	specification	MU Met?
Response time	45	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	0.01	% full scale	<5% range / 24hr	Yes
Span drift	0.18	% full scale	<5% range / 24hr	Yes
volume or pressure flow dependence	0.25	% of full scale/3 kPa	<2 % / 3 kPa	Yes
atmospheric pressure dependence	0.25	% 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	-0.01	% range	<4% of Range	Yes
dependence on voltage	0.15	% 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)	0.15	% 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	$U_{d,z}$	0.0085
short term span drift	$U_{d,s}$	0.1032
influence of Ambient Temp at Zero	$U_{t,z}$	0.0000
influence of Ambient Temp at Span	$U_{t,s}$	2.9250
influence of sample gas pressure	U_p	0.0000
influence of sample gas flow	U_{fit}	0.1732
influence of supply voltage	U_v	0.4558
Combined Interference	U_i	-0.0018
Uncertainty of Cal gas	U_{adj}	2.0700

Measurement uncertainty (Concentration Measured)	436.90	mg/m ³
Combined uncertainty	3.63	ma/m ³
Expanded at a 95% confidence interval	7.11	ma/m ³

Expanded uncertainty expressed with a level of confidence of 95%	1.42	% ELV
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Expanded uncertainty expressed with a level of confidence of 95%	7.1	mg/m³
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Expanded uncertainty expressed with a level of confidence of 95%	1.6	% value
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APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - CARBON MONOXIDE

Limit value	1500	mg/m ³
Concentration @ Ref conditions	306.5	mg/m ³
Cal gas conc	196.3	mg/m ³
Analyser Full Scale	250	mg/m ³

Performance characteristics	Value	Units	specification	MU Met?
Response time	45	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	0.06	% full scale	<5% range / 24hr	Yes
Span drift	0.25	% 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)	0.00	% 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	$U_{d,s}$	0.04
influence of Ambient Temp zero	$U_{t,z}$	-0.10
influence of Ambient Temp span	$U_{t,s}$	0.23
influence of sample gas pressure	U_p	0.00
influence of sample gas flow	U_{fit}	0.14
influence of supply voltage	U_v	-0.09
Combined Interference	U_i	-0.45
Uncertainty of Cal gas	U_{adj}	0.79

Measurement uncertainty (Concentration Measured)	297.3	mg/m ³
Combined uncertainty	1.0	mg/m ³
Expanded uncertainty	2.0	mg/m ³

Expanded uncertainty expressed with a level of confidence of 95%	0.1	% ELV
Expanded uncertainty expressed with a level of confidence of 95%	2.0	mg/m³
Expanded uncertainty expressed with a level of confidence of 95%	0.7	% value

Reference – SOCOTEC Technical Procedure AE150 Estimation of Uncertainty of Measurement

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - OXYGEN

Reference	10	%vol
Reported Concentration	10.33	%vol
Calibration gas	20.95	%vol
Analyser Full Scale	25	%vol

	Value	Units	specification	MU Met?
Response time	40	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	-0.10	% 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	0.00	% 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	$U_{d,z}$	0.0552
short term span drift	$U_{d,s}$	-0.0551
influence of Ambient Temp at Zero	$U_{t,z}$	0.0007
influence of Ambient Temp at Span	$U_{t,s}$	0.0000
influence of sample gas pressure	U_p	0.0000
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}	0.1048

Measurement uncertainty (Concentration Measured)	10.33	%
Combined uncertainty	0.15	%
Expanded uncertainty	0.30	%

Expanded uncertainty expressed with a level of confidence of 95%	0.3	%
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Expanded uncertainty expressed with a level of confidence of 95%	2.88	% vol
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APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - OXYGEN

Day 1 - 25 October 2023

Reference	10	%vol
Measured concentration	10.78	%vol
Calibration gas	20.95	%vol
Analyser Full Scale	25	%vol

	Value	Units	specification	MU Met?
Response time	23	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	0.1	% of value	<2 % range	Yes
Zero drift	0.10	% full scale	<2% range / 24hr	Yes
Span drift	-0.10	% full scale	<2% range/24hr	Yes
volume or pressure flow dependence	-0.0425	% of full scale/3 kPa	<2 % / 3 kPa	Yes
atmospheric pressure dependence	0.0475	% of full scale/2 kPa	<3% / 2 kPa	Yes
ambient temperature dependence	0.0025	% full scale/10K	<3% range / 10 K	Yes
Combined interference	0.00	% range	<4% of Range	Yes
dependence on voltage	0.01	% full scale/10V	< 0.1%vol /10 volt	Yes
losses in the line (leak)	0.00	% of value	< 2% of value	Yes
Uncertainty of calibration gas	1.00	% of value	< 2% of value	Yes

losses in the line (leak)	Uncertainty	< 2% of value
repeatability	$U_r = S_r$	0.0083
lack of fit	U_{lof}	0.0577
short term zero drift	$U_{d,z}$	0.0553
short term span drift	$U_{d,s}$	-0.0551
influence of Ambient Temp at Zero	$U_{t,z}$	0.0000
influence of Ambient Temp at Span	$U_{t,s}$	0.0000
influence of sample gas pressure	U_p	-0.0009
influence of sample gas flow	U_{fit}	-0.0294
influence of supply voltage	U_v	0.0006
Combined Interference	U_i	0.0000
Uncertainty of Cal gas	U_{adj}	0.1048

Measurement uncertainty (Concentration Measured)	10.78	%
Combined Interference	0.15	%
Uncertainty of Cal gas	0.29	%

Expanded uncertainty expressed with a level of confidence of 95%	0.29	%
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Expanded uncertainty as percentage of the result	2.66	% vol
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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	24.5	m/s
Measured Volumetric Flow rate at Actual Conditions	505192	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	-	2.90		
Uncertainty of mean local dynamic pressures	-	2.90		
Factor loading, function of the number of measurements.	3 readings	0.591	minimum 3	Yes
Range of measurement device	pa	1000		
Resolution	pa	1.00		
Calibration uncertainty	pa	56.53	<1% of Value or 20 Pa whichever is greater	Yes
Drift	% range	0.10		
Linearity	% range	0.06	<2% of value	Yes
Uncertainty of gas density determination				
Uncertainty of molar mass determination	kg/mol	0.00310		
Uncertainty of temperature measurement	K	2.13	<1% of value	Yes
Uncertainty of absolute pressure in the duct	pa	515		
Uncertainty associated with the calculation of density	kg/m ³	0.008		
Uncertainty associated with the measurement of local velocity	-	0.0001		
Uncertainty associated with the measurement of mean velocity	-	0.0002		

Measurement Uncertainty - Velocity	m/s
Combined uncertainty	0.30
Expanded uncertainty at a 95% Confidence Interval	0.60

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	1.2
Expanded uncertainty at a 95% Confidence Interval	2.4

Measurement Uncertainty Volumetric Flow Rate	m ³ /hr
Combined uncertainty	13252
Expanded uncertainty at a 95% Confidence Interval	25974

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	5.1

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

APPENDIX 4 - Raw Gases Data

Summary of Raw Gases Data Day 1										
Time	Oxides of Nitrogen		Sulphur Dioxide		Carbon Monoxide		Carbon Dioxide		Oxygen	
hh:mm	Actual ppm	Corr ppm	Actual ppm	Corr ppm	Actual ppm	Corr ppm	Actual %	Corr %	Actual %	Corr %
Averages	206.348	-	-	-	237.826	-	18.8538	-	10.3271	-
13:15	198.483	-	-	-	224.544	-	19.1386	-	10.2788	-
13:16	210.8	-	-	-	216.327	-	18.6402	-	10.434	-
13:17	228.158	-	-	-	207.92	-	18.6411	-	10.4098	-
13:18	223.263	-	-	-	202.895	-	18.4736	-	10.5022	-
13:19	210.994	-	-	-	215.468	-	18.7744	-	10.4195	-
13:20	200.609	-	-	-	218.024	-	18.6878	-	10.371	-
13:21	194.307	-	-	-	226.373	-	18.8459	-	10.2982	-
13:22	208.493	-	-	-	216.146	-	18.5861	-	10.4435	-
13:23	189.451	-	-	-	222.69	-	18.6843	-	10.429	-
13:24	203.941	-	-	-	216.997	-	18.5757	-	10.4631	-
13:25	184.163	-	-	-	229.433	-	18.8094	-	10.3225	-
13:26	179.372	-	-	-	243.834	-	19.2441	-	10.2107	-
13:27	182.975	-	-	-	232.378	-	19.1223	-	10.2885	-
13:28	175.798	-	-	-	240.963	-	19.0796	-	10.2155	-
13:29	191.624	-	-	-	231.305	-	19.0793	-	10.2638	-
13:30	183.046	-	-	-	254.242	-	19.2748	-	10.1183	-
13:31	205.194	-	-	-	221.178	-	18.7539	-	10.2684	-
13:32	196.178	-	-	-	227.771	-	18.948	-	10.2539	-
13:33	191.414	-	-	-	242.519	-	19.2179	-	10.1908	-
13:34	198.593	-	-	-	232.933	-	18.9696	-	10.2294	-
13:35	189.755	-	-	-	238.152	-	19.0608	-	10.1809	-
13:36	189.417	-	-	-	268.716	-	19.666	-	10.0885	-
13:37	196.291	-	-	-	234.203	-	19.0353	-	10.2001	-
13:38	198.86	-	-	-	234.398	-	19.2029	-	10.1613	-
13:39	195.984	-	-	-	258.561	-	19.3067	-	10.1077	-
13:40	206.268	-	-	-	226.916	-	19.1487	-	10.2486	-
13:41	212.107	-	-	-	224.714	-	18.9146	-	10.3114	-
13:42	196.891	-	-	-	244.365	-	19.0813	-	10.0834	-
13:43	203.295	-	-	-	230.857	-	18.8917	-	10.3112	-
13:44	210.971	-	-	-	221.892	-	18.8592	-	10.253	-
13:45	221.92	-	-	-	216.186	-	18.8648	-	10.3206	-
13:46	207.736	-	-	-	232.816	-	18.9468	-	10.1848	-
13:47	216.998	-	-	-	222.585	-	18.7906	-	10.3109	-
13:48	218.863	-	-	-	226.72	-	18.9513	-	10.2382	-
13:49	219.713	-	-	-	223.895	-	19.1236	-	10.2236	-
13:50	197.2	-	-	-	271.535	-	19.6126	-	10.1269	-
13:51	205.722	-	-	-	247.258	-	19.2874	-	10.1315	-
13:52	214.449	-	-	-	233.021	-	18.9097	-	10.2091	-
13:53	215.093	-	-	-	249.91	-	19.3871	-	10.1313	-
13:54	213.751	-	-	-	240.863	-	19.1455	-	10.204	-
13:55	216.483	-	-	-	232.431	-	19.2067	-	10.2377	-
13:56	217.633	-	-	-	243.645	-	19.311	-	10.141	-
13:57	203.665	-	-	-	242.27	-	19.2862	-	10.1941	-
13:58	221.192	-	-	-	230.669	-	19.1036	-	10.1844	-
13:59	237.969	-	-	-	233.372	-	18.4176	-	10.3832	-
14:00	264.458	-	-	-	243.115	-	17.9839	-	10.5821	-
14:01	259.64	-	-	-	242.827	-	17.957	-	10.5338	-
14:02	230.929	-	-	-	257.615	-	18.7422	-	10.4172	-
14:03	225.791	-	-	-	255.122	-	18.5635	-	10.4414	-
14:04	211.431	-	-	-	255.685	-	18.5888	-	10.3883	-
14:05	211.768	-	-	-	263.053	-	18.4732	-	10.4128	-
14:06	214.502	-	-	-	251.673	-	18.3603	-	10.5001	-
14:07	224.578	-	-	-	247.026	-	18.3419	-	10.5871	-
14:08	214.329	-	-	-	246.36	-	18.4585	-	10.5287	-
14:09	207.86	-	-	-	250.859	-	18.5266	-	10.543	-
14:10	217.992	-	-	-	236.99	-	18.2468	-	10.6737	-
14:11	202.523	-	-	-	249.83	-	18.2769	-	10.664	-
14:12	205.964	-	-	-	247.239	-	18.2557	-	10.664	-
14:13	193.206	-	-	-	254.106	-	18.4268	-	10.601	-
14:14	174.803	-	-	-	262.23	-	18.6971	-	10.4994	-
14:15	142.388	-	-	-	289.756	-	19.1269	-	10.3391	-
-	-	-	-	-	-	-	-	-	-	-

APPENDIX 4 - Raw Gases Data

Summary of Raw Gases Data Day 2										
Time	Oxides of Nitrogen		Sulphur Dioxide		Carbon Monoxide		Carbon Dioxide		Oxygen	
hh:mm	Actual ppm	Corr ppm	Actual ppm	Corr ppm	Actual ppm	Corr ppm	Actual %	Corr %	Actual %	Corr %
Averages	-	-	-	-	-	-	-	-	10.7785	-
10:17	-	-	-	-	-	-	-	-	11.11	-
10:18	-	-	-	-	-	-	-	-	11.11	-
10:19	-	-	-	-	-	-	-	-	11.02	-
10:20	-	-	-	-	-	-	-	-	11.11	-
10:21	-	-	-	-	-	-	-	-	11.18	-
10:22	-	-	-	-	-	-	-	-	11.04	-
10:23	-	-	-	-	-	-	-	-	10.99	-
10:24	-	-	-	-	-	-	-	-	10.97	-
10:25	-	-	-	-	-	-	-	-	11.03	-
10:26	-	-	-	-	-	-	-	-	10.97	-
10:27	-	-	-	-	-	-	-	-	10.99	-
10:28	-	-	-	-	-	-	-	-	10.86	-
10:29	-	-	-	-	-	-	-	-	10.83	-
10:30	-	-	-	-	-	-	-	-	10.85	-
10:31	-	-	-	-	-	-	-	-	10.72	-
10:32	-	-	-	-	-	-	-	-	10.78	-
10:33	-	-	-	-	-	-	-	-	10.76	-
10:34	-	-	-	-	-	-	-	-	10.72	-
10:35	-	-	-	-	-	-	-	-	10.81	-
10:36	-	-	-	-	-	-	-	-	10.83	-
10:37	-	-	-	-	-	-	-	-	11.09	-
10:38	-	-	-	-	-	-	-	-	10.93	-
10:39	-	-	-	-	-	-	-	-	10.97	-
10:40	-	-	-	-	-	-	-	-	10.98	-
10:41	-	-	-	-	-	-	-	-	10.94	-
10:42	-	-	-	-	-	-	-	-	10.83	-
10:43	-	-	-	-	-	-	-	-	11.01	-
10:44	-	-	-	-	-	-	-	-	10.98	-
10:45	-	-	-	-	-	-	-	-	10.95	-
10:46	-	-	-	-	-	-	-	-	10.98	-
10:47	-	-	-	-	-	-	-	-	11.02	-
10:48	-	-	-	-	-	-	-	-	10.99	-
10:49	-	-	-	-	-	-	-	-	10.82	-
10:50	-	-	-	-	-	-	-	-	10.76	-
10:51	-	-	-	-	-	-	-	-	10.84	-
10:52	-	-	-	-	-	-	-	-	10.74	-
10:53	-	-	-	-	-	-	-	-	10.80	-
10:54	-	-	-	-	-	-	-	-	10.76	-
10:55	-	-	-	-	-	-	-	-	10.82	-
10:56	-	-	-	-	-	-	-	-	10.76	-
10:57	-	-	-	-	-	-	-	-	10.59	-
10:58	-	-	-	-	-	-	-	-	10.61	-
10:59	-	-	-	-	-	-	-	-	10.52	-
11:00	-	-	-	-	-	-	-	-	10.48	-
11:01	-	-	-	-	-	-	-	-	10.42	-
11:02	-	-	-	-	-	-	-	-	10.47	-
11:03	-	-	-	-	-	-	-	-	10.55	-
11:04	-	-	-	-	-	-	-	-	10.49	-
11:05	-	-	-	-	-	-	-	-	10.48	-
11:06	-	-	-	-	-	-	-	-	10.48	-
11:07	-	-	-	-	-	-	-	-	10.48	-
11:08	-	-	-	-	-	-	-	-	10.48	-
11:09	-	-	-	-	-	-	-	-	10.60	-
11:10	-	-	-	-	-	-	-	-	10.61	-
11:11	-	-	-	-	-	-	-	-	10.54	-
11:12	-	-	-	-	-	-	-	-	10.54	-
11:13	-	-	-	-	-	-	-	-	10.53	-
11:14	-	-	-	-	-	-	-	-	10.43	-
11:15	-	-	-	-	-	-	-	-	10.50	-
11:16	-	-	-	-	-	-	-	-	10.54	-
11:17	-	-	-	-	-	-	-	-	10.51	-

APPENDIX 4 - Raw Gases Data

Summary of Raw Gases Data											
TVOC Run 1				TVOC Run 2				TVOC Run 3			
Time hh:mm	Actual ppm	Corr ppm	Oxygen %	Time hh:mm	Actual ppm	Corr ppm	Oxygen %	Time hh:mm	Actual ppm	Corr ppm	Oxygen %
Averages	3.33607	-	10.7785	Averages	-	-	-	Averages	-	-	-
11:30	5.50	-	10.7785	-	-	-	-	-	-	-	-
11:31	5.50	-	10.7785	-	-	-	-	-	-	-	-
11:32	5.50	-	10.7785	-	-	-	-	-	-	-	-
11:33	5.50	-	10.7785	-	-	-	-	-	-	-	-
11:34	5.50	-	10.7785	-	-	-	-	-	-	-	-
11:35	5.50	-	10.7785	-	-	-	-	-	-	-	-
11:36	5.50	-	10.7785	-	-	-	-	-	-	-	-
11:37	5.50	-	10.7785	-	-	-	-	-	-	-	-
11:38	5.50	-	10.7785	-	-	-	-	-	-	-	-
11:39	5.00	-	10.7785	-	-	-	-	-	-	-	-
11:40	5.00	-	10.7785	-	-	-	-	-	-	-	-
11:41	5.00	-	10.7785	-	-	-	-	-	-	-	-
11:42	5.00	-	10.7785	-	-	-	-	-	-	-	-
11:43	5.00	-	10.7785	-	-	-	-	-	-	-	-
11:44	5.00	-	10.7785	-	-	-	-	-	-	-	-
11:45	5.00	-	10.7785	-	-	-	-	-	-	-	-
11:46	4.50	-	10.7785	-	-	-	-	-	-	-	-
11:47	4.50	-	10.7785	-	-	-	-	-	-	-	-
11:48	4.00	-	10.7785	-	-	-	-	-	-	-	-
11:49	4.50	-	10.7785	-	-	-	-	-	-	-	-
11:50	4.50	-	10.7785	-	-	-	-	-	-	-	-
11:51	4.00	-	10.7785	-	-	-	-	-	-	-	-
11:52	4.50	-	10.7785	-	-	-	-	-	-	-	-
11:53	4.50	-	10.7785	-	-	-	-	-	-	-	-
11:54	4.50	-	10.7785	-	-	-	-	-	-	-	-
11:55	4.50	-	10.7785	-	-	-	-	-	-	-	-
11:56	4.00	-	10.7785	-	-	-	-	-	-	-	-
11:57	4.00	-	10.7785	-	-	-	-	-	-	-	-
11:58	4.00	-	10.7785	-	-	-	-	-	-	-	-
11:59	4.00	-	10.7785	-	-	-	-	-	-	-	-
12:00	4.00	-	10.7785	-	-	-	-	-	-	-	-
12:01	4.00	-	10.7785	-	-	-	-	-	-	-	-
12:02	3.50	-	10.7785	-	-	-	-	-	-	-	-
12:03	4.00	-	10.7785	-	-	-	-	-	-	-	-
12:04	3.50	-	10.7785	-	-	-	-	-	-	-	-
12:05	3.50	-	10.7785	-	-	-	-	-	-	-	-
12:06	3.50	-	10.7785	-	-	-	-	-	-	-	-
12:07	3.00	-	10.7785	-	-	-	-	-	-	-	-
12:08	3.00	-	10.7785	-	-	-	-	-	-	-	-
12:09	2.50	-	10.7785	-	-	-	-	-	-	-	-
12:10	2.50	-	10.7785	-	-	-	-	-	-	-	-
12:11	2.50	-	10.7785	-	-	-	-	-	-	-	-
12:12	2.00	-	10.7785	-	-	-	-	-	-	-	-
12:13	1.50	-	10.7785	-	-	-	-	-	-	-	-
12:14	1.50	-	10.7785	-	-	-	-	-	-	-	-
12:15	1.50	-	10.7785	-	-	-	-	-	-	-	-
12:16	1.50	-	10.7785	-	-	-	-	-	-	-	-
12:17	1.50	-	10.7785	-	-	-	-	-	-	-	-
12:18	1.00	-	10.7785	-	-	-	-	-	-	-	-
12:19	1.00	-	10.7785	-	-	-	-	-	-	-	-
12:20	1.00	-	10.7785	-	-	-	-	-	-	-	-
12:21	1.00	-	10.7785	-	-	-	-	-	-	-	-
12:22	1.00	-	10.7785	-	-	-	-	-	-	-	-
12:23	1.00	-	10.7785	-	-	-	-	-	-	-	-
12:24	1.00	-	10.7785	-	-	-	-	-	-	-	-
12:25	0.50	-	10.7785	-	-	-	-	-	-	-	-
12:26	0.50	-	10.7785	-	-	-	-	-	-	-	-
12:27	0.50	-	10.7785	-	-	-	-	-	-	-	-
12:28	0.50	-	10.7785	-	-	-	-	-	-	-	-
12:29	0.50	-	10.7785	-	-	-	-	-	-	-	-
12:30	0.50	-	10.7785	-	-	-	-	-	-	-	-

TEST REPORT ASC/60331

Customer: Brian Walsh
SOCOTEC
2-8 Langlands Place
Kelvin South Business Park
Glasgow
East Kilbride
G75 0YF

Testing Facility: Advanced Chemistry & Research
SOCOTEC
Etwell Building
Bretby Business Park
Ashby Road
Burton Upon Trent
DE15 0YZ

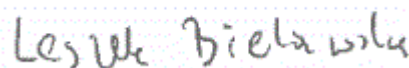
Purchase Order Number: LEK 14098

Date Samples Received: 02 November 2023

Condition of Samples: Ambient and Satisfactory

Analysis Date: 09 November 2023

Approved by:



Approver's name: Leszek Bielawski

Job Title: Senior Analyst

Test Report Date: 15 November 2023

Opinions and Interpretations expressed herein are outside the scope of our UKAS accreditation
The results reported relate only to the sample tested
The results apply to the sample as received



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ASC/60331 Report: Page 1 of 5
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Sample and Method Descriptions

Number of Samples Received	Matrix / Sample Description	Method ID	Description
4	Probe rinse and filter combinations	ASC/SOP/117	THE ANALYSIS OF NITRIC ACID AND HYDROGEN PEROXIDE IMPINGERS, FILTERS AND PROBE RINSE SAMPLES FOR METALS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROSCOPY (ICP-AES) AND BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY (ICP-MS) – Probe rinses were evaporated and combined with the associated filter. Filter and filter/probe rinse samples were digested, using a mixture of high-purity concentrated acids in sealed Teflon vessels with microwave-assisted heating, and diluted to a known volume with deionised water. Filter and filter/probe rinse digests and impinger samples were diluted as necessary and analysed by ICP-MS and/or ICP-AES using certified standards.
3	Nitric acid / hydrogen peroxide impingers		
3	Nitric acid / potassium dichromate impingers	ASC/SOP/112	ANALYSIS OF POTASSIUM DICHROMATE/NITRIC ACID IMPINGERS FOR MERCURY BY ATOMIC FLUORESCENCE SPECTROSCOPY – Samples were diluted as necessary and analysed by CVAFS using certified standards.

- *The results for Hg in Nitric Acid / Hydrogen Peroxide Impingers deviate from method ASC/SOP/117; the MLoD has been raised from 0.0001 mg/L to 0.0002 mg/L due to contamination in the matrix blank.

Results

Table 1: Probe Rinse and Filters

Units		µg	µg	µg	µg	µg	µg	µg	µg	µg	µg	µg	µg
Method ID (ASC/SOP/xxx)		117	117	117	117	117	117	117	117	117	117	117	117
Method Limit of Detection		0.4	0.5	0.2	0.3	0.5	0.5	0.4	0.4	0.5	0.4	0.6	0.3
Accreditation		MCERTs	MCERTs	MCERTs	MCERTs	MCERTs	UKAS	MCERTs	MCERTs	MCERTs	MCERTs	MCERTs	MCERTs
Customer Sample Reference	Laboratory Sample Reference	As	Cd	Co	Cr	Cu	Hg	Mn	Ni	Pb	Sb	Tl	V
BW 067	ASC/60331.001	<0.4	<0.5	<0.2	0.7	<0.5	<0.5	0.5	0.9	<0.5	<0.4	<0.6	<0.3
BW 069	ASC/60331.003	<0.4	<0.5	<0.2	1	15	<0.5	0.8	1	1	<0.4	<0.6	<0.3



1252



Results

Table 2: Nitric Acid / Hydrogen Peroxide Impingers

Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mL
Method ID (ASC/SOP/xxx)		117	117	117	117	117	117	117	117	117	117	117	117	117
Method Limit of Detection		0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	NA
Accreditation		MCERTs	MCERTs	MCERTs	MCERTs	MCERTs	UKAS	MCERTs	MCERTs	MCERTs	MCERTs	MCERTs	MCERTs	MCERTs
Customer Sample Reference	Laboratory Sample Reference	As	Cd	Co	Cr	Cu	Hg	Mn	Ni	Pb	Sb	Tl	V	Volume
BW 068	ASC/60331.002	<0.0001	<0.0001	<0.0001	0.0007	0.0002	<0.0002*	0.0002	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	352
BW 070	ASC/60331.004	0.0001	0.0006	<0.0001	0.096	0.0046	0.011*	0.0017	0.0026	0.0042	0.0002	<0.0001	0.0005	345
BW 071	ASC/60331.005	<0.0001	<0.0001	<0.0001	0.013	0.0006	<0.0002*	0.0006	0.0004	0.0008	0.0001	<0.0001	<0.0001	105

1. NA means not applicable
2. * These results are classified as deviating; the MLoD for Hg was raised due to contamination in the matrix blank.

Results

Table 3: Probe Rinse and Filters

		Units	µg
		Method ID (ASC/SOP/xxx)	117
		Method Limit of Detection	0.5
		Accreditation	UKAS
Customer Sample Reference	Laboratory Sample Reference	Hg	
BW 072	ASC/60331.006	<0.5	
BW 074	ASC/60331.008	<0.5	

Table 4: Nitric Acid / Potassium Dichromate Impingers

		Units	mg/L	mL
		Method ID (ASC/SOP/xxx)	112	112
		Method Limit of Detection	0.0001	NA
		Accreditation	MCERTs	MCERTs
Customer Sample Reference	Laboratory Sample Reference	Hg	Volume	
BW 073	ASC/60331.007	<0.0001	361	
BW 075	ASC/60331.009	0.026	268	
BW 076	ASC/60331.010	0.011	98.3	

1. NA means not applicable

END OF TEST REPORT

TEST REPORT ASC/60332

Customer: SOCOTEC
2-8 Langlands Place
Kelvin South Business Park
Glasgow
East Kilbride
G75 0YF

Testing Facility: Advanced Chemistry & Research
SOCOTEC
Etwall Building
Bretby Business Park
Ashby Road
Burton Upon Trent
DE15 0YZ

Purchase Order Number: LEK14098

Date Samples Received: 02 November 2023

Condition of Samples: Ambient and Satisfactory

Approved by: *Timothy Withnall*

Approver's name: Timothy Withnall

Job Title: Analyst

Test Report Date: 15 November 2023

Opinions and Interpretations expressed herein are outside the scope of our UKAS accreditation
The results reported relate only to the sample tested
The results apply to the sample as received

Sample and Method Descriptions

Number of Samples Received	Matrix / Sample Description	Method ID	Description
3	HPLC Water	ASC/SOP/110	THE DETERMINATION OF ANIONS USING ION CHROMATOGRAPHY – Samples were diluted as necessary and analysed by IC calibrated using certified standards.
3	0.1N Sodium Hydroxide		
3	0.3% Hydrogen Peroxide		
3	0.05M Sulphuric Acid	ASC/SOP/108	DETERMINATION OF AMMONIUM BY ION CHROMATOGRAPHY – Samples were diluted as necessary and analysed by IC calibrated using certified standards.

Results

Table 1:

Units		mg/L	mg/L	mg/L	mg/L	mL
Method ID (ASC/SOP/xxx)		110	110	110	108	108/110
Method Limit of Detection		0.02	0.01	0.1	0.02/2*	N/A
Matrix		0.1N Sodium Hydroxide	HPLC Water	0.3% Hydrogen Peroxide	0.05M Sulphuric Acid	N/A
Accreditation		MCERTs	MCERTs	MCERTs	UKAS	UKAS
Customer Sample Reference	Laboratory Sample Reference	Fluoride expressed as HF	Chloride expressed as HCl	Sulphate expressed as SO ₂	Ammonium expressed as Ammonia	Volume
077	ASC/60332.001	NR	<0.01	NR	NR	377
078	ASC/60332.002	NR	0.19	NR	NR	287
079	ASC/60332.003	NR	0.04	NR	NR	94.9
080	ASC/60332.004	0.2	NR	NR	NR	376
081	ASC/60332.005	0.04	NR	NR	NR	253
082	ASC/60332.006	1.3	NR	NR	NR	123
083	ASC/60332.007	NR	NR	0.1	NR	344
084	ASC/60332.008	NR	NR	3.3	NR	339
085	ASC/60332.009	NR	NR	<0.1	NR	196
086	ASC/60332.010	NR	NR	NR	<0.02	337
087	ASC/60332.011	NR	NR	NR	81*	269
089	ASC/60332.012	NR	NR	NR	0.49	156

1. N/A means not applicable
2. NR means not requested
3. Results marked with an asterisk (*) also have the corresponding MLoD marked with an asterisk (*)

END OF TEST REPORT

CERTIFICATE OF ANALYSIS

MSSL reference: 23-62214

Report date: 21-11-2023

Customer: Socotec UK Ltd
2 Langlands Place,
Kelvin South Business Park,
East Kilbride,
G75 0YF

Customer contact(s): Brian Walsh

Customer reference: P0029-06CAR23-01 (LEK 14098)	Analysis started: 15-11-2023
Customer PO: B198078LSL	Analysis complete: 21-11-2023
Customer sampling date: 24-10-2023	Conforming: YES
Date received: 01-11-2023	

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Results only relate to the items tested. Results apply to the samples as received.

Conformance is contingent upon accurate information being provided by the customer and customer compliance with relevant sample handling and storage conditions prior to receipt at the laboratory.

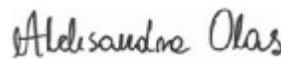
All opinions and interpretations expressed within this report are outside Marchwood's scope of accreditation.

Accreditation Key:

Y : ISO/IEC 17025 M : MCERTS
N : Non Accredited (S) : Subcontracted

Notes:

Reported by: Aleksandra Olas
Position: Scientist



Approved by: Giuseppe Reitano
Position: Technical Laboratory Manager
For/on behalf of Marchwood Scientific Services Ltd



355523 Dioxin Results Summary

Sample Type : Stack
MSS Sample Ref : 355523
Customer Sample Ref : BW 065 10:30 24 Oct 23 Blank 1
Sample Condition : Conforming
Test Method : 2002b

Dioxins/ Furans

Analysis	Accreditation	Lower Bound	Upper Bound
I-TEQ	M	0.00103	0.00257

355523 Dioxin Results

Sample Type : Stack
 MSS Sample Ref : 355523
 Customer Sample Ref : BW 065 10:30 24 Oct 23 Blank 1
 Sample Condition : Conforming
 Test Method : 2002b

Congener	LOD	Detected	Lower Bound	Upper Bound	Recovery	Sampling Recovery	UKAS
Dioxins/Furans	ng/Sample	ng/Sample	ng/Sample	ng/Sample	%	%	
2378-TCDD	0.00074	< 0.00074	0.0000	0.00074	94		M
12378-PeCDD	0.00060	< 0.00060	0.0000	0.00030	80		M
123478-HxCDD	0.00042	< 0.00042	0.0000	0.00004	88		M
123678-HxCDD	0.00045	< 0.00045	0.0000	0.00004	92		M
123789-HxCDD	0.00042	< 0.00042	0.0000	0.00004			M
1234678-HpCDD	0.00050	< 0.00050	0.0000	0.00001	86		M
OCDD	0.0010	0.00950	0.00001	0.00001	95		M
Dioxins Total			0.00001	0.00118			M
2378-TCDF	0.00129	0.0102	0.00102	0.00102	76		M
12378-PeCDF	0.00037	< 0.00037	0.0000	0.00002		106	M
23478-PeCDF	0.00036	< 0.00036	0.0000	0.00018	78		M
123478-HxCDF	0.00045	< 0.00045	0.0000	0.00005	88		M
123678-HxCDF	0.00042	< 0.00042	0.0000	0.00004	89		M
234678-HxCDF	0.00044	< 0.00044	0.0000	0.00004	79		M
123789-HxCDF	0.00037	< 0.00037	0.0000	0.00004		77	M
1234678-HpCDF	0.00025	< 0.00025	0.0000	0.00000	80		M
1234789-HpCDF	0.00030	< 0.00030	0.0000	0.00000		98	M
OCDF	0.00039	< 0.00039	0.0000	0.00000	85		M
Furans Total			0.00102	0.00139			M
Dioxin/Furan Total			0.00103	0.00257			M

Additional Information

Measurement Information

	Institution	Socotec East Kilbride
	Person	n/a
	Site sampling location	P0029-06CAR23-01(LEK 14098)
	Date : Time	24/10/2023 10:30
		PCDD/F
Precision		5.7%
Expanded Uncertainty (of total TEQ)		14.8%
Sample storage	Location	Millbrook
	Temperature (°C)	<25
	Date into storage	01/11/23
Extraction	Date	15/11/23
	Standard Concentration	1 ng
	Date Added	15/11/23
Concentration		
	Final Volume	30µl
Recovery Standards		
	Date Added	16/11/23
	Extract volume at injection	30µl
	Date of Analysis	17/11/23

Expanded Uncertainty - (95% coverage established over 12 month period). Further information on individual congener uncertainties are available on request.

The analysis was performed in accordance with EN1948-2:2006 and this European Standard, i.e. EN1948-4:2010

355524 Dioxin Results Summary

Sample Type : Stack
MSS Sample Ref : 355524
Customer Sample Ref : BW 066 10:50 - 16:50 24 Oct 23 Run 1
Sample Condition : Conforming
Test Method : 2002b

Dioxins/ Furans

Analysis	Accreditation	Lower Bound	Upper Bound
I-TEQ	M	0.00215	0.00826

355524 Dioxin Results

Sample Type : Stack
 MSS Sample Ref : 355524
 Customer Sample Ref : BW 066 10:50 - 16:50 24 Oct 23 Run 1
 Sample Condition : Conforming
 Test Method : 2002b

Congener	LOD	Detected	Lower Bound	Upper Bound	Recovery	Sampling Recovery	UKAS
Dioxins/Furans	ng/Sample	ng/Sample	ng/Sample	ng/Sample	%	%	
2378-TCDD	0.00386	< 0.00386	0.0000	0.00386	100		M
12378-PeCDD	0.00241	< 0.00241	0.0000	0.00121	80		M
123478-HxCDD	0.00105	< 0.00105	0.0000	0.00011	86		M
123678-HxCDD	0.00127	< 0.00127	0.0000	0.00013	79		M
123789-HxCDD	0.00120	< 0.00120	0.0000	0.00012			M
1234678-HpCDD	0.00054	0.0140	0.00014	0.00014	75		M
OCDD	0.0010	0.0196	0.00002	0.00002	80		M
Dioxins Total			0.00016	0.00558			M
2378-TCDF	0.00325	0.0163	0.00163	0.00163	82		M
12378-PeCDF	0.00099	< 0.00099	0.0000	0.00005		108	M
23478-PeCDF	0.00096	< 0.00096	0.0000	0.00048	80		M
123478-HxCDF	0.00058	< 0.00058	0.0000	0.00006	81		M
123678-HxCDF	0.00057	< 0.00057	0.0000	0.00006	79		M
234678-HxCDF	0.00053	0.00281	0.00028	0.00028	83		M
123789-HxCDF	0.00044	< 0.00044	0.0000	0.00004		72	M
1234678-HpCDF	0.00035	0.00695	0.00007	0.00007	70		M
1234789-HpCDF	0.00043	< 0.00043	0.0000	0.00000		100	M
OCDF	0.00050	0.00696	0.00001	0.00001	69		M
Furans Total			0.00199	0.00268			M
Dioxin/Furan Total			0.00215	0.00826			M

Additional Information

Measurement Information

	Institution	Socotec East Kilbride
	Person	n/a
	Site sampling location	P0029-06CAR23-01(LEK 14098)
	Date : Time	24/10/2023 10:50-16:50
		PCDD/F
Precision		5.7%
Expanded Uncertainty (of total TEQ)		14.8%
Sample storage	Location	Millbrook
	Temperature (°C)	<25
	Date into storage	01/11/23
Extraction	Date	15/11/23
	Standard Concentration	1 ng
	Date Added	15/11/23
Concentration		
	Final Volume	30µl
Recovery Standards		
	Date Added	16/11/23
	Extract volume at injection	30µl
	Date of Analysis	17/11/23

Expanded Uncertainty - (95% coverage established over 12 month period). Further information on individual congener uncertainties are available on request.

The analysis was performed in accordance with EN1948-2:2006 and this European Standard, i.e. EN1948-4:2010

FOLLOW-UP ACTIONS

The licensee is required to complete the actions outlined in this site visit report within the specified timeframes. Where required, the licensee shall also respond to actions specified in Compliance Investigations and/or submit a response to this site visit report via the EDEN system. The licensee shall maintain a documentary evidence, for review by the Agency, that the prescribed actions were completed within the required timeframe.

(i) Compliance Investigations

The Agency may generate a Compliance Investigation through the EDEN system and issue instructions and actions to the licensee. The licensee will receive notification when an instruction or action is issued and the licensee must respond to the actions within the Compliance Investigation within the specified timeframe.

(ii) Response to Site Visit Report

Where the licensee is requested to (or wishes to) respond to the Agency in relation to this site visit report, the licensee may select the 'Make a Response' link on the Site Visits page in EDEN where a .pdf document containing the response can be attached and submitted. The response should include details of the actions taken by the licensee to address the issues raised in this site visit report and the target completion dates. This Licensee Public Response provides the licensee with an opportunity to inform both the Agency and the public about the implementing of actions set out in the Agency site visit report. The response must be submitted **within 21 calendar days** of the issue date of this site visit report.

(iii) Publication of Reports

This site visit report will be published on the EPA's website, www.epa.ie, 30 calendar days after the site visit report issue date.

Any licensee response to this site visit report will be published on the EPA's website simultaneously (i.e. 30 calendar days after the site visit report issue date).

Please note that licensees are required to comply with the conditions of the licence at all times, and where non-compliance occurs, compliance must be restored within the shortest possible time. These actions will be verified during subsequent Agency visits. Please quote the above Inspection Reference Number in any correspondence in relation this Report.