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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
12th March 2018

Job Reference Number
CAT-4068

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

Report Approved by
Matthew Pendlebury Team Leader MCERTS Level 2 MM 04 535 TE1 TE2 TE3 TE4

Report Date
26th March 2018

Version
Version 1

Signature of Report Approver


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MONITORING OBJECTIVES

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust
12th March 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 NO_2), Carbon Monoxide

Executive Summary

MONITORING RESULTS

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust
12th March 2018

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	0.98		0.12	20	g/hr	0.57	0.08	-
Total VOCs (as Carbon) [1]	mg/m³	13.3		0.95	20	g/hr	7.71	0.81	-
Oxides of Nitrogen (as NO_2) [1]	mg/m³	90.3		5.86	200	g/hr	52.3	5.24	-
Carbon Monoxide [1]	mg/m³	156		9.11	200	g/hr	90.3	8.68	-
Carbon Dioxide	% v/v	**Dry**	4.89	0.19					
Oxygen	% v/v	**Dry**	12.2	0.61					
Water Vapour	% v/v	8.03		0.41					
Stack Gas Temperature	°C	752							
Stack Gas Velocity	m/s	5.31		0.33					
Volumetric Flow Rate (ACTUAL)	m³/hr	2400		183					
Volumetric Flow Rate (REF) [1]	m³/hr	708		54.1					

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

[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
12th March 2018

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	0.98	g/hr	0.57	12/03/2018	11:30 - 15:42	252
Total VOCs (as Carbon)	R1	mg/m³	13.3	g/hr	7.71	12/03/2018	11:30 - 15:42	252
Oxides of Nitrogen (as NO_2)	R1	mg/m³	90.3	g/hr	52.3	12/03/2018	11:30 - 15:42	252
Carbon Monoxide	R1	mg/m³	156	g/hr	90.3	12/03/2018	11:30 - 15:42	252
Carbon Dioxide	R1	% v/v	4.89			12/03/2018	11:30 - 15:42	252
Oxygen	R1	% v/v	12.2			12/03/2018	11:30 - 15:42	252
Velocity Traverse	R1					12/03/2018	11:24 - 11:29	

All results are expressed at the respective reference conditions.

PROCESS DETAILS

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust
12th March 2018

Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	Standard Operating Capacity
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	Not Visible

Executive Summary

MONITORING & ANALYTICAL METHODS

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust
12th March 2018

	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	0.10 % 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/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	0.31 mg/m³
Carbon Dioxide	ISO 12039	CAT-TP-39	Yes	CAT	NDIR by Horiba PG-350E				Yes	0.10 % v/v
Oxygen	EN 14789	CAT-TP-39	Yes	CAT	Dry Paramagnetic Cell by Horiba PG-350E				Yes	0.10 % v/v
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

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.40
Width	m	-
Area	m²	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

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	8.0					> 5 Pa	Yes
Mean Velocity	m/s	5.31					-	-
Lowest Gas Velocity	m/s	4.94					-	-
Highest Gas Velocity	m/s	5.81					-	-
Ratio of Above	: 1	1.18					< 3 : 1	Yes
Maximum Angle of Swirl	°	1					< 15°	Yes
No Local Negative Flow	-	Yes					-	Yes

Executive Summary

PLANT PHOTOS

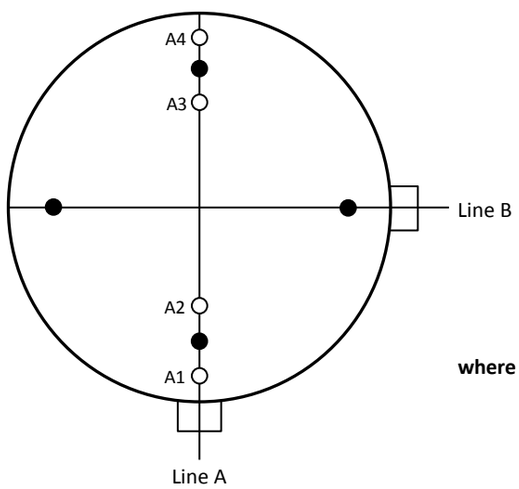
Photo 1

Photo 2

Photo 3

Photo 4

SAMPLE POINTS



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

APPENDIX CONTENTS

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
Trainee	Lee Heaton	MCERTS Trainee	MM 17 1433	None

LIST OF EQUIPMENT

Extractive Sampling	
Equipment Type	**Equipment I.D.**
Control Box DGM (1)	CAT 7.57
Control Box DGM (2)	-
Box Thermocouples (1)	CAT 3.146
Box Thermocouples (2)	-
Umbilical (1)	CAT 3.146
Umbilical (2)	-
Oven Box (1)	CAT 12.109
Oven Box (2)	-
Heated Probe (1)	-
Heated Probe (2)	-
Heated Probe (3)	-
S-Pitot (1)	CAT 21S.57
S-Pitot (2)	CAT 21P.67
L-Pitot	-
Site Balance	CAT 17.33
500g / 1Kg Check Weights	CAT 17.33 a & b
Last Impinger Arm	-
Callipers	CAT 23.40
Tubes Kit Thermocouple	-

Instrumental Analysers	
Equipment Type	**Equipment I.D.**
Horiba PG-350E	CAT 39.10
Horiba PG-250	-
Servomex 4900	-
Eco Physics CLD 822Mh	-
ABB AO2020-URAS26	-
Testo 350 XL	-
Ankersmid APS 313	CAT 4.847
Gasmet DX4000	-
Gasmet Sampling System	-
Bernath 3006 FID	CAT 8.31
M&C PSS	CAT 12.107
Mass Flow Controller (1)	CAT 6.61
Mass Flow Controller (2)	CAT 6.62
Mass View (1)	-
Mass View (2)	-
Hioki 5043 (V)	CAT 11.69
Easylogger EN-EL-12 Bit	-
Bioaerosols Temperature Logger	-
Electronic Refrigerator	-

Miscellaneous Items	
Equipment Type	**Equipment I.D.**
Digital Manometer (1)	CAT 3.142
Digital Manometer (2)	CAT 3.144
Digital Temperature Meter	-
Stopwatch	CAT 14.84
Barometer	CAT 13.40
Stack Thermocouple (1)	CAT 4.1153
Stack Thermocouple (2)	-
Stack Thermocouple (3)	-
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 20.116
20m Heated Line (2)	-
Dual Channel Heater Controller	-
Single Channel Heater Controller	CAT 20.116
Laboratory Balance	CAT 1.18 / 1.18a
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	m²	0.13
Average Stack Gas Temperature, T_a	°C	450
Average Stack Gas Pressure	Pa	9.28
Average Stack Static Pressure, P_{static}	kPa	0.02
Average Barometric Pressure, P_b	kPa	97.4
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/m³ p	Conc kg/m³ p_i
CO_2	-	4.89	4.50	0.0489	44.01	1.9635	0.0960
O_2	-	12.17	11.19	0.1217	32.00	1.4277	0.1737
N_2	-	82.94	76.28	0.8294	28.01	1.2498	1.0366
Moisture (H_2O)	-	-	8.03	0.0803	18.02	0.8037	0.0646

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	1.3064
Wet Density (STP), P_{STW}	kg/m³	1.2660
Dry Density (Actual), P_{Actual}	kg/m³	0.4747
Average Wet Density (Actual), $P_{ActualW}$	kg/m³	0.4600

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	450	0.00
Total Pressure	kPa	97.4	101.3
Moisture	%	8.03	0.00
Oxygen (Dry)	%	12.2	11.0

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m³/hr	2400
Gas Volumetric Flowrate (STP, Wet)	m³/hr	872
Gas Volumetric Flowrate (STP, Dry)	m³/hr	802
Gas Volumetric Flowrate REF [1]	m³/hr	708

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	12/03/2018
Time of Survey	-	11:24 - 11:29
Atmospheric Pressure	kPa	97.4
Average Stack Static Pressure	Pa	17
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					Sampling Line B				
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m³	Velocity m/s	Swirl °	ΔP	Temp °C	Wet Density kg/m³	Velocity m/s	Swirl °
STATIC (Units: Pa)		*17.2*									
Mean		**9.3**	**449.5**	**0.460**	**5.31**						
1	0.03	11.1	448.0	0.461	5.81	0.0					
2	0.10	9.7	449.0	0.460	5.44	1.0					
3	0.30	8.3	450.0	0.460	5.03	1.0					
4	0.37	8.0	451.0	0.459	4.94	0.0					

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

(1 of 1)

Performance characteristics (Uncertainty Components)	Uncertainty	Value	Units
Standard Uncertainty on the coefficient of the Pitot Tube	u(k)	0.005	-
Standard Uncertainty associated with the mean local dynamic pressures	u(Δpi)	1.047	Pa
- Resolution	u(res)	0.00087	
- Calibration	u(cal)	0.009	
- Drift	u(drift)	0.083	
- Lack of Fit	u(fit)	0.002	
- Overall corrections to dynamic measurements	u(Cf)	0.095	
Standard uncertainty associated with the molar mass of the gas	u(M)	0.00005	-
- $\varphi O_2,w$	-	11.192	
- $\varphi CO_2,w$	-	4.496	
- Oxygen, dry	u(ϕO_2,d)	0.373	
- Carbon Dioxide, dry	u(ϕCO_2,d)	0.150	
- Water Vapour	u(ϕH_2O)	0.410	
- Oxygen, wet	u(ϕO_2,w)	0.346	
- Carbon Dioxide, wet	u(ϕCO_2,w)	0.139	
Standard uncertainty associated with the stack temperature	u(Tc)	3.686	K
Standard uncertainty associated with the absolute pressure in the duct	u(pc)	175.695	Pa
- Atmospheric Pressure	u(patm)	175.692	
- Static Pressure	u(pstat)	1.047	
Standard uncertainty associated with the density in the duct	u(ρ)	0.00249	-
Standard uncertainty associated with the local velocities	u(vi)	0.310	Pa
Standard uncertainty associated with the mean velocity	u(v)	0.166	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	Uc(v)	0.326	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	Uc,rel(v)	6.14	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	Uc(qV,w)	183.2	m^3/hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00152	
- $u^2(qV,w)$	-	8736	
- $u(qV,w)$	-	93.5	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	Uc,rel(qV,w)	7.63	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	0.98		0.98
Uncertainty	±mg/m³	0.12		0.12
Mass Emission	g/hr	0.57		0.57
Uncertainty	±g/hr	0.08		0.08

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	8.03		8.03
Uncertainty	±% v/v	0.41		0.41

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m³	0.05		0.05

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

General Sampling Information

Parameter	Value	
Standard	EN 13284-1	
Technical Procedure	CAT-TP-01	
Probe Material	Borosilicate Glass	
Filter Housing Material	Borosilicate Glass	
Positioning of Filter	Out Stack	
Filter Size and Material	47mm Quartz 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	730.5				
Stack static pressure, P_{static}	mmH_2O	1.8				
$P_s = (P_b + (P_{static} / 13.6)$	mmHg	730.6				
Volume of water vapour collected, V_{wstd}						
Total mass collected in impingers (liquid trap)	g	220.9				
Total mass collected in impingers (silica trap)	g	22.2				
Total mass of liquid collected, V_{lc}	g	243.1				
$V_{wstd} = (0.001246)(V_{lc})$	m^3	0.3029				
Volume of gas metered dry, V_{mstd}						
Volume of gas sample through gas meter, V_m	m^3	3.8450				
Gas meter correction factor, Y_d	-	0.9940				
Average dry gas meter temperature, T_m	°C	16.9				
Average pressure drop across orifice, ΔH	mmH_2O	23.2				
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m^3	3.4680				
Moisture content, B_{wo} & R_{wv}						
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m^3	0.0803				
B_{wo} as a percentage	% v/v	8.03				
Reported Water Vapour, checked with Tables in EN 14790, Rwv	% v/v	8.03				
Volume of gas metered wet, V_{mstw}						
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m^3	3.7709				
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	11.19				
% dry oxygen measured in gas stream, $ACT\%O_{2d}$	% v/v	12.17				
% oxygen reference condition, $REF\%O_2$	% v/v	11.00				
O_2 Reference Factor wet $(O_{2REFw}) = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$	-	1.02				
O_2 Reference Factor dry $(O_{2REFd}) = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$	-	1.13				
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m^3	3.6984				
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m^3	3.0623				
Molecular weight of dry gas stream, M_d						
CO_2	% v/v	5.10				
O_2	% v/v	12.17				
Total	% v/v	17.27				
N_2	% v/v	82.73				
$M_d = 0.44(\%CO_2)+0.32(\%O_2)+0.28(\%N_2)$	g/gmol	29.30				
Molecular weight of stack gas (wet), M_s						
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.39				
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	0.89				
Average square root of velocity heads, √ΔP	$\sqrt{mmH_2O}$	0.94				
Average stack gas temperature, T_s	°C	751.5				
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s} + 273)) / (\sqrt{(M_s)(P_s)})$	m/s	6.15				
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	46.4				
Conversion factor (K/mm.Hg), C_f	-	0.3592				
$Q_{stw} = ((Q_a)(P_{s)}(C_f)) / ((T_s) + 273)$	m^3/min	11.9				
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m^3/min	10.9				
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m^3/min	11.7				
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m^3/min	9.7				
Percent isokinetic, %I						
Nozzle diameter, D_n	mm	14.00				
Nozzle area, A_n	mm^2	153.96				
Total sampling time, q	min	252				
$\%I = (4.6398E^6)(T_s+273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	102.7				

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1				
Sampling Times	-	11:30 - 15:42				
Sampling Dates	-	12/03/2018				
Sampling Device	-	ISO				
Volume Sampled (REF)	m^3	3.0623				
Filter I.D. Number	-	47-45651				
Start Filter Mass	g	0.15364				
End Filter Mass	g	0.15576				
Total Mass on Filter	g	0.00212				
Probe Rinse I.D. Number	-	PR-47-45651				
Start Probe Rinse Mass	g	3.00057				
End Probe Rinse Mass	g	3.00146				
Total Mass in Probe Rinse	g	0.00089				
Total Mass Collected	mg	3.01				
Calculated Concentration	mg/m^3	0.98				
Balance Uncertainty / LOD	mg/m^3	0.05				

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1				
Blank Dates	-	12/03/2018				
Average Volume Sampled (REF)	m^3	3.0623				
Filter I.D. Number	-	47-45652				
Start Filter Mass	g	0.15340				
End Filter Mass	g	0.15345				
Total Mass on Filter	g	0.00005				
Probe Rinse I.D. Number	-	PR-47-45652				
Start Probe Rinse Mass	g	2.82132				
End Probe Rinse Mass	g	2.82137				
Total Mass in Probe Rinse	g	0.00005				
Total Mass Collected	mg	0.10				
Calculated Concentration	mg/m^3	0.03				
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	15.2				
Pre-Sampling Leak Rate	l/min	0.05				
Post-Sampling Leak Rate	l/min	0.05				
Allowable Leak Rate	l/min	0.30				
Leak Test Acceptable	-	Yes				

Water Droplets	Units	Run 1				
Are Water Droplets Present	-	No				

MU (Concurrent Water Vapour)	Units	Run 1				
Measurement Uncertainty (MU)	%	5.2				
Allowable MU	%	20				
MU Acceptable	%	Yes				

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

Isokinetic Criterion Compliance	Units	Run 1				
Isokinetic Variation	%	102.7				
Allowable Isokinetic Range	%	95 - 115				
Isokineticity Acceptable	-	Yes				

Weighing Uncertainty Criteria	Units	Run 1				
Overall Weighing Uncertainty	± mg	0.27				
Overall Weighing Uncertainty	± mg/m³	0.09				
ELV [Daily ELV for IED]	mg/m³	20.0				
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	160				

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	20.0				
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/m³	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				
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

	Value						Standard uncertainty						
Measured Quantities	**Symbol**	**Run 1**					**Symbol**	**Units**	**Run 1**				
Sampled Volume (Actual)	V_m	3.85					uV_m	m³	0.08				
Sampled Gas Temperature	T_m	289.9					uT_m	K	2.00				
Sampled Gas Pressure	ρ_m	97.4					$u\rho_m$	kPa	0.50				
Sampled Gas Humidity	H_m	0.00					uH_m	% v/v	1.00				
Leak	L	0.33					uL	%	-				
Mass of Particulate	m	3.01					um	mg	0.14				
Uncollected Mass	UCM	0.10					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	%	0.51					≤1%
Sampled Gas Humidity	%	1.00					≤1%
Leak	%	0.33					≤2%
Mass of Particulate	%	0.23					<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	3.47					0.28				
Leak	L	mg/m³	0.00					1.00				
Mass of Particulate	L_r	mg	3.01					0.33				
Uncollected Mass	UCM	mg	0.06					0.33				

	Uncertainty in Result						
Measured Quantities	**Units**	**Run 1**					
Sampled Volume (STP)	mg/m³	0.03					
Leak	mg/m³	0.00					
Mass of Particulate	mg/m³	0.05					
Uncollected Mass	mg/m³	0.02					

	Oxygen Correction Part of MU Budget						
Measured Quantities	**Units**	**Run 1**					
O_2 Correction Factor	-	1.13					
Stack Gas O_2 Content	% v/v	12.2					
MU for O_2 Correction	-	0.06					
Overall MU For O_2 Measurement	%	5.66					

Parameter	**Units**	**Run 1**				
Combined uncertainty	mg/m³	0.06				
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m³	0.11				
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m³	0.12				
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m³	0.12				
Reported Uncertainty	mg/m³	0.12				
Expanded uncertainty (95% confidence), without Oxygen Correction	%	11.0				
Expanded uncertainty (95% confidence), with Oxygen Correction	%	12.4				
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	12.4				
Reported Uncertainty	%	12.4				

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	13.3		13.3
Uncertainty	±mg/m³	0.95		0.95
Mass Emission	g/hr	7.71		7.71
Uncertainty	±g/hr	0.81		0.81

General Sampling Information

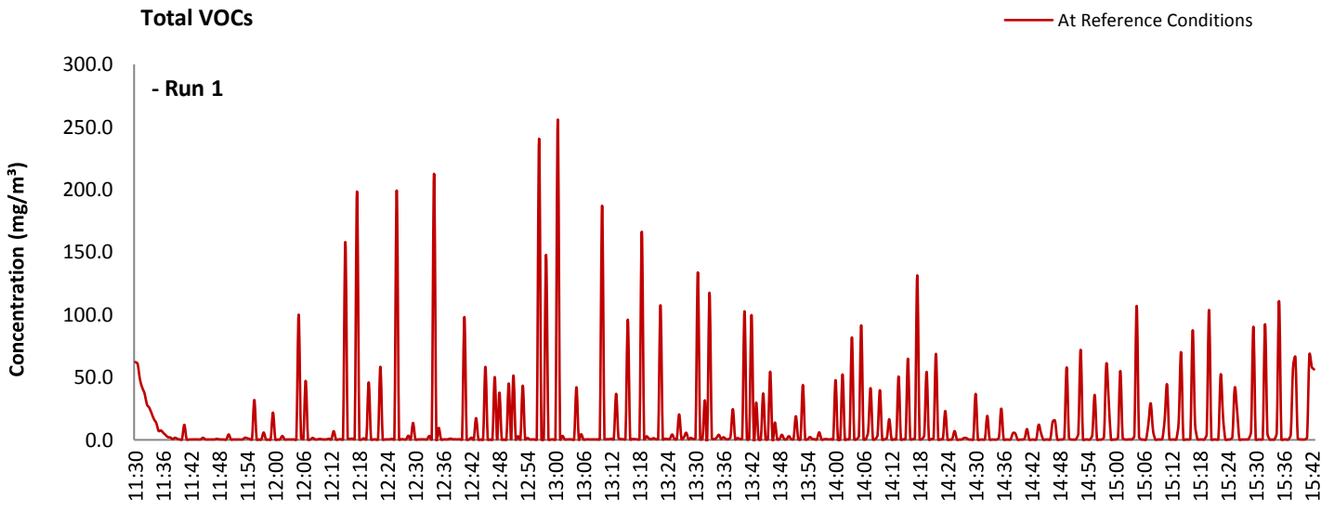
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Type	Propane in 12% O_2 in N_2 (5 Grade)	
Span Gas Reference Number	CYL 1.0119n in N_2 | CYL 1.0293a in AIR	
Span Gas Expiry Date	23/12/2019 | 12/09/2021	
Span Gas Start Pressure (bar)	90 | 10	
Gas Cylinder Concentration (ppm)	83.42 | 79.9	
Span Gas Set Point (ppm)	81.41	This is the blended concentration of both propane cylinders
Span Gas Uncertainty (%)	2 | 2	
Zero Gas Type	12% 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	A2	

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	-	11:30 - 15:42		
Sampling Dates	-	12/03/2018		
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	0.00		
	Zero Down Sampling Line (Post)	ppm	0.00		
	Zero Drift	ppm	0.00		
	Allowable Zero Drift	± ppm	4.07		
	Zero Drift Acceptable	-	Yes		

	Span Drift	Units	Run 1		
CAL 1	Span Down Sampling Line (Pre)	ppm	80.80		
	Span Down Sampling Line (Post)	ppm	81.70		
	Span Drift	ppm	0.90		
	Allowable Span Drift	± ppm	4.07		
	Span Drift Acceptable	-	Yes		

Test Conditions	Units	Run 1		
Run Ambient Temperature Range	°C	4 - 10		

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/m³ (REF)
TGN M2 Allowable MU	15.0			%
Measured concentration	11.75			mg/m³ (STP, dry)
Range Used	100.0			ppm
Range Used [A]	160.6			mg/m³
Cal gas conc.	81.4			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.	130.8			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	0.00			% of value
Zero drift	0.00			% full scale
Span drift	1.11			% 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)	0.74			% 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	0.00			mg/m³
Drift	0.08			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)	0.05			mg/m³
Uncertainty of calibration gas	0.19			mg/m³

Measurement uncertainty		Result	RUN 1			Units
Combined uncertainty			11.75			mg/m³
Expanded uncertainty	k =	1.96	0.30			mg/m³
Uncertainty corrected to std conds. (O_2)			0.60			mg/m³
			0.67			mg/m³ (REF)

	RUN 1			Units
Expanded uncertainty (no O_2) - at 95% Confidence	5.07			% of Value
Expanded uncertainty (no O_2) - at 95% Confidence	2.98			% 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	7.15			% of Value
Expanded uncertainty (with O_2) - at 95% Confidence	6.07			% at ELV
Overall Allowable uncertainty (with O_2) - at 95% Confidence	15.8			% 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	90.3		90.3
Uncertainty	±mg/m³	5.86		5.86
Mass Emission	g/hr	52.3		52.3
Uncertainty	±g/hr	5.24		5.24

General Sampling Information

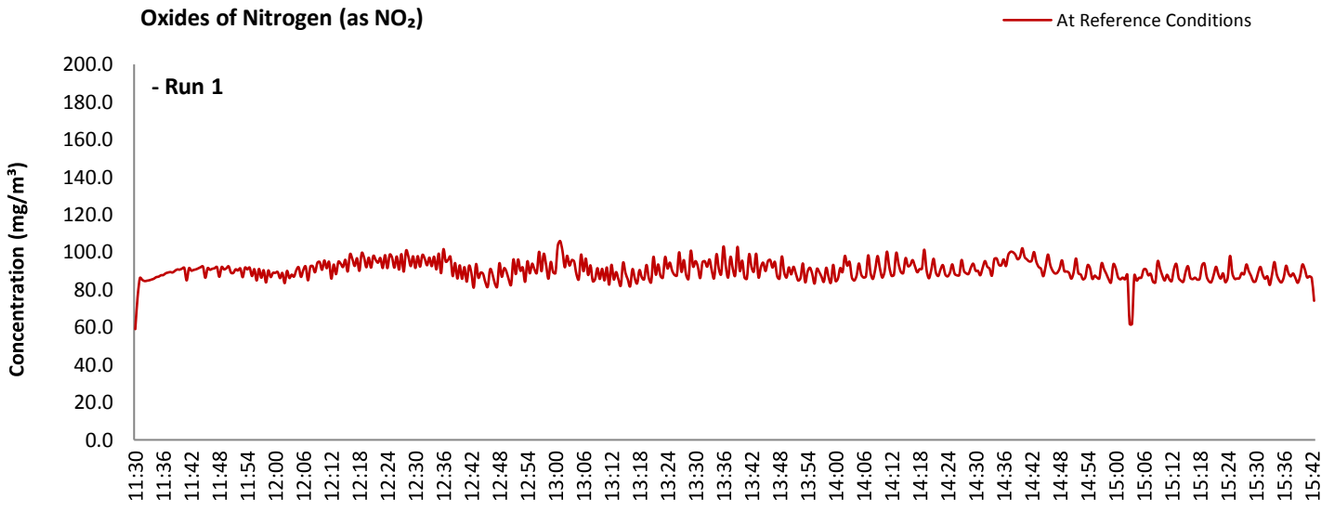
Parameter	Value	
Standard	EN 14792	
Technical Procedure	CAT-TP-39	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Date & Result of Last Converter Check	11/05/2017 - 95.9%	
Span Gas Type	Nitrogen Monoxide	
Span Gas Reference Number	CYL 4.0183	
Span Gas Expiry Date	02/09/2020	
Span Gas Start Pressure (bar)	50	
Gas Cylinder Concentration (ppm)	403.92	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	A2	

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	-	11:30 - 15:42		
Sampling Dates	-	12/03/2018		
Instrument Range	ppm	250		
Span Gas Value	ppm	97.5		

Quality Assurance

Conditioning Unit Temperature	Units	Run 1		
Average Temperature	°C	1.0		
Allowable Temperature	< °C	4.0		
Temperature Acceptable	-	Yes		

	Zero Drift	Units	Run 1		
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.00		
	Zero Down Sampling Line (Post)	ppm	0.00		
	Zero Drift	ppm	0.00		
	Allowable Zero Drift	± ppm	4.87		
	Zero Drift Acceptable	-	Yes		

	Span Drift	Units	Run 1		
CAL 1	Span Down Sampling Line (Pre)	ppm	98.0		
	Span Down Sampling Line (Post)	ppm	97.0		
	Span Drift	ppm	-1.00		
	Allowable Span Drift	± ppm	4.87		
	Span Drift Acceptable	-	Yes		

Test Conditions	Units	Run 1		
Run Ambient Temperature Range	°C	4 - 10		

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	79.77			mg/m³ (STP, dry)
Ration 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	0.33			% of value
Zero drift	0.00			% full scale
Span drift	-1.02			% 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/m³
Standard deviation of repeatability at span level	0.01			mg/m³
Lack of fit	0.39			mg/m³
Drift	-0.47			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	0.09			mg/m³
Losses in the line (leak)	0.00			mg/m³
Uncertainty of calibration gas blending	0.64			mg/m³
Uncertainty of calibration gas	0.92			mg/m³

			RUN 1			Units
Measurement uncertainty		**Result**	79.77			mg/m³
Combined uncertainty			1.66			mg/m³
Expanded uncertainty	k =	1.96	3.26			mg/m³
Uncertainty corrected to std conds. (O_2)			3.69			mg/m³ (REF)

	RUN 1			Units
Expanded uncertainty (no O_2) - at 95% Confidence	4.08			% of Value
Expanded uncertainty (no O_2) - at 95% Confidence	1.63			% 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	6.49			% of Value
Expanded uncertainty (with O_2) - at 95% Confidence	5.37			% at ELV
Overall Allowable uncertainty (with O_2) - at 95% Confidence	11.2			% 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	156		156
Uncertainty	±mg/m³	9.11		9.11
Mass Emission	g/hr	90.3		90.3
Uncertainty	±g/hr	8.68		8.68

General Sampling Information

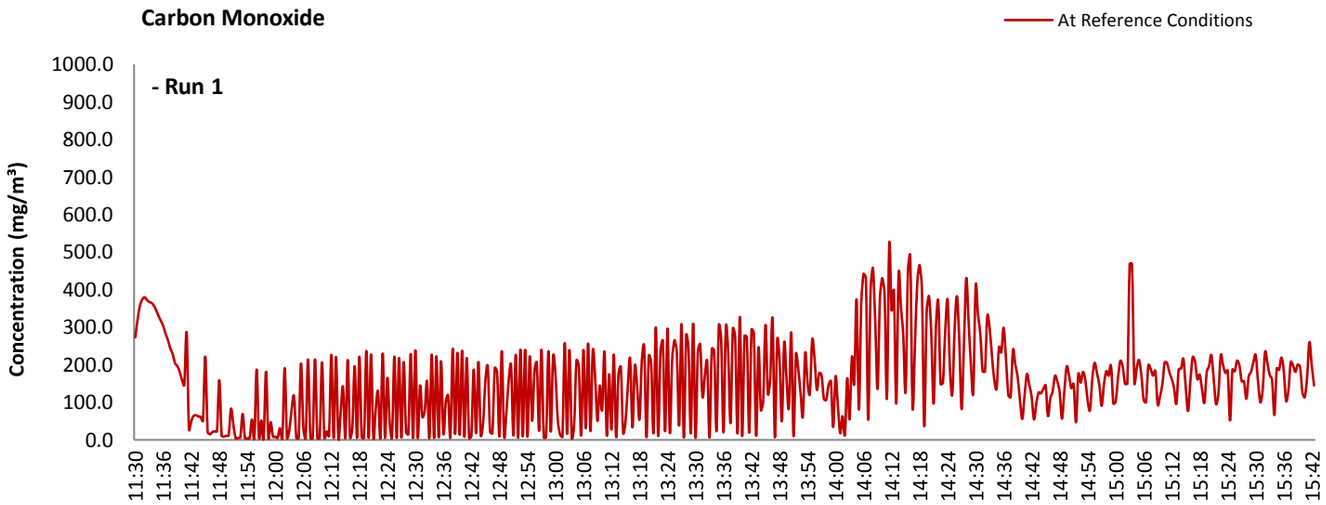
Parameter	Value	
Standard	EN 15058	
Technical Procedure	CAT-TP-39	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Type	Carbon Monoxide	
Span Gas Reference Number	CYL 2.0127	
Span Gas Expiry Date	22/07/2021	
Span Gas Start Pressure (bar)	70	
Gas Cylinder Concentration (ppm)	401.3	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	A2	

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	-	11:30 - 15:42		
Sampling Dates	-	12/03/2018		
Instrument Range	ppm	500		
Span Gas Value	ppm	160.1		

Quality Assurance

Conditioning Unit Temperature	Units	Run 1		
Average Temperature	°C	1.0		
Allowable Temperature	< °C	4.0		
Temperature Acceptable	-	Yes		

	Zero Drift	Units	Run 1		
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.00		
	Zero Down Sampling Line (Post)	ppm	0.40		
	Zero Drift	ppm	0.40		
	Allowable Zero Drift	± ppm	8.01		
	Zero Drift Acceptable	-	Yes		

	Span Drift	Units	Run 1		
CAL 1	Span Down Sampling Line (Pre)	ppm	159.2		
	Span Down Sampling Line (Post)	ppm	159.6		
	Span Drift	ppm	0.40		
	Allowable Span Drift	± ppm	8.01		
	Span Drift Acceptable	-	Yes		

Test Conditions	Units	Run 1		
Run Ambient Temperature Range	°C	4 - 10		

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	137.69			mg/m³ (STP, dry)
Range Used	500.0			ppm
Range Used [A]	624.6			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	0.31			% of value
Zero drift	0.25			% full scale
Span drift	0.25			% 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)	0.56			% 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	0.13			mg/m³
Drift	0.49			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)	0.45			mg/m³
Uncertainty of calibration gas blending	1.11			mg/m³
Uncertainty of calibration gas	1.59			mg/m³

			RUN 1			Units
Measurement uncertainty		**Result**	137.69			mg/m³
Combined uncertainty			2.08			mg/m³
Expanded uncertainty	k =	1.96	4.07			mg/m³
Uncertainty corrected to std conds. (O_2)			4.61			mg/m³ (REF)

	RUN 1			Units
Expanded uncertainty (no O_2) - at 95% Confidence	2.96			% of Value
Expanded uncertainty (no O_2) - at 95% Confidence	2.04			% 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	5.84			% of Value
Expanded uncertainty (with O_2) - at 95% Confidence	5.54			% at ELV
Overall Allowable uncertainty (with O_2) - at 95% Confidence	7.8			% 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

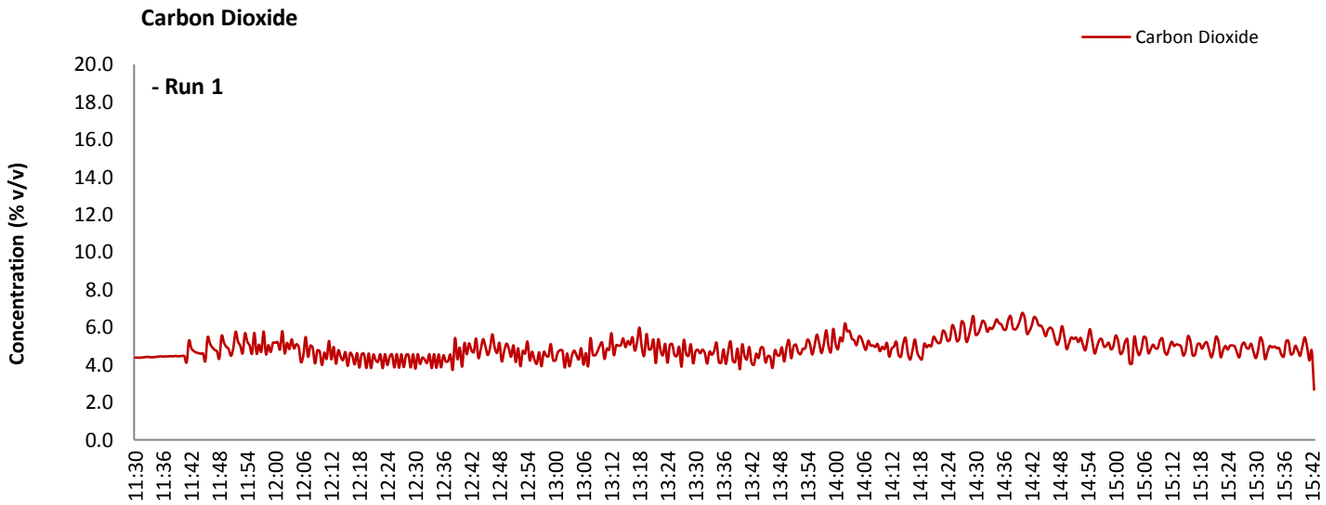
Parameter	Units	Run 1		Mean
Concentration	% v/v	4.89		4.89
Uncertainty	±% v/v	0.19		0.19

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)	170	
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	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A2	

CARBON DIOXIDE: DATA TREND

Graphical Trend of Data



CARBON DIOXIDE: SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1		
Sampling Times	-	11:30 - 15:42		
Sampling Dates	-	12/03/2018		
Instrument Range	% v/v	20.0		
Span Gas Value	% v/v	16.0		

Quality Assurance

Conditioning Unit Temperature	Units	Run 1		
Average Temperature	°C	1.0		
Allowable Temperature	< °C	4.0		
Temperature Acceptable	-	Yes		

	Zero Drift	Units	Run 1		
CAL 1	Zero Down Sampling Line (Pre)	% v/v	0.01		
	Zero Down Sampling Line (Post)	% v/v	0.04		
	Zero Drift	% v/v	0.03		
	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	16.02		
	Span Down Sampling Line (Post)	% v/v	16.16		
	Span Drift	% v/v	0.14		
	Allowable Span Drift	± % v/v	0.80		
	Span Drift Acceptable	-	Yes		

Test Conditions	Units	Run 1		
Run Ambient Temperature Range	°C	4 - 10		

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	4.89			%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	252			-
Repeatability at zero	0.00			% full scale
Repeatability at span level	0.10			% full scale
Deviation from linearity	0.34			% of value
Zero drift	0.19			% full scale
Span drift	0.87			% 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	0.04			%vol
Drift	0.04			%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

			RUN 1			Units
Measurement uncertainty		**Result**	4.89			%vol
Combined uncertainty			0.10			%vol
Expanded uncertainty	k =	1.96	0.19			%vol

	RUN 1			Units
Expanded uncertainty (no O_2) - at 95% Confidence	3.97			% of Value

OXYGEN: RESULTS SUMMARY

Liberty Pressing Solutions Ltd, Coventry
Burn Off Oven Exhaust

Sample Runs

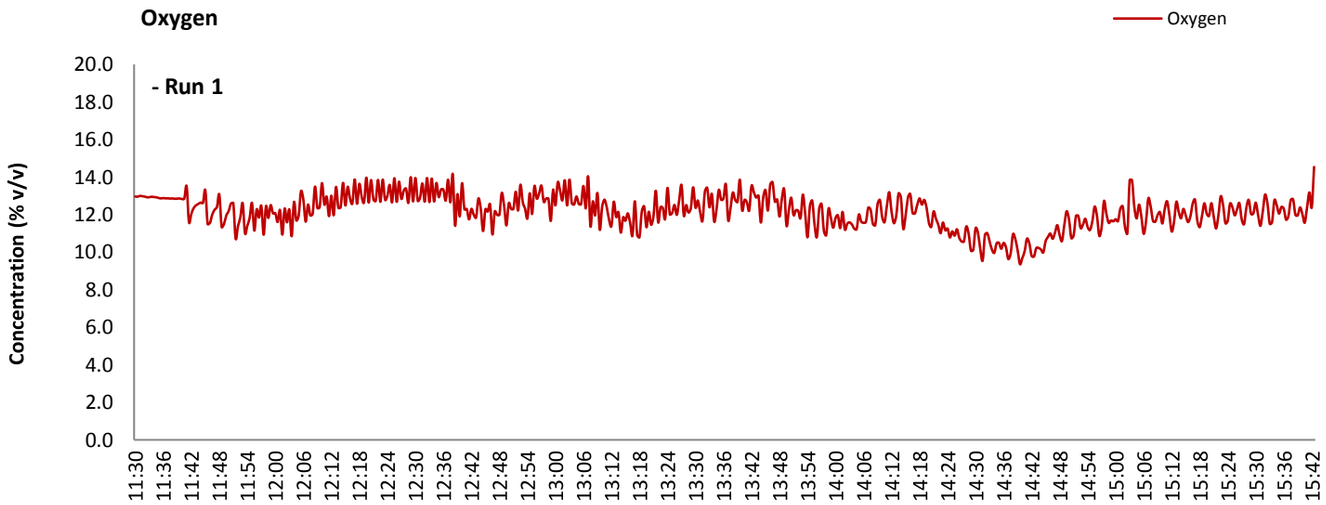
Parameter	Units	Run 1		Mean
Concentration	% v/v	12.2		12.2
Uncertainty	±% v/v	0.61		0.61

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)	40	
Gas Cylinder Concentration (% v/v)	21.16	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	A2	

OXYGEN: DATA TREND

Graphical Trend of Data



OXYGEN: SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1		
Sampling Times	-	11:30 - 15:42		
Sampling Dates	-	12/03/2018		
Instrument Range	% v/v	25.0		
Span Gas Value	% v/v	11.0		

Quality Assurance

Conditioning Unit Temperature	Units	Run 1		
Average Temperature	°C	1.0		
Allowable Temperature	< °C	4.0		
Temperature Acceptable	-	Yes		

	Zero Drift	Units	Run 1		
CAL 1	Zero Down Sampling Line (Pre)	% v/v	0.08		
	Zero Down Sampling Line (Post)	% v/v	-0.13		
	Zero Drift	% v/v	-0.21		
	Allowable Zero Drift	± % v/v	0.55		
	Zero Drift Acceptable	-	Yes		

	Span Drift	Units	Run 1		
CAL 1	Span Down Sampling Line (Pre)	% v/v	11.01		
	Span Down Sampling Line (Post)	% v/v	10.94		
	Span Drift	% v/v	-0.07		
	Allowable Span Drift	± % v/v	0.55		
	Span Drift Acceptable	-	Yes		

Test Conditions	Units	Run 1		
Run Ambient Temperature Range	°C	4 - 10		

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	12.17			%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	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	-1.91			% full scale
Span drift	-0.64			% 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	-0.28			%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**	12.17			%vol
Combined uncertainty			0.31			%vol
Expanded uncertainty	k =	1.96	0.61			%vol

	RUN 1			Units
Expanded uncertainty (no O_2) - at 95% Confidence	5.04			% 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.