Exova Catalyst, Unit 3, Wednesbury One, Black Country New Road, Wednesbury, WS10 7NZ
Your Exova Catalyst Contact: James Eldridge (07826 916 684)
E: james.eldridge@exova.com

Stack Emissions Testing Report Commissioned by
Liberty Pressing Solutions Ltd

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

PPC Permit: PPC/193

Stack Reference
Burn Off Oven Exhaust

Dates of the Monitoring Campaign
1st April 2019

Job Reference Number
CAT-4808

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

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

Report Date
15th April 2019

Version
Version 1

Signature of Report Approver
[redacted]

CONTENTS

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

MONITORING OBJECTIVES

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust
1st April 2019

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 NO_2), Carbon Monoxide, Carbon Dioxide

Executive Summary

MONITORING RESULTS

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust
1st April 2019

where MU = Measurement Uncertainty associated with the Result

	Concentration					Mass Emission			
Parameter	**Units**	**Result**		**MU +/-**	**Limit**	**Units**	**Result**	**MU +/-**	**Limit**
Total Particulate Matter [1]	mg/m³	1.2		0.19	20	g/hr	0.69	0.59	-
Total VOCs (as Carbon) [1]	mg/m³	4.6		0.60	20	g/hr	2.7	2.3	-
Oxides of Nitrogen (as NO_2) [1]	mg/m³	93.6		4.3	200	g/hr	55.5	46.9	-
Carbon Monoxide [1]	mg/m³	84.0		3.2	200	g/hr	49.8	42.0	-
Carbon Dioxide	% v/v	**Dry**	5.0	0.18					
Oxygen	% v/v	**Dry**	12.5	0.30					
Water Vapour	% v/v	8.6		0.43					
Stack Gas Temperature	°C	777							
Stack Gas Velocity	m/s	6.5		5.5					
Volumetric Flow Rate (ACTUAL)	m³/hr	2936		2474					
Volumetric Flow Rate (REF) [1]	m³/hr	593		500					

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

MONITORING DATE(S) & TIMES

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust
1st April 2019

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	1.2	g/hr	0.69	01/04/2019	10:08 - 14:20	252
Total VOCs (as Carbon)	R1	mg/m³	4.6	g/hr	2.7	01/04/2019	10:08 - 14:20	252
Oxides of Nitrogen (as NO_2)	R1	mg/m³	93.6	g/hr	55.5	01/04/2019	10:08 - 14:20	252
Carbon Monoxide	R1	mg/m³	84.0	g/hr	49.8	01/04/2019	10:08 - 14:20	252
Carbon Dioxide	R1	% v/v	5.0			01/04/2019	10:08 - 14:20	252
Oxygen	R1	% v/v	12.5			01/04/2019	10:08 - 14:20	252
Velocity Traverse	R1					01/04/2019	10:00 - 10:06	

All results are expressed at the respective reference conditions.

PROCESS DETAILS

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust
1st April 2019

Standard Operating Conditions

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

MONITORING & ANALYTICAL METHODS

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust
1st April 2019

	Monitoring				Analysis					
Parameter	**Standard**	**Technical Procedure**	**ISO 17025 Testing**	**Testing Lab**	**Analytical Procedure**	**Analytical Technique**	**ISO 17025 Analysis**	**Analysis Lab**	**MCERTS Testing**	**LOD (Average)**
Total Particulate Matter	EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.05 mg/m³
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.1 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.32 mg/m³
Oxides of Nitrogen (as NO_2)	EN 14792	CAT-TP-39	Yes	CAT	Chemiluminescence by Horiba PG-350E				Yes	0.41 mg/m³
Carbon Monoxide	EN 15058	CAT-TP-39	Yes	CAT	NDIR by Horiba PG-350E				Yes	0.25 mg/m³
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	0.2 %
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	Yes	CAT	Pitot Tube and Thermocouple				Yes	1.8 m/s

ANALYSIS LABORATORIES

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

Exova Catalyst (CAT)	ISO 17025 Accreditation Number: 4279

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

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	-	3" 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

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	7.8	> 5 Pa	Yes
Mean Velocity	m/s	4.84	-	-
Lowest Gas Velocity	m/s	4.44	-	-
Highest Gas Velocity	m/s	5.05	-	-
Ratio of Above	: 1	1.14	< 3 : 1	Yes
Maximum Angle of Swirl	°	4.00	< 15°	Yes
No Local Negative Flow	-	Yes	-	Yes

Executive Summary

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PLANT PHOTOS

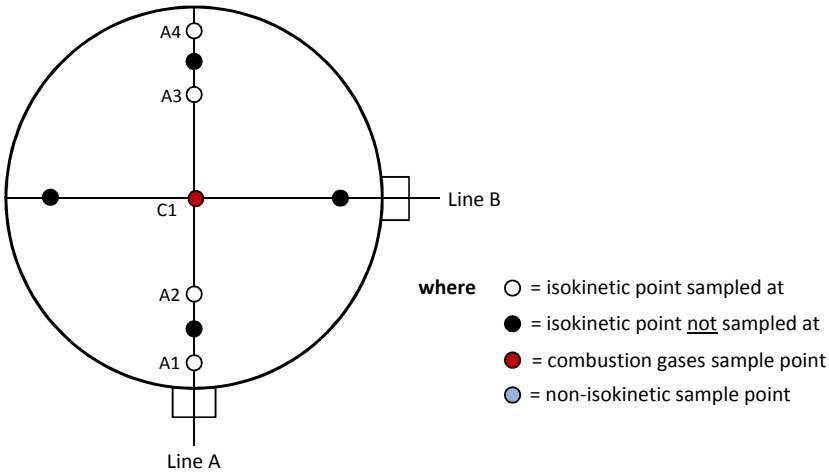
Photo 1

Photo 2

Photo 3

Photo 4

SAMPLE POINTS



APPENDIX CONTENTS

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
Technician	Luke Williams	MCERTS Level 1	MM 18 1496	None

LIST OF EQUIPMENT

Extractive Sampling	
Equipment Type	**Equipment I.D.**
Control Box DGM (1)	CAT 7.58
Control Box DGM (2)	-
Box Thermocouples (1)	CAT 3.148
Box Thermocouples (2)	-
Umbilical (1)	CAT 3.148
Umbilical (2)	-
Oven Box (1)	CAT 12.201
Oven Box (2)	-
Heated Probe (1)	CAT 5.129
Heated Probe (2)	CAT 5.130
Heated Probe (3)	CAT 5.131
S-Pitot (1)	CAT 21P.97
S-Pitot (2)	CAT 21S.56
L-Pitot	CAT 21L.41
Site Balance	CAT 17.38
500g / 1Kg Check Weights	CAT 17.38
Last Impinger Arm	-
Callipers	CAT 23.41
Tubes Kit Thermocouple	-

Instrumental Analysers	
Equipment Type	**Equipment I.D.**
Horiba PG-350E	CAT 39.11
Horiba PG-250	-
Servomex 4900	-
Eco Physics CLD 822Mh	-
ABB AO2020-URAS26	-
Servomex 5200MP	-
Ankersmid APS 313	CAT 4.848
Gasmet DX4000	-
Gasmet Sampling System	-
Bernath 3006 FID	CAT 8.32
M&C PSS	CAT 12.108
Mass Flow Controller (1)	CAT 6.63
Mass Flow Controller (2)	CAT 6.64
Mass View (1)	CAT 25.61
Mass View (2)	CAT 25.62
Hioki 5043 (V)	CAT 11.70
Easylogger EN-EL-12 Bit	-
Bioaerosols Temperature Logger	-
Electronic Refrigerator	-

Miscellaneous Items	
Equipment Type	**Equipment I.D.**
Digital Manometer (1)	CAT 3.143
Digital Manometer (2)	CAT 3.145
Digital Temperature Meter	-
Stopwatch	CAT 14.86
Barometer	CAT 13.41
Stack Thermocouple (1)	CAT 4.1014
Stack Thermocouple (2)	CAT 4.1041
Stack Thermocouple (3)	CAT 4.0014
1m Heated Line (1)	-
1m Heated Line (2)	-
1m Heated Line (3)	-
5m Heated Line (1)	-
15m Heated Line (1)	-
20m Heated Line (1)	CAT 20.119
20m Heated Line (2)	-
Dual Channel Heater Controller	CAT 3.002
Single Channel Heater Controller	CAT 20.119
Laboratory Balance	CAT 1.18 / 1.18a
Tape Measure	CAT 16.49

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
Water Vapour	EN 14790	CAT-TP-05
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20
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	357.0
Average Stack Gas Pressure	mmH_2O	1.0
Average Stack Static Pressure, P_{static}	kPa	0.015
Average Barometric Pressure, P_b	kPa	100.9
Average Pitot Tube Calibration Coefficient, C_p	-	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/m³ p	Conc kg/m³ p_i
CO_2	-	4.95	4.52	0.0495	44.01	1.9635	0.09724
O_2	-	12.46	11.38	0.1246	32.00	1.4277	0.17787
N_2	-	82.59	75.46	0.8259	28.01	1.2498	1.03223
Moisture (H_2O)	-	-	8.64	0.0864	18.02	0.8037	0.06941

Where: p = M / 22.41

p_i = r x p

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P_{STD}	kg/m³	1.307
Wet Density (STP), P_{STW}	kg/m³	1.264
Dry Density (Actual), P_{Actual}	kg/m³	0.564
Average Wet Density (Actual), $P_{ActualW}$	kg/m³	0.546

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

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

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

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

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF [1]
Temperature	°C	357.0	0.0
Total Pressure	kPa	100.9	101.3
Moisture	%	8.64	0.00
Oxygen (Dry)	%	12.5	11.0

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m³/hr	2190
Gas Volumetric Flowrate (STP, Wet)	m³/hr	946
Gas Volumetric Flowrate (STP, Dry)	m³/hr	864
Gas Volumetric Flowrate REF [1]	m³/hr	738

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	01/04/2019
Time of Survey	-	10:00 - 10:06
Atmospheric Pressure	kPa	100.9
Average Stack Static Pressure	Pa	15
Result of Pitot Stagnation Test	-	Pass
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with Liquid Incline Manometer	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C_p	-	0.83
Number of Lines Available	-	2
Number of Lines Used	-	1

		Sampling Line A					Sampling Line B - Restricted Access				
Traverse Point	Depth m	ΔP mmH_2O	Temp °C	Wet Density kg/m^3	Velocity m/s	Swirl °	ΔP	Temp °C	Wet Density kg/m^3	Velocity m/s	Swirl °
STATIC (Units: Pa)		*15.0*									
Mean		**1.0**	**357.0**	**0.546**	**4.84**						
1	0.03	1.0	346.0	0.555	4.93	2.0					
2	0.10	1.0	348.0	0.553	4.94	4.0					
3	0.30	0.8	356.0	0.546	4.44	0.0					
4	0.37	1.0	378.0	0.528	5.05	2.0					

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

(1 of 1)

Performance characteristics (Uncertainty Components)	Uncertainty	Value	Units
Standard Uncertainty on the coefficient of the Pitot Tube	u(k)	0.005	-
Standard Uncertainty associated with the mean local dynamic pressures	u(Δpi)	1.621	Pa
- Resolution	u(res)	0.52154	
- Calibration	u(cal)	0.009	
- Drift	u(drift)	1.096	
- Lack of Fit	u(fit)	0.001	
- Overall corrections to dynamic measurements	u(Cf)	1.627	
Standard uncertainty associated with the molar mass of the gas	u(M)	0.00005	-
- $\varphi O_2,w$	-	11.383	
- $\varphi CO_2,w$	-	4.525	
- Oxygen, dry	u(ϕO_2,d)	0.381	
- Carbon Dioxide, dry	u(ϕCO_2,d)	0.152	
- Water Vapour	u(ϕH_2O)	0.441	
- Oxygen, wet	u(ϕO_2,w)	0.353	
- Carbon Dioxide, wet	u(ϕCO_2,w)	0.140	
Standard uncertainty associated with the stack temperature	u(Tc)	3.214	K
Standard uncertainty associated with the absolute pressure in the duct	u(pc)	175.700	Pa
- Atmospheric Pressure	u(patm)	175.692	
- Static Pressure	u(pstat)	1.621	
Standard uncertainty associated with the density in the duct	u(ρ)	0.00294	-
Standard uncertainty associated with the local velocities	u(vi)	4.149	Pa
Standard uncertainty associated with the mean velocity	u(v)	2.078	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	Uc(v)	4.073	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	Uc,rel(v)	84.13	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	Uc(qV,w)	1845.4	m^3/hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.18477	
- $u^2(qV,w)$	-	886448	
- u(qV,w)	-	941.5	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	Uc,rel(qV,w)	84.25	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	1.2		1.2
Uncertainty	±mg/m³	0.19		0.19
Mass Emission	g/hr	0.69		0.69
Uncertainty	±g/hr	0.59		0.59

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	8.6		8.6
Uncertainty	±% v/v	0.43		0.43

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m³	0.11		0.11

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 Glass Fibre	
Number of Sampling Lines Used	1 / 2	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 4	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1, A2, A3 & A4	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, 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	756.8	
Stack static pressure, P_{static}	mmH_2O	0.9	
$P_s = (P_b + (P_{static} / 13.6)$	mmHg	756.8	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	275.8	
Total mass collected in impingers (silica trap)	g	13.1	
Total mass of liquid collected, V_{lc}	g	288.9	
$V_{wstd} = (0.001246)(V_{lc})$	m^3	0.3600	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m^3	4.0020	
Gas meter correction factor, Y_d	-	1.0110	
Average dry gas meter temperature, T_m	°C	16.5	
Average pressure drop across orifice, ΔH	mmH_2O	25.5	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m^3	3.8085	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m^3	0.0864	
B_{wo} as a percentage	% v/v	8.64	
Reported Water Vapour, checked with Tables in EN 14790, Rwv	% v/v	8.64	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m^3	4.1685	
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$			
IED & Incinerates Hazardous Material? (Yes = no positive O_2 correction)	-	No	
% wet oxygen measured in gas stream, $ACT\%O_{2w}$	% v/v	11.38	
% dry oxygen measured in gas stream, $ACT\%O_{2d}$	% v/v	12.46	
% oxygen reference condition, $REF\%O_2$	% v/v	11.00	
O_2 Reference Factor wet $(O_{2REFw}) = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$	-	1.04	
O_2 Reference Factor dry $(O_{2REFd}) = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$	-	1.17	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m^3	4.0088	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m^3	3.2529	
Molecular weight of dry gas stream, M_d			
CO_2	% v/v	4.95	
O_2	% v/v	12.46	
Total	% v/v	17.41	
N_2	% v/v	82.59	
$M_d = 0.44(\%CO_2)+0.32(\%O_2)+0.28(\%N_2)$	g/gmol	29.29	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.32	
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_2O	0.99	
Average square root of velocity heads, √ΔP	$\sqrt{mmH_2O}$	1.00	
Average stack gas temperature, T_s	°C	777.3	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s} + 273)) / (\sqrt{(M_s)(P_s)})$	m/s	6.49	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})			
Area of stack, A_s	m^2	0.13	
$Q_a = (60)(A_s)(V_s)$	m^3/min	48.9	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m^3/min	12.7	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m^3/min	11.6	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m^3/min	12.2	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m^3/min	9.9	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	13.98	
Nozzle area, A_n	mm^2	153.52	
Total sampling time, q	min	252	
$\%I = (4.6398E^6)(T_s+273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	106.9	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1
Sampling Times	-	10:08 - 14:20
Sampling Dates	-	01/04/2019
Sampling Device	-	ISO
Volume Sampled (REF)	m^3	3.2529
Filter I.D. Number	-	47-56616
Start Filter Mass	g	0.15726
End Filter Mass	g	0.16061
Total Mass on Filter	g	0.00335
Probe Rinse I.D. Number	-	PR-47-56616
Start Probe Rinse Mass	g	2.97015
End Probe Rinse Mass	g	2.97059
Total Mass in Probe Rinse	g	0.00043
Total Mass Collected	mg	3.78
Calculated Concentration	mg/m^3	1.16
Balance Uncertainty / LOD	mg/m^3	0.05

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1
Blank Dates	-	01/04/2019
Average Volume Sampled (REF)	m^3	3.2529
Filter I.D. Number	-	47-59518
Start Filter Mass	g	0.14540
End Filter Mass	g	0.14548
Total Mass on Filter	g	0.00008
Probe Rinse I.D. Number	-	PR-47-59518
Start Probe Rinse Mass	g	2.94196
End Probe Rinse Mass	g	2.94224
Total Mass in Probe Rinse	g	0.00029
Total Mass Collected	mg	0.37
Calculated Concentration	mg/m^3	0.11
Balance Uncertainty / LOD	mg/m^3	0.05

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

Sample Runs

Leak Test Results	Units	Run 1
Mean Sampling Rate	l/min	16.1
Pre-Sampling Leak Rate	l/min	0.10
Post-Sampling Leak Rate	l/min	0.10
Allowable Leak Rate	l/min	0.32
Leak Test Acceptable	-	Yes

Water Droplets	Units	Run 1
Are Water Droplets Present	-	No

MU (Concurrent Water Vapour)	Units	Run 1
Measurement Uncertainty (MU)	%	5.0
Allowable MU	%	20.0
MU Acceptable	%	Yes

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

Isokinetic Criterion Compliance	Units	Run 1
Isokinetic Variation	%	106.9
Allowable Isokinetic Range	%	95 - 115
Isokineticity Acceptable	-	Yes

Weighing Uncertainty Criteria	Units	Run 1
Overall Weighing Uncertainty	± mg	0.32
Overall Weighing Uncertainty	± mg/m³	0.10
ELV [Daily ELV for IED]	mg/m³	20.00
Allowable Weighing Uncertainty	mg/m³	1.00
Weighing Uncertainty Acceptable	-	Yes

Filter Temperatures	Units	Run 1
Pre-Conditioning Temperature	°C	180
Post-Conditioning Temperature	°C	160
Maximum Filter Temperature	°C	120

Test Conditions	Units	Run 1
Ambient Temperature Recorded?	-	Yes

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

Blank Runs

Leak Test Results	Units	Blank 1
Expected Sampling Rate	l/min	25.0
Pre-Sampling Leak Rate	l/min	0.10
Post-Sampling Leak Rate	l/min	0.10
Allowable Leak Rate	l/min	0.50
Leak Test Acceptable	-	Yes

Validity of Blank vs ELV	Units	Blank 1
Allowable Blank	mg/m^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 (x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	Run Number 1	
Only one out of two required sampling lines was available, however the number of sample points used on the available line were increased to the minimum required by the Standard	wx	

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

	Value		Standard uncertainty		
Measured Quantities	**Symbol**	**Run 1**	**Symbol**	**Units**	**Run 1**
Sampled Volume (Actual)	V_m	4.0020	uV_m	m³	0.0800
Sampled Gas Temperature	T_m	289.5	uT_m	K	2.0
Sampled Gas Pressure	ρ_m	100.9	$u\rho_m$	kPa	0.5
Sampled Gas Humidity	H_m	0.0	uH_m	% v/v	1.0
Leak	L	0.62	uL	%	-
Mass of Particulate	m	3.78	um	mg	0.17
Uncollected Mass	UCM	0.37	uUCM	mg	-

	Uncertainty as a Percentage		
Measured Quantities	**Units**	**Run 1**	**Requirement of Standard**
Sampled Volume (Actual)	%	2.00	≤2%
Sampled Gas Temperature	%	0.69	≤1%
Sampled Gas Pressure	%	0.50	≤1%
Sampled Gas Humidity	%	1.00	≤1%
Leak	%	0.62	≤2%
Mass of Particulate	%	0.26	<5% of ELV
Uncollected Mass	%	-	-

	Uncertainty in Measurement Units			Sensitivity Coefficient
Measured Quantities	**Symbol**	**Units**	**Run 1**	**Run 1**
Sampled Volume (STP)	V_m	m³	3.8085	0.31
Leak	L	mg/m³	0.004	1.00
Mass of Particulate	L_r	mg	3.783	0.31
Uncollected Mass	UCM	mg	0.21	0.31

	Uncertainty in Result	
Measured Quantities	**Units**	**Run 1**
Sampled Volume (STP)	mg/m³	0.029
Leak	mg/m³	0.0042
Mass of Particulate	mg/m³	0.0523
Uncollected Mass	mg/m³	0.0651

	Oxygen Correction Part of MU Budget	
Measured Quantities	**Units**	**Run 1**
O_2 Correction Factor	-	1.17
Stack Gas O_2 Content	% v/v	12.46
MU for O_2 Correction	-	0.07
Overall MU For O_2 Measurement	%	5.85

Parameter	**Units**	**Run 1**
Combined uncertainty	mg/m³	0.09
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m³	0.17
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m³	0.19
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m³	0.19
Reported Uncertainty	mg/m³	0.19
Expanded uncertainty (95% confidence), without Oxygen Correction	%	14.9
Expanded uncertainty (95% confidence), with Oxygen Correction	%	16.0
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	16.0
Reported Uncertainty	%	16.0

TOTAL VOCs (as CARBON): RESULTS SUMMARY

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	4.6		4.6
Uncertainty	±mg/m³	0.60		0.60
Mass Emission	g/hr	2.7		2.7
Uncertainty	±g/hr	2.3		2.3

General Sampling Information

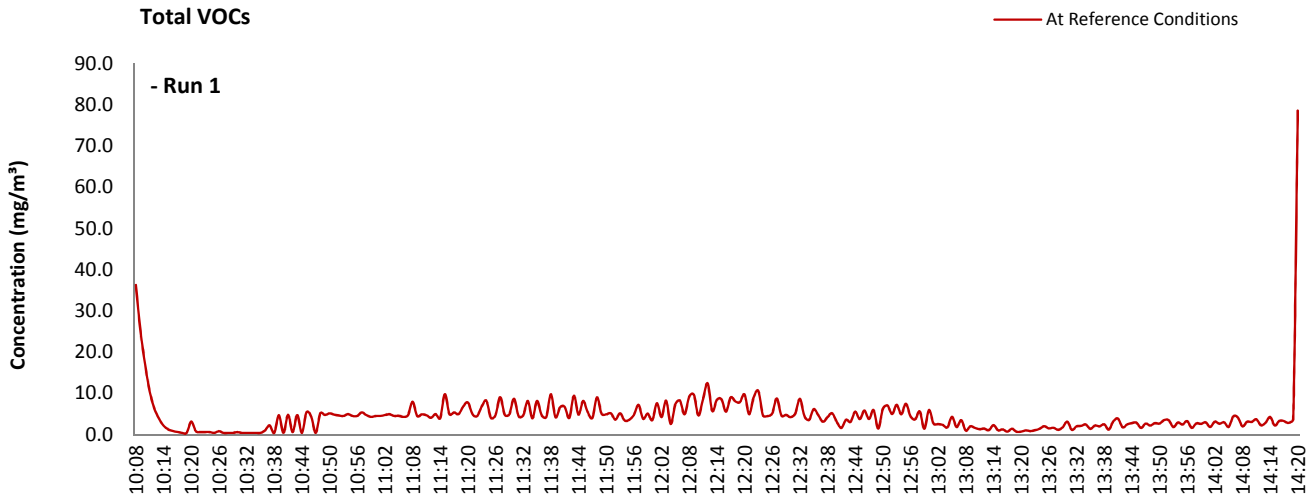
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Type	Propane in 13% O_2 in N_2 (5 Grade)	
Span Gas Reference Number	CYL 1.0237n in N_2 | CYL 1.0292a in AIR	
Span Gas Expiry Date	18/06/2021 | 12/09/2021	
Span Gas Start Pressure (bar)	120 | 100	
Gas Cylinder Concentration (ppm)	83.46 | 79.9	
Span Gas Set Point (ppm)	81.26	This is the blended concentration of both propane cylinders
Span Gas Uncertainty (%)	2 | 2	
Zero Gas Type	13% O_2 in N_2 (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	C1	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, 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	-	10:08 - 14:20
Sampling Dates	-	01/04/2019
Instrument Range	ppm	100
Span Gas Value	ppm	81.3

Quality Assurance

	Zero Drift	Units	Run 1
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.00
CAL 1	Zero Down Sampling Line (Post)	ppm	0.10
CAL 1	Zero Drift	ppm	0.10
	Allowable Zero Drift	± ppm	4.06
	Zero Drift Acceptable	-	Yes

	Span Drift	Units	Run 1
CAL 1	Span Down Sampling Line (Pre)	ppm	81.20
CAL 1	Span Down Sampling Line (Post)	ppm	81.40
CAL 1	Span Drift	ppm	0.20
	Allowable Span Drift	± ppm	4.06
	Span Drift Acceptable	-	Yes

Test Conditions	Units	Run 1
Run Ambient Temperature Range	°C	11 - 13

Method Deviations

Nature of Deviation (x = deviation applies to the associated run)	Run Number 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/m³ (REF)
TGN M2 Allowable MU	15.0		%
Measured concentration	3.90		mg/m³ (STP, dry)
Range Used	100.0		ppm
Range Used [A]	160.6		mg/m³
Cal gas conc.	81.3		ppm
Conversion	1.61		ppm to mg/m³
MCERTS Range [B]	15.0		mg/m³
Lower of [A] or [B]	15.0		mg/m³
Cal gas conc.	130.5		mg/m³

Performance characteristics	RUN 1		Units
Response time	45		seconds
Number of readings in measurement	252		-
Repeatability at zero	2.00		% full scale
Repeatability at span level	0.00		% full scale
Deviation from linearity	0.73		% of value
Zero drift	0.12		% full scale
Span drift	0.25		% 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/m³
Standard deviation of repeatability at span level	0.00		mg/m³
Lack of fit	0.06		mg/m³
Drift	0.10		mg/m³
Volume or pressure flow dependence	0.00		mg/m³
Atmospheric pressure dependence	0.01		mg/m³
Ambient temperature dependence	0.20		mg/m³
Combined interference (from MCERTS Certificate)	0.04		mg/m³
Dependence on voltage	0.06		mg/m³
Losses in the line (leak)	0.00		mg/m³
Uncertainty of calibration gas	0.06		mg/m³

			RUN 1		Units
Measurement uncertainty		**Result**	3.90		mg/m³
Combined uncertainty			0.26		mg/m³
Expanded uncertainty	k =	1.96	0.50		mg/m³
Uncertainty corrected to std conds. (O_2)			0.59		mg/m³ (REF)

	RUN 1		Units
Expanded uncertainty (no O_2) - at 95% Confidence	12.81		% of Value
Expanded uncertainty (no O_2) - at 95% Confidence	2.50		% 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	13.04		% of Value
Expanded uncertainty (with O_2) - at 95% Confidence	3.78		% at ELV
Overall Allowable uncertainty (with O_2) - at 95% Confidence	15.2		% 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 O_2 correction is applied less than 15% + the uncertainty associated with the O_2 correction (using sqrt of sum squares to add uncertainty components). Ref EA TGN M2.

OXIDES OF NITROGEN (as NO_2): RESULTS SUMMARY

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	93.6		93.6
Uncertainty	±mg/m³	4.3		4.3
Mass Emission	g/hr	55.5		55.5
Uncertainty	±g/hr	46.9		46.9

General Sampling Information

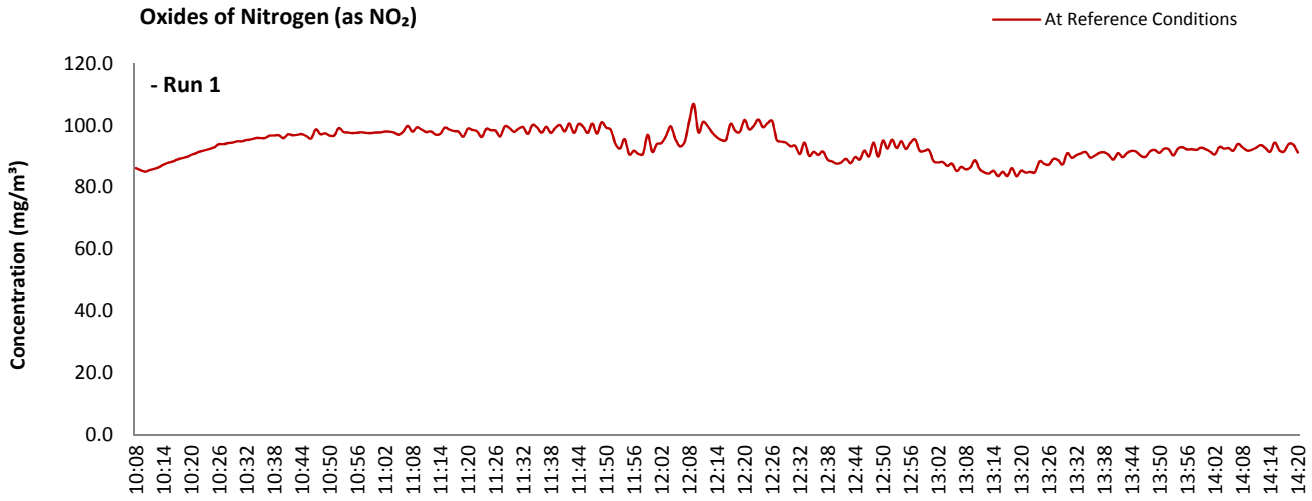
Parameter	Value	
Standard	EN 14792	
Technical Procedure	CAT-TP-39	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Date & Result of Last Converter Check	10/05/2018 - 96.5%	
Span Gas Type	Nitrogen Monoxide	
Span Gas Reference Number	CYL 12.0099	
Span Gas Expiry Date	13/07/2019	
Span Gas Start Pressure (bar)	150	
Gas Cylinder Concentration (ppm)	410.9	NOTE: Dilution performed to achieve correct span value
Span Gas Uncertainty (%)	2	
Zero Gas Type	Nitrogen (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	C1	

Reference Conditions

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

OXIDES OF NITROGEN (as NO_2): DATA TREND

Graphical Trend of Data



OXIDES OF NITROGEN (as NO_2): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1
Sampling Times	-	10:08 - 14:20
Sampling Dates	-	01/04/2019
Instrument Range	ppm	250
Span Gas Value	ppm	97.5

Quality Assurance

Conditioning Unit Temperature	Units	Run 1
Average Temperature	°C	3.0
Allowable Temperature	< °C	4.0
Temperature Acceptable	-	Yes

	Zero Drift	Units	Run 1
CAL 1	Zero at Analyser (Pre)	ppm	0.00
CAL 1	Zero at Analyser (Post)	ppm	0.00
CAL 1	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
CAL 1	Span at Analyser (Post)	ppm	97.30
CAL 1	Span Drift	ppm	-0.20
	Allowable Span Drift	± ppm	4.87
	Span Drift Acceptable	-	Yes

Test Conditions	Units	Run 1
Run Ambient Temperature Range	°C	11 - 13

Method Deviations

Nature of Deviation (x = deviation applies to the associated run)	Run Number 1	
There are no deviations associated with the sampling employed.	x	

OXIDES OF NITROGEN (as NO_2): MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1		Units
Limit value	200.0		mg/m³ (REF)
TGN M2 Allowable MU	10.0		%
Measured concentration	79.98		mg/m³ (STP, dry)
Ratio NO / NO_2	5		%
Range Used	250.0		ppm
Range Used [A]	513.1		mg/m³
Cal gas conc.	97.5		ppm
Conversion	2.05		ppm to mg/m³
MCERTS Range [B]	205.0		mg/m³
Lower of [A] or [B]	205.0		mg/m³
Cal gas conc.	200.0		mg/m³

Performance characteristics	RUN 1		Units
Response time	31		seconds
Number of readings in measurement	252		-
Repeatability at zero	0.00		% full scale
Repeatability at span level	0.10		% full scale
Deviation from linearity	0.27		% of value
Zero drift	0.00		% full scale
Span drift	-0.21		% 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	96.5		%
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/m³
Standard deviation of repeatability at span level	0.01		mg/m³
Lack of fit	0.32		mg/m³
Drift	-0.09		mg/m³
Volume or pressure flow dependence	0.00		mg/m³
Atmospheric pressure dependence	0.06		mg/m³
Ambient temperature dependence	0.01		mg/m³
Combined interference (from MCERTS Certificate)	0.75		mg/m³
Dependence on voltage	-0.03		mg/m³
Converter efficiency	0.08		mg/m³
Losses in the line (leak)	0.00		mg/m³
Uncertainty of calibration gas blending	0.65		mg/m³
Uncertainty of calibration gas	0.92		mg/m³

			RUN 1		Units
Measurement uncertainty		**Result**	79.98		mg/m³
Combined uncertainty			1.58		mg/m³
Expanded uncertainty	k =	1.96	3.10		mg/m³
Uncertainty corrected to std conds. (O_2)			3.63		mg/m³ (REF)

	RUN 1		Units
Expanded uncertainty (no O_2) - at 95% Confidence	3.88		% of Value
Expanded uncertainty (no O_2) - at 95% Confidence	1.55		% 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	4.56		% of Value
Expanded uncertainty (with O_2) - at 95% Confidence	3.00		% at ELV
Overall Allowable uncertainty (with O_2) - at 95% Confidence	10.3		% 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 O_2 correction is applied less than 10% + the uncertainty associated with the O_2 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/m³	84.0		84.0
Uncertainty	±mg/m³	3.2		3.2
Mass Emission	g/hr	49.8		49.8
Uncertainty	±g/hr	42.0		42.0

General Sampling Information

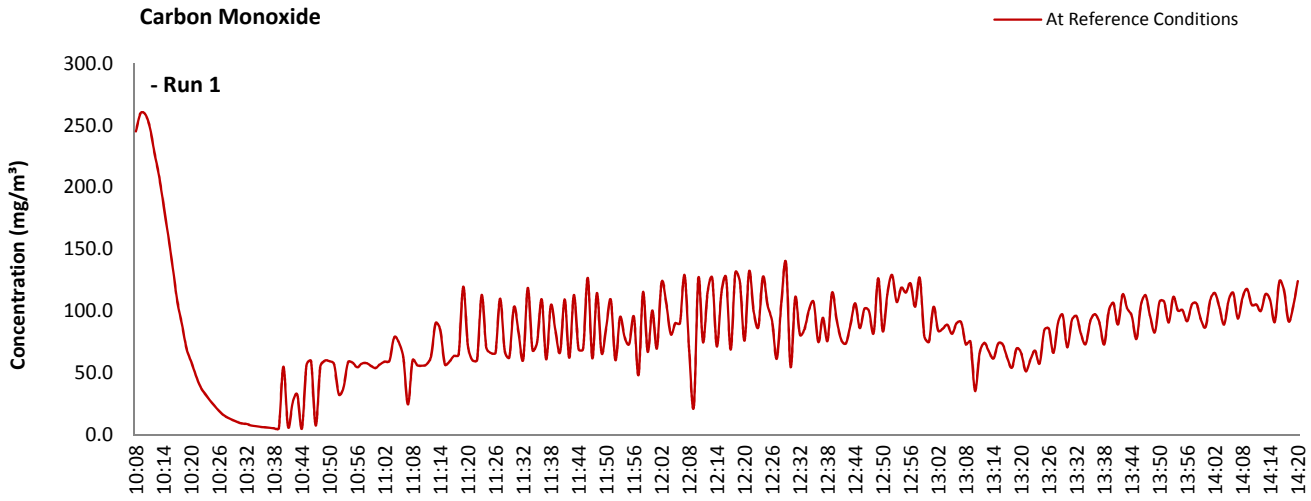
Parameter	Value	
Standard	EN 15058	
Technical Procedure	CAT-TP-39	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Type	Carbon Monoxide	
Span Gas Reference Number	CYL 12.0099	
Span Gas Expiry Date	13/07/2019	
Span Gas Start Pressure (bar)	150	
Gas Cylinder Concentration (ppm)	412	NOTE: Dilution performed to achieve correct span value
Span Gas Uncertainty (%)	2	
Zero Gas Type	Nitrogen (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	C1	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, 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	-	10:08 - 14:20
Sampling Dates	-	01/04/2019
Instrument Range	ppm	200
Span Gas Value	ppm	160.1

Quality Assurance

Conditioning Unit Temperature	Units	Run 1
Average Temperature	°C	3.0
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	0.10
	Zero Drift	ppm	0.10
	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	159.90
	Span Drift	ppm	-0.20
	Allowable Span Drift	± ppm	8.01
	Span Drift Acceptable	-	Yes

Test Conditions	Units	Run 1
Run Ambient Temperature Range	°C	11 - 13

Method Deviations

Nature of Deviation (x = deviation applies to the associated run)	Run Number 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/m³ (REF)
TGN M2 Allowable MU	6.0		%
Measured concentration	71.78		mg/m³ (STP, dry)
Range Used	200.0		ppm
Range Used [A]	249.8		mg/m³
Cal gas conc.	160.1		ppm
Conversion	1.25		ppm to mg/m³
MCERTS Range [B]	75.0		mg/m³
Lower of [A] or [B]	75.0		mg/m³
Cal gas conc.	200.0		mg/m³

Performance characteristics	RUN 1		Units
Response time	28		seconds
Number of readings in measurement	252		-
Repeatability at zero	0.10		% full scale
Repeatability at span level	0.20		% full scale
Deviation from linearity	0.52		% of value
Zero drift	0.06		% full scale
Span drift	-0.12		% 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)	0.06		% 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/m³
Standard deviation of repeatability at span level	0.01		mg/m³
Lack of fit	0.23		mg/m³
Drift	0.02		mg/m³
Volume or pressure flow dependence	0.00		mg/m³
Atmospheric pressure dependence	0.05		mg/m³
Ambient temperature dependence	-0.03		mg/m³
Combined interference (from MCERTS Certificate)	-0.21		mg/m³
Dependence on voltage	-0.04		mg/m³
Losses in the line (leak)	0.03		mg/m³
Uncertainty of calibration gas blending	0.58		mg/m³
Uncertainty of calibration gas	0.83		mg/m³

			RUN 1		Units
Measurement uncertainty		**Result**	71.78		mg/m³
Combined uncertainty			1.08		mg/m³
Expanded uncertainty	k =	1.96	2.12		mg/m³
Uncertainty corrected to std conds. (O_2)			2.48		mg/m³ (REF)

	RUN 1		Units
Expanded uncertainty (no O_2) - at 95% Confidence	2.95		% of Value
Expanded uncertainty (no O_2) - at 95% Confidence	1.06		% 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	3.80		% of Value
Expanded uncertainty (with O_2) - at 95% Confidence	2.69		% at ELV
Overall Allowable uncertainty (with O_2) - at 95% Confidence	6.5		% 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 O_2 correction is applied less than 6% + the uncertainty associated with the O_2 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

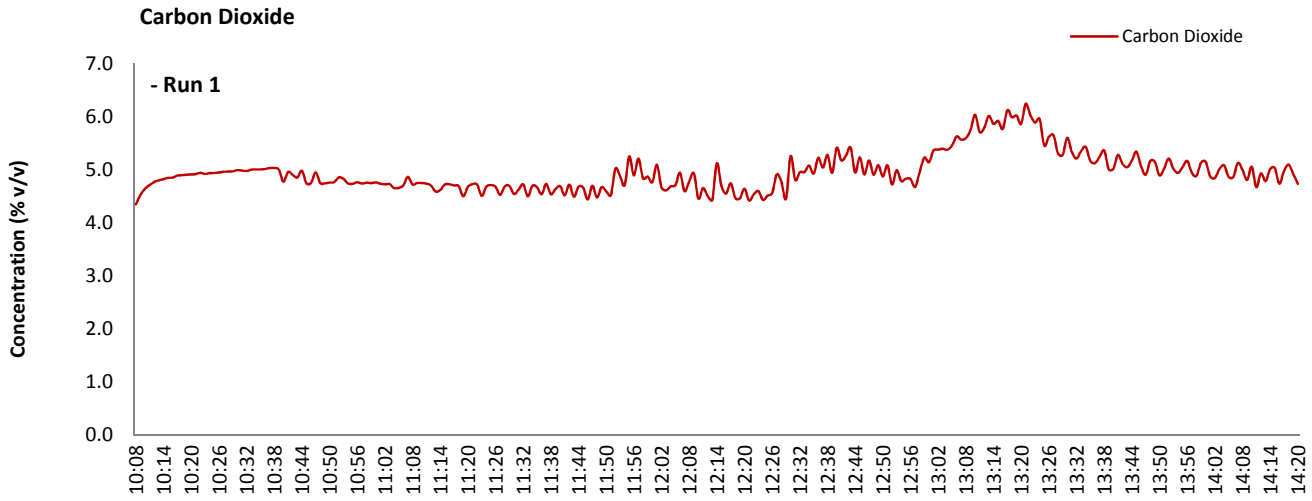
Parameter	Units	Run 1		Mean
Concentration	% v/v	5.0		5.0
Uncertainty	±% v/v	0.18		0.18

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 6.0032	
Span Gas Expiry Date	02/09/2021	
Span Gas Start Pressure (bar)	160	
Gas Cylinder Concentration (% v/v)	16.09	
Span Gas Uncertainty (%)	2.00	
Zero Gas Type	Nitrogen (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	C1	

CARBON DIOXIDE: DATA TREND

Graphical Trend of Data



CARBON DIOXIDE: SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1
Sampling Times	-	10:08 - 14:20
Sampling Dates	-	01/04/2019
Instrument Range	% v/v	20
Span Gas Value	% v/v	16.1

Quality Assurance

Conditioning Unit Temperature	Units	Run 1
Average Temperature	°C	3.0
Allowable Temperature	< °C	4.0
Temperature Acceptable	-	Yes

	Zero Drift	Units	Run 1
CAL 1	Zero Down Sampling Line (Pre)	% v/v	0.00
CAL 1	Zero Down Sampling Line (Post)	% v/v	0.02
CAL 1	Zero Drift	% v/v	0.02
	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	16.06
CAL 1	Span Down Sampling Line (Post)	% v/v	16.00
CAL 1	Span Drift	% v/v	-0.06
	Allowable Span Drift	± % v/v	0.80
	Span Drift Acceptable	-	Yes

Test Conditions	Units	Run 1
Run Ambient Temperature Range	°C	11 - 13

Method Deviations

Nature of Deviation (x = deviation applies to the associated run)	Run Number 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	4.95		%vol
Range Used	20.0		%vol
Cal gas conc.	16.1		%vol

Performance characteristics	RUN 1		Units
Response time	29		seconds
Number of readings in measurement	252		-
Repeatability at zero	0.00		% full scale
Repeatability at span level	0.10		% full scale
Deviation from linearity	0.36		% of value
Zero drift	0.12		% full scale
Span drift	-0.37		% 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)	0.19		% 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	0.04		%vol
Drift	0.00		%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)	0.01		%vol
Uncertainty of calibration gas	0.06		%vol

			RUN 1		Units
Measurement uncertainty		**Result**	4.95		%vol
Combined uncertainty			0.09		%vol
Expanded uncertainty	k =	1.96	0.18		%vol

	RUN 1		Units
Expanded uncertainty (no O_2) - at 95% Confidence	3.61		% of Value

OXYGEN: RESULTS SUMMARY

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust

Sample Runs

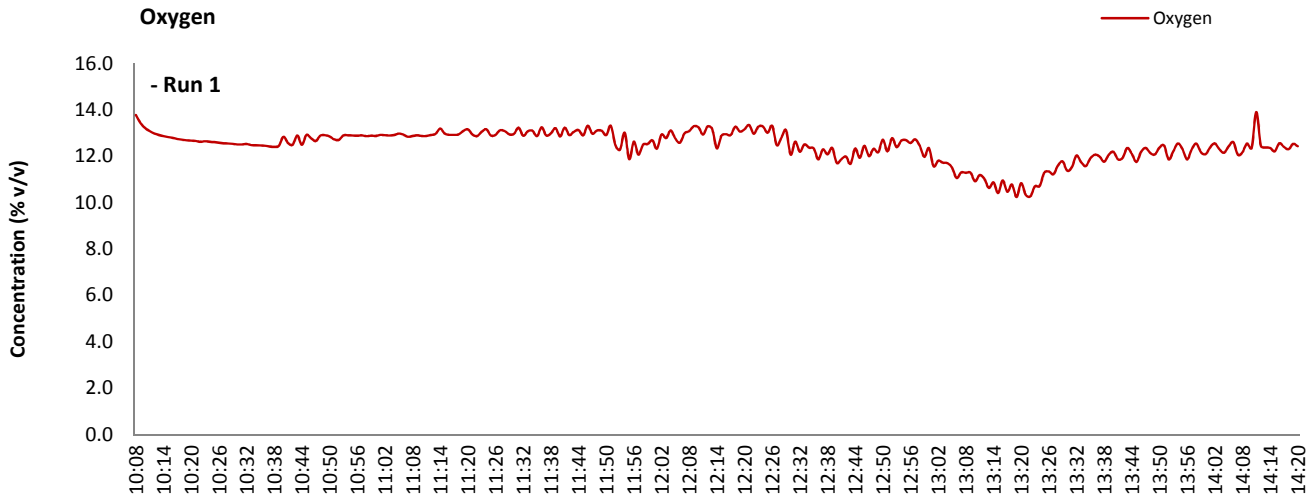
Parameter	Units	Run 1		Mean
Concentration	% v/v	12.5		12.5
Uncertainty	±% v/v	0.30		0.30

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 11.0281	
Span Gas Expiry Date	24/02/2022	
Span Gas Start Pressure (bar)	180	
Gas Cylinder Concentration (% v/v)	21.94	NOTE: Dilution performed to achieve correct span value
Span Gas Uncertainty (%)	2	
Zero Gas Type	Nitrogen (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	C1	

OXYGEN: DATA TREND

Graphical Trend of Data



OXYGEN: SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1
Sampling Times	-	10:08 - 14:20
Sampling Dates	-	01/04/2019
Instrument Range	% v/v	25
Span Gas Value	% v/v	13.0

Quality Assurance

Conditioning Unit Temperature	Units	Run 1
Average Temperature	°C	3.0
Allowable Temperature	< °C	4.0
Temperature Acceptable	-	Yes

	Zero Drift	Units	Run 1
CAL 1	Zero at Analyser (Pre)	% v/v	0.00
	Zero at Analyser (Post)	% v/v	-0.02
	Zero Drift	% v/v	-0.02
	Allowable Zero Drift	± % v/v	0.65
	Zero Drift Acceptable	-	Yes

	Span Drift	Units	Run 1
CAL 1	Span at Analyser (Pre)	% v/v	13.05
	Span at Analyser (Post)	% v/v	13.02
	Span Drift	% v/v	-0.03
	Allowable Span Drift	± % v/v	0.65
	Span Drift Acceptable	-	Yes

Test Conditions	Units	Run 1
Run Ambient Temperature Range	°C	11 - 13

Method Deviations

Nature of Deviation (x = deviation applies to the associated run)	Run Number 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	12.46		%vol
Range Used	25.0		%vol
Cal gas conc.	21.9		%vol

Performance characteristics	RUN 1		Units
Response time	41		seconds
Number of readings in measurement	252		-
Repeatability at zero	0.02		% full scale
Repeatability at span level	0.02		% full scale
Deviation from linearity	0.03		% of value
Zero drift	-0.15		% full scale
Span drift	-0.23		% 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	-0.04		%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	0.14		%vol

			RUN 1		Units
Measurement uncertainty		**Result**	12.46		%vol
Combined uncertainty			0.15		%vol
Expanded uncertainty	k =	1.96	0.30		%vol

	RUN 1		Units
Expanded uncertainty (no O_2) - at 95% Confidence	2.39		% 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.