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Stack Emissions Testing Report Commissioned by
Liberty Pressing Solutions Ltd

Installation Name & Address
Liberty Pressing Solutions Ltd
Burnsall Road
Canley
Coventry
West Midlands
CV5 6RT

PPC Permit: PPC/193

Stack Reference
Burn Off Oven Exhaust

Dates of the Monitoring Campaign
5th July 2018

Job Reference Number
CAT-4229

| |
|--|
| Report Written by |
| Harpreet Badwal Team Leader MCERTS Level 2 MM 03 149 TE1 TE2 TE3 TE4 |

| |
|---|
| Report Approved by |
| Michelle Edwards Team Leader MCERTS Level 2 MM 05 659 TE1 TE2 TE3 TE4 |

| |
|--------------------|
| Report Date |
| 19th July 2018 |

| |
|----------------|
| Version |
| Version 1 |

| |
|-------------------------------------|
| Signature of Report Approver |
| |

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Executive Summary

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MONITORING OBJECTIVES

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust
5th July 2018

Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by Liberty Pressing Solutions Ltd to carry out stack emissions testing on the Burn Off Oven Exhaust at Coventry.

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), Oxides of Nitrogen (as NO₂), Carbon Monoxide

Executive Summary

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MONITORING RESULTS

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust
5th July 2018

where MU = Measurement Uncertainty associated with the Result

| Parameter | Concentration | | | | Mass Emission | | | |
|--|---------------------------------|----------|--------|-------|---------------|--------|--------|-------|
| | Units | Result | MU +/- | Limit | Units | Result | MU +/- | Limit |
| Total Particulate Matter | ¹ mg/m ³ | 0.72 | 0.14 | 20 | g/hr | 0.46 | 0.09 | - |
| Total VOCs (as Carbon) | ¹ mg/m ³ | 4.4 | 0.94 | 20 | g/hr | 2.8 | 0.64 | - |
| Oxides of Nitrogen (as NO ₂) | ¹ mg/m ³ | 112 | 6.1 | 200 | g/hr | 72.7 | 6.5 | - |
| Carbon Monoxide | ¹ mg/m ³ | 160 | 8.3 | 200 | g/hr | 104 | 9.1 | - |
| Carbon Dioxide | % v/v | Dry 4.8 | 0.27 | | | | | |
| Oxygen | % v/v | Dry 12.7 | 0.49 | | | | | |
| Water Vapour | % v/v | 3.6 | 0.19 | | | | | |
| Stack Gas Temperature | °C | 672 | | | | | | |
| Stack Gas Velocity | m/s | 6.3 | 0.34 | | | | | |
| Volumetric Flow Rate (ACTUAL) | m ³ /hr | 2835 | 200 | | | | | |
| Volumetric Flow Rate (REF) | ¹ m ³ /hr | 648 | 45.6 | | | | | |

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

¹ Reference Conditions (REF) are: 273K, 101.3kPa, dry gas, 11% oxygen.

Executive Summary

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MONITORING DATE(S) & TIMES

Liberty Pressing Solutions Ltd, Coventry
 Burn Off Oven Exhaust
 5th July 2018

| Parameter | Units | Concentration | Units | Mass Emission | Sampling Date(s) | Sampling Times | Duration mins |
|--|----------------------|---------------|-------|---------------|------------------|------------------------------|---------------|
| Total Particulate Matter | R1 mg/m ³ | 0.72 | g/hr | 0.46 | 05/07/2018 | 09:48 - 09:52, 10:03 - 14:17 | 258 |
| Total VOCs (as Carbon) | R1 mg/m ³ | 4.4 | g/hr | 2.8 | 05/07/2018 | 09:48 - 09:52, 10:03 - 14:17 | 258 |
| Oxides of Nitrogen (as NO ₂) | R1 mg/m ³ | 112 | g/hr | 72.7 | 05/07/2018 | 09:48 - 09:52, 10:03 - 14:17 | 258 |
| Carbon Monoxide | R1 mg/m ³ | 160 | g/hr | 104 | 05/07/2018 | 09:48 - 09:52, 10:03 - 14:17 | 258 |
| Carbon Dioxide | R1 % v/v | 4.8 | | | 05/07/2018 | 09:48 - 09:52, 10:03 - 14:17 | 258 |
| Oxygen | R1 % v/v | 12.7 | | | 05/07/2018 | 09:48 - 09:52, 10:03 - 14:17 | 258 |
| Velocity Traverse | R1 | | | | 05/07/2018 | 09:39 - 09:46 | |

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

Liberty Pressing Solutions Ltd, Coventry
 Burn Off Oven Exhaust
 5th July 2018

Standard Operating Conditions

| Parameter | Value |
|--------------------------------------|---|
| Process Status | Normal Operation |
| Capacity (of 100%) and Tonnes / Hour | 100% Operating Capacity - 30 JLR Fixes Loaded |
| Continuous or Batch Process | Batch |
| Feedstock (if applicable) | JLR Bars |
| Abatement System | N/A |
| Abatement System Running Status | N/A |
| Fuel | Natural Gas |
| Plume Appearance | None Visible |

Executive Summary

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MONITORING & ANALYTICAL METHODS

Liberty Pressing Solutions Ltd, Coventry

Burn Off Oven Exhaust

5th July 2018

| Parameter | Monitoring | | | | Analysis | | | | MCERTS Testing | LOD (Average) |
|--|------------------|---------------------|-------------------|-------------|---|----------------------|--------------------|--------------|----------------|------------------------|
| | Standard | Technical Procedure | ISO 17025 Testing | Testing Lab | Analytical Procedure | Analytical Technique | ISO 17025 Analysis | Analysis Lab | | |
| Total Particulate Matter | EN 13284-1 | CAT-TP-01 | Yes | CAT | CAT-TP-03 | Gravimetric | Yes | CAT | Yes | 0.05 mg/m ³ |
| Water Vapour | EN 14790 | CAT-TP-05 | Yes | CAT | CAT-TP-05 | Gravimetric | Yes | CAT | Yes | 0.10 % v/v |
| Total VOCs (as Carbon) | EN 12619:2013 | CAT-TP-20 | Yes | CAT | Flame Ionisation Detection by Sick 3006 FID | | | | Yes | 0.32 mg/m ³ |
| Oxides of Nitrogen (as NO ₂) | EN 14792 | CAT-TP-39 | Yes | CAT | Chemiluminescence by Horiba PG-350E | | | | Yes | 0.41 mg/m ³ |
| Carbon Monoxide | EN 15058 | CAT-TP-39 | Yes | CAT | NDIR by Horiba PG-350E | | | | Yes | 0.4 mg/m ³ |
| Carbon Dioxide | ISO 12039 | CAT-TP-39 | Yes | CAT | NDIR by Horiba PG-350E | | | | Yes | 0.1 % |
| Oxygen | EN 14789 | CAT-TP-39 | Yes | CAT | Dry Paramagnetic Cell by Horiba PG-350E | | | | Yes | 0.1 % |
| Velocity & Vol. Flow Rate | EN 16911-1 (MID) | CAT-TP-41 | Yes | CAT | Pitot Tube and Thermocouple | | | | Yes | 1.2 m/s |

ANALYSIS LABORATORIES

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

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

SUMMARY OF SAMPLING DEVIATIONS

| Parameter | Run | Deviation |
|--------------------------|-----|---|
| Total Particulate Matter | 1 | One out of two sampling lines was used due to sampling location restrictions, however the number of sample points used on the available line were increased to the minimum required by the Standard |

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

| Parameter | Units | Value |
|---------------------|----------------|----------|
| Type | - | Circular |
| Depth | m | 0.40 |
| Width | m | - |
| Area | m ² | 0.13 |
| Port Depth | cm | 0 |
| Orientation of Duct | - | Vertical |
| Number of Ports | - | 2 |
| Sample Port Size | - | Hole |

Location of Sampling Platform

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

Platform Details

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

Sampling Location / Platform Improvement Recommendations

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

EN 15259 Homogeneity Test Requirements

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

Sampling Plane Validation Criteria (from EN 15259)

| Criteria in EN 15259 | Units | Traverse 1 | Required | Compliant |
|------------------------------|-------|------------|----------|-----------|
| Lowest Differential Pressure | Pa | 9.0 | > 5 Pa | Yes |
| Mean Velocity | m/s | 4.21 | - | - |
| Lowest Gas Velocity | m/s | 3.82 | - | - |
| Highest Gas Velocity | m/s | 4.97 | - | - |
| Ratio of Above | : 1 | 1.30 | < 3 : 1 | Yes |
| Maximum Angle of Swirl | ° | 1 | < 15° | Yes |
| No Local Negative Flow | - | Yes | - | Yes |

Executive Summary

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PLANT PHOTOS

Photo 1



Photo 2



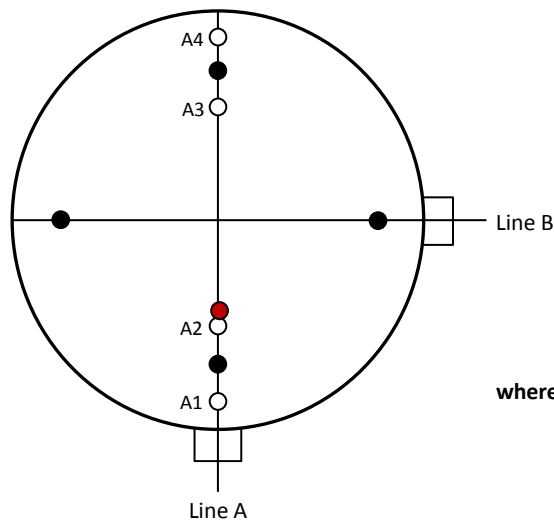
Photo 3



Photo 4



SAMPLE POINTS



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



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 | Harpreet Badwal | MCERTS Level 2 | MM 03 149 | TE1 TE2 TE3 TE4 |
| Technician | Lee Heaton | MCERTS Level 1 | MM 17 1433 | 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 7.67 | Horiba PG-350E | CAT 39.10 | Digital Manometer (1) | CAT 3.142 |
| Control Box DGM (2) | - | Horiba PG-250 | - | Digital Manometer (2) | CAT 3.144 |
| Box Thermocouples (1) | CAT 3.164 | Servomex 4900 | - | Digital Temperature Meter | - |
| Box Thermocouples (2) | - | Eco Physics CLD 822Mh | - | Stopwatch | CAT 14.84 |
| Umbilical (1) | CAT 3.146 | ABB AO2020-URAS26 | - | Barometer | CAT 13.40 |
| Umbilical (2) | - | Testo 350 XL | - | Stack Thermocouple (1) | CAT 4.874 |
| Oven Box (1) | CAT 12.109 | Ankersmid APS 313 | CAT 4.847 | Stack Thermocouple (2) | CAT 4.870 |
| 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 8.31 | 1m Heated Line (2) | - |
| Heated Probe (3) | - | M&C PSS | CAT 12.107 | 1m Heated Line (3) | - |
| S-Pitot (1) | CAT 21S.57 | Mass Flow Controller (1) | CAT 6.61 | 5m Heated Line (1) | - |
| S-Pitot (2) | - | Mass Flow Controller (2) | CAT 6.62 | 15m Heated Line (1) | - |
| L-Pitot | CAT 21L.44 | Mass View (1) | - | 20m Heated Line (1) | CAT 20.116 |
| Site Balance | CAT 17.33 | Mass View (2) | - | 20m Heated Line (2) | - |
| 500g / 1Kg Check Weights | CAT 17.33 a & b | Hioki 5043 (V) | - | Dual Channel Heater Controller | - |
| Last Impinger Arm | - | Easylogger EN-EL-12 Bit | - | Single Channel Heater Controller | CAT 20.116 |
| Callipers | CAT 23.40 | Bioaerosols Temperature Logger | - | Laboratory Balance | CAT 1.18 / 1.18a |
| Tubes Kit Thermocouple | - | Electronic Refrigerator | - | Tape Measure | CAT 16.45 |

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 |
| Oxides of Nitrogen (as NO ₂) | EN 14792 | CAT-TP-39 |
| Carbon Monoxide | EN 15058 | CAT-TP-39 |
| Carbon Dioxide | ISO 12039 | CAT-TP-39 |
| Oxygen | EN 14789 | CAT-TP-39 |
| 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 | 0.40 |
| Stack Width, W | m | - |
| Stack Area, A | m ² | 0.13 |
| Average Stack Gas Temperature, T _a | °C | 129.6 |
| Average Stack Gas Pressure | Pa | 11.1 |
| Average Stack Static Pressure, P _{static} | kPa | 0.021 |
| Average Barometric Pressure, P _b | kPa | 100.6 |
| Average Pitot Tube Calibration Coefficient, C _p | - | 0.84 |

Stack Gas Composition & Molecular Weights

| Component | Conc ppm | Conc Dry % v/v | Conc Wet % v/v | Volume Fraction r | Molar Mass M | Density kg/m ³ ρ | Conc kg/m ³ p _i |
|-----------------------------|----------|----------------|----------------|-------------------|--------------|-----------------------------|---------------------------------------|
| CO ₂ | - | 4.82 | 4.65 | 0.0482 | 44.01 | 1.9635 | 0.09470 |
| O ₂ | - | 12.73 | 12.28 | 0.1273 | 32.00 | 1.4277 | 0.18179 |
| N ₂ | - | 82.44 | 79.49 | 0.8244 | 28.01 | 1.2498 | 1.03042 |
| Moisture (H ₂ O) | - | - | 3.59 | 0.0359 | 18.02 | 0.8037 | 0.02881 |

Where: $\rho = M / 22.41$

$p_i = r \times \rho$

Calculation of Stack Gas Densities

| Determinand | Units | Result |
|--|-------------------|--------|
| Dry Density (STP), P _{STD} | kg/m ³ | 1.307 |
| Wet Density (STP), P _{STW} | kg/m ³ | 1.289 |
| Dry Density (Actual), P _{Actual} | kg/m ³ | 0.880 |
| Average Wet Density (Actual), P _{ActualW} | kg/m ³ | 0.868 |

Where: P_{STD} = sum of component concentrations, kg/m³ (not including water vapour)

P_{STW} = sum of all wet concentrations / 100 x density, kg/m³ (including water vapour)

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

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

Calculation of Stack Gas Volumetric Flowrate, Q

| Duct gas flow conditions | Units | Actual | REF ¹ |
|--------------------------|-------|--------|------------------|
| Temperature | °C | 129.6 | 0.0 |
| Total Pressure | kPa | 100.6 | 101.3 |
| Moisture | % | 3.59 | 0.00 |
| Oxygen (Dry) | % | 12.7 | 11.0 |

| Gas Volumetric Flowrate (from Traverse) | Units | Result |
|--|--------------------|--------|
| Gas Volumetric Flowrate (Actual) | m ³ /hr | 1904 |
| Gas Volumetric Flowrate (STP, Wet) | m ³ /hr | 1283 |
| Gas Volumetric Flowrate (STP, Dry) | m ³ /hr | 1237 |
| Gas Volumetric Flowrate REF ¹ | m ³ /hr | 1022 |

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

(1 of 1)

| Parameter | Units | Value |
|---------------------------------|---------------------------------------|---------------|
| Date of Survey | - | 05/07/2018 |
| Time of Survey | - | 09:39 - 09:46 |
| Atmospheric Pressure | kPa | 100.6 |
| Average Stack Static Pressure | Pa | 21 |
| 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 | - | 0.84 |
| Number of Lines Available | - | 2 |
| Number of Lines Used | - | 1 |

| Sampling Line A | | | | | | |
|--------------------|---------|-------------|--------------|-------------------------------|--------------|---------|
| Traverse Point | Depth m | ΔP Pa | Temp °C | Wet Density kg/m ³ | Velocity m/s | Swirl ° |
| STATIC (Units: Pa) | | 21.4 | | | | |
| Mean | | 11.1 | 129.6 | 0.868 | 4.21 | |
| 1 | 0.03 | 15.3 | 128.7 | 0.870 | 4.97 | 1.0 |
| 2 | 0.10 | 10.6 | 129.2 | 0.869 | 4.14 | 1.0 |
| 3 | 0.30 | 9.5 | 129.8 | 0.868 | 3.92 | 1.0 |
| 4 | 0.37 | 9.0 | 130.6 | 0.866 | 3.82 | 1.0 |

| Sampling Line B - Restricted Access | | | | |
|-------------------------------------|---------|-------------------------------|--------------|---------|
| ΔP | Temp °C | Wet Density kg/m ³ | Velocity m/s | Swirl ° |
| | | | | |

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 | $u(cal)$ | 0.013 | |
| - Drift | $u(drift)$ | 0.083 | |
| - Lack of Fit | $u(fit)$ | 0.000 | |
| - Overall corrections to dynamic measurements | $u(C_f)$ | 0.097 | |
| Standard uncertainty associated with the molar mass of the gas | $u(M)$ | 0.00003 | - |
| - $\phi_{O_2,w}$ | - | 12.277 | |
| - $\phi_{CO_2,w}$ | - | 4.650 | |
| - Oxygen, dry | $u(\phi_{O_2,d})$ | 0.390 | |
| - Carbon Dioxide, dry | $u(\phi_{CO_2,d})$ | 0.148 | |
| - Water Vapour | $u(\phi_{H_2O})$ | 0.183 | |
| - Oxygen, wet | $u(\phi_{O_2,w})$ | 0.377 | |
| - Carbon Dioxide, wet | $u(\phi_{CO_2,w})$ | 0.143 | |
| Standard uncertainty associated with the stack temperature | $u(T_c)$ | 2.054 | 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 | $u(\rho)$ | 0.00468 | - |
| Standard uncertainty associated with the local velocities | $u(v_i)$ | 0.211 | Pa |
| Standard uncertainty associated with the mean velocity | $u(\bar{v})$ | 0.116 | m/s |
| Standard uncertainty associated with the mean velocity (95% Confidence) | $U_c(v)$ | 0.227 | m/s |
| Standard uncertainty associated with the mean velocity (95% Confidence), relative | $U_{c,rel}(v)$ | 5.39 | % |
| Standard uncertainty associated with the volume flow rate (95% Confidence) | $U_c(qV,w)$ | 134.1 | m ³ /hr |
| - $u^2(a)/a^2$ | - | 0.00053 | |
| - $u^2(qV,w)/q^2V,w$ | - | 0.00129 | |
| - $u^2(qV,w)$ | - | 4682 | |
| - $u(qV,w)$ | - | 68.4 | |
| Standard uncertainty associated with the volume flow rate (95% Confidence), relative | $U_{c,rel}(qV,w)$ | 7.04 | % |

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust

Sample Runs

| Parameter | Units | Run 1 | | Mean |
|---------------|--------------------|-------|--|------|
| Concentration | mg/m ³ | 0.72 | | 0.72 |
| Uncertainty | ±mg/m ³ | 0.14 | | 0.14 |
| Mass Emission | g/hr | 0.46 | | 0.46 |
| Uncertainty | ±g/hr | 0.09 | | 0.09 |

| Parameter | Units | Run 1 | | Mean |
|--------------|--------|-------|--|------|
| Water Vapour | % v/v | 3.6 | | 3.6 |
| Uncertainty | ±% v/v | 0.19 | | 0.19 |

Blank Runs

| Parameter | Units | Blank 1 | | Maximum |
|---------------|-------------------|---------|--|---------|
| Concentration | mg/m ³ | 0.06 | | 0.06 |

General Sampling Information

| Parameter | Value |
|--------------------------------|-------------------|
| Standard | EN 13284-1 |
| Technical Procedure | CAT-TP-01 |
| Probe Material | Titanium |
| Filter Housing Material | Titanium |
| Positioning of Filter | Out Stack |
| Filter Size and Material | 47mm Quartz Fibre |
| Number of Sampling Lines Used | 1 / 2 |
| Number of Sampling Points Used | 4 / 4 |
| Sample Point I.D.'s | A1, A2, A3 & A4 |

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

TOTAL PARTICULATE MATTER: ISOKINETIC SAMPLING CALCULATIONS

| Test | Units | Run 1 | |
|--|---------------------|--------|--|
| Absolute pressure of stack gas, P_s | | | |
| Barometric pressure, P _b | mmHg | 754.5 | |
| Stack static pressure, P _{static} | mmH ₂ O | 2.2 | |
| $P_s = (P_b + (P_{static} / 13.6))$ | mmHg | 754.7 | |
| Volume of water vapour collected, V_{wstd} | | | |
| Total mass collected in impingers (liquid trap) | g | 103.8 | |
| Total mass collected in impingers (silica trap) | g | 22.5 | |
| Total mass of liquid collected, V _{lc} | g | 126.3 | |
| $V_{wstd} = (0.001246)(V_{lc})$ | m ³ | 0.1574 | |
| Volume of gas metered dry, V_{mstd} | | | |
| Volume of gas sample through gas meter, V _m | m ³ | 4.8400 | |
| Gas meter correction factor, Y _d | - | 0.9890 | |
| Average dry gas meter temperature, T _m | °C | 34.6 | |
| Average pressure drop across orifice, ΔH | mmH ₂ O | 34.7 | |
| $V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$ | m ³ | 4.2322 | |
| Moisture content, B_{wv} & R_{wv} | | | |
| $B_{wv} = V_{wstd} / (V_{mstd} + V_{wstd})$ | m ³ | 0.0359 | |
| B _{wv} as a percentage | % v/v | 3.59 | |
| Reported Water Vapour, checked with Tables in EN 14790, R _{wv} | % v/v | 3.59 | |
| Volume of gas metered wet, V_{mstw} | | | |
| $V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$ | m ³ | 4.3896 | |
| Volume of gas metered at Oxygen Reference Conditions, V_{mstd@X%O₂} & V_{mstw@X%O₂} | | | |
| IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction) | - | No | |
| % wet oxygen measured in gas stream, ACT%O _{2w} | % v/v | 12.28 | |
| % dry oxygen measured in gas stream, ACT%O _{2d} | % v/v | 12.73 | |
| % oxygen reference condition, REF%O ₂ | % v/v | 11.00 | |
| O ₂ Reference Factor wet (O _{2REFw}) = (21 - REF%O ₂) / (21 - ACT%O _{2w}) | - | 1.15 | |
| O ₂ Reference Factor dry (O _{2REFd}) = (21 - REF%O ₂) / (21 - ACT%O _{2d}) | - | 1.21 | |
| $V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$ | m ³ | 3.8287 | |
| $V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$ | m ³ | 3.4982 | |
| Molecular weight of dry gas stream, M_d | | | |
| CO ₂ | % v/v | 5.10 | |
| O ₂ | % v/v | 12.73 | |
| Total | % v/v | 17.83 | |
| N ₂ | % v/v | 82.17 | |
| $M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$ | g/gmol | 29.33 | |
| Molecular weight of stack gas (wet), M_s | | | |
| $M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$ | g/gmol | 28.92 | |
| Velocity of stack gas, V_s | | | |
| Pitot tube velocity constant, K _p | - | 34.97 | |
| Velocity pressure coefficient, C _p | - | 0.84 | |
| Average of velocity heads, ΔP _{avg} | mmH ₂ O | 1.05 | |
| Average square root of velocity heads, √ΔP | √mmH ₂ O | 1.02 | |
| Average stack gas temperature, T _s | °C | 671.8 | |
| $V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s + 273})) / (V(M_s)(P_s))$ | m/s | 6.27 | |
| Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO₂}), Dry@O_{2REF} (Q_{stdO₂}) | | | |
| Area of stack, A _s | m ² | 0.13 | |
| $Q_a = (60)(A_s)(V_s)$ | m ³ /min | 47.3 | |
| Conversion factor (K/mm.Hg), C _f | - | 0.3592 | |
| $Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$ | m ³ /min | 13.6 | |
| $Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$ | m ³ /min | 13.1 | |
| $Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$ | m ³ /min | 11.8 | |
| $Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$ | m ³ /min | 10.8 | |
| Percent isokinetic, %I | | | |
| Nozzle diameter, D _n | mm | 14.02 | |
| Nozzle area, A _n | mm ² | 154.32 | |
| Total sampling time, q | min | 258 | |
| $\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$ | % | 102.2 | |

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

| Parameter | Units | Run 1 | |
|---------------------------|-------------------|---------------------------------|--|
| Sampling Times | - | 09:48 - 09:52, 10:03 - 14:17 | |
| Sampling Dates | - | 05/07/2018 | |
| Sampling Device | - | ISO | |
| Volume Sampled (REF) | m ³ | 3.4982 | |
| Filter I.D. Number | - | 47-43445 | |
| Start Filter Mass | g | 0.14789 | |
| End Filter Mass | g | 0.14928 | |
| Total Mass on Filter | g | 0.00139 | |
| Probe Rinse I.D. Number | - | PR-47-43445 | |
| Start Probe Rinse Mass | g | 2.80014 | |
| End Probe Rinse Mass | g | 2.80126 | |
| Total Mass in Probe Rinse | g | 0.00112 | |
| Total Mass Collected | mg | 2.51 | |
| Calculated Concentration | mg/m ³ | 0.72 | |
| Balance Uncertainty / LOD | mg/m ³ | 0.05 | |

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

| Parameter | Units | Blank 1 | |
|------------------------------|-------------------|-------------|--|
| Blank Dates | - | 05/07/2018 | |
| Average Volume Sampled (REF) | m ³ | 3.4982 | |
| Filter I.D. Number | - | 47-43079 | |
| Start Filter Mass | g | 0.14623 | |
| End Filter Mass | g | 0.14626 | |
| Total Mass on Filter | g | 0.00003 | |
| Probe Rinse I.D. Number | - | PR-47-43079 | |
| Start Probe Rinse Mass | g | 2.68532 | |
| End Probe Rinse Mass | g | 2.68549 | |
| Total Mass in Probe Rinse | g | 0.00017 | |
| Total Mass Collected | mg | 0.20 | |
| Calculated Concentration | mg/m ³ | 0.06 | |
| Balance Uncertainty / LOD | mg/m ³ | 0.05 | |

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

| Leak Test Results | Units | Run 1 | |
|---|---------------------|--------------|--|
| Mean Sampling Rate | l/min | 18.55 | |
| Pre-Sampling Leak Rate | l/min | 0.05 | |
| Post-Sampling Leak Rate | l/min | 0.05 | |
| Allowable Leak Rate | l/min | 0.37 | |
| Leak Test Acceptable | - | Yes | |
| Water Droplets | | | |
| Are Water Droplets Present | - | No | |
| MU (Concurrent Water Vapour) | | | |
| Measurement Uncertainty (MU) | % | 5.3 | |
| Allowable MU | % | 20 | |
| MU Acceptable | % | Yes | |
| Silica Gel (Concurrent Water Vapour) | | | |
| Less than 50% Faded | % | Yes | |
| Isokinetic Criterion Compliance | | | |
| Isokinetic Variation | % | 102.2 | |
| Allowable Isokinetic Range | % | 95 - 115 | |
| Isokineticity Acceptable | - | Yes | |
| Weighing Uncertainty Criteria | | | |
| Overall Weighing Uncertainty | ± mg | 0.33 | |
| Overall Weighing Uncertainty | ± mg/m ³ | 0.09 | |
| ELV [Daily ELV for IED] | mg/m ³ | 20.00 | |
| Allowable Weighing Uncertainty | mg/m ³ | 1.00 | |
| Weighing Uncertainty Acceptable | - | Yes | |
| Filter Temperatures | | | |
| Pre-Conditioning Temperature | °C | 180 | |
| Post-Conditioning Temperature | °C | 160 | |
| Maximum Filter Temperature | °C | 160 | |
| Test Conditions | | | |
| 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 | 20.00 | |
| Pre-Sampling Leak Rate | l/min | 0.05 | |
| Post-Sampling Leak Rate | l/min | 0.05 | |
| Allowable Leak Rate | l/min | 0.40 | |
| Leak Test Acceptable | - | Yes | |

| Validity of Blank vs ELV | Units | Blank 1 | |
|--------------------------|-------------------|---------|--|
| Allowable Blank | mg/m ³ | 2.0 | |
| Blank Acceptable | - | Yes | |

| Acetone / Water Rinse Blank | Units | Blank |
|-----------------------------|-------|-------|
| Acetone / Water Rinse Value | mg/l | 2.7 |
| Allowable Blank | mg/l | 10 |
| Blank Acceptable | - | Yes |

Method Deviations

| Nature of Deviation | Run Number |
|---|------------|
| (x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run) | 1 |
| One out of two sampling lines was used due to sampling location restrictions, however the number of sample points used on the available line were increased to the minimum required by the Standard | x |

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

| Measured Quantities | Value | | | Standard uncertainty | | | |
|-------------------------|----------------|--------|--|----------------------|----------------|--------|--|
| | Symbol | Run 1 | | Symbol | Units | Run 1 | |
| Sampled Volume (Actual) | V _m | 4.8400 | | uV _m | m ³ | 0.0968 | |
| Sampled Gas Temperature | T _m | 307.6 | | uT _m | K | 2.0 | |
| Sampled Gas Pressure | p _m | 100.6 | | uρ _m | kPa | 0.5 | |
| Sampled Gas Humidity | H _m | 0.0 | | uH _m | % v/v | 1.0 | |
| Leak | L | 0.27 | | uL | % | - | |
| Mass of Particulate | m | 2.51 | | um | mg | 0.19 | |
| Uncollected Mass | UCM | 0.20 | | uUCM | mg | - | |

| Measured Quantities | Uncertainty as a Percentage | | | Requirement of Standard |
|-------------------------|-----------------------------|-------|--|-------------------------|
| | Units | Run 1 | | |
| Sampled Volume (Actual) | % | 2.00 | | ≤2% |
| Sampled Gas Temperature | % | 0.65 | | ≤1% |
| Sampled Gas Pressure | % | 0.50 | | ≤1% |
| Sampled Gas Humidity | % | 1.00 | | ≤1% |
| Leak | % | 0.27 | | ≤2% |
| Mass of Particulate | % | 0.27 | | <5% of ELV |
| Uncollected Mass | % | - | | - |

| Measured Quantities | Uncertainty in Measurement Units | | | | Sensitivity Coefficient | |
|----------------------|----------------------------------|-------------------|--------|--|-------------------------|--|
| | Symbol | Units | Run 1 | | Run 1 | |
| Sampled Volume (STP) | V _m | m ³ | 4.2322 | | 0.17 | |
| Leak | L | mg/m ³ | 0.001 | | 1.00 | |
| Mass of Particulate | L _r | mg | 2.507 | | 0.29 | |
| Uncollected Mass | UCM | mg | 0.12 | | 0.29 | |

| Measured Quantities | Uncertainty in Result | | |
|----------------------|-----------------------|--------|--|
| | Units | Run 1 | |
| Sampled Volume (STP) | mg/m ³ | 0.019 | |
| Leak | mg/m ³ | 0.0011 | |
| Mass of Particulate | mg/m ³ | 0.0543 | |
| Uncollected Mass | mg/m ³ | 0.0330 | |

| Measured Quantities | Oxygen Correction Part of MU Budget | | |
|---|-------------------------------------|-------|--|
| | Units | Run 1 | |
| O ₂ Correction Factor | - | 1.21 | |
| Stack Gas O ₂ Content | % v/v | 12.73 | |
| MU for O ₂ Correction | - | 0.07 | |
| Overall MU For O ₂ Measurement | % | 6.05 | |

| Parameter | Units | Run 1 | |
|---|-------------------|-------|--|
| Combined uncertainty | mg/m ³ | 0.07 | |
| Expanded uncertainty (95% confidence), without Oxygen Correction | mg/m ³ | 0.13 | |
| Expanded uncertainty (95% confidence), with Oxygen Correction | mg/m ³ | 0.14 | |
| Expanded uncertainty (95% confidence), estimated with Method Deviations | mg/m ³ | 0.14 | |
| Reported Uncertainty | mg/m ³ | 0.14 | |
| Expanded uncertainty (95% confidence), without Oxygen Correction | % | 18.1 | |
| Expanded uncertainty (95% confidence), with Oxygen Correction | % | 19.1 | |
| Expanded uncertainty (95% confidence), estimated with Method Deviations | % | 19.1 | |
| Reported Uncertainty | % | 19.1 | |

TOTAL VOCs (as CARBON): RESULTS SUMMARY

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust

Sample Runs

| Parameter | Units | Run 1 | Mean |
|---------------|--------------------|-------|------|
| Concentration | mg/m ³ | 4.4 | 4.4 |
| Uncertainty | ±mg/m ³ | 0.94 | 0.94 |
| Mass Emission | g/hr | 2.8 | 2.8 |
| Uncertainty | ±g/hr | 0.64 | 0.64 |

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 12.2% O ₂ in N ₂ (5 Grade) |
| Span Gas Reference Number | CYL 1.0119n in N ₂ CYL 1.0297a in AIR |
| Span Gas Expiry Date | 23/12/2019 11/10/2022 |
| Span Gas Start Pressure (bar) | 100 180 |
| Gas Cylinder Concentration (ppm) | 83.42 79.9 |
| Span Gas Set Point (ppm) | 81.38 |
| Span Gas Uncertainty (%) | 2 2 |
| Zero Gas Type | 12.2% O ₂ in N ₂ (5 Grade) |
| Number of Sampling Lines Used | 1 / 1 |
| Number of Sampling Points Used | 1 / 1 |
| Sample Point I.D.'s | A2 |

This is the blended concentration of both propane cylinders

FORMAT: Number Used / Number Required

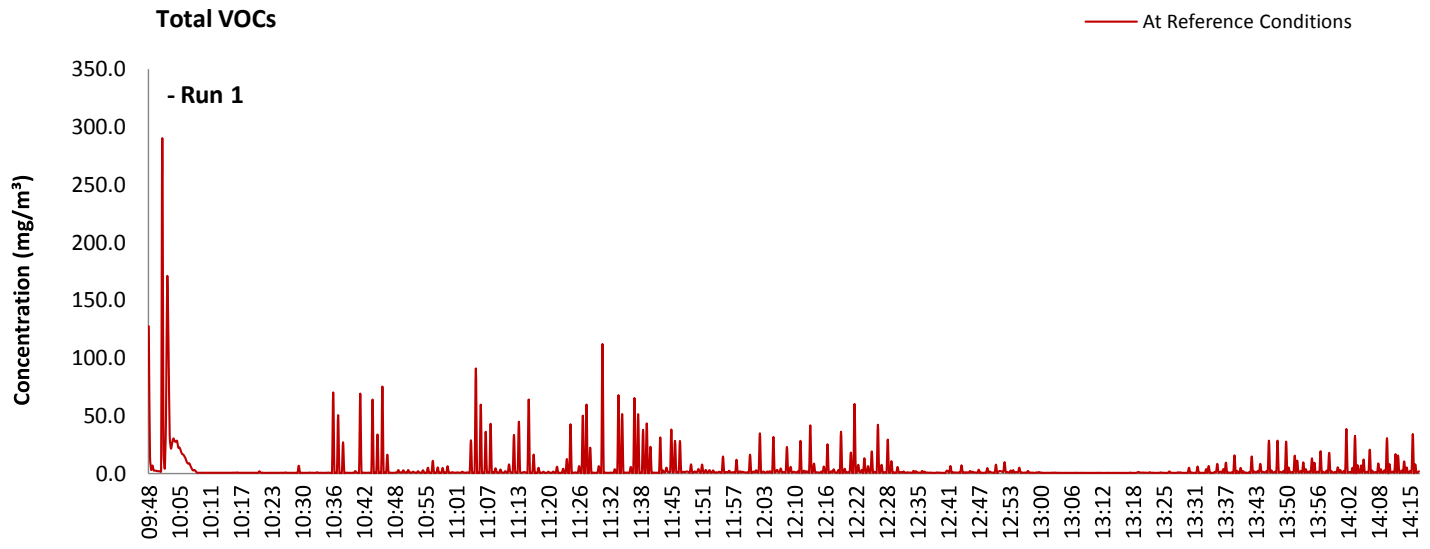
FORMAT: Number Used / Number Required

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

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 | - | 09:48 - 09:52, 10:03 - 14:17 | |
| Sampling Dates | - | 05/07/2018 | |
| Instrument Range | ppm | 100 | |
| Span Gas Value | ppm | 81.4 | |

Quality Assurance

| Zero Drift | | Units | Run 1 | |
|------------|--------------------------------|-------|-------|--|
| CAL 1 | Zero Down Sampling Line (Pre) | ppm | 0.10 | |
| | Zero Down Sampling Line (Post) | ppm | -0.20 | |
| | Zero Drift | ppm | -0.30 | |
| | Allowable Zero Drift | ± ppm | 4.07 | |
| | Zero Drift Acceptable | - | Yes | |

| Span Drift | | Units | Run 1 | |
|------------|--------------------------------|-------|-------|--|
| CAL 1 | Span Down Sampling Line (Pre) | ppm | 82.00 | |
| | Span Down Sampling Line (Post) | ppm | 80.50 | |
| | Span Drift | ppm | -1.50 | |
| | Allowable Span Drift | ± ppm | 4.07 | |
| | Span Drift Acceptable | - | Yes | |

| Test Conditions | Units | Run 1 | |
|-------------------------------|-------|---------|--|
| Run Ambient Temperature Range | °C | 12 - 25 | |

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 | 20.0 | mg/m ³ (REF) |
| TGN M2 Allowable MU | 15.0 | % |
| Measured concentration | 3.62 | mg/m ³ (STP, dry) |
| Range Used | 100.0 | ppm |
| Range Used [A] | 160.6 | mg/m ³ |
| Cal gas conc. | 81.4 | ppm |
| Conversion | 1.61 | ppm to mg/m ³ |
| MCERTS Range [B] | 15.0 | mg/m ³ |
| Lower of [A] or [B] | 15.0 | mg/m ³ |
| Cal gas conc. | 130.7 | mg/m ³ |

| Performance characteristics | RUN 1 | Units |
|------------------------------------|-------|------------------|
| Response time | 45 | seconds |
| Number of readings in measurement | 258 | - |
| Repeatability at zero | 2.00 | % full scale |
| Repeatability at span level | 0.00 | % full scale |
| Deviation from linearity | 0.45 | % of value |
| Zero drift | -0.37 | % full scale |
| Span drift | -1.83 | % 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 | 2.83 | % of value |

| Performance characteristic | RUN 1 | Units |
|---|-----------------|-------------------|
| Standard deviation of repeatability at zero | use rep at span | mg/m ³ |
| Standard deviation of repeatability at span level | 0.00 | mg/m ³ |
| Lack of fit | 0.04 | mg/m ³ |
| Drift | -0.31 | mg/m ³ |
| Volume or pressure flow dependence | 0.00 | mg/m ³ |
| Atmospheric pressure dependence | 0.01 | mg/m ³ |
| Ambient temperature dependence | 0.20 | mg/m ³ |
| Combined interference (from MCERTS Certificate) | 0.04 | mg/m ³ |
| Dependence on voltage | 0.06 | mg/m ³ |
| Losses in the line (leak) | 0.00 | mg/m ³ |
| Uncertainty of calibration gas | 0.06 | mg/m ³ |

| Measurement uncertainty | Result | RUN 1 | Units |
|---|----------|-------|-------------------------|
| Combined uncertainty | | 3.62 | mg/m ³ |
| Expanded uncertainty | k = 1.96 | 0.39 | mg/m ³ |
| Expanded uncertainty | | 0.76 | mg/m ³ |
| Uncertainty corrected to std conds. (O ₂) | | 0.92 | mg/m ³ (REF) |

| | RUN 1 | Units |
|--|-------|------------|
| Expanded uncertainty (no O ₂) - at 95% Confidence | 21.04 | % of Value |
| Expanded uncertainty (no O ₂) - at 95% Confidence | 3.81 | % at ELV |
| Overall Allowable uncertainty (no O ₂) - at 95% Confidence | 15.0 | % at ELV |
| Result of Compliance with Uncertainty Requirement in M2 | N/A | - |

| | RUN 1 | Units |
|--|------------------|------------|
| Expanded uncertainty (with O ₂) - at 95% Confidence | 21.39 | % of Value |
| Expanded uncertainty (with O ₂) - at 95% Confidence | 6.01 | % at ELV |
| Overall Allowable uncertainty (with O ₂) - at 95% Confidence | 15.5 | % at ELV |
| Result of Compliance with Uncertainty Requirement in M2 | COMPLIANT | - |

Requirement for SRM is that Uncertainty should be <15% of the value at the ELV, on a dry gas basis, or if O₂ correction is applied less than 15% + the uncertainty associated with the O₂ correction (using sqrt of sum squares to add uncertainty components). Ref EA TGN M2.

OXIDES OF NITROGEN (as NO₂): RESULTS SUMMARY

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust

Sample Runs

| Parameter | Units | Run 1 | Mean |
|---------------|--------------------|-------|------|
| Concentration | mg/m ³ | 112 | 112 |
| Uncertainty | ±mg/m ³ | 6.1 | 6.1 |
| Mass Emission | g/hr | 72.7 | 72.7 |
| Uncertainty | ±g/hr | 6.5 | 6.5 |

General Sampling Information

| Parameter | Value |
|---------------------------------------|--------------------|
| Standard | EN 14792 |
| Technical Procedure | CAT-TP-39 |
| Probe Material | Stainless Steel |
| Filtration Type / Size | 0.1µm Glass Fibre |
| Heated Head Filter Used | Yes |
| Heated Line Temperature | 180°C |
| Date & Result of Last Converter Check | 02/05/2018 - 95.9% |
| Span Gas Type | Nitrogen Monoxide |
| Span Gas Reference Number | CYL 4.0183 |
| Span Gas Expiry Date | 02/09/2020 |
| Span Gas Start Pressure (bar) | 40 |
| Gas Cylinder Concentration (ppm) | 403.92 |
| Span Gas Uncertainty (%) | 2 |
| Zero Gas Type | Nitrogen (5 Grade) |
| Number of Sampling Lines Used | 1 / 1 |
| Number of Sampling Points Used | 1 / 1 |
| Sample Point I.D.'s | A2 |

NOTE: Dilution performed to achieve correct span value

FORMAT: Number Used / Number Required

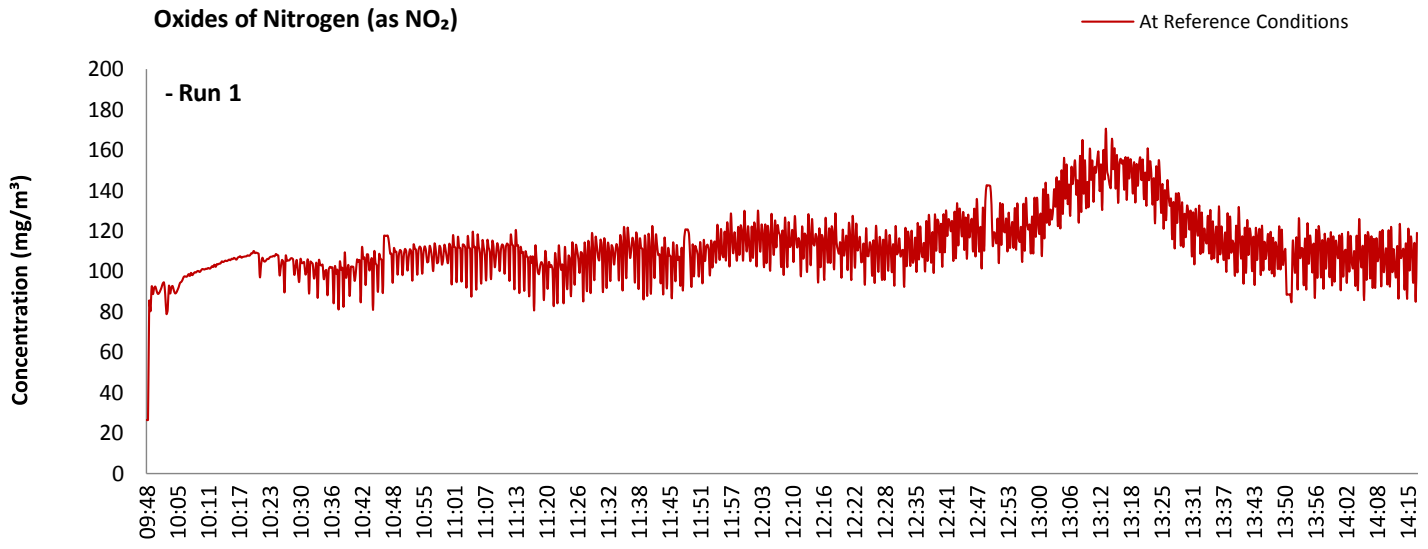
FORMAT: Number Used / Number Required

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

OXIDES OF NITROGEN (as NO₂): DATA TREND

Graphical Trend of Data



OXIDES OF NITROGEN (as NO₂): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

| Parameter | Units | Run 1 | |
|------------------|-------|---------------------------------|--|
| Sampling Times | - | 09:48 - 09:52, 10:03 - 14:17 | |
| Sampling Dates | - | 05/07/2018 | |
| Instrument Range | ppm | 250 | |
| Span Gas Value | ppm | 97.5 | |

Quality Assurance

| Conditioning Unit Temperature | Units | Run 1 | |
|-------------------------------|-------|-------|--|
| Average Temperature | °C | 2.0 | |
| Allowable Temperature | < °C | 4.0 | |
| Temperature Acceptable | - | Yes | |

| | Zero Drift | Units | Run 1 | |
|-------|-------------------------|-------|-------|--|
| CAL 1 | Zero at Analyser (Pre) | ppm | 0.00 | |
| | Zero at Analyser (Post) | ppm | 0.00 | |
| | Zero Drift | ppm | 0.00 | |
| | Allowable Zero Drift | ± ppm | 4.87 | |
| | Zero Drift Acceptable | - | Yes | |

| | Span Drift | Units | Run 1 | |
|-------|-------------------------|-------|-------|--|
| CAL 1 | Span at Analyser (Pre) | ppm | 97.50 | |
| | Span at Analyser (Post) | ppm | 97.00 | |
| | Span Drift | ppm | -0.50 | |
| | Allowable Span Drift | ± ppm | 4.87 | |
| | Span Drift Acceptable | - | Yes | |

| Test Conditions | Units | Run 1 | |
|-------------------------------|-------|---------|--|
| Run Ambient Temperature Range | °C | 14 - 25 | |

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 | |

OXIDES OF NITROGEN (as NO₂): MEASUREMENT UNCERTAINTY CALCULATIONS

| Performance characteristics | RUN 1 | Units |
|-----------------------------|-------|------------------------------|
| Limit value | 200.0 | mg/m ³ (REF) |
| TGN M2 Allowable MU | 10.0 | % |
| Measured concentration | 92.68 | mg/m ³ (STP, dry) |
| Ration NO / NO ₂ | 5 | % |
| Range Used | 250.0 | ppm |
| Range Used [A] | 513.1 | mg/m ³ |
| Cal gas conc. | 97.5 | ppm |
| Conversion | 2.05 | ppm to mg/m ³ |
| MCERTS Range [B] | 205.0 | mg/m ³ |
| Lower of [A] or [B] | 205.0 | mg/m ³ |
| Cal gas conc. | 200.0 | mg/m ³ |

| Performance characteristics | RUN 1 | Units |
|---|-------|------------------|
| Response time | 31 | seconds |
| Number of readings in measurement | 258 | - |
| Repeatability at zero | 0.00 | % full scale |
| Repeatability at span level | 0.10 | % full scale |
| Deviation from linearity | 0.58 | % of value |
| Zero drift | 0.00 | % full scale |
| Span drift | -0.51 | % full scale |
| Volume or pressure flow dependence | 0.10 | % of full scale |
| Atmospheric pressure dependence | 0.10 | % of value/kPa |
| Ambient temperature dependence | 0.04 | % full scale/10K |
| Combined interference | 0.63 | % range |
| Dependence on voltage | -0.23 | % full scale/10V |
| Converter efficiency | 95.9 | % |
| Losses in the line (leak) | 0.00 | % of value |
| Uncertainty of calibration gas blending | 1.40 | % of value |
| Uncertainty of calibration gas | 2.00 | % of value |

| Performance characteristic | RUN 1 | Units |
|---|-----------------|-------------------|
| Standard deviation of repeatability at zero | use rep at span | mg/m ³ |
| Standard deviation of repeatability at span level | 0.01 | mg/m ³ |
| Lack of fit | 0.69 | mg/m ³ |
| Drift | -0.27 | mg/m ³ |
| Volume or pressure flow dependence | 0.00 | mg/m ³ |
| Atmospheric pressure dependence | 0.06 | mg/m ³ |
| Ambient temperature dependence | 0.01 | mg/m ³ |
| Combined interference (from MCERTS Certificate) | 0.75 | mg/m ³ |
| Dependence on voltage | -0.03 | mg/m ³ |
| Converter efficiency | 0.11 | mg/m ³ |
| Losses in the line (leak) | 0.00 | mg/m ³ |
| Uncertainty of calibration gas blending | 0.75 | mg/m ³ |
| Uncertainty of calibration gas | 1.07 | mg/m ³ |

| Measurement uncertainty | Result | RUN 1 | Units |
|---|----------|-------|-------------------------|
| Combined uncertainty | | 92.68 | mg/m ³ |
| Expanded uncertainty | | 1.84 | mg/m ³ |
| Expanded uncertainty | k = 1.96 | 3.60 | mg/m ³ |
| Uncertainty corrected to std conds. (O ₂) | | 4.36 | mg/m ³ (REF) |

| | RUN 1 | Units |
|--|------------|------------|
| Expanded uncertainty (no O ₂) - at 95% Confidence | 3.89 | % of Value |
| Expanded uncertainty (no O ₂) - at 95% Confidence | 1.80 | % at ELV |
| Overall Allowable uncertainty (no O ₂) - at 95% Confidence | 10.0 | % at ELV |
| Result of Compliance with Uncertainty Requirement in M2 | N/A | - |

| | RUN 1 | Units |
|--|------------------|------------|
| Expanded uncertainty (with O ₂) - at 95% Confidence | 5.48 | % of Value |
| Expanded uncertainty (with O ₂) - at 95% Confidence | 4.43 | % at ELV |
| Overall Allowable uncertainty (with O ₂) - at 95% Confidence | 10.7 | % at ELV |
| Result of Compliance with Uncertainty Requirement in M2 | COMPLIANT | - |

Requirement for SRM is that Uncertainty should be <10% of the value at the ELV, on a dry gas basis, or if O₂ correction is applied less than 10% + the uncertainty associated with the O₂ correction (using sqrt of sum squares to add uncertainty components). Ref EA TGN M2.

CARBON MONOXIDE: RESULTS SUMMARY

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust

Sample Runs

| Parameter | Units | Run 1 | Mean |
|---------------|--------------------|-------|------|
| Concentration | mg/m ³ | 160 | 160 |
| Uncertainty | ±mg/m ³ | 8.3 | 8.3 |
| Mass Emission | g/hr | 104 | 104 |
| Uncertainty | ±g/hr | 9.1 | 9.1 |

General Sampling Information

| Parameter | Value |
|----------------------------------|--------------------|
| Standard | EN 15058 |
| Technical Procedure | CAT-TP-39 |
| Probe Material | Stainless Steel |
| Filtration Type / Size | 0.1µm Glass Fibre |
| Heated Head Filter Used | Yes |
| Heated Line Temperature | 180°C |
| Span Gas Type | Carbon Monoxide |
| Span Gas Reference Number | CYL 2.0127 |
| Span Gas Expiry Date | 22/07/2021 |
| Span Gas Start Pressure (bar) | 60 |
| Gas Cylinder Concentration (ppm) | 401.3 |
| Span Gas Uncertainty (%) | 2 |
| Zero Gas Type | Nitrogen (5 Grade) |
| Number of Sampling Lines Used | 1 / 1 |
| Number of Sampling Points Used | 1 / 1 |
| Sample Point I.D.'s | A2 |

NOTE: Dilution performed to achieve correct span value

FORMAT: Number Used / Number Required

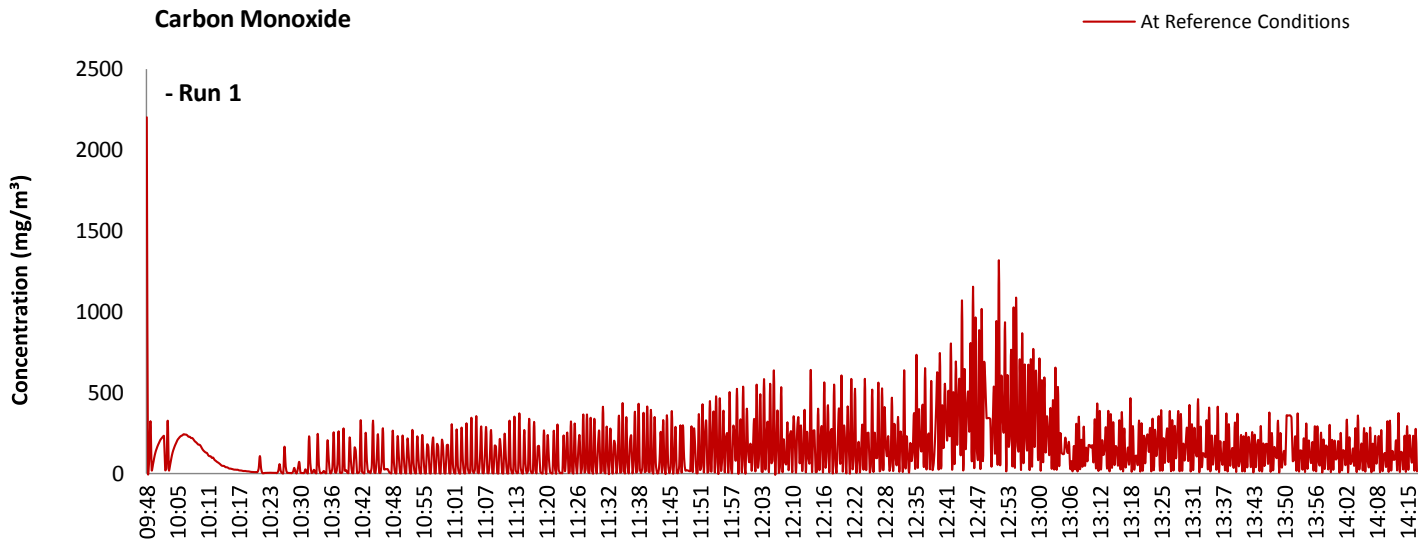
FORMAT: Number Used / Number Required

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

CARBON MONOXIDE: DATA TREND

Graphical Trend of Data



CARBON MONOXIDE: SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

| Parameter | Units | Run 1 | |
|------------------|-------|---------------------------------|--|
| Sampling Times | - | 09:48 - 09:52, 10:03 - 14:17 | |
| Sampling Dates | - | 05/07/2018 | |
| Instrument Range | ppm | 200 | |
| Span Gas Value | ppm | 160.1 | |

Quality Assurance

| Conditioning Unit Temperature | Units | Run 1 | |
|-------------------------------|-------|-------|--|
| Average Temperature | °C | 2.0 | |
| Allowable Temperature | < °C | 4.0 | |
| Temperature Acceptable | - | Yes | |

| Zero Drift | Units | Run 1 | | |
|------------|-------------------------|-------|------|--|
| CAL 1 | Zero at Analyser (Pre) | ppm | 0.00 | |
| | Zero at Analyser (Post) | ppm | 0.30 | |
| | Zero Drift | ppm | 0.30 | |
| | Allowable Zero Drift | ± ppm | 8.01 | |
| | Zero Drift Acceptable | - | Yes | |

| Span Drift | Units | Run 1 | | |
|------------|-------------------------|-------|--------|--|
| CAL 1 | Span at Analyser (Pre) | ppm | 160.10 | |
| | Span at Analyser (Post) | ppm | 157.00 | |
| | Span Drift | ppm | -3.10 | |
| | Allowable Span Drift | ± ppm | 8.01 | |
| | Span Drift Acceptable | - | Yes | |

| Test Conditions | Units | Run 1 | |
|-------------------------------|-------|---------|--|
| Run Ambient Temperature Range | °C | 14 - 25 | |

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 | |

CARBON MONOXIDE: MEASUREMENT UNCERTAINTY CALCULATIONS

| Performance characteristics | RUN 1 | Units |
|-----------------------------|--------|------------------------------|
| Limit value | 200.0 | mg/m ³ (REF) |
| TGN M2 Allowable MU | 6.0 | % |
| Measured concentration | 132.38 | mg/m ³ (STP, dry) |
| Range Used | 200.0 | ppm |
| Range Used [A] | 249.8 | mg/m ³ |
| Cal gas conc. | 160.1 | ppm |
| Conversion | 1.25 | ppm to mg/m ³ |
| MCERTS Range [B] | 75.0 | mg/m ³ |
| Lower of [A] or [B] | 75.0 | mg/m ³ |
| Cal gas conc. | 200.0 | mg/m ³ |

| Performance characteristics | RUN 1 | Units |
|---|-------|------------------|
| Response time | 28 | seconds |
| Number of readings in measurement | 258 | - |
| Repeatability at zero | 0.10 | % full scale |
| Repeatability at span level | 0.20 | % full scale |
| Deviation from linearity | 0.60 | % of value |
| Zero drift | 0.19 | % full scale |
| Span drift | -1.94 | % full scale |
| Volume or pressure flow dependence | 0.10 | % of full scale |
| Atmospheric pressure dependence | 0.22 | % of value/kPa |
| Ambient temperature dependence | -0.20 | % full scale/10K |
| Combined interference | -0.48 | % range |
| Dependence on voltage | -0.35 | % full scale/10V |
| Losses in the line (leak) | 0.62 | % of value |
| Uncertainty of calibration gas blending | 1.40 | % of value |
| Uncertainty of calibration gas | 2.00 | % of value |

| Performance characteristic | RUN 1 | Units |
|---|-----------------|-------------------|
| Standard deviation of repeatability at zero | use rep at span | mg/m ³ |
| Standard deviation of repeatability at span level | 0.01 | mg/m ³ |
| Lack of fit | 0.26 | mg/m ³ |
| Drift | -1.26 | mg/m ³ |
| Volume or pressure flow dependence | 0.00 | mg/m ³ |
| Atmospheric pressure dependence | 0.05 | mg/m ³ |
| Ambient temperature dependence | -0.03 | mg/m ³ |
| Combined interference (from MCERTS Certificate) | -0.21 | mg/m ³ |
| Dependence on voltage | -0.04 | mg/m ³ |
| Losses in the line (leak) | 0.48 | mg/m ³ |
| Uncertainty of calibration gas blending | 1.07 | mg/m ³ |
| Uncertainty of calibration gas | 1.53 | mg/m ³ |

| Measurement uncertainty | Result | RUN 1 | Units |
|---|----------|--------|-------------------------|
| Combined uncertainty | | 132.38 | mg/m ³ |
| Expanded uncertainty | k = 1.96 | 2.34 | mg/m ³ |
| Expanded uncertainty | | 4.58 | mg/m ³ |
| Uncertainty corrected to std conds. (O ₂) | | 5.54 | mg/m ³ (REF) |

| | RUN 1 | Units |
|--|------------|------------|
| Expanded uncertainty (no O ₂) - at 95% Confidence | 3.46 | % of Value |
| Expanded uncertainty (no O ₂) - at 95% Confidence | 2.29 | % at ELV |
| Overall Allowable uncertainty (no O ₂) - at 95% Confidence | 6.0 | % at ELV |
| Result of Compliance with Uncertainty Requirement in M2 | N/A | - |

| | RUN 1 | Units |
|--|------------------|------------|
| Expanded uncertainty (with O ₂) - at 95% Confidence | 5.18 | % of Value |
| Expanded uncertainty (with O ₂) - at 95% Confidence | 4.75 | % at ELV |
| Overall Allowable uncertainty (with O ₂) - at 95% Confidence | 7.1 | % at ELV |
| Result of Compliance with Uncertainty Requirement in M2 | COMPLIANT | - |

Requirement for SRM is that Uncertainty should be <6% of the value at the ELV, on a dry gas basis, or if O₂ correction is applied less than 6% + the uncertainty associated with the O₂ correction (using sqrt of sum squares to add uncertainty components). Ref EA TGN M2.

CARBON DIOXIDE: RESULTS SUMMARY

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust

Sample Runs

| Parameter | Units | Run 1 | Mean |
|---------------|--------|-------|------|
| Concentration | % v/v | 4.8 | 4.8 |
| Uncertainty | ±% v/v | 0.27 | 0.27 |

General Sampling Information

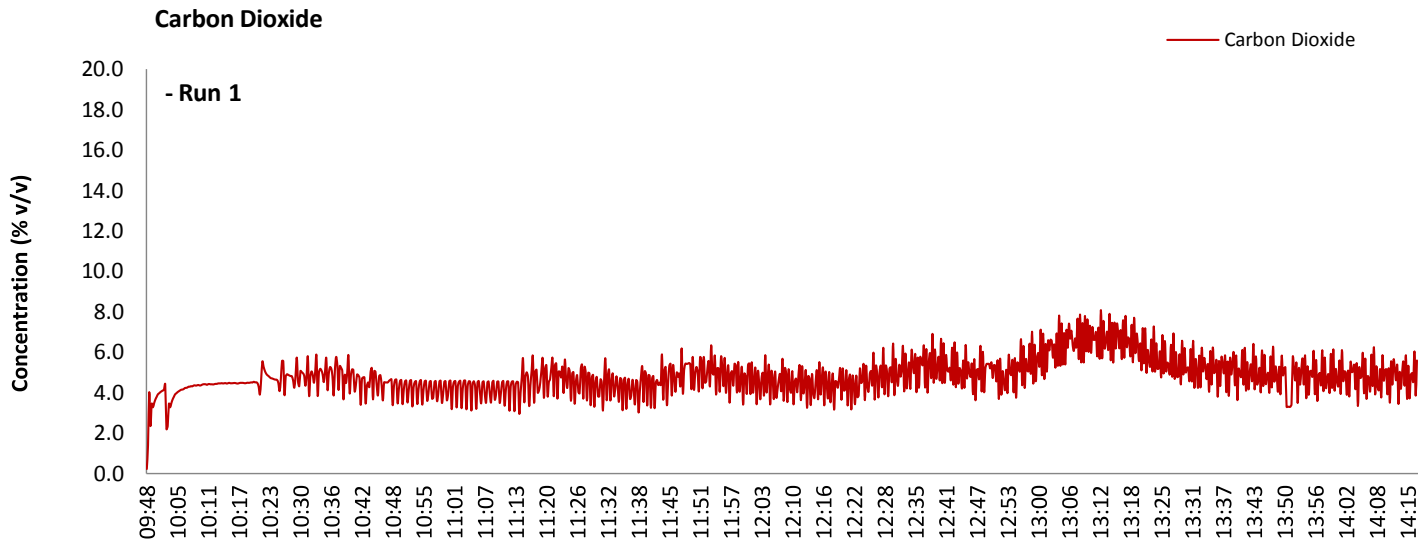
| Parameter | Value |
|------------------------------------|--------------------|
| Standard | ISO 12039 |
| Technical Procedure | CAT-TP-39 |
| Probe Material | Stainless Steel |
| Filtration Type / Size | 0.1µm Glass Fibre |
| Heated Head Filter Used | Yes |
| Heated Line Temperature | 180°C |
| Span Gas Type | Carbon Dioxide |
| Span Gas Reference Number | CYL 6.0028 |
| Span Gas Expiry Date | 05/04/2021 |
| Span Gas Start Pressure (bar) | 180 |
| Gas Cylinder Concentration (% v/v) | 15.99 |
| Span Gas Uncertainty (%) | 2.00 |
| Zero Gas Type | Nitrogen (5 Grade) |
| Number of Sampling Lines Used | 1 / 1 |
| Number of Sampling Points Used | 1 / 1 |
| Sample Point I.D.'s | A2 |

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

CARBON DIOXIDE: DATA TREND

Graphical Trend of Data



CARBON DIOXIDE: SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

| Parameter | Units | Run 1 | |
|------------------|-------|---------------------------------|--|
| Sampling Times | - | 09:48 - 09:52, 10:03 - 14:17 | |
| Sampling Dates | - | 05/07/2018 | |
| Instrument Range | % v/v | 20 | |
| Span Gas Value | % v/v | 15.99 | |

Quality Assurance

| Conditioning Unit Temperature | Units | Run 1 | |
|-------------------------------|-------|-------|--|
| Average Temperature | °C | 2.0 | |
| Allowable Temperature | < °C | 4.0 | |
| Temperature Acceptable | - | Yes | |

| Zero Drift | Units | Run 1 | | |
|------------|--------------------------------|---------|------|--|
| CAL 1 | Zero Down Sampling Line (Pre) | % v/v | 0.00 | |
| | Zero Down Sampling Line (Post) | % v/v | 0.06 | |
| | Zero Drift | % v/v | 0.06 | |
| | Allowable Zero Drift | ± % v/v | 0.80 | |
| | Zero Drift Acceptable | - | Yes | |

| Span Drift | Units | Run 1 | | |
|------------|--------------------------------|---------|-------|--|
| CAL 1 | Span Down Sampling Line (Pre) | % v/v | 16.00 | |
| | Span Down Sampling Line (Post) | % v/v | 16.31 | |
| | Span Drift | % v/v | 0.31 | |
| | Allowable Span Drift | ± % v/v | 0.80 | |
| | Span Drift Acceptable | - | Yes | |

| Test Conditions | Units | Run 1 | |
|-------------------------------|-------|---------|--|
| Run Ambient Temperature Range | °C | 14 - 25 | |

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 | |

CARBON DIOXIDE: MEASUREMENT UNCERTAINTY CALCULATIONS

| Performance characteristics | RUN 1 | Units |
|-----------------------------|-------|-------|
| Limit value | N/A | %vol |
| TGN M2 Allowable MU | 25.0 | % |
| Measured concentration | 4.82 | %vol |
| Range Used | 20.0 | %vol |
| Cal gas conc. | 16.0 | %vol |

| Performance characteristics | RUN 1 | Units |
|------------------------------------|-------|------------------|
| Response time | 29 | seconds |
| Number of readings in measurement | 258 | - |
| Repeatability at zero | 0.00 | % full scale |
| Repeatability at span level | 0.10 | % full scale |
| Deviation from linearity | 0.61 | % of value |
| Zero drift | 0.38 | % full scale |
| Span drift | 1.94 | % full scale |
| Volume or pressure flow dependence | 0.10 | % of full scale |
| Atmospheric pressure dependence | 0.30 | % of value/kPa |
| Ambient temperature dependence | -0.20 | % full scale/10K |
| Combined interference | 0.00 | % range |
| Dependence on voltage | 0.40 | % 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 | %vol |
| Standard deviation of repeatability at span level | 0.01 | %vol |
| Lack of fit | 0.07 | %vol |
| Drift | 0.09 | %vol |
| Volume or pressure flow dependence | 0.00 | %vol |
| Atmospheric pressure dependence | 0.02 | %vol |
| Ambient temperature dependence | -0.03 | %vol |
| Combined interference (from MCERTS Certificate) | 0.00 | %vol |
| Dependence on voltage | 0.05 | %vol |
| Losses in the line (leak) | 0.00 | %vol |
| Uncertainty of calibration gas | 0.06 | %vol |

| Measurement uncertainty | Result | RUN 1 | Units |
|---|----------|-------|------------|
| Combined uncertainty | | 4.82 | %vol |
| Expanded uncertainty | k = 1.96 | 0.14 | %vol |
| | | 0.27 | %vol |
| | | RUN 1 | Units |
| Expanded uncertainty (no O ₂) - at 95% Confidence | | 5.63 | % of Value |

OXYGEN: RESULTS SUMMARY

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust

Sample Runs

| Parameter | Units | Run 1 | Mean |
|---------------|--------|-------|------|
| Concentration | % v/v | 12.7 | 12.7 |
| Uncertainty | ±% v/v | 0.49 | 0.49 |

General Sampling Information

| Parameter | Value |
|------------------------------------|-------------------------|
| Standard | EN 14789 |
| Technical Procedure | CAT-TP-39 |
| Probe Material | Stainless Steel |
| Filtration Type / Size | 0.1µm Glass Fibre |
| Heated Head Filter Used | Yes |
| Heated Line Temperature | 180°C |
| Span Gas Type | Synthetic Air (5 Grade) |
| Span Gas Reference Number | CYL 11.0250 |
| Span Gas Expiry Date | 20/07/2021 |
| Span Gas Start Pressure (bar) | 20 |
| Gas Cylinder Concentration (% v/v) | 21.16 |
| Span Gas Uncertainty (%) | 2 |
| Zero Gas Type | Nitrogen (5 Grade) |
| Number of Sampling Lines Used | 1 / 1 |
| Number of Sampling Points Used | 1 / 1 |
| Sample Point I.D.'s | A2 |

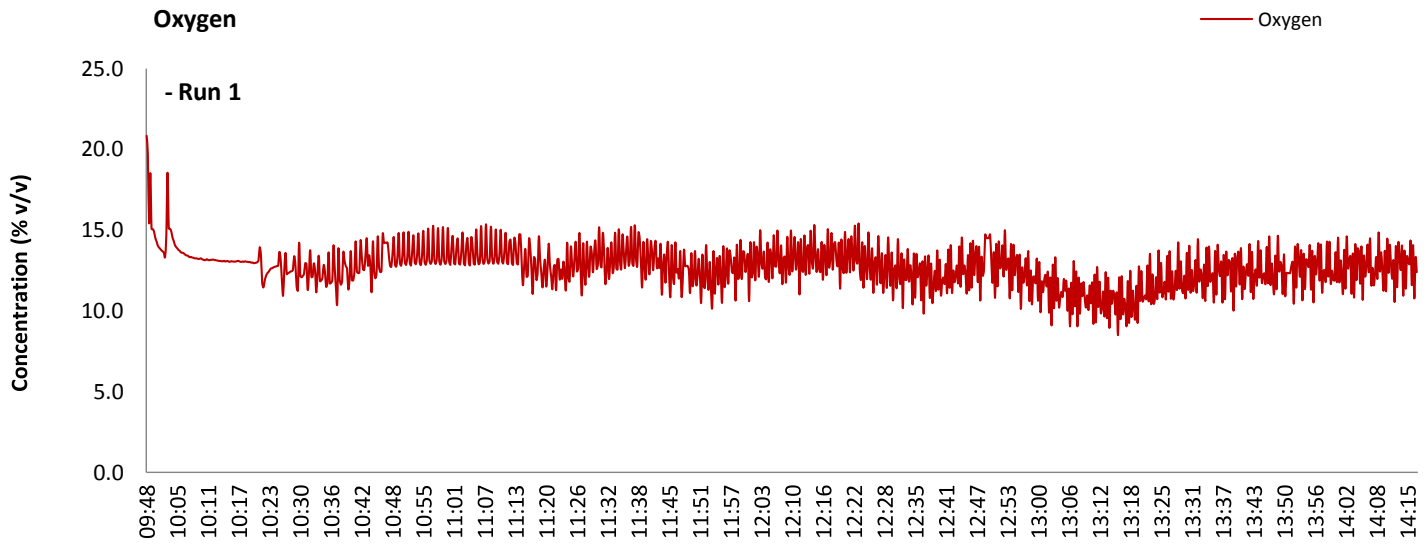
NOTE: Dilution performed to achieve correct span value

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

OXYGEN: DATA TREND

Graphical Trend of Data



OXYGEN: SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

| Parameter | Units | Run 1 | |
|------------------|-------|---------------------------------|--|
| Sampling Times | - | 09:48 - 09:52, 10:03 - 14:17 | |
| Sampling Dates | - | 05/07/2018 | |
| Instrument Range | % v/v | 25 | |
| Span Gas Value | % v/v | 11.00 | |

Quality Assurance

| Conditioning Unit Temperature | Units | Run 1 | |
|-------------------------------|-------|-------|--|
| Average Temperature | °C | 2.0 | |
| Allowable Temperature | < °C | 4.0 | |
| Temperature Acceptable | - | Yes | |

| Zero Drift | Units | Run 1 | |
|-------------------------|---------|-------|--|
| Zero at Analyser (Pre) | % v/v | 0.00 | |
| Zero at Analyser (Post) | % v/v | -0.18 | |
| Zero Drift | % v/v | -0.18 | |
| Allowable Zero Drift | ± % v/v | 0.55 | |
| Zero Drift Acceptable | - | Yes | |

CAL 1

| Span Drift | Units | Run 1 | |
|-------------------------|---------|-------|--|
| Span at Analyser (Pre) | % v/v | 11.00 | |
| Span at Analyser (Post) | % v/v | 10.64 | |
| Span Drift | % v/v | -0.36 | |
| Allowable Span Drift | ± % v/v | 0.55 | |
| Span Drift Acceptable | - | Yes | |

CAL 1

| Test Conditions | Units | Run 1 | |
|-------------------------------|-------|---------|--|
| Run Ambient Temperature Range | °C | 14 - 25 | |

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 |

OXYGEN: MEASUREMENT UNCERTAINTY CALCULATIONS

| Performance characteristics | RUN 1 | Units |
|-----------------------------|-------|-------|
| Limit value | N/A | %vol |
| TGN M2 Allowable MU | 6.0 | % |
| Measured concentration | 12.73 | %vol |
| Range Used | 25.0 | %vol |
| Cal gas conc. | 21.2 | %vol |

| Performance characteristics | RUN 1 | Units |
|------------------------------------|-------|------------------|
| Response time | 41 | seconds |
| Number of readings in measurement | 258 | - |
| Repeatability at zero | 0.02 | % full scale |
| Repeatability at span level | 0.02 | % full scale |
| Deviation from linearity | 0.02 | % of value |
| Zero drift | -1.64 | % full scale |
| Span drift | 0.00 | % full scale |
| Volume or pressure flow dependence | 0.10 | % of full scale |
| Atmospheric pressure dependence | 0.19 | % of value/kPa |
| Ambient temperature dependence | -0.21 | % full scale/10K |
| Combined interference | 0.00 | % range |
| Dependence on voltage | 0.02 | % 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 | %vol |
| Standard deviation of repeatability at span level | 0.00 | %vol |
| Lack of fit | 0.00 | %vol |
| Drift | -0.20 | %vol |
| Volume or pressure flow dependence | 0.00 | %vol |
| Atmospheric pressure dependence | 0.01 | %vol |
| Ambient temperature dependence | -0.03 | %vol |
| Combined interference (from MCERTS Certificate) | 0.00 | %vol |
| Dependence on voltage | 0.00 | %vol |
| Losses in the line (leak) | 0.00 | %vol |
| Uncertainty of calibration gas | 0.15 | %vol |

| Measurement uncertainty | Result | RUN 1 | Units |
|-------------------------|----------|-------|-------|
| Combined uncertainty | | 12.73 | %vol |
| Expanded uncertainty | k = 1.96 | 0.25 | %vol |
| | | 0.49 | %vol |

| | RUN 1 | Units |
|--|------------------|------------|
| Expanded uncertainty (no O ₂) - at 95% Confidence | 3.85 | % of Value |
| Result of Compliance with Uncertainty Requirement in M2 | COMPLIANT | - |

Requirement for SRM is that Uncertainty should be 0.5%vol absolute or 6% relative whichever is the lower, on a dry gas basis. Ref EA TGN M2.