

Stack Emissions Summary Report

		Particulate Matter		Total VOCs			Test Dates	Flow Rate (REF)	Reference Conditions
Release Point	Units	Result	Limit	Result	Limit			m³/hr	
Stack 8A	mg/m³	0.60	10	1.7	-		30/09/2015	1546.0	STP Wet Gas
	g/hr	0.93	-	2.6	-				
Stack 8C	mg/m³	0.56	10	0.44	-		30/09/2015	2162.0	STP Wet Gas
	g/hr	1.2	-	0.95	-				
Stack 15	mg/m³	0.57	10	2.0	-		01/10/2015	3811.0	STP Wet Gas
	g/hr	2.2	-	7.8	-				
Stack 23	mg/m³	0.47	10	2.1	-		30/09/2015	7878.0	STP Wet Gas
	g/hr	3.7	-	16.8	-				
Stack 35D	mg/m³	0.67	10	5.2	-		01/10/2015	9755.0	STP Wet Gas
	g/hr	6.5	-	50.6	-				
Stack 43	mg/m³	1.0	10	4.6	-		30/09/2015	23703.0	STP Wet Gas
	g/hr	24.8	-	110	-				
Stack 44	mg/m³	1.2	10	3.1	-		01/10/2015	6100.0	STP Wet Gas
	g/hr	7.5	-	18.7	-				
Stack 46	mg/m³	0.77	10	39.7	-		01/10/2015	21845.0	STP Wet Gas
	g/hr	16.8	-	867	-				
Stack 55	mg/m³	0.57	10	5.0	-		30/09/2015	14946.0	STP Wet Gas
	g/hr	8.5	-	74.0	-				
Stack 91	mg/m³	0.54	10	2.6	-		01/10/2015	8452.0	STP Wet Gas
	g/hr	4.6	-	21.8	-				
Standard Reference Method		BS EN 13284-1		BS EN 12619:2013					
Accreditation Status of Test		UKAS & MCERTS		UKAS & MCERTS					

Summary Writer Matthew Hopes

MCERTS Accreditation

MCERTS Level 2

MCERTS Number

MM 06 688

Report Date

15th October 2015

Summary Approver Matthew Hopes

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MCERTS Level 2

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Report Version

Version 1



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Stack Emissions Testing Report Commissioned by
VIP Polymers Ltd

Installation Name & Address
VIP Polymers Ltd
15 Windover Road
Huntingdon
Cambridgeshire
PE29 7EB

LAPPC Permit: B11/94

Stack Reference
Stack 8A

Dates of the Monitoring Campaign
30th September 2015

Job Reference Number
CSW-1977

Report Written by
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Report Date
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Signature of Report Approver


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Executive Summary

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MONITORING OBJECTIVES

VIP Polymers Ltd, Huntingdon

Stack 8A

30th September 2015

Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by VIP Polymers Ltd to carry out stack emissions testing on the Stack 8A 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, Total VOCs (as Carbon)

Executive Summary

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MONITORING RESULTS

VIP Polymers Ltd, Huntingdon

Stack 8A

30th September 2015

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	0.60	1.6	10	g/hr	0.93	2.4	-
Total VOCs (as Carbon)	¹ mg/m ³	1.7	0.47	-	g/hr	2.6	0.75	-
Water Vapour	% v/v	0.29	0.02					
Stack Gas Temperature	°C	24.0						
Stack Gas Velocity	m/s	4.6	0.30					
Volumetric Flow Rate (ACTUAL)	m ³ /hr	1670	134					
Volumetric Flow Rate (REF)	¹ m ³ /hr	1546	124					

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

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

Executive Summary

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MONITORING DATE(S) & TIMES

VIP Polymers Ltd, Huntingdon

Stack 8A

30th September 2015

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	0.60	g/hr	0.93	30/09/2015	12:18 - 12:58	40
Total VOCs (as Carbon)	R1	mg/m³	1.7	g/hr	2.6	30/09/2015	12:20 - 12:50	30
Velocity & Volumetric Flow Rate	R1					30/09/2015	11:29 - 11:45	

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

VIP Polymers Ltd, Huntingdon

Stack 8A

30th September 2015

Standard Operating Conditions

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

Executive Summary

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MONITORING & ANALYTICAL METHODS

VIP Polymers Ltd, Huntingdon

Stack 8A

30th September 2015

Parameter	Monitoring				Analysis				MCERTS Testing	LOD (Average)
	Standard	Technical Procedure	ISO 17025 Testing	Testing Lab	Analytical Procedure	Analytical Technique	ISO 17025 Analysis	Analysis Lab		
Total Particulate Matter	EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.15 mg/m ³
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.1 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.32 mg/m ³
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	Yes	CAT	Pitot Tube and Thermocouple				Yes	1.2 m/s

ANALYSIS LABORATORIES

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

Exova Catalyst (CAT)	ISO 17025 Accreditation Number: 4279
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SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter	1	Ratio highest to lowest velocities > 5 : 1.
		The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl points after this increase were omitted.
		Only one sampling line was installed on the stack, however the number of sample points used on the available line were increased to meet the requirements of the Standard.

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.36
Width	m	-
Area	m ²	0.10
Port Depth	cm	9
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

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

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

All platforms should be designed in accordance with the requirements in EPA Guidance Note AG1 and EN 15259.

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	0.5		> 5 Pa	No
Mean Velocity	m/s	4.56		-	-
Lowest Gas Velocity	m/s	0.77		-	-
Highest Gas Velocity	m/s	10.01		-	-
Ratio of Above	: 1	13.03		< 3 : 1	No
Maximum Angle of Swirl	°	87		< 15°	No
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

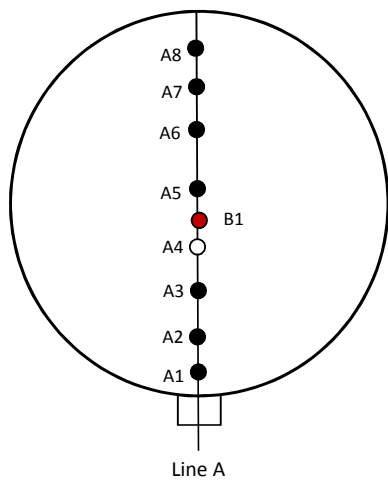
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PLANT PHOTOS

Photo 1



SAMPLE POINTS



where ○ = isokinetic point sampled at
● = isokinetic point not sampled at
● = combustion gases sample point

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	Neil Teixeira	MCERTS Level 2	MM 05 583	TE1 TE2 TE3 TE4
Team Leader	Phil Soley	MCERTS Level 2	MM 12 1187	TE1 TE2 TE3 TE4

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 7.46	Horiba PG-250	-	Digital Manometer (1)	CAT 3.12
Control Box DGM (2)	-	Horiba PG-250 SRM	-	Digital Manometer (2)	-
Box Thermocouples (1)	CAT 3.22	Servomex 4900	-	Digital Temperature Meter	CAT 3.12
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.63
Umbilical (1)	CAT 3.22	ABB AO2020-URAS26	-	Barometer	CAT 13.37
Umbilical (2)	-	Servomex 5200MP	-	Stack Thermocouple (1)	CAT 4.584
Oven Box (1)	-	JCT JCC P1 Cooler	-	Stack Thermocouple (2)	-
Oven Box (2)	-	ProtIR 304M	-	Stack Thermocouple (3)	-
Heated Probe (1)	CAT 5.85	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	-	Bernath 3006 FID	CAT 8.22	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.86	1m Heated Line (3)	-
S-Pitot (1)	CAT 21.P43	Mass Flow Controller (1)	CAT 6.52	5m Heated Line (1)	CAT 20.77
S-Pitot (2)	-	Mass Flow Controller (2)	-	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	-	20m Heated Line (1)	-
500g Check Weight	CAT 17.25	Mass View (2)	-	20m Heated Line (2)	-
1Kg Check Weight	CAT 17.25	Hioki 5043 (V)	CAT 11.91	Dual Channel Heater Controller	-
Last Impinger Arm	-	Easylogger EN-EL-12 Bit	-	Single Channel Heater Controller	-
Callipers	CAT 23.29	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.9

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
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	0.36
Stack Width, W	m	-
Stack Area, A	m ²	0.10
Average Stack Gas Temperature, T _a	°C	24.0
Average Stack Gas Pressure	Pa	28.2
Average Stack Static Pressure, P _{static}	kPa	0.031
Average Barometric Pressure, P _b	kPa	102.0
Average Pitot Tube Calibration Coefficient, C _p	-	0.84

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)	-	20.80	20.74	0.2080	32.00	1.4277	0.29696
N ₂	-	79.14	78.91	0.7914	28.01	1.2498	0.98913
Moisture (H ₂ O)	-	-	0.29	0.0029	18.02	0.8037	0.00233

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	1.286
Dry Density (Actual), P _{Actual}	kg/m ³	1.192
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.190

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} x (T_s / P_s) x (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	102.0	101.3
Moisture	%	0.29	0.29

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	1670
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	1546
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	1542
Gas Volumetric Flowrate REF ¹	m ³ /hr	1546

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	30/09/2015
Time of Survey	-	11:29 - 11:45
Atmospheric Pressure	kPa	102.0
Average Stack Static Pressure	Pa	31
Result of Pitot Stagnation Test	-	NOT REQUIRED
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with KIMO MP 210 (500Pa)	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C_p	-	0.84
Number of Lines Available	-	1
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)		31.0				
Mean		28.2	24.0	1.190	4.56	
1	0.01	0.5	24.0	1.190	0.77	60.0
2	0.04	1.5	24.0	1.190	1.33	61.0
3	0.07	1.7	24.0	1.190	1.42	44.0
4	0.12	5.0	24.0	1.190	2.43	9.0
5	0.24	13.5	24.0	1.190	3.99	87.0
6	0.29	39.7	24.0	1.190	6.85	75.0
7	0.32	79.0	24.0	1.190	9.66	65.0
8	0.35	84.9	24.0	1.190	10.01	60.0

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	$u(\Delta p_i)$	1.080	Pa
- Resolution	$u(res)$	0.00087	
- Calibration	$u(cal)$	0.083	
- Drift	$u(drift)$	0.083	
- Lack of Fit	$u(fit)$	0.000	
- Overall corrections to dynamic measurements	$u(C_f)$	0.167	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00003	-
- $\phi_{O_2,w}$	-	20.740	
- $\phi_{CO_2,w}$	-	0.060	
- Oxygen, dry	$u(\phi_{O_2,d})$	0.637	
- Carbon Dioxide, dry	$u(\phi_{CO_2,d})$	0.002	
- Water Vapour	$u(\phi_{H_2O})$	0.015	
- Oxygen, wet	$u(\phi_{O_2,w})$	0.635	
- Carbon Dioxide, wet	$u(\phi_{CO_2,w})$	0.002	
Standard uncertainty associated with the stack temperature	$u(T_c)$	1.515	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.695	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	1.080	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00641	-
Standard uncertainty associated with the local velocities	$u(v_i)$	0.330	Pa
Standard uncertainty associated with the mean velocity	$u(\bar{v})$	0.154	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	0.301	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	6.61	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV,w)$	133.7	m ³ /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00167	
- $u^2(qV,w)$	-	4655	
- $u(qV,w)$	-	68.2	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV,w)$	8.01	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 8A

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.60		0.60
Uncertainty	±mg/m ³	1.6		1.6
Mass Emission	g/hr	0.9		0.9
Uncertainty	±g/hr	2.4		2.4

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	0.29		0.29
Uncertainty	±% v/v	0.02		0.02

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.56		0.56

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	1 / 8	FORMAT: Number Used / Number Required
Sample Point I.D.'s	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	772.5	
Stack static pressure, P_{static}	mmH ₂ O	3.2	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	772.7	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	-25.0	
Total mass collected in impingers (silica trap)	g	27.0	
Total mass of liquid collected, V_{lc}	g	2.0	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0025	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	0.9290	
Gas meter correction factor, Y_d	-	0.9940	
Average dry gas meter temperature, T_m	°C	27.1	
Average pressure drop across orifice, ΔH	mmH ₂ O	51.3	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	0.8581	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0029	
B_{wo} as a percentage	% v/v	0.29	
Reported Water Vapour, checked with Tables in EN 14790, R_{wv}	% v/v	0.29	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	0.8606	
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	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	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	28.81	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.82	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	1.00	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	1.00	
Average stack gas temperature, T_s	°C	24.1	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	3.32	
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	0.10	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	20.3	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	19.0	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	18.9	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	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	11.88	
Nozzle area, A_n	mm ²	110.80	
Total sampling time, q	min	40	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	104.2	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	12:18 - 12:58	
Sampling Dates	-	30/09/2015	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	0.8606	
Filter I.D. Number	-	47-26562	
Start Filter Mass	g	0.13937	
End Filter Mass	g	0.13974	
Total Mass on Filter	g	0.00037	
Probe Rinse I.D. Number	-	PR-47-26562	
Start Probe Rinse Mass	g	2.94206	
End Probe Rinse Mass	g	2.94221	
Total Mass in Probe Rinse	g	0.00015	
Total Mass Collected	mg	0.52	
Calculated Concentration	mg/m ³	0.60	
Balance Uncertainty / LOD	mg/m ³	0.15	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	30/09/2015	
Average Volume Sampled (REF)	m ³	0.8606	
Filter I.D. Number	-	47-26500	
Start Filter Mass	g	0.14010	
End Filter Mass	g	0.14058	
Total Mass on Filter	g	0.00048	
Probe Rinse I.D. Number	-	PR-47-26500	
Start Probe Rinse Mass	g	3.13340	
End Probe Rinse Mass	g	3.13340	
Total Mass in Probe Rinse	g	0.00000	
Total Mass Collected	mg	0.48	
Calculated Concentration	mg/m ³	0.56	
Balance Uncertainty / LOD	mg/m ³	0.15	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	23.09	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.46	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	7.8	
Allowable MU	%	20	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	104.2	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.28	
ELV [Daily ELV for IED]	mg/m ³	10.00	
Allowable Weighing Uncertainty	mg/m ³	0.50	
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?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Pre-Sampling Leak Rate	l/min	0.20	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
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	
Ratio highest to lowest velocities > 5 : 1.	x	
The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl points after this increase were omitted.	x	
Only one sampling line was installed on the stack, however the number of sample points used on the available line were increased to meet the requirements of 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	0.9290		uV_m	m^3	0.0186	
Sampled Gas Temperature	T_m	300.1		uT_m	K	2.0	
Sampled Gas Pressure	p_m	103.0		up_m	kPa	0.5	
Sampled Gas Humidity	H_m	0.0		uH_m	% v/v	1.0	
Leak	L	0.43		uL	%	-	
Mass of Particulate	m	0.52		um	mg	0.13	
Uncollected Mass	UCM	0.48		uUCM	mg	-	

Uncertainty as a Percentage				Requirement of Standard
Measured Quantities	Units	Run 1		
Sampled Volume (Actual)	%	2.00		$\leq 2\%$
Sampled Gas Temperature	%	0.67		$\leq 1\%$
Sampled Gas Pressure	%	0.49		$\leq 1\%$
Sampled Gas Humidity	%	1.00		$\leq 1\%$
Leak	%	0.43		$\leq 2\%$
Mass of Particulate	%	1.51		$< 5\%$ 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	0.8581	0.70	
Leak	L	mg/m^3	0.002	1.00	
Mass of Particulate	L_r	mg	0.517	1.16	
Uncollected Mass	UCM	mg	0.28	1.16	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m^3	0.015	
Leak	mg/m^3	0.0015	
Mass of Particulate	mg/m^3	0.1511	
Uncollected Mass	mg/m^3	0.3243	

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	0.36	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m^3	0.70	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m^3	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m^3	1.58	
Reported Uncertainty	mg/m^3	1.58	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	116.9	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	263.0	
Reported Uncertainty	%	263.0	

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 8A

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	1.7		1.7
Uncertainty	±mg/m ³	0.47		0.47
Mass Emission	g/hr	2.6		2.6
Uncertainty	±g/hr	0.75		0.75

General Sampling Information

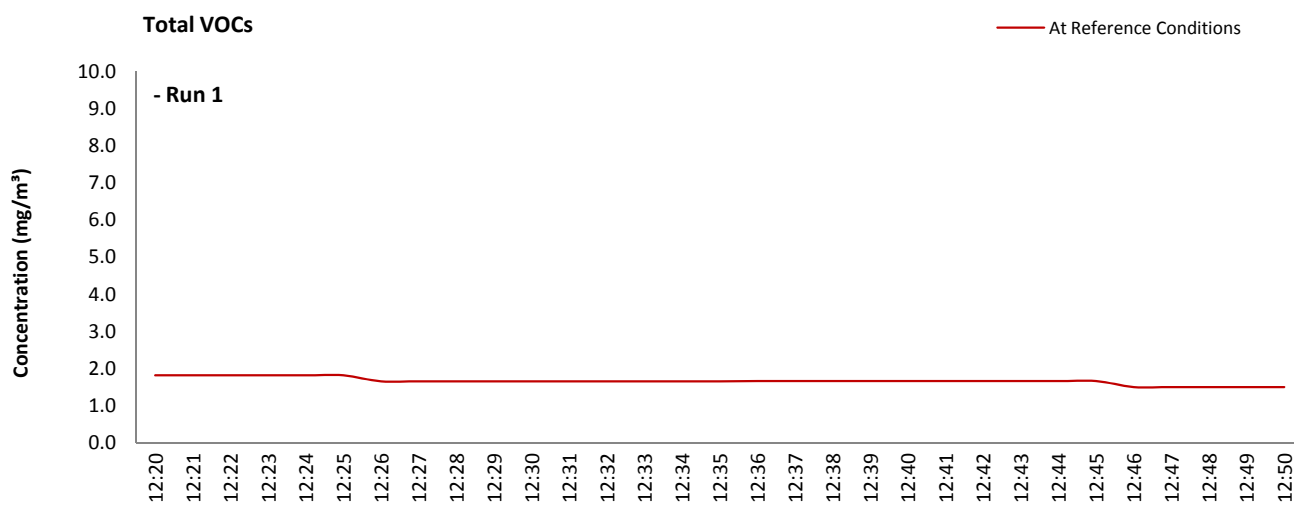
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180	
Span Gas Type	Propane In Synthetic Air (5 Grade)	
Span Gas Reference Number	1.072a	
Span Gas Expiry Date	26/06/2020	
Span Gas Start Pressure (bar)	130	
Gas Cylinder Concentration (ppm)	80.2	
Span Gas Set Point (ppm)	80.20	
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	-	12:20 - 12:50	
Sampling Dates	-	30/09/2015	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.2	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.30	
	Zero Down Sampling Line (Post)	ppm	0.20	
	Zero Drift	ppm	-0.10	
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	4.01	
	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	78.90	
	Span Drift	ppm	-0.10	
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	4.01	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	21 - 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.	x	

TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1		Units
Limit value	-		mg/m ³ (REF)
TGN M2 Allowable MU	15.0		%
Measured concentration	1.66		mg/m ³ (STP, dry)
Range Used	100.0		ppm
Range Used [A]	160.6		mg/m ³
Cal gas conc.	80.2		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.	128.8		mg/m ³

Performance characteristics	RUN 1		Units
Response time	45		seconds
Number of readings in measurement	30		-
Repeatability at zero	2.00		% full scale
Repeatability at span level	0.00		% full scale
Deviation from linearity	0.22		% of value
Zero drift	-0.13		% full scale
Span drift	-0.13		% 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)	1.50		% 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	0.019		mg/m ³
Drift	-0.10		mg/m ³
Volume or pressure flow dependence	0.0014		mg/m ³
Atmospheric pressure dependence	0.013		mg/m ³
Ambient temperature dependence	0.20		mg/m ³
Combined interference (from MCERTS Certificate)	0.039		mg/m ³
Dependence on voltage	0.058		mg/m ³
Losses in the line (leak)	0.014		mg/m ³
Uncertainty of calibration gas	0.019		mg/m ³

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		1.66	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	28.28	% of Value
Expanded uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Overall Allowable uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Result of Compliance with Uncertainty Requirement in M2	N/A	-

	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 in M2	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). Ref EA TGN M2.



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Stack Emissions Testing Report Commissioned by
 VIP Polymers Ltd

Installation Name & Address

VIP Polymers Ltd
 15 Windover Road
 Huntingdon
 Cambridgeshire
 PE29 7EB

LAPPC Permit: B11/94

Stack Reference

Stack 8C

Dates of the Monitoring Campaign

30th September 2015

Job Reference Number

CSW-1977

Report Written by
Neil Teixeira Team Leader MCERTS Level 2 MM 05 583 TE1 TE2 TE3 TE4

Report Approved by
Matthew Hopes Team Leader MCERTS Level 2 MM 06 688 TE1 TE2 TE3 TE4

Report Date
15th October 2015

Version
Version 1

Signature of Report Approver


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TITLE PAGE

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EXECUTIVE SUMMARY

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APPENDIX 1 - Monitoring Personnel & List of Equipment

APPENDIX 2 - Raw Data, Sampling Equations & Charts

Opinions and interpretations expressed herein are outside the scope of Exova Catalyst's ISO 17025 accreditation.

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Executive Summary

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MONITORING OBJECTIVES

VIP Polymers Ltd, Huntingdon

Stack 8C

30th September 2015

Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by VIP Polymers Ltd to carry out stack emissions testing on the Stack 8C 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, Total VOCs (as Carbon)

Executive Summary

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MONITORING RESULTS

VIP Polymers Ltd, Huntingdon

Stack 8C

30th September 2015

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	0.56	1.1	10	g/hr	1.2	2.3	-
Total VOCs (as Carbon)	¹ mg/m ³	0.44	0.47	-	g/hr	0.95	1.0	-
Water Vapour	% v/v	0.20	0.02					
Stack Gas Temperature	°C	23.0						
Stack Gas Velocity	m/s	6.7	0.22					
Volumetric Flow Rate (ACTUAL)	m ³ /hr	2305	129					
Volumetric Flow Rate (REF)	¹ m ³ /hr	2162	121					

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

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

Executive Summary

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MONITORING DATE(S) & TIMES

VIP Polymers Ltd, Huntingdon

Stack 8C

30th September 2015

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m ³	0.56	g/hr	1.2	30/09/2015	13:38 - 14:18	40
Total VOCs (as Carbon)	R1	mg/m ³	0.44	g/hr	0.95	30/09/2015	13:40 - 14:10	30
Velocity & Volumetric Flow Rate	R1					30/09/2015	13:23 - 13:37	

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

VIP Polymers Ltd, Huntingdon

Stack 8C

30th September 2015

Standard Operating Conditions

Parameter	Value
Process Status	Normal production
Capacity (of 100%) and Tonnes / Hour	N/A
Continuous or Batch Process	Continuous
Feedstock (if applicable)	Rubber
Abatement System	None
Abatement System Running Status	N/A
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

(Page 5 of 7)

MONITORING & ANALYTICAL METHODS

VIP Polymers Ltd, Huntingdon

Stack 8C

30th September 2015

Parameter	Monitoring				Analysis				MCERTS Testing	LOD (Average)
	Standard	Technical Procedure	ISO 17025 Testing	Testing Lab	Analytical Procedure	Analytical Technique	ISO 17025 Analysis	Analysis Lab		
Total Particulate Matter	EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.17 mg/m ³
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.1 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.32 mg/m ³
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	Yes	CAT	Pitot Tube and Thermocouple				Yes	1.2 m/s

ANALYSIS LABORATORIES

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

Exova Catalyst (CAT)	ISO 17025 Accreditation Number: 4279
----------------------	--------------------------------------

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter	1	The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl points after this increase were omitted.
		Ratio highest to lowest velocities between 3 and 5 : 1.
		Only one sampling line was installed on the stack, however the number of sample points used on the available line were increased to meet the requirements of the Standard.

Executive Summary

(Page 6 of 7)

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.35
Width	m	-
Area	m ²	0.10
Port Depth	cm	4
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

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

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

All platforms should be designed in accordance with the requirements in EPA Guidance Note AG1 and EN 15259.

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	4.0		> 5 Pa	No
Mean Velocity	m/s	6.65		-	-
Lowest Gas Velocity	m/s	2.16		-	-
Highest Gas Velocity	m/s	9.53		-	-
Ratio of Above	: 1	4.42		< 3 : 1	No
Maximum Angle of Swirl	°	80		< 15°	No
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

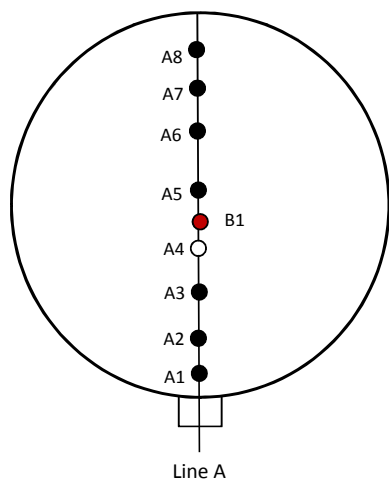
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PLANT PHOTOS

Photo 1



SAMPLE POINTS



where ○ = isokinetic point sampled at
● = isokinetic point not sampled at
● = combustion gases sample point

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	Neil Teixeira	MCERTS Level 2	MM 05 583	TE1 TE2 TE3 TE4
Team Leader	Phil Soley	MCERTS Level 2	MM 12 1187	TE1 TE2 TE3 TE4

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 7.46	Horiba PG-250	-	Digital Manometer (1)	CAT 3.12
Control Box DGM (2)	-	Horiba PG-250 SRM	-	Digital Manometer (2)	-
Box Thermocouples (1)	CAT 3.22	Servomex 4900	-	Digital Temperature Meter	CAT 3.12
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.63
Umbilical (1)	CAT 3.22	ABB AO2020-URAS26	-	Barometer	CAT 13.37
Umbilical (2)	-	Servomex 5200MP	-	Stack Thermocouple (1)	CAT 4.584
Oven Box (1)	-	JCT JCC P1 Cooler	-	Stack Thermocouple (2)	-
Oven Box (2)	-	ProtIR 304M	-	Stack Thermocouple (3)	-
Heated Probe (1)	CAT 5.85	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	-	Bernath 3006 FID	CAT 8.22	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.86	1m Heated Line (3)	-
S-Pitot (1)	CAT 21.P43	Mass Flow Controller (1)	CAT 6.52	5m Heated Line (1)	CAT 20.77
S-Pitot (2)	-	Mass Flow Controller (2)	-	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	-	20m Heated Line (1)	-
500g Check Weight	CAT 17.25	Mass View (2)	-	20m Heated Line (2)	-
1Kg Check Weight	CAT 17.25	Hioki 5043 (V)	CAT 11.91	Dual Channel Heater Controller	-
Last Impinger Arm	-	Easylogger EN-EL-12 Bit	-	Single Channel Heater Controller	-
Callipers	CAT 23.29	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.9

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
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	0.35
Stack Width, W	m	-
Stack Area, A	m ²	0.10
Average Stack Gas Temperature, T _a	°C	23.0
Average Stack Gas Pressure	Pa	44.4
Average Stack Static Pressure, P _{static}	kPa	0.044
Average Barometric Pressure, P _b	kPa	103.0
Average Pitot Tube Calibration Coefficient, C _p	-	0.84

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)	-	20.80	20.76	0.2080	32.00	1.4277	0.29696
N ₂	-	79.14	78.98	0.7914	28.01	1.2498	0.98913
Moisture (H ₂ O)	-	-	0.20	0.0020	18.02	0.8037	0.00157

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	1.286
Dry Density (Actual), P _{Actual}	kg/m ³	1.208
Average Wet Density (Actual), P _{ActualW}	kg/m ³	0.603

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} x (T_s / P_s) x (P_a / T_a)

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	23.0	0.0
Total Pressure	kPa	103.0	101.3
Moisture	%	0.20	0.20

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	2305
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	2162
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	2158
Gas Volumetric Flowrate REF ¹	m ³ /hr	2162

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	30/09/2015
Time of Survey	-	13:23 - 13:37
Atmospheric Pressure	kPa	103.0
Average Stack Static Pressure	Pa	44
Result of Pitot Stagnation Test	-	NOT REQUIRED
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with KIMO MP 210 (500Pa)	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C_p	-	0.84
Number of Lines Available	-	1
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)		44.0				
Mean		44.4	23.0	1.207	6.65	
1	0.01	13.0	23.0	1.207	3.89	42.0
2	0.04	4.0	23.0	1.207	2.16	59.0
3	0.07	14.0	23.0	1.207	4.04	80.0
4	0.11	39.0	23.0	1.207	6.74	6.0
5	0.24	61.0	23.0	1.207	8.43	60.0
6	0.28	76.0	23.0	1.207	9.41	71.0
7	0.31	70.0	23.0	1.207	9.03	62.0
8	0.34	78.0	23.0	1.207	9.53	44.0

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	$u(\Delta p_i)$	1.156	Pa
- Resolution	$u(res)$	0.00087	
- Calibration	$u(cal)$	0.205	
- Drift	$u(drift)$	0.083	
- Lack of Fit	$u(fit)$	0.046	
- Overall corrections to dynamic measurements	$u(C_f)$	0.336	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00003	-
- $\phi O_2, w$	-	20.759	
- $\phi CO_2, w$	-	0.060	
- Oxygen, dry	$u(\phi O_2, d)$	0.637	
- Carbon Dioxide, dry	$u(\phi CO_2, d)$	0.002	
- Water Vapour	$u(\phi H_2O)$	0.010	
- Oxygen, wet	$u(\phi O_2, w)$	0.635	
- Carbon Dioxide, wet	$u(\phi CO_2, w)$	0.002	
Standard uncertainty associated with the stack temperature	$u(T_c)$	1.510	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.696	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	1.156	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00649	-
Standard uncertainty associated with the local velocities	$u(v_i)$	0.179	Pa
Standard uncertainty associated with the mean velocity	$u(v)$	0.112	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	0.220	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	3.31	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV, w)$	129.3	m ³ /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV, w)/q^2V, w$	-	0.00082	
- $u^2(qV, w)$	-	4351	
- $u(qV, w)$	-	66.0	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV, w)$	5.61	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 8C

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.56		0.56
Uncertainty	±mg/m ³	1.1		1.1
Mass Emission	g/hr	1.2		1.2
Uncertainty	±g/hr	2.3		2.3

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	0.20		0.20
Uncertainty	±% v/v	0.02		0.02

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.39		0.39

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	1 / 8	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A5	

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	772.5	
Stack static pressure, P_{static}	mmH ₂ O	4.5	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	772.8	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	-8.7	
Total mass collected in impingers (silica trap)	g	9.9	
Total mass of liquid collected, V_{lc}	g	1.2	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0015	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	0.8310	
Gas meter correction factor, Y_d	-	0.9940	
Average dry gas meter temperature, T_m	°C	29.1	
Average pressure drop across orifice, ΔH	mmH ₂ O	40.5	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	0.7616	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0020	
B_{wo} as a percentage	% v/v	0.20	
Reported Water Vapour, checked with Tables in EN 14790, R_{wv}	% v/v	0.20	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	0.7631	
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	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	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	28.82	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.82	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	2.50	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	1.58	
Average stack gas temperature, T_s	°C	23.0	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	5.25	
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	0.10	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	30.3	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	28.4	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	28.3	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	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	8.88	
Nozzle area, A_n	mm ²	61.89	
Total sampling time, q	min	40	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	104.4	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	13:38 - 14:18	
Sampling Dates	-	30/09/2015	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	0.7631	
Filter I.D. Number	-	47-26886	
Start Filter Mass	g	0.13807	
End Filter Mass	g	0.13837	
Total Mass on Filter	g	0.00030	
Probe Rinse I.D. Number	-	PR-47-26886	
Start Probe Rinse Mass	g	3.09115	
End Probe Rinse Mass	g	3.09128	
Total Mass in Probe Rinse	g	0.00013	
Total Mass Collected	mg	0.43	
Calculated Concentration	mg/m ³	0.56	
Balance Uncertainty / LOD	mg/m ³	0.17	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	30/09/2015	
Average Volume Sampled (REF)	m ³	0.7631	
Filter I.D. Number	-	47-26848	
Start Filter Mass	g	0.13836	
End Filter Mass	g	0.13866	
Total Mass on Filter	g	0.00030	
Probe Rinse I.D. Number	-	PR-47-26848	
Start Probe Rinse Mass	g	2.94342	
End Probe Rinse Mass	g	2.94342	
Total Mass in Probe Rinse	g	0.00000	
Total Mass Collected	mg	0.30	
Calculated Concentration	mg/m ³	0.39	
Balance Uncertainty / LOD	mg/m ³	0.17	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	20.65	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.20	
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)	%	11.1	
Allowable MU	%	20	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	104.4	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.32	
ELV [Daily ELV for IED]	mg/m ³	10.00	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	23	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Pre-Sampling Leak Rate	l/min	0.20	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
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	
The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl points after this increase were omitted.	x	
Ratio highest to lowest velocities between 3 and 5 : 1.	x	
Only one sampling line was installed on the stack, however the number of sample points used on the available line were increased to meet the requirements of 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	0.8310		uV _m	m ³	0.0166	
Sampled Gas Temperature	T _m	302.1		uT _m	K	2.0	
Sampled Gas Pressure	p _m	103.1		up _m	kPa	0.5	
Sampled Gas Humidity	H _m	0.0		uH _m	% v/v	1.0	
Leak	L	0.97		uL	%	-	
Mass of Particulate	m	0.43		um	mg	0.13	
Uncollected Mass	UCM	0.30		uUCM	mg	-	

Uncertainty as a Percentage				Requirement of Standard
Measured Quantities	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.66		≤1%
Sampled Gas Pressure	%	0.49		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	0.97		≤2%
Mass of Particulate	%	1.70		<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	0.7616	0.73	
Leak	L	mg/m ³	0.003	1.00	
Mass of Particulate	L _r	mg	0.427	1.31	
Uncollected Mass	UCM	mg	0.17	1.31	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m ³	0.014	
Leak	mg/m ³	0.0031	
Mass of Particulate	mg/m ³	0.1704	
Uncollected Mass	mg/m ³	0.2245	

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	0.28	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m ³	0.55	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m ³	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m ³	1.08	
Reported Uncertainty	mg/m ³	1.08	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	98.9	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	192.9	
Reported Uncertainty	%	192.9	

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 8C

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.44		0.44
Uncertainty	±mg/m ³	0.47		0.47
Mass Emission	g/hr	0.95		0.95
Uncertainty	±g/hr	1.0		1.0

General Sampling Information

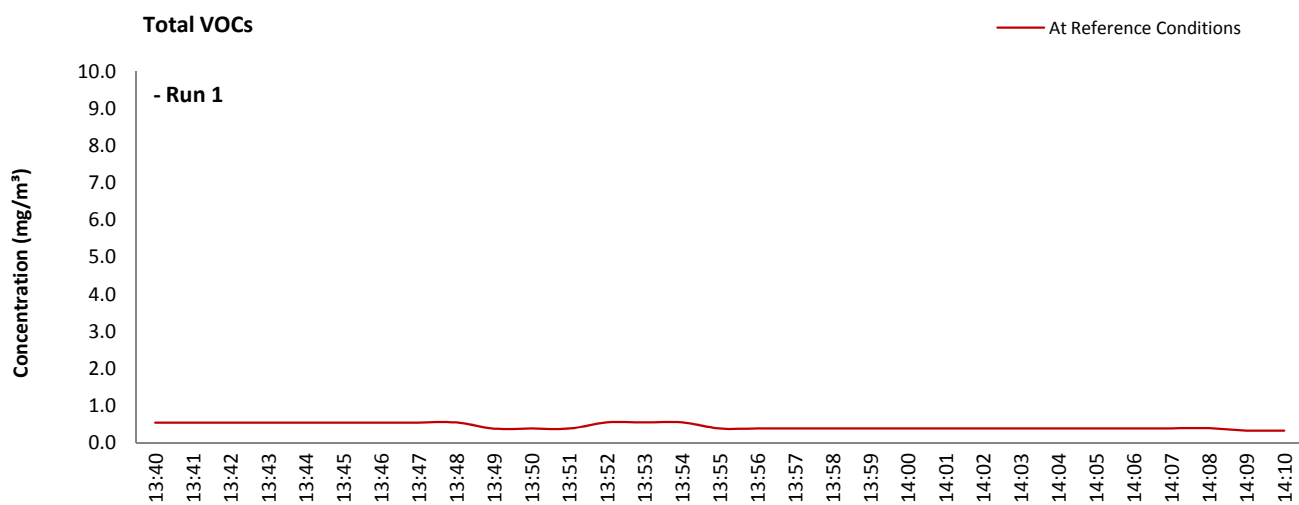
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180	
Span Gas Type	Propane In Synthetic Air (5 Grade)	
Span Gas Reference Number	1.072a	
Span Gas Expiry Date	26/06/2020	
Span Gas Start Pressure (bar)	130	
Gas Cylinder Concentration (ppm)	80.2	
Span Gas Set Point (ppm)	80.20	
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	-	13:40 - 14:10	
Sampling Dates	-	30/09/2015	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.2	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.30	
	Zero Down Sampling Line (Post)	ppm	0.20	
	Zero Drift	ppm	-0.10	
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	4.01	
	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	78.90	
	Span Drift	ppm	-0.10	
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	4.01	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	23.5 - 24	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	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	-		mg/m ³ (REF)
TGN M2 Allowable MU	15.0		%
Measured concentration	0.44		mg/m ³ (STP, dry)
Range Used	100.0		ppm
Range Used [A]	160.6		mg/m ³
Cal gas conc.	80.2		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.	128.8		mg/m ³

Performance characteristics	RUN 1		Units
Response time	45		seconds
Number of readings in measurement	30		-
Repeatability at zero	2.00		% full scale
Repeatability at span level	0.00		% full scale
Deviation from linearity	0.22		% of value
Zero drift	-0.13		% full scale
Span drift	-0.13		% 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)	1.50		% 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	0.019		mg/m ³
Drift	-0.094		mg/m ³
Volume or pressure flow dependence	0.0014		mg/m ³
Atmospheric pressure dependence	0.013		mg/m ³
Ambient temperature dependence	0.20		mg/m ³
Combined interference (from MCERTS Certificate)	0.039		mg/m ³
Dependence on voltage	0.058		mg/m ³
Losses in the line (leak)	0.0038		mg/m ³
Uncertainty of calibration gas	0.0051		mg/m ³

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		0.44	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	106.57	% of Value
Expanded uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Overall Allowable uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Result of Compliance with Uncertainty Requirement in M2	N/A	-

	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 in M2	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). Ref EA TGN M2.



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Stack Emissions Testing Report Commissioned by
VIP Polymers Ltd

Installation Name & Address
VIP Polymers Ltd
15 Windover Road
Huntingdon
Cambridgeshire
PE29 7EB

LAPPC Permit: B11/94

Stack Reference
Stack 15

Dates of the Monitoring Campaign
1st October 2015

Job Reference Number
CSW-1977

Report Written by
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Report Date
15th October 2015

Version
Version 1

Signature of Report Approver


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APPENDIX 1 - Monitoring Personnel & List of Equipment

APPENDIX 2 - Raw Data, Sampling Equations & Charts

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Executive Summary

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MONITORING OBJECTIVES

VIP Polymers Ltd, Huntingdon

Stack 15

1st October 2015

Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by VIP Polymers Ltd to carry out stack emissions testing on the Stack 15 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, Total VOCs (as Carbon)

Executive Summary

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MONITORING RESULTS

VIP Polymers Ltd, Huntingdon

Stack 15

1st October 2015

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	0.57	0.76	10	g/hr	2.2	2.9	-
Total VOCs (as Carbon)	¹ mg/m ³	2.0	0.46	-	g/hr	7.8	1.8	-
Water Vapour	% v/v	0.017	0.020					
Stack Gas Temperature	°C	23.0						
Stack Gas Velocity	m/s	11.7	0.36					
Volumetric Flow Rate (ACTUAL)	m ³ /hr	4067	222					
Volumetric Flow Rate (REF)	¹ m ³ /hr	3811	208					

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

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

Executive Summary

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MONITORING DATE(S) & TIMES

VIP Polymers Ltd, Huntingdon

Stack 15

1st October 2015

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	0.57	g/hr	2.2	01/10/2015	13:02 - 13:42	40
Total VOCs (as Carbon)	R1	mg/m³	2.0	g/hr	7.8	01/10/2015	13:10 - 13:40	30
Velocity & Volumetric Flow Rate	R1					01/10/2015	12:23 - 12:32	

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

VIP Polymers Ltd, Huntingdon

Stack 15

1st October 2015

Standard Operating Conditions

Parameter	Value
Process Status	Normal production
Capacity (of 100%) and Tonnes / Hour	N/A
Continuous or Batch Process	Continuous
Feedstock (if applicable)	Rubber
Abatement System	None
Abatement System Running Status	N/A
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

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MONITORING & ANALYTICAL METHODS

VIP Polymers Ltd, Huntingdon

Stack 15

1st October 2015

Parameter	Monitoring				Analysis				MCERTS Testing	LOD (Average)
	Standard	Technical Procedure	ISO 17025 Testing	Testing Lab	Analytical Procedure	Analytical Technique	ISO 17025 Analysis	Analysis Lab		
Total Particulate Matter	EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.18 mg/m ³
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.1 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.32 mg/m ³
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	Yes	CAT	Pitot Tube and Thermocouple				Yes	1.2 m/s

ANALYSIS LABORATORIES

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

Exova Catalyst (CAT)	ISO 17025 Accreditation Number: 4279
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SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter	1	Only one sampling line was installed on the stack, however the number of sample points used on the available line were increased to meet the requirements of the Standard.
Total Particulate Matter	1	The measurement uncertainty for water vapour was greater than 20%. This was due to the low level of water vapour which was found to be present in the stack.

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.35
Width	m	-
Area	m ²	0.10
Port Depth	cm	4
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

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

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

All platforms should be designed in accordance with the requirements in EPA Guidance Note AG1 and EN 15259.

EN 15259 Homogeneity Test Requirements

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

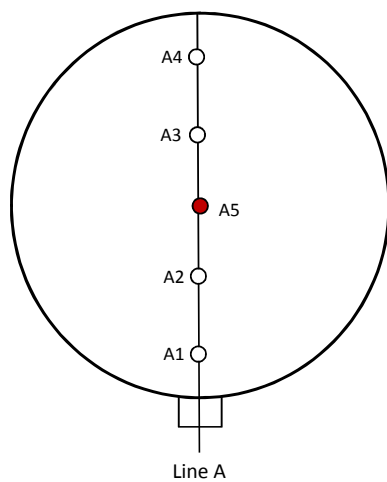
Sampling Plane Validation Criteria (from EN 15259)

Criteria in EN 15259	Units	Traverse 1		Required	Compliant
Lowest Differential Pressure	Pa	111.0		> 5 Pa	Yes
Mean Velocity	m/s	11.74		-	-
Lowest Gas Velocity	m/s	11.37		-	-
Highest Gas Velocity	m/s	12.54		-	-
Ratio of Above	: 1	1.10		< 3 : 1	Yes
Maximum Angle of Swirl	°	10		< 15°	Yes
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

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SAMPLE POINTS



where ○ = isokinetic point sampled at

● = combustion gases sample point

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	Neil Teixeira	MCERTS Level 2	MM 05 583	TE1 TE2 TE3 TE4
Team Leader	Phil Soley	MCERTS Level 2	MM 12 1187	TE1 TE2 TE3 TE4

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 7.46	Horiba PG-250	-	Digital Manometer (1)	CAT 3.12
Control Box DGM (2)	-	Horiba PG-250 SRM	-	Digital Manometer (2)	-
Box Thermocouples (1)	CAT 3.22	Servomex 4900	-	Digital Temperature Meter	CAT 3.12
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.63
Umbilical (1)	CAT 3.22	ABB AO2020-URAS26	-	Barometer	CAT 13.37
Umbilical (2)	-	Servomex 5200MP	-	Stack Thermocouple (1)	CAT 4.584
Oven Box (1)	-	JCT JCC P1 Cooler	-	Stack Thermocouple (2)	-
Oven Box (2)	-	ProtIR 304M	-	Stack Thermocouple (3)	-
Heated Probe (1)	CAT 5.85	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	-	Bernath 3006 FID	CAT 8.22	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.86	1m Heated Line (3)	-
S-Pitot (1)	CAT 21.P43	Mass Flow Controller (1)	CAT 6.52	5m Heated Line (1)	CAT 20.77
S-Pitot (2)	-	Mass Flow Controller (2)	-	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	-	20m Heated Line (1)	-
500g Check Weight	CAT 17.25	Mass View (2)	-	20m Heated Line (2)	-
1Kg Check Weight	CAT 17.25	Hioki 5043 (V)	CAT 11.91	Dual Channel Heater Controller	-
Last Impinger Arm	-	Easylogger EN-EL-12 Bit	-	Single Channel Heater Controller	-
Callipers	CAT 23.29	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.9

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
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	0.35
Stack Width, W	m	-
Stack Area, A	m ²	0.10
Average Stack Gas Temperature, T _a	°C	23.0
Average Stack Gas Pressure	Pa	118.5
Average Stack Static Pressure, P _{static}	kPa	0.111
Average Barometric Pressure, P _b	kPa	102.8
Average Pitot Tube Calibration Coefficient, C _p	-	0.84

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)	-	20.80	20.80	0.2080	32.00	1.4277	0.29696
N ₂	-	79.14	79.13	0.7914	28.01	1.2498	0.98913
Moisture (H ₂ O)	-	-	0.02	0.0002	18.02	0.8037	0.00014

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	1.287
Dry Density (Actual), P _{Actual}	kg/m ³	1.206
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.206

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} x (T_s / P_s) x (P_a / T_a)

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	23.0	0.0
Total Pressure	kPa	102.9	101.3
Moisture	%	0.02	0.02

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	4067
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	3811
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	3810
Gas Volumetric Flowrate REF ¹	m ³ /hr	3811

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	01/10/2015
Time of Survey	-	12:23 - 12:32
Atmospheric Pressure	kPa	102.8
Average Stack Static Pressure	Pa	111
Result of Pitot Stagnation Test	-	NOT REQUIRED
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with KIMO MP 210 (500Pa)	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C_p	-	0.84
Number of Lines Available	-	1
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)		111.0				
Mean		118.5	23.0	1.206	11.74	
1	0.02	117.0	23.0	1.206	11.68	8.0
2	0.09	111.0	23.0	1.206	11.37	10.0
3	0.26	135.0	23.0	1.206	12.54	9.0
4	0.33	111.0	23.0	1.206	11.37	9.0

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	$u(\Delta p_i)$	2.223	Pa
- Resolution	$u(res)$	0.00087	
- Calibration	$u(cal)$	1.462	
- Drift	$u(drift)$	0.083	
- Lack of Fit	$u(fit)$	2.395	
- Overall corrections to dynamic measurements	$u(C_f)$	3.941	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00003	-
- $\phi O_2, w$	-	20.796	
- $\phi CO_2, w$	-	0.060	
- Oxygen, dry	$u(\phi O_2, d)$	0.637	
- Carbon Dioxide, dry	$u(\phi CO_2, d)$	0.002	
- Water Vapour	$u(\phi H_2O)$	0.001	
- Oxygen, wet	$u(\phi O_2, w)$	0.637	
- Carbon Dioxide, wet	$u(\phi CO_2, w)$	0.002	
Standard uncertainty associated with the stack temperature	$u(T_c)$	1.510	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.706	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	2.223	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00649	-
Standard uncertainty associated with the local velocities	$u(v_i)$	0.206	Pa
Standard uncertainty associated with the mean velocity	$u(v)$	0.183	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	0.358	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	3.05	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV, w)$	222.0	m ³ /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV, w)/q^2V, w$	-	0.00078	
- $u^2(qV, w)$	-	12826	
- $u(qV, w)$	-	113.3	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV, w)$	5.46	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 15

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.57		0.57
Uncertainty	±mg/m ³	0.76		0.76
Mass Emission	g/hr	2.2		2.2
Uncertainty	±g/hr	2.9		2.9

NOTE: Where the maximum Blank concentration is higher than the Sample concentration, the maximum Blank concentration has been reported.

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	0.017		0.017
Uncertainty	±% v/v	0.020		0.020

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.57		0.57

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	771.0	
Stack static pressure, P_{static}	mmH ₂ O	11.3	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	771.8	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	-4.4	
Total mass collected in impingers (silica trap)	g	4.5	
Total mass of liquid collected, V_{lc}	g	0.1	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0001	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	0.7860	
Gas meter correction factor, Y_d	-	0.9940	
Average dry gas meter temperature, T_m	°C	26.3	
Average pressure drop across orifice, ΔH	mmH ₂ O	37.8	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	0.7255	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0002	
B_{wo} as a percentage	% v/v	0.02	
Reported Water Vapour, checked with Tables in EN 14790, R_{wv}	% v/v	0.02	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	0.7256	
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	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	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	28.84	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.82	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	12.19	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	3.49	
Average stack gas temperature, T_s	°C	22.0	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	11.57	
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	0.10	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	66.8	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	62.8	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	62.7	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	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	5.88	
Nozzle area, A_n	mm ²	27.16	
Total sampling time, q	min	40	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	102.4	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	13:02 - 13:42	
Sampling Dates	-	01/10/2015	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	0.7256	
Filter I.D. Number	-	47-27440	
Start Filter Mass	g	0.13804	
End Filter Mass	g	0.13834	
Total Mass on Filter	g	0.00030	
Probe Rinse I.D. Number	-	PR-47-27440	
Start Probe Rinse Mass	g	3.17795	
End Probe Rinse Mass	g	3.17805	
Total Mass in Probe Rinse	g	0.00010	
Total Mass Collected	mg	0.40	
Calculated Concentration	mg/m ³	0.56	
Balance Uncertainty / LOD	mg/m ³	0.18	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	01/10/2015	
Average Volume Sampled (REF)	m ³	0.7256	
Filter I.D. Number	-	47-26559	
Start Filter Mass	g	0.14039	
End Filter Mass	g	0.14071	
Total Mass on Filter	g	0.00032	
Probe Rinse I.D. Number	-	PR-47-26559	
Start Probe Rinse Mass	g	3.06368	
End Probe Rinse Mass	g	3.06378	
Total Mass in Probe Rinse	g	0.00010	
Total Mass Collected	mg	0.42	
Calculated Concentration	mg/m ³	0.57	
Balance Uncertainty / LOD	mg/m ³	0.18	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	19.53	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.20	
Allowable Leak Rate	l/min	0.39	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	117.7	
Allowable MU	%	20	
MU Acceptable	%	No	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	102.4	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.33	
ELV [Daily ELV for IED]	mg/m ³	10.00	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	22	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Pre-Sampling Leak Rate	l/min	0.20	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
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	
Only one sampling line was installed on the stack, however the number of sample points used on the available line were increased to meet the requirements of the Standard.	x	
The measurement uncertainty for water vapour was greater than 20%. This was due to the low level of water vapour which was found to be present in the stack.	x	

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V _m	0.7860		uV _m	m ³	0.0157	
Sampled Gas Temperature	T _m	299.3		uT _m	K	2.0	
Sampled Gas Pressure	p _m	102.9		up _m	kPa	0.5	
Sampled Gas Humidity	H _m	0.0		uH _m	% v/v	1.0	
Leak	L	1.02		uL	%	-	
Mass of Particulate	m	0.40		um	mg	0.13	
Uncollected Mass	UCM	0.42		uUCM	mg	-	

Uncertainty as a Percentage				Requirement of Standard
Measured Quantities	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.67		≤1%
Sampled Gas Pressure	%	0.49		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	1.02		≤2%
Mass of Particulate	%	1.85		<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	0.7255	0.79	
Leak	L	mg/m ³	0.003	1.00	
Mass of Particulate	L _r	mg	0.403	1.42	
Uncollected Mass	UCM	mg	0.24	1.42	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m ³	0.015	
Leak	mg/m ³	0.0034	
Mass of Particulate	mg/m ³	0.1851	
Uncollected Mass	mg/m ³	0.3425	

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	0.39	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m ³	0.76	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m ³	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m ³	0.76	
Reported Uncertainty	mg/m ³	0.76	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	133.0	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	133.0	
Reported Uncertainty	%	133.0	

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 15

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	2.0		2.0
Uncertainty	±mg/m ³	0.46		0.46
Mass Emission	g/hr	7.8		7.8
Uncertainty	±g/hr	1.8		1.8

General Sampling Information

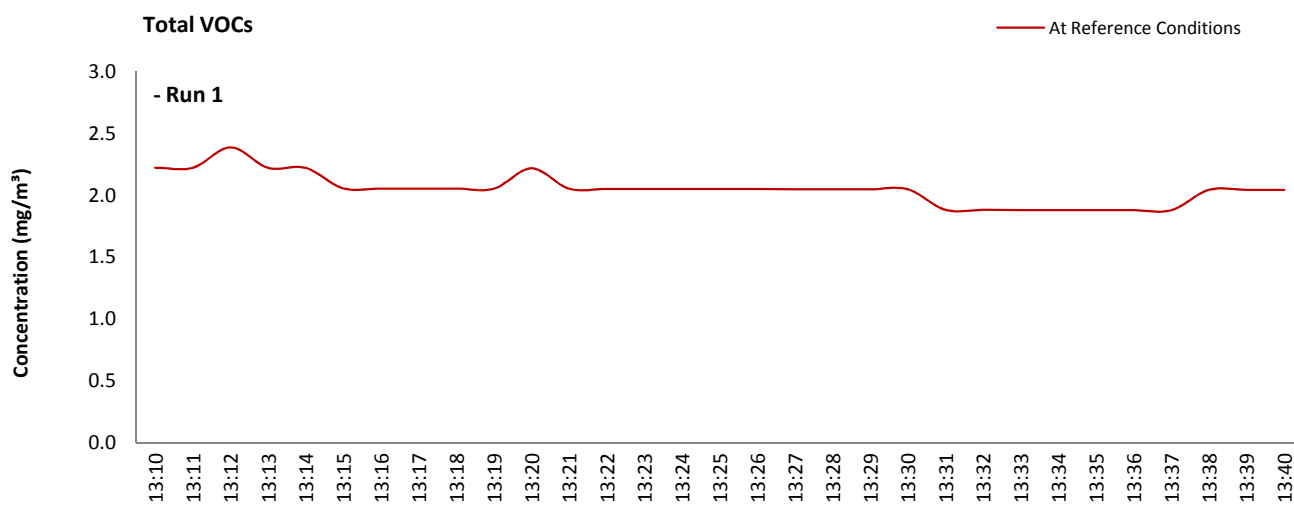
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180	
Span Gas Type	Propane In Synthetic Air (5 Grade)	
Span Gas Reference Number	1.072a	
Span Gas Expiry Date	26/06/2020	
Span Gas Start Pressure (bar)	130	
Gas Cylinder Concentration (ppm)	80.2	
Span Gas Set Point (ppm)	80.20	
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	A3	

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	-	13:10 - 13:40	
Sampling Dates	-	01/10/2015	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.2	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.20	
	Zero Down Sampling Line (Post)	ppm	0.30	
	Zero Drift	ppm	0.10	
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	4.01	
	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	77.80	
	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	4.01	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	28 - 28.5	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	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	-	mg/m ³ (REF)
TGN M2 Allowable MU	15.0	%
Measured concentration	2.05	mg/m ³ (STP, dry)
Range Used	100.0	ppm
Range Used [A]	160.6	mg/m ³
Cal gas conc.	80.2	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.	128.8	mg/m ³

Performance characteristics	RUN 1	Units
Response time	45	seconds
Number of readings in measurement	30	-
Repeatability at zero	2.00	% full scale
Repeatability at span level	0.00	% full scale
Deviation from linearity	0.22	% of value
Zero drift	0.13	% 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)	1.50	% 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	0.019	mg/m ³
Drift	0.076	mg/m ³
Volume or pressure flow dependence	0.0014	mg/m ³
Atmospheric pressure dependence	0.013	mg/m ³
Ambient temperature dependence	0.20	mg/m ³
Combined interference (from MCERTS Certificate)	0.039	mg/m ³
Dependence on voltage	0.058	mg/m ³
Losses in the line (leak)	0.018	mg/m ³
Uncertainty of calibration gas	0.024	mg/m ³

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		2.05	mg/m ³
Expanded uncertainty	k = 1.96	0.23	mg/m ³
Expanded uncertainty		0.46	mg/m ³
Uncertainty corrected to std conds. (O ₂)		0.46	mg/m ³ (REF)

	RUN 1	Units
Expanded uncertainty (no O ₂) - at 95% Confidence	22.32	% of Value
Expanded uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Overall Allowable uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Result of Compliance with Uncertainty Requirement in M2	N/A	-

	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 in M2	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). Ref EA TGN M2.



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Stack Emissions Testing Report Commissioned by
VIP Polymers Ltd

Installation Name & Address

VIP Polymers Ltd
15 Windover Road
Huntingdon
Cambridgeshire
PE29 7EB

LAPPC Permit: B11/94

Stack Reference

Stack 23

Dates of the Monitoring Campaign

30th September 2015

Job Reference Number

CSW-1977

Report Written by

Neil Teixeira
Team Leader
MCERTS Level 2
MM 05 583
TE1 TE2 TE3 TE4

Report Approved by

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MCERTS Level 2
MM 06 688
TE1 TE2 TE3 TE4

Report Date

15th October 2015

Version

Version 1

Signature of Report Approver



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TITLE PAGE

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APPENDIX 1 - Monitoring Personnel & List of Equipment

APPENDIX 2 - Raw Data, Sampling Equations & Charts

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Executive Summary

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MONITORING OBJECTIVES

VIP Polymers Ltd, Huntingdon

Stack 23

30th September 2015

Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by VIP Polymers Ltd to carry out stack emissions testing on the Stack 23 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, Total VOCs (as Carbon)

Executive Summary

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MONITORING RESULTS

VIP Polymers Ltd, Huntingdon

Stack 23

30th September 2015

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	0.47	1.2	10	g/hr	3.7	9.3	-
Total VOCs (as Carbon)	¹ mg/m ³	2.1	0.47	-	g/hr	16.8	3.8	-
Water Vapour	% v/v	0.58	0.03					
Stack Gas Temperature	°C	33.0						
Stack Gas Velocity	m/s	13.9	0.29					
Volumetric Flow Rate (ACTUAL)	m ³ /hr	8680	433					
Volumetric Flow Rate (REF)	¹ m ³ /hr	7878	393					

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

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

Executive Summary

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MONITORING DATE(S) & TIMES

VIP Polymers Ltd, Huntingdon

Stack 23

30th September 2015

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m ³	0.47	g/hr	3.74	30/09/2015	17:16 - 17:56	40
Total VOCs (as Carbon)	R1	mg/m ³	2.13	g/hr	16.79	30/09/2015	17:20 - 17:50	30
Velocity & Volumetric Flow Rate	R1					30/09/2015	16:30 - 16:46	

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

VIP Polymers Ltd, Huntingdon

Stack 23

30th September 2015

Standard Operating Conditions

Parameter	Value
Process Status	Normal production
Capacity (of 100%) and Tonnes / Hour	N/A
Continuous or Batch Process	Continuous
Feedstock (if applicable)	Rubber
Abatement System	None
Abatement System Running Status	N/A
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

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MONITORING & ANALYTICAL METHODS

VIP Polymers Ltd, Huntingdon

Stack 23

30th September 2015

Parameter	Monitoring				Analysis				MCERTS Testing	LOD (Average)
	Standard	Technical Procedure	ISO 17025 Testing	Testing Lab	Analytical Procedure	Analytical Technique	ISO 17025 Analysis	Analysis Lab		
Total Particulate Matter	EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.14 mg/m ³
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.1 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.32 mg/m ³
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	Yes	CAT	Pitot Tube and Thermocouple				Yes	1.2 m/s

ANALYSIS LABORATORIES

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

Exova Catalyst (CAT)	ISO 17025 Accreditation Number: 4279
----------------------	--------------------------------------

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter	1	The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl points after this increase were omitted..
		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 meet the requirements of the Standard.
		The sample points where negative flow was measured during the preliminary traverse were omitted from the sampling exercise.

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.47
Width	m	-
Area	m ²	0.17
Port Depth	cm	9
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

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

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

All platforms should be designed in accordance with the requirements in EPA Guidance Note AG1 and EN 15259.

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	-9.0		> 5 Pa	No
Mean Velocity	m/s	13.90		-	-
Lowest Gas Velocity	m/s	5.38		-	-
Highest Gas Velocity	m/s	18.18		-	-
Ratio of Above	: 1	3.38		< 3 : 1	No
Maximum Angle of Swirl	°	87		< 15°	No
No Local Negative Flow	-	No		-	No

Executive Summary

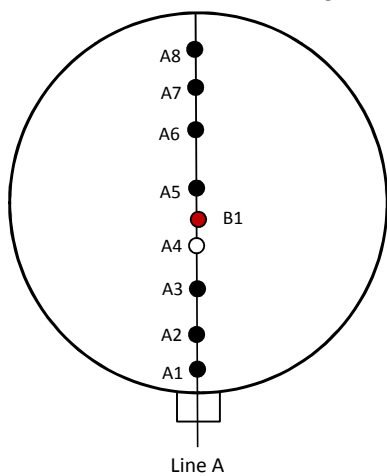
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PLANT PHOTOS

Photo 1



SAMPLE POINTS



where ○ = isokinetic point sampled at
● = isokinetic point not sampled at
● = combustion gases sample point

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	Neil Teixeira	MCERTS Level 2	MM 05 583	TE1 TE2 TE3 TE4
Team Leader	Phil Soley	MCERTS Level 2	MM 12 1187	TE1 TE2 TE3 TE4

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 7.46	Horiba PG-250	-	Digital Manometer (1)	CAT 3.12
Control Box DGM (2)	-	Horiba PG-250 SRM	-	Digital Manometer (2)	-
Box Thermocouples (1)	CAT 3.22	Servomex 4900	-	Digital Temperature Meter	CAT 3.12
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.63
Umbilical (1)	CAT 3.22	ABB AO2020-URAS26	-	Barometer	CAT 13.37
Umbilical (2)	-	Servomex 5200MP	-	Stack Thermocouple (1)	CAT 4.584
Oven Box (1)	-	JCT JCC P1 Cooler	-	Stack Thermocouple (2)	-
Oven Box (2)	-	ProtIR 304M	-	Stack Thermocouple (3)	-
Heated Probe (1)	CAT 5.85	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	-	Bernath 3006 FID	CAT 8.22	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.86	1m Heated Line (3)	-
S-Pitot (1)	CAT 21.P43	Mass Flow Controller (1)	CAT 6.52	5m Heated Line (1)	CAT 20.77
S-Pitot (2)	-	Mass Flow Controller (2)	-	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	-	20m Heated Line (1)	-
500g Check Weight	CAT 17.25	Mass View (2)	-	20m Heated Line (2)	-
1Kg Check Weight	CAT 17.25	Hioki 5043 (V)	CAT 11.91	Dual Channel Heater Controller	-
Last Impinger Arm	-	Easylogger EN-EL-12 Bit	-	Single Channel Heater Controller	-
Callipers	CAT 23.29	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.9

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
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	0.47
Stack Width, W	m	-
Stack Area, A	m ²	0.17
Average Stack Gas Temperature, T _a	°C	33.0
Average Stack Gas Pressure	Pa	153.3
Average Stack Static Pressure, P _{static}	kPa	0.052
Average Barometric Pressure, P _b	kPa	103.0
Average Pitot Tube Calibration Coefficient, C _p	-	0.84

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)	-	20.80	20.68	0.2080	32.00	1.4277	0.29696
N ₂	-	79.14	78.68	0.7914	28.01	1.2498	0.98913
Moisture (H ₂ O)	-	-	0.58	0.0058	18.02	0.8037	0.00468

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	1.284
Dry Density (Actual), P _{Actual}	kg/m ³	1.168
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.166

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} x (T_s / P_s) x (P_a / T_a)

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	33.0	0.0
Total Pressure	kPa	103.1	101.3
Moisture	%	0.58	0.58

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	8680
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	7878
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	7832
Gas Volumetric Flowrate REF ¹	m ³ /hr	7878

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	30/09/2015
Time of Survey	-	16:30 - 16:46
Atmospheric Pressure	kPa	103.0
Average Stack Static Pressure	Pa	52
Result of Pitot Stagnation Test	-	NOT REQUIRED
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with KIMO MP 210 (500Pa)	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C_p	-	0.84
Number of Lines Available	-	1
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)		52.0				
Mean		153.3	33.0	1.166	13.90	
1	0.02	68.0	33.0	1.166	9.05	65.0
2	0.05	24.0	33.0	1.166	5.38	43.0
3	0.09	-9.0	33.0	1.166	NEG	87.0
4	0.15	196.0	33.0	1.166	15.37	11.0
5	0.32	197.0	33.0	1.166	15.41	16.0
6	0.38	274.0	33.0	1.166	18.18	54.0
7	0.42	236.0	33.0	1.166	16.87	59.0
8	0.45	240.0	33.0	1.166	17.01	68.0

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	$u(\Delta p_i)$	3.047	Pa
- Resolution	$u(res)$	0.00087	
- Calibration	$u(cal)$	2.445	
- Drift	$u(drift)$	0.083	
- Lack of Fit	$u(fit)$	5.757	
- Overall corrections to dynamic measurements	$u(C_f)$	8.286	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00003	-
- $\phi_{O_2,w}$	-	20.679	
- $\phi_{CO_2,w}$	-	0.060	
- Oxygen, dry	$u(\phi_{O_2,d})$	0.637	
- Carbon Dioxide, dry	$u(\phi_{CO_2,d})$	0.002	
- Water Vapour	$u(\phi_{H_2O})$	0.030	
- Oxygen, wet	$u(\phi_{O_2,w})$	0.633	
- Carbon Dioxide, wet	$u(\phi_{CO_2,w})$	0.002	
Standard uncertainty associated with the stack temperature	$u(T_c)$	1.561	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.718	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	3.047	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00627	-
Standard uncertainty associated with the local velocities	$u(v_i)$	0.207	Pa
Standard uncertainty associated with the mean velocity	$u(v)$	0.149	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	0.293	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	2.11	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV,w)$	433.4	m ³ /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00065	
- $u^2(qV,w)$	-	48887	
- $u(qV,w)$	-	221.1	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV,w)$	4.99	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 23

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.47		0.47
Uncertainty	±mg/m ³	1.19		1.19
Mass Emission	g/hr	3.7		3.7
Uncertainty	±g/hr	9.3		9.3

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	0.58		0.58
Uncertainty	±% v/v	0.03		0.03

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.40		0.40

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	1 / 8	FORMAT: Number Used / Number Required
Sample Point I.D.'s	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	772.5	
Stack static pressure, P _{static}	mmH ₂ O	5.3	
P _s = (P _b + (P _{static} / 13.6))	mmHg	772.9	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	1.5	
Total mass collected in impingers (silica trap)	g	3.0	
Total mass of liquid collected, V _{lc}	g	4.5	
V _{wstd} = (0.001246)(V _{lc})	m ³	0.0056	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V _m	m ³	1.0290	
Gas meter correction factor, Y _d	-	0.9940	
Average dry gas meter temperature, T _m	°C	25.4	
Average pressure drop across orifice, ΔH	mmH ₂ O	59.1	
V _{mstd} = ((0.3592)(V _m)(P _b + (ΔH/13.6))(Y _d)) / (T _m + 273)	m ³	0.9564	
Moisture content, B_{wv} & R_{wv}			
B _{wv} = V _{wstd} / (V _{mstd} + V _{wstd})	m ³	0.0058	
B _{wv} as a percentage	% v/v	0.58	
Reported Water Vapour, checked with Tables in EN 14790, R _{wv}	% v/v	0.58	
Volume of gas metered wet, V_{mstw}			
V _{mstw} = (V _{mstd})(100/(100 - R _{wv}))	m ³	0.9620	
Volume of gas metered at Oxygen Reference Conditions, V_{mstd@X%O₂} & V_{mstw@X%O₂}			
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	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
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	28.78	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K _p	-	34.97	
Velocity pressure coefficient, C _p	-	0.82	
Average of velocity heads, ΔP _{avg}	mmH ₂ O	19.28	
Average square root of velocity heads, √ΔP	√mmH ₂ O	4.39	
Average stack gas temperature, T _s	°C	33.0	
V _s = ((K _p)(C _p)(√ΔP)(√T _s + 273)) / (√(M _s)(P _s))	m/s	14.82	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO₂}), Dry@O_{2REF} (Q_{stdO₂})			
Area of stack, A _s	m ²	0.17	
Q _a = (60)(A _s)(V _s)	m ³ /min	154.3	
Conversion factor (K/mm.Hg), C _f	-	0.3592	
Q _{stw} = ((Q _a)(P _s)(C _f)) / ((T _s + 273))	m ³ /min	140.0	
Q _{std} = ((Q _a)(P _s)(C _f)(1 - (R _{wv} /100))) / ((T _s + 273))	m ³ /min	139.2	
Q _{stwO₂} = ((Q _a)(P _s)(C _f)) / ((T _s + 273)) / (O _{2REFw})	m ³ /min	N/A	
Q _{stdO₂} = ((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	5.92	
Nozzle area, A _n	mm ²	27.56	
Total sampling time, q	min	40	
%I = (4.6398E ⁶)(T _s +273)(V _{mstd}) / (P _s)(V _s)(A _n)(q)(1 - (R _{wv} /100))	%	108.2	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	17:16 - 17:56	
Sampling Dates	-	30/09/2015	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	0.9620	
Filter I.D. Number	-	47-27449	
Start Filter Mass	g	0.13907	
End Filter Mass	g	0.13946	
Total Mass on Filter	g	0.00039	
Probe Rinse I.D. Number	-	PR-47-27449	
Start Probe Rinse Mass	g	2.92793	
End Probe Rinse Mass	g	2.92800	
Total Mass in Probe Rinse	g	0.00007	
Total Mass Collected	mg	0.46	
Calculated Concentration	mg/m ³	0.47	
Balance Uncertainty / LOD	mg/m ³	0.14	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	30/09/2015	
Average Volume Sampled (REF)	m ³	0.9620	
Filter I.D. Number	-	47-27141	
Start Filter Mass	g	0.13968	
End Filter Mass	g	0.14003	
Total Mass on Filter	g	0.00035	
Probe Rinse I.D. Number	-	PR-47-27141	
Start Probe Rinse Mass	g	3.13543	
End Probe Rinse Mass	g	3.13547	
Total Mass in Probe Rinse	g	0.00004	
Total Mass Collected	mg	0.39	
Calculated Concentration	mg/m ³	0.40	
Balance Uncertainty / LOD	mg/m ³	0.14	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	25.57	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.20	
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)	%	5.7	
Allowable MU	%	20	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	108.2	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.25	
ELV [Daily ELV for IED]	mg/m ³	10.00	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	33	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
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	
The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl points after this increase were omitted.	x	
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 meet the requirements of the Standard.	x	
The sample points where negative flow was measured during the preliminary traverse were omitted from the sampling exercise.	x	

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V _m	1.0290		uV _m	m ³	0.0206	
Sampled Gas Temperature	T _m	298.4		uT _m	K	2.0	
Sampled Gas Pressure	p _m	103.1		up _m	kPa	0.5	
Sampled Gas Humidity	H _m	0.0		uH _m	% v/v	1.0	
Leak	L	0.78		uL	%	-	
Mass of Particulate	m	0.46		um	mg	0.13	
Uncollected Mass	UCM	0.39		uUCM	mg	-	

Uncertainty as a Percentage				Requirement of Standard
Measured Quantities	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.67		≤1%
Sampled Gas Pressure	%	0.49		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	0.78		≤2%
Mass of Particulate	%	1.35		<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	0.9564	0.50	
Leak	L	mg/m ³	0.002	1.00	
Mass of Particulate	L _r	mg	0.457	1.04	
Uncollected Mass	UCM	mg	0.22	1.04	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m ³	0.012	
Leak	mg/m ³	0.0021	
Mass of Particulate	mg/m ³	0.1351	
Uncollected Mass	mg/m ³	0.2321	

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	0.27	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m ³	0.53	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m ³	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m ³	1.19	
Reported Uncertainty	mg/m ³	1.19	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	111.0	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	249.7	
Reported Uncertainty	%	249.7	

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 23

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	2.1		2.1
Uncertainty	±mg/m ³	0.47		0.47
Mass Emission	g/hr	16.8		16.8
Uncertainty	±g/hr	3.8		3.8

General Sampling Information

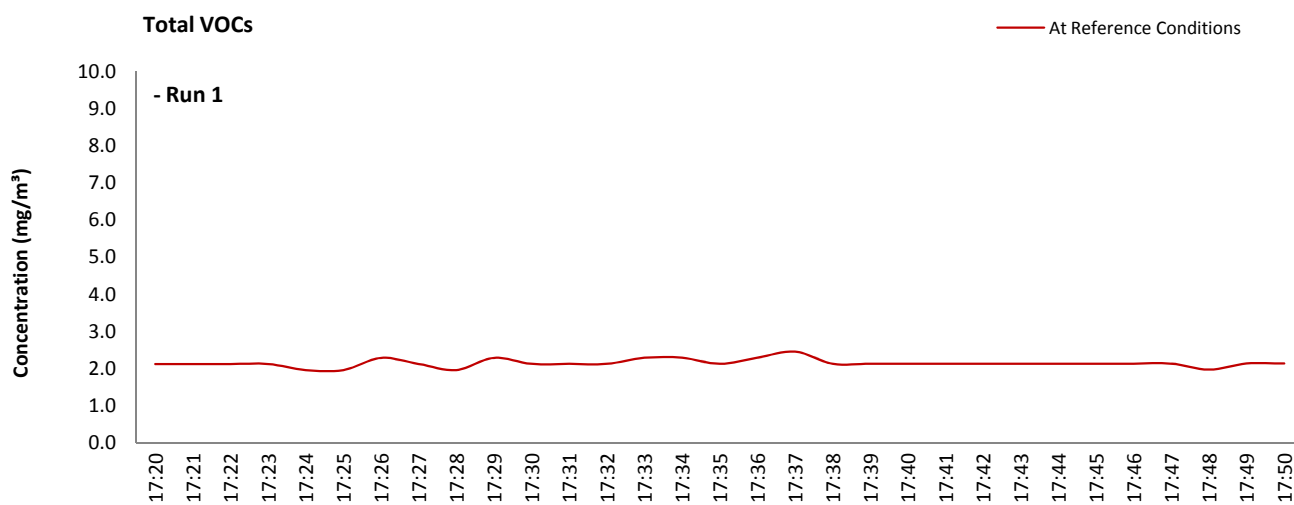
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180	
Span Gas Type	Propane In Synthetic Air (5 Grade)	
Span Gas Reference Number	1.072a	
Span Gas Expiry Date	26/06/2020	
Span Gas Start Pressure (bar)	130	
Gas Cylinder Concentration (ppm)	80.2	
Span Gas Set Point (ppm)	80.20	
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	-	17:20 - 17:50	
Sampling Dates	-	30/09/2015	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.2	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.30	
	Zero Down Sampling Line (Post)	ppm	0.20	
	Zero Drift	ppm	-0.10	
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	4.01	
	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	78.90	
	Span Drift	ppm	-0.10	
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	4.01	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	22.5 - 20.5	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	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	-	mg/m ³ (REF)
TGN M2 Allowable MU	15.0	%
Measured concentration	2.14	mg/m ³ (STP, dry)
Range Used	100.0	ppm
Range Used [A]	160.6	mg/m ³
Cal gas conc.	80.2	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.	128.8	mg/m ³

Performance characteristics	RUN 1	Units
Response time	45	seconds
Number of readings in measurement	30	-
Repeatability at zero	2.00	% full scale
Repeatability at span level	0.00	% full scale
Deviation from linearity	0.22	% of value
Zero drift	-0.13	% full scale
Span drift	-0.13	% 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)	1.50	% 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	0.019	mg/m ³
Drift	-0.096	mg/m ³
Volume or pressure flow dependence	0.0014	mg/m ³
Atmospheric pressure dependence	0.013	mg/m ³
Ambient temperature dependence	0.20	mg/m ³
Combined interference (from MCERTS Certificate)	0.039	mg/m ³
Dependence on voltage	0.058	mg/m ³
Losses in the line (leak)	0.019	mg/m ³
Uncertainty of calibration gas	0.025	mg/m ³

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		2.14	mg/m ³
Expanded uncertainty	k = 1.96	0.24	mg/m ³
Expanded uncertainty		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	21.99	% of Value
Expanded uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Overall Allowable uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Result of Compliance with Uncertainty Requirement in M2	N/A	-

	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 in M2	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). Ref EA TGN M2.



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Stack Emissions Testing Report Commissioned by
VIP Polymers Ltd

Installation Name & Address
VIP Polymers Ltd
15 Windover Road
Huntingdon
Cambridgeshire
PE29 7EB

LAPPC Permit: B11/94

Stack Reference
Stack 35D

Dates of the Monitoring Campaign
1st October 2015

Job Reference Number
CSW-1977

Report Written by
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Report Date
15th October 2015

Version
Version 1

Signature of Report Approver


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APPENDIX 1 - Monitoring Personnel & List of Equipment

APPENDIX 2 - Raw Data, Sampling Equations & Charts

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Executive Summary

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MONITORING OBJECTIVES

VIP Polymers Ltd, Huntingdon

Stack 35D

1st October 2015

Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by VIP Polymers Ltd to carry out stack emissions testing on the Stack 35D 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, Total VOCs (as Carbon)

Executive Summary

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MONITORING RESULTS

VIP Polymers Ltd, Huntingdon

Stack 35D

1st October 2015

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	0.67	0.86	10	g/hr	6.5	8.4	-
Total VOCs (as Carbon)	¹ mg/m ³	5.2	0.46	-	g/hr	50.6	5.1	-
Water Vapour	% v/v	0.72	0.04					
Stack Gas Temperature	°C	44.0						
Stack Gas Velocity	m/s	8.0	0.15					
Volumetric Flow Rate (ACTUAL)	m ³ /hr	11153	544					
Volumetric Flow Rate (REF)	¹ m ³ /hr	9755	476					

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

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

Executive Summary

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MONITORING DATE(S) & TIMES

VIP Polymers Ltd, Huntingdon

Stack 35D

1st October 2015

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m ³	0.67	g/hr	6.5	01/10/2015	10:40 - 11:20	40
Total VOCs (as Carbon)	R1	mg/m ³	5.2	g/hr	50.6	01/10/2015	10:50 - 11:20	30
Velocity & Volumetric Flow Rate	R1					01/10/2015	09:30 - 09:38	

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

VIP Polymers Ltd, Huntingdon

Stack 35D

1st October 2015

Standard Operating Conditions

Parameter	Value
Process Status	Normal production
Capacity (of 100%) and Tonnes / Hour	N/A
Continuous or Batch Process	Continuous
Feedstock (if applicable)	Rubber
Abatement System	None
Abatement System Running Status	N/A
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

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MONITORING & ANALYTICAL METHODS

VIP Polymers Ltd, Huntingdon

Stack 35D

1st October 2015

Parameter	Monitoring				Analysis				MCERTS Testing	LOD (Average)
	Standard	Technical Procedure	ISO 17025 Testing	Testing Lab	Analytical Procedure	Analytical Technique	ISO 17025 Analysis	Analysis Lab		
Total Particulate Matter	EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.12 mg/m ³
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.1 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.32 mg/m ³
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	Yes	CAT	Pitot Tube and Thermocouple				Yes	1.2 m/s

ANALYSIS LABORATORIES

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

Exova Catalyst (CAT)	ISO 17025 Accreditation Number: 4279
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SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter	1	The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl points after this increase were omitted.
		Ratio highest to lowest velocities between 3 and 5 : 1.

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.70
Width	m	-
Area	m ²	0.38
Port Depth	cm	5
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

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

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

All platforms should be designed in accordance with the requirements in EPA Guidance Note AG1 and EN 15259.

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	13.0		> 5 Pa	Yes
Mean Velocity	m/s	8.05		-	-
Lowest Gas Velocity	m/s	4.03		-	-
Highest Gas Velocity	m/s	12.41		-	-
Ratio of Above	: 1	3.08		< 3 : 1	No
Maximum Angle of Swirl	°	87		< 15°	No
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

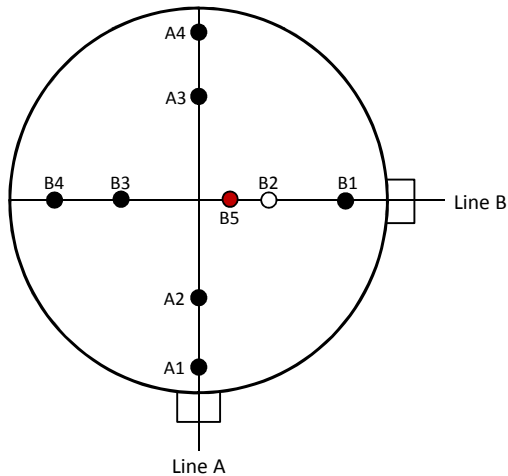
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PLANT PHOTOS

Photo 1



SAMPLE POINTS



where ○ = isokinetic point sampled at
● = isokinetic point not sampled at
● = combustion gases sample point

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	Neil Teixeira	MCERTS Level 2	MM 05 583	TE1 TE2 TE3 TE4
Team Leader	Phil Soley	MCERTS Level 2	MM 12 1187	TE1 TE2 TE3 TE4

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 7.46	Horiba PG-250	-	Digital Manometer (1)	CAT 3.12
Control Box DGM (2)	-	Horiba PG-250 SRM	-	Digital Manometer (2)	-
Box Thermocouples (1)	CAT 3.22	Servomex 4900	-	Digital Temperature Meter	CAT 3.12
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.63
Umbilical (1)	CAT 3.22	ABB AO2020-URAS26	-	Barometer	CAT 13.37
Umbilical (2)	-	Servomex 5200MP	-	Stack Thermocouple (1)	CAT 4.584
Oven Box (1)	-	JCT JCC P1 Cooler	-	Stack Thermocouple (2)	-
Oven Box (2)	-	ProtIR 304M	-	Stack Thermocouple (3)	-
Heated Probe (1)	CAT 5.85	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	-	Bernath 3006 FID	CAT 8.22	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.86	1m Heated Line (3)	-
S-Pitot (1)	CAT 21.P43	Mass Flow Controller (1)	CAT 6.52	5m Heated Line (1)	CAT 20.77
S-Pitot (2)	-	Mass Flow Controller (2)	-	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	-	20m Heated Line (1)	-
500g Check Weight	CAT 17.25	Mass View (2)	-	20m Heated Line (2)	-
1Kg Check Weight	CAT 17.25	Hioki 5043 (V)	CAT 11.91	Dual Channel Heater Controller	-
Last Impinger Arm	-	Easylogger EN-EL-12 Bit	-	Single Channel Heater Controller	-
Callipers	CAT 23.29	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.9

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
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	0.70
Stack Width, W	m	-
Stack Area, A	m ²	0.38
Average Stack Gas Temperature, T _a	°C	44.0
Average Stack Gas Pressure	Pa	58.1
Average Stack Static Pressure, P _{static}	kPa	0.079
Average Barometric Pressure, P _b	kPa	102.8
Average Pitot Tube Calibration Coefficient, C _p	-	0.84

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)	-	20.80	20.65	0.2080	32.00	1.4277	0.29696
N ₂	-	79.14	78.57	0.7914	28.01	1.2498	0.98913
Moisture (H ₂ O)	-	-	0.72	0.0072	18.02	0.8037	0.00577

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	1.284
Dry Density (Actual), P _{Actual}	kg/m ³	1.126
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.123

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} x (T_s / P_s) x (P_a / T_a)

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	44.0	0.0
Total Pressure	kPa	102.9	101.3
Moisture	%	0.72	0.72

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	11153
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	9755
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	9685
Gas Volumetric Flowrate REF ¹	m ³ /hr	9755

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	01/10/2015
Time of Survey	-	09:30 - 09:38
Atmospheric Pressure	kPa	102.8
Average Stack Static Pressure	Pa	79
Result of Pitot Stagnation Test	-	NOT REQUIRED
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with KIMO MP 210 (500Pa)	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C_p	-	0.84
Number of Lines Available	-	2
Number of Lines Used	-	2

Sampling Line A							Sampling Line B				
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s	Swirl °	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s	Swirl °
STATIC (Units: Pa)		79.0					79.0				
Mean		59.5	44.0	1.123	8.24		56.8	44.0	1.123	7.86	
1	0.05	40.0	44.0	1.123	7.08	67.0	31.0	44.0	1.123	6.23	87.0
2	0.18	24.0	44.0	1.123	5.48	86.0	13.0	44.0	1.123	4.03	13.0
3	0.53	51.0	44.0	1.123	7.99	65.0	65.0	44.0	1.123	9.02	21.0
4	0.65	123.0	44.0	1.123	12.41	78.0	118.0	44.0	1.123	12.15	76.0

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	$u(\Delta p_i)$	1.231	Pa
- Resolution	$u(res)$	0.00087	
- Calibration	$u(cal)$	0.352	
- Drift	$u(drift)$	0.083	
- Lack of Fit	$u(fit)$	0.080	
- Overall corrections to dynamic measurements	$u(C_f)$	0.516	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00003	-
- $\phi O_{2,w}$	-	20.651	
- $\phi CO_{2,w}$	-	0.060	
- Oxygen, dry	$u(\phi O_{2,d})$	0.637	
- Carbon Dioxide, dry	$u(\phi CO_{2,d})$	0.002	
- Water Vapour	$u(\phi H_2O)$	0.037	
- Oxygen, wet	$u(\phi O_{2,w})$	0.632	
- Carbon Dioxide, wet	$u(\phi CO_{2,w})$	0.002	
Standard uncertainty associated with the stack temperature	$u(T_c)$	1.617	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.694	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	0.871	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00604	-
Standard uncertainty associated with the local velocities	$u(v_i)$	0.131	Pa
Standard uncertainty associated with the mean velocity	$u(v)$	0.075	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	0.147	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	1.82	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV,w)$	544.2	m ³ /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00062	
- $u^2(qV,w)$	-	77087	
- $u(qV,w)$	-	277.6	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV,w)$	4.88	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 35D

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.67		0.67
Uncertainty	±mg/m ³	0.86		0.86
Mass Emission	g/hr	6.5		6.5
Uncertainty	±g/hr	8.4		8.4

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	0.72		0.72
Uncertainty	±% v/v	0.04		0.04

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.33		0.33

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	1 / 8	FORMAT: Number Used / Number Required
Sample Point I.D.'s	B2	

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	771.0	
Stack static pressure, P _{static}	mmH ₂ O	8.1	
P _s = (P _b + (P _{static} / 13.6))	mmHg	771.6	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	-4.2	
Total mass collected in impingers (silica trap)	g	10.4	
Total mass of liquid collected, V _{lc}	g	6.2	
V _{wstd} = (0.001246)(V _{lc})	m ³	0.0077	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V _m	m ³	1.1390	
Gas meter correction factor, Y _d	-	0.9940	
Average dry gas meter temperature, T _m	°C	22.6	
Average pressure drop across orifice, ΔH	mmH ₂ O	82.6	
V _{mstd} = ((0.3592)(V _m)(P _b + (ΔH/13.6))(Y _d) / (T _m + 273))	m ³	1.0692	
Moisture content, B_{wv} & R_{wv}			
B _{wv} = V _{wstd} / (V _{mstd} + V _{wstd})	m ³	0.0072	
B _{wv} as a percentage	% v/v	0.72	
Reported Water Vapour, checked with Tables in EN 14790, R _{wv}	% v/v	0.72	
Volume of gas metered wet, V_{mstw}			
V _{mstw} = (V _{mstd})(100/(100 - R _{wv}))	m ³	1.0769	
Volume of gas metered at Oxygen Reference Conditions, V_{mstd@X%O₂} & V_{mstw@X%O₂}			
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	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
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	28.76	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K _p	-	34.97	
Velocity pressure coefficient, C _p	-	0.82	
Average of velocity heads, ΔP _{avg}	mmH ₂ O	5.50	
Average square root of velocity heads, √ΔP	√mmH ₂ O	2.35	
Average stack gas temperature, T _s	°C	44.0	
V _s = ((K _p)(C _p)(√ΔP)(√T _s + 273)) / (√(M _s)(P _s))	m/s	8.07	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO₂}), Dry@O_{2REF} (Q_{stdO₂})			
Area of stack, A _s	m ²	0.38	
Q _a = (60)(A _s)(V _s)	m ³ /min	186.3	
Conversion factor (K/mm.Hg), C _f	-	0.3592	
Q _{stw} = ((Q _a)(P _s)(C _f)) / ((T _s + 273))	m ³ /min	162.9	
Q _{std} = ((Q _a)(P _s)(C _f)(1 - (R _{wv} /100))) / ((T _s + 273))	m ³ /min	161.7	
Q _{stwO₂} = ((Q _a)(P _s)(C _f)) / ((T _s + 273)) / (O _{2REFw})	m ³ /min	N/A	
Q _{stdO₂} = ((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	8.91	
Nozzle area, A _n	mm ²	62.36	
Total sampling time, q	min	40	
%I = (4.6398E ⁶)(T _s +273)(V _{mstd}) / (P _s)(V _s)(A _n)(q)(1 - (R _{wv} /100))	%	102.0	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	10:40 - 11:20	
Sampling Dates	-	01/10/2015	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	1.0769	
Filter I.D. Number	-	47-27479	
Start Filter Mass	g	0.13952	
End Filter Mass	g	0.14018	
Total Mass on Filter	g	0.00066	
Probe Rinse I.D. Number	-	PR-47-27479	
Start Probe Rinse Mass	g	2.92809	
End Probe Rinse Mass	g	2.92815	
Total Mass in Probe Rinse	g	0.00006	
Total Mass Collected	mg	0.72	
Calculated Concentration	mg/m ³	0.67	
Balance Uncertainty / LOD	mg/m ³	0.12	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	01/10/2015	
Average Volume Sampled (REF)	m ³	1.0769	
Filter I.D. Number	-	47-27478	
Start Filter Mass	g	0.13910	
End Filter Mass	g	0.13943	
Total Mass on Filter	g	0.00033	
Probe Rinse I.D. Number	-	PR-47-27478	
Start Probe Rinse Mass	g	3.01765	
End Probe Rinse Mass	g	3.01767	
Total Mass in Probe Rinse	g	0.00002	
Total Mass Collected	mg	0.35	
Calculated Concentration	mg/m ³	0.33	
Balance Uncertainty / LOD	mg/m ³	0.12	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	28.30	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.57	
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	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	102.0	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.22	
ELV [Daily ELV for IED]	mg/m ³	10.00	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	44	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
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	
The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl points after this increase were omitted.	x	
Ratio highest to lowest velocities between 3 and 5 : 1.	x	

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V _m	1.1390		uV _m	m ³	0.0228	
Sampled Gas Temperature	T _m	295.6		uT _m	K	2.0	
Sampled Gas Pressure	p _m	102.9		up _m	kPa	0.5	
Sampled Gas Humidity	H _m	0.0		uH _m	% v/v	1.0	
Leak	L	0.35		uL	%	-	
Mass of Particulate	m	0.72		um	mg	0.13	
Uncollected Mass	UCM	0.35		uUCM	mg	-	

Uncertainty as a Percentage				Requirement of Standard
Measured Quantities	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.68		≤1%
Sampled Gas Pressure	%	0.49		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	0.35		≤2%
Mass of Particulate	%	1.21		<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	1.0692	0.62	
Leak	L	mg/m ³	0.001	1.00	
Mass of Particulate	L _r	mg	0.717	0.93	
Uncollected Mass	UCM	mg	0.20	0.93	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m ³	0.017	
Leak	mg/m ³	0.0014	
Mass of Particulate	mg/m ³	0.1207	
Uncollected Mass	mg/m ³	0.1894	

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	0.23	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m ³	0.44	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m ³	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m ³	0.86	
Reported Uncertainty	mg/m ³	0.86	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	66.3	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	129.4	
Reported Uncertainty	%	129.4	

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 35D

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	5.2		5.2
Uncertainty	±mg/m ³	0.46		0.46
Mass Emission	g/hr	50.6		50.6
Uncertainty	±g/hr	5.1		5.1

General Sampling Information

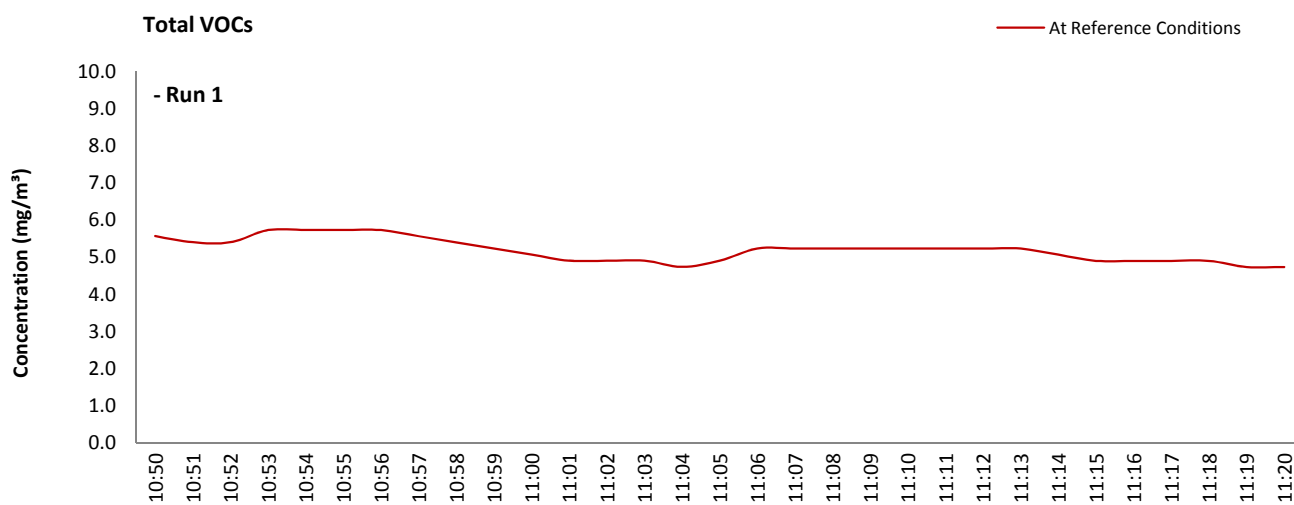
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180	
Span Gas Type	Propane In Synthetic Air (5 Grade)	
Span Gas Reference Number	1.072a	
Span Gas Expiry Date	26/06/2020	
Span Gas Start Pressure (bar)	130	
Gas Cylinder Concentration (ppm)	80.2	
Span Gas Set Point (ppm)	80.20	
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	B3	

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	-	10:50 - 11:20	
Sampling Dates	-	01/10/2015	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.2	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.20	
	Zero Down Sampling Line (Post)	ppm	0.30	
	Zero Drift	ppm	0.10	
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	4.01	
	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	77.80	
	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	4.01	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	18.5 - 19.5	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	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	-		mg/m ³ (REF)
TGN M2 Allowable MU	15.0		%
Measured concentration	5.22		mg/m ³ (STP, dry)
Range Used	100.0		ppm
Range Used [A]	160.6		mg/m ³
Cal gas conc.	80.2		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.	128.8		mg/m ³

Performance characteristics	RUN 1		Units
Response time	45		seconds
Number of readings in measurement	30		-
Repeatability at zero	2.00		% full scale
Repeatability at span level	0.00		% full scale
Deviation from linearity	0.22		% of value
Zero drift	0.13		% 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)	1.50		% 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	0.019		mg/m ³
Drift	0.048		mg/m ³
Volume or pressure flow dependence	0.0014		mg/m ³
Atmospheric pressure dependence	0.013		mg/m ³
Ambient temperature dependence	0.20		mg/m ³
Combined interference (from MCERTS Certificate)	0.039		mg/m ³
Dependence on voltage	0.058		mg/m ³
Losses in the line (leak)	0.045		mg/m ³
Uncertainty of calibration gas	0.060		mg/m ³

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		5.22	mg/m ³
Expanded uncertainty		0.24	mg/m ³
Expanded uncertainty	k = 1.96	0.46	mg/m ³
Uncertainty corrected to std conds. (O ₂)		0.46	mg/m ³ (REF)

	RUN 1	Units
Expanded uncertainty (no O ₂) - at 95% Confidence	8.86	% of Value
Expanded uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Overall Allowable uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Result of Compliance with Uncertainty Requirement in M2	N/A	-

	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 in M2	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). Ref EA TGN M2.



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Stack Emissions Testing Report Commissioned by
VIP Polymers Ltd

Installation Name & Address

VIP Polymers Ltd
15 Windover Road
Huntingdon
Cambridgeshire
PE29 7EB

LAPPC Permit: B11/94

Stack Reference

Stack 43

Dates of the Monitoring Campaign

30th September 2015

Job Reference Number

CSW-1977

Report Written by

Neil Teixeira
Team Leader
MCERTS Level 2
MM 05 583
TE1 TE2 TE3 TE4

Report Approved by

Matthew Hopes
Team Leader
MCERTS Level 2
MM 06 688
TE1 TE2 TE3 TE4

Report Date

15th October 2015

Version

Version 1

Signature of Report Approver

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TITLE PAGE

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APPENDIX 1 - Monitoring Personnel & List of Equipment

APPENDIX 2 - Raw Data, Sampling Equations & Charts

Opinions and interpretations expressed herein are outside the scope of Exova Catalyst's ISO 17025 accreditation.

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Executive Summary

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MONITORING OBJECTIVES

VIP Polymers Ltd, Huntingdon

Stack 43

30th September 2015

Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by VIP Polymers Ltd to carry out stack emissions testing on the Stack 43 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, Total VOCs (as Carbon)

Executive Summary

(Page 2 of 7)

MONITORING RESULTS

VIP Polymers Ltd, Huntingdon

Stack 43

30th September 2015

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	1.0	0.52	10	g/hr	24.8	12.5	-
Total VOCs (as Carbon)	¹ mg/m ³	4.6	0.49	-	g/hr	110	12.8	-
Water Vapour	% v/v	0.25	0.02					
Stack Gas Temperature	°C	23.0						
Stack Gas Velocity	m/s	34.3	0.79					
Volumetric Flow Rate (ACTUAL)	m ³ /hr	25220	1280					
Volumetric Flow Rate (REF)	¹ m ³ /hr	23703	1203					

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

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

Executive Summary

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MONITORING DATE(S) & TIMES

VIP Polymers Ltd, Huntingdon

Stack 43

30th September 2015

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m ³	1.0	g/hr	24.8	30/09/2015	16:19 - 16:59	40
Total VOCs (as Carbon)	R1	mg/m ³	4.6	g/hr	110	30/09/2015	16:25 - 16:55	30
Velocity & Volumetric Flow Rate	R1					30/09/2015	15:14 - 15:28	

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

VIP Polymers Ltd, Huntingdon

Stack 43

30th September 2015

Standard Operating Conditions

Parameter	Value
Process Status	Normal production
Capacity (of 100%) and Tonnes / Hour	N/A
Continuous or Batch Process	Continuous
Feedstock (if applicable)	Rubber
Abatement System	None
Abatement System Running Status	N/A
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

(Page 5 of 7)

MONITORING & ANALYTICAL METHODS

VIP Polymers Ltd, Huntingdon

Stack 43

30th September 2015

Parameter	Monitoring				Analysis				MCERTS Testing	LOD (Average)
	Standard	Technical Procedure	ISO 17025 Testing	Testing Lab	Analytical Procedure	Analytical Technique	ISO 17025 Analysis	Analysis Lab		
Total Particulate Matter	EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.13 mg/m ³
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.1 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.32 mg/m ³
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	Yes	CAT	Pitot Tube and Thermocouple				Yes	1.2 m/s

ANALYSIS LABORATORIES

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

Exova Catalyst (CAT)	ISO 17025 Accreditation Number: 4279
----------------------	--------------------------------------

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
All	1	There are no deviations associated with the sampling employed.

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.51
Width	m	-
Area	m ²	0.20
Port Depth	cm	5
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

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

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

All platforms should be designed in accordance with the requirements in EPA Guidance Note AG1 and EN 15259.

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	221.0		> 5 Pa	Yes
Mean Velocity	m/s	34.29		-	-
Lowest Gas Velocity	m/s	16.03		-	-
Highest Gas Velocity	m/s	52.75		-	-
Ratio of Above	: 1	3.29		< 3 : 1	No
Maximum Angle of Swirl	°	10		< 15°	Yes
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

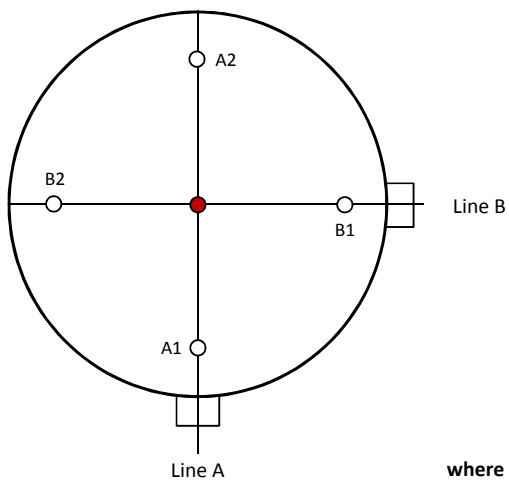
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PLANT PHOTOS

Photo 1



SAMPLE POINTS



where ○ = isokinetic point sampled at

● = combustion gases sample point

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	Neil Teixeira	MCERTS Level 2	MM 05 583	TE1 TE2 TE3 TE4
Team Leader	Phil Soley	MCERTS Level 2	MM 12 1187	TE1 TE2 TE3 TE4

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 7.46	Horiba PG-250	-	Digital Manometer (1)	CAT 3.12
Control Box DGM (2)	-	Horiba PG-250 SRM	-	Digital Manometer (2)	-
Box Thermocouples (1)	CAT 3.22	Servomex 4900	-	Digital Temperature Meter	CAT 3.12
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.63
Umbilical (1)	CAT 3.22	ABB AO2020-URAS26	-	Barometer	CAT 13.37
Umbilical (2)	-	Servomex 5200MP	-	Stack Thermocouple (1)	CAT 4.584
Oven Box (1)	-	JCT JCC P1 Cooler	-	Stack Thermocouple (2)	-
Oven Box (2)	-	ProtIR 304M	-	Stack Thermocouple (3)	-
Heated Probe (1)	CAT 5.85	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	-	Bernath 3006 FID	CAT 8.22	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.86	1m Heated Line (3)	-
S-Pitot (1)	CAT 21.P43	Mass Flow Controller (1)	CAT 6.52	5m Heated Line (1)	CAT 20.77
S-Pitot (2)	-	Mass Flow Controller (2)	-	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	-	20m Heated Line (1)	-
500g Check Weight	CAT 17.25	Mass View (2)	-	20m Heated Line (2)	-
1Kg Check Weight	CAT 17.25	Hioki 5043 (V)	CAT 11.91	Dual Channel Heater Controller	-
Last Impinger Arm	-	Easylogger EN-EL-12 Bit	-	Single Channel Heater Controller	-
Callipers	CAT 23.29	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.9

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
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	0.51
Stack Width, W	m	-
Stack Area, A	m ²	0.20
Average Stack Gas Temperature, T _a	°C	23.0
Average Stack Gas Pressure	Pa	233.8
Average Stack Static Pressure, P _{static}	kPa	0.227
Average Barometric Pressure, P _b	kPa	103.0
Average Pitot Tube Calibration Coefficient, C _p	-	0.84

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)	-	20.80	20.75	0.2080	32.00	1.4277	0.29696
N ₂	-	79.14	78.94	0.7914	28.01	1.2498	0.98913
Moisture (H ₂ O)	-	-	0.25	0.0025	18.02	0.8037	0.00204

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	1.286
Dry Density (Actual), P _{Actual}	kg/m ³	1.210
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.209

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	23.0	0.0
Total Pressure	kPa	103.2	101.3
Moisture	%	0.25	0.25

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	25220
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	23703
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	23643
Gas Volumetric Flowrate REF ¹	m ³ /hr	23703

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	30/09/2015
Time of Survey	-	15:14 - 15:28
Atmospheric Pressure	kPa	103.0
Average Stack Static Pressure	Pa	227
Result of Pitot Stagnation Test	-	NOT REQUIRED
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with KIMO MP 210 (500Pa)	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C_p	-	0.84
Number of Lines Available	-	1
Number of Lines Used	-	1

Sampling Line A										
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m³	Velocity m/s	Swirl °				
STATIC (Units: Pa)		229.0	224.0							
Mean		227.5	23.0	1.209	16.26		240.0	23.0	1.209	52.31
1	0.07	234.0	23.0	1.209	16.50	10.0	244.0	23.0	1.209	52.75 6.0
2	0.44	221.0	23.0	1.209	16.03	9.0	236.0	23.0	1.209	51.88 8.0

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	$u(\Delta p_i)$	5.099	Pa
- Resolution	$u(res)$	0.00087	
- Calibration	$u(cal)$	5.689	
- Drift	$u(drift)$	0.083	
- Lack of Fit	$u(fit)$	19.223	
- Overall corrections to dynamic measurements	$u(C_f)$	24.997	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00003	-
- $\phi_{O_2,w}$	-	20.747	
- $\phi_{CO_2,w}$	-	0.060	
- Oxygen, dry	$u(\phi_{O_2,d})$	0.637	
- Carbon Dioxide, dry	$u(\phi_{CO_2,d})$	0.002	
- Water Vapour	$u(\phi_{H_2O})$	0.013	
- Oxygen, wet	$u(\phi_{O_2,w})$	0.635	
- Carbon Dioxide, wet	$u(\phi_{CO_2,w})$	0.002	
Standard uncertainty associated with the stack temperature	$u(T_c)$	1.510	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.766	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	5.099	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00650	-
Standard uncertainty associated with the local velocities	$u(v_i)$	0.512	Pa
Standard uncertainty associated with the mean velocity	$u(v)$	0.401	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	0.787	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	2.29	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV,w)$	1279.9	m ³ /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00067	
- $u^2(qV,w)$	-	426427	
- $u(qV,w)$	-	653.0	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV,w)$	5.07	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 43

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	1.0		1.0
Uncertainty	±mg/m ³	0.52		0.52
Mass Emission	g/hr	24.8		24.8
Uncertainty	±g/hr	12.5		12.5

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	0.25		0.25
Uncertainty	±% v/v	0.02		0.02

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.40		0.40

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	2 / 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, B1, B2	

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	772.5	
Stack static pressure, P_{static}	mmH ₂ O	23.1	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	774.2	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	0.7	
Total mass collected in impingers (silica trap)	g	1.4	
Total mass of liquid collected, V_{lc}	g	2.1	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0026	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	1.1090	
Gas meter correction factor, Y_d	-	0.9940	
Average dry gas meter temperature, T_m	°C	26.6	
Average pressure drop across orifice, ΔH	mmH ₂ O	72.6	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	1.0279	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0025	
B_{wo} as a percentage	% v/v	0.25	
Reported Water Vapour, checked with Tables in EN 14790, R_{wv}	% v/v	0.25	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	1.0306	
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	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	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	28.81	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.82	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	23.00	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	4.80	
Average stack gas temperature, T_s	°C	26.0	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	15.98	
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	0.20	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	195.9	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	182.2	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	181.7	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	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	5.92	
Nozzle area, A_n	mm ²	27.56	
Total sampling time, q	min	40	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	104.8	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	16:19 - 16:59	
Sampling Dates	-	30/09/2015	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	1.0306	
Filter I.D. Number	-	47-27527	
Start Filter Mass	g	0.14071	
End Filter Mass	g	0.14142	
Total Mass on Filter	g	0.00071	
Probe Rinse I.D. Number	-	PR-47-27527	
Start Probe Rinse Mass	g	3.04037	
End Probe Rinse Mass	g	3.04074	
Total Mass in Probe Rinse	g	0.00037	
Total Mass Collected	mg	1.08	
Calculated Concentration	mg/m ³	1.04	
Balance Uncertainty / LOD	mg/m ³	0.13	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	30/09/2015	
Average Volume Sampled (REF)	m ³	1.0306	
Filter I.D. Number	-	47-24108	
Start Filter Mass	g	0.15267	
End Filter Mass	g	0.15309	
Total Mass on Filter	g	0.00042	
Probe Rinse I.D. Number	-	PR-47-24108	
Start Probe Rinse Mass	g	2.96503	
End Probe Rinse Mass	g	2.96503	
Total Mass in Probe Rinse	g	0.00000	
Total Mass Collected	mg	0.42	
Calculated Concentration	mg/m ³	0.40	
Balance Uncertainty / LOD	mg/m ³	0.13	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	27.56	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.55	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	7.5	
Allowable MU	%	20	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	104.8	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.23	
ELV [Daily ELV for IED]	mg/m ³	10.00	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	26	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Pre-Sampling Leak Rate	l/min	0.20	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
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	
There are no deviations associated with the sampling employed.	x	

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V _m	1.1090		uV _m	m ³	0.0222	
Sampled Gas Temperature	T _m	299.6		uT _m	K	2.0	
Sampled Gas Pressure	p _m	103.2		up _m	kPa	0.5	
Sampled Gas Humidity	H _m	0.0		uH _m	% v/v	1.0	
Leak	L	0.36		uL	%	-	
Mass of Particulate	m	1.08		um	mg	0.13	
Uncollected Mass	UCM	0.42		uUCM	mg	-	

Uncertainty as a Percentage				Requirement of Standard
Measured Quantities	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.67		≤1%
Sampled Gas Pressure	%	0.48		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	0.36		≤2%
Mass of Particulate	%	1.26		<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	1.0279	1.02	
Leak	L	mg/m ³	0.002	1.00	
Mass of Particulate	L _r	mg	1.077	0.97	
Uncollected Mass	UCM	mg	0.24	0.97	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m ³	0.026	
Leak	mg/m ³	0.0022	
Mass of Particulate	mg/m ³	0.1261	
Uncollected Mass	mg/m ³	0.2334	

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	0.27	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m ³	0.52	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m ³	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m ³	0.52	
Reported Uncertainty	mg/m ³	0.52	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	50.0	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	50.0	
Reported Uncertainty	%	50.0	

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 43

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	4.6		4.6
Uncertainty	±mg/m ³	0.49		0.49
Mass Emission	g/hr	110		110
Uncertainty	±g/hr	12.8		12.8

General Sampling Information

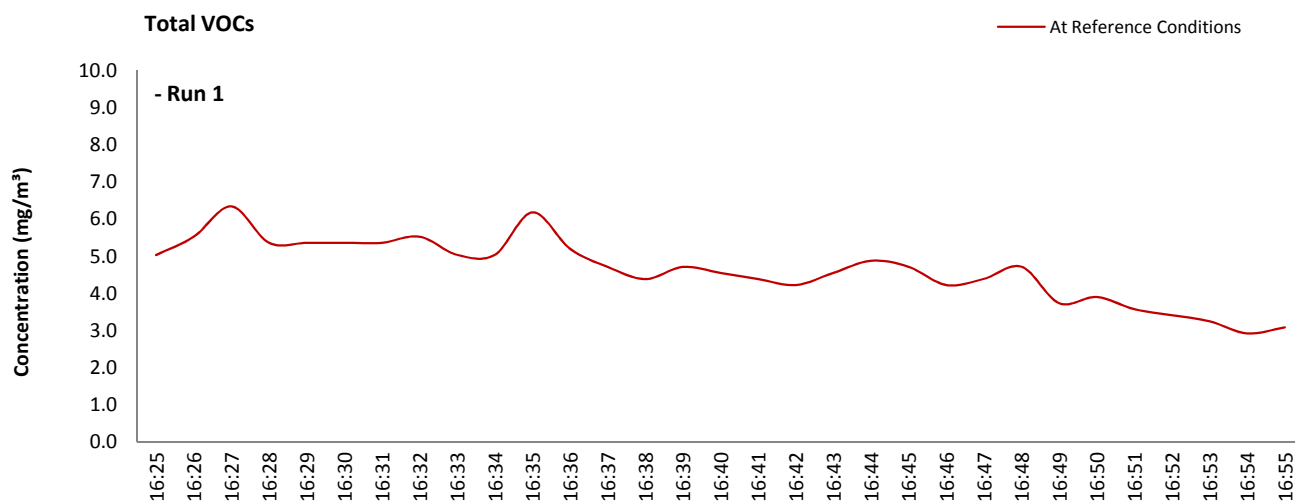
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180	
Span Gas Type	Propane In Synthetic Air (5 Grade)	
Span Gas Reference Number	1.072a	
Span Gas Expiry Date	26/06/2020	
Span Gas Start Pressure (bar)	130	
Gas Cylinder Concentration (ppm)	80.2	
Span Gas Set Point (ppm)	80.20	
Span Gas Uncertainty (%)	N/A	
Zero Gas Type	Synthetic Air (5 Grade)	
Number of Sampling Lines Used	1 / 2	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A3	

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	-	16:25 - 16:55	
Sampling Dates	-	30/09/2015	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.2	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.30	
	Zero Down Sampling Line (Post)	ppm	0.20	
	Zero Drift	ppm	-0.10	
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	4.01	
	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	78.90	
	Span Drift	ppm	-0.10	
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	4.01	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	23	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	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	-	mg/m ³ (REF)
TGN M2 Allowable MU	15.0	%
Measured concentration	4.64	mg/m ³ (STP, dry)
Range Used	100.0	ppm
Range Used [A]	160.6	mg/m ³
Cal gas conc.	80.2	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.	128.8	mg/m ³

Performance characteristics	RUN 1	Units
Response time	45	seconds
Number of readings in measurement	30	-
Repeatability at zero	2.00	% full scale
Repeatability at span level	0.00	% full scale
Deviation from linearity	0.22	% of value
Zero drift	-0.13	% full scale
Span drift	-0.13	% 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)	1.50	% 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	0.019	mg/m ³
Drift	-0.10	mg/m ³
Volume or pressure flow dependence	0.0014	mg/m ³
Atmospheric pressure dependence	0.013	mg/m ³
Ambient temperature dependence	0.20	mg/m ³
Combined interference (from MCERTS Certificate)	0.039	mg/m ³
Dependence on voltage	0.058	mg/m ³
Losses in the line (leak)	0.040	mg/m ³
Uncertainty of calibration gas	0.054	mg/m ³

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		4.64	mg/m ³
Expanded uncertainty		0.25	mg/m ³
Expanded uncertainty	k = 1.96	0.49	mg/m ³
Uncertainty corrected to std conds. (O ₂)		0.49	mg/m ³ (REF)

	RUN 1	Units
Expanded uncertainty (no O ₂) - at 95% Confidence	10.49	% of Value
Expanded uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Overall Allowable uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Result of Compliance with Uncertainty Requirement in M2	N/A	-

	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 in M2	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). Ref EA TGN M2.



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Stack Emissions Testing Report Commissioned by
VIP Polymers Ltd

Installation Name & Address
VIP Polymers Ltd
15 Windover Road
Huntingdon
Cambridgeshire
PE29 7EB

LAPPC Permit: B11/94

Stack Reference
Stack 44 - Carbon Black

Dates of the Monitoring Campaign
1st October 2015

Job Reference Number
CSW-1977

Report Written by
Neil Teixeira Team Leader MCERTS Level 2 MM 05 583 TE1 TE2 TE3 TE4

Report Approved by
Matthew Hopes Team Leader MCERTS Level 2 MM 06 688 TE1 TE2 TE3 TE4

Report Date
15th October 2015

Version
Version 1

Signature of Report Approver


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EXECUTIVE SUMMARY

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APPENDIX 1 - Monitoring Personnel & List of Equipment

APPENDIX 2 - Raw Data, Sampling Equations & Charts

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Executive Summary

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MONITORING OBJECTIVES

VIP Polymers Ltd, Huntingdon

Stack 44 - Carbon Black

1st October 2015

Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by VIP Polymers Ltd to carry out stack emissions testing on the Stack 44 - Carbon Black 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, Total VOCs (as Carbon)

Executive Summary

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MONITORING RESULTS

VIP Polymers Ltd, Huntingdon

Stack 44 - Carbon Black

1st October 2015

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	1.2	0.71	10	g/hr	7.5	4.4	-
Total VOCs (as Carbon)	¹ mg/m ³	3.1	0.46	-	g/hr	18.7	2.9	-
Water Vapour	% v/v	0.11	0.02					
Stack Gas Temperature	°C	30.0						
Stack Gas Velocity	m/s	12.2	0.30					
Volumetric Flow Rate (ACTUAL)	m ³ /hr	6667	345					
Volumetric Flow Rate (REF)	¹ m ³ /hr	6100	316					

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

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

Executive Summary

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MONITORING DATE(S) & TIMES

VIP Polymers Ltd, Huntingdon

Stack 44 - Carbon Black

1st October 2015

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	1.2	g/hr	7.5	01/10/2015	14:27 - 15:07	40
Total VOCs (as Carbon)	R1	mg/m³	3.1	g/hr	18.7	01/10/2015	14:35 - 15:05	30
Velocity & Volumetric Flow Rate	R1					01/10/2015	13:20 - 13:30	

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

VIP Polymers Ltd, Huntingdon

Stack 44 - Carbon Black

1st October 2015

Standard Operating Conditions

Parameter	Value
Process Status	Normal
Capacity (of 100%) and Tonnes / Hour	N/A
Continuous or Batch Process	Continuous
Feedstock (if applicable)	Carbon Black
Abatement System	Bag filter
Abatement System Running Status	Normal
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

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MONITORING & ANALYTICAL METHODS

VIP Polymers Ltd, Huntingdon

Stack 44 - Carbon Black

1st October 2015

Parameter	Monitoring				Analysis				MCERTS Testing	LOD (Average)
	Standard	Technical Procedure	ISO 17025 Testing	Testing Lab	Analytical Procedure	Analytical Technique	ISO 17025 Analysis	Analysis Lab		
Total Particulate Matter	EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.18 mg/m ³
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.1 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.32 mg/m ³
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	Yes	CAT	Pitot Tube and Thermocouple				Yes	1.2 m/s

ANALYSIS LABORATORIES

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

Exova Catalyst (CAT)	ISO 17025 Accreditation Number: 4279
----------------------	--------------------------------------

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter	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 meet the requirements of the Standard.
Total Particulate Matter	1	The measurement uncertainty for water vapour was greater than 20%. This was due to the low level of water vapour which was found to be present in the stack.

Executive Summary

(Page 6 of 7)

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.44
Width	m	-
Area	m ²	0.15
Port Depth	cm	8
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

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

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

All platforms should be designed in accordance with the requirements in EPA Guidance Note AG1 and EN 15259.

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	119.0		> 5 Pa	Yes
Mean Velocity	m/s	12.18		-	-
Lowest Gas Velocity	m/s	11.92		-	-
Highest Gas Velocity	m/s	12.36		-	-
Ratio of Above	: 1	1.04		< 3 : 1	Yes
Maximum Angle of Swirl	°	7		< 15°	Yes
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

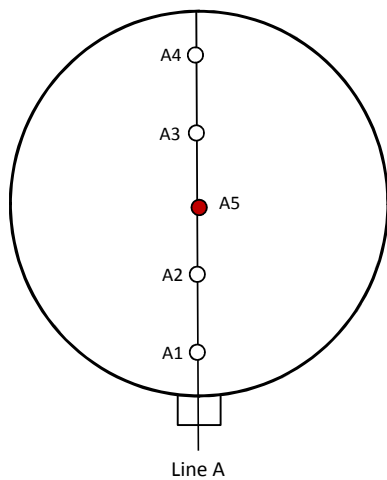
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PLANT PHOTOS

Photo 1



SAMPLE POINTS



where ○ = isokinetic point sampled at

● = combustion gases sample point

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	Neil Teixeira	MCERTS Level 2	MM 05 583	TE1 TE2 TE3 TE4
Team Leader	Phil Soley	MCERTS Level 2	MM 12 1187	TE1 TE2 TE3 TE4

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 7.46	Horiba PG-250	-	Digital Manometer (1)	CAT 3.12
Control Box DGM (2)	-	Horiba PG-250 SRM	-	Digital Manometer (2)	-
Box Thermocouples (1)	CAT 3.22	Servomex 4900	-	Digital Temperature Meter	CAT 3.12
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.63
Umbilical (1)	CAT 3.22	ABB AO2020-URAS26	-	Barometer	CAT 13.37
Umbilical (2)	-	Servomex 5200MP	-	Stack Thermocouple (1)	CAT 4.584
Oven Box (1)	-	JCT JCC P1 Cooler	-	Stack Thermocouple (2)	-
Oven Box (2)	-	ProtIR 304M	-	Stack Thermocouple (3)	-
Heated Probe (1)	CAT 5.85	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	-	Bernath 3006 FID	CAT 8.22	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.86	1m Heated Line (3)	-
S-Pitot (1)	CAT 21.P43	Mass Flow Controller (1)	CAT 6.52	5m Heated Line (1)	CAT 20.77
S-Pitot (2)	-	Mass Flow Controller (2)	-	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	-	20m Heated Line (1)	-
500g Check Weight	CAT 17.25	Mass View (2)	-	20m Heated Line (2)	-
1Kg Check Weight	CAT 17.25	Hioki 5043 (V)	CAT 11.91	Dual Channel Heater Controller	-
Last Impinger Arm	-	Easylogger EN-EL-12 Bit	-	Single Channel Heater Controller	-
Callipers	CAT 23.29	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.9

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
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	0.44
Stack Width, W	m	-
Stack Area, A	m ²	0.15
Average Stack Gas Temperature, T _a	°C	30.0
Average Stack Gas Pressure	Pa	124.3
Average Stack Static Pressure, P _{static}	kPa	0.072
Average Barometric Pressure, P _b	kPa	102.8
Average Pitot Tube Calibration Coefficient, C _p	-	0.84

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)	-	20.80	20.78	0.2080	32.00	1.4277	0.29696
N ₂	-	79.14	79.06	0.7914	28.01	1.2498	0.98913
Moisture (H ₂ O)	-	-	0.11	0.0011	18.02	0.8037	0.00085

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	1.287
Dry Density (Actual), P _{Actual}	kg/m ³	1.178
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.177

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} x (T_s / P_s) x (P_a / T_a)

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	30.0	0.0
Total Pressure	kPa	102.9	101.3
Moisture	%	0.11	0.11

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	6667
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	6100
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	6094
Gas Volumetric Flowrate REF ¹	m ³ /hr	6100

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	01/10/2015
Time of Survey	-	13:20 - 13:30
Atmospheric Pressure	kPa	102.8
Average Stack Static Pressure	Pa	72
Result of Pitot Stagnation Test	-	NOT REQUIRED
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with KIMO MP 210 (500Pa)	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C_p	-	0.84
Number of Lines Available	-	1
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)		72.0				
Mean		124.3	30.0	1.177	12.18	
1	0.03	126.0	30.0	1.177	12.26	5.0
2	0.11	124.0	30.0	1.177	12.17	7.0
3	0.33	119.0	30.0	1.177	11.92	3.0
4	0.41	128.0	30.0	1.177	12.36	6.0

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	$u(\Delta p_i)$	2.308	Pa
- Resolution	$u(res)$	0.00087	
- Calibration	$u(cal)$	1.607	
- Drift	$u(drift)$	0.083	
- Lack of Fit	$u(fit)$	2.633	
- Overall corrections to dynamic measurements	$u(C_f)$	4.325	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00003	-
- $\phi O_2, w$	-	20.778	
- $\phi CO_2, w$	-	0.060	
- Oxygen, dry	$u(\phi O_2, d)$	0.637	
- Carbon Dioxide, dry	$u(\phi CO_2, d)$	0.002	
- Water Vapour	$u(\phi H_2O)$	0.005	
- Oxygen, wet	$u(\phi O_2, w)$	0.636	
- Carbon Dioxide, wet	$u(\phi CO_2, w)$	0.002	
Standard uncertainty associated with the stack temperature	$u(T_c)$	1.546	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.707	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	2.308	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00633	-
Standard uncertainty associated with the local velocities	$u(v_i)$	0.184	Pa
Standard uncertainty associated with the mean velocity	$u(\bar{v})$	0.156	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	0.305	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	2.50	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV, w)$	344.9	m ³ /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV, w)/q^2V, w$	-	0.00070	
- $u^2(qV, w)$	-	30964	
- $u(qV, w)$	-	176.0	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV, w)$	5.17	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 44 - Carbon Black

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	1.2		1.2
Uncertainty	±mg/m ³	0.71		0.71
Mass Emission	g/hr	7.5		7.5
Uncertainty	±g/hr	4.4		4.4

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	0.11		0.11
Uncertainty	±% v/v	0.02		0.02

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.54		0.54

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	772.5	
Stack static pressure, P _{static}	mmH ₂ O	7.3	
P _s = (P _b + (P _{static} / 13.6))	mmHg	773.0	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	-1.2	
Total mass collected in impingers (silica trap)	g	1.8	
Total mass of liquid collected, V _{lc}	g	0.6	
V _{wstd} = (0.001246)(V _{lc})	m ³	0.0007	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V _m	m ³	0.7560	
Gas meter correction factor, Y _d	-	0.9940	
Average dry gas meter temperature, T _m	°C	23.8	
Average pressure drop across orifice, ΔH	mmH ₂ O	37.2	
V _{mstd} = ((0.3592)(V _m)(P _b + (ΔH/13.6))(Y _d) / (T _m + 273))	m ³	0.7052	
Moisture content, B_{wv} & R_{wv}			
B _{wv} = V _{wstd} / (V _{mstd} + V _{wstd})	m ³	0.0011	
B _{wv} as a percentage	% v/v	0.11	
Reported Water Vapour, checked with Tables in EN 14790, R _{wv}	% v/v	0.11	
Volume of gas metered wet, V_{mstw}			
V _{mstw} = (V _{mstd})(100/(100 - R _{wv}))	m ³	0.7059	
Volume of gas metered at Oxygen Reference Conditions, V_{mstd@X%O₂} & V_{mstw@X%O₂}			
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	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
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	28.83	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K _p	-	34.97	
Velocity pressure coefficient, C _p	-	0.82	
Average of velocity heads, ΔP _{avg}	mmH ₂ O	12.43	
Average square root of velocity heads, √ΔP	√mmH ₂ O	3.52	
Average stack gas temperature, T _s	°C	30.0	
V _s = ((K _p)(C _p)(√ΔP)(V _{Ts} + 273)) / (V(M _s)(P _s))	m/s	11.83	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO₂}), Dry@O_{2REF} (Q_{stdO₂})			
Area of stack, A _s	m ²	0.15	
Q _a = (60)(A _s)(V _s)	m ³ /min	107.9	
Conversion factor (K/mm.Hg), C _f	-	0.3592	
Q _{stw} = ((Q _a)(P _s)(C _f)) / ((T _s + 273))	m ³ /min	98.9	
Q _{std} = ((Q _a)(P _s)(C _f)(1 - (R _{wv} /100))) / ((T _s + 273))	m ³ /min	98.8	
Q _{stwO₂} = ((Q _a)(P _s)(C _f)) / ((T _s + 273)) / (O _{2REFw})	m ³ /min	N/A	
Q _{stdO₂} = ((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	5.88	
Nozzle area, A _n	mm ²	27.16	
Total sampling time, q	min	40	
%I = (4.6398E ⁶)(T _s +273)(V _{mstd}) / (P _s)(V _s)(A _n)(q)(1 - (R _{wv} /100))	%	99.9	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	14:27 - 15:07	
Sampling Dates	-	01/10/2015	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	0.7059	
Filter I.D. Number	-	47-27504	
Start Filter Mass	g	0.14082	
End Filter Mass	g	0.14148	
Total Mass on Filter	g	0.00066	
Probe Rinse I.D. Number	-	PR-47-27504	
Start Probe Rinse Mass	g	2.95775	
End Probe Rinse Mass	g	2.95796	
Total Mass in Probe Rinse	g	0.00021	
Total Mass Collected	mg	0.87	
Calculated Concentration	mg/m ³	1.24	
Balance Uncertainty / LOD	mg/m ³	0.18	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	01/10/2015	
Average Volume Sampled (REF)	m ³	0.7059	
Filter I.D. Number	-	47-27501	
Start Filter Mass	g	0.14028	
End Filter Mass	g	0.14064	
Total Mass on Filter	g	0.00036	
Probe Rinse I.D. Number	-	PR-47-27501	
Start Probe Rinse Mass	g	3.09702	
End Probe Rinse Mass	g	3.09704	
Total Mass in Probe Rinse	g	0.00002	
Total Mass Collected	mg	0.38	
Calculated Concentration	mg/m ³	0.54	
Balance Uncertainty / LOD	mg/m ³	0.18	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	18.79	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.20	
Allowable Leak Rate	l/min	0.38	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	20.3	
Allowable MU	%	20	
MU Acceptable	%	No	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	99.9	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.34	
ELV [Daily ELV for IED]	mg/m ³	10.00	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	30	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
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 meet the requirements of the Standard.	x	
The measurement uncertainty for water vapour was greater than 20%. This was due to the low level of water vapour which was found to be present in the stack.	x	

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V_m	0.7560		uV_m	m^3	0.0151	
Sampled Gas Temperature	T_m	296.8		uT_m	K	2.0	
Sampled Gas Pressure	p_m	103.1		up_m	kPa	0.5	
Sampled Gas Humidity	H_m	0.0		uH_m	% v/v	1.0	
Leak	L	1.06		uL	%	-	
Mass of Particulate	m	0.87		um	mg	0.13	
Uncollected Mass	UCM	0.38		uUCM	mg	-	

Uncertainty as a Percentage				Requirement of Standard
Measured Quantities	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.67		≤1%
Sampled Gas Pressure	%	0.49		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	1.06		≤2%
Mass of Particulate	%	1.84		<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	0.7052	1.75	
Leak	L	mg/ m^3	0.008	1.00	
Mass of Particulate	L_r	mg	0.873	1.42	
Uncollected Mass	UCM	mg	0.22	1.42	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/ m^3	0.031	
Leak	mg/ m^3	0.0076	
Mass of Particulate	mg/ m^3	0.1842	
Uncollected Mass	mg/ m^3	0.3108	

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	0.36	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/ m^3	0.71	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/ m^3	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/ m^3	0.71	
Reported Uncertainty	mg/ m^3	0.71	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	57.5	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	57.5	
Reported Uncertainty	%	57.5	

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 44 - Carbon Black

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	3.1		3.1
Uncertainty	±mg/m ³	0.46		0.46
Mass Emission	g/hr	18.7		18.7
Uncertainty	±g/hr	2.9		2.9

General Sampling Information

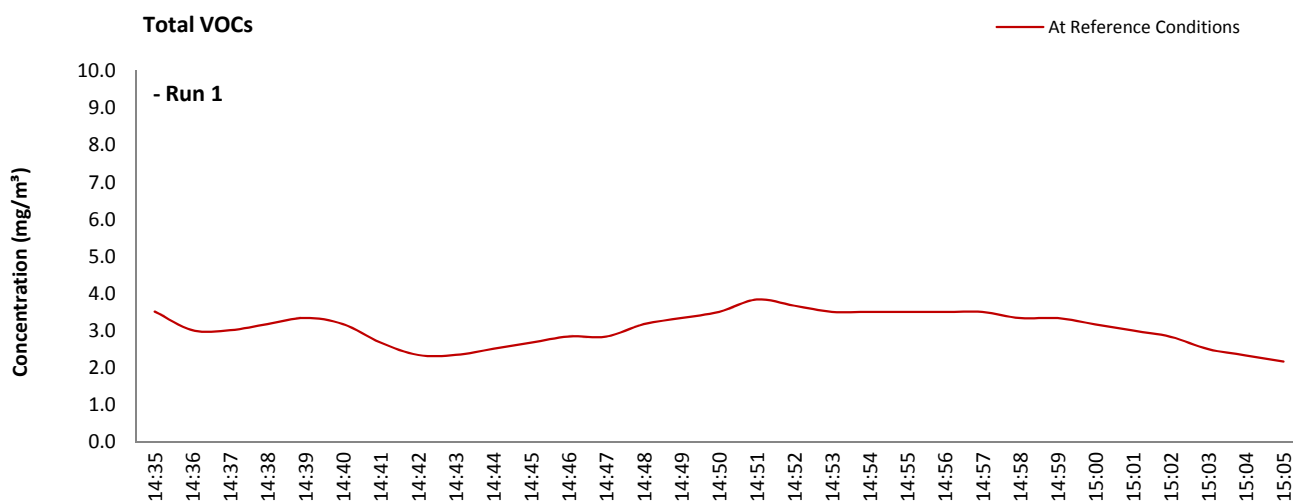
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180	
Span Gas Type	Propane In Synthetic Air (5 Grade)	
Span Gas Reference Number	1.072a	
Span Gas Expiry Date	26/06/2020	
Span Gas Start Pressure (bar)	130	
Gas Cylinder Concentration (ppm)	80.2	
Span Gas Set Point (ppm)	80.20	
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	A3	

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	-	14:35 - 15:05	
Sampling Dates	-	01/10/2015	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.2	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.20	
	Zero Down Sampling Line (Post)	ppm	0.30	
	Zero Drift	ppm	0.10	
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	4.01	
	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	77.80	
	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	4.01	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	26 - 26.5	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	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	-	mg/m ³ (REF)
TGN M2 Allowable MU	15.0	%
Measured concentration	3.07	mg/m ³ (STP, dry)
Range Used	100.0	ppm
Range Used [A]	160.6	mg/m ³
Cal gas conc.	80.2	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.	128.8	mg/m ³

Performance characteristics	RUN 1	Units
Response time	45	seconds
Number of readings in measurement	30	-
Repeatability at zero	2.00	% full scale
Repeatability at span level	0.00	% full scale
Deviation from linearity	0.22	% of value
Zero drift	0.13	% 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)	1.50	% 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	0.019	mg/m ³
Drift	0.067	mg/m ³
Volume or pressure flow dependence	0.0014	mg/m ³
Atmospheric pressure dependence	0.013	mg/m ³
Ambient temperature dependence	0.20	mg/m ³
Combined interference (from MCERTS Certificate)	0.039	mg/m ³
Dependence on voltage	0.058	mg/m ³
Losses in the line (leak)	0.027	mg/m ³
Uncertainty of calibration gas	0.035	mg/m ³

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		3.07	mg/m ³
Expanded uncertainty		0.23	mg/m ³
Expanded uncertainty	k = 1.96	0.46	mg/m ³
Uncertainty corrected to std conds. (O ₂)		0.46	mg/m ³ (REF)

	RUN 1	Units
Expanded uncertainty (no O ₂) - at 95% Confidence	14.87	% of Value
Expanded uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Overall Allowable uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Result of Compliance with Uncertainty Requirement in M2	N/A	-

	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 in M2	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). Ref EA TGN M2.



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Stack Emissions Testing Report Commissioned by
 VIP Polymers Ltd

Installation Name & Address

VIP Polymers Ltd
 15 Windover Road
 Huntingdon
 Cambridgeshire
 PE29 7EB

LAPPC Permit: B11/94

Stack Reference

Stack 46

Dates of the Monitoring Campaign

1st October 2015

Job Reference Number

CSW-1977

Report Written by
Neil Teixeira Team Leader MCERTS Level 2 MM 05 583 TE1 TE2 TE3 TE4

Report Approved by
Matthew Hopes Team Leader MCERTS Level 2 MM 06 688 TE1 TE2 TE3 TE4

Report Date
15th October 2015

Version
Version 1

Signature of Report Approver


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APPENDIX 1 - Monitoring Personnel & List of Equipment

APPENDIX 2 - Raw Data, Sampling Equations & Charts

Opinions and interpretations expressed herein are outside the scope of Exova Catalyst's ISO 17025 accreditation.

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Executive Summary

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MONITORING OBJECTIVES

VIP Polymers Ltd, Huntingdon

Stack 46

1st October 2015

Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by VIP Polymers Ltd to carry out stack emissions testing on the Stack 46 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, Total VOCs (as Carbon)

Executive Summary

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MONITORING RESULTS

VIP Polymers Ltd, Huntingdon

Stack 46

1st October 2015

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	0.77	0.55	50	g/hr	16.8	12.0	-
Total VOCs (as Carbon)	¹ mg/m ³	39.7	1.7	-	g/hr	867	56.6	-
Water Vapour	% v/v	0.10	0.02					
Stack Gas Temperature	°C	22.0						
Stack Gas Velocity	m/s	16.3	0.36					
Volumetric Flow Rate (ACTUAL)	m ³ /hr	23246	1168					
Volumetric Flow Rate (REF)	¹ m ³ /hr	21845	1097					

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

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

Executive Summary

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MONITORING DATE(S) & TIMES

VIP Polymers Ltd, Huntingdon

Stack 46

1st October 2015

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	0.77	g/hr	16.8	01/10/2015	16:56 - 17:36	40
Total VOCs (as Carbon)	R1	mg/m³	39.7	g/hr	867	01/10/2015	17:00 - 17:30	30
Velocity & Volumetric Flow Rate	R1					30/09/2015	16:20 - 16:40	

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

VIP Polymers Ltd, Huntingdon

Stack 46

1st October 2015

Standard Operating Conditions

Parameter	Value
Process Status	Normal
Capacity (of 100%) and Tonnes / Hour	N/A
Continuous or Batch Process	Continuous
Feedstock (if applicable)	Paint + Thinners
Abatement System	Water Backed Booth
Abatement System Running Status	Normal
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

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MONITORING & ANALYTICAL METHODS

VIP Polymers Ltd, Huntingdon

Stack 46

1st October 2015

Parameter	Monitoring				Analysis				MCERTS Testing	LOD (Average)
	Standard	Technical Procedure	ISO 17025 Testing	Testing Lab	Analytical Procedure	Analytical Technique	ISO 17025 Analysis	Analysis Lab		
Total Particulate Matter	EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.17 mg/m ³
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.1 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.32 mg/m ³
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	Yes	CAT	Pitot Tube and Thermocouple				Yes	1.2 m/s

ANALYSIS LABORATORIES

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

Exova Catalyst (CAT)	ISO 17025 Accreditation Number: 4279
----------------------	--------------------------------------

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter	1	The measurement uncertainty for water vapour was greater than 20%. This was due to the low level of water vapour which was found to be present in the stack.

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.71
Width	m	-
Area	m ²	0.40
Port Depth	cm	5
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

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

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

All platforms should be designed in accordance with the requirements in EPA Guidance Note AG1 and EN 15259.

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	25.0		> 5 Pa	Yes
Mean Velocity	m/s	16.31		-	-
Lowest Gas Velocity	m/s	5.39		-	-
Highest Gas Velocity	m/s	32.38		-	-
Ratio of Above	: 1	6.01		< 3 : 1	No
Maximum Angle of Swirl	°	5		< 15°	Yes
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

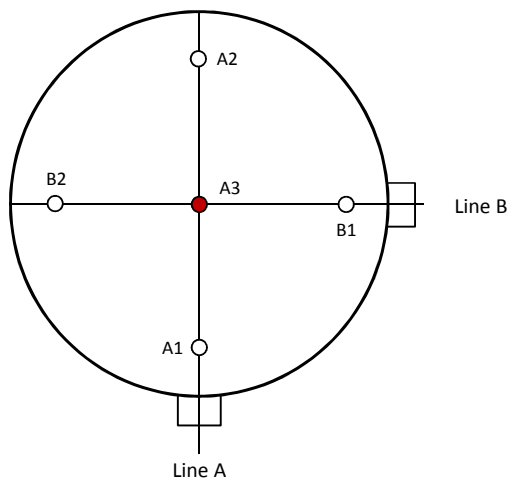
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PLANT PHOTOS

Photo 1



SAMPLE POINTS



where ○ = isokinetic point sampled at

● = combustion gases sample point

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	Neil Teixeira	MCERTS Level 2	MM 05 583	TE1 TE2 TE3 TE4
Team Leader	Phil Soley	MCERTS Level 2	MM 12 1187	TE1 TE2 TE3 TE4

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 7.46	Horiba PG-250	-	Digital Manometer (1)	CAT 3.12
Control Box DGM (2)	-	Horiba PG-250 SRM	-	Digital Manometer (2)	-
Box Thermocouples (1)	CAT 3.22	Servomex 4900	-	Digital Temperature Meter	CAT 3.12
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.63
Umbilical (1)	CAT 3.22	ABB AO2020-URAS26	-	Barometer	CAT 13.37
Umbilical (2)	-	Servomex 5200MP	-	Stack Thermocouple (1)	CAT 4.584
Oven Box (1)	-	JCT JCC P1 Cooler	-	Stack Thermocouple (2)	-
Oven Box (2)	-	ProtIR 304M	-	Stack Thermocouple (3)	-
Heated Probe (1)	CAT 5.85	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	-	Bernath 3006 FID	CAT 8.22	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.86	1m Heated Line (3)	-
S-Pitot (1)	CAT 21.P43	Mass Flow Controller (1)	CAT 6.52	5m Heated Line (1)	CAT 20.77
S-Pitot (2)	-	Mass Flow Controller (2)	-	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	-	20m Heated Line (1)	-
500g Check Weight	CAT 17.25	Mass View (2)	-	20m Heated Line (2)	-
1Kg Check Weight	CAT 17.25	Hioki 5043 (V)	CAT 11.91	Dual Channel Heater Controller	-
Last Impinger Arm	-	Easylogger EN-EL-12 Bit	-	Single Channel Heater Controller	-
Callipers	CAT 23.29	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.9

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
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	0.71
Stack Width, W	m	-
Stack Area, A	m ²	0.40
Average Stack Gas Temperature, T _a	°C	22.0
Average Stack Gas Pressure	Pa	55.0
Average Stack Static Pressure, P _{static}	kPa	0.065
Average Barometric Pressure, P _b	kPa	102.8
Average Pitot Tube Calibration Coefficient, C _p	-	0.84

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)	-	20.80	20.78	0.2080	32.00	1.4277	0.29696
N ₂	-	79.14	79.06	0.7914	28.01	1.2498	0.98913
Moisture (H ₂ O)	-	-	0.10	0.0010	18.02	0.8037	0.00080

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	1.287
Dry Density (Actual), P _{Actual}	kg/m ³	1.210
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.209

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} x (T_s / P_s) x (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	102.9	101.3
Moisture	%	0.10	0.10

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	23246
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	21845
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	21823
Gas Volumetric Flowrate REF ¹	m ³ /hr	21845

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	30/09/2015
Time of Survey	-	16:20 - 16:40
Atmospheric Pressure	kPa	102.8
Average Stack Static Pressure	Pa	65
Result of Pitot Stagnation Test	-	NOT REQUIRED
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with KIMO MP 210 (500Pa)	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C_p	-	0.84
Number of Lines Available	-	1
Number of Lines Used	-	1

Sampling Line A										
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m³	Velocity m/s	Swirl °				
STATIC (Units: Pa)		67.0	62.0							
Mean		49.5	22.0	1.209	7.33		60.5	22.0	1.209	25.28
1	0.10	74.0	22.0	1.209	9.27	3.0	29.0	22.0	1.209	18.18
2	0.61	25.0	22.0	1.209	5.39	2.0	92.0	22.0	1.209	32.38

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	$u(\Delta p_i)$	1.463	Pa
- Resolution	$u(res)$	0.00087	
- Calibration	$u(cal)$	0.315	
- Drift	$u(drift)$	0.083	
- Lack of Fit	$u(fit)$	0.741	
- Overall corrections to dynamic measurements	$u(C_f)$	1.141	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00003	-
- $\phi_{O_2,w}$	-	20.779	
- $\phi_{CO_2,w}$	-	0.060	
- Oxygen, dry	$u(\phi_{O_2,d})$	0.637	
- Carbon Dioxide, dry	$u(\phi_{CO_2,d})$	0.002	
- Water Vapour	$u(\phi_{H_2O})$	0.005	
- Oxygen, wet	$u(\phi_{O_2,w})$	0.636	
- 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	$u(p_c)$	175.698	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	1.463	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00651	-
Standard uncertainty associated with the local velocities	$u(v_i)$	0.279	Pa
Standard uncertainty associated with the mean velocity	$u(\bar{v})$	0.181	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	0.355	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	2.18	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV,w)$	1167.9	m ³ /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00066	
- $u^2(qV,w)$	-	355036	
- $u(qV,w)$	-	595.8	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV,w)$	5.02	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 46

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.77		0.77
Uncertainty	±mg/m ³	0.55		0.55
Mass Emission	g/hr	16.8		16.8
Uncertainty	±g/hr	12.0		12.0

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	0.10		0.10
Uncertainty	±% v/v	0.02		0.02

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.38		0.38

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	2 / 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, B1, B2	

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	771.0	
Stack static pressure, P_{static}	mmH ₂ O	6.6	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	771.5	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	-1.4	
Total mass collected in impingers (silica trap)	g	2.0	
Total mass of liquid collected, V_{lc}	g	0.6	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0007	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	0.8010	
Gas meter correction factor, Y_d	-	0.9940	
Average dry gas meter temperature, T_m	°C	21.4	
Average pressure drop across orifice, ΔH	mmH ₂ O	33.7	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	0.7513	
Moisture content, B_{wo} & R_{ww}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0010	
B_{wo} as a percentage	% v/v	0.10	
Reported Water Vapour, checked with Tables in EN 14790, R_{ww}	% v/v	0.10	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{ww}))$	m ³	0.7520	
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	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	28.84	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{ww}/100)) + 18(R_{ww}/100)$	g/gmol	28.83	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.82	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	5.88	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	2.42	
Average stack gas temperature, T_s	°C	23.0	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	8.05	
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	0.40	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	191.2	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	179.0	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{ww}/100))) / ((T_s) + 273)$	m ³ /min	178.8	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m ³ /min	N/A	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{ww}/100))) / ((T_s) + 273) / (O_{2REFd})$	m ³ /min	N/A	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	6.89	
Nozzle area, A_n	mm ²	37.29	
Total sampling time, q	min	40	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{ww}/100))$	%	111.5	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	16:56 - 17:36	
Sampling Dates	-	01/10/2015	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	0.7520	
Filter I.D. Number	-	47-27505	
Start Filter Mass	g	0.14048	
End Filter Mass	g	0.14089	
Total Mass on Filter	g	0.00041	
Probe Rinse I.D. Number	-	PR-47-27505	
Start Probe Rinse Mass	g	3.05856	
End Probe Rinse Mass	g	3.05873	
Total Mass in Probe Rinse	g	0.00017	
Total Mass Collected	mg	0.58	
Calculated Concentration	mg/m ³	0.77	
Balance Uncertainty / LOD	mg/m ³	0.17	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	01/10/2015	
Average Volume Sampled (REF)	m ³	0.7520	
Filter I.D. Number	-	47-27460	
Start Filter Mass	g	0.13750	
End Filter Mass	g	0.13779	
Total Mass on Filter	g	0.00029	
Probe Rinse I.D. Number	-	PR-47-27460	
Start Probe Rinse Mass	g	3.04597	
End Probe Rinse Mass	g	3.04597	
Total Mass in Probe Rinse	g	0.00000	
Total Mass Collected	mg	0.29	
Calculated Concentration	mg/m ³	0.38	
Balance Uncertainty / LOD	mg/m ³	0.17	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	19.90	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.20	
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)	%	20.3	
Allowable MU	%	20	
MU Acceptable	%	No	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	111.5	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.32	
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	23	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Pre-Sampling Leak Rate	l/min	0.20	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.30	
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	
The measurement uncertainty for water vapour was greater than 20%. This was due to the low level of water vapour which was found to be present in the stack.	x	

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V_m	0.8010		uV_m	m^3	0.0160	
Sampled Gas Temperature	T_m	294.4		uT_m	K	2.0	
Sampled Gas Pressure	p_m	102.9		up_m	kPa	0.5	
Sampled Gas Humidity	H_m	0.0		uH_m	% v/v	1.0	
Leak	L	1.00		uL	%	-	
Mass of Particulate	m	0.58		um	mg	0.13	
Uncollected Mass	UCM	0.29		uUCM	mg	-	

Uncertainty as a Percentage				Requirement of Standard
Measured Quantities	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.68		≤1%
Sampled Gas Pressure	%	0.49		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	1.00		≤2%
Mass of Particulate	%	0.35		<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	0.7513	1.03	
Leak	L	mg/ m^3	0.004	1.00	
Mass of Particulate	L_r	mg	0.580	1.33	
Uncollected Mass	UCM	mg	0.17	1.33	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/ m^3	0.019	
Leak	mg/ m^3	0.0045	
Mass of Particulate	mg/ m^3	0.1729	
Uncollected Mass	mg/ m^3	0.2201	

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	0.28	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/ m^3	0.55	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/ m^3	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/ m^3	0.55	
Reported Uncertainty	mg/ m^3	0.55	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	71.3	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	71.3	
Reported Uncertainty	%	71.3	

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 46

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	39.7		39.7
Uncertainty	±mg/m ³	1.7		1.7
Mass Emission	g/hr	867		867
Uncertainty	±g/hr	56.6		56.6

General Sampling Information

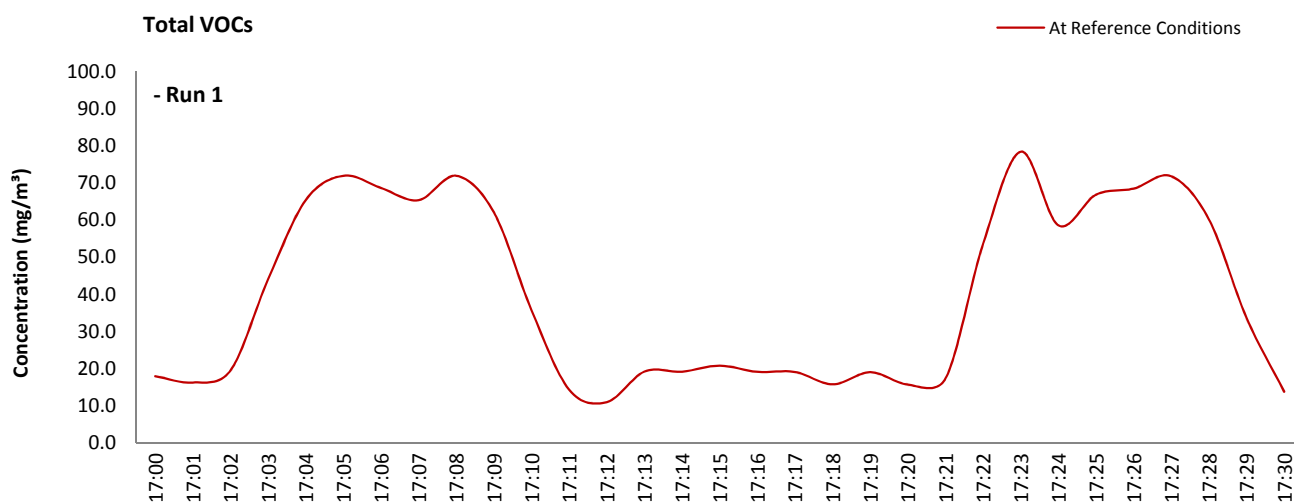
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180	
Span Gas Type	Propane In Synthetic Air (5 Grade)	
Span Gas Reference Number	1.0096	
Span Gas Expiry Date	10/02/2019	
Span Gas Start Pressure (bar)	150	
Gas Cylinder Concentration (ppm)	802	
Span Gas Set Point (ppm)	802.00	
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	A3	

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	-	17:00 - 17:30	
Sampling Dates	-	01/10/2015	
Instrument Range	ppm	1000	
Span Gas Value	ppm	802.0	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	1.00	
	Zero Down Sampling Line (Post)	ppm	2.00	
	Zero Drift	ppm	1.00	
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	40.10	
	Zero Drift Acceptable	-	Yes	

	Span Drift	Units	Run 1	
CAL 1	Span Down Sampling Line (Pre)	ppm	789.00	
	Span Down Sampling Line (Post)	ppm	776.00	
	Span Drift	ppm	-13.00	
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	40.10	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	20.5 - 20	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	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	-	mg/m ³ (REF)
TGN M2 Allowable MU	15.0	%
Measured concentration	39.74	mg/m ³ (STP, dry)
Range Used	1000.0	ppm
Range Used [A]	1606.1	mg/m ³
Cal gas conc.	802.0	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.	1288.1	mg/m ³

Performance characteristics	RUN 1	Units
Response time	45	seconds
Number of readings in measurement	30	-
Repeatability at zero	2.00	% full scale
Repeatability at span level	0.00	% full scale
Deviation from linearity	0.23	% of value
Zero drift	0.13	% full scale
Span drift	-1.65	% 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)	1.62	% 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	0.020	mg/m ³
Drift	0.56	mg/m ³
Volume or pressure flow dependence	0.0014	mg/m ³
Atmospheric pressure dependence	0.013	mg/m ³
Ambient temperature dependence	0.20	mg/m ³
Combined interference (from MCERTS Certificate)	0.039	mg/m ³
Dependence on voltage	0.058	mg/m ³
Losses in the line (leak)	0.37	mg/m ³
Uncertainty of calibration gas	0.46	mg/m ³

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		39.74	mg/m ³
Expanded uncertainty		0.85	mg/m ³
Expanded uncertainty	k = 1.96	1.66	mg/m ³
Uncertainty corrected to std conds. (O ₂)		1.66	mg/m ³ (REF)

	RUN 1	Units
Expanded uncertainty (no O ₂) - at 95% Confidence	4.17	% of Value
Expanded uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Overall Allowable uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Result of Compliance with Uncertainty Requirement in M2	N/A	-

	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 in M2	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). Ref EA TGN M2.



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Stack Emissions Testing Report Commissioned by
 VIP Polymers Ltd

Installation Name & Address

VIP Polymers Ltd
 15 Windover Road
 Huntingdon
 Cambridgeshire
 PE29 7EB

LAPPC Permit: B11/94

Stack Reference

Stack 55

Dates of the Monitoring Campaign

30th September 2015

Job Reference Number

CSW-1977

Report Written by
Neil Teixeira Team Leader MCERTS Level 2 MM 05 583 TE1 TE2 TE3 TE4

Report Approved by
Matthew Hopes Team Leader MCERTS Level 2 MM 06 688 TE1 TE2 TE3 TE4

Report Date
15th October 2015

Version
Version 1

Signature of Report Approver


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TITLE PAGE

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APPENDIX 1 - Monitoring Personnel & List of Equipment

APPENDIX 2 - Raw Data, Sampling Equations & Charts

Opinions and interpretations expressed herein are outside the scope of Exova Catalyst's ISO 17025 accreditation.

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Executive Summary

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MONITORING OBJECTIVES

VIP Polymers Ltd, Huntingdon

Stack 55

30th September 2015

Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by VIP Polymers Ltd to carry out stack emissions testing on the Stack 55 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, Total VOCs (as Carbon)

Executive Summary

(Page 2 of 7)

MONITORING RESULTS

VIP Polymers Ltd, Huntingdon

Stack 55

30th September 2015

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	0.57	0.99	10	g/hr	8.5	14.8	-
Total VOCs (as Carbon)	¹ mg/m ³	5.0	0.49	-	g/hr	74.0	8.2	-
Water Vapour	% v/v	0.12	0.02					
Stack Gas Temperature	°C	23.0						
Stack Gas Velocity	m/s	14.2	0.35					
Volumetric Flow Rate (ACTUAL)	m ³ /hr	15925	821					
Volumetric Flow Rate (REF)	¹ m ³ /hr	14946	771					

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

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

Executive Summary

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MONITORING DATE(S) & TIMES

VIP Polymers Ltd, Huntingdon

Stack 55

30th September 2015

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m ³	0.57	g/hr	8.5	30/09/2015	15:05 - 15:45	40
Total VOCs (as Carbon)	R1	mg/m ³	5.0	g/hr	74.0	30/09/2015	15:10 - 15:40	30
Velocity & Volumetric Flow Rate	R1					30/09/2015	14:11 - 14:25	

All results are expressed at the respective reference conditions.

Executive Summary

(Page 4 of 7)

PROCESS DETAILS

VIP Polymers Ltd, Huntingdon

Stack 55

30th September 2015

Standard Operating Conditions

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

Executive Summary

(Page 5 of 7)

MONITORING & ANALYTICAL METHODS

VIP Polymers Ltd, Huntingdon

Stack 55

30th September 2015

Parameter	Monitoring				Analysis				MCERTS Testing	LOD (Average)
	Standard	Technical Procedure	ISO 17025 Testing	Testing Lab	Analytical Procedure	Analytical Technique	ISO 17025 Analysis	Analysis Lab		
Total Particulate Matter	EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.14 mg/m ³
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.1 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.32 mg/m ³
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	Yes	CAT	Pitot Tube and Thermocouple				Yes	1.2 m/s

ANALYSIS LABORATORIES

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

Exova Catalyst (CAT)	ISO 17025 Accreditation Number: 4279
----------------------	--------------------------------------

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter	1	Ratio highest to lowest velocities > 5 : 1
		The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl points after this increase were omitted.

Executive Summary

(Page 6 of 7)

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.63
Width	m	-
Area	m ²	0.31
Port Depth	cm	4
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

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

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

All platforms should be designed in accordance with the requirements in EPA Guidance Note AG1 and EN 15259.

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	4.0		> 5 Pa	No
Mean Velocity	m/s	14.19		-	-
Lowest Gas Velocity	m/s	4.04		-	-
Highest Gas Velocity	m/s	37.47		-	-
Ratio of Above	: 1	9.28		< 3 : 1	No
Maximum Angle of Swirl	°	70		< 15°	No
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

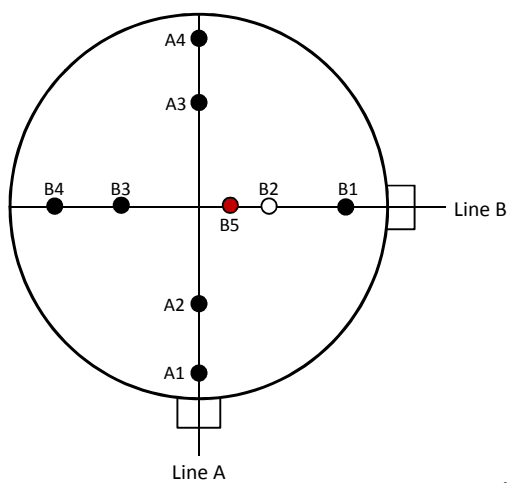
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PLANT PHOTOS

Photo 1



SAMPLE POINTS



where ○ = isokinetic point sampled at
● = isokinetic point not sampled at
● = combustion gases sample point

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	Neil Teixeira	MCERTS Level 2	MM 05 583	TE1 TE2 TE3 TE4
Team Leader	Phil Soley	MCERTS Level 2	MM 12 1187	TE1 TE2 TE3 TE4

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 7.46	Horiba PG-250	-	Digital Manometer (1)	CAT 3.12
Control Box DGM (2)	-	Horiba PG-250 SRM	-	Digital Manometer (2)	-
Box Thermocouples (1)	CAT 3.22	Servomex 4900	-	Digital Temperature Meter	CAT 3.12
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.63
Umbilical (1)	CAT 3.22	ABB AO2020-URAS26	-	Barometer	CAT 13.37
Umbilical (2)	-	Servomex 5200MP	-	Stack Thermocouple (1)	CAT 4.584
Oven Box (1)	-	JCT JCC P1 Cooler	-	Stack Thermocouple (2)	-
Oven Box (2)	-	ProtIR 304M	-	Stack Thermocouple (3)	-
Heated Probe (1)	CAT 5.85	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	-	Bernath 3006 FID	CAT 8.22	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.86	1m Heated Line (3)	-
S-Pitot (1)	CAT 21.P43	Mass Flow Controller (1)	CAT 6.52	5m Heated Line (1)	CAT 20.77
S-Pitot (2)	-	Mass Flow Controller (2)	-	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	-	20m Heated Line (1)	-
500g Check Weight	CAT 17.25	Mass View (2)	-	20m Heated Line (2)	-
1Kg Check Weight	CAT 17.25	Hioki 5043 (V)	CAT 11.91	Dual Channel Heater Controller	-
Last Impinger Arm	-	Easylogger EN-EL-12 Bit	-	Single Channel Heater Controller	-
Callipers	CAT 23.29	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.9

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
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	0.63
Stack Width, W	m	-
Stack Area, A	m ²	0.31
Average Stack Gas Temperature, T _a	°C	23.0
Average Stack Gas Pressure	Pa	56.5
Average Stack Static Pressure, P _{static}	kPa	0.081
Average Barometric Pressure, P _b	kPa	103.0
Average Pitot Tube Calibration Coefficient, C _p	-	0.84

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)	-	20.80	20.77	0.2080	32.00	1.4277	0.29696
N ₂	-	79.14	79.04	0.7914	28.01	1.2498	0.98913
Moisture (H ₂ O)	-	-	0.12	0.0012	18.02	0.8037	0.00098

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	1.287
Dry Density (Actual), P _{Actual}	kg/m ³	1.208
Average Wet Density (Actual), P _{ActualW}	kg/m ³	0.805

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} x (T_s / P_s) x (P_a / T_a)

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	23.0	0.0
Total Pressure	kPa	103.1	101.3
Moisture	%	0.12	0.12

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	15925
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	14946
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	14928
Gas Volumetric Flowrate REF ¹	m ³ /hr	14946

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	30/09/2015
Time of Survey	-	14:11 - 14:25
Atmospheric Pressure	kPa	103.0
Average Stack Static Pressure	Pa	81
Result of Pitot Stagnation Test	-	NOT REQUIRED
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with KIMO MP 210 (500Pa)	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C _p	-	0.84
Number of Lines Available	-	1
Number of Lines Used	-	1

Sampling Line A											
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m³	Velocity m/s	Swirl °					
STATIC (Units: Pa)		80.0	82.0								
Mean		66.0	23.0	1.208	8.06		47.0	23.0	1.208	20.31	
1	0.04	25.0	23.0	1.208	5.39	63.0	38.0	23.0	1.208	20.83	44.0
2	0.16	96.0	23.0	1.208	10.57	57.0	23.0	23.0	1.208	16.20	12.0
3	0.47	14.0	23.0	1.208	4.04	43.0	4.0	23.0	1.208	6.76	64.0
4	0.59	129.0	23.0	1.208	12.25	19.0	123.0	23.0	1.208	37.47	70.0

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	$u(\Delta p_i)$	1.483	Pa
- Resolution	$u(res)$	0.00087	
- Calibration	$u(cal)$	0.332	
- Drift	$u(drift)$	0.083	
- Lack of Fit	$u(fit)$	0.782	
- Overall corrections to dynamic measurements	$u(C_f)$	1.199	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00003	-
- $\phi_{O_2,w}$	-	20.775	
- $\phi_{CO_2,w}$	-	0.060	
- Oxygen, dry	$u(\phi_{O_2,d})$	0.637	
- Carbon Dioxide, dry	$u(\phi_{CO_2,d})$	0.002	
- Water Vapour	$u(\phi_{H_2O})$	0.006	
- Oxygen, wet	$u(\phi_{O_2,w})$	0.636	
- Carbon Dioxide, wet	$u(\phi_{CO_2,w})$	0.002	
Standard uncertainty associated with the stack temperature	$u(T_c)$	1.510	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.698	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	1.483	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00650	-
Standard uncertainty associated with the local velocities	$u(v_i)$	0.407	Pa
Standard uncertainty associated with the mean velocity	$u(\bar{v})$	0.179	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	0.351	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	2.47	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV,w)$	821.4	m ³ /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00069	
- $u^2(qV,w)$	-	175645	
- $u(qV,w)$	-	419.1	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV,w)$	5.16	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 55

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.57		0.57
Uncertainty	±mg/m ³	0.99		0.99
Mass Emission	g/hr	8.5		8.5
Uncertainty	±g/hr	14.8		14.8

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	0.12		0.12
Uncertainty	±% v/v	0.02		0.02

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.30		0.30

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	1 / 8	FORMAT: Number Used / Number Required
Sample Point I.D.'s	B2	

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	772.5	
Stack static pressure, P _{static}	mmH ₂ O	8.2	
P _s = (P _b + (P _{static} / 13.6))	mmHg	773.1	
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	9.2	
Total mass of liquid collected, V _{lc}	g	0.9	
V _{wstd} = (0.001246)(V _{lc})	m ³	0.0011	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V _m	m ³	0.9980	
Gas meter correction factor, Y _d	-	0.9940	
Average dry gas meter temperature, T _m	°C	29.9	
Average pressure drop across orifice, ΔH	mmH ₂ O	64.9	
V _{mstd} = ((0.3592)(V _m)(P _b + (ΔH/13.6))(Y _d)) / (T _m + 273)	m ³	0.9145	
Moisture content, B_{wv} & R_{wv}			
B _{wv} = V _{wstd} / (V _{mstd} + V _{wstd})	m ³	0.0012	
B _{wv} as a percentage	% v/v	0.12	
Reported Water Vapour, checked with Tables in EN 14790, R _{wv}	% v/v	0.12	
Volume of gas metered wet, V_{mstw}			
V _{mstw} = (V _{mstd})(100/(100 - R _{wv}))	m ³	0.9156	
Volume of gas metered at Oxygen Reference Conditions, V_{mstd@X%O₂} & V_{mstw@X%O₂}			
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	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
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	28.83	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K _p	-	34.97	
Velocity pressure coefficient, C _p	-	0.82	
Average of velocity heads, ΔP _{avg}	mmH ₂ O	4.00	
Average square root of velocity heads, √ΔP	√mmH ₂ O	2.00	
Average stack gas temperature, T _s	°C	23.0	
V _s = ((K _p)(C _p)(√ΔP)(√T _s + 273)) / (√(M _s)(P _s))	m/s	6.63	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO₂}), Dry@O_{2REF} (Q_{stdO₂})			
Area of stack, A _s	m ²	0.31	
Q _a = (60)(A _s)(V _s)	m ³ /min	124.1	
Conversion factor (K/mm.Hg), C _f	-	0.3592	
Q _{stw} = ((Q _a)(P _s)(C _f)) / ((T _s + 273))	m ³ /min	116.4	
Q _{std} = ((Q _a)(P _s)(C _f)(1 - (R _{wv} /100))) / ((T _s + 273))	m ³ /min	116.3	
Q _{stwO₂} = ((Q _a)(P _s)(C _f)) / ((T _s + 273)) / (O _{2REFw})	m ³ /min	N/A	
Q _{stdO₂} = ((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	8.88	
Nozzle area, A _n	mm ²	61.89	
Total sampling time, q	min	40	
%I = (4.6398E ⁶)(T _s +273)(V _{mstd}) / (P _s)(V _s)(A _n)(q)(1 - (R _{wv} /100))	%	99.0	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	15:05 - 15:45	
Sampling Dates	-	30/09/2015	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	0.9156	
Filter I.D. Number	-	47-26885	
Start Filter Mass	g	0.13873	
End Filter Mass	g	0.13915	
Total Mass on Filter	g	0.00042	
Probe Rinse I.D. Number	-	PR-47-26885	
Start Probe Rinse Mass	g	3.03554	
End Probe Rinse Mass	g	3.03564	
Total Mass in Probe Rinse	g	0.00010	
Total Mass Collected	mg	0.52	
Calculated Concentration	mg/m ³	0.57	
Balance Uncertainty / LOD	mg/m ³	0.14	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	30/09/2015	
Average Volume Sampled (REF)	m ³	0.9156	
Filter I.D. Number	-	47-26884	
Start Filter Mass	g	0.13941	
End Filter Mass	g	0.13967	
Total Mass on Filter	g	0.00026	
Probe Rinse I.D. Number	-	PR-47-26884	
Start Probe Rinse Mass	g	2.91815	
End Probe Rinse Mass	g	2.91816	
Total Mass in Probe Rinse	g	0.00001	
Total Mass Collected	mg	0.27	
Calculated Concentration	mg/m ³	0.30	
Balance Uncertainty / LOD	mg/m ³	0.14	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	24.80	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.20	
Allowable Leak Rate	l/min	0.50	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	14.0	
Allowable MU	%	20	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	99.0	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.26	
ELV [Daily ELV for IED]	mg/m ³	10.00	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	23	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

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Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Pre-Sampling Leak Rate	l/min	0.20	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
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	
	1	
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)		
Ratio highest to lowest velocities > 5 : 1.	x	
The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl points after this increase were omitted.	x	
The measurement uncertainty for water vapour was greater than 20%. This was due to the low level of water vapour which was found to be present in the stack.	x	

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V _m	0.9980		uV _m	m ³	0.0200	
Sampled Gas Temperature	T _m	302.9		uT _m	K	2.0	
Sampled Gas Pressure	p _m	103.1		up _m	kPa	0.5	
Sampled Gas Humidity	H _m	0.0		uH _m	% v/v	1.0	
Leak	L	0.81		uL	%	-	
Mass of Particulate	m	0.52		um	mg	0.13	
Uncollected Mass	UCM	0.27		uUCM	mg	-	

Uncertainty as a Percentage				Requirement of Standard
Measured Quantities	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.66		≤1%
Sampled Gas Pressure	%	0.49		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	0.81		≤2%
Mass of Particulate	%	1.42		<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	0.9145	0.63	
Leak	L	mg/m ³	0.003	1.00	
Mass of Particulate	L _r	mg	0.523	1.09	
Uncollected Mass	UCM	mg	0.16	1.09	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m ³	0.014	
Leak	mg/m ³	0.0027	
Mass of Particulate	mg/m ³	0.1420	
Uncollected Mass	mg/m ³	0.1724	

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	0.22	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m ³	0.44	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m ³	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m ³	0.99	
Reported Uncertainty	mg/m ³	0.99	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	76.7	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	172.7	
Reported Uncertainty	%	172.7	

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 55

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	5.0		5.0
Uncertainty	±mg/m ³	0.49		0.49
Mass Emission	g/hr	74.0		74.0
Uncertainty	±g/hr	8.2		8.2

General Sampling Information

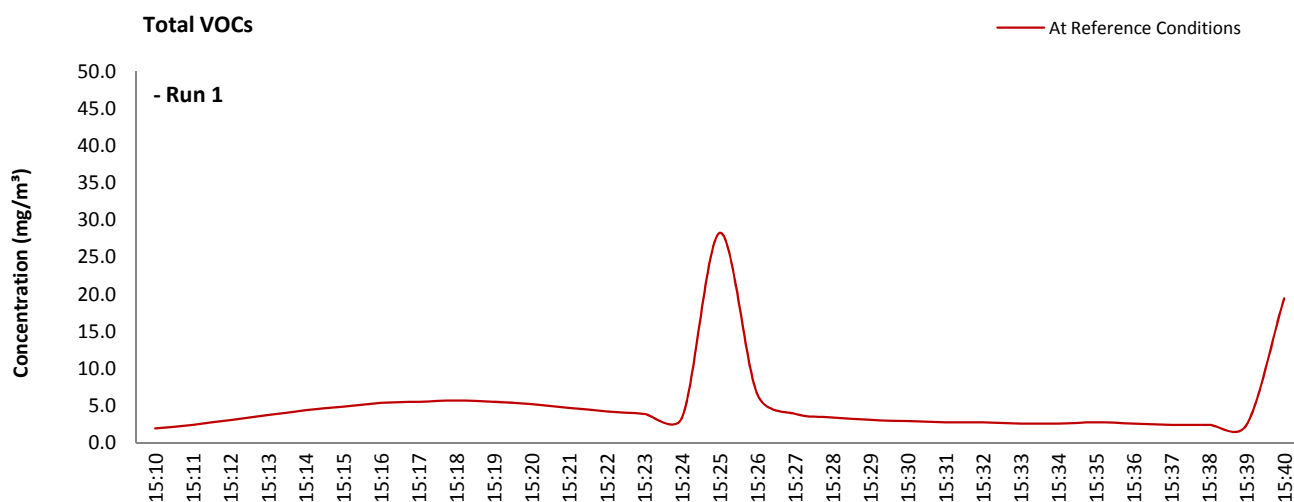
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180	
Span Gas Type	Propane In Synthetic Air (5 Grade)	
Span Gas Reference Number	1.072a	
Span Gas Expiry Date	26/06/2020	
Span Gas Start Pressure (bar)	130	
Gas Cylinder Concentration (ppm)	80.2	
Span Gas Set Point (ppm)	80.20	
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	B5	

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	-	15:10 - 15:40	
Sampling Dates	-	30/09/2015	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.2	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.30	
	Zero Down Sampling Line (Post)	ppm	0.20	
	Zero Drift	ppm	-0.10	
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	4.01	
	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	78.90	
	Span Drift	ppm	-0.10	
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	4.01	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	24.5 - 24	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	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	-	mg/m ³ (REF)
TGN M2 Allowable MU	15.0	%
Measured concentration	4.96	mg/m ³ (STP, dry)
Range Used	100.0	ppm
Range Used [A]	160.6	mg/m ³
Cal gas conc.	80.2	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.	128.8	mg/m ³

Performance characteristics	RUN 1	Units
Response time	45	seconds
Number of readings in measurement	30	-
Repeatability at zero	2.00	% full scale
Repeatability at span level	0.00	% full scale
Deviation from linearity	0.22	% of value
Zero drift	-0.13	% full scale
Span drift	-0.13	% 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)	1.50	% 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	0.019	mg/m ³
Drift	-0.10	mg/m ³
Volume or pressure flow dependence	0.0014	mg/m ³
Atmospheric pressure dependence	0.013	mg/m ³
Ambient temperature dependence	0.20	mg/m ³
Combined interference (from MCERTS Certificate)	0.039	mg/m ³
Dependence on voltage	0.058	mg/m ³
Losses in the line (leak)	0.043	mg/m ³
Uncertainty of calibration gas	0.057	mg/m ³

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		4.96	mg/m ³
Expanded uncertainty		0.25	mg/m ³
Expanded uncertainty	k = 1.96	0.49	mg/m ³
Uncertainty corrected to std conds. (O ₂)		0.49	mg/m ³ (REF)

	RUN 1	Units
Expanded uncertainty (no O ₂) - at 95% Confidence	9.87	% of Value
Expanded uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Overall Allowable uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Result of Compliance with Uncertainty Requirement in M2	N/A	-

	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 in M2	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). Ref EA TGN M2.



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Stack Emissions Testing Report Commissioned by
VIP Polymers Ltd

Installation Name & Address
VIP Polymers Ltd
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Huntingdon
Cambridgeshire
PE29 7EB

LAPPC Permit: B11/94

Stack Reference
Stack 91

Dates of the Monitoring Campaign
1st October 2015

Job Reference Number
CSW-1977

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Report Date
15th October 2015

Version
Version 1

Signature of Report Approver


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APPENDIX 1 - Monitoring Personnel & List of Equipment

APPENDIX 2 - Raw Data, Sampling Equations & Charts

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Executive Summary

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MONITORING OBJECTIVES

VIP Polymers Ltd, Huntingdon

Stack 91

1st October 2015

Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by VIP Polymers Ltd to carry out stack emissions testing on the Stack 91 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, Total VOCs (as Carbon)

Executive Summary

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MONITORING RESULTS

VIP Polymers Ltd, Huntingdon

Stack 91

1st October 2015

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	0.54	0.84	10	g/hr	4.6	7.1	-
Total VOCs (as Carbon)	¹ mg/m ³	2.6	0.45	-	g/hr	21.8	4.0	-
Water Vapour	% v/v	1.6	0.08					
Stack Gas Temperature	°C	30.0						
Stack Gas Velocity	m/s	13.1	0.41					
Volumetric Flow Rate (ACTUAL)	m ³ /hr	9241	510					
Volumetric Flow Rate (REF)	¹ m ³ /hr	8452	466					

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

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

Executive Summary

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MONITORING DATE(S) & TIMES

VIP Polymers Ltd, Huntingdon

Stack 91

1st October 2015

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	0.54	g/hr	4.6	01/10/2015	11:56 - 12:36	40
Total VOCs (as Carbon)	R1	mg/m³	2.6	g/hr	21.8	01/10/2015	12:00 - 12:30	30
Velocity & Volumetric Flow Rate	R1					30/09/2015	11:10 - 11:18	

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

VIP Polymers Ltd, Huntingdon

Stack 91

1st October 2015

Standard Operating Conditions

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

Executive Summary

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MONITORING & ANALYTICAL METHODS

VIP Polymers Ltd, Huntingdon

Stack 91

1st October 2015

Parameter	Monitoring				Analysis				MCERTS Testing	LOD (Average)
	Standard	Technical Procedure	ISO 17025 Testing	Testing Lab	Analytical Procedure	Analytical Technique	ISO 17025 Analysis	Analysis Lab		
Total Particulate Matter	EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.15 mg/m ³
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.1 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.32 mg/m ³
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	Yes	CAT	Pitot Tube and Thermocouple				Yes	1.2 m/s

ANALYSIS LABORATORIES

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

Exova Catalyst (CAT)	ISO 17025 Accreditation Number: 4279
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SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter	1	Ratio highest to lowest velocities > 5 : 1.

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.50
Width	m	-
Area	m ²	0.20
Port Depth	cm	1
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

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

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

All platforms should be designed in accordance with the requirements in EPA Guidance Note AG1 and EN 15259.

EN 15259 Homogeneity Test Requirements

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

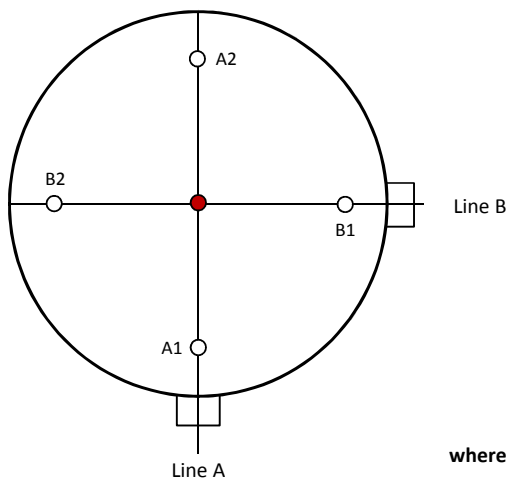
Sampling Plane Validation Criteria (from EN 15259)

Criteria in EN 15259	Units	Traverse 1		Required	Compliant
Lowest Differential Pressure	Pa	9.0		> 5 Pa	Yes
Mean Velocity	m/s	13.07		-	-
Lowest Gas Velocity	m/s	3.29		-	-
Highest Gas Velocity	m/s	25.45		-	-
Ratio of Above	: 1	7.74		< 3 : 1	No
Maximum Angle of Swirl	°	10		< 15°	Yes
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

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SAMPLE POINTS



where ○ = isokinetic point sampled at

● = combustion gases sample point

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	Neil Teixeira	MCERTS Level 2	MM 05 583	TE1 TE2 TE3 TE4
Team Leader	Phil Soley	MCERTS Level 2	MM 12 1187	TE1 TE2 TE3 TE4

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 7.46	Horiba PG-250	-	Digital Manometer (1)	CAT 3.12
Control Box DGM (2)	-	Horiba PG-250 SRM	-	Digital Manometer (2)	-
Box Thermocouples (1)	CAT 3.22	Servomex 4900	-	Digital Temperature Meter	CAT 3.12
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.63
Umbilical (1)	CAT 3.22	ABB AO2020-URAS26	-	Barometer	CAT 13.37
Umbilical (2)	-	Servomex 5200MP	-	Stack Thermocouple (1)	CAT 4.584
Oven Box (1)	-	JCT JCC P1 Cooler	-	Stack Thermocouple (2)	-
Oven Box (2)	-	ProtIR 304M	-	Stack Thermocouple (3)	-
Heated Probe (1)	CAT 5.85	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	-	Bernath 3006 FID	CAT 8.22	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.86	1m Heated Line (3)	-
S-Pitot (1)	CAT 21.P43	Mass Flow Controller (1)	CAT 6.52	5m Heated Line (1)	CAT 20.77
S-Pitot (2)	-	Mass Flow Controller (2)	-	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	-	20m Heated Line (1)	-
500g Check Weight	CAT 17.25	Mass View (2)	-	20m Heated Line (2)	-
1Kg Check Weight	CAT 17.25	Hioki 5043 (V)	CAT 11.91	Dual Channel Heater Controller	-
Last Impinger Arm	-	Easylogger EN-EL-12 Bit	-	Single Channel Heater Controller	-
Callipers	CAT 23.29	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.9

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
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	0.50
Stack Width, W	m	-
Stack Area, A	m ²	0.20
Average Stack Gas Temperature, T _a	°C	30.0
Average Stack Gas Pressure	Pa	30.8
Average Stack Static Pressure, P _{static}	kPa	0.027
Average Barometric Pressure, P _b	kPa	102.8
Average Pitot Tube Calibration Coefficient, C _p	-	0.84

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)	-	20.80	20.48	0.2080	32.00	1.4277	0.29696
N ₂	-	79.14	77.90	0.7914	28.01	1.2498	0.98913
Moisture (H ₂ O)	-	-	1.56	0.0156	18.02	0.8037	0.01255

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	1.280
Dry Density (Actual), P _{Actual}	kg/m ³	1.177
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.170

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} x (T_s / P_s) x (P_a / T_a)

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	30.0	0.0
Total Pressure	kPa	102.8	101.3
Moisture	%	1.56	1.56

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	9241
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	8452
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	8320
Gas Volumetric Flowrate REF ¹	m ³ /hr	8452

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	30/09/2015
Time of Survey	-	11:10 - 11:18
Atmospheric Pressure	kPa	102.8
Average Stack Static Pressure	Pa	27
Result of Pitot Stagnation Test	-	NOT REQUIRED
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with KIMO MP 210 (500Pa)	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C_p	-	0.84
Number of Lines Available	-	1
Number of Lines Used	-	1

Sampling Line A											
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m³	Velocity m/s	Swirl °					
STATIC (Units: Pa)		25.0									
Mean		21.5	30.0	1.170	4.84		29.0	40.0	30.0	1.170	21.30
1	0.07	9.0	30.0	1.170	3.29	9.0	55.0	30.0	1.170	25.45	10.0
2	0.43	34.0	30.0	1.170	6.39	10.0	25.0	30.0	1.170	17.16	10.0

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	$u(\Delta p_i)$	1.159	Pa
- Resolution	$u(res)$	0.00087	
- Calibration	$u(cal)$	0.098	
- Drift	$u(drift)$	0.083	
- Lack of Fit	$u(fit)$	0.161	
- Overall corrections to dynamic measurements	$u(C_f)$	0.344	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00003	-
- $\phi O_2, w$	-	20.475	
- $\phi CO_2, w$	-	0.059	
- Oxygen, dry	$u(\phi O_2, d)$	0.637	
- Carbon Dioxide, dry	$u(\phi CO_2, d)$	0.002	
- Water Vapour	$u(\phi H_2O)$	0.080	
- Oxygen, wet	$u(\phi O_2, w)$	0.627	
- Carbon Dioxide, wet	$u(\phi CO_2, w)$	0.002	
Standard uncertainty associated with the stack temperature	$u(T_c)$	1.546	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.696	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	1.159	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00630	-
Standard uncertainty associated with the local velocities	$u(v_i)$	0.290	Pa
Standard uncertainty associated with the mean velocity	$u(\bar{v})$	0.210	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	0.413	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	3.16	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV, w)$	509.9	m ³ /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV, w)/q^2V, w$	-	0.00079	
- $u^2(qV, w)$	-	67685	
- $u(qV, w)$	-	260.2	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV, w)$	5.52	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 91

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.54		0.54
Uncertainty	±mg/m ³	0.84		0.84
Mass Emission	g/hr	4.6		4.6
Uncertainty	±g/hr	7.1		7.1

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	1.6		1.6
Uncertainty	±% v/v	0.08		0.08

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.42		0.42

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	2 / 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, B1, B2	

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	772.5	
Stack static pressure, P _{static}	mmH ₂ O	2.5	
P _s = (P _b + (P _{static} / 13.6))	mmHg	772.7	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	-4.4	
Total mass collected in impingers (silica trap)	g	15.1	
Total mass of liquid collected, V _{lc}	g	10.7	
V _{wstd} = (0.001246)(V _{lc})	m ³	0.0133	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V _m	m ³	0.9040	
Gas meter correction factor, Y _d	-	0.9940	
Average dry gas meter temperature, T _m	°C	25.3	
Average pressure drop across orifice, ΔH	mmH ₂ O	52.1	
V _{mstd} = ((0.3592)(V _m)(P _b + (ΔH/13.6))(Y _d) / (T _m + 273))	m ³	0.8402	
Moisture content, B_{wv} & R_{wv}			
B _{wv} = V _{wstd} / (V _{mstd} + V _{wstd})	m ³	0.0156	
B _{wv} as a percentage	% v/v	1.56	
Reported Water Vapour, checked with Tables in EN 14790, R _{wv}	% v/v	1.56	
Volume of gas metered wet, V_{mstw}			
V _{mstw} = (V _{mstd})(100/(100 - R _{wv}))	m ³	0.8535	
Volume of gas metered at Oxygen Reference Conditions, V_{mstd@X%O₂} & V_{mstw@X%O₂}			
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	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
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	28.67	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K _p	-	34.97	
Velocity pressure coefficient, C _p	-	0.82	
Average of velocity heads, ΔP _{avg}	mmH ₂ O	3.29	
Average square root of velocity heads, √ΔP	√mmH ₂ O	1.81	
Average stack gas temperature, T _s	°C	30.0	
V _s = ((K _p)(C _p)(√ΔP)(T _s + 273)) / (V(M _s)(P _s))	m/s	6.10	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO₂}), Dry@O_{2REF} (Q_{stdO₂})			
Area of stack, A _s	m ²	0.20	
Q _a = (60)(A _s)(V _s)	m ³ /min	71.9	
Conversion factor (K/mm.Hg), C _f	-	0.3592	
Q _{stw} = ((Q _a)(P _s)(C _f)) / ((T _s + 273))	m ³ /min	65.9	
Q _{std} = ((Q _a)(P _s)(C _f)(1 - (R _{wv} /100))) / ((T _s + 273))	m ³ /min	64.8	
Q _{stwO₂} = ((Q _a)(P _s)(C _f)) / ((T _s + 273)) / (O _{2REFw})	m ³ /min	N/A	
Q _{stdO₂} = ((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	8.91	
Nozzle area, A _n	mm ²	62.36	
Total sampling time, q	min	40	
%I = (4.6398E ⁶)(T _s +273)(V _{mstd}) / (P _s)(V _s)(A _n)(q)(1 - (R _{wv} /100))	%	102.0	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	11:56 - 12:36	
Sampling Dates	-	01/10/2015	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	0.8535	
Filter I.D. Number	-	47-27526	
Start Filter Mass	g	0.14006	
End Filter Mass	g	0.14043	
Total Mass on Filter	g	0.00037	
Probe Rinse I.D. Number	-	PR-47-27526	
Start Probe Rinse Mass	g	3.03573	
End Probe Rinse Mass	g	3.03582	
Total Mass in Probe Rinse	g	0.00009	
Total Mass Collected	mg	0.46	
Calculated Concentration	mg/m ³	0.54	
Balance Uncertainty / LOD	mg/m ³	0.15	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	01/10/2015	
Average Volume Sampled (REF)	m ³	0.8535	
Filter I.D. Number	-	47-27525	
Start Filter Mass	g	0.13866	
End Filter Mass	g	0.13898	
Total Mass on Filter	g	0.00032	
Probe Rinse I.D. Number	-	PR-47-27525	
Start Probe Rinse Mass	g	2.96684	
End Probe Rinse Mass	g	2.96688	
Total Mass in Probe Rinse	g	0.00004	
Total Mass Collected	mg	0.36	
Calculated Concentration	mg/m ³	0.42	
Balance Uncertainty / LOD	mg/m ³	0.15	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	22.46	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.45	
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	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	102.0	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.28	
ELV [Daily ELV for IED]	mg/m ³	10.00	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	30	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
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	
Ratio highest to lowest velocities > 5 : 1.	x	

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V _m	0.9040		uV _m	m ³	0.0181	
Sampled Gas Temperature	T _m	298.3		uT _m	K	2.0	
Sampled Gas Pressure	p _m	103.0		up _m	kPa	0.5	
Sampled Gas Humidity	H _m	0.0		uH _m	% v/v	1.0	
Leak	L	0.45		uL	%	-	
Mass of Particulate	m	0.46		um	mg	0.13	
Uncollected Mass	UCM	0.36		uUCM	mg	-	

Uncertainty as a Percentage				Requirement of Standard
Measured Quantities	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.67		≤1%
Sampled Gas Pressure	%	0.49		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	0.45		≤2%
Mass of Particulate	%	1.52		<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	0.8402	0.65	
Leak	L	mg/m ³	0.001	1.00	
Mass of Particulate	L _r	mg	0.463	1.17	
Uncollected Mass	UCM	mg	0.21	1.17	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m ³	0.014	
Leak	mg/m ³	0.0014	
Mass of Particulate	mg/m ³	0.1523	
Uncollected Mass	mg/m ³	0.2413	

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	0.29	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m ³	0.56	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m ³	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m ³	0.84	
Reported Uncertainty	mg/m ³	0.84	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	103.1	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	154.7	
Reported Uncertainty	%	154.7	

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack 91

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	2.6		2.6
Uncertainty	±mg/m ³	0.45		0.45
Mass Emission	g/hr	21.8		21.8
Uncertainty	±g/hr	4.0		4.0

General Sampling Information

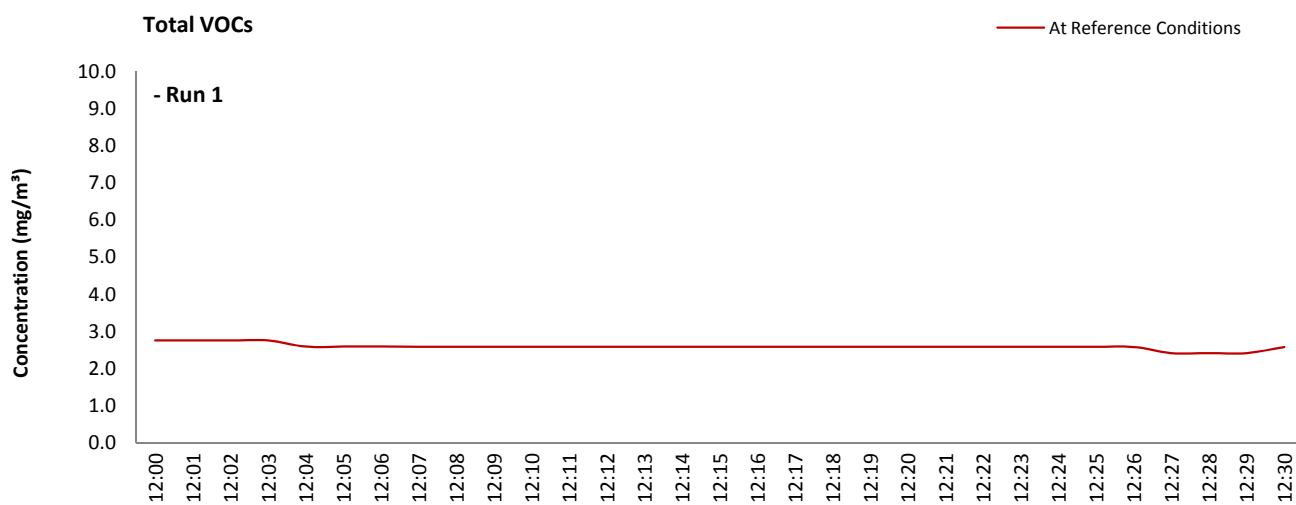
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180	
Span Gas Type	Propane In Synthetic Air (5 Grade)	
Span Gas Reference Number	1.072a	
Span Gas Expiry Date	26/06/2020	
Span Gas Start Pressure (bar)	130	
Gas Cylinder Concentration (ppm)	80.2	
Span Gas Set Point (ppm)	80.20	
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	A3	

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	-	12:00 - 12:30	
Sampling Dates	-	01/10/2015	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.2	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.20	
	Zero Down Sampling Line (Post)	ppm	0.30	
	Zero Drift	ppm	0.10	
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	4.01	
	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	77.80	
	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	4.01	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	20 - 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.	x	

TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1	Units
Limit value	-	mg/m ³ (REF)
TGN M2 Allowable MU	15.0	%
Measured concentration	2.62	mg/m ³ (STP, dry)
Range Used	100.0	ppm
Range Used [A]	160.6	mg/m ³
Cal gas conc.	80.2	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.	128.8	mg/m ³

Performance characteristics	RUN 1	Units
Response time	45	seconds
Number of readings in measurement	30	-
Repeatability at zero	2.00	% full scale
Repeatability at span level	0.00	% full scale
Deviation from linearity	0.22	% of value
Zero drift	0.13	% 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)	1.50	% 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	0.019	mg/m ³
Drift	0.071	mg/m ³
Volume or pressure flow dependence	0.0014	mg/m ³
Atmospheric pressure dependence	0.013	mg/m ³
Ambient temperature dependence	0.20	mg/m ³
Combined interference (from MCERTS Certificate)	0.039	mg/m ³
Dependence on voltage	0.058	mg/m ³
Losses in the line (leak)	0.023	mg/m ³
Uncertainty of calibration gas	0.030	mg/m ³

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		2.62	mg/m ³
Expanded uncertainty		0.23	mg/m ³
Expanded uncertainty	k = 1.96	0.46	mg/m ³
Uncertainty corrected to std conds. (O ₂)		0.46	mg/m ³ (REF)

	RUN 1	Units
Expanded uncertainty (no O ₂) - at 95% Confidence	17.41	% of Value
Expanded uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Overall Allowable uncertainty (no O ₂) - at 95% Confidence	N/A	% at ELV
Result of Compliance with Uncertainty Requirement in M2	N/A	-

	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 in M2	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). Ref EA TGN M2.