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Stack Emissions Testing Report Commissioned by
Paxford Composites Ltd

Installation Name & Address

Paxford Composites Ltd
Red Wongs Way
Huntingdon
Cambridgeshire
PE29 7HB

PPC Permit: B01/02

Stack Reference

Cyclone II Booth

Dates of the Monitoring Campaign

19th November 2020

Job Reference Number

ESW-4162

Report Written by

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Report Date

17th December 2020

Version

Version 1

Signature of Report Approver



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Executive Summary

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MONITORING OBJECTIVES

Paxford Composites Ltd, Huntingdon
Cyclone II Booth
19th November 2020

Overall Aim of the Monitoring Campaign

Element were commissioned by Paxford Composites Ltd to carry out stack emissions testing on the Cyclone II Booth at Huntingdon.

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values (ELVs) as specified in the Site's Permit.

Special Requirements

There were no special requirements.

Target Parameters

Total Particulate Matter, Isocyanates, Total VOCs (as Carbon)

Executive Summary

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MONITORING RESULTS

Paxford Composites Ltd, Huntingdon

Cyclone II Booth

19th November 2020

where MU = Measurement Uncertainty associated with the Result

Parameter	Concentration				Mass Emission			
	Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Total Particulate Matter	¹ mg/m ³	0.51	0.38	50	g/hr	13.6	10.2	-
Isocyanates	¹ mg/m ³	0.00042	0.00010	0.1	g/hr	0.011	0.0028	-
Total VOCs (as Carbon)	¹ mg/m ³	7.1	0.47	100	g/hr	192	15.9	-
Water Vapour	% v/v	0.88	0.047					
Stack Gas Temperature	°C	22.0						
Stack Gas Velocity	m/s	16.3	0.34					
Volumetric Flow Rate (ACTUAL)	m ³ /hr	29534	1473					
Volumetric Flow Rate (REF)	¹ m ³ /hr	26934	1343					

NOTE: VOLUMETRIC FLOW RATE & VELOCITY DATA TAKEN FROM AN AVERAGE OF ALL OF THE ISOKINETIC RUNS.

¹ Reference Conditions (REF) are: 273K, 101.3kPa, without correction for water vapour content.

Executive Summary

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MONITORING DATE(S) & TIMES

Paxford Composites Ltd, Huntingdon
Cyclone II Booth
19th November 2020

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m ³	0.51	g/hr	13.6	19/11/2020	11:02 - 12:02	60
Isocyanates	R1	mg/m ³	0.00042	g/hr	0.011	19/11/2020	12:22 - 13:22	60
Total VOCs (as Carbon)	R1	mg/m ³	7.1	g/hr	192	19/11/2020	11:02 - 12:02	60
Velocity Traverse	R1					19/11/2020	10:40 - 10:45	

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

Paxford Composites Ltd, Huntingdon

Cyclone II Booth

19th November 2020

Standard Operating Conditions

Parameter	Value
Process Status	Operational
Capacity (of 100%) and Tonnes / Hour	N/A
Continuous or Batch Process	Batch
Feedstock (if applicable)	Painting of components
Abatement System	Cartridge Filters
Abatement System Running Status	Operational
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

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MONITORING & ANALYTICAL METHODS

Paxford Composites Ltd, Huntingdon

Cyclone II Booth

19th November 2020

Parameter	Monitoring				Analysis				Overall Status	LOD (Average)
	Standard	Technical Procedure	Sampling Status	Testing Lab	Analytical Procedure	Analytical Technique	Analysis Status	Analysis Lab		
Total Particulate Matter	EN 13284-1	CAT-TP-01	MCERTS	EET	CAT-TP-03	Gravimetric	MCERTS	EET	MCERTS	0.19 mg/m ³
Isocyanates	US EPA CTM36	CAT-TP-17	MCERTS	EET	M119	HPLC	MCERTS	RPS	MCERTS	0.0001 mg/m ³
Water Vapour	EN 14790	CAT-TP-05	MCERTS	EET	CAT-TP-05	Gravimetric	MCERTS	EET	MCERTS	0.10 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	MCERTS	EET	Flame Ionisation Detection by Sick 3006 FID				MCERTS	0.32 mg/m ³
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	MCERTS	EET	Pitot Tube and Thermocouple				MCERTS	3.0 m/s

ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Element Materials Technology (EET)	ISO 17025 Accreditation Number: 4279
RPS Laboratories Ltd (RPS)	ISO 17025 Accreditation Number: 0605

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter, Isocyanates	All	One out of two sampling lines was used due to sampling location restrictions, however the number of sample points used on the available line were increased to the minimum required by the Standard

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.80
Width	m	-
Area	m ²	0.50
Port Depth	cm	9
Orientation of Duct	-	Vertical
Number of Ports	-	2
Sample Port Size	-	4" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	Temporary
Inside / Outside	Inside

Platform Details

EA Technical Guidance Note M1 / EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	Yes
Platform has vertical base boards (approx. 0.25m high)	Yes
Platform has chains / self closing gates at top of ladders	Yes
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

Sampling Location / Platform Improvement Recommendations

The sampling location meets all the requirements specified in EA Guidance Note M1 and EN 15259, and therefore there are no improvement recommendations.

EN 15259 Homogeneity Test Requirements

There is no requirement to perform a EN 15259 Homogeneity Test on this Stack.

Sampling Plane Validation Criteria (from EN 15259)

Criteria in EN 15259	Units	Traverse 1	Required	Compliant
Lowest Differential Pressure	Pa	210.0	> 5 Pa	Yes
Mean Velocity	m/s	15.98	-	-
Lowest Gas Velocity	m/s	15.70	-	-
Highest Gas Velocity	m/s	16.18	-	-
Ratio of Above	: 1	1.03	< 3 : 1	Yes
Maximum Angle of Swirl	°	5.00	< 15°	Yes
No Local Negative Flow	-	Yes	-	Yes

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PLANT PHOTOS

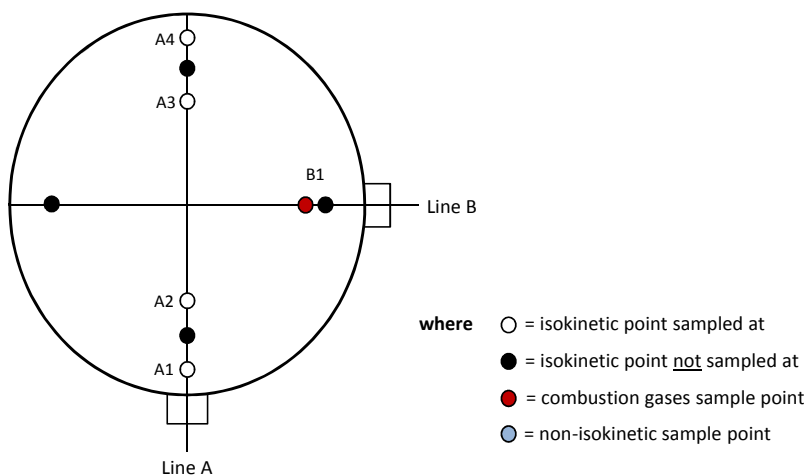
Photo 1



Photo 2



SAMPLE POINTS



APPENDICES

APPENDIX CONTENTS

APPENDIX 1 - Stack Emissions Monitoring Personnel, List of Equipment & Methods and Technical Procedures Used

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Richard Carter	MCERTS Level 2	MM 07 861	TE1 TE2 TE3 TE4
Technician	Guy Livermore	MCERTS Level 1	MM 19 1571	None

LIST OF EQUIPMENT

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM (1)	CAT 7.40	Horiba PG-250	-	Digital Manometer (1)	CAT 3.116
Control Box DGM (2)	-	Horiba PG-250	-	Digital Manometer (2)	-
Box Thermocouples (1)	CAT 7.40	Servomex 4900	-	Digital Temperature Meter	CAT 3.116
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.53
Umbilical (1)	CAT 7.40	ABB AO2020-URAS26	-	Barometer	-
Umbilical (2)	-	Testo 350 XL	-	Stack Thermocouple (1)	CAT 4.1344
Oven Box (1)	-	JCT JCC P1 Cooler	-	Stack Thermocouple (2)	-
Oven Box (2)	-	Gasmex DX4000	-	Stack Thermocouple (3)	-
Heated Probe (1)	CAT 5.102	Gasmex Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	-	Bernath 3006 FID	CAT 8.28	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.100	1m Heated Line (3)	-
S-Pitot (1)	CAT 21P.127	Mass Flow Controller (1)	CAT 6.32	5m Heated Line (1)	-
S-Pitot (2)	-	Mass Flow Controller (2)	CAT 6.33	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	-	20m Heated Line (1)	CAT 20.178
Site Balance	CAT 17.51	Mass View (2)	-	20m Heated Line (2)	-
500g / 1Kg Check Weights	CAT 17.51	Easylogger EN-EL-12 Bit	-	Dual Channel Heater Controller	-
Last Impinger Arm	-	Hioki 5043 (V)	-	Single Channel Heater Controller	CAT 20.178
Callipers	-	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18, 1.18a, 1.18b
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.99

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
Isocyanates	US EPA CTM36	CAT-TP-17
Water Vapour	EN 14790	CAT-TP-05
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41

PRELIMINARY STACK SURVEY: CALCULATIONS

General Stack Details

Stack Details (from Traverse)	Units	Value
Stack Diameter / Depth, D	m	0.80
Stack Width, W	m	-
Stack Area, A	m ²	0.50
Average Stack Gas Temperature, T _a	°C	22.0
Average Stack Gas Pressure	Pa	217.8
Average Stack Static Pressure, P _{static}	kPa	-0.170
Average Barometric Pressure, P _b	kPa	100.4
Average Pitot Tube Calibration Coefficient, C _p	-	0.83

Stack Gas Composition & Molecular Weights

Component	Conc ppm	Conc Dry % v/v	Conc Wet % v/v	Volume Fraction r	Molar Mass M	Density kg/m ³ p	Conc kg/m ³ p _i
CO ₂ (Estimated)	-	0.06	0.06	0.0006	44.01	1.9635	0.00118
O ₂ (Estimated)	-	20.90	20.72	0.2090	32.00	1.4277	0.29838
N ₂	-	79.04	78.34	0.7904	28.01	1.2498	0.98788
Moisture (H ₂ O)	-	-	0.88	0.0088	18.02	0.8037	0.00707

Where: $p = M / 22.41$

$p_i = r \times p$

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P _{STD}	kg/m ³	1.287
Wet Density (STP), P _{STW}	kg/m ³	1.283
Dry Density (Actual), P _{Actual}	kg/m ³	1.179
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.175

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

P_{STW} = sum of all wet concentrations / 100 x density, kg/m³ (including water vapour)

$P_{Actual} = P_{STD} \times (T_{STP} / (P_{STP})) \times ((P_{static} + P_b) / T_a)$

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

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	22.0	0.0
Total Pressure	kPa	100.2	101.3
Moisture	%	0.88	0.88

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	28929
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	26489
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	26256
Gas Volumetric Flowrate REF ¹	m ³ /hr	26489

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE TO EN 16911-1 (MID)

(1 of 1)

Parameter	Units	Value
Date of Survey	-	19/11/2020
Time of Survey	-	10:40 - 10:45
Atmospheric Pressure	kPa	100.4
Average Stack Static Pressure	Pa	-170
Result of Pitot Stagnation Test	-	Pass
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with KIMO MP 200 (10000Pa)	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C _p	-	0.83
Number of Lines Available	-	2
Number of Lines Used	-	1

Sampling Line A						
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s	Swirl °
STATIC (Units: Pa)		-170.0				
Mean		217.8	22.0	1.175	15.98	
1	0.05	223.0	22.0	1.175	16.18	5.0
2	0.20	218.0	22.0	1.175	16.00	5.0
3	0.60	210.0	22.0	1.175	15.70	5.0
4	0.75	220.0	22.0	1.175	16.07	5.0

Sampling Line B - Unsafe to Access				
ΔP	Temp °C	Wet Density kg/m ³	Velocity m/s	Swirl °

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE TO EN 16911-1 (MID) - MEASUREMENT UNCERTAINTY

(1 of 1)

Performance characteristics (Uncertainty Components)	Uncertainty	Value	Units
Standard Uncertainty on the coefficient of the Pitot Tube	$u(k)$	0.005	-
Standard Uncertainty associated with the mean local dynamic pressures	$u(\Delta p_i)$	7.090	Pa
- Resolution	$u(res)$	0.08677	
- Calibration	$u(cal)$	4.937	
- Drift	$u(drift)$	33.333	
- Lack of Fit	$u(fit)$	10.909	
- Overall corrections to dynamic measurements	$u(C_f)$	49.266	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00003	-
- $\varphi_{O_2,w}$	-	20.716	
- $\varphi_{CO_2,w}$	-	0.059	
- Oxygen, dry	$u(\phi_{O_2,d})$	0.640	
- Carbon Dioxide, dry	$u(\phi_{CO_2,d})$	0.002	
- Water Vapour	$u(\phi_{H_2O})$	0.045	
- Oxygen, wet	$u(\phi_{O_2,w})$	0.634	
- Carbon Dioxide, wet	$u(\phi_{CO_2,w})$	0.002	
Standard uncertainty associated with the stack temperature	$u(T_c)$	1.505	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.835	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	7.090	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00634	-
Standard uncertainty associated with the local velocities	$u(v_i)$	0.283	Pa
Standard uncertainty associated with the mean velocity	$u(\bar{v})$	0.171	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	0.335	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	2.09	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV,w)$	1442.9	m ³ /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00065	
- $u^2(qV,w)$	-	541972	
- $u(qV,w)$	-	736.2	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV,w)$	4.99	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

Paxford Composites Ltd, Huntingdon
Cyclone II Booth

Sample Runs

Parameter	Units	Run 1	Mean
Concentration	mg/m ³	0.51	0.51
Uncertainty	±mg/m ³	0.38	0.38
Mass Emission	g/hr	13.6	13.6
Uncertainty	±g/hr	10.2	10.2

Parameter	Units	Run 1	Mean
Water Vapour	% v/v	0.66	0.66
Uncertainty	±% v/v	0.035	0.035

Blank Runs

Parameter	Units	Blank 1	Maximum
Concentration	mg/m ³	0.19	0.19

NOTE: Where the Balance Uncertainty / Limit of Detection is higher than the Blank concentration, the Balance Uncertainty / Limit of Detection concentration has been reported.

General Sampling Information

Parameter	Value	
Standard	EN 13284-1	
Technical Procedure	CAT-TP-01	
Probe Material	Titanium	
Filter Housing Material	Titanium	
Positioning of Filter	In Stack	
Filter Size and Material	47mm Glass Fibre	
Number of Sampling Lines Used	1 / 2	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 4	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1, A2, A3, A4	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

TOTAL PARTICULATE MATTER: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
Absolute pressure of stack gas, P_s			
Barometric pressure, P_b	mmHg	753.1	
Stack static pressure, P_{static}	mmH ₂ O	-16.3	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	751.9	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	4.6	
Total mass collected in impingers (silica trap)	g	2.8	
Total mass of liquid collected, V_{lc}	g	7.4	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0092	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	1.5235	
Gas meter correction factor, Y_d	-	0.9840	
Average dry gas meter temperature, T_m	°C	19.7	
Average pressure drop across orifice, ΔH	mmH ₂ O	66.9	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	1.3944	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0066	
B_{wo} as a percentage	% v/v	0.66	
Reported Water Vapour, checked with Tables in EN 14790, R_{wv}	% v/v	0.66	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	1.4037	
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$			
IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction)	-	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	N/A	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	N/A	
% oxygen reference condition, REF%O ₂	% v/v	N/A	
O ₂ Reference Factor wet ($O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$)	-	N/A	
O ₂ Reference Factor dry ($O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$)	-	N/A	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m ³	N/A	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m ³	N/A	
Molecular weight of dry gas stream, M_d			
CO ₂ (Estimated)	% v/v	0.04	
O ₂ (Estimated)	% v/v	20.90	
Total	% v/v	20.94	
N ₂	% v/v	79.06	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	28.84	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.77	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.83	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	22.52	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	4.75	
Average stack gas temperature, T_s	°C	22.1	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s + 273})) / (V(M_s)(P_s))$	m/s	16.09	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} ($Q_{stw@O_2}$), Dry@O_{2REF} ($Q_{std@O_2}$)			
Area of stack, A_s	m ²	0.50	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	485.2	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	444.1	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	441.2	
$Q_{stw@O_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m ³ /min	N/A	
$Q_{std@O_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m ³ /min	N/A	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	5.80	
Nozzle area, A_n	mm ²	26.42	
Total sampling time, q	min	60	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	100.2	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1
Sampling Times	-	11:02 - 12:02
Sampling Dates	-	19/11/2020
Sampling Device	-	ISO
Volume Sampled (REF)	m ³	1.4037
Filter I.D. Number	-	47-74114
Start Filter Mass	g	0.16422
End Filter Mass	g	0.16452
Total Mass on Filter	g	0.00030
Probe Rinse I.D. Number	-	PR-47-74114
Start Probe Rinse Mass	g	3.16883
End Probe Rinse Mass	g	3.16924
Total Mass in Probe Rinse	g	0.00041
Total Mass Collected	mg	0.71
Calculated Concentration	mg/m ³	0.51
Balance Uncertainty / LOD	mg/m ³	0.19

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1
Blank Dates	-	18/11/2020
Average Volume Sampled (REF)	m ³	1.4037
Filter I.D. Number	-	47-72404
Start Filter Mass	g	0.15007
End Filter Mass	g	0.14999
Total Mass on Filter	g	-0.00008
Probe Rinse I.D. Number	-	PR-47-72404
Start Probe Rinse Mass	g	3.07033
End Probe Rinse Mass	g	3.07028
Total Mass in Probe Rinse	g	-0.00005
Total Mass Collected	mg	-0.13
Calculated Concentration	mg/m ³	-0.09
Balance Uncertainty / LOD	mg/m ³	0.19

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

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Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	25.0	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min		
Allowable Leak Rate	l/min	0.40	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	5.4	
Allowable MU	%	20.0	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	100.2	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.49	
Overall Weighing Uncertainty	± mg/m ³	0.35	
ELV [Daily ELV for IED]	mg/m ³	50.00	
Allowable Weighing Uncertainty	mg/m ³	2.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	24	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	No	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	18.0	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min		
Allowable Leak Rate	l/min	0.36	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	5.0	
Blank Acceptable	-	Yes	

Acetone / Water Rinse Blank	Units	Blank
Acetone / Water Rinse Value	mg/l	2.7
Allowable Blank	mg/l	10
Blank Acceptable	-	Yes

Method Deviations

Nature of Deviation	Run Number
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	1
One out of two sampling lines was used due to sampling location restrictions, however the number of sample points used on the available line were increased to the minimum required by the Standard	x

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value		Standard uncertainty		
	Symbol	Run 1	Symbol	Units	Run 1
Sampled Volume (Actual)	V _m	1.5235	uV _m	m ³	0.0305
Sampled Gas Temperature	T _m	292.7	uT _m	K	2.00
Sampled Gas Pressure	p _m	100.3	up _m	kPa	0.50
Sampled Gas Humidity	H _m	0.00	uH _m	% v/v	1.00
Leak	L	0.40	uL	%	-
Mass of Particulate	m	0.71	um	mg	0.26
Uncollected Mass	UCM	-0.13	uUCM	mg	-

Measured Quantities	Uncertainty as a Percentage		Requirement of Standard
	Units	Run 1	
Sampled Volume (Actual)	%	2.00	≤2%
Sampled Gas Temperature	%	0.68	≤1%
Sampled Gas Pressure	%	0.50	≤1%
Sampled Gas Humidity	%	1.00	≤1%
Leak	%	0.40	≤2%
Mass of Particulate	%	0.37	<5% of ELV
Uncollected Mass	%	-	-

Measured Quantities	Uncertainty in Measurement Units			Sensitivity Coefficient
	Symbol	Units	Run 1	
Sampled Volume (STP)	V _m	m ³	1.3944	0.36
Leak	L	mg/m ³	0.001	1.00
Mass of Particulate	L _r	mg	0.710	0.71
Uncollected Mass	UCM	mg	-0.08	0.71

Measured Quantities	Uncertainty in Result	
	Units	Run 1
Sampled Volume (STP)	mg/m ³	0.013
Leak	mg/m ³	0.0012
Mass of Particulate	mg/m ³	0.1852
Uncollected Mass	mg/m ³	-0.0535

Measured Quantities	Oxygen Correction Part of MU Budget	
	Units	Run 1
O ₂ Correction Factor	-	N/A
Stack Gas O ₂ Content	% v/v	N/A
MU for O ₂ Correction	-	N/A
Overall MU For O ₂ Measurement	%	N/A

Parameter	Units	Run 1
Combined uncertainty	mg/m ³	0.19
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m ³	0.38
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m ³	N/A
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m ³	0.38
Reported Uncertainty	mg/m ³	0.38
Expanded uncertainty (95% confidence), without Oxygen Correction	%	74.9
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	74.9
Reported Uncertainty	%	74.9

ISOCYANATES: RESULTS SUMMARY

Paxford Composites Ltd, Huntingdon
Cyclone II Booth

Sample Runs

Parameter	Units	Run 1	Mean
Concentration	mg/m ³	0.00042	0.00042
Uncertainty	±mg/m ³	0.00010	0.00010
Mass Emission	g/hr	0.011	0.011
Uncertainty	±g/hr	0.0028	0.0028

Parameter	Units	Run 1	Mean
Water Vapour	% v/v	1.1	1.1
Uncertainty	±% v/v	0.058	0.058

Blank Runs

Parameter	Units	Blank 1	Maximum
Concentration	mg/m ³	0.00023	0.00023

General Sampling Information

Parameter	Value	
Standard	US EPA CTM36	
Technical Procedure	CAT-TP-17	
Name of Analytical Laboratory	RPS	
Analytical Laboratory's Procedure	M119	
ISO 17025 Accredited Analysis?	MCERTS	
Date of Sample Analysis	14/12/2020	
Probe Material	Titanium	
Filter Housing / Nozzle Material	Titanium	
Positioning of Filter	In Stack	
Filter Size and Material	1 2-PP Impregnated 47mm Glass Fibre	
Number of Sampling Lines Used	1 / 2	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 4	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1, A2, A3, A4	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

ISOCYANATES: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
Absolute pressure of stack gas, P_s			
Barometric pressure, P_b	mmHg	753.1	
Stack static pressure, P_{static}	mmH ₂ O	-16.3	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	751.9	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	8.3	
Total mass collected in impingers (silica trap)	g	4.2	
Total mass of liquid collected, V_{lc}	g	12.5	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0156	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	1.5533	
Gas meter correction factor, Y_d	-	0.9840	
Average dry gas meter temperature, T_m	°C	24.9	
Average pressure drop across orifice, ΔH	mmH ₂ O	71.9	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	1.3975	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0110	
B_{wo} as a percentage	% v/v	1.10	
Reported Water Vapour, checked with Tables in EN 14790, R_{wv}	% v/v	1.10	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd}) / (100 / (100 - R_{wv}))$	m ³	1.4131	
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$			
IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction)	-	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	N/A	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	N/A	
% oxygen reference condition, REF%O ₂	% v/v	N/A	
O ₂ Reference Factor wet ($O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$)	-	N/A	
O ₂ Reference Factor dry ($O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$)	-	N/A	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m ³	N/A	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m ³	N/A	
Molecular weight of dry gas stream, M_d			
CO ₂ (Estimated)	% v/v	0.04	
O ₂ (Estimated)	% v/v	20.90	
Total	% v/v	20.94	
N ₂	% v/v	79.06	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	28.84	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.72	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.83	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	23.63	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	4.86	
Average stack gas temperature, T_s	°C	24.2	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s + 273})) / (\sqrt{M_s})(P_s))$	m/s	16.55	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})			
Area of stack, A_s	m ²	0.50	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	499.3	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	453.7	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	448.7	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m ³ /min	N/A	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m ³ /min	N/A	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	5.82	
Nozzle area, A_n	mm ²	26.61	
Total sampling time, q	min	60	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	98.1	

ISOCYANATES: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	12:22 - 13:22	
Sampling Dates	-	19/11/2020	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	1.4131	
Methyl Diisocyanate (MDI)	µg	< 0.070	
Hexamethylene Diisocyanate (HDI)	µg	< 0.070	
Toluene Diisocyanates (TDI)	µg	0.460	
Total Mass Collected	µg	0.600	
Calculated Concentration	mg/m ³	0.000	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	19/11/2020	
Average Volume Sampled (REF)	m ³	1.4131	
Methyl Diisocyanate (MDI)	µg	< 0.070	
Hexamethylene Diisocyanate (HDI)	µg	0.140	
Toluene Diisocyanates (TDI)	µg	0.120	
Total Mass Collected	µg	0.330	
Calculated Concentration	mg/m ³	0.000	

ISOCYANATES: QUALITY ASSURANCE

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	25.5	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.51	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	5.2	
Allowable MU	%	20.0	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	98.1	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Maximum Filter Temperature	°C	25	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	No	

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	18.0	
Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.36	
Leak Test Acceptable	-	Yes	
Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	0.010	
Blank Acceptable	-	Yes	

Method Deviations

Nature of Deviation	Run Number
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	1
One out of two sampling lines was used due to sampling location restrictions, however the number of sample points used on the available line were increased to the minimum required by the Standard	x

ISOCYANATES: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value		Standard uncertainty		
	Symbol	Run 1	Symbol	Units	Run 1
Sampled Volume (Actual)	V_m	1.5533	uV_m	m ³	0.0311
Sampled Gas Temperature	T_m	297.9	uT_m	K	2.00
Sampled Gas Pressure	p_m	100.3	up_m	kPa	0.50
Sampled Gas Humidity	H_m	0.00	uH_m	% v/v	1.00
Leak	L	0.39	uL	%	-
Laboratory Result	L_r	11.80	uL_r	%	-

Measured Quantities	Uncertainty as a Percentage		Requirement of Standard
	Units	Run 1	
Sampled Volume (Actual)	%	2.00	≤2%
Sampled Gas Temperature	%	0.67	≤1%
Sampled Gas Pressure	%	0.50	≤1%
Sampled Gas Humidity	%	1.00	≤1%
Leak	%	0.39	≤2%
Laboratory Result	%	11.80	No Requirement

Measured Quantities	Uncertainty in Measurement Units			Sensitivity Coefficient
	Symbol	Units	Run 1	
Sampled Volume (STP)	V_m	m ³	1.3975	0.00
Leak	L	mg/m ³	0.000	1.00
Laboratory Result	L_r	mg/m ³	0.000	1.00

Measured Quantities	Uncertainty in Result	
	Units	Run 1
Sampled Volume (STP)	mg/m ³	0.000
Leak	mg/m ³	0.0000
Laboratory Result	mg/m ³	0.0001

Measured Quantities	Oxygen Correction Part of MU Budget	
	Units	Run 1
O ₂ Correction Factor	-	N/A
Stack Gas O ₂ Content	% v/v	N/A
MU for O ₂ Correction	-	N/A
Overall MU For O ₂ Measurement	%	N/A

Parameter	Units	Run 1
Combined uncertainty	mg/m ³	0.00
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m ³	0.00
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m ³	N/A
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m ³	0.00
Reported Uncertainty	mg/m ³	0.00
Expanded uncertainty (95% confidence), without Oxygen Correction	%	23.7
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	23.7
Reported Uncertainty	%	23.7

TOTAL VOCs (as CARBON): RESULTS SUMMARY

Paxford Composites Ltd, Huntingdon
Cyclone II Booth

Sample Runs

Parameter	Units	Run 1	Mean
Concentration	mg/m ³	7.1	7.1
Uncertainty	±mg/m ³	0.47	0.47
Mass Emission	g/hr	192	192
Uncertainty	±g/hr	15.9	15.9

General Sampling Information

Parameter	Value
Standard	EN 12619:2013
Technical Procedure	CAT-TP-20
Probe Material	Stainless Steel
Filtration Type / Size	0.1µm Glass Fibre
Heated Head Filter Used	Yes
Heated Line Temperature	180°C
Span Gas Type	Propane In Synthetic Air (5 Grade)
Span Gas Reference Number	1.0319a
Span Gas Expiry Date	22/03/2023
Span Gas Start Pressure (bar)	100
Gas Cylinder Concentration (ppm)	79.9
Span Gas Set Point (ppm)	79.90
Span Gas Uncertainty (%)	N/A
Zero Gas Type	Synthetic Air (5 Grade)
Number of Sampling Lines Used	1 / 1
Number of Sampling Points Used	1 / 1
Sample Point I.D.'s	B1

FORMAT: Number Used / Number Required

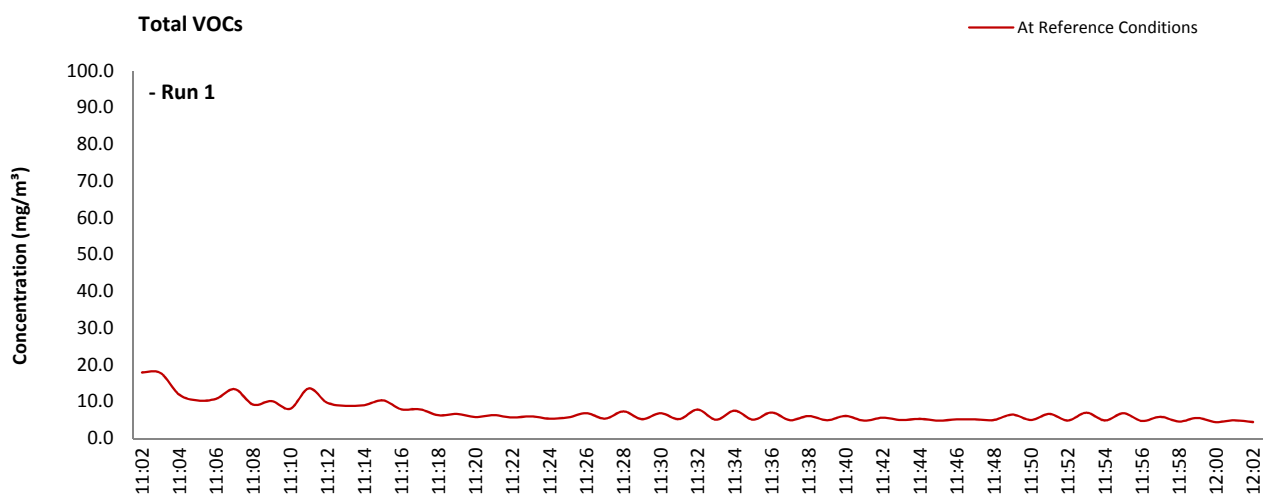
FORMAT: Number Used / Number Required

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

TOTAL VOCs (as CARBON): DATA TREND

Graphical Trend of Data



TOTAL VOCs (as CARBON): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1
Sampling Times	-	11:02 - 12:02
Sampling Dates	-	19/11/2020
Instrument Range	ppm	100
Span Gas Value	ppm	79.9

Quality Assurance

	Zero Drift	Units	Run 1
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.60
	Zero Down Sampling Line (Post)	ppm	-0.10
	Zero Drift	ppm	-0.70
CAL 2	Zero Down Sampling Line (Pre)	ppm	
	Zero Down Sampling Line (Post)	ppm	
	Zero Drift	ppm	
CAL 3	Zero Down Sampling Line (Pre)	ppm	
	Zero Down Sampling Line (Post)	ppm	
	Zero Drift	ppm	
	Allowable Zero Drift	± ppm	4.00
	Zero Drift Acceptable	-	Yes

	Span Drift	Units	Run 1
CAL 1	Span Down Sampling Line (Pre)	ppm	79.00
	Span Down Sampling Line (Post)	ppm	80.20
	Span Drift	ppm	1.20
CAL 2	Span Down Sampling Line (Pre)	ppm	
	Span Down Sampling Line (Post)	ppm	
	Span Drift	ppm	
CAL 3	Span Down Sampling Line (Pre)	ppm	
	Span Down Sampling Line (Post)	ppm	
	Span Drift	ppm	
	Allowable Span Drift	± ppm	4.00
	Span Drift Acceptable	-	Yes

Test Conditions	Units	Run 1
Run Ambient Temperature Range	°C	19 -22

Method Deviations

Nature of Deviation	Run Number
(x = deviation applies to the associated run)	1
There are no deviations associated with the sampling employed.	

TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1	Units
Limit value	100.0	mg/m ³ (REF)
Allowable MU	15.0	%
Measured concentration	7.20	mg/m ³ (STP, dry)
Range Used	100.0	ppm
Range Used [A]	160.6	mg/m ³
Cal gas conc.	79.9	ppm
Conversion	1.61	ppm to mg/m ³
MCERTS Range [B]	15.0	mg/m ³
Lower of [A] or [B]	15.0	mg/m ³
Cal gas conc.	128.3	mg/m ³

Performance characteristics	RUN 1	Units
Response time	45	seconds
Number of readings in measurement	60	-
Repeatability at zero	2.00	% full scale
Repeatability at span level	0.00	% full scale
Deviation from linearity	0.43	% of value
Zero drift	-0.89	% full scale
Span drift	1.52	% full scale
Volume or pressure flow dependence	1.60	% of full scale
Atmospheric pressure dependence	0.30	% of value/kPa
Ambient temperature dependence	1.40	% full scale/10K
Combined interference	0.45	% range
Dependence on voltage	0.50	% full scale/10V
Losses in the line (leak)	1.25	% of value
Uncertainty of calibration gas	2.00	% of value

Performance characteristic	RUN 1	Units
Standard deviation of repeatability at zero	use rep at span	mg/m ³
Standard deviation of repeatability at span level	0.00	mg/m ³
Lack of fit	0.04	mg/m ³
Drift	0.00	mg/m ³
Volume or pressure flow dependence	0.00	mg/m ³
Atmospheric pressure dependence	0.01	mg/m ³
Ambient temperature dependence	0.20	mg/m ³
Combined interference (from MCERTS Certificate)	0.04	mg/m ³
Dependence on voltage	0.06	mg/m ³
Losses in the line (leak)	0.05	mg/m ³
Uncertainty of calibration gas	0.08	mg/m ³

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		7.20	mg/m ³
Expanded uncertainty		0.24	mg/m ³
Expanded uncertainty	k = 1.96	0.47	mg/m ³
Uncertainty corrected to std conds. (O ₂)		0.47	mg/m ³ (REF)

	RUN 1	Units
Expanded uncertainty (no O ₂) - at 95% Confidence	6.58	% of Value
Expanded uncertainty (no O ₂) - at 95% Confidence	0.47	% at ELV
Overall Allowable uncertainty (no O ₂) - at 95% Confidence	15.0	% at ELV
Result of Compliance with Uncertainty Requirement	COMPLIANT	-

	RUN 1	Units
Expanded uncertainty (with O ₂) - at 95% Confidence	N/A	% of Value
Expanded uncertainty (with O ₂) - at 95% Confidence	N/A	% at ELV
Overall Allowable uncertainty (with O ₂) - at 95% Confidence	N/A	% at ELV
Result of Compliance with Uncertainty Requirement	N/A	-

Requirement for SRM is that Uncertainty should be <15% of the value at the ELV, on a dry gas basis, or if O₂ correction is applied less than 15% + the uncertainty associated with the O₂ correction (using sqrt of sum squares to add uncertainty components).

Version Number	Record of changes made within this version of the document
V1	The original document issued to the client