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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
Large Commercial Booth

Dates of the Monitoring Campaign
19th November 2020

Job Reference Number
ESW-4162

Report Written by
Richard Carter Team Leader MCERTS Level 2 MM 07 861 TE1 TE2 TE3 TE4

Report Approved by
Martin Futter Assistant Operations Manager MCERTS Level 2 MM 03 216 TE1 TE2 TE3 TE4

Report Date
17th December 2020

Version
Version 1

Signature of Report Approver


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MONITORING OBJECTIVES

Paxford Composites Ltd, Huntingdon
Large Commercial 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 Large Commercial 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

MONITORING RESULTS

Paxford Composites Ltd, Huntingdon
Large Commercial Booth
19th November 2020

where MU = Measurement Uncertainty associated with the Result

	Concentration				Mass Emission			
Parameter	**Units**	**Result**	**MU +/-**	**Limit**	**Units**	**Result**	**MU +/-**	**Limit**
Total Particulate Matter [1]	mg/m³	0.50	0.51	50	g/hr	10.6	10.7	-
Isocyanates [1]	mg/m³	0.0010	0.0002	0.1	g/hr	0.022	0.01	-
Total VOCs (as Carbon) [1]	mg/m³	40.5	1.05	100	g/hr	847	52.4	-
Water Vapour	% v/v	1.4	0.1					
Stack Gas Temperature	°C	24.0						
Stack Gas Velocity	m/s	12.7	0.42					
Volumetric Flow Rate (ACTUAL)	m³/hr	22907	1287					
Volumetric Flow Rate (REF) [1]	m³/hr	20922	1176					

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

MONITORING DATE(S) & TIMES

Paxford Composites Ltd, Huntingdon
Large Commercial Booth
19th November 2020

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	0.50	g/hr	10.6	19/11/2020	14:17 - 15:17	60
Isocyanates	R1	mg/m³	0.001	g/hr	0.022	19/11/2020	15:26 - 16:26	60
Total VOCs (as Carbon)	R1	mg/m³	40.5	g/hr	847	19/11/2020	14:17 - 15:17	60
Velocity Traverse	R1					19/11/2020	44154	

All results are expressed at the respective reference conditions.

PROCESS DETAILS

Paxford Composites Ltd, Huntingdon
Large Commercial 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)	Painitng of components
Abatement System	Cartridge Filters
Abatement System Running Status	Operational
Fuel	N/A
Plume Appearance	None Visible

MONITORING & ANALYTICAL METHODS

Paxford Composites Ltd, Huntingdon
Large Commercial Booth
19th November 2020

	Monitoring				Analysis					
Parameter	**Standard**	**Technical Procedure**	**Sampling Status**	**Testing Lab**	**Analytical Procedure**	**Analytical Technique**	**Analysis Status**	**Analysis Lab**	**Overall Status**	**LOD (Average)**
Total Particulate Matter	EN 13284-1	CAT-TP-01	MCERTS	EET	CAT-TP-03	Gravimetric	MCERTS	EET	MCERTS	0.25 mg/m³
Isocyanates	US EPA CTM36	CAT-TP-17	MCERTS	EET	M119	HPLC	MCERTS	RPS	MCERTS	0.0002 mg/m³
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/m³
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

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.80
Width	m	-
Area	m²	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.

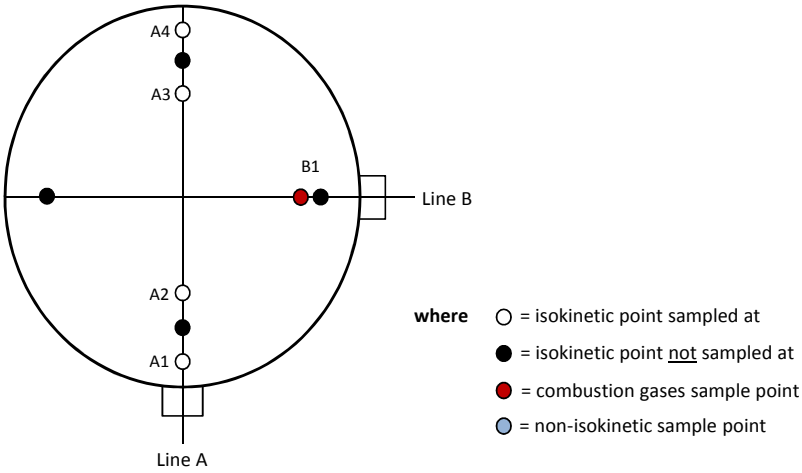
Sampling Plane Validation Criteria (from EN 15259)

Criteria in EN 15259	Units	Traverse 1	Required	Compliant
Lowest Differential Pressure	Pa	47.0	> 5 Pa	Yes
Mean Velocity	m/s	11.36	-	-
Lowest Gas Velocity	m/s	7.46	-	-
Highest Gas Velocity	m/s	13.50	-	-
Ratio of Above	: 1	1.81	< 3 : 1	Yes
Maximum Angle of Swirl	°	5.00	< 15°	Yes
No Local Negative Flow	-	Yes	-	Yes

PLANT PHOTOS

Photo 1

SAMPLE POINTS



APPENDIX CONTENTS

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	
Equipment Type	**Equipment I.D.**
Control Box DGM (1)	CAT 7.40
Control Box DGM (2)	-
Box Thermocouples (1)	CAT 7.40
Box Thermocouples (2)	-
Umbilical (1)	CAT 7.40
Umbilical (2)	-
Oven Box (1)	-
Oven Box (2)	-
Heated Probe (1)	CAT 5.102
Heated Probe (2)	-
Heated Probe (3)	-
S-Pitot (1)	CAT 21P.127
S-Pitot (2)	-
L-Pitot	-
Site Balance	CAT 17.51
500g / 1Kg Check Weights	CAT 17.51
Last Impinger Arm	-
Callipers	-
Tubes Kit Thermocouple	-

Instrumental Analysers	
Equipment Type	**Equipment I.D.**
Horiba PG-250 SRM	-
Horiba PG-250	-
Servomex 4900	-
Eco Physics CLD 822Mh	-
ABB AO2020-URAS26	-
Testo 350 XL	-
JCT JCC P1 Cooler	-
Gasmet DX4000	-
Gasmet Sampling System	-
Bernath 3006 FID	CAT 8.28
M&C PSS	CAT 12.100
Mass Flow Controller (1)	CAT 6.32
Mass Flow Controller (2)	CAT 6.33
Mass View (1)	-
Mass View (2)	-
Easylogger EN-EL-12 Bit	-
Hioki 5043 (V)	-
Bioaerosols Temperature Logger	-
Electronic Refrigerator	-

Miscellaneous Items	
Equipment Type	**Equipment I.D.**
Digital Manometer (1)	CAT 3.116
Digital Manometer (2)	-
Digital Temperature Meter	CAT 3.116
Stopwatch	CAT 14.53
Barometer	-
Stack Thermocouple (1)	CAT 4.1344
Stack Thermocouple (2)	-
Stack Thermocouple (3)	-
1m Heated Line (1)	-
1m Heated Line (2)	-
1m Heated Line (3)	-
5m Heated Line (1)	-
15m Heated Line (1)	-
20m Heated Line (1)	CAT 20.178
20m Heated Line (2)	-
Dual Channel Heater Controller	-
Single Channel Heater Controller	CAT 20.178
Laboratory Balance	CAT 1.18, 1.18a, 1.18b
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	24.0
Average Stack Gas Pressure	Pa	113.5
Average Stack Static Pressure, P_{static}	kPa	-0.023
Average Barometric Pressure, P_b	kPa	100.3
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	20.61	0.2090	32.00	1.4277	0.29838
N_2	-	79.04	77.94	0.7904	28.01	1.2498	0.98788
Moisture (H_2O)	-	-	1.39	0.0139	18.02	0.8037	0.01115

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	1.281
Dry Density (Actual), P_{Actual}	kg/m^3	1.171
Average Wet Density (Actual), $P_{ActualW}$	kg/m^3	1.165

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

P_{STW} = sum of all wet concentrations / 100 x density, kg/m^3 (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	24.0	0.0
Total Pressure	kPa	100.3	101.3
Moisture	%	1.39	1.39

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m^3/hr	20553
Gas Volumetric Flowrate (STP, Wet)	m^3/hr	18701
Gas Volumetric Flowrate (STP, Dry)	m^3/hr	18442
Gas Volumetric Flowrate REF [1]	m^3/hr	18701

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	-	44154
Atmospheric Pressure	kPa	100.3
Average Stack Static Pressure	Pa	-23
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					Sampling Line B - Unsafe to Access				
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m³	Velocity m/s	Swirl °	ΔP	Temp °C	Wet Density kg/m³	Velocity m/s	Swirl °
STATIC (Units: Pa)		*-23.0*									
Mean		**113.5**	**24.0**	**1.165**	**11.36**						
1	0.05	47.0	24.0	1.165	7.46	5.0					
2	0.20	127.0	24.0	1.165	12.26	5.0					
3	0.60	154.0	24.0	1.165	13.50	5.0					
4	0.75	126.0	24.0	1.165	12.21	5.0					

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(Δpi)	6.210	Pa
- Resolution	u(res)	0.08677	
- Calibration	u(cal)	1.341	
- Drift	u(drift)	33.333	
- Lack of Fit	u(fit)	2.806	
- Overall corrections to dynamic measurements	u(Cf)	37.567	
Standard uncertainty associated with the molar mass of the gas	u(M)	0.00003	-
- $\varphi O_2,w$	-	20.610	
- $\varphi CO_2,w$	-	0.059	
- Oxygen, dry	u(ϕO_2,d)	0.640	
- Carbon Dioxide, dry	u(ϕCO_2,d)	0.002	
- Water Vapour	u(ϕH_2O)	0.071	
- Oxygen, wet	u(ϕO_2,w)	0.631	
- Carbon Dioxide, wet	u(ϕCO_2,w)	0.002	
Standard uncertainty associated with the stack temperature	u(Tc)	1.515	K
Standard uncertainty associated with the absolute pressure in the duct	u(pc)	175.802	Pa
- Atmospheric Pressure	u(patm)	175.692	
- Static Pressure	u(pstat)	6.210	
Standard uncertainty associated with the density in the duct	u(ρ)	0.00629	-
Standard uncertainty associated with the local velocities	u(vi)	0.352	Pa
Standard uncertainty associated with the mean velocity	u(v)	0.193	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	Uc(v)	0.378	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	Uc,rel(v)	3.33	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	Uc(qV,w)	1155.1	m³/hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00082	
- $u^2(qV,w)$	-	347322	
- $u(qV,w)$	-	589.3	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	Uc,rel(qV,w)	5.62	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

Paxford Composites Ltd, Huntingdon
Large Commercial Booth

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	0.50		0.50
Uncertainty	±mg/m³	0.51		0.51
Mass Emission	g/hr	10.6		10.6
Uncertainty	±g/hr	10.7		10.7

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	1.4		1.4
Uncertainty	±% v/v	0.073		0.073

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m³	0.25		0.25

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_2O	-2.0
$P_s = (P_b + (P_{static} / 13.6)$	mmHg	752.9
Volume of water vapour collected, V_{wstd}		
Total mass collected in impingers (liquid trap)	g	5.8
Total mass collected in impingers (silica trap)	g	5.8
Total mass of liquid collected, V_{lc}	g	11.6
$V_{wstd} = (0.001246)(V_{lc})$	m^3	0.0145
Volume of gas metered dry, V_{mstd}		
Volume of gas sample through gas meter, V_m	m^3	1.1522
Gas meter correction factor, Y_d	-	0.9840
Average dry gas meter temperature, T_m	°C	24.3
Average pressure drop across orifice, ΔH	mmH_2O	39.7
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m^3	1.0354
Moisture content, B_{wo} & R_{wv}		
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m^3	0.0138
B_{wo} as a percentage	% v/v	1.38
Reported Water Vapour, checked with Tables in EN 14790, Rwv	% v/v	1.38
Volume of gas metered wet, V_{mstw}		
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m^3	1.0499
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	28.69
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_2O	12.85
Average square root of velocity heads, √ΔP	$\sqrt{mmH_2O}$	3.58
Average stack gas temperature, T_s	°C	22.2
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s} + 273)) / (\sqrt{(M_s)(P_s)})$	m/s	12.21
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	368.1
Conversion factor (K/mm.Hg), C_f	-	0.3592
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m^3/min	337.2
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m^3/min	332.6
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	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	26.64
Total sampling time, q	min	60
$\%I = (4.6398E^6)(T_s+273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	97.9

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1
Sampling Times	-	14:17 - 15:17
Sampling Dates	-	19/11/2020
Sampling Device	-	ISO
Volume Sampled (REF)	m^3	1.0499
Filter I.D. Number	-	47-73140
Start Filter Mass	g	0.15257
End Filter Mass	g	0.15295
Total Mass on Filter	g	0.00038
Probe Rinse I.D. Number	-	PR-47-73140
Start Probe Rinse Mass	g	2.89386
End Probe Rinse Mass	g	2.89401
Total Mass in Probe Rinse	g	0.00015
Total Mass Collected	mg	0.53
Calculated Concentration	mg/m^3	0.50
Balance Uncertainty / LOD	mg/m^3	0.25

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	1.0499
Filter I.D. Number	-	47-65365
Start Filter Mass	g	0.14657
End Filter Mass	g	0.14662
Total Mass on Filter	g	0.00005
Probe Rinse I.D. Number	-	PR-47-65365
Start Probe Rinse Mass	g	2.93519
End Probe Rinse Mass	g	2.93528
Total Mass in Probe Rinse	g	0.00009
Total Mass Collected	mg	0.14
Calculated Concentration	mg/m^3	0.13
Balance Uncertainty / LOD	mg/m^3	0.25

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

Sample Runs

Leak Test Results	Units	Run 1
Mean Sampling Rate	l/min	18.9
Pre-Sampling Leak Rate	l/min	0.10
Post-Sampling Leak Rate	l/min	
Allowable Leak Rate	l/min	0.48
Leak Test Acceptable	-	Yes

Water Droplets	Units	Run 1
Are Water Droplets Present	-	No

MU (Concurrent Water Vapour)	Units	Run 1
Measurement Uncertainty (MU)	%	5.3
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	%	97.9
Allowable Isokinetic Range	%	95 - 115
Isokineticity Acceptable	-	Yes

Weighing Uncertainty Criteria	Units	Run 1
Overall Weighing Uncertainty	± mg	0.49
Overall Weighing Uncertainty	± mg/m³	0.47
ELV [Daily ELV for IED]	mg/m³	50.00
Allowable Weighing Uncertainty	mg/m³	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	19.0
Pre-Sampling Leak Rate	l/min	0.10
Post-Sampling Leak Rate	l/min	
Allowable Leak Rate	l/min	0.38
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 (x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	Run Number 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

	Value		Standard uncertainty		
Measured Quantities	**Symbol**	**Run 1**	**Symbol**	**Units**	**Run 1**
Sampled Volume (Actual)	V_m	1.1522	uV_m	m^3	0.0230
Sampled Gas Temperature	T_m	297.3	uT_m	K	2.00
Sampled Gas Pressure	ρ_m	100.4	$u\rho_m$	kPa	0.50
Sampled Gas Humidity	H_m	0.00	uH_m	% v/v	1.00
Leak	L	0.53	uL	%	-
Mass of Particulate	m	0.53	um	mg	0.26
Uncollected Mass	UCM	0.14	uUCM	mg	-

	Uncertainty as a Percentage		
Measured Quantities	**Units**	**Run 1**	**Requirement of Standard**
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	%	0.53	≤2%
Mass of Particulate	%	0.50	<5% of ELV
Uncollected Mass	%	-	-

	Uncertainty in Measurement Units			Sensitivity Coefficient
Measured Quantities	**Symbol**	**Units**	**Run 1**	**Run 1**
Sampled Volume (STP)	V_m	m^3	1.0354	0.49
Leak	L	mg/m^3	0.002	1.00
Mass of Particulate	L_r	mg	0.530	0.95
Uncollected Mass	UCM	mg	0.08	0.95

	Uncertainty in Result	
Measured Quantities	**Units**	**Run 1**
Sampled Volume (STP)	mg/m^3	0.013
Leak	mg/m^3	0.0015
Mass of Particulate	mg/m^3	0.2477
Uncollected Mass	mg/m^3	0.0770

	Oxygen Correction Part of MU Budget	
Measured Quantities	**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	0.26
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m^3	0.51
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m^3	N/A
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m^3	0.51
Reported Uncertainty	mg/m^3	0.51
Expanded uncertainty (95% confidence), without Oxygen Correction	%	100.8
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	100.8
Reported Uncertainty	%	100.8

ISOCYANATES: RESULTS SUMMARY

Paxford Composites Ltd, Huntingdon
Large Commercial Booth

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	0.0010		0.0010
Uncertainty	±mg/m³	0.00024		0.00024
Mass Emission	g/hr	0.022		0.022
Uncertainty	±g/hr	0.0053		0.0053

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	1.4		1.4
Uncertainty	±% v/v	0.074		0.074

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m³	0.00024		0.00024

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_2O	-2.0	
$P_s = (P_b + (P_{static} / 13.6)$	mmHg	752.9	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	7.5	
Total mass collected in impingers (silica trap)	g	5.3	
Total mass of liquid collected, V_{lc}	g	12.8	
$V_{wstd} = (0.001246)(V_{lc})$	m^3	0.0159	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m^3	1.2598	
Gas meter correction factor, Y_d	-	0.9840	
Average dry gas meter temperature, T_m	°C	26.3	
Average pressure drop across orifice, ΔH	mmH_2O	45.6	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m^3	1.1254	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m^3	0.0140	
B_{wo} as a percentage	% v/v	1.40	
Reported Water Vapour, checked with Tables in EN 14790, Rwv	% v/v	1.40	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m^3	1.1413	
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	28.69	
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_2O	14.73	
Average square root of velocity heads, √ΔP	$\sqrt{mmH_2O}$	3.84	
Average stack gas temperature, T_s	°C	23.9	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s} + 273)) / (\sqrt{(M_s)(P_s)})$	m/s	13.11	
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	395.4	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_{sj})(C_f)) / ((T_s) + 273)$	m^3/min	360.2	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m^3/min	355.1	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	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	26.64	
Total sampling time, q	min	60	
$\%I = (4.6398E^6)(T_s+273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	99.7	

ISOCYANATES: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1
Sampling Times	-	15:26 - 16:26
Sampling Dates	-	19/11/2020
Sampling Device	-	ISO
Volume Sampled (REF)	m^3	1.1413
Methyl Diisocyanate (MDI)	µg	0.270
Hexamethylene Diisocyanate (HDI)	µg	0.640
Toluene Diisocyanates (TDI)	µg	0.270
Total Mass Collected	µg	1.180
Calculated Concentration	mg/m^3	0.001

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	1.1413
Methyl Diisocyanate (MDI)	µg	0.100
Hexamethylene Diisocyanate (HDI)	µg	0.100
Toluene Diisocyanates (TDI)	µg	< 0.070
Total Mass Collected	µg	0.270
Calculated Concentration	mg/m^3	0.000

ISOCYANATES: QUALITY ASSURANCE

Sample Runs

Leak Test Results	Units	Run 1
Mean Sampling Rate	l/min	20.7
Pre-Sampling Leak Rate	l/min	0.10
Post-Sampling Leak Rate	l/min	0.10
Allowable Leak Rate	l/min	0.41
Leak Test Acceptable	-	Yes

Water Droplets	Units	Run 1
Are Water Droplets Present	-	No

MU (Concurrent Water Vapour)	Units	Run 1
Measurement Uncertainty (MU)	%	5.3
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	%	99.7
Allowable Isokinetic Range	%	95 - 115
Isokineticity Acceptable	-	Yes

Filter Temperatures	Units	Run 1
Maximum Filter Temperature	°C	24

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 (x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	Run Number 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

	Value			Standard uncertainty		
Measured Quantities	**Symbol**	**Run 1**		**Symbol**	**Units**	**Run 1**
Sampled Volume (Actual)	V_m	1.2598		uV_m	m^3	0.0252
Sampled Gas Temperature	T_m	299.3		uT_m	K	2.00
Sampled Gas Pressure	ρ_m	100.4		$u\rho_m$	kPa	0.50
Sampled Gas Humidity	H_m	0.00		uH_m	% v/v	1.00
Leak	L	0.48		uL	%	-
Laboratory Result	L_r	11.80		uL_r	%	-

	Uncertainty as a Percentage		
Measured Quantities	**Units**	**Run 1**	**Requirement of Standard**
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	%	0.48	≤2%
Laboratory Result	%	11.80	No Requirement

	Uncertainty in Measurement Units			Sensitivity Coefficient
Measured Quantities	**Symbol**	**Units**	**Run 1**	**Run 1**
Sampled Volume (STP)	V_m	m^3	1.1254	0.00
Leak	L	mg/m^3	0.000	1.00
Laboratory Result	L_r	mg/m^3	0.000	1.00

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

	Oxygen Correction Part of MU Budget	
Measured Quantities	**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
Large Commercial Booth

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	40.5		40.5
Uncertainty	±mg/m³	1.1		1.1
Mass Emission	g/hr	847		847
Uncertainty	±g/hr	52.4		52.4

General Sampling Information

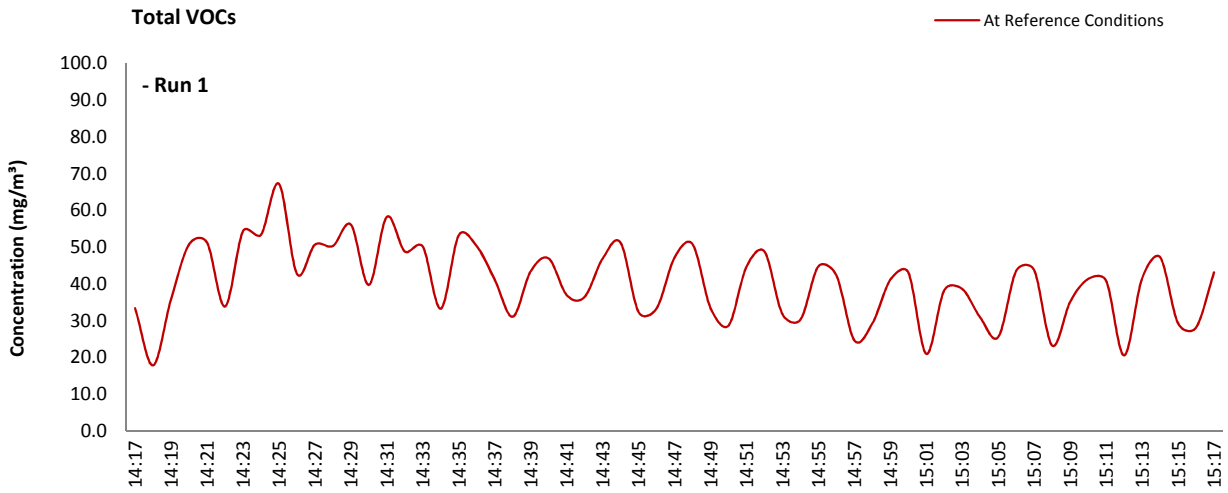
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Type	Propane In Synthetic Air (5 Grade)	
Span Gas Reference Number	1.0319a	
Span Gas Expiry Date	22/03/2023	
Span Gas Start Pressure (bar)	60	
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	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	B1	

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	-	14:17 - 15:17
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	1.00
	Zero Down Sampling Line (Post)	ppm	1.50
	Zero Drift	ppm	0.50
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	78.50
	Span Down Sampling Line (Post)	ppm	79.40
	Span Drift	ppm	0.90
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	20 - 22

Method Deviations

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

TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1		Units
Limit value	100.0		mg/m³ (REF)
Allowable MU	15.0		%
Measured concentration	41.04		mg/m³ (STP, dry)
Range Used	100.0		ppm
Range Used [A]	160.6		mg/m³
Cal gas conc.	79.9		ppm
Conversion	1.61		ppm to mg/m³
MCERTS Range [B]	15.0		mg/m³
Lower of [A] or [B]	15.0		mg/m³
Cal gas conc.	128.3		mg/m³

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	0.64		% full scale
Span drift	1.15		% 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)	0.63		% 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/m³
Standard deviation of repeatability at span level	0.00		mg/m³
Lack of fit	0.04		mg/m³
Drift	0.00		mg/m³
Volume or pressure flow dependence	0.00		mg/m³
Atmospheric pressure dependence	0.01		mg/m³
Ambient temperature dependence	0.20		mg/m³
Combined interference (from MCERTS Certificate)	0.04		mg/m³
Dependence on voltage	0.06		mg/m³
Losses in the line (leak)	0.15		mg/m³
Uncertainty of calibration gas	0.47		mg/m³

			RUN 1		Units
Measurement uncertainty		**Result**	41.04		mg/m³
Combined uncertainty			0.54		mg/m³
Expanded uncertainty	k =	1.96	1.07		mg/m³
Uncertainty corrected to std conds. (O_2)			1.07		mg/m³ (REF)

	RUN 1		Units
Expanded uncertainty (no O_2) - at 95% Confidence	2.60		% of Value
Expanded uncertainty (no O_2) - at 95% Confidence	1.07		% 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 O_2 correction is applied less than 15% + the uncertainty associated with the O_2 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