



Exova Catalyst, Unit 3, Wednesbury One, Black Country New Road, Wednesbury, WS10 7NZ  
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**Stack Emissions Testing Report Commissioned by**  
Xaarjet Ltd

**Installation Name & Address**

Xaarjet Ltd  
1 Hurricane Close  
Ermine Business Park  
Huntingdon  
Cambridgeshire  
PE29 6XX

PPC Permit: B22/11

**Stack Reference**

20 - CR4 Room Extract

**Dates of the Monitoring Campaign**

28th - 30th January 2019

**Job Reference Number**

CAT-4655

**Report Written by**

David Burns  
Team Leader  
MCERTS Level 2  
MM 05 579  
TE1 TE2 TE3 TE4

**Report Approved by**

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**Report Date**

12th February 2019

**Version**

Version 1

**Signature of Report Approver**

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APPENDIX 1 - Monitoring Personnel & List of Equipment

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## Executive Summary

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### MONITORING OBJECTIVES

Xaarjet Ltd, Huntingdon

20 - CR4 Room Extract

28th - 30th January 2019

#### Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by Xaarjet Ltd to carry out stack emissions testing on the 20 - CR4 Room Extract 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 VOCs (as Carbon)

## MONITORING RESULTS

Xaarjet Ltd, Huntingdon  
20 - CR4 Room Extract  
28th - 30th 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 VOCs (as Carbon)        | <sup>1</sup> mg/m <sup>3</sup>  | 12.4   | 1.8       | 75    | g/hr          | 8.4    | 1.8       | -     |
| Stack Gas Temperature         | °C                              | 19.5   |           |       |               |        |           |       |
| Stack Gas Velocity            | m/s                             | 2.9    | 0.31      |       |               |        |           |       |
| Volumetric Flow Rate (ACTUAL) | m <sup>3</sup> /hr              | 736    | 85.5      |       |               |        |           |       |
| Volumetric Flow Rate (REF)    | <sup>1</sup> m <sup>3</sup> /hr | 678    | 78.8      |       |               |        |           |       |

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.

### MONITORING DATE(S) & TIMES

Xaarjet Ltd, Huntingdon  
20 - CR4 Room Extract  
28th - 30th January 2019

| Parameter              |    | Units             | Concentration | Units | Mass Emission | Sampling Date(s) | Sampling Times | Duration mins |
|------------------------|----|-------------------|---------------|-------|---------------|------------------|----------------|---------------|
| Total VOCs (as Carbon) | R1 | mg/m <sup>3</sup> | 10.8          | g/hr  | 7.3           | 30/01/2019       | 11:41 - 12:11  | 30            |
| Total VOCs (as Carbon) | R2 | mg/m <sup>3</sup> | 10.0          | g/hr  | 6.7           | 30/01/2019       | 12:12 - 12:42  | 30            |
| Total VOCs (as Carbon) | R3 | mg/m <sup>3</sup> | 16.4          | g/hr  | 11.1          | 30/01/2019       | 12:43 - 13:13  | 30            |
| Velocity Traverse      | R1 |                   |               |       |               | 30/01/2019       | 10:47 - 10:57  |               |

All results are expressed at the respective reference conditions.

## PROCESS DETAILS

Xaarjet Ltd, Huntingdon  
20 - CR4 Room Extract  
28th - 30th January 2019

### Standard Operating Conditions

| Parameter                            | Value            |
|--------------------------------------|------------------|
| Process Status                       | Normal Operation |
| Capacity (of 100%) and Tonnes / Hour | 100% of Capacity |
| Continuous or Batch Process          | Continuous       |
| Feedstock (if applicable)            | N/A              |
| 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

Xaarjet Ltd, Huntingdon  
20 - CR4 Room Extract  
28th - 30th January 2019

| 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 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. |

## 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             | 0        |
| Orientation of Duct | -              | Vertical |
| Number of Ports     | -              | 1        |
| Sample Port Size    | -              | 2" Hole  |

### Location of Sampling Platform

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

### Platform Details

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

### Sampling Location / Platform Improvement Recommendations

All platforms should be designed in accordance with the requirements in 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    | 6.4        | > 5 Pa   | Yes       |
| Mean Velocity                | m/s   | 2.89       | -        | -         |
| Lowest Gas Velocity          | m/s   | 2.73       | -        | -         |
| Highest Gas Velocity         | m/s   | 3.05       | -        | -         |
| Ratio of Above               | : 1   | 1.12       | < 3 : 1  | Yes       |
| Maximum Angle of Swirl       | °     | NM         | NM       | NM        |
| No Local Negative Flow       | -     | Yes        | -        | Yes       |

Where NM = Not Measured as no Isokinetic sampling was performed.

## PLANT PHOTOS

Photo 1



Photo 2



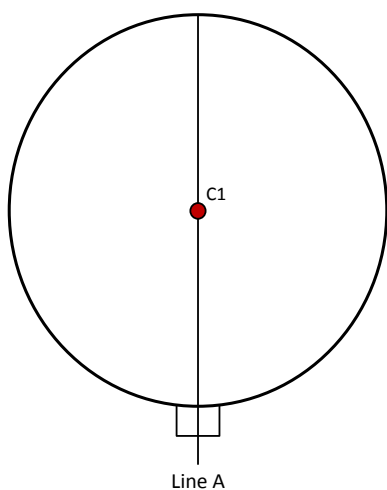
Photo 3



Photo 4



## SAMPLE POINTS



- where
- = isokinetic point sampled at
  - = isokinetic point not sampled at
  - = combustion gases sample point
  - = non-isokinetic sample point

## 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)      | -              | 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)    | -              | Servomex 4900                  | -              | Digital Temperature Meter        | -              |
| Box Thermocouples (2)    | -              | Eco Physics CLD 822Mh          | -              | Stopwatch                        | CAT 14.86      |
| Umbilical (1)            | -              | ABB AO2020-URAS26              | -              | Barometer                        | CAT 13.41      |
| Umbilical (2)            | -              | Servomex 5200MP                | -              | Stack Thermocouple (1)           | -              |
| Oven Box (1)             | -              | Ankersmid APS 313              | -              | Stack Thermocouple (2)           | -              |
| Oven Box (2)             | -              | Gasmet DX4000                  | -              | Stack Thermocouple (3)           | -              |
| Heated Probe (1)         | -              | Gasmet Sampling System         | -              | 1m Heated Line (1)               | -              |
| Heated Probe (2)         | -              | Bernath 3006 FID               | CAT 8.32       | 1m Heated Line (2)               | -              |
| Heated Probe (3)         | -              | M&C PSS                        | CAT 12.108     | 1m Heated Line (3)               | -              |
| S-Pitot (1)              | -              | Mass Flow Controller (1)       | -              | 5m Heated Line (1)               | -              |
| S-Pitot (2)              | CAT 21S.56     | Mass Flow Controller (2)       | -              | 15m Heated Line (1)              | -              |
| L-Pitot                  | CAT 21L.41     | Mass View (1)                  | -              | 20m Heated Line (1)              | CAT 20.119     |
| Site Balance             | -              | Mass View (2)                  | -              | 20m Heated Line (2)              | -              |
| 500g / 1Kg Check Weights | -              | Hioki 5043 (V)                 | CAT 11.70      | Dual Channel Heater Controller   | -              |
| Last Impinger Arm        | -              | Easylogger EN-EL-12 Bit        | -              | Single Channel Heater Controller | CAT 20.119     |
| Callipers                | -              | Bioaerosols Temperature Logger | -              | Laboratory Balance               | -              |
| Tubes Kit Thermocouple   | -              | Electronic Refrigerator        | -              | Tape Measure                     | CAT 16.49      |

## METHODS & TECHNICAL PROCEDURES USED

| Parameter                 | Standard         | Technical Procedure |
|---------------------------|------------------|---------------------|
| 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             | 19.5  |
| Average Stack Gas Pressure                                 | Pa             | 7.2   |
| Average Stack Static Pressure, P <sub>static</sub>         | kPa            | 0.011 |
| Average Barometric Pressure, P <sub>b</sub>                | kPa            | 100.0 |
| 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          | 20.59          | 0.2080            | 32.00        | 1.4277                      | 0.29696                               |
| N <sub>2</sub>                          | -        | 79.14          | 78.35          | 0.7914            | 28.01        | 1.2498                      | 0.98913                               |
| Moisture (H <sub>2</sub> O) (Estimated) | -        | -              | 1.00           | 0.0100            | 18.02        | 0.8037                      | 0.00804                               |

NOTE: Moisture has been estimated as no moisture test was performed on the date(s) of testing

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> | 1.186  |
| Average Wet Density (Actual), P <sub>ActualW</sub> | kg/m <sup>3</sup> | 1.182  |

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    | 19.5   | 0.0              |
| Total Pressure           | kPa   | 100.0  | 101.3            |
| Moisture                 | %     | 1.00   | 1.00             |

| Gas Volumetric Flowrate (from Traverse)  | Units              | Result |
|------------------------------------------|--------------------|--------|
| Gas Volumetric Flowrate (Actual)         | m <sup>3</sup> /hr | 736    |
| Gas Volumetric Flowrate (STP, Wet)       | m <sup>3</sup> /hr | 678    |
| Gas Volumetric Flowrate (STP, Dry)       | m <sup>3</sup> /hr | 671    |
| Gas Volumetric Flowrate REF <sup>1</sup> | m <sup>3</sup> /hr | 678    |

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

(1 of 1)

| Parameter                       | Units                                 | Value         |
|---------------------------------|---------------------------------------|---------------|
| Date of Survey                  | -                                     | 30/01/2019    |
| Time of Survey                  | -                                     | 10:47 - 10:57 |
| Atmospheric Pressure            | kPa                                   | 100.0         |
| Average Stack Static Pressure   | Pa                                    | 5             |
| 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, $C_p$         | -     | 0.83     |
| Number of Lines Available | -     | 1        |
| Number of Lines Used      | -     | 1        |

| Sampling Line A    |         |               |         |                               |              |         |
|--------------------|---------|---------------|---------|-------------------------------|--------------|---------|
| Traverse Point     | Depth m | $\Delta P$ Pa | Temp °C | Wet Density kg/m <sup>3</sup> | Velocity m/s | Swirl ° |
| STATIC (Units: Pa) |         | 10.8          |         |                               |              |         |
| Mean               |         | 7.2           | 19.5    | 1.182                         | 2.89         |         |
| 1                  | 0.04    | 8.0           | 19.5    | 1.182                         | 3.05         |         |
| 2                  | 0.26    | 6.4           | 19.5    | 1.182                         | 2.73         |         |

**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                | $u(\Delta p_i)$    | 1.047   | Pa                 |
| - Resolution                                                                         | $u(res)$           | 0.00087 |                    |
| - Calibration                                                                        | $u(cal)$           | 0.005   |                    |
| - Drift                                                                              | $u(drift)$         | 0.083   |                    |
| - Lack of Fit                                                                        | $u(fit)$           | 0.007   |                    |
| - Overall corrections to dynamic measurements                                        | $u(C_f)$           | 0.096   |                    |
| Standard uncertainty associated with the molar mass of the gas                       | $u(M)$             | 0.00003 | -                  |
| - $\phi_{O_2,w}$                                                                     | -                  | 20.592  |                    |
| - $\phi_{CO_2,w}$                                                                    | -                  | 0.059   |                    |
| - Oxygen, dry                                                                        | $u(\phi_{O_2,d})$  | 0.637   |                    |
| - Carbon Dioxide, dry                                                                | $u(\phi_{CO_2,d})$ | 0.002   |                    |
| - Water Vapour                                                                       | $u(\phi_{H_2O})$   | 0.051   |                    |
| - 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                           | $u(T_c)$           | 1.492   | K                  |
| Standard uncertainty associated with the absolute pressure in the duct               | $u(p_c)$           | 175.695 | Pa                 |
| - Atmospheric Pressure                                                               | $u(p_{atm})$       | 175.692 |                    |
| - Static Pressure                                                                    | $u(p_{stat})$      | 1.047   |                    |
| Standard uncertainty associated with the density in the duct                         | $u(\rho)$          | 0.00638 | -                  |
| Standard uncertainty associated with the local velocities                            | $u(v_i)$           | 0.217   | Pa                 |
| Standard uncertainty associated with the mean velocity                               | $u(\bar{v})$       | 0.158   | m/s                |
| Standard uncertainty associated with the mean velocity (95% Confidence)              | $U_c(v)$           | 0.309   | m/s                |
| Standard uncertainty associated with the mean velocity (95% Confidence), relative    | $U_{c,rel}(v)$     | 10.70   | %                  |
| Standard uncertainty associated with the volume flow rate (95% Confidence)           | $U_c(qV,w)$        | 85.5    | m <sup>3</sup> /hr |
| - $u^2(a)/a^2$                                                                       | -                  | 0.00053 |                    |
| - $u^2(qV,w)/q^2V,w$                                                                 | -                  | 0.00351 |                    |
| - $u^2(qV,w)$                                                                        | -                  | 1902    |                    |
| - $u(qV,w)$                                                                          | -                  | 43.6    |                    |
| Standard uncertainty associated with the volume flow rate (95% Confidence), relative | $U_{c,rel}(qV,w)$  | 11.62   | %                  |

## TOTAL VOCs (as CARBON): RESULTS SUMMARY

Xaarjet Ltd, Huntingdon  
20 - CR4 Room Extract

### Sample Runs

| Parameter     | Units              | Run 1 | Run 2 | Run 3 | Mean |
|---------------|--------------------|-------|-------|-------|------|
| Concentration | mg/m <sup>3</sup>  | 10.8  | 10.0  | 16.4  | 12.4 |
| Uncertainty   | ±mg/m <sup>3</sup> | 4.5   | 0.49  | 0.58  | 1.8  |
| Mass Emission | g/hr               | 7.3   | 6.7   | 11.1  | 8.4  |
| Uncertainty   | ±g/hr              | 3.1   | 0.9   | 1.4   | 1.8  |

### General Sampling Information

| Parameter                        | Value                              |
|----------------------------------|------------------------------------|
| Standard                         | EN 12619:2013                      |
| Technical Procedure              | CAT-TP-20                          |
| Probe Material                   | Stainless Steel                    |
| Filtration Type / Size           | 0.1µm Glass Fibre                  |
| Heated Head Filter Used          | Yes                                |
| Heated Line Temperature          | 180°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                              |
| Number of Sampling Points Used   | 1 / 1                              |
| Sample Point I.D.'s              | C1                                 |

FORMAT: Number Used / Number Required

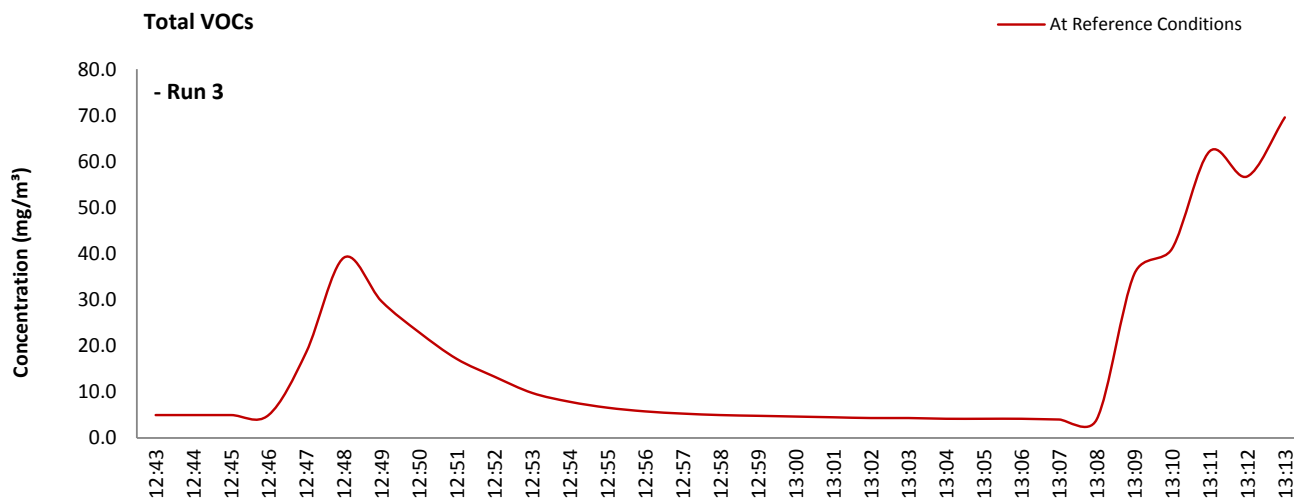
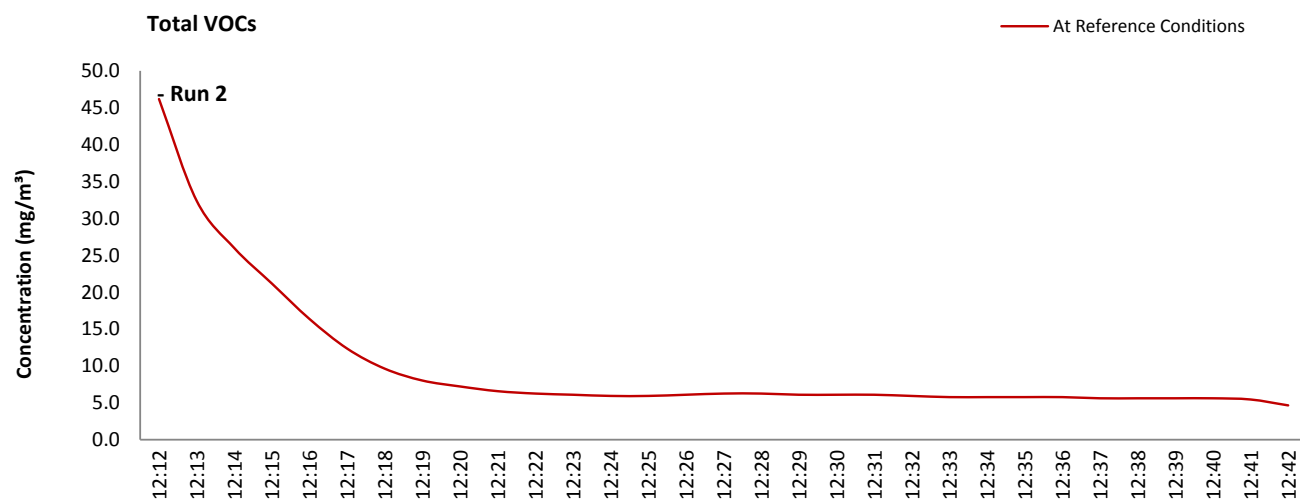
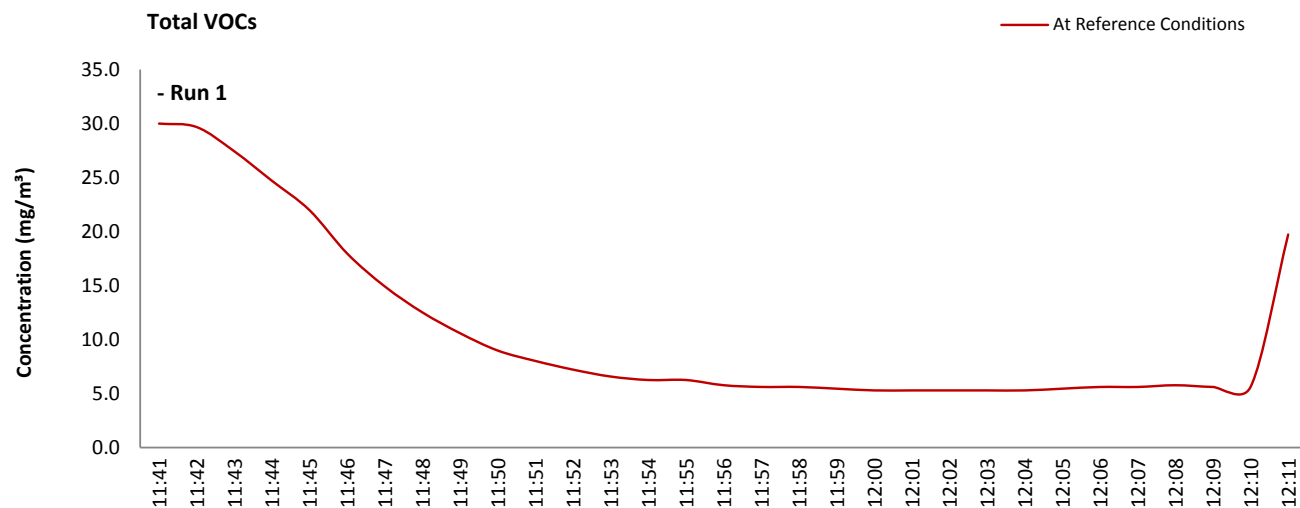
FORMAT: Number Used / Number Required

### Reference Conditions

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

## TOTAL VOCs (as CARBON): DATA TREND

### Graphical Trend of Data



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

### Sampling Details

| Parameter        | Units | Run 1         | Run 2         | Run 3         |
|------------------|-------|---------------|---------------|---------------|
| Sampling Times   | -     | 11:41 - 12:11 | 12:12 - 12:42 | 12:43 - 13:13 |
| Sampling Dates   | -     | 30/01/2019    | 30/01/2019    | 30/01/2019    |
| Instrument Range | ppm   | 100           | 100           | 100           |
| Span Gas Value   | ppm   | 79.9          | 79.9          | 79.9          |

### Quality Assurance

|       | Zero Drift                     | Units | Run 1 | Run 2 | Run 3 |
|-------|--------------------------------|-------|-------|-------|-------|
| CAL 1 | Zero Down Sampling Line (Pre)  | ppm   | 0.00  | 0.00  | 0.00  |
|       | Zero Down Sampling Line (Post) | ppm   | 0.00  | 0.00  | 0.00  |
|       | Zero Drift                     | ppm   | 0.00  | 0.00  | 0.00  |
|       | Allowable Zero Drift           | ± ppm | 4.00  | 4.00  | 4.00  |
|       | Zero Drift Acceptable          | -     | Yes   | Yes   | Yes   |

|       | Span Drift                     | Units | Run 1 | Run 2 | Run 3 |
|-------|--------------------------------|-------|-------|-------|-------|
| CAL 1 | Span Down Sampling Line (Pre)  | ppm   | 79.90 | 79.90 | 79.90 |
|       | Span Down Sampling Line (Post) | ppm   | 80.10 | 80.10 | 80.10 |
|       | Span Drift                     | ppm   | 0.20  | 0.20  | 0.20  |
|       | Allowable Span Drift           | ± ppm | 4.00  | 4.00  | 4.00  |
|       | Span Drift Acceptable          | -     | Yes   | Yes   | Yes   |

| Test Conditions               | Units | Run 1 | Run 2 | Run 3 |
|-------------------------------|-------|-------|-------|-------|
| Run Ambient Temperature Range | °C    | 3 - 4 | 3 - 4 | 3 - 4 |

### Method Deviations

| Nature of Deviation<br>(x = deviation applies to the associated run) | Run Number |   |   |
|----------------------------------------------------------------------|------------|---|---|
|                                                                      | 1          | 2 | 3 |
| There are no deviations associated with the sampling employed.       | x          | x | x |

**TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS**

| Performance characteristics | RUN 1 | RUN 2 | RUN 3 | Units                        |
|-----------------------------|-------|-------|-------|------------------------------|
| Limit value                 | 75.0  | 75.0  | 75.0  | mg/m <sup>3</sup> (REF)      |
| TGN M2 Allowable MU         | 15.0  | 15.0  | 15.0  | %                            |
| Measured concentration      | 1.08  | 10.05 | 16.58 | mg/m <sup>3</sup> (STP, dry) |
| Range Used                  | 100.0 | 100.0 | 100.0 | ppm                          |
| Range Used [A]              | 160.6 | 160.6 | 160.6 | mg/m <sup>3</sup>            |
| Cal gas conc.               | 79.9  | 79.9  | 79.9  | ppm                          |
| Conversion                  | 1.61  | 1.61  | 1.61  | ppm to mg/m <sup>3</sup>     |
| MCERTS Range [B]            | 15.0  | 15.0  | 15.0  | mg/m <sup>3</sup>            |
| Lower of [A] or [B]         | 15.0  | 15.0  | 15.0  | mg/m <sup>3</sup>            |
| Cal gas conc.               | 128.3 | 128.3 | 128.3 | mg/m <sup>3</sup>            |

| Performance characteristics        | RUN 1 | RUN 2 | RUN 3 | Units            |
|------------------------------------|-------|-------|-------|------------------|
| Response time                      | 45    | 45    | 45    | seconds          |
| Number of readings in measurement  | 30    | 30    | 30    | -                |
| Repeatability at zero              | 2.00  | 2.00  | 2.00  | % full scale     |
| Repeatability at span level        | 0.00  | 0.00  | 0.00  | % full scale     |
| Deviation from linearity           | 0.73  | 0.73  | 0.73  | % of value       |
| Zero drift                         | 0.00  | 0.00  | 0.00  | % full scale     |
| Span drift                         | 0.25  | 0.25  | 0.25  | % full scale     |
| Volume or pressure flow dependence | 1.60  | 1.60  | 1.60  | % of full scale  |
| Atmospheric pressure dependence    | 0.30  | 0.30  | 0.30  | % of value/kPa   |
| Ambient temperature dependence     | 1.40  | 1.40  | 1.40  | % full scale/10K |
| Combined interference              | 0.45  | 0.45  | 0.45  | % range          |
| Dependence on voltage              | 0.50  | 0.50  | 0.50  | % full scale/10V |
| Losses in the line (leak)          | 0.00  | 0.00  | 0.00  | % of value       |
| Uncertainty of calibration gas     | 2.00  | 2.00  | 2.00  | % of value       |

| Performance characteristic                        | RUN 1           | RUN 2           | RUN 3           | Units             |
|---------------------------------------------------|-----------------|-----------------|-----------------|-------------------|
| Standard deviation of repeatability at zero       | use rep at span | use rep at span | use rep at span | mg/m <sup>3</sup> |
| Standard deviation of repeatability at span level | 0.00            | 0.00            | 0.00            | mg/m <sup>3</sup> |
| Lack of fit                                       | 0.06            | 0.06            | 0.06            | mg/m <sup>3</sup> |
| Drift                                             | 0.00            | 0.01            | 0.02            | mg/m <sup>3</sup> |
| Volume or pressure flow dependence                | 0.00            | 0.00            | 0.00            | mg/m <sup>3</sup> |
| Atmospheric pressure dependence                   | 0.01            | 0.01            | 0.01            | mg/m <sup>3</sup> |
| Ambient temperature dependence                    | 0.20            | 0.20            | 0.20            | mg/m <sup>3</sup> |
| Combined interference (from MCERTS Certificate)   | 0.04            | 0.04            | 0.04            | mg/m <sup>3</sup> |
| Dependence on voltage                             | 0.06            | 0.06            | 0.06            | mg/m <sup>3</sup> |
| Losses in the line (leak)                         | 0.00            | 0.00            | 0.00            | mg/m <sup>3</sup> |
| Uncertainty of calibration gas                    | 0.01            | 0.12            | 0.19            | mg/m <sup>3</sup> |

|                                                       |          | RUN 1 | RUN 2 | RUN 3 | Units                   |
|-------------------------------------------------------|----------|-------|-------|-------|-------------------------|
| Measurement uncertainty                               | Result   | 1.08  | 10.05 | 16.58 | mg/m <sup>3</sup>       |
| Combined uncertainty                                  |          | 0.23  | 0.26  | 0.30  | mg/m <sup>3</sup>       |
| Expanded uncertainty                                  | k = 1.96 | 0.44  | 0.50  | 0.58  | mg/m <sup>3</sup>       |
| Uncertainty corrected to std conds. (O <sub>2</sub> ) |          | 0.44  | 0.50  | 0.58  | mg/m <sup>3</sup> (REF) |

|                                                                        | RUN 1            | RUN 2            | RUN 3            | Units      |
|------------------------------------------------------------------------|------------------|------------------|------------------|------------|
| Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence          | 41.17            | 4.97             | 3.52             | % of Value |
| Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence          | 0.59             | 0.67             | 0.78             | % at ELV   |
| Overall Allowable uncertainty (no O <sub>2</sub> ) - at 95% Confidence | 15.0             | 15.0             | 15.0             | % at ELV   |
| <b>Result of Compliance with Uncertainty Requirement in M2</b>         | <b>COMPLIANT</b> | <b>COMPLIANT</b> | <b>COMPLIANT</b> | -          |

|                                                                          | RUN 1      | RUN 2      | RUN 3      | Units      |
|--------------------------------------------------------------------------|------------|------------|------------|------------|
| Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence          | N/A        | N/A        | N/A        | % of Value |
| Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence          | N/A        | N/A        | N/A        | % at ELV   |
| Overall Allowable uncertainty (with O <sub>2</sub> ) - at 95% Confidence | N/A        | N/A        | N/A        | % at ELV   |
| <b>Result of Compliance with Uncertainty Requirement in M2</b>           | <b>N/A</b> | <b>N/A</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.