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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

PPC Permit: B11/94

**Stack Reference**  
Stack 24 - The Cooling Booth on Desma 14

**Dates of the Monitoring Campaign**  
9th January 2018

**Job Reference Number**  
CAT-3927

<b>Report Written by</b>
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<b>Report Date</b>
24th January 2018

<b>Version</b>
Version 1

<b>Signature of Report Approver</b>

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## Executive Summary

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### MONITORING OBJECTIVES

VIP Polymers Ltd, Huntingdon  
Stack 24 - The Cooling Booth on Desma 14  
9th January 2018

#### Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by VIP Polymers Ltd to carry out stack emissions testing on the Stack 24 - The Cooling Booth on Desma 14 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 24 - The Cooling Booth on Desma 14  
 9th January 2018

where MU = Measurement Uncertainty associated with the Result

Parameter	Concentration				Mass Emission			
	Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Total Particulate Matter	<sup>1</sup> mg/m <sup>3</sup>	0.68	0.81	10	g/hr	0.94	1.2	-
Total VOCs (as Carbon)	<sup>1</sup> mg/m <sup>3</sup>	3.8	0.44	-	g/hr	5.2	2.9	-
Water Vapour	% v/v	1.1	0.09					
Stack Gas Temperature	°C	17.0						
Stack Gas Velocity	m/s	5.8	3.2					
Volumetric Flow Rate (ACTUAL)	m <sup>3</sup> /hr	1481	807					
Volumetric Flow Rate (REF)	<sup>1</sup> m <sup>3</sup> /hr	1378	750					

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

<sup>1</sup> 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 24 - The Cooling Booth on Desma 14  
 9th January 2018

Parameter	Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1 mg/m <sup>3</sup>	0.68	g/hr	0.94	09/01/2018	15:16 - 15:56	40
Total VOCs (as Carbon)	R1 mg/m <sup>3</sup>	3.8	g/hr	5.2	09/01/2018	12:36 - 13:16	40
Velocity & Volumetric Flow Rate	R1				09/01/2018	15:07 - 15:14	

All results are expressed at the respective reference conditions.

## Executive Summary

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### PROCESS DETAILS

VIP Polymers Ltd, Huntingdon  
 Stack 24 - The Cooling Booth on Desma 14  
 9th January 2018

#### Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	Full Capacity
Continuous or Batch Process	Continuous Batch 3 - 4 min cycle
Feedstock (if applicable)	Rubber Products
Abatement System	N/A
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 24 - The Cooling Booth on Desma 14  
 9th January 2018

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	0.32 mg/m <sup>3</sup>
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.10 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.21 mg/m <sup>3</sup>
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	Yes	CAT	Pitot Tube and Thermocouple				Yes	1.8 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
All Parameters	All Runs	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	0.30
Width	m	-
Area	m <sup>2</sup>	0.07
Port Depth	cm	5
Orientation of Duct	-	Vertical
Number of Ports	-	2
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)	N/A
Platform has vertical base boards (approx. 0.25m high)	N/A
Platform has chains / self closing gates at top of ladders	N/A
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	No

#### Sampling Location / Platform Improvement Recommendations

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

#### EN 15259 Homogeneity Test Requirements

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

#### Sampling Plane Validation Criteria (from EN 15259)

Criteria in EN 15259	Units	Traverse 1	Required	Compliant
Lowest Differential Pressure	Pa	29.4	> 5 Pa	Yes
Mean Velocity	m/s	5.82	-	-
Lowest Gas Velocity	m/s	5.82	-	-
Highest Gas Velocity	m/s	5.82	-	-
Ratio of Above	: 1	1.00	< 3 : 1	Yes
Maximum Angle of Swirl	°	0	< 15°	Yes
No Local Negative Flow	-	Yes	-	Yes



# Executive Summary

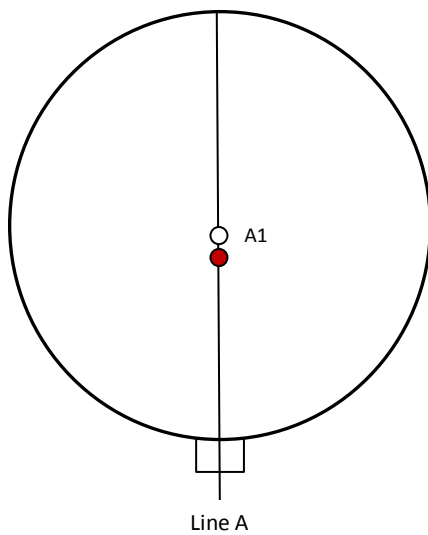
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## PLANT PHOTOS

Photo 1



## SAMPLE POINTS



- where
- = isokinetic point sampled at
  - = isokinetic point not sampled at
  - = combustion gases sample point
  - = non-isokinetic 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	Ian Baggley	MCERTS Level 2	MM 05 653	TE1 TE2 TE3 TE4
Technician	Gareth Jones	MCERTS Level 1	MM 13 1241	TE1

**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 7.5	Horiba PG-250	-	Digital Manometer (1)	CAT 3.125
Control Box DGM (2)	-	Horiba PG-350E	-	Digital Manometer (2)	-
Box Thermocouples (1)	CAT 3.12	Servomex 4900	-	Digital Temperature Meter	CAT 3.125
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	-
Umbilical (1)	CAT 3.12	ABB AO2020-URAS26	-	Barometer	CAT 13.29
Umbilical (2)	-	Testo 350 XL	-	Stack Thermocouple (1)	CAT 4.0018
Oven Box (1)	-	JCT JCC P1 Cooler	-	Stack Thermocouple (2)	-
Oven Box (2)	-	ProtIR 204M	-	Stack Thermocouple (3)	-
Heated Probe (1)	CAT 5.19	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	CAT 5.20	Bernath 3006 FID	CAT 8.5	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	-	1m Heated Line (3)	-
S-Pitot (1)	CAT 21.S79	Mass Flow Controller (1)	CAT 6.19	5m Heated Line (1)	-
S-Pitot (2)	-	Mass Flow Controller (2)	CAT 6.20	15m Heated Line (1)	CAT 20.89
L-Pitot	-	Mass View (1)	-	20m Heated Line (1)	-
Site Balance	CAT 17.2	Mass View (2)	-	20m Heated Line (2)	-
500g / 1Kg Check Weights	CAT 17.2	Easylogger EN-EL-12 Bit	-	Dual Channel Heater Controller	-
Last Impinger Arm	-	Hioki 5043 (V)	CAT 8.40	Single Channel Heater Controller	-
Callipers	CAT 23.7	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.26

**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	0.30
Stack Width, W	m	-
Stack Area, A	m <sup>2</sup>	0.07
Average Stack Gas Temperature, T <sub>a</sub>	°C	17.0
Average Stack Gas Pressure	mmH <sub>2</sub> O	3.0
Average Stack Static Pressure, P <sub>static</sub>	kPa	0.012
Average Barometric Pressure, P <sub>b</sub>	kPa	100.1
Average Pitot Tube Calibration Coefficient, C <sub>p</sub>	-	0.83

### Stack Gas Composition & Molecular Weights

Component	Conc ppm	Conc Dry % v/v	Conc Wet % v/v	Volume Fraction r	Molar Mass M	Density kg/m <sup>3</sup> p	Conc kg/m <sup>3</sup> p <sub>i</sub>
CO <sub>2</sub> (Estimated)	-	0.06	0.06	0.0006	44.01	1.9635	0.00118
O <sub>2</sub> (Estimated)	-	20.80	20.58	0.2080	32.00	1.4277	0.29696
N <sub>2</sub>	-	79.14	78.30	0.7914	28.01	1.2498	0.98913
Moisture (H <sub>2</sub> O)	-	-	1.06	0.0106	18.02	0.8037	0.00855

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

### Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P <sub>STD</sub>	kg/m <sup>3</sup>	1.287
Wet Density (STP), P <sub>STW</sub>	kg/m <sup>3</sup>	1.282
Dry Density (Actual), P <sub>Actual</sub>	kg/m <sup>3</sup>	1.198
Average Wet Density (Actual), P <sub>ActualW</sub>	kg/m <sup>3</sup>	0.596

Where:  $P_{STD}$  = sum of component concentrations, kg/m<sup>3</sup> (not including water vapour)  
 $P_{STW}$  = sum of all wet concentrations / 100 x density, kg/m<sup>3</sup> (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 <sup>1</sup>
Temperature	°C	17.0	0.0
Total Pressure	kPa	100.1	101.3
Moisture	%	1.06	1.06

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m <sup>3</sup> /hr	1481
Gas Volumetric Flowrate (STP, Wet)	m <sup>3</sup> /hr	1378
Gas Volumetric Flowrate (STP, Dry)	m <sup>3</sup> /hr	1363
Gas Volumetric Flowrate REF <sup>1</sup>	m <sup>3</sup> /hr	1378

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	09/01/2018
Time of Survey	-	15:07 - 15:14
Atmospheric Pressure	kPa	100.1
Average Stack Static Pressure	Pa	12
Result of Pitot Stagnation Test	-	Pass
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with Liquid Incline Manometer	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C <sub>p</sub>	-	0.83
Number of Lines Available	-	1
Number of Lines Used	-	1

**Sampling Line A**

Traverse Point	Depth m	ΔP mmH <sub>2</sub> O	Temp °C	Wet Density kg/m <sup>3</sup>	Velocity m/s	Swirl °
<i>STATIC (Units: Pa)</i>		12.0				
<b>Mean</b>		<b>3.0</b>	<b>17.0</b>	<b>1.193</b>	<b>5.82</b>	
1	0.15	3.0	17.0	1.193	5.82	0.0

**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	$u(\Delta p_i)$	1.659	Pa
- Resolution	$u(res)$	0.52154	
- Calibration	$u(cal)$	0.090	
- Drift	$u(drift)$	1.096	
- Lack of Fit	$u(fit)$	0.043	
- Overall corrections to dynamic measurements	$u(C_f)$	1.751	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00003	-
- $\varphi_{O_2,w}$	-	20.579	
- $\varphi_{CO_2,w}$	-	0.059	
- Oxygen, dry	$u(\phi_{O_2,d})$	0.637	
- Carbon Dioxide, dry	$u(\phi_{CO_2,d})$	0.002	
- Water Vapour	$u(\phi_{H_2O})$	0.054	
- Oxygen, wet	$u(\phi_{O_2,w})$	0.630	
- Carbon Dioxide, wet	$u(\phi_{CO_2,w})$	0.002	
Standard uncertainty associated with the stack temperature	$u(T_c)$	1.480	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.700	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	1.659	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00644	-
Standard uncertainty associated with the local velocities	$u(v_i)$	1.611	Pa
Standard uncertainty associated with the mean velocity	$u(\underline{v})$	1.611	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	3.158	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	54.28	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV,w)$	806.5	m <sup>3</sup> /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.07724	
- $u^2(qV,w)$	-	169336	
- $u(qV,w)$	-	411.5	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV,w)$	54.47	%

**TOTAL PARTICULATE MATTER: RESULTS SUMMARY**

VIP Polymers Ltd, Huntingdon  
Stack 24 - The Cooling Booth on Desma 14

**Sample Runs**

Parameter	Units	Run 1	Mean
Concentration	mg/m <sup>3</sup>	0.68	0.68
Uncertainty	±mg/m <sup>3</sup>	0.81	0.81
Mass Emission	g/hr	0.94	0.94
Uncertainty	±g/hr	1.2	1.2

Parameter	Units	Run 1	Mean
Water Vapour	% v/v	1.1	1.1
Uncertainty	±% v/v	0.09	0.09

**Blank Runs**

Parameter	Units	Blank 1	Maximum
Concentration	mg/m <sup>3</sup>	0.44	0.44

**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 / 1
Number of Sampling Points Used	1 / 1
Sample Point I.D.'s	A1

FORMAT: Number Used / Number Required  
FORMAT: Number Used / Number Required

**Reference Conditions**

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

**TOTAL PARTICULATE MATTER: ISOKINETIC SAMPLING CALCULATIONS**

Test	Units	Run 1	
<b>Absolute pressure of stack gas, P<sub>s</sub></b>			
Barometric pressure, P <sub>b</sub>	mmHg	750.8	
Stack static pressure, P <sub>static</sub>	mmH <sub>2</sub> O	1.3	
P <sub>s</sub> = (P <sub>b</sub> + (P <sub>static</sub> / 13.6))	mmHg	750.9	
<b>Volume of water vapour collected, V<sub>wstd</sub></b>			
Total mass collected in impingers (liquid trap)	g	-0.8	
Total mass collected in impingers (silica trap)	g	4.5	
Total mass of liquid collected, V <sub>lc</sub>	g	3.7	
V <sub>wstd</sub> = (0.001246)(V <sub>lc</sub> )	m <sup>3</sup>	0.0046	
<b>Volume of gas metered dry, V<sub>mstd</sub></b>			
Volume of gas sample through gas meter, V <sub>m</sub>	m <sup>3</sup>	0.4573	
Gas meter correction factor, Y <sub>d</sub>	-	0.9870	
Average dry gas meter temperature, T <sub>m</sub>	°C	11.3	
Average pressure drop across orifice, ΔH	mmH <sub>2</sub> O	14.6	
V <sub>mstd</sub> = ((0.3592)(V <sub>m</sub> )(P <sub>b</sub> + (ΔH/13.6))(Y <sub>d</sub> )) / (T <sub>m</sub> + 273)	m <sup>3</sup>	0.4288	
<b>Moisture content, B<sub>wv</sub> &amp; R<sub>wv</sub></b>			
B <sub>wv</sub> = V <sub>wstd</sub> / (V <sub>mstd</sub> + V <sub>wstd</sub> )	m <sup>3</sup>	0.0106	
B <sub>wv</sub> as a percentage	% v/v	1.06	
Reported Water Vapour, checked with Tables in EN 14790, R <sub>wv</sub>	% v/v	1.06	
<b>Volume of gas metered wet, V<sub>mstw</sub></b>			
V <sub>mstw</sub> = (V <sub>mstd</sub> )(100/(100 - R <sub>wv</sub> ))	m <sup>3</sup>	0.4334	
<b>Volume of gas metered at Oxygen Reference Conditions, V<sub>mstd@X%O<sub>2</sub></sub> &amp; V<sub>mstw@X%O<sub>2</sub></sub></b>			
IED & Incinerates Hazardous Material? (Yes = no positive O <sub>2</sub> correction)	-	No	
% wet oxygen measured in gas stream, ACT%O <sub>2w</sub>	% v/v	N/A	
% dry oxygen measured in gas stream, ACT%O <sub>2d</sub>	% v/v	N/A	
% oxygen reference condition, REF%O <sub>2</sub>	% v/v	N/A	
O <sub>2</sub> Reference Factor wet (O <sub>2REFw</sub> ) = (21 - REF%O <sub>2</sub> ) / (21 - ACT%O <sub>2w</sub> )	-	N/A	
O <sub>2</sub> Reference Factor dry (O <sub>2REFd</sub> ) = (21 - REF%O <sub>2</sub> ) / (21 - ACT%O <sub>2d</sub> )	-	N/A	
V <sub>mstw@X%oxygen</sub> = (V <sub>mstw</sub> ) / (O <sub>2REFw</sub> )	m <sup>3</sup>	N/A	
V <sub>mstd@X%oxygen</sub> = (V <sub>mstd</sub> ) / (O <sub>2REFd</sub> )	m <sup>3</sup>	N/A	
<b>Molecular weight of dry gas stream, M<sub>d</sub></b>			
CO <sub>2</sub> (Estimated)	% v/v	0.06	
O <sub>2</sub> (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N <sub>2</sub>	% v/v	79.14	
M <sub>d</sub> = 0.44(%CO <sub>2</sub> )+0.32(%O <sub>2</sub> )+0.28(%N <sub>2</sub> )	g/gmol	28.84	
<b>Molecular weight of stack gas (wet), M<sub>s</sub></b>			
M <sub>s</sub> = M <sub>d</sub> (1 - (R <sub>wv</sub> /100)) + 18(R <sub>wv</sub> /100)	g/gmol	28.73	
<b>Velocity of stack gas, V<sub>s</sub></b>			
Pitot tube velocity constant, K <sub>p</sub>	-	34.97	
Velocity pressure coefficient, C <sub>p</sub>	-	0.83	
Average of velocity heads, ΔP <sub>avg</sub>	mmH <sub>2</sub> O	2.48	
Average square root of velocity heads, √ΔP	√mmH <sub>2</sub> O	1.57	
Average stack gas temperature, T <sub>s</sub>	°C	17.0	
V <sub>s</sub> = ((K <sub>p</sub> )(C <sub>p</sub> )(√ΔP)(√T <sub>s</sub> + 273)) / (√(M <sub>s</sub> )(P <sub>s</sub> ))	m/s	5.29	
<b>Total flow of stack gas: Actual (Q<sub>a</sub>), Wet (Q<sub>stw</sub>), Dry (Q<sub>std</sub>), Wet@O<sub>2REF</sub> (Q<sub>stwO<sub>2</sub></sub>), Dry@O<sub>2REF</sub> (Q<sub>stdO<sub>2</sub></sub>)</b>			
Area of stack, A <sub>s</sub>	m <sup>2</sup>	0.07	
Q <sub>a</sub> = (60)(A <sub>s</sub> )(V <sub>s</sub> )	m <sup>3</sup> /min	22.5	
Conversion factor (K/mm.Hg), C <sub>f</sub>	-	0.3592	
Q <sub>stw</sub> = ((Q <sub>a</sub> )(P <sub>s</sub> )(C <sub>f</sub> )) / ((T <sub>s</sub> + 273)	m <sup>3</sup> /min	20.9	
Q <sub>std</sub> = ((Q <sub>a</sub> )(P <sub>s</sub> )(C <sub>f</sub> )(1 - (R <sub>wv</sub> /100))) / ((T <sub>s</sub> + 273)	m <sup>3</sup> /min	20.7	
Q <sub>stwO<sub>2</sub></sub> = ((Q <sub>a</sub> )(P <sub>s</sub> )(C <sub>f</sub> )) / ((T <sub>s</sub> + 273) / (O <sub>2REFw</sub> ))	m <sup>3</sup> /min	N/A	
Q <sub>stdO<sub>2</sub></sub> = ((Q <sub>a</sub> )(P <sub>s</sub> )(C <sub>f</sub> )(1 - (R <sub>wv</sub> /100))) / ((T <sub>s</sub> + 273) / (O <sub>2REFd</sub> ))	m <sup>3</sup> /min	N/A	
<b>Percent isokinetic, %I</b>			
Nozzle diameter, D <sub>n</sub>	mm	6.93	
Nozzle area, A <sub>n</sub>	mm <sup>2</sup>	37.69	
Total sampling time, q	min	40	
%I = (4.6398E <sup>6</sup> )(T <sub>s</sub> +273)(V <sub>mstd</sub> ) / (P <sub>s</sub> )(V <sub>s</sub> )(A <sub>n</sub> )(q)(1 - (R <sub>wv</sub> /100))	%	97.3	



**TOTAL PARTICULATE MATTER: SAMPLING DETAILS**

**Sample Runs**

Parameter	Units	Run 1
Sampling Times	-	15:16 - 15:56
Sampling Dates	-	09/01/2018
Sampling Device	-	ISO
Volume Sampled (REF)	m <sup>3</sup>	0.4334
Filter I.D. Number	-	47-48551
Start Filter Mass	g	0.15220
End Filter Mass	g	0.15231
Total Mass on Filter	g	0.00011
Probe Rinse I.D. Number	-	PR-47-48551
Start Probe Rinse Mass	g	3.05516
End Probe Rinse Mass	g	3.05535
Total Mass in Probe Rinse	g	0.00018
Total Mass Collected	mg	0.30
Calculated Concentration	mg/m <sup>3</sup>	0.68
Balance Uncertainty / LOD	mg/m <sup>3</sup>	0.32

**Where:** ISO stands for Manual Isokinetic Sampling Train

**Blank Runs**

Parameter	Units	Blank 1
Blank Dates	-	09/01/2018
Average Volume Sampled (REF)	m <sup>3</sup>	0.4334
Filter I.D. Number	-	47-48550
Start Filter Mass	g	0.15230
End Filter Mass	g	0.15231
Total Mass on Filter	g	0.00001
Probe Rinse I.D. Number	-	PR-47-48550
Start Probe Rinse Mass	g	2.96836
End Probe Rinse Mass	g	2.96854
Total Mass in Probe Rinse	g	0.00018
Total Mass Collected	mg	0.19
Calculated Concentration	mg/m <sup>3</sup>	0.44
Balance Uncertainty / LOD	mg/m <sup>3</sup>	0.32

**TOTAL PARTICULATE MATTER: QUALITY ASSURANCE**

(PAGE 1 OF 2)

**Sample Runs**

<b>Leak Test Results</b>	<b>Units</b>	<b>Run 1</b>	
Mean Sampling Rate	l/min	11.28	
Pre-Sampling Leak Rate	l/min	0.12	
Post-Sampling Leak Rate	l/min	0.14	
Allowable Leak Rate	l/min	0.23	
Leak Test Acceptable	-	Yes	

<b>Water Droplets</b>	<b>Units</b>	<b>Run 1</b>	
Are Water Droplets Present	-	No	

<b>MU (Concurrent Water Vapour)</b>	<b>Units</b>	<b>Run 1</b>	
Measurement Uncertainty (MU)	%	8.2	
Allowable MU	%	20	
MU Acceptable	%	Yes	

<b>Silica Gel (Concurrent Water Vapour)</b>	<b>Units</b>	<b>Run 1</b>	
Less than 50% Faded	%	Yes	

<b>Isokinetic Criterion Compliance</b>	<b>Units</b>	<b>Run 1</b>	
Isokinetic Variation	%	97.3	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	

<b>Weighing Uncertainty Criteria</b>	<b>Units</b>	<b>Run 1</b>	
Overall Weighing Uncertainty	± mg	0.25	
Overall Weighing Uncertainty	± mg/m <sup>3</sup>	0.58	
ELV [Daily ELV for IED]	mg/m <sup>3</sup>	10.00	
Allowable Weighing Uncertainty	mg/m <sup>3</sup>	0.50	
Weighing Uncertainty Acceptable	-	No	

<b>Filter Temperatures</b>	<b>Units</b>	<b>Run 1</b>	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	17	

<b>Test Conditions</b>	<b>Units</b>	<b>Run 1</b>	
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	12.00	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.24	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m <sup>3</sup>	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.	wx

**TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS**

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V <sub>m</sub>	0.4573		uV <sub>m</sub>	m <sup>3</sup>	0.0091	
Sampled Gas Temperature	T <sub>m</sub>	284.3		uT <sub>m</sub>	K	2.0	
Sampled Gas Pressure	p <sub>m</sub>	100.1		up <sub>m</sub>	kPa	0.5	
Sampled Gas Humidity	H <sub>m</sub>	0.0		uH <sub>m</sub>	% v/v	1.0	
Leak	L	1.24		uL	%	-	
Mass of Particulate	m	0.30		um	mg	0.14	
Uncollected Mass	UCM	0.19		uUCM	mg	-	

Measured Quantities	Uncertainty as a Percentage			Requirement of Standard
	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.70		≤1%
Sampled Gas Pressure	%	0.50		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	1.24		≤2%
Mass of Particulate	%	3.23		<5% of ELV
Uncollected Mass	%	-		-

Measured Quantities	Uncertainty in Measurement Units				Sensitivity Coefficient	
	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	V <sub>m</sub>	m <sup>3</sup>	0.4288		1.60	
Leak	L	mg/m <sup>3</sup>	0.005		1.00	
Mass of Particulate	L <sub>r</sub>	mg	0.297		2.31	
Uncollected Mass	UCM	mg	0.11		2.31	

Measured Quantities	Uncertainty in Result		
	Units	Run 1	
Sampled Volume (STP)	mg/m <sup>3</sup>	0.017	
Leak	mg/m <sup>3</sup>	0.0049	
Mass of Particulate	mg/m <sup>3</sup>	0.3230	
Uncollected Mass	mg/m <sup>3</sup>	0.2531	

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

Parameter	Units	Run 1	
Combined uncertainty	mg/m <sup>3</sup>	0.41	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m <sup>3</sup>	0.81	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m <sup>3</sup>	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m <sup>3</sup>	0.81	
Reported Uncertainty	mg/m <sup>3</sup>	0.81	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	117.6	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	117.6	
Reported Uncertainty	%	117.6	

**TOTAL VOCs (as CARBON): RESULTS SUMMARY**

VIP Polymers Ltd, Huntingdon  
Stack 24 - The Cooling Booth on Desma 14

**Sample Runs**

Parameter	Units	Run 1	Mean
Concentration	mg/m <sup>3</sup>	3.8	3.8
Uncertainty	±mg/m <sup>3</sup>	0.44	0.44
Mass Emission	g/hr	5.2	5.2
Uncertainty	±g/hr	2.9	2.9

**General Sampling Information**

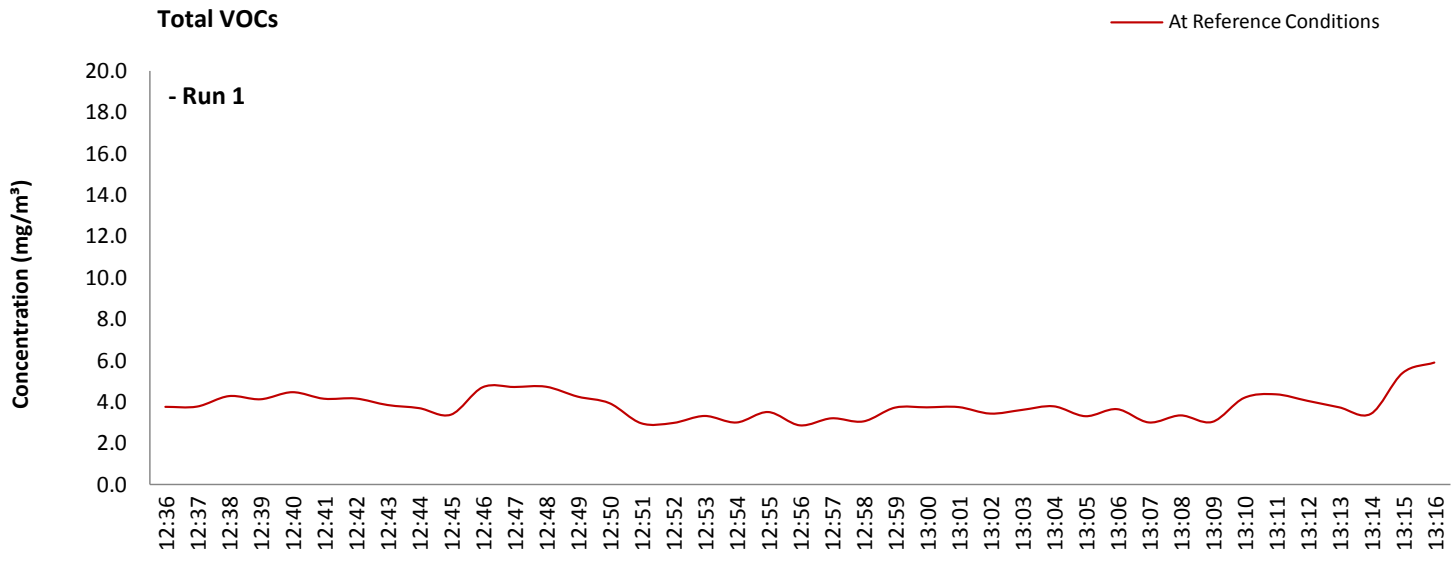
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Type	Propane In Synthetic Air (5 Grade)	
Span Gas Reference Number	1.316a	
Span Gas Expiry Date	24/11/2022	
Span Gas Start Pressure (bar)	60	
Gas Cylinder Concentration (ppm)	80.4	
Span Gas Set Point (ppm)	80.40	
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	A1	

**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	-	12:36 - 13:16	
Sampling Dates	-	09/01/2018	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.4	

**Quality Assurance**

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.60	
	Zero Down Sampling Line (Post)	ppm	-1.60	
	Zero Drift	ppm	-2.20	
	Allowable Zero Drift	± ppm	4.02	
	Zero Drift Acceptable	-	Yes	

	Span Drift	Units	Run 1	
CAL 1	Span Down Sampling Line (Pre)	ppm	78.80	
	Span Down Sampling Line (Post)	ppm	79.30	
	Span Drift	ppm	0.50	
	Allowable Span Drift	± ppm	4.02	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	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 <sup>3</sup> (REF)
TGN M2 Allowable MU	15.0	%
Measured concentration	3.85	mg/m <sup>3</sup> (STP, dry)
Range Used	100.0	ppm
Range Used [A]	160.6	mg/m <sup>3</sup>
Cal gas conc.	80.4	ppm
Conversion	1.61	ppm to mg/m <sup>3</sup>
MCERTS Range [B]	15.0	mg/m <sup>3</sup>
Lower of [A] or [B]	15.0	mg/m <sup>3</sup>
Cal gas conc.	129.1	mg/m <sup>3</sup>

Performance characteristics	RUN 1	Units
Response time	45	seconds
Number of readings in measurement	40	-
Repeatability at zero	2.00	% full scale
Repeatability at span level	0.00	% full scale
Deviation from linearity	0.20	% of value
Zero drift	0.00	% full scale
Span drift	0.63	% 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)	1.99	% 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 <sup>3</sup>
Standard deviation of repeatability at span level	0.00	mg/m <sup>3</sup>
Lack of fit	0.02	mg/m <sup>3</sup>
Drift	0.01	mg/m <sup>3</sup>
Volume or pressure flow dependence	0.00	mg/m <sup>3</sup>
Atmospheric pressure dependence	0.01	mg/m <sup>3</sup>
Ambient temperature dependence	0.20	mg/m <sup>3</sup>
Combined interference (from MCERTS Certificate)	0.04	mg/m <sup>3</sup>
Dependence on voltage	0.06	mg/m <sup>3</sup>
Losses in the line (leak)	0.04	mg/m <sup>3</sup>
Uncertainty of calibration gas	0.04	mg/m <sup>3</sup>

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		3.85	mg/m <sup>3</sup>
Expanded uncertainty		0.23	mg/m <sup>3</sup>
Expanded uncertainty	k = 1.96	0.45	mg/m <sup>3</sup>
Uncertainty corrected to std conds. (O <sub>2</sub> )		0.45	mg/m <sup>3</sup> (REF)

	RUN 1	Units
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence	11.59	% of Value
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence	N/A	% at ELV
Overall Allowable uncertainty (no O <sub>2</sub> ) - at 95% Confidence	N/A	% at ELV
<b>Result of Compliance with Uncertainty Requirement in M2</b>	N/A	-

	RUN 1	Units
Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence	N/A	% of Value
Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence	N/A	% at ELV
Overall Allowable uncertainty (with O <sub>2</sub> ) - at 95% Confidence	N/A	% at ELV
<b>Result of Compliance with Uncertainty Requirement in M2</b>	N/A	-

Requirement for SRM is that Uncertainty should be <15% of the value at the ELV, on a dry gas basis, or if O<sub>2</sub> correction is applied less than 15% + the uncertainty associated with the O<sub>2</sub> correction (using sqrt of sum squares to add uncertainty components). Ref EA TGN M2.