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Stack Emissions Testing Report Commissioned by
AGM Services Ltd

Installation Name & Address
Northern Accident Repair Centre
Lester Road
Little Hulton
Walkden
Greater Manchester
M38 0PT

Stack Reference
Spraybooth No.1

Dates of the Monitoring Campaign
11th August 2017

Job Reference Number
CAT-3558

Report Written by
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Report Date
23rd August 2017

Version
Version 1

Signature of Report Approver

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Executive Summary

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MONITORING OBJECTIVES

Northern Accident Repair Centre, Walkden

Spraybooth No.1

11th August 2017

Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by AGM Services Ltd to carry out stack emissions testing for Northern Accident Repair Centre on the Spraybooth No.1 at Walkden.

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

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MONITORING RESULTS

Northern Accident Repair Centre, Walkden

Spraybooth No.1

11th August 2017

where MU = Measurement Uncertainty associated with the Result

Parameter	Concentration				Mass Emission			
	Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Total Particulate Matter	¹ mg/m ³	2.6	0.45	10	g/hr	50.1	8.9	-
Water Vapour	% v/v	0.95	0.06					
Stack Gas Temperature	°C	33.4						
Stack Gas Velocity	m/s	16.6	0.30					
Volumetric Flow Rate (ACTUAL)	m ³ /hr	21070	1025					
Volumetric Flow Rate (REF)	¹ m ³ /hr	19001	924					

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

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

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MONITORING DATE(S) & TIMES

Northern Accident Repair Centre, Walkden
 Spraybooth No.1
 11th August 2017

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m ³	3.2	g/hr	60.5	11/08/2017	10:32 - 10:48, 10:50 - 11:06	32
Total Particulate Matter	R2	mg/m ³	1.5	g/hr	29.2	11/08/2017	11:48 - 12:04, 12:06 - 12:22	32
Total Particulate Matter	R3	mg/m ³	3.2	g/hr	60.7	11/08/2017	13:02 - 13:18, 13:20 - 13:36	32
Velocity & Volumetric Flow Rate	R1					11/08/2017	10:08 - 10:18	

All results are expressed at the respective reference conditions.



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PROCESS DETAILS

Northern Accident Repair Centre, Walkden
Spraybooth No.1
11th August 2017

Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	Full Capacity
Continuous or Batch Process	Batch Process
Feedstock (if applicable)	Cars and Spray Paint
Abatement System	Synthetic Filters
Abatement System Running Status	On
Fuel	N/A
Plume Appearance	None Visible

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MONITORING & ANALYTICAL METHODS

Northern Accident Repair Centre, Walkden

Spraybooth No.1

11th August 2017

Parameter	Monitoring				Analysis				MCERTS Testing	LOD (Average)
	Standard	Technical Procedure	ISO 17025 Testing	Testing Lab	Analytical Procedure	Analytical Technique	ISO 17025 Analysis	Analysis Lab		
Total Particulate Matter	EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.17 mg/m ³
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	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
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SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
All Parameters	All runs	There are no deviations associated with the sampling employed.

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.67
Width	m	-
Area	m ²	0.35
Port Depth	cm	9
Orientation of Duct	-	Vertical
Number of Ports	-	2
Sample Port Size	-	4" BSP

Location of Sampling Platform

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

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	265.0		> 5 Pa	Yes
Mean Velocity	m/s	18.11		-	-
Lowest Gas Velocity	m/s	17.90		-	-
Highest Gas Velocity	m/s	18.54		-	-
Ratio of Above	: 1	1.04		< 3 : 1	Yes
Maximum Angle of Swirl	°	5		< 15°	Yes
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

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PLANT PHOTOS

Photo 1



Photo 2



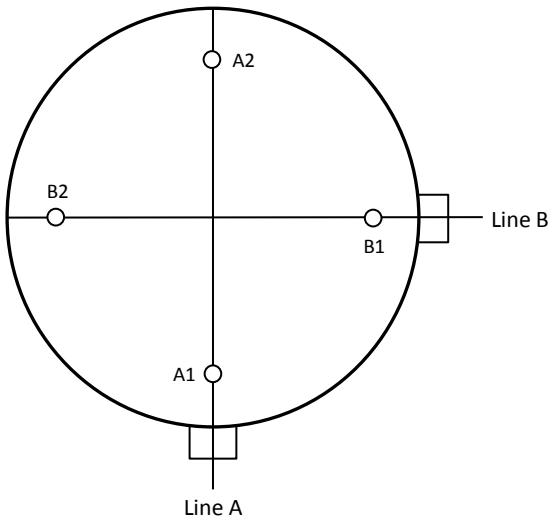
Photo 3



Photo 4



SAMPLE POINTS



- where

○ = isokinetic point sampled at

● = isokinetic point not sampled at

● = combustion gases sample point

● = non-isokinetic sample point



APPENDICES

APPENDIX CONTENTS

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

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Danny Pryke	MCERTS Level 2	MM 03 163	TE1 TE2 TE3 TE4
Technician	Craig Macdonald	MCERTS Level 1	MM 11 1130	None
Trainee	Michael Biagioni	MCERTS Trainee	Number Pending	None

LIST OF EQUIPMENT

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM (1)	CAT 7.47	Horiba PG-250	-	Digital Manometer (1)	CAT 3.119
Control Box DGM (2)	-	Horiba PG-250 SRM	-	Digital Manometer (2)	-
Box Thermocouples (1)	CAT 3.110	Servomex 4900	-	Digital Temperature Meter	CAT 3.119
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.53
Umbilical (1)	CAT 3.110	ABB AO2020-URAS26	-	Barometer	CAT 13.38
Umbilical (2)	-	Testo 350 XL	-	Stack Thermocouple (1)	CAT 4.790
Oven Box (1)	-	JCT JCC P1 Cooler	-	Stack Thermocouple (2)	-
Oven Box (2)	-	ProtiR 204M	-	Stack Thermocouple (3)	-
Heated Probe (1)	CAT 5.113	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	-	Bernath 3006 FID	-	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	-	1m Heated Line (3)	-
S-Pitot (1)	CAT 21P.63	Mass Flow Controller (1)	-	5m Heated Line (1)	-
S-Pitot (2)	CAT 21S.51	Mass Flow Controller (2)	-	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	-	20m Heated Line (1)	-
Site Balance	CAT 17.26	Mass View (2)	-	20m Heated Line (2)	-
500g / 1Kg Check Weights	CAT 17.26	Easylogger EN-EL-12 Bit	-	Dual Channel Heater Controller	-
Last Impinger Arm	-	Hioki 5043 (V)	-	Single Channel Heater Controller	-
Callipers	CAT 23.27	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.41

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
Water Vapour	EN 14790	CAT-TP-05
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	0.67
Stack Width, W	m	-
Stack Area, A	m ²	0.35
Average Stack Gas Temperature, T _a	°C	31.5
Average Stack Gas Pressure	Pa	271.8
Average Stack Static Pressure, P _{static}	kPa	0.055
Average Barometric Pressure, P _b	kPa	102.5
Average Pitot Tube Calibration Coefficient, C _p	-	0.84

Stack Gas Composition & Molecular Weights

Component	Conc ppm	Conc Dry % v/v	Conc Wet % v/v	Volume Fraction r	Molar Mass M	Density kg/m ³ p	Conc kg/m ³ p _i
CO ₂ (Estimated)	-	0.06	0.06	0.0006	44.01	1.9635	0.00118
O ₂ (Estimated)	-	20.80	20.60	0.2080	32.00	1.4277	0.29696
N ₂	-	79.14	78.38	0.7914	28.01	1.2498	0.98913
Moisture (H ₂ O)	-	-	0.95	0.0095	18.02	0.8037	0.00767

Where: $p = M / 22.41$

$p_i = r \times p$

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P _{STD}	kg/m ³	1.287
Wet Density (STP), P _{STW}	kg/m ³	1.283
Dry Density (Actual), P _{Actual}	kg/m ³	1.169
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.164

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

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

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

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

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	31.5	0.0
Total Pressure	kPa	102.6	101.3
Moisture	%	0.95	0.95

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	22988
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	20868
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	20669
Gas Volumetric Flowrate REF ¹	m ³ /hr	20868

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	11/08/2017
Time of Survey	-	10:08 - 10:18
Atmospheric Pressure	kPa	102.5
Average Stack Static Pressure	Pa	55
Result of Pitot Stagnation Test	-	Pass
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with KIMO MP 200 (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	-	2

Sampling Line A							Sampling Line B				
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s	Swirl °	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s	Swirl °
STATIC (Units: Pa)		56.0					53.0				
Mean		267.5	31.3	1.165	17.96		276.0	31.7	1.164	18.25	
1	0.10	270.0	30.4	1.168	18.02	4.0	286.0	30.2	1.169	18.54	4.0
2	0.57	265.0	32.1	1.162	17.90	3.0	266.0	33.1	1.158	17.97	5.0

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

(1 of 1)

Performance characteristics (Uncertainty Components)	Uncertainty	Value	Units
Standard Uncertainty on the coefficient of the Pitot Tube	$u(k)$	0.005	-
Standard Uncertainty associated with the mean local dynamic pressures	$u(\Delta p_i)$	4.519	Pa
- Resolution	$u(res)$	0.00087	
- Calibration	$u(cal)$	7.689	
- Drift	$u(drift)$	0.083	
- Lack of Fit	$u(fit)$	11.645	
- Overall corrections to dynamic measurements	$u(C_f)$	19.418	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00003	-
- $\phi_{O_2,w}$	-	20.601	
- $\phi_{CO_2,w}$	-	0.059	
- Oxygen, dry	$u(\phi_{O_2,d})$	0.637	
- Carbon Dioxide, dry	$u(\phi_{CO_2,d})$	0.002	
- Water Vapour	$u(\phi_{H_2O})$	0.049	
- Oxygen, wet	$u(\phi_{O_2,w})$	0.631	
- Carbon Dioxide, wet	$u(\phi_{CO_2,w})$	0.002	
Standard uncertainty associated with the stack temperature	$u(T_c)$	1.553	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.721	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	3.195	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00627	-
Standard uncertainty associated with the local velocities	$u(v_i)$	0.210	Pa
Standard uncertainty associated with the mean velocity	$u(\bar{v})$	0.165	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	0.322	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	1.78	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV,w)$	1118.1	m ³ /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00062	
- $u^2(qV,w)$	-	325445	
- $u(qV,w)$	-	570.5	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV,w)$	4.86	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

Northern Accident Repair Centre, Walkden
Spraybooth No.1

Sample Runs

Parameter	Units	Run 1	Run 2	Run 3		Mean
Concentration	mg/m ³	3.2	1.5	3.2		2.6
Uncertainty	±mg/m ³	0.46	0.43	0.46		0.45
Mass Emission	g/hr	60.5	29.2	60.7		50.1
Uncertainty	±g/hr	9.2	8.4	9.2		8.9

Parameter	Units	Run 1	Run 2	Run 3		Mean
Water Vapour	% v/v	1.01	0.92	0.94		0.95
Uncertainty	±% v/v	0.06	0.06	0.06		0.06

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.24		0.24

General Sampling Information

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

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

Reference Conditions

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

TOTAL PARTICULATE MATTER: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	Run 2	Run 3	
Absolute pressure of stack gas, P_s					
Barometric pressure, P_b	mmHg	768.8	768.8	768.8	
Stack static pressure, P_{static}	mmH ₂ O	5.7	5.7	5.7	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	769.2	769.2	769.2	
Volume of water vapour collected, V_{wstd}					
Total mass collected in impingers (liquid trap)	g	0.7	4.0	4.3	
Total mass collected in impingers (silica trap)	g	5.9	2.1	1.9	
Total mass of liquid collected, V_{lc}	g	6.6	6.1	6.2	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0082	0.0076	0.0077	
Volume of gas metered dry, V_{mstd}					
Volume of gas sample through gas meter, V_m	m ³	0.8440	0.8600	0.8550	
Gas meter correction factor, Y_d	-	1.0060	1.0060	1.0060	
Average dry gas meter temperature, T_m	°C	19.6	20.6	21.0	
Average pressure drop across orifice, ΔH	mmH ₂ O	83.8	89.3	90.1	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	0.8078	0.8206	0.8148	
Moisture content, B_{wo} & R_{wv}					
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0101	0.0092	0.0094	
B_{wo} as a percentage	% v/v	1.01	0.92	0.94	
Reported Water Vapour, checked with Tables in EN 14790, R_{wv}	% v/v	1.01	0.92	0.94	
Volume of gas metered wet, V_{mstw}					
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	0.8160	0.8282	0.8226	
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	No	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	N/A	N/A	N/A	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	N/A	N/A	N/A	
% oxygen reference condition, REF%O ₂	% v/v	N/A	N/A	N/A	
O ₂ Reference Factor wet ($O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$)	-	N/A	N/A	N/A	
O ₂ Reference Factor dry ($O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$)	-	N/A	N/A	N/A	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m ³	N/A	N/A	N/A	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m ³	N/A	N/A	N/A	
Molecular weight of dry gas stream, M_d					
CO ₂ (Estimated)	% v/v	0.06	0.06	0.06	
O ₂ (Estimated)	% v/v	20.80	20.80	20.80	
Total	% v/v	20.86	20.86	20.86	
N ₂	% v/v	79.14	79.14	79.14	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	28.84	28.84	28.84	
Molecular weight of stack gas (wet), M_s					
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.73	28.74	28.74	
Velocity of stack gas, V_s					
Pitot tube velocity constant, K_p	-	34.97	34.97	34.97	
Velocity pressure coefficient, C_p	-	0.84	0.84	0.84	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	22.13	23.38	23.63	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	4.70	4.83	4.86	
Average stack gas temperature, T_s	°C	34.1	32.6	33.4	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s + 273})) / (V(M_s)(P_s))$	m/s	16.29	16.70	16.81	
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	0.35	0.35	0.35	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	344.6	353.3	355.6	
Conversion factor ($K/mm.Hg$), C_f	-	0.3592	0.3592	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	310.0	319.4	320.7	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	306.9	316.4	317.7	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m ³ /min	N/A	N/A	N/A	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m ³ /min	N/A	N/A	N/A	
Percent isokinetic, %I					
Nozzle diameter, D_n	mm	5.90	5.90	5.90	
Nozzle area, A_n	mm ²	27.37	27.37	27.37	
Total sampling time, q	min	32	32	32	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	106.0	104.4	103.2	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	Run 2	Run 3	
Sampling Times	-	10:32 - 10:48, 10:50 - 11:06	11:48 - 12:04, 12:06 - 12:22	13:02 - 13:18, 13:20 - 13:36	
Sampling Dates	-	11/08/2017	11/08/2017	11/08/2017	
Sampling Device	-	ISO	ISO	ISO	
Volume Sampled (REF)	m ³	0.8160	0.8282	0.8226	
Filter I.D. Number	-	47-43974	47-43775	47-44609	
Start Filter Mass	g	0.15676	0.15621	0.15359	
End Filter Mass	g	0.15724	0.15686	0.15552	
Total Mass on Filter	g	0.00048	0.00065	0.00193	
Probe Rinse I.D. Number	-	PR-47-43974	PR-47-43775	PR-47-44609	
Start Probe Rinse Mass	g	3.09995	2.87978	2.99218	
End Probe Rinse Mass	g	3.10207	2.88040	2.99288	
Total Mass in Probe Rinse	g	0.00212	0.00063	0.00070	
Total Mass Collected	mg	2.60	1.27	2.63	
Calculated Concentration	mg/m ³	3.18	1.54	3.19	
Balance Uncertainty / LOD	mg/m ³	0.17	0.17	0.17	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	11/08/2017	
Average Volume Sampled (REF)	m ³	0.8223	
Filter I.D. Number	-	47-44478	
Start Filter Mass	g	0.15118	
End Filter Mass	g	0.15136	
Total Mass on Filter	g	0.00018	
Probe Rinse I.D. Number	-	PR-47-44478	
Start Probe Rinse Mass	g	3.00374	
End Probe Rinse Mass	g	3.00376	
Total Mass in Probe Rinse	g	0.00002	
Total Mass Collected	mg	0.20	
Calculated Concentration	mg/m ³	0.24	
Balance Uncertainty / LOD	mg/m ³	0.17	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

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Sample Runs

Leak Test Results	Units	Run 1	Run 2	Run 3	
Mean Sampling Rate	l/min	26.53	27.04	26.88	
Pre-Sampling Leak Rate	l/min	0.12	0.14	0.13	
Post-Sampling Leak Rate	l/min	0.13	0.14	0.13	
Allowable Leak Rate	l/min	0.53	0.54	0.54	
Leak Test Acceptable	-	Yes	Yes	Yes	
Water Droplets	Units	Run 1	Run 2	Run 3	
Are Water Droplets Present	-	No	No	No	
MU (Concurrent Water Vapour)	Units	Run 1	Run 2	Run 3	
Measurement Uncertainty (MU)	%	6.3	6.5	6.4	
Allowable MU	%	20	20	20	
MU Acceptable	%	Yes	Yes	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	Run 2	Run 3	
Less than 50% Faded	%	Yes	Yes	Yes	
Isokinetic Criterion Compliance	Units	Run 1	Run 2	Run 3	
Isokinetic Variation	%	106.0	104.4	103.2	
Allowable Isokinetic Range	%	95 - 115	95 - 115	95 - 115	
Isokineticity Acceptable	-	Yes	Yes	Yes	
Weighing Uncertainty Criteria	Units	Run 1	Run 2	Run 3	
Overall Weighing Uncertainty	± mg	0.25	0.25	0.25	
Overall Weighing Uncertainty	± mg/m ³	0.31	0.30	0.31	
ELV [Daily ELV for IED]	mg/m ³	10.00	10.00	10.00	
Allowable Weighing Uncertainty	mg/m ³	0.50	0.50	0.50	
Weighing Uncertainty Acceptable	-	Yes	Yes	Yes	
Filter Temperatures	Units	Run 1	Run 2	Run 3	
Pre-Conditioning Temperature	°C	180	180	180	
Post-Conditioning Temperature	°C	160	160	160	
Maximum Filter Temperature	°C	36	35	34	
Test Conditions	Units	Run 1	Run 2	Run 3	
Ambient Temperature Recorded?	-	Yes	Yes	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

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Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	25.00	
Pre-Sampling Leak Rate	l/min	0.12	
Post-Sampling Leak Rate	l/min	0.14	
Allowable Leak Rate	l/min	0.50	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
Blank Acceptable	-	Yes	

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

Method Deviations

Nature of Deviation	Run Number			
	1	2	3	
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)				
There are no deviations associated with the sampling employed.	wx	wx	wx	

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value					Symbol	Standard uncertainty				
	Symbol	Run 1	Run 2	Run 3			Units	Run 1	Run 2	Run 3	
Sampled Volume (Actual)	V _m	0.8440	0.8600	0.8550		uV _m	m ³	0.0169	0.0172	0.0171	
Sampled Gas Temperature	T _m	292.6	293.6	294.0		uT _m	K	2.0	2.0	2.0	
Sampled Gas Pressure	p _m	102.6	102.6	102.6		uP _m	kPa	0.5	0.5	0.5	
Sampled Gas Humidity	H _m	0.0	0.0	0.0		uH _m	% v/v	1.0	1.0	1.0	
Leak	L	0.49	0.52	0.48		uL	%	-	-	-	
Mass of Particulate	m	2.60	1.27	2.63		um	mg	0.14	0.14	0.14	
Uncollected Mass	UCM	0.20	0.20	0.20		uUCM	mg	-	-	-	

Measured Quantities	Uncertainty as a Percentage					Requirement of Standard
	Units	Run 1	Run 2	Run 3		
Sampled Volume (Actual)	%	2.00	2.00	2.00		≤2%
Sampled Gas Temperature	%	0.68	0.68	0.68		≤1%
Sampled Gas Pressure	%	0.49	0.49	0.49		≤1%
Sampled Gas Humidity	%	1.00	1.00	1.00		≤1%
Leak	%	0.49	0.52	0.48		≤2%
Mass of Particulate	%	1.72	1.69	1.70		<5% of ELV
Uncollected Mass	%	-	-	-		-

Measured Quantities	Uncertainty in Measurement Units					Symbol	Sensitivity Coefficient			
	Units	Run 1	Run 2	Run 3			Run 1	Run 2	Run 3	
Sampled Volume (STP)	V _m	m ³	0.8078	0.8206	0.8148		3.94	1.87	3.92	
Leak	L	mg/m ³	0.009	0.005	0.009		1.00	1.00	1.00	
Mass of Particulate	L _r	mg	2.597	1.273	2.627		1.23	1.21	1.22	
Uncollected Mass	UCM	mg	0.11	0.11	0.11		1.23	1.21	1.22	

Measured Quantities	Uncertainty in Result			
	Units	Run 1	Run 2	Run 3
Sampled Volume (STP)	mg/m ³	0.078	0.038	0.079
Leak	mg/m ³	0.0090	0.0046	0.0089
Mass of Particulate	mg/m ³	0.1716	0.1690	0.1702
Uncollected Mass	mg/m ³	0.1391	0.1371	0.1380

Measured Quantities	Oxygen Correction Part of MU Budget			
	Units	Run 1	Run 2	Run 3
O ₂ Correction Factor	-	N/A	N/A	N/A
Stack Gas O ₂ Content	% v/v	N/A	N/A	N/A
MU for O ₂ Correction	-	N/A	N/A	N/A
Overall MU For O ₂ Measurement	%	N/A	N/A	N/A

Parameter	Units	Run 1	Run 2	Run 3
Combined uncertainty	mg/m ³	0.23	0.22	0.23
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m ³	0.46	0.43	0.46
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m ³	N/A	N/A	N/A
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m ³	0.46	0.43	0.46
Reported Uncertainty	mg/m ³	0.46	0.43	0.46
Expanded uncertainty (95% confidence), without Oxygen Correction	%	14.4	28.2	14.3
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	N/A	N/A
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	14.4	28.2	14.3
Reported Uncertainty	%	14.4	28.2	14.3