STACK EMISSIONS MONITORING REPORT

2-4 Langlands Place
Kelvin South Business Park
East Kilbride
G75 0YF
Tel: 01355 246 730

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Operator & Address:
Medite Europe Limited Redmondstown Clonmel Co. Tipperary

Permit Reference:
IE Licence: P0027-04

Release Point:
A2-22

Sampling Date(s):
30th September - 2nd October

SOCOTEC Job Number:	LIR 1328 / Q3
Report Date:	04-Nov-25
Version:	1
Report By: MCERTS Number: MCERTS Level: Technical Endorsements:	Stuart Gordon MM 22 1745 MCERTS Level 1 Technician 1, 3 & 4
Report Approved By: MCERTS Number: Business Title: Technical Endorsements: Signature:	Brian Walsh MM 17 1414 MCERTS Level 2 - Team Leader 1, 2, 3 & 4

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EXECUTIVE SUMMARY

MONITORING OBJECTIVES

Medite Europe Limited operates a press fan process at Medite Europe Limited which is subject to IE Licence P0027-04, under the EPA Act 1992.

SOCOTEC UK LTD were commissioned by Medite Europe Limited 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, P0027-04.

Plant

A2-22

Operator

Medite Europe Limited
Redmondstown
Clonmel
Co. Tipperary

IE Licence: P0027-04

Stack Emissions Monitoring Test House

SOCOTEC UK LTD - 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.

EXECUTIVE SUMMARY

EMISSIONS SUMMARY A2-22					
Parameter	**Units**	**Result**	**Calculated Uncertainty +/-**	**Emission Limit Value (ELV)**	**Accreditation**
Total Particulate Matter Particulate Emission Rate	mg/m³ g/hr	4.1 170	0.25 10	15 -	MCERTS
PM_{10} PM_{10} Emission Rate	mg/m³ g/hr	0.3 12.2	0.04 2	3.75 -	MCERTS
$PM_{2.5}$ $PM_{2.5}$ Emission Rate	mg/m³ g/hr	0.27 11.63	0.03 1.23	- -	MCERTS
Formaldehyde Formaldehyde Emission Rate	mg/m³ g/hr	0.1 5	0.12 4.9	6 -	MCERTS
Total Volatile Organic Compounds Total Volatile Organic Compounds Emission Rate	mg/m³ g/hr	6.59 291.28	1.3 57.67	100 -	MCERTS
Moisture	%	0.12	0.05	-	MCERTS
Stack Gas Temperature	°C	27	-	-	MCERTS
Stack Gas Velocity	m/s	17.2	0.42	-	
Gas Volumetric Flow Rate (Actual)	m³/hr	48730	2506	-	
Gas Volumetric Flow Rate (STP, Wet)	m³/hr	44231	2274	-	
Gas Volumetric Flow Rate (STP, Dry)	m³/hr	44179	2272	-	
Gas Volumetric Flow Rate at Reference Conditions	m³/hr	44231	2274	50000	

ND = None Detected,
Results at or below the limit of detection are highlighted by bold italic text.
The above volumetric flow rate is calculated using data from the preliminary survey. Mass emissions for non isokinetic tests are calculated using these values. For all isokinetic testing the mass emission is calculated using test specific flow data and not the above values.
Reference conditions are 273K, 101.3kPa without correction for water vapour

EXECUTIVE SUMMARY

MONITORING TIMES			
Parameter	**Sampling Date(s)**	**Sampling Times**	**Sampling Duration**
Total Particulate Matter Run 1	01 October 2025	10:46 - 11:18	32 minutes
PM_{10} Run 1	02 October 2025	15:10 - 16:10	60 minutes
$PM_{2.5}$ Run 1	02 October 2025	15:10 - 16:10	60 minutes
Formaldehyde Run 1	01 October 2025	10:46 - 11:18	32 minutes
Total Volatile Organic Compounds Run 1	02 October 2025	14:07 - 15:07	60 minutes
Preliminary Stack Traverse	01 October 2025	10:31	-

EXECUTIVE SUMMARY

PROCESS DETAILS

Parameter	Process Details
Description of process	Press Fan
Continuous or batch	Continuous
Product Details	MDF
Part of batch to be monitored (if applicable)	N/A
Normal load, throughput or continuous rating	Normal Load
Fuel used during monitoring	Wood
Abatement	Cyclone
Plume Appearance	Very Heavy Steam Plume

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	0.11 mg/m³	6.1%	1.67%
PM_{10}	SRM - EN 23210	AE 136	1015	MCERTS	0.02 mg/m³	14.1%	1%
$PM_{2.5}$	SRM - EN 23210	AE 136	1015	MCERTS	0.01 mg/m³	10.6%	N/A - No ELV
Formaldehyde	CEN/TS 17638	AE114	1015	MCERTS	0.038 mg/m³	102.8%	1.96%
Total Volatile Organic Compounds	SRM - EN 12619:2013	AE 102	1015	MCERTS	0.3 mg/m³	19.8%	1.3%
Moisture	EN 14790	AE 105	1015	MCERTS	0.02%	46.3%	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%	4.55%

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 Analyis**	**Archive Period**
Total Particulate Matter	Gravimetric	AE 106	1015	MCERTS	SOCOTEC (East Kilbride)	N/A	8 Weeks
PM_{10}	Gravimetric	AE 106	1015	MCERTS	SOCOTEC (East Kilbride)	N/A	8 Weeks
$PM_{2.5}$	Gravimetric	AE 106	1015	MCERTS	SOCOTEC (East Kilbride)	N/A	8 Weeks
Formaldehyde	Spectrophotometric	M103	0605	MCERTS	RPS	25-08503-1	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
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	>= 5 Pa	Yes	EN 15259
Lowest Gas Velocity	17.0	m/s	-	-	-
Highest Gas Velocity	17.5	m/s	-	-	-
Ratio of Gas Velocities	1.0	: 1	< 3 : 1	Yes	EN 15259
Mean Velocity	17.2	m/s	-	-	-
Maximum angle of flow with regard to duct axis	<15	°	< 15°	Yes	EN 15259
No local negative flow	Yes	-	-	Yes	EN 15259

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

SAMPLING LINES & POINTS		
	Isokinetic	**Non-Iso & Gases**
Sample port size	4" BSP	1" Port
Number of lines used	2	1
Number of points / line	2	1
Duct orientation	Vertical	Vertical
Filtration	Out Stack	Out Stack
Filtration for TPM	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	No
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	No
Depth of Platform = >Stack depth / diameter + wall and port thickness + 1.5m	No

Sampling Platform Improvement Recommendations (if applicable)

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EXECUTIVE SUMMARY

Sampling & Analytical Method Deviations

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

APPENDICES

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APPENDIX 1 - Monitoring Schedule, Calibration Checklist & Monitoring Team

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
PM10	SRM - EN 23210	AE 136	1015	MCERTS	1
PM2.5	SRM - EN 23210	AE 136	1015	MCERTS	1
Formaldehyde	CEN/TS 17638	AE114	1015	MCERTS	1
Total Volatile Organic Compounds	SRM - EN 12619:2013	AE 102	1015	MCERTS	1
Moisture	EN 14790	AE 105	1015	MCERTS	1
Velocity	SRM - EN ISO 16911-1	AE 154	1015	MCERTS	1

APPENDIX 1 - Monitoring Schedule, Calibration Checklist & Monitoring Team

CALIBRATABLE EQUIPMENT CHECKLIST					
Extractive Sampling		Instrumental Analyser/s		Miscellaneous	
Equipment	Equipment I.D.	Equipment	Equipment I.D.	Equipment	Equipment I.D.
Control Box DGM	LIR 9.49	Horiba PG - 350E Analyser	LIR 12.2	Laboratory Balance	LIR 15.21
Box Thermocouples	LIR 9.50	FT-IR	-	Tape Measure	LIR 20.2
Meter In Thermocouple	LIR 9.50	FT-IR Oven Box	-	Stopwatch	-
Meter Out Thermocouple	LIR 9.50	Bernath 3006 FID	LIR 8.4	Protractor	-
Control Box Timer	LIR 17.27	Signal 3030 FID	-	Barometer	LIR 16.13
Oven Box	LIR 13.25	Servomex	-	Digital Micromanometer	LIR 15.AF1
Probe	LIR 6.22	JCT Heated Head Filter	LIR 13.32a	Digital Temperature Meter	LIR 2.11
Probe Thermocouple	-	Thermo FID	LIR 8.27	Stack Thermocouple	-
Probe	LIR 6.17	Stackmaster	-	Mass Flow Controller	-
Probe Thermocouple	-	FTIR Heater Box for Heated Line	-	MFC Display module	-
S-Pitot	LIR 6.17	Anemometer	-	1m Heated Line (1)	-
L-Pitot	-	Ecophysics NOx Analyser	-	1m Heated Line (2)	-
Site Balance	LIR 23.24	Chiller (JCT/MAK 10)	LIR 12.12	1m Heated Line (3)	-
Last Impinger Arm	LIR 3.109	Heated Line Controller (1)	LIR 8.49	5m Heated Line (1)	-
Dioxins Cond. Thermocouple	LIR 3.209	Heated Line Controller (2)	-	10m Heated Line (1)	-
Callipers	LIR 15.1X	Site temperature Logger	-	10m Heated Line (2)	-
Small DGM	-	Gas Divider (1)	-	15m Heated Line (1)	-
Heater Controller	-	Gas Divider (2)	-	20m Heated Line (1)	LIR 8.49
Inclinometer (Swirl Device)	LIR 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 +/- %
Propane	LEK 232	BOC	82.8	-	2.0

Note: Span gases may be diluted to an appropriate range with a gas divider.

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	May-27	Jan-28	Mar-29	Nov-28	May-28	May-27
Stuart Gordon	MM 22 1745	MCERTS Level 1	Sep-27	Apr-29	-	Mar-30	May-30	Sep-27

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

TOTAL PARTICULATE MATTER SUMMARY					
Parameter	**Sampling Times**	**Concentration mg/m³**	**Uncertainty mg/m³**	**ELV mg/m³**	**Emission Rate g/hr**
Run 1	10:46 - 11:18 01 October 2025	4.08	0.25	15	169.6
Blank	-	0.17	-	-	-

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

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

FILTER INFORMATION

SAMPLES								
Test	Filter & Probe Rinse Number	Filter Start Weight g	Filter End Weight g	Mass Gained on Filter g	Probe Rinse Start Weight g	Probe Rinse End Weight g	Mass Gained on Probe g	Combined Total Mass Gained g
Run 1	IAQ 208	0.15289	0.15386	0.00097	54.40004	54.40126	0.00122	0.00219

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

BLANKS								
Test	Filter & Probe Number	Filter Start Weight g	Filter End Weight g	Mass Gained Filter g	Probe Start Weight g	Probe End Weight g	Mass Gained Probe g	Combined Total Mass Gained g
Run 1	IAQ 209	0.14980	0.14984	0.00004	57.10940	57.10945	0.00005	0.00009

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

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

ISOKINETIC SAMPLING EQUATIONS - RUN 1 — TPM

Absolute pressure of stack gas, P_s		
Barometric pressure, P_b	Kpa	101.0
Stack static pressure, P_{static}	pa	81.0
$P_s = P_b + P_{static}$	Kpa	101.1
Vol. of water vapour collected, V_{wstd}		
Moisture trap weight increase,Vlc	g	0.5
$V_{wstd} = (0.001246)(V_{lc})$	m^3	0.000623
Volume of gas metered dry, V_{mstd}		
Volume of gas sample through gas meter, V_m		0.577
Gas meter correction factor, Y_d		0.993
Mean dry gas meter temperature, T_m		292
Mean pressure drop across orifice, DH	mmH_2O	29.111
$V_{mstd} = \frac{(0.3592)(V_m)(P_b+(DH/13.6))(Y_d)}{T_m}$	m^3	0.536
Volume of gas metered wet, V_{mstw}		
$V_{mstw} = V_{mstd} + V_{wstd}$	m^3	0.5362
Vol. of gas metered at O_2 Ref. Cond., $V_{mstd@X\%O2}$		
Is the process burning hazardous waste? *(If yes, no favourable oxygen correction)*		No
% oxygen measured in gas stream, act%O_2		20.9
% oxygen reference condition		21
O_2 Reference Factor O_2 Ref $= \frac{21.0 - act\%O_2}{21.0 - ref\%O_2}$		No O2 Ref
$V_{mstd@X\%oxygen} = (V_{mstd})(O_{2\,Ref})$	m^3	No O2 Ref
Moisture content, B_{wo}		
$B_{wo} = \frac{V_{wstd}}{V_{mstd} + V_{wstd}}$		0.0012
	%	0.12
Moisture by FTIR	%	-
Velocity of stack gas, V_s		
Velocity pressure coefficient, C_p		0.84
Mean of velocity heads, DP_{avg}	Pa	216.83
Mean stack gas temperature, T_s	K	300
Gas density $_{(wet,\ ambient)}$, ρ		
p=(Ms*Ps)/(8.314*Ts)	kg/m^3	1.168
Stack Velocity, Vs $V_s = \frac{\sum_{i=1}^{n} V_i}{n}$	m/s	16.17

Molecular weight of dry gas, M_d		
CO_2	%	0.04
O_2	%	20.90
Total	%	20.94
N_2 (100 -Total)	%	79.06
$M_d = 0.44(\%CO_2)+0.32(\%O_2)+0.28(\%N_2)$		28.84
Molecular weight of wet gas, M_s		
$M_s = M_d(1 - B_{wo}) + 18(B_{wo})$	g/gmol	28.83
Actual flow of stack gas, Q_a		
Area of stack, A_s	m^2	0.79
$Q_a = (60)(A_s)(V_s)$	m^3/min	762.3
Total flow of stack gas, Q		
Conversion factor (K/mm.Hg)		0.3592
$Q_{std} = \frac{(Q_a)P_s(0.3592)(1-B_{wo})}{(T_s)}$	Dry	691.1
$Q_{stdO2} = \frac{(Q_a)P_s(0.3592)(1-B_{wo})(O_2REF)}{(T_s)}$	@O_2ref	No O2 Ref
$Q_{stw} = \frac{(Q_a)P_s(0.3592)}{(T_s)}$	Wet	691.95
Percent isokinetic, %I		
Nozzle diameter, D_n	mm	4.99
Nozzle area, A_n	mm^2	19.59
Total sampling time, q	min	32
$\%I = \frac{(4.6398E6)(T_s)(V_{mstd})}{(P_s)(V_s)(A_n)(q)(1-B_{wo})}$	%	97.1
Acceptable isokinetic range 95% to 115%		Yes
Particulate Concentration, C		
Mass collected on filter, M_f	g	0.00097
Mass collected in probe, M_p	g	0.00122
Total mass collected, M_n	g	0.00219
$C_{wet} = \frac{M_n}{V_{mstw}}$	mg/m³	4.084
$C_{dry} = \frac{M_n}{V_{mstd}}$	mg/m³	4.089
$C_{dry@X\%O2} = \frac{M_n}{V_{mstd@X\%oxygen}}$	mg/m³	No O2 Ref
Particulate Emission Rates, E		
$E = [(C_{wet})(Q_{stw})(60)] / 1000$		169.57

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

TOTAL PARTICULATE MATTER QUALITY ASSURANCE CHECKLIST

LEAK RATE						
Run	Mean Sampling Rate litre/min	Pre-sampling Leak Rate litre/min	Post-sampling Leak Rate litre/min	Maximum Vacuum mm Hg	Acceptable Leak Rate litre/min	Leak Tests Acceptable?
Run 1	17.91	0.13	-	-381	0.36	Yes

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

ISOKINETICITY		
Run	Isokinetic Variation %	Acceptable Isokineticity
Run 1	97.12	Yes

Acceptable isokinetic range 95% to 115%

WEIGHING BALANCE UNCERTAINTY			
Run	Result mg/m³	5% ELV mg/m³	LOD < 5% ELV
Run 1	0.11	0.8	Yes

The above is based on both the Filter and rinse uncertainty

BLANK VALUE				
Run	Overall Blank Value mg/m^3	Daily Limit Value mg/m^3	Acceptable Blank Value mg/m^3	Overall Blank Acceptable
Blank 1	0.17	15	1.5	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	Quartz Fibre	47	27	180	160

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

PM_{10} SUMMARY					
Test	Sampling Times	Concentration mg/m³	LOD mg/m³	ELV mg/m³	Emission Rate g/hr
Run 1	15:10 - 16:10 02 October 2025	0.3	0.02	3.75	12.2
Blank 1	-	0.027	-	-	-

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

$PM_{2.5}$ SUMMARY					
Test	Sampling Times	Concentration mg/m³	LOD mg/m³	ELV mg/m³	Emission Rate g/hr
Run 1	15:10 - 16:10 02 October 2025	0.3	0.01	-	11.6
Blank 1	-	0.014	-	-	-

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

FILTER INFORMATION

	PM_{10} SAMPLES WEIGHTS				$PM_{2.5}$ SAMPLES WEIGHTS			
Sample Run	PM_{10} Filter Number	Filter Start Weight g	Filter End Weight g	PM_{10} Mass Gained on Filter g	$PM_{2.5}$ Filter Number	Filter Start Weight g	Filter End Weight g	$PM_{2.5}$ Mass Gained on Filter g
Run 1	IAC 303	0.10	0.10	-0.00064	IAC 301	0.10	0.10	0.00039
Blank 1	IAC 362	0.10098	0.10025	-0.00073	IAC 385	0.1019	0.10185	-0.00005

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

ISOKINETIC SAMPLING EQUATIONS RUN 1 — PM_{10} & $PM_{2.5}$

Absolute pressure of stack gas, P_s		
Barometric pressure, P_b	kPa	101.0
Stack static pressure, P_{static}	Pa	81.0
$P_s = P_b + (P_{static})$	kPa	101.1
Vol. of water vapour collected, V_{wstd}		
Moisture trap weight increase,Vlc	g	0.0
$V_{wstd} = (0.001246)(V_{lc})$	m^3	6.23E-07
Volume of gas metered dry, V_{mstd}		
Volume of gas sample through gas meter, V_m	m	1.61
Gas meter correction factor, Y_d		0.99
Mean dry gas meter temperature, T_m		298.50
Mean pressure drop across orifice, DH	mmH_2O	55.00
$V_{mstd} = \frac{(0.3592)(V_m)(P_b+(DH/13.6))(Y_d)}{T_m + 273}$	m^3	1.468
Volume of gas metered wet, V_{mstw}		
$V_{mstw} = V_{mstd} + V_{wstd}$	m^3	1.468
Vol. of gas metered at O_2 Ref. Cond., $V_{mstd@X\%O2}$		
Is the process burning hazardous waste? *(If yes, no favourable oxygen correction)*		No
% oxygen measured in gas stream, act%O_2		20.90
% oxygen reference condition		21
O_2 Reference Factor $O2\ Ref = \frac{21.0 - act\%O2}{21.0 - ref\%O2}$		No O2 Ref
$V_{mstd@X\%oxygen} = (V_{mstd})\ (O_{2\ Ref})$	m^3	No O2 Ref
Moisture content, B_{wo}		
$B_{wo} = \frac{V_{wstd}}{V_{mstd} + V_{wstd}}$		0.0000
	%	0.12
Moisture by FTIR	%	-
Velocity of stack gas, V_s		
Velocity pressure coefficient, C_p		0.84
Mean of velocity heads, DP_{avg}	Pa	245.82
Mean stack gas temperature, T_s	K	303
Gas density (wet, ambient), p		
p=(Ms*Ps)/(8.314*Ts)	kg/m^3	1.157
Stack Velocity, Vs $V_s = Cp\sqrt{\frac{\Delta DPavg}{p}}$	m/s	17.23
*Velocity taken from premlinary survey		

Molecular weight of dry gas, M_d		
CO_2		0.04
O_2		20.90
Total		20.94
N_2 (100 -Total)		79.06
$M_d = 0.44(\%CO_2)+0.32(\%O_2)+0.28(\%N_2)$		28.84
Molecular weight of wet gas, M_s		
$M_s = M_d(1 - B_{wo}) + 18(B_{wo})$		28.84
Actual flow of stack gas, Q_a		
Area of stack, A_s	m^2	0.79
$Q_a = (60)(A_s)(V_s)$	m^3/min	812.2
$Q_{stw} = \frac{(Q_a)P_s(0.3592)}{(T_s) +273}$	Wet	729.91
Percent isokinetic, %I		
Required Flow Rate @ DGM	l/min	29.00
Actual Flow Rate @ DGM	l/min	29.4
Isokinetic Rate		101.35
Acceptable 90% - 130%		Yes
Particulate Concentration, C_{PM10}		
Mass of particulate collected on PM_{10} filter, M_f		0.00002
Mass of particulate collected on $PM_{2.5}$ filter, M_f		0.00039
$C_{wet} = \frac{M_n}{V_{mstw}}$	mg/m^3	0.28
$C_{dry} = \frac{M_n}{V_{mstd}}$	mg/m^3	0.28
$C_{dry@X\%O2} = \frac{M_n}{V_{mstd@X\%oxygen}}$	mg/m^3	No O2 Ref
Particulate Emission Rates, E		
$E = [(C_{wet})(Q_{stw})(60)] / 1000$		12.23
Particulate Concentration, $C_{PM2.5}$		
Mass of particulate collected on filter, M_f		0.00039
$C_{wet} = \frac{M_n}{V_{mstw}}$	mg/m^3	0.2657
$C_{dry} = \frac{M_n}{V_{mstd}}$	mg/m^3	0.2657
$C_{dry@X\%O2} = \frac{M_n}{V_{mstd@X\%oxygen}}$	mg/m^3	No O2 Ref
$E = [(C_{wet})(Q_{stw})(60)] / 1000$		11.63

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

PM_{10} & $PM_{2.5}$ 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	29.39	0.18	0.15	-381	0.59	Yes

FLOW CRITERIA					
Run	Isokinetic Variation %	Acceptable Isokineticity (90% - 130%)	Nominal Flow Rate l/min	Maximum Flow Variation %	Acceptable Deviation from the Nominal Flow Rate (+/-5%)
Run 1	101.35	Yes	29	1.42	Yes

Acceptable Isokinetic rate 90 -130%

FILTERS					
Run	Filter Material	Filter Size mm	Max Filtration Temperature °C	Pre-conditioning Filter Temperature °C	Post conditioning Filtration Temperature °C
Run 1	Glass Fibre	47	30	180	160

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

FORMALDEHYDE SUMMARY					
Test	**Sampling Times**	**Concentration mg/m³**	**LOD mg/m³**	**ELV mg/m³**	**Emission Rate g/hr**
Run 1	10:46 - 11:18 01 October 2025	***0.11***	0.038	6	5
Field Blank	-	0.072	-	-	-

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

FORMALDEHYDE QUALITY ASSURANCE CHECKLIST

	Barometric Pressure Kpa	Average Oxygen Value for Referencing %	Total Sample Volume @ ref Conditions m³	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	-	0.536	17.9	0.13	-	0.36	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	27	25-08503-1	PTFE	Analytical Grade Water

FORMALDEHYDE ABSORPTION EFFICIENCY

Parameter	Total ug	IMP C ug	Absorption Efficiency %	Acceptable Absorption Efficiency %	Absorption Efficiency Acceptable ?
Run 1	61.4	20.6	66	95	N/A - <30% ELV

ND - None Detected

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

ISOKINETIC SAMPLING EQUATIONS 1 — Formaldehyde

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	81	Mean of velocity heads, DP_{avg}	Pa	216.83
$P_s = P_b + (P_{static})$	kPa	101.08	Mean stack gas temperature, T_s	K	300.00
			Gas density $_{(wet, ambient)}$, p		
Vol. of water vapour collected, V_{wstd}			p=(Ms*Ps)/(8.314*Ts)	kg/m^3	1.168
Moisture trap weight increase,Vlc	g	-	Stack Velocity, Vs		
$V_{wstd} = (0.001246)(V_{lc})$	m^3	-	$V_s = \frac{\sum_{i=1}^{n} V_i}{n}$	m/s	16.17
Volume of gas metered dry, V_{mstd}			**Actual flow of stack gas, Q_a**		
Volume of gas sample through gas meter, V_m	m^3	0.5770	Area of stack, A_s	m^2	0.79
Gas meter correction factor, Y_d		0.9933	$Q_a = (60)(A_s)(V_s)$	m^3/min	762
Mean dry gas meter temperature, T_m	K	292.00	**Dry total flow of stack gas, Q_{std}**		
Mean pressure drop across orifice, DH	mmH_2O	29.11	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	0.54	$Q_{std} = \frac{(Q_a)P_s(0.3592)(1-B_{wo})}{(T_s)}$	m^3/min	691
Volume of gas metered wet, V_{mstw}			**Wet total flow of stack gas, Q_{stw}**		
$V_{mstw} = V_{mstd} + V_{wstd}$	m^3	0.5362	$Q_{stw} = \frac{(Q_a)P_s(0.3592)}{(T_s)}$	m^3/min	692
Vol. of gas metered at O_2 Ref. Cond., $V_{mstd@X\%O2}$			**Dry total flow of stack gas at X% O_2, Q_{stdO2}**		
Is the process burning hazardous waste? *(If yes, no favourable oxygen correction)*		No	$Q_{stdO2} = \frac{(Q_a)P_s(0.3592)(1-B_{wo})(O_2REF)}{(T_s)}$	m^3/min	No O2 Ref
% oxygen measured in gas stream, act%O_2		20.90			
% oxygen reference condition		21	**Percent isokinetic, %I**		
O_2 Reference Factor $\frac{O2\ Ref = 21.0 - act\%O2}{21.0 - ref\%O2}$		No O2 Ref	Nozzle diameter, D_n	mm	4.99
			Nozzle area, A_n	mm^2	19.59
$V_{mstd@X\%oxygen} = (V_{mstd})\ (O_{2\ Ref})$	m^3	No O2 Ref	Total sampling time, q	min	32
Moisture content, B_{wo}			$\%I = \frac{(4.6398E6)(T_s)(V_{mstd})}{(P_s)(V_s)(A_n)(q)(1-B_{wo})}$	%	97
$B_{wo} = \frac{V_{wstd}}{V_{mstd} + V_{wstd}}$		0.0012			
	%	0.12	Acceptable isokinetic range 95% to 115%		Yes
Moisture by FTIR	%	-	**Formaldehyde Concentration, C**		
Molecular weight of dry gas, M_d			Mass collected , M	ug	61
CO_2		0.04	$C_{wet} = \frac{M_n}{V_{mstw}}$	mg/m^3	0.115
O_2		20.90			
Total		20.94	$C_{dry} = \frac{M_n}{V_{mstd}}$	mg/m^3	0.115
N_2 (100 -Total)		79.06	$C_{dry@X\%O2} = \frac{M_n}{V_{mstd@X\%oxygen}}$	mg/m^3	No O2 Ref
$M_d = 0.44(\%CO_2)+0.32(\%O_2)+0.28(\%N_2)$		28.84			
Molecular weight of wet gas, M_s			**Formaldehyde Emission Rates, E**		
$M_s = M_d(1 - B_{wo}) + 18(B_{wo})$	g/gmol	28.8	$E = [(C_{wet})(Q_{stw})(60)] / 1000$	g/hr	4.75

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

TOTAL VOLATILE ORGANIC COMPOUNDS SUMMARY

Test	Sampling Times	Concentration mg/m³	LOD mg/m³	ELV mg/m³	Emission Rate g/hr
Run 1	14:07 - 15:07 02 October 2025	6.6	0.30	100	291.28

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

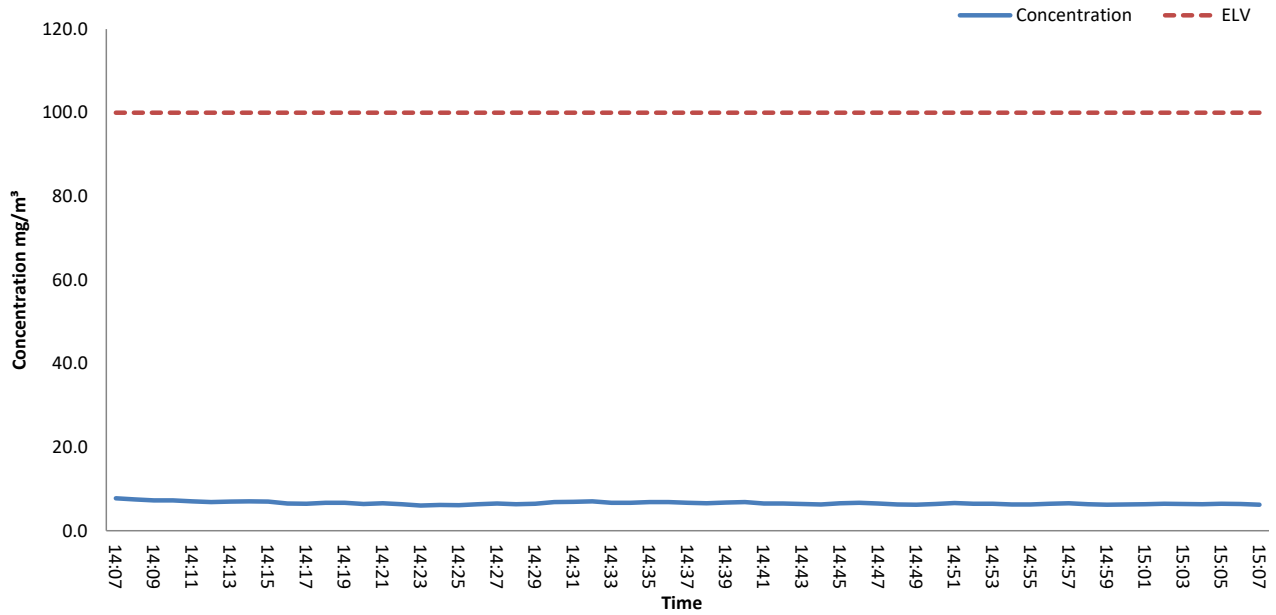
INSTRUMENTAL SPAN & ZERO CHECKS

PRE-SAMPLING CALIBRATION CHECKS								
Date	02 October 2025							
Start Time	13:10							
End Time	13:45							
Gas	Span Conc (ppm)	Analyser Range	Instrument Zero Reading	Instrument Span Reading	Instrument Zero Reading	Zero Down line reading	Span down line reading	Leak Rate (%)
Propane	82.8	100	0.19	82.8	0.22	0.17	82.9	-0.12

Zero and Span gas contained 20.27% Oxygen

POST-SAMPLING CALIBRATION CHECKS								
Date	02 October 2025							
Start Time	16:20							
End Time	16:35							
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	4.10	0.21	82.2	0.05	-0.89	×	×	N/A - not corrected

TOTAL VOLATILE ORGANIC COMPOUNDS EMISSIONS CHART



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

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

MOISTURE CALCULATIONS

Moisture Determination - Isokinetic							
Test Number	Sampling Time and Date	Start Weight kg	End Weight kg	Total gain kg	Concentration %	LOD %	Uncertainty %
Run 1	10:46 - 11:18 01 October 2025	2.9994	2.9999	0.0005	0.1	0.02	46.3

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	32	536	17.9	0.13	-	0.36	Yes

PRELIMINARY STACK SURVEY

Stack Characteristics		
Stack Diameter / Depth, D	1.00	m
Stack Width, W	-	m
Stack Area, A	0.79	m^2
Average stack gas temperature	27	^oC
Stack static pressure	0.041	kPa
Barometric Pressure	101	kPa

Stack Gas Composition & Molecular Weights								
Component	Molar Mass M	Density kg/m^3 p	Conc Dry % Vol	Dry Volume Fraction r	Dry Conc kg/m^3 pi	Conc Wet % Vol	Wet Volume Fraction r	Wet Conc kg/m^3 pi
CO_2	44	1.963059	0.042095	0.000421	0.000826	0.042046	0.000420	0.000825
O_2	32	1.427679	20.900000	0.209000	0.298385	20.875717	0.208757	0.298038
N_2	28	1.249219	79.057905	0.790579	0.987607	78.966049	0.789660	0.986459
H_2O	18	0.803070	-	-	-	0.116188	0.001162	0.000933

Where: p = M / 22.41 pi = r x p

Calculation of Stack Gas Densities		
Determinand	Result	Units
Dry Density (STP), P_{STD}	1.2868	kg/m^3
Wet Density (STP), P_{STW}	1.2863	kg/m^3
Dry Density (Actual), P_{Actual}	1.1680	kg/m^3
Average Wet Density (Actual), $P_{ActualW}$	1.168	kg/m^3

Where:

P_{STD} = sum of component concentrations, kg/m^3 (not including water vapour)

P_{STW} = (P_{STD} + pi of H_2O) / (1 + (pi of H_2O / 0.8036))

P_{Actual} = P_{STD} x (Ts / Ps) x (Pa / Ta)

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

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

PRELIMINARY STACK SURVEY

TRAVERSE 1

Date of Survey	01 October 2025
Time of Survey	10:31
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_2O (average of 3 readings)	Temp °C	Velocity m/s	Volumetric Flow Rate (actual) m^3/s	O_2 % Vol	Angle of Swirl °
1	0.15	251.5	25.7	27	17.4	13.7	-	<15
2	0.85	238.5	24.3	27	17.0	13.3	-	<15
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
Mean	-	245.0	25.0	27	17.2	13.5	-	-

Sampling Line B								
Traverse Point	Distance into duct (m)	DP pt Pa (average of 3 readings)	DP pt mmH_2O (average of 3 readings)	Temp °C	Velocity m/s	Volumetric Flow Rate (actual) m^3/s	O_2 % Vol	Angle of Swirl °
1	0.15	254.8	26.0	27	17.5	13.8	-	<15
2	0.85	238.5	24.3	27	17.0	13.3	-	<15
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
Mean	-	246.6	25.2	27	17.3	13.6	-	-

PRELIMINARY STACK SURVEY QUALITY ASSURANCE CHECKLIST

PITOT LEAK CHECK								
Run	Pre Traverse Leak Rate				Post Traverse Leak Rate			
	Start Value mmH2O	End Value mmH2O	Difference %	Outcome	Start Value mmH2O	End Value mmH2O	Difference %	Outcome
Run 1	145	144	0.7	Pass	138	138	0.0	Pass

To complete a compliant pitot leak check a pressure of over 80 mmH_2O (or 800 Pa) is applied and the pressure drop monitored over 15 seconds. 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	41	44	-3.0	Pass

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

PRELIMINARY STACK SURVEY (CONTINUED)

Sampling Plane Validation Criteria				
EA Technical Guidance Note (Monitoring) M1	Result	Units	Requirement	Compliant
Lowest Average Differential Pressure	238	Pa	>= 5 Pa	Yes
Lowest Gas Velocity	17.0	m/s	-	-
Highest Gas Velocity	17.5	m/s	-	-
Ratio of Gas Velocities	1.0	-	< 3 : 1	Yes
Maximum angle of flow with regard to duct axis	<15	°	< 15°	Yes
No local negative flow	Yes	-	-	Yes

Calculation of Stack Gas Velocity, V		
Velocity at Traverse Point, V = K_{pt} x (1-e) * Ö(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	**17.2**	m/s

Calculation of Stack Gas Volumetric Flowrate, Q			
Duct gas flow conditions	Actual	Reference	Units
Temperature	27	0	°C
Total Pressure	101.041	101.3	kPa
Oxygen	20.9	21	%
Moisture	0.12	0.12	%
Pitot tube calibration coefficient, K_{pt}	0.84		

Gas Volumetric Flowrate	Result	Units
Average Stack Gas Velocity (Va)	17.23	m/s
Stack Area (A)	0.79	m^2
Gas Volumetric Flowrate (Actual), Q_{Actual}	48729.55	m^3/hr
Gas Volumetric Flowrate (STP, Wet), Q_{STP}	44230.51	m^3/hr
Gas Volumetric Flowrate (STP, Dry), $Q_{STP,Dry}$	44179.12	m^3/hr
Gas Volumetric Flowrate (REF), Q_{Ref}	44230.51	m^3/hr

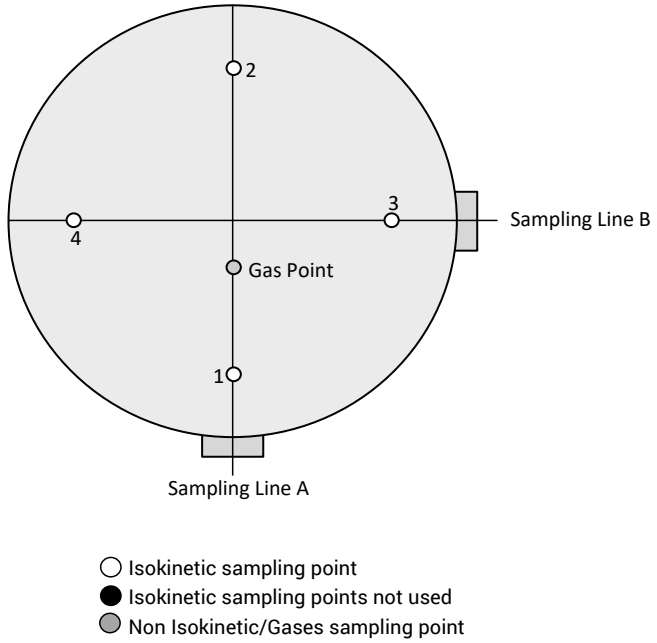
Where:
Q_{Actual} = Va x A x 3600
Q_{STP} = Q (Actual) x (Ts / Ta) x (Pa / Ps)
$Q_{STP,Dry}$ = Q (STP) / (100 - (100 / Ma))
Q_{Ref} = Q (STP) x ((100 - Ma) / (100 - Ms)) x ((21 - O_2a) / (21 - O_2s))

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

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

STACK DIAGRAM

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



Non-Isokinetic/Gases Sampling			
Sampling Point	Distance (% of Depth)	Distance into Stack	Units
A	30	0.30	m

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

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - TOTAL PARTICULATE MATTER

Run	Sampled Volume	Sampled Gas Temp	Sampled Gas Pressure	Sampled Gas Humidity	Oxygen Content	Limit of Detection	Leak	Uncollected Mass
	m^3	K	kPa	% by volume	% by volume	% by mass	%	mg
MU required	**≤ 2%**	**≤ 2%**	**≤ 1%**	**≤ 1%**	**≤ 10%**	**≤ 5% of ELV**	**≤ 2%**	**≤ 10% of ELV**
Run 1	0.001	2.0	0.50	1.0	N/A	0.06	-	-
as a %	0.20	0.67	0.50	1.0	N/A	0.75	0.73	0.001
compliant?	**Yes**	**Yes**	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**

Run	Volume (STP)	Mass of particulate	O_2 Correction	Leak	Uncollected Mass	Combined uncertainty
	m^3	mg	-	mg/m^3	mg	
Run 1	0.49	2.1900	1.0	0.0171	0.0001	-
MU as mg/m^3	0.0538	0.1119	-	0.0171	0.0001	**0.13**
MU as %	1.32	2.7397	-	0.419	0.0024	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	**0.25**	**mg/m^3**	**6.14**	**% Result**	**1.67**	**% ELV**

(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 - PM 10

Run	Sampled Volume m³	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%**	**≤ 1%**	**≤ 1%**	**≤ 10%**	**≤ 5% of ELV**	**≤ 2%**
Run 1	0.003	2.0	0.50	1.0	N/A	0.03	-
as a %	0.20	0.7	0.50	1.0	N/A	0.51376	0.51
compliant?	**Yes**	**Yes**	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**

Run	Volume (STP) m³	Mass of particulate mg	O2 Correction -	Leak mg/m³	Combined uncertainty
Run 1	0.21	0.6812	0.28	1.000	-
MU as mg/m³	0.00	0.0193	-	0.001	**68.13**
MU as %	1.32	68.1157	-	0.295	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	**0.04**	**mg/m³**	**14.06**	**% Result**	**1.05**	**% ELV**

(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 - PM 2.5

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%**	**≤ 1%**	**≤ 1%**	**≤ 10%**	**≤ 5% of ELV**	**≤ 2%**
Run 1	0.003	2.0	0.50	1.0	N/A	0.02	-
as a %	0.20	0.7	0.50	1.0	N/A	N/A	0.51
compliant?	**Yes**	**Yes**	**Yes**	**Yes**	**N/A**	**N/A**	**Yes**

Run	Volume (STP) m^3	Mass of particulate mg	O2 Correction -	Leak mg/m^3	Combined uncertainty
Run 1	0.20	0.6812	0.27	1.000	-
MU as mg/m^3	0.00	0.0136	-	0.001	**68.13**
MU as %	1.32	68.1157	-	0.295	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	**0.03**	**mg/m^3**	**10.60**	**% Result**	**N/A**	**% ELV**

(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 - ISOKINETIC FORMALDEHYDE

Run	Sampled Volume	Sampled Gas Temp	Sampled Gas Pressure	Sampled Gas Humidity	Oxygen Content	Limit of Detection	Leak
	m^3	K	kPa	% by volume	% by volume	% by mass	%
MU required	**<=2%**	**<2.5 k**	**<=1%**	**<=1%**	**<=10%**	**≤ 5% of ELV**	**<=2%**
Run 1	0.536	292	101.81	1.0	-	0.1	-
as a %	0.19	0.68	0.49	1.0	-	0.95	0.73
compliant?	**Yes**	**Yes**	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**

Run	Volume (STP)	Mass of Formaldehyde	O2 Correction	Leak	Lab Uncertainty	Combined uncertainty
	m^3	mg	-	mg/m^3	mg	
Run 1	0.5038	0.1228	-	0.0005	-	-
MU as mg/m^3	0.0015	0.0573	-	0.0005	0.0136	**0.0589**
MU as %	1.3228	50.0003	-	0.4191	11.9	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	**0.12**	**mg/m^3**	**102.81**	**% Result**	**1.96**	**% ELV**

(k is a coverage factor which gives a 95% confidence in the quoted figures)
Reference – SOCOTEC Technical Procedure AE150 Estimation of Uncertainty of Measurement

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - MOISTURE

Run	Sampled Volume m^3	Sampled Gas Temp K	Sampled Gas Pressure kPa	Sampled Gas Humidity % by volume	Oxygen Content % by volume	Leak %
MU required	**≤ 2%**	**≤ 2%**	**≤ 1%**	**≤ 1%**	**≤ 10%**	**≤ 2%**
Run 1	0.0011	2.0	0.50	1.0	N/A	-
as a %	0.20	0.67	0.50	1.0	N/A	0.73
compliant?	**Yes**	**Yes**	**Yes**	**Yes**	**N/A**	**Yes**

Run	Volume (STP) m^3	Mass Gained mg	O_2 Correction -	Leak mg/m^3	Uncollected Mass mg	Combined uncertainty
Run 1	0.49	500	1.0	3.91	58	-
MU as % v/v	0.002	0.024	-	0.000	0.014	**0.027**
MU as %	1.32	20.00	-	0.42	11.55	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	**0.05**	**% v/v**	**46.27**	**%**

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - VOLATILE ORGANIC COMPOUNDS RUN 1

Measured Concentration	6.6	mg/m^3
Limit	100	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	31	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	0.05	% full scale	<5% range / 24hr	Yes
Span drift	-0.89	% 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)	-0.12	% 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	0.00
volume or pressure flow dependence	uspres	0.00
atmopsheric pressure dependence	uapres	0.04
ambient temperature dependence	utemp	0.00
Dependence on voltage	uvolt	0.14
losses in the line (leak)	uleak	0.00
Uncertainty of calibration gas	ucalib	0.04
Uncertainty in factor	uf	0.00

Measurement uncertainty Measured Concentration	6.59	mg/m^3
Combined uncertainty	0.66	mg/m^3
Expanded uncertainty	1.30	mg/m^3

Expanded uncertainty expressed with a level of confidence of 95%	**1.30**	**% ELV**
Expanded uncertainty expressed with a level of confidence of 95%	**1.30**	**mg/m^3**
Expanded uncertainty expressed with a level of confidence of 95%	**19.75**	**% value**

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	17.2	m/s
Measured Volumetric Flow rate at Actual Conditions	48730	m³/hr

Performance Characteristics & Source of Value	Units	Values	Requirement	Compliant
Uncertainty of Local Gas Velocity Determination				
Uncertainty of pitot tube coefficient	-	0.010		
Uncertainty of mean local dynamic pressures	-	1.93		
Factor loading, function of the number of measurements.	3 readings	0.591	minimum 3	Yes
Range of measurment device	pa	1000		
Resolution	pa	1.00		
Calibration uncertainty	pa	37.37	<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	0.00003		
Uncertainty of temperature measurement	K	1.53	<1% of value	Yes
Uncertainty of absolute pressure in the duct	pa	516		
Uncertainty associated with the calculation of density	kg/m3	0.007		
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	0.21
Expanded uncertainty at a 95% Confidence Interval	0.42

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	m³/hr
Combined uncertainty	1278
Expanded uncertainty at a 95% Confidence Interval	2506

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