



Exova Catalyst, Unit 3, Wednesbury One, Black Country New Road, Wednesbury, WS10 7NZ  
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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 11 - Strip Press & Cooling Booth

**Dates of the Monitoring Campaign**

23rd - 24th January 2019

**Job Reference Number**

CAT-4654

|                                                                                      |
|--------------------------------------------------------------------------------------|
| <b>Report Written by</b>                                                             |
| David Burns<br>Team Leader<br>MCERTS Level 2<br>MM 05 579<br>TE1 TE2 TE3 TE4         |
| <b>Report Approved by</b>                                                            |
| Michelle Edwards<br>Team Leader<br>MCERTS Level 2<br>MM 05 659<br>TE1 TE2 TE3 TE4    |
| <b>Report Date</b>                                                                   |
| 7th February 2019                                                                    |
| <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 11 - Strip Press & Cooling Booth  
23rd - 24th January 2019

#### Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by VIP Polymers Ltd to carry out stack emissions testing on the Stack 11 - Strip Press & Cooling Booth at Huntingdon.

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

#### Special Requirements

There were no special requirements.

#### Target Parameters

Total Particulate Matter, Total VOCs (as Carbon)

## Executive Summary

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### MONITORING RESULTS

VIP Polymers Ltd, Huntingdon  
Stack 11 - Strip Press & Cooling Booth  
23rd - 24th January 2019

where MU = Measurement Uncertainty associated with the Result

| Parameter                               | Concentration      |        |           |       | Mass Emission |        |           |       |
|-----------------------------------------|--------------------|--------|-----------|-------|---------------|--------|-----------|-------|
|                                         | Units              | Result | MU<br>+/- | Limit | Units         | Result | MU<br>+/- | Limit |
| Total Particulate Matter <sup>1</sup>   | mg/m <sup>3</sup>  | 0.55   | 0.51      | 10    | g/hr          | 5.3    | 4.9       | -     |
| Total VOCs (as Carbon) <sup>1</sup>     | mg/m <sup>3</sup>  | 4.4    | 0.45      | -     | g/hr          | 42.3   | 4.8       | -     |
| Water Vapour                            | % v/v              | 0.79   | 0.06      |       |               |        |           |       |
| Stack Gas Temperature                   | °C                 | 11.0   |           |       |               |        |           |       |
| Stack Gas Velocity                      | m/s                | 5.9    | 0.13      |       |               |        |           |       |
| Volumetric Flow Rate (ACTUAL)           | m <sup>3</sup> /hr | 10157  | 510       |       |               |        |           |       |
| Volumetric Flow Rate (REF) <sup>1</sup> | m <sup>3</sup> /hr | 9603   | 482       |       |               |        |           |       |

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

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

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### MONITORING DATE(S) & TIMES

VIP Polymers Ltd, Huntingdon  
Stack 11 - Strip Press & Cooling Booth  
23rd - 24th January 2019

| Parameter                |    | Units             | Concentration | Units | Mass Emission | Sampling Date(s) | Sampling Times               | Duration mins |
|--------------------------|----|-------------------|---------------|-------|---------------|------------------|------------------------------|---------------|
| Total Particulate Matter | R1 | mg/m <sup>3</sup> | 0.55          | g/hr  | 5.3           | 23/01/2019       | 11:30 - 11:50, 11:51 - 12:11 | 40            |
| Total VOCs (as Carbon)   | R1 | mg/m <sup>3</sup> | 4.4           | g/hr  | 42.3          | 23/01/2019       | 11:30 - 12:10                | 40            |
| Velocity Traverse        | R1 |                   |               |       |               | 23/01/2019       | 11:06 - 11:16                |               |

All results are expressed at the respective reference conditions.

# Executive Summary

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## PROCESS DETAILS

VIP Polymers Ltd, Huntingdon  
Stack 11 - Strip Press & Cooling Booth  
23rd - 24th January 2019

### Standard Operating Conditions

| Parameter                            | Value            |
|--------------------------------------|------------------|
| Process Status                       | Normal Operation |
| Capacity (of 100%) and Tonnes / Hour | Full Capacity    |
| Continuous or Batch Process          | Continuous       |
| 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 11 - Strip Press & Cooling Booth  
23rd - 24th January 2019

| Parameter                 | Monitoring       |                        |                         |                | Analysis                                    |                         |                          |                 | MCERTS<br>Testing | LOD<br>(Average)       |
|---------------------------|------------------|------------------------|-------------------------|----------------|---------------------------------------------|-------------------------|--------------------------|-----------------|-------------------|------------------------|
|                           | Standard         | Technical<br>Procedure | ISO<br>17025<br>Testing | Testing<br>Lab | Analytical<br>Procedure                     | Analytical<br>Technique | ISO<br>17025<br>Analysis | Analysis<br>Lab |                   |                        |
| Total Particulate Matter  | EN 13284-1       | CAT-TP-01              | Yes                     | CAT            | CAT-TP-03                                   | Gravimetric             | Yes                      | CAT             | Yes               | 0.26 mg/m <sup>3</sup> |
| 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 <sup>3</sup> |
| 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 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              | 0.78     |
| Width               | m              | -        |
| Area                | m <sup>2</sup> | 0.48     |
| Port Depth          | cm             | 9        |
| Orientation of Duct | -              | Vertical |
| Number of Ports     | -              | 2        |
| Sample Port Size    | -              | 4" BSP   |

#### Location of Sampling Platform

| General Platform Information   | Value   |
|--------------------------------|---------|
| Permanent / Temporary Platform | 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                                                             | Yes   |

#### Sampling Location / Platform Improvement Recommendations

All platforms should be designed in accordance with the requirements in the Environment Agency's Technical Guidance Note M1 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    | 30.1       | > 5 Pa   | Yes       |
| Mean Velocity                | m/s   | 6.05       | -        | -         |
| Lowest Gas Velocity          | m/s   | 5.84       | -        | -         |
| Highest Gas Velocity         | m/s   | 6.19       | -        | -         |
| Ratio of Above               | : 1   | 1.06       | < 3 : 1  | Yes       |
| Maximum Angle of Swirl       | °     | 0.00       | < 15°    | Yes       |
| No Local Negative Flow       | -     | Yes        | -        | Yes       |



Executive Summary

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PLANT PHOTOS

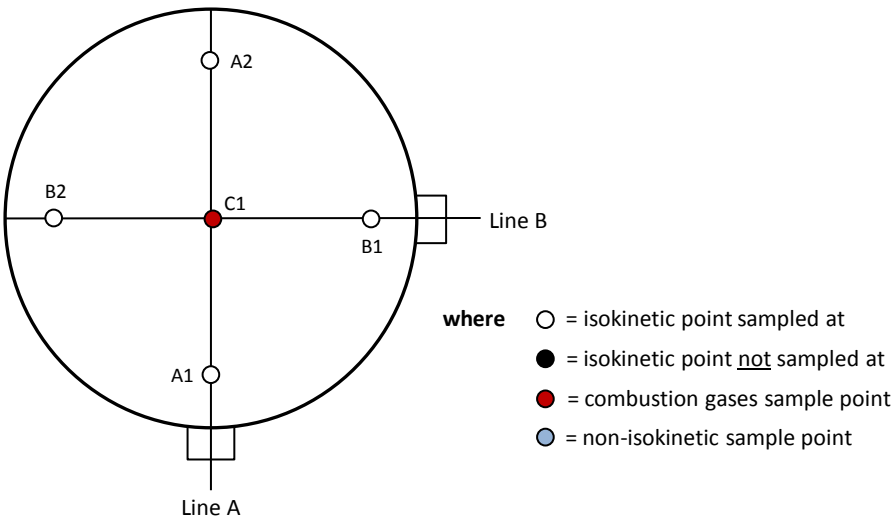
Photo 1



Photo 2



SAMPLE POINTS



## APPENDICES

### APPENDIX CONTENTS

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

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

## STACK EMISSIONS MONITORING PERSONNEL

| Position    | Name          | MCERTS Accreditation | MCERTS Number | Technical Endorsements |
|-------------|---------------|----------------------|---------------|------------------------|
| Team Leader | David Burns   | MCERTS Level 2       | MM 05 579     | TE1 TE2 TE3 TE4        |
| Trainee     | Luke Williams | MCERTS Trainee       | MM 18 1496    | None                   |

## LIST OF EQUIPMENT

| Extractive Sampling      |                 | Instrumental Analysers         |                | Miscellaneous Items              |                  |
|--------------------------|-----------------|--------------------------------|----------------|----------------------------------|------------------|
| Equipment Type           | Equipment I.D.  | Equipment Type                 | Equipment I.D. | Equipment Type                   | Equipment I.D.   |
| Control Box DGM (1)      | CAT 7.58        | Horiba PG-350E                 | -              | Digital Manometer (1)            | CAT 3.143        |
| Control Box DGM (2)      | -               | Horiba PG-250                  | -              | Digital Manometer (2)            | CAT 3.145        |
| Box Thermocouples (1)    | CAT 3.148       | Servomex 4900                  | -              | Digital Temperature Meter        | -                |
| Box Thermocouples (2)    | -               | Eco Physics CLD 822Mh          | -              | Stopwatch                        | CAT 14.86        |
| Umbilical (1)            | CAT 3.148       | ABB AO2020-URAS26              | -              | Barometer                        | CAT 13.41        |
| Umbilical (2)            | -               | Servomex 5200MP                | -              | Stack Thermocouple (1)           | CAT 4.1014       |
| Oven Box (1)             | CAT 12.201      | Ankersmid APS 313              | -              | Stack Thermocouple (2)           | CAT 4.1041       |
| Oven Box (2)             | -               | Gasmet DX4000                  | -              | Stack Thermocouple (3)           | CAT 4.0014       |
| Heated Probe (1)         | CAT 5.129       | Gasmet Sampling System         | -              | 1m Heated Line (1)               | -                |
| Heated Probe (2)         | CAT 5.130       | Bernath 3006 FID               | CAT 8.32       | 1m Heated Line (2)               | -                |
| Heated Probe (3)         | CAT 5.131       | M&C PSS                        | CAT 12.108     | 1m Heated Line (3)               | -                |
| S-Pitot (1)              | CAT 21P.97      | Mass Flow Controller (1)       | CAT 6.63       | 5m Heated Line (1)               | -                |
| S-Pitot (2)              | CAT 21S.56      | Mass Flow Controller (2)       | CAT 6.64       | 15m Heated Line (1)              | -                |
| L-Pitot                  | CAT 21L.41      | Mass View (1)                  | -              | 20m Heated Line (1)              | CAT 20.119       |
| Site Balance             | CAT 17.38       | Mass View (2)                  | -              | 20m Heated Line (2)              | -                |
| 500g / 1Kg Check Weights | CAT 17.38       | Hioki 5043 (V)                 | CAT 11.70      | Dual Channel Heater Controller   | -                |
| Last Impinger Arm        | CAT 4.902/4.903 | Easylogger EN-EL-12 Bit        | -              | Single Channel Heater Controller | CAT 20.119       |
| Callipers                | CAT 23.41       | Bioaerosols Temperature Logger | -              | Laboratory Balance               | CAT 1.18 / 1.18a |
| Tubes Kit Thermocouple   | -               | Electronic Refrigerator        | -              | Tape Measure                     | CAT 16.49        |

## 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              | 0.78  |
| Stack Width, W                                             | m              | -     |
| Stack Area, A                                              | m <sup>2</sup> | 0.48  |
| Average Stack Gas Temperature, T <sub>a</sub>              | °C             | 11.0  |
| Average Stack Gas Pressure                                 | Pa             | 32.3  |
| Average Stack Static Pressure, P <sub>static</sub>         | kPa            | 0.077 |
| Average Barometric Pressure, P <sub>b</sub>                | kPa            | 99.6  |
| Average Pitot Tube Calibration Coefficient, C <sub>p</sub> | -              | 0.83  |

### Stack Gas Composition & Molecular Weights

| Component                   | Conc<br>ppm | Conc<br>Dry<br>% v/v | Conc<br>Wet<br>% v/v | Volume<br>Fraction<br>r | Molar<br>Mass<br>M | Density<br>kg/m <sup>3</sup><br>p | Conc<br>kg/m <sup>3</sup><br>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                | 20.64                | 0.2080                  | 32.00              | 1.4277                            | 0.29696                                     |
| N <sub>2</sub>              | -           | 79.14                | 78.52                | 0.7914                  | 28.01              | 1.2498                            | 0.98913                                     |
| Moisture (H <sub>2</sub> O) | -           | -                    | 0.79                 | 0.0079                  | 18.02              | 0.8037                            | 0.00632                                     |

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> | 1.283  |
| Dry Density (Actual), P <sub>Actual</sub>          | kg/m <sup>3</sup> | 1.218  |
| Average Wet Density (Actual), P <sub>ActualW</sub> | kg/m <sup>3</sup> | 1.214  |

Where: P<sub>STD</sub> = sum of component concentrations, kg/m<sup>3</sup> (not including water vapour)

P<sub>STW</sub> = sum of all wet concentrations / 100 x density, kg/m<sup>3</sup> (including water vapour)

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

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

### Calculation of Stack Gas Volumetric Flowrate, Q

| Duct gas flow conditions | Units | Actual | REF <sup>1</sup> |
|--------------------------|-------|--------|------------------|
| Temperature              | °C    | 11.0   | 0.0              |
| Total Pressure           | kPa   | 99.7   | 101.3            |
| Moisture                 | %     | 0.79   | 0.79             |

| Gas Volumetric Flowrate (from Traverse)  | Units              | Result |
|------------------------------------------|--------------------|--------|
| Gas Volumetric Flowrate (Actual)         | m <sup>3</sup> /hr | 10406  |
| Gas Volumetric Flowrate (STP, Wet)       | m <sup>3</sup> /hr | 9842   |
| Gas Volumetric Flowrate (STP, Dry)       | m <sup>3</sup> /hr | 9765   |
| Gas Volumetric Flowrate REF <sup>1</sup> | m <sup>3</sup> /hr | 9842   |

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

| Parameter                       | Units                                 | Value         |
|---------------------------------|---------------------------------------|---------------|
| Date of Survey                  | -                                     | 23/01/2019    |
| Time of Survey                  | -                                     | 11:06 - 11:16 |
| Atmospheric Pressure            | kPa                                   | 99.6          |
| Average Stack Static Pressure   | Pa                                    | 77            |
| Result of Pitot Stagnation Test | -                                     | Pass          |
| 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 <sub>p</sub> | -     | 0.83     |
| 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/m³ | Velocity m/s | Swirl ° | ΔP Pa           | Temp °C | Wet Density kg/m³ | Velocity m/s | Swirl ° |
| STATIC (Units: Pa) |         | 75.0  |         |                   |              |         | 78.0            |         |                   |              |         |
| Mean               |         | 31.7  | 11.0    | 1.214             | 5.99         |         | 33.0            | 11.0    | 1.214             | 6.11         |         |
| 1                  | 0.11    | 30.1  | 11.0    | 1.214             | 5.84         | 0.0     | 33.8            | 11.0    | 1.214             | 6.19         | 0.0     |
| 2                  | 0.67    | 33.2  | 11.0    | 1.214             | 6.13         | 0.0     | 32.1            | 11.0    | 1.214             | 6.03         | 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                | $u(\Delta p_i)$    | 1.103   | Pa                 |
| - Resolution                                                                         | $u(res)$           | 0.00087 |                    |
| - Calibration                                                                        | $u(cal)$           | 0.109   |                    |
| - Drift                                                                              | $u(drift)$         | 0.083   |                    |
| - Lack of Fit                                                                        | $u(fit)$           | 0.025   |                    |
| - Overall corrections to dynamic measurements                                        | $u(C_f)$           | 0.217   |                    |
| Standard uncertainty associated with the molar mass of the gas                       | $u(M)$             | 0.00003 | -                  |
| - $\phi_{O_2,w}$                                                                     | -                  | 20.637  |                    |
| - $\phi_{CO_2,w}$                                                                    | -                  | 0.060   |                    |
| - Oxygen, dry                                                                        | $u(\phi_{O_2,d})$  | 0.637   |                    |
| - Carbon Dioxide, dry                                                                | $u(\phi_{CO_2,d})$ | 0.002   |                    |
| - Water Vapour                                                                       | $u(\phi_{H_2O})$   | 0.040   |                    |
| - 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                           | $u(T_c)$           | 1.449   | 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                                                                    | $u(p_{stat})$      | 0.780   |                    |
| Standard uncertainty associated with the density in the duct                         | $u(\rho)$          | 0.00655 | -                  |
| Standard uncertainty associated with the local velocities                            | $u(v_i)$           | 0.112   | Pa                 |
| Standard uncertainty associated with the mean velocity                               | $u(\bar{v})$       | 0.067   | m/s                |
| Standard uncertainty associated with the mean velocity (95% Confidence)              | $U_c(v)$           | 0.132   | 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)           | $U_c(qV,w)$        | 522.6   | m <sup>3</sup> /hr |
| - $u^2(a)/a^2$                                                                       | -                  | 0.00053 |                    |
| - $u^2(qV,w)/q^2V,w$                                                                 | -                  | 0.00066 |                    |
| - $u^2(qV,w)$                                                                        | -                  | 71088   |                    |
| - $u(qV,w)$                                                                          | -                  | 266.6   |                    |
| 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 11 - Strip Press & Cooling Booth

### Sample Runs

| Parameter     | Units              | Run 1 | Mean |
|---------------|--------------------|-------|------|
| Concentration | mg/m <sup>3</sup>  | 0.55  | 0.55 |
| Uncertainty   | ±mg/m <sup>3</sup> | 0.51  | 0.51 |
| Mass Emission | g/hr               | 5.3   | 5.3  |
| Uncertainty   | ±g/hr              | 4.9   | 4.9  |

| Parameter    | Units  | Run 1 | Mean |
|--------------|--------|-------|------|
| Water Vapour | % v/v  | 0.79  | 0.79 |
| Uncertainty  | ±% v/v | 0.06  | 0.06 |

### Blank Runs

| Parameter     | Units             | Blank 1 | Maximum |
|---------------|-------------------|---------|---------|
| Concentration | mg/m <sup>3</sup> | 0.26    | 0.26    |

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

### General Sampling Information

| Parameter                      | Value            |
|--------------------------------|------------------|
| Standard                       | EN 13284-1       |
| Technical Procedure            | CAT-TP-01        |
| Probe Material                 | Titanium         |
| Filter Housing Material        | Titanium         |
| Positioning of Filter          | In Stack         |
| Filter Size and Material       | 47mm Glass Fibre |
| Number of Sampling Lines Used  | 2 / 2            |
| Number of Sampling Points Used | 4 / 4            |
| Sample Point I.D.'s            | A1, A2, B1 & B2  |

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, <math>P_s</math></b>                                                                                                                                                           |                     |        |  |
| Barometric pressure, $P_b$                                                                                                                                                                                        | mmHg                | 747.0  |  |
| Stack static pressure, $P_{static}$                                                                                                                                                                               | mmH <sub>2</sub> O  | 7.6    |  |
| $P_s = (P_b + (P_{static} / 13.6))$                                                                                                                                                                               | mmHg                | 747.6  |  |
| <b>Volume of water vapour collected, <math>V_{wstd}</math></b>                                                                                                                                                    |                     |        |  |
| Total mass collected in impingers (liquid trap)                                                                                                                                                                   | g                   | 3.7    |  |
| Total mass collected in impingers (silica trap)                                                                                                                                                                   | g                   | 0.4    |  |
| Total mass of liquid collected, $V_{lc}$                                                                                                                                                                          | g                   | 4.1    |  |
| $V_{wstd} = (0.001246)(V_{lc})$                                                                                                                                                                                   | m <sup>3</sup>      | 0.0051 |  |
| <b>Volume of gas metered dry, <math>V_{mstd}</math></b>                                                                                                                                                           |                     |        |  |
| Volume of gas sample through gas meter, $V_m$                                                                                                                                                                     | m <sup>3</sup>      | 0.6560 |  |
| Gas meter correction factor, $Y_d$                                                                                                                                                                                | -                   | 1.0110 |  |
| Average dry gas meter temperature, $T_m$                                                                                                                                                                          | °C                  | 3.8    |  |
| Average pressure drop across orifice, $\Delta H$                                                                                                                                                                  | mmH <sub>2</sub> O  | 30.1   |  |
| $V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$                                                                                                                                            | m <sup>3</sup>      | 0.6449 |  |
| <b>Moisture content, <math>B_{wo}</math> &amp; <math>R_{wv}</math></b>                                                                                                                                            |                     |        |  |
| $B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$                                                                                                                                                                       | m <sup>3</sup>      | 0.0079 |  |
| $B_{wo}$ as a percentage                                                                                                                                                                                          | % v/v               | 0.79   |  |
| Reported Water Vapour, checked with Tables in EN 14790, $R_{wv}$                                                                                                                                                  | % v/v               | 0.79   |  |
| <b>Volume of gas metered wet, <math>V_{mstw}</math></b>                                                                                                                                                           |                     |        |  |
| $V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$                                                                                                                                                                       | m <sup>3</sup>      | 0.6500 |  |
| <b>Volume of gas metered at Oxygen Reference Conditions, <math>V_{mstd@X\%O_2}</math> &amp; <math>V_{mstw@X\%O_2}</math></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 ( $O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$ )                                                                                                                        | -                   | N/A    |  |
| O <sub>2</sub> Reference Factor dry ( $O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$ )                                                                                                                        | -                   | N/A    |  |
| $V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$                                                                                                                                                                   | m <sup>3</sup>      | N/A    |  |
| $V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$                                                                                                                                                                   | m <sup>3</sup>      | N/A    |  |
| <b>Molecular weight of dry gas stream, <math>M_d</math></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  |  |
| $M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$                                                                                                                                                                  | g/gmol              | 28.84  |  |
| <b>Molecular weight of stack gas (wet), <math>M_s</math></b>                                                                                                                                                      |                     |        |  |
| $M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$                                                                                                                                                                    | g/gmol              | 28.76  |  |
| <b>Velocity of stack gas, <math>V_s</math></b>                                                                                                                                                                    |                     |        |  |
| Pitot tube velocity constant, $K_p$                                                                                                                                                                               | -                   | 34.97  |  |
| Velocity pressure coefficient, $C_p$                                                                                                                                                                              | -                   | 0.84   |  |
| Average of velocity heads, $\Delta P_{avg}$                                                                                                                                                                       | mmH <sub>2</sub> O  | 3.05   |  |
| Average square root of velocity heads, $\sqrt{\Delta P}$                                                                                                                                                          | √mmH <sub>2</sub> O | 1.75   |  |
| Average stack gas temperature, $T_s$                                                                                                                                                                              | °C                  | 11.0   |  |
| $V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s + 273})) / (\sqrt{M_s}(P_s))$                                                                                                                                       | m/s                 | 5.90   |  |
| <b>Total flow of stack gas: Actual (<math>Q_a</math>), Wet (<math>Q_{stw}</math>), Dry (<math>Q_{std}</math>), Wet@O<sub>2REF</sub> (<math>Q_{stwO_2}</math>), Dry@O<sub>2REF</sub> (<math>Q_{stdO_2}</math>)</b> |                     |        |  |
| Area of stack, $A_s$                                                                                                                                                                                              | m <sup>2</sup>      | 0.48   |  |
| $Q_a = (60)(A_s)(V_s)$                                                                                                                                                                                            | m <sup>3</sup> /min | 169.3  |  |
| Conversion factor (K/mm.Hg), $C_f$                                                                                                                                                                                | -                   | 0.3592 |  |
| $Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$                                                                                                                                                                     | m <sup>3</sup> /min | 160.1  |  |
| $Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$                                                                                                                                                   | m <sup>3</sup> /min | 158.8  |  |
| $Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$                                                                                                                                                    | m <sup>3</sup> /min | N/A    |  |
| $Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$                                                                                                                                  | m <sup>3</sup> /min | N/A    |  |
| <b>Percent isokinetic, %I</b>                                                                                                                                                                                     |                     |        |  |
| Nozzle diameter, $D_n$                                                                                                                                                                                            | mm                  | 7.94   |  |
| Nozzle area, $A_n$                                                                                                                                                                                                | mm <sup>2</sup>     | 49.48  |  |
| Total sampling time, $q$                                                                                                                                                                                          | min                 | 40     |  |
| $\%I = (4.6398E^6)(T_s+273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$                                                                                                                                     | %                   | 98.1   |  |



## TOTAL PARTICULATE MATTER: SAMPLING DETAILS

### Sample Runs

| Parameter                 | Units             | Run 1                           |
|---------------------------|-------------------|---------------------------------|
| Sampling Times            | -                 | 11:30 - 11:50,<br>11:51 - 12:11 |
| Sampling Dates            | -                 | 23/01/2019                      |
| Sampling Device           | -                 | ISO                             |
| Volume Sampled (REF)      | m <sup>3</sup>    | 0.6500                          |
| Filter I.D. Number        | -                 | 47-55280                        |
| Start Filter Mass         | g                 | 0.15232                         |
| End Filter Mass           | g                 | 0.15247                         |
| Total Mass on Filter      | g                 | 0.00015                         |
| Probe Rinse I.D. Number   | -                 | PR-47-55280                     |
| Start Probe Rinse Mass    | g                 | 2.77986                         |
| End Probe Rinse Mass      | g                 | 2.78007                         |
| Total Mass in Probe Rinse | g                 | 0.00021                         |
| Total Mass Collected      | mg                | 0.36                            |
| Calculated Concentration  | mg/m <sup>3</sup> | 0.55                            |
| Balance Uncertainty / LOD | mg/m <sup>3</sup> | 0.26                            |

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

### Blank Runs

| Parameter                    | Units             | Blank 1     |
|------------------------------|-------------------|-------------|
| Blank Dates                  | -                 | 23/01/2019  |
| Average Volume Sampled (REF) | m <sup>3</sup>    | 0.6500      |
| Filter I.D. Number           | -                 | 47-54224    |
| Start Filter Mass            | g                 | 0.15854     |
| End Filter Mass              | g                 | 0.15844     |
| Total Mass on Filter         | g                 | -0.00010    |
| Probe Rinse I.D. Number      | -                 | PR-47-54224 |
| Start Probe Rinse Mass       | g                 | 3.11795     |
| End Probe Rinse Mass         | g                 | 3.11806     |
| Total Mass in Probe Rinse    | g                 | 0.00011     |
| Total Mass Collected         | mg                | 0.01        |
| Calculated Concentration     | mg/m <sup>3</sup> | 0.01        |
| Balance Uncertainty / LOD    | mg/m <sup>3</sup> | 0.26        |

## TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

### Sample Runs

| Leak Test Results                    | Units               | Run 1    |  |
|--------------------------------------|---------------------|----------|--|
| Mean Sampling Rate                   | l/min               | 16.6     |  |
| Pre-Sampling Leak Rate               | l/min               | 0.00     |  |
| Post-Sampling Leak Rate              | l/min               | 0.10     |  |
| Allowable Leak Rate                  | l/min               | 0.33     |  |
| Leak Test Acceptable                 | -                   | Yes      |  |
| Water Droplets                       | Units               | Run 1    |  |
| Are Water Droplets Present           | -                   | No       |  |
| MU (Concurrent Water Vapour)         | Units               | Run 1    |  |
| Measurement Uncertainty (MU)         | %                   | 7.6      |  |
| Allowable MU                         | %                   | 20.0     |  |
| MU Acceptable                        | %                   | Yes      |  |
| Silica Gel (Concurrent Water Vapour) | Units               | Run 1    |  |
| Less than 50% Faded                  | %                   | Yes      |  |
| Isokinetic Criterion Compliance      | Units               | Run 1    |  |
| Isokinetic Variation                 | %                   | 98.1     |  |
| Allowable Isokinetic Range           | %                   | 95 - 115 |  |
| Isokineticity Acceptable             | -                   | Yes      |  |
| Weighing Uncertainty Criteria        | Units               | Run 1    |  |
| Overall Weighing Uncertainty         | ± mg                | 0.32     |  |
| Overall Weighing Uncertainty         | ± mg/m <sup>3</sup> | 0.49     |  |
| 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      | -                   | Yes      |  |
| Filter Temperatures                  | Units               | Run 1    |  |
| Pre-Conditioning Temperature         | °C                  | 180      |  |
| Post-Conditioning Temperature        | °C                  | 160      |  |
| Maximum Filter Temperature           | °C                  | 11       |  |
| 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 | 25.0    |  |
| Pre-Sampling Leak Rate  | l/min | 0.10    |  |
| Post-Sampling Leak Rate | l/min | 0.10    |  |
| Allowable Leak Rate     | l/min | 0.50    |  |
| 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> | 0.6560 | uV <sub>m</sub>      | m <sup>3</sup> | 0.0131 |
| Sampled Gas Temperature | T <sub>m</sub> | 276.8  | uT <sub>m</sub>      | K              | 2.0    |
| Sampled Gas Pressure    | p <sub>m</sub> | 99.7   | 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              | 0.60   | uL                   | %              | -      |
| Mass of Particulate     | m              | 0.36   | um                   | mg             | 0.17   |
| Uncollected Mass        | UCM            | 0.01   | uUCM                 | mg             | -      |

| Measured Quantities     | Uncertainty as a Percentage |       | Requirement of Standard |
|-------------------------|-----------------------------|-------|-------------------------|
|                         | Units                       | Run 1 |                         |
| Sampled Volume (Actual) | %                           | 2.00  | ≤2%                     |
| Sampled Gas Temperature | %                           | 0.72  | ≤1%                     |
| Sampled Gas Pressure    | %                           | 0.50  | ≤1%                     |
| Sampled Gas Humidity    | %                           | 1.00  | ≤1%                     |
| Leak                    | %                           | 0.60  | ≤2%                     |
| Mass of Particulate     | %                           | 2.62  | <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>    | 0.6449 | 0.86                    |  |
| Leak                 | L                                | mg/m <sup>3</sup> | 0.002  | 1.00                    |  |
| Mass of Particulate  | L <sub>r</sub>                   | mg                | 0.360  | 1.54                    |  |
| Uncollected Mass     | UCM                              | mg                | 0.00   | 1.54                    |  |

| Measured Quantities  | Uncertainty in Result |        |
|----------------------|-----------------------|--------|
|                      | Units                 | Run 1  |
| Sampled Volume (STP) | mg/m <sup>3</sup>     | 0.013  |
| Leak                 | mg/m <sup>3</sup>     | 0.0019 |
| Mass of Particulate  | mg/m <sup>3</sup>     | 0.2615 |
| Uncollected Mass     | mg/m <sup>3</sup>     | 0.0059 |

| 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> | 0.26  |
| Expanded uncertainty (95% confidence), without Oxygen Correction        | mg/m <sup>3</sup> | 0.51  |
| 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> | 0.51  |
| Reported Uncertainty                                                    | mg/m <sup>3</sup> | 0.51  |
| Expanded uncertainty (95% confidence), without Oxygen Correction        | %                 | 92.7  |
| Expanded uncertainty (95% confidence), with Oxygen Correction           | %                 | N/A   |
| Expanded uncertainty (95% confidence), estimated with Method Deviations | %                 | 92.7  |
| Reported Uncertainty                                                    | %                 | 92.7  |

## TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon  
Stack 11 - Strip Press & Cooling Booth

### Sample Runs

| Parameter     | Units              | Run 1 | Mean |
|---------------|--------------------|-------|------|
| Concentration | mg/m <sup>3</sup>  | 4.4   | 4.4  |
| Uncertainty   | ±mg/m <sup>3</sup> | 0.45  | 0.45 |
| Mass Emission | g/hr               | 42.3  | 42.3 |
| Uncertainty   | ±g/hr              | 4.8   | 4.8  |

### General Sampling Information

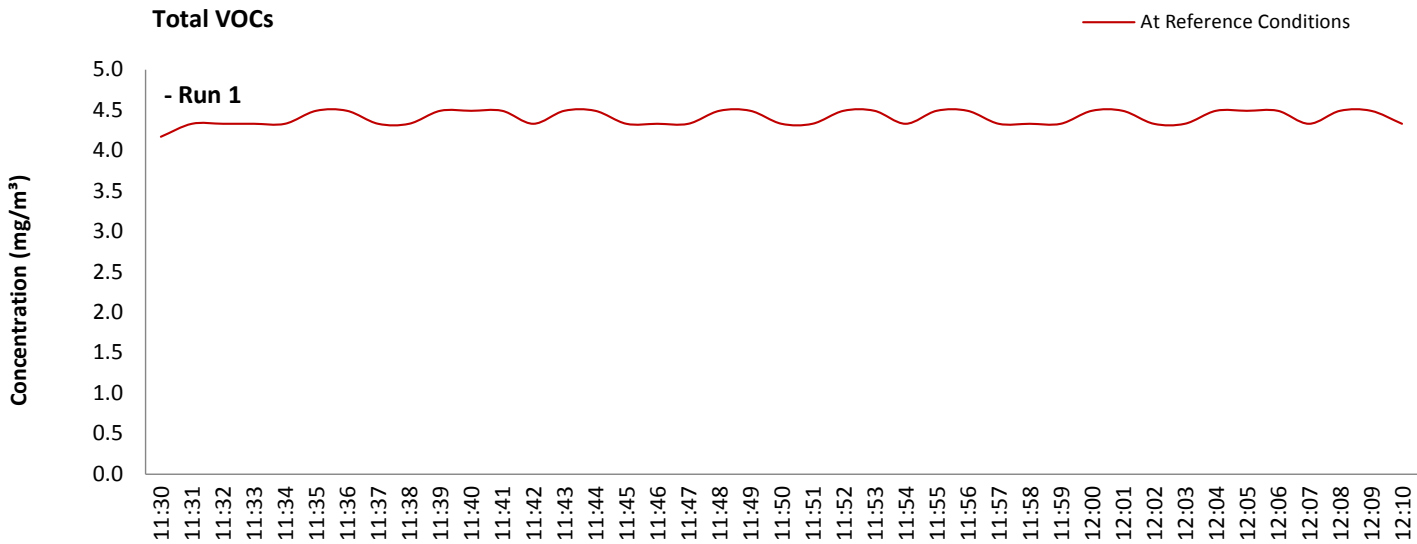
| Parameter                        | Value                              |                                       |
|----------------------------------|------------------------------------|---------------------------------------|
| Standard                         | EN 12619:2013                      |                                       |
| 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°C                              |                                       |
| Span Gas Type                    | Propane In Synthetic Air (5 Grade) |                                       |
| Span Gas Reference Number        | CYL 1.0292a                        |                                       |
| Span Gas Expiry Date             | 12/09/2021                         |                                       |
| Span Gas Start Pressure (bar)    | 100                                |                                       |
| Gas Cylinder Concentration (ppm) | 79.9                               |                                       |
| Span Gas Set Point (ppm)         | 79.90                              |                                       |
| Span Gas Uncertainty (%)         | 2                                  |                                       |
| 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              | C1                                 |                                       |

### Reference Conditions

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

TOTAL VOCs (as CARBON): DATA TREND

Graphical Trend of Data



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

### Sampling Details

| Parameter        | Units | Run 1         |
|------------------|-------|---------------|
| Sampling Times   | -     | 11:30 - 12:10 |
| Sampling Dates   | -     | 23/01/2019    |
| Instrument Range | ppm   | 100           |
| Span Gas Value   | ppm   | 79.9          |

### Quality Assurance

|       | Zero Drift                     | Units | Run 1 |
|-------|--------------------------------|-------|-------|
| CAL 1 | Zero Down Sampling Line (Pre)  | ppm   | 0.00  |
|       | Zero Down Sampling Line (Post) | ppm   | 0.00  |
|       | Zero Drift                     | ppm   | 0.00  |
|       | Allowable Zero Drift           | ± ppm | 4.00  |
|       | Zero Drift Acceptable          | -     | Yes   |

|       | Span Drift                     | Units | Run 1 |
|-------|--------------------------------|-------|-------|
| CAL 1 | Span Down Sampling Line (Pre)  | ppm   | 80.00 |
|       | Span Down Sampling Line (Post) | ppm   | 80.00 |
|       | Span Drift                     | ppm   | 0.00  |
|       | Allowable Span Drift           | ± ppm | 4.00  |
|       | Span Drift Acceptable          | -     | Yes   |

| Test Conditions               | Units | Run 1 |
|-------------------------------|-------|-------|
| Run Ambient Temperature Range | °C    | 2 - 3 |

### 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      | 4.44  | 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.               | 79.9  | 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.               | 128.3 | 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           | 0.73  | % of value       |
| Zero drift                         | 0.00  | % full scale     |
| Span drift                         | 0.00  | % full scale     |
| Volume or pressure flow dependence | 1.60  | % of full scale  |
| Atmospheric pressure dependence    | 0.30  | % of value/kPa   |
| Ambient temperature dependence     | 1.40  | % full scale/10K |
| Combined interference              | 0.45  | % range          |
| Dependence on voltage              | 0.50  | % full scale/10V |
| Losses in the line (leak)          | 0.00  | % 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                                       | 0.06            | mg/m <sup>3</sup> |
| Drift                                             | 0.00            | 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)                         | 0.00            | mg/m <sup>3</sup> |
| Uncertainty of calibration gas                    | 0.05            | mg/m <sup>3</sup> |

| Measurement uncertainty                               | Result   | RUN 1 | Units                   |
|-------------------------------------------------------|----------|-------|-------------------------|
| Combined uncertainty                                  |          | 4.44  | mg/m <sup>3</sup>       |
| Expanded uncertainty                                  | k = 1.96 | 0.23  | mg/m <sup>3</sup>       |
| Expanded uncertainty                                  |          | 0.46  | mg/m <sup>3</sup>       |
| Uncertainty corrected to std conds. (O <sub>2</sub> ) |          | 0.46  | mg/m <sup>3</sup> (REF) |

|                                                                        | RUN 1      | Units      |
|------------------------------------------------------------------------|------------|------------|
| Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence          | 10.26      | % 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>         | <b>N/A</b> | -          |

|                                                                          | 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>           | <b>N/A</b> | -          |

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.