

STACK EMISSIONS MONITORING REPORT



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Operator & Address:

Medite Europe Limited
Redmonstown,
Clonmel,
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Ireland

Permit Reference:

IE Licence: P0027-04

Release Point:

A2-06

Sampling Date(s):

18 December 2023

SOCOTEC Job Number:	LEK 14211 / Q4
Report Date:	12-Mar-24
Version:	1
Report By:	Aidan Whitney
MCERTS Number:	MM 20 1603
MCERTS Level:	MCERTS Level 1 Technician
Technical Endorsements:	1 & 4
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MCERTS Number:	MM 12 1170
Business Title:	MCERTS Level 2 - Team Leader
Technical Endorsements:	1, 2, 3 & 4
Signature:	



1015



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EXECUTIVE SUMMARY

MONITORING OBJECTIVES

Medite Europe Limited operates a wood production/wood drier process at Clonmel which is subject to IE Licence P0027-04, under the EPA Act 1992.

SOCOTEC 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

A2-06

Operator

Medite Europe Limited
Redmonstown,
Clonmel,
Co. Tipperary,
Ireland

IE Licence: P0027-04

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
Formaldehyde	mg/m ³	0.1	0.09	15	MCERTS
Formaldehyde Emission Rate	g/hr	28	28.6	-	
Moisture	%	16.90	0.43	-	MCERTS

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 .

EXECUTIVE SUMMARY

MONITORING TIMES			
Parameter	Sampling Date(s)	Sampling Times	Sampling Duration
Formaldehyde Run 1	18 December 2023	13:58 - 14:28	30 minutes
Preliminary Stack Traverse	18 December 2023	13:18-13:47	-

EXECUTIVE SUMMARY

PROCESS DETAILS

Parameter	Process Details
Description of process	wood Production/Wood Drier
Continuous or batch	Continuous
Product Details	Wood Drier
Part of batch to be monitored (if applicable)	N/A
Normal load, throughput or continuous rating	Normal Production
Fuel used during monitoring	N/A
Abatement	Cyclone
Plume Appearance	Heavy 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
Formaldehyde	US EPA M316	AE114	1015	MCERTS	0.031 mg/m ³	100.5%	0.63%
Moisture	SRM - EN 14790	AE 105	1015	MCERTS	0.04%	2.6%	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%	8.86%

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
Formaldehyde	HPLC	M103(U)	0605	MCERTS	RPS	23-13572-1	8 Weeks
-	-	-	-	-	-	-	-

ON-SITE TESTING							
Species	Analytical Technique	Analytical Procedure	UKAS Lab Number	Accreditation	Laboratory	Data Archive Location	Archive Period
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	29	Pa	≥ 5 Pa	Yes	EN 15259
Lowest Gas Velocity	9.2	m/s	-	-	-
Highest Gas Velocity	41.5	m/s	-	-	-
Ratio of Gas Velocities	4.5	: 1	< 3 : 1	No	EN 15259
Mean Velocity	29.1	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	2.30	m
Width	-	m
Area	4.16	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	9	1
Duct orientation	Vertical	Vertical
Filtration	In Stack	Out Stack

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

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	N/A
Depth of Platform = >Stack depth / diameter + wall and port thickness + 1.5m	Yes

Sampling Platform Improvement Recommendations (if applicable)

The sampling location meets all the requirements as specified in EPA Guidance Note AG1 for the tests undertaken.

EXECUTIVE SUMMARY

Sampling & Analytical Method Deviations

Velocity Profile

As this sampling location shows high levels of turbulence throughout the results from the standard flow traverse are indicative. In the past, reports detailing the volumetric flow rate according to fan rating have been used to calculate mass emission rates for this stack.

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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
Formaldehyde	US EPA M316	AE114	1015	MCERTS	1
Moisture	SRM - EN 14790	AE 105	1015	MCERTS	1
Velocity	SRM - EN ISO 16911-1	AE 154	1015	MCERTS	1

APPENDIX 1 - Monitoring Schedule, Calibration Checklist & Monitoring Team

CALIBRATEABLE EQUIPMENT CHECKLIST					
Extractive Sampling		Instrumental Analyser/s		Miscellaneous	
Equipment	Equipment I.D.	Equipment	Equipment I.D.	Equipment	Equipment I.D.
Control Box DGM	LEK 9.47	Horiba PG-250 Analyser	-	Laboratory Balance	LEK 15.21
Box Thermocouples	LEK 9.48	FT-IR	-	Tape Measure	LEK 20.16
Meter In Thermocouple	LEK 9.48	FT-IR Oven Box	-	Stopwatch	-
Meter Out Thermocouple	LEK 9.48	Bernath 3006 FID	-	Protractor	-
Control Box Timer	LEK 17.26	Signal 3030 FID	-	Barometer	LEK 16.8
Oven Box	-	Servomex	-	Digital Micromanometer	LEK 1.20
Probe	LEK 6.53	JCT Heated Head Filter	-	Digital Temperature Meter	LEK 2.20
Probe Thermocouple	-	Thermo FID	-	Stack Thermocouple	-
Probe	-	Stackmaster	-	Mass Flow Controller	-
Probe Thermocouple	-	FTIR Heater Box for Heated Line	-	MFC Display module	-
S-Pitot	LEK 6.53	Anemometer	-	1m Heated Line (1)	-
L-Pitot	-	Ecophysics NOx Analyser	-	1m Heated Line (2)	-
Site Balance	LEK 23.12	Chiller (JCT/MAK 10)	-	1m Heated Line (3)	-
Last Impinger Arm	-	Heated Line Controller (1)	-	5m Heated Line (1)	-
Dioxins Cond. Thermocouple	-	Heated Line Controller (2)	-	10m Heated Line (1)	-
Callipers	LEK 15.1F	Site temperature Logger	-	10m Heated Line (2)	-
Small DGM	-			15m Heated Line (1)	-
Heater Controller	-			20m Heated Line (1)	-
Inclinometer (Swirl Device)	LEK 24.10			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 +/- %
-	-	-	-	-	-

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
Enda Flood	MM 12 1170	MCERTS Level 2	Apr-23	Mar-24	Mar-24	Jun-23	Nov-23	Apr-23
Barry Kehoe	MM 23 1818	MCERTS Trainee	Sep-28	-	-	-	-	Sep-28

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

FORMALDEHYDE SUMMARY					
Test	Sampling Times	Concentration mg/m ³	LOD mg/m ³	ELV mg/m ³	Emission Rate g/hr
Run 1	13:58 - 14:28 18 December 2023	0.09	0.031	15	28
Field Blank	-	0.116	-	-	-

Reference conditions are 273K, 101.3kPa, dry gas .

FORMALDEHYDE 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	102.3	-	0.315	10.5	0.00	0.00	0.21	Yes

	Filter Material	Filter Size mm	Max. Filtration Temp. °C	Temperature during storage / transit <25°C	Type of Absorbers	Absorption Solutions
Run 1	QF	47	60	N/A	Glass	HPLC Water / DNPH derivatization
Additional Test Information	Orifice Setting mmH ₂ O	DGM Corr Factor (Yd)	DGM Temp °C	DGM Total Volume m ³		
Run 1	10	0.9643	11	0.33673		

FORMALDEHYDE ABSORPTION EFFICIENCY

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

ND - None Detected

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

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	13:58-14:28 18 December 2023	1.5580	1.6110	0.0530	16.9	0.04	2.6

Moisture Quality Assurance							
Test Number	Sampling Duration	Total Volume Sampled	Sampling Rate	Start Leak Rate	End Leak Rate	Acceptable Leak Rate	Leak Tests Acceptable?
	mins	l	l/min	l/min	l/min	l/min	
Run 1	30	325	10.8	0.00	0.00	0.22	Yes

PRELIMINARY STACK SURVEY

Stack Characteristics		
Stack Diameter / Depth, D	2.30	m
Stack Width, W	-	m
Stack Area, A	4.16	m ²
Average stack gas temperature	60	°C
Stack static pressure	0.355	kPa
Barometric Pressure	102.3	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	0.028571	0.000286	0.000561	0.023743	0.000237	0.000466
O ₂	32	1.427679	20.383538	0.203835	0.291012	16.938626	0.169386	0.241829
N ₂	28	1.249219	79.587890	0.795879	0.994227	66.137170	0.661372	0.826198
H ₂ O	18	0.803070	-	-	-	16.900461	0.169005	0.135722

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

Calculation of Stack Gas Densities		
Determinand	Result	Units
Dry Density (STP), P_{STD}	1.2858	kg/m ³
Wet Density (STP), P_{STW}	1.2042	kg/m ³
Dry Density (Actual), P_{Actual}	1.0682	kg/m ³
Average Wet Density (Actual), $P_{ActualW}$	1.000	kg/m ³

Where:

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

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

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

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

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

PRELIMINARY STACK SURVEY

TRAVERSE 1

Date of Survey	18 December 2023
Time of Survey	13:18-13:47
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	0.06	1185.8	121.0	60	41.4	172.1	-	<15
2	0.19	1097.6	112.0	60	39.9	165.6	-	<15
3	0.34	960.4	98.0	60	37.3	154.9	-	<15
4	0.52	333.2	34.0	60	22.0	91.2	-	<15
5	0.79	441.0	45.0	60	25.3	105.0	-	<15
6	1.51	568.4	58.0	60	28.7	119.2	-	<15
7	1.78	58.8	6.0	60	9.2	38.3	-	<15
8	1.96	313.6	32.0	60	21.3	88.5	-	<15
9	2.11	548.8	56.0	60	28.2	117.1	-	<15
10	2.24	1127.0	115.0	60	40.4	167.8	-	<15
Mean	-	663.5	67.7	60	29.4	122.0	-	-

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	0.06	1189.1	121.3	60	41.5	172.4	-	<15
2	0.19	1071.5	109.3	60	39.4	163.6	-	<15
3	0.34	770.9	78.7	60	33.4	138.8	-	<15
4	0.52	679.5	69.3	60	31.4	130.3	-	<15
5	0.79	813.4	83.0	60	34.3	142.6	-	<15
6	1.51	228.7	23.3	60	18.2	75.6	-	<15
7	1.78	414.9	42.3	60	24.5	101.8	-	<15
8	1.96	98.0	10.0	60	11.9	49.5	-	<15
9	2.11	365.9	37.3	60	23.0	95.6	-	<15
10	2.24	686.0	70.0	60	31.5	130.9	-	<15
Mean	-	631.8	64.5	60	28.9	120.1	-	-

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	112	107	4.5	Pass	124	122	1.6	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	368	359	9.0	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	59	Pa	>= 5 Pa	Yes
Lowest Gas Velocity	9.2	m/s	-	-
Highest Gas Velocity	41.5	m/s	-	-
Ratio of Gas Velocities	4.5	-	< 3 : 1	No
Maximum angle of flow with regard to duct axis	<15	°	< 15°	Yes
No local negative flow	Yes	-	-	Yes

Calculation of Stack Gas Velocity, V		
Velocity at Traverse Point, $V = K_{pt} \times (1-e) \times \sqrt{2 \times DP_{pt} / P_{ActualW}}$		
Where:		
K_{pt} = Pitot tube calibration coefficient		
(1-e) = Compressibility correction factor, assumed at a constant 0.998		
Average Stack Gas Velocity, V_a	29.1	m/s

Calculation of Stack Gas Volumetric Flowrate, Q			
Duct gas flow conditions	Actual	Reference	Units
Temperature	60	0	°C
Total Pressure	102.655	101.3	kPa
Oxygen	20.4	21	%
Moisture	16.90	0.00	%
Pitot tube calibration coefficient, K_{pt}	0.85		

Gas Volumetric Flowrate	Result	Units
Average Stack Gas Velocity (V_a)	29.13	m/s
Stack Area (A)	4.16	m ²
Gas Volumetric Flowrate (Actual), Q_{Actual}	435773.22	m ³ /hr
Gas Volumetric Flowrate (STP, Wet), Q_{STP}	362034.22	m ³ /hr
Gas Volumetric Flowrate (STP, Dry), $Q_{STP,Dry}$	300848.76	m ³ /hr
Gas Volumetric Flowrate (REF), Q_{Ref}	300848.76	m ³ /hr

Where:

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

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

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

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

Nomenclature:

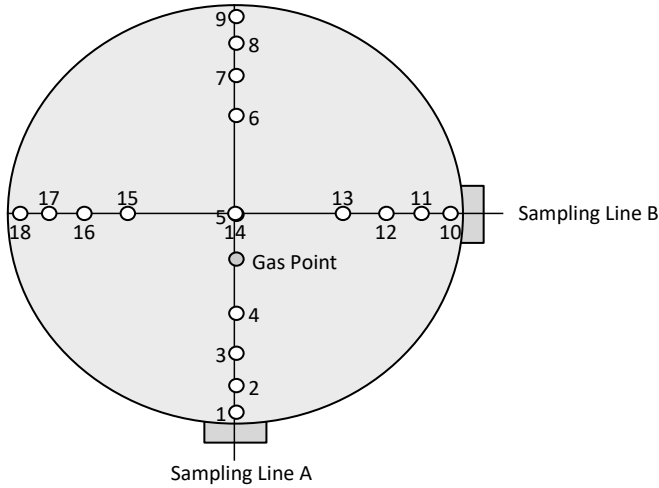
T_s = Absolute Temperature, Standard Conditions, 273 K
 P_s = Absolute Pressure, Standard Conditions, 101.3 kPa
 T_a = Absolute Temperature, Actual Conditions, K
 P_a = Absolute Pressure, Actual Conditions, kPa
 Ma = Water vapour, Actual Conditions, % Vol
 Ms = Water vapour, Reference Conditions, % Vol
 O_{2a} = Oxygen, Actual Conditions, % Vol
 O_{2s} = Oxygen, Reference Conditions, % Vol

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

STACK DIAGRAM

	Value	Units
Stack Depth	2.30	m
Stack Width	-	m
Area	4.16	m ²

Non-Isokinetic/Gases Sampling			
Sampling Point	Distance (% of Depth)	Distance into Stack	Units
A	0.3	0.01	m



Isokinetic Sampling			
Sampling Point	Distance (% of Depth)	Distance into Stack (m)	Swirl °
1	2.9	0.07	< 15
2	9.2	0.21	< 15
3	16.7	0.38	< 15
4	26.4	0.61	< 15
5	50.0	1.15	< 15
6	73.6	1.69	< 15
7	83.3	1.92	< 15
8	90.8	2.09	< 15
9	97.1	2.23	< 15
10	2.9	0.07	< 15
11	9.2	0.21	< 15
12	16.7	0.38	< 15
13	26.4	0.61	< 15
14	50.0	1.15	< 15
15	73.6	1.69	< 15
16	83.3	1.92	< 15
17	90.8	2.09	< 15
18	97.1	2.23	< 15
-	-	-	-
-	-	-	-

SAMPLING LOCATION

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - NON-ISOKINETIC FORMALDEHYDE

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	0.030	-
as a %	0.067	0.704	0.489	1.000	-	0.315	0.000
compliant?	Yes	Yes	Yes	Yes	N/A	Yes	Yes

Run	Volume (STP) m ³	Mass of Formaldehyde mg	O2 Correction -	Leak mg/m ³	Lab Uncertainty mg	Combined uncertainty
Run 1	0.3062	0.0596	-	0.0000	-	-
MU as mg/m ³	0.0012	0.0472	-	0.0000	0.0047	0.047
MU as %	1.3189	50.0011	-	0.0000	5.0	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	0.095	mg/m³	100.54	% Result	0.63	% ELV
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(k is a coverage factor which gives a 95% confidence in the quoted figures)

Reference – SOCOTEC Technical Procedure AE150 Estimation of Uncertainty of Measurement

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - MOISTURE

Run	Sampled Volume m ³	Sampled Gas Temp K	Sampled Gas Pressure kPa	Sampled Gas Humidity % by volume	Oxygen Content % by volume	Leak %
MU required	≤ 2%	≤ 2%	≤ 1%	≤ 1%	≤ 10%	≤ 2%
Run 1	0.000	2.0	0.50	1.0	N/A	-
as a %	0.07	0.60	0.49	1.0	N/A	0.00
compliant?	Yes	Yes	Yes	Yes	N/A	Yes

Run	Volume (STP) m ³	Mass Gained mg	O2 Correction -	Leak mg/m ³	Uncollected Mass mg	Combined uncertainty
Run 1	0.3	53000	1.0	0.0	58	-
MU as % v/v	0.26	0.04	-	0.00	0.02	0.26
MU as %	1.3	0.2	-	0.0	0.1	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	0.53	% v/v	2.57	%
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Reference – SOCOTEC Technical Procedure AE150 Estimation of Uncertainty of Measurement

MEASUREMENT UNCERTAINTY BUDGET - VELOCITY & VOLUMETRIC FLOW RATE

Measured Velocity at Actual Conditions	29.1	m/s
Measured Volumetric Flow rate at Actual Conditions	435773	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	-	4.87		
Uncertainty of mean local dynamic pressures	-	4.87		
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	95.26	<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	0.00002		
Uncertainty of temperature measurement	K	1.70	<1% of value	Yes
Uncertainty of absolute pressure in the duct	pa	524		
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	0.36
Expanded uncertainty at a 95% Confidence Interval	0.70

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	11409
Expanded uncertainty at a 95% Confidence Interval	22361

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