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Stack Emissions Testing Report Commissioned by
Alan Nuttall Partnership Ltd

Installation Name & Address
Alan Nuttall Partnership Ltd
National Works
Hall Street
Dudley
West Midlands
DY2 7DQ

PPC Permit: PB/23 Dudley MBC

Stack Reference
Wet Spray Booth

Dates of the Monitoring Campaign
12th October 2017

Job Reference Number
CAT-3673

Report Written by
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Report Date
8th November 2017

Version
Version 1

Signature of Report Approver

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Executive Summary

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MONITORING OBJECTIVES

Alan Nuttall Partnership Ltd, West Midlands

Wet Spray Booth

12th October 2017

Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by Alan Nuttall Partnership Ltd to carry out stack emissions testing on the Wet Spray Booth at West Midlands .

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

Executive Summary

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MONITORING RESULTS

Alan Nuttall Partnership Ltd, West Midlands

Wet Spray Booth

12th October 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	0.55	0.56	50	g/hr	7.8	7.9	-
Water Vapour	% v/v	0.48	0.04					
Stack Gas Temperature	°C	20.0						
Stack Gas Velocity	m/s	8.6	0.15					
Volumetric Flow Rate (ACTUAL)	m ³ /hr	15551	753					
Volumetric Flow Rate (REF) ¹	m ³ /hr	14178	686					

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.

Executive Summary

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MONITORING DATE(S) & TIMES

Alan Nuttall Partnership Ltd, West Midlands
Wet Spray Booth
12th October 2017

Parameter	Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins	
Total Particulate Matter	R1	mg/m ³	0.55	g/hr	7.8	12/10/2017	12:51 - 13:31	40
Velocity & Volumetric Flow Rate	R1					12/10/2017	11:39 - 12:00	

All results are expressed at the respective reference conditions.

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PROCESS DETAILS

Alan Nuttall Partnership Ltd, West Midlands
Wet Spray Booth
12th October 2017

Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	Full Capacity
Continuous or Batch Process	Batch
Feedstock (if applicable)	Wooden Parts
Abatement System	Fabric Filter
Abatement System Running Status	On
Fuel	N/A
Plume Appearance	None Visible

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MONITORING & ANALYTICAL METHODS

Alan Nuttall Partnership Ltd, West Midlands
Wet Spray Booth
12th October 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	0.15 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
Total Particulate Matter	All Runs	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

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.80
Width	m	-
Area	m ²	0.50
Port Depth	cm	0
Orientation of Duct	-	Vertical
Number of Ports	-	1
Sample Port Size	-	Hole

Location of Sampling Platform

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

Platform Details

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

Sampling Location / Platform Improvement Recommendations

All platforms should be designed in accordance with the requirements in the Environment Agency's Technical Guidance Note M1 and EN 15259.

EN 15259 Homogeneity Test Requirements

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

Sampling Plane Validation Criteria (from EN 15259)

Criteria in EN 15259	Units	Traverse 1	Required	Compliant
Lowest Differential Pressure	Pa	43.3	> 5 Pa	Yes
Mean Velocity	m/s	8.26	-	-
Lowest Gas Velocity	m/s	7.13	-	-
Highest Gas Velocity	m/s	9.00	-	-
Ratio of Above	: 1	1.26	< 3 : 1	Yes
Maximum Angle of Swirl	°	4	< 15°	Yes
No Local Negative Flow	-	Yes	-	Yes

Executive Summary

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PLANT PHOTOS

Photo 1



Photo 2



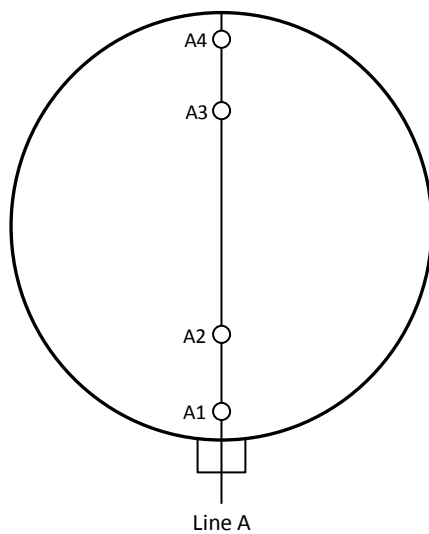
Photo 3



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	David Burns	MCERTS Level 2	MM 05 579	TE1 TE2 TE3 TE4
Technician	Bill Trueman	MCERTS Level 1	MM 06 753	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 7.58	Horiba PG-350E	-	Digital Manometer (1)	CAT 3.143
Control Box DGM (2)	-	Horiba PG-250	-	Digital Manometer (2)	CAT 3.145
Box Thermocouples (1)	CAT 3.148	Servomex 4900	-	Digital Temperature Meter	-
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.86
Umbilical (1)	CAT 3.148	ABB AO2020-URAS26	-	Barometer	CAT 13.41
Umbilical (2)	-	Servomex 5200MP	-	Stack Thermocouple (1)	-
Oven Box (1)	-	Ankersmid APS 313	-	Stack Thermocouple (2)	CAT 4.849
Oven Box (2)	-	Gasmet DX4000	-	Stack Thermocouple (3)	-
Heated Probe (1)	-	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	CAT 5.130	Bernath 3006 FID	-	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	-	1m Heated Line (3)	-
S-Pitot (1)	CAT 21P.97	Mass Flow Controller (1)	-	5m Heated Line (1)	-
S-Pitot (2)	CAT 21S.56	Mass Flow Controller (2)	-	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	-	20m Heated Line (1)	-
Site Balance	CAT 17.38	Mass View (2)	-	20m Heated Line (2)	-
500g / 1Kg Check Weights	CAT 17.38	Hioki 5043 (V)	-	Dual Channel Heater Controller	-
Last Impinger Arm	-	Easylogger EN-EL-12 Bit	-	Single Channel Heater Controller	-
Callipers	CAT 23.41	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	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
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	0.80
Stack Width, W	m	-
Stack Area, A	m ²	0.50
Average Stack Gas Temperature, T _a	°C	20.0
Average Stack Gas Pressure	Pa	58.6
Average Stack Static Pressure, P _{static}	kPa	0.060
Average Barometric Pressure, P _b	kPa	99.1
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/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	20.70	0.2080	32.00	1.4277	0.29696
N ₂	-	79.14	78.76	0.7914	28.01	1.2498	0.98913
Moisture (H ₂ O)	-	-	0.48	0.0048	18.02	0.8037	0.00383

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	1.285
Dry Density (Actual), P _{Actual}	kg/m ³	1.174
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.172

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	20.0	0.0
Total Pressure	kPa	99.2	101.3
Moisture	%	0.48	0.48

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	14948
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	13633
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	13568
Gas Volumetric Flowrate REF ¹	m ³ /hr	13633

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	12/10/2017
Time of Survey	-	11:39 - 12:00
Atmospheric Pressure	kPa	99.1
Average Stack Static Pressure	Pa	60
Result of Pitot Stagnation Test	-	Pass
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with KIMO MP 210 (500Pa)	

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

Sampling Line A

Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s	Swirl °
<i>STATIC (Units: Pa)</i>		60.0				
Mean		58.6	20.0	1.172	8.26	
1	0.05	43.3	20.0	1.172	7.13	2.0
2	0.20	56.0	20.0	1.172	8.11	4.0
3	0.60	69.0	20.0	1.172	9.00	4.0
4	0.75	66.0	20.0	1.172	8.80	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	$u(\Delta p_i)$	1.234	Pa
- Resolution	$u(res)$	0.00087	
- Calibration	$u(cal)$	0.357	
- Drift	$u(drift)$	0.083	
- Lack of Fit	$u(fit)$	0.081	
- Overall corrections to dynamic measurements	$u(C_f)$	0.522	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00003	-
- $\varphi_{O_2,w}$	-	20.701	
- $\varphi_{CO_2,w}$	-	0.060	
- Oxygen, dry	$u(\phi_{O_2,d})$	0.637	
- Carbon Dioxide, dry	$u(\phi_{CO_2,d})$	0.002	
- Water Vapour	$u(\phi_{H_2O})$	0.024	
- Oxygen, wet	$u(\phi_{O_2,w})$	0.634	
- Carbon Dioxide, wet	$u(\phi_{CO_2,w})$	0.002	
Standard uncertainty associated with the stack temperature	$u(T_c)$	1.495	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.696	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	1.234	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00633	-
Standard uncertainty associated with the local velocities	$u(v_i)$	0.106	Pa
Standard uncertainty associated with the mean velocity	$u(\underline{v})$	0.072	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	0.142	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	1.72	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV,w)$	723.7	m ³ /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00061	
- $u^2(qV,w)$	-	136340	
- $u(qV,w)$	-	369.2	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV,w)$	4.84	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

Alan Nuttall Partnership Ltd, West Midlands
Wet Spray Booth

Sample Runs

Parameter	Units	Run 1	Mean
Concentration	mg/m ³	0.55	0.55
Uncertainty	±mg/m ³	0.56	0.56
Mass Emission	g/hr	7.8	7.8
Uncertainty	±g/hr	7.9	7.9

Parameter	Units	Run 1	Mean
Water Vapour	% v/v	0.48	0.48
Uncertainty	±% v/v	0.04	0.04

Blank Runs

Parameter	Units	Blank 1	Maximum
Concentration	mg/m ³	0.42	0.42

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	1 / 2
Number of Sampling Points Used	4 / 4
Sample Point I.D.'s	A1, A2, A3, A4

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	
Absolute pressure of stack gas, P_s			
Barometric pressure, P _b	mmHg	743.3	
Stack static pressure, P _{static}	mmH ₂ O	6.1	
P _s = (P _b + (P _{static} / 13.6))	mmHg	743.7	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	2.4	
Total mass collected in impingers (silica trap)	g	1.2	
Total mass of liquid collected, V _{lc}	g	3.6	
V _{wstd} = (0.001246)(V _{lc})	m ³	0.0045	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V _m	m ³	1.0190	
Gas meter correction factor, Y _d	-	1.0030	
Average dry gas meter temperature, T _m	°C	20.6	
Average pressure drop across orifice, ΔH	mmH ₂ O	72.8	
V _{mstd} = ((0.3592)(V _m)(P _b + (ΔH/13.6))(Y _d)) / (T _m + 273)	m ³	0.9360	
Moisture content, B_{wv} & R_{wv}			
B _{wv} = V _{wstd} / (V _{mstd} + V _{wstd})	m ³	0.0048	
B _{wv} as a percentage	% v/v	0.48	
Reported Water Vapour, checked with Tables in EN 14790, R _{wv}	% v/v	0.48	
Volume of gas metered wet, V_{mstw}			
V _{mstw} = (V _{mstd})(100/(100 - R _{wv}))	m ³	0.9405	
Volume of gas metered at Oxygen Reference Conditions, V_{mstd@X%O₂} & V_{mstw@X%O₂}			
IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction)	-	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	N/A	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	N/A	
% oxygen reference condition, REF%O ₂	% v/v	N/A	
O ₂ Reference Factor wet (O _{2REFw}) = (21 - REF%O ₂) / (21 - ACT%O _{2w})	-	N/A	
O ₂ Reference Factor dry (O _{2REFd}) = (21 - REF%O ₂) / (21 - ACT%O _{2d})	-	N/A	
V _{mstw@X%oxygen} = (V _{mstw}) / (O _{2REFw})	m ³	N/A	
V _{mstd@X%oxygen} = (V _{mstd}) / (O _{2REFd})	m ³	N/A	
Molecular weight of dry gas stream, M_d			
CO ₂ (Estimated)	% v/v	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
M _d = 0.44(%CO ₂)+0.32(%O ₂)+0.28(%N ₂)	g/gmol	28.84	
Molecular weight of stack gas (wet), M_s			
M _s = M _d (1 - (R _{wv} /100)) + 18(R _{wv} /100)	g/gmol	28.79	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K _p	-	34.97	
Velocity pressure coefficient, C _p	-	0.84	
Average of velocity heads, ΔP _{avg}	mmH ₂ O	6.19	
Average square root of velocity heads, √ΔP	√mmH ₂ O	2.49	
Average stack gas temperature, T _s	°C	20.0	
V _s = ((K _p)(C _p)(√ΔP)(√T _s + 273)) / (√(M _s)(P _s))	m/s	8.59	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO₂}), Dry@O_{2REF} (Q_{stdO₂})			
Area of stack, A _s	m ²	0.50	
Q _a = (60)(A _s)(V _s)	m ³ /min	259.2	
Conversion factor (K/mm.Hg), C _f	-	0.3592	
Q _{stw} = ((Q _a)(P _s)(C _f)) / ((T _s + 273)	m ³ /min	236.3	
Q _{std} = ((Q _a)(P _s)(C _f)(1 - (R _{wv} /100))) / ((T _s + 273)	m ³ /min	235.2	
Q _{stwO₂} = ((Q _a)(P _s)(C _f)) / ((T _s + 273) / (O _{2REFw}))	m ³ /min	N/A	
Q _{stdO₂} = ((Q _a)(P _s)(C _f)(1 - (R _{wv} /100))) / ((T _s + 273) / (O _{2REFd}))	m ³ /min	N/A	
Percent isokinetic, %I			
Nozzle diameter, D _n	mm	7.95	
Nozzle area, A _n	mm ²	49.65	
Total sampling time, q	min	40	
%I = (4.6398E ⁶)(T _s +273)(V _{mstd}) / (P _s)(V _s)(A _n)(q)(1 - (R _{wv} /100))	%	100.8	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1
Sampling Times	-	12:51 - 13:31
Sampling Dates	-	12/10/2017
Sampling Device	-	ISO
Volume Sampled (REF)	m ³	0.9405
Filter I.D. Number	-	47-42640
Start Filter Mass	g	0.15550
End Filter Mass	g	0.15571
Total Mass on Filter	g	0.00021
Probe Rinse I.D. Number	-	PR-47-42640
Start Probe Rinse Mass	g	2.72522
End Probe Rinse Mass	g	2.72554
Total Mass in Probe Rinse	g	0.00031
Total Mass Collected	mg	0.52
Calculated Concentration	mg/m ³	0.55
Balance Uncertainty / LOD	mg/m ³	0.15

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1
Blank Dates	-	12/10/2017
Average Volume Sampled (REF)	m ³	0.9405
Filter I.D. Number	-	47-42639
Start Filter Mass	g	0.15563
End Filter Mass	g	0.15573
Total Mass on Filter	g	0.00010
Probe Rinse I.D. Number	-	PR-47-42639
Start Probe Rinse Mass	g	2.92771
End Probe Rinse Mass	g	2.92801
Total Mass in Probe Rinse	g	0.00030
Total Mass Collected	mg	0.40
Calculated Concentration	mg/m ³	0.42
Balance Uncertainty / LOD	mg/m ³	0.15

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

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Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	25.55	
Pre-Sampling Leak Rate	l/min	0.00	
Post-Sampling Leak Rate	l/min	0.00	
Allowable Leak Rate	l/min	0.51	
Leak Test Acceptable	-	Yes	

Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	

MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	7.9	
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	%	100.8	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	

Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.25	
Overall Weighing Uncertainty	± mg/m ³	0.27	
ELV [Daily ELV for IED]	mg/m ³	50.00	
Allowable Weighing Uncertainty	mg/m ³	2.50	
Weighing Uncertainty Acceptable	-	Yes	

Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	20	

Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

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Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	20.00	
Pre-Sampling Leak Rate	l/min	0.00	
Post-Sampling Leak Rate	l/min	0.00	
Allowable Leak Rate	l/min	0.40	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	5.0	
Blank Acceptable	-	Yes	

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

Method Deviations

Nature of Deviation	Run Number
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	1
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	x

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V _m	1.0190		uV _m	m ³	0.0204	
Sampled Gas Temperature	T _m	293.6		uT _m	K	2.0	
Sampled Gas Pressure	p _m	99.2		up _m	kPa	0.5	
Sampled Gas Humidity	H _m	0.0		uH _m	% v/v	1.0	
Leak	L	0.00		uL	%	-	
Mass of Particulate	m	0.52		um	mg	0.14	
Uncollected Mass	UCM	0.40		uUCM	mg	-	

Measured Quantities	Uncertainty as a Percentage			Requirement of Standard
	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.68		≤1%
Sampled Gas Pressure	%	0.50		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	0.00		≤2%
Mass of Particulate	%	0.30		<5% of ELV
Uncollected Mass	%	-		-

Measured Quantities	Uncertainty in Measurement Units				Sensitivity Coefficient	
	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	V _m	m ³	0.9360		0.59	
Leak	L	mg/m ³	0.000		1.00	
Mass of Particulate	L _r	mg	0.520		1.06	
Uncollected Mass	UCM	mg	0.23		1.06	

Measured Quantities	Uncertainty in Result		
	Units	Run 1	
Sampled Volume (STP)	mg/m ³	0.014	
Leak	mg/m ³	0.0000	
Mass of Particulate	mg/m ³	0.1489	
Uncollected Mass	mg/m ³	0.2435	

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

Parameter	Units	Run 1	
Combined uncertainty	mg/m ³	0.29	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m ³	0.56	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m ³	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m ³	0.56	
Reported Uncertainty	mg/m ³	0.56	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	101.3	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	101.3	
Reported Uncertainty	%	101.3	