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Your Element Contact: Paul Martin (07827 332 630)
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Stack Emissions Testing Report Commissioned by
Sundown Products Ltd

Installation Name & Address
Sundown Products Ltd
Chipping Plant
Station Road
Tilbrook
Huntingdon
PE28 3PA

PPC Permit: B02/06

Stack Reference
S2 - Cooler Plant

Dates of the Monitoring Campaign
4th July 2019

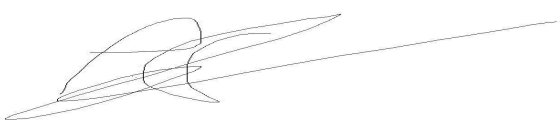
Job Reference Number
ELU-0319

Report Written by
Neil Teixeira Team Leader MCERTS Level 2 MM 05 583 TE1 TE2 TE3 TE4

Report Approved by
Phil Soley Deputy Regional Manager MCERTS Level 2 MM 12 1187 TE1 TE2 TE3 TE4

Report Date
16th September 2019

Version
Version 2

Signature of Report Approver


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

This version of the test report supersedes the previous version of the test report. Please destroy all previous versions to ensure no confusion arises from having multiple test reports in existence.

MONITORING OBJECTIVES

Sundown Products Ltd, Tilbrook
S2 - Cooler Plant
4th July 2019

Overall Aim of the Monitoring Campaign

Element were commissioned by Sundown Products Ltd to carry out stack emissions testing on the S2 - Cooler Plant at Tilbrook.

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

MONITORING RESULTS

Sundown Products Ltd, Tilbrook
S2 - Cooler Plant
4th July 2019

where MU = Measurement Uncertainty associated with the Result

	Concentration				Mass Emission			
Parameter	**Units**	**Result**	**MU +/-**	**Limit**	**Units**	**Result**	**MU +/-**	**Limit**
Total Particulate Matter [1]	mg/m³	26.6	2.7	150	g/hr	671	74.9	-
Water Vapour	% v/v	0.50	0.058					
Stack Gas Temperature	°C	31.9						
Stack Gas Velocity	m/s	10.0	0.14					
Volumetric Flow Rate (ACTUAL)	m³/hr	28236	1341					
Volumetric Flow Rate (REF) [1]	m³/hr	25267	1200					

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

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

Executive Summary

MONITORING DATE(S) & TIMES

Sundown Products Ltd, Tilbrook
S2 - Cooler Plant
4th July 2019

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	26.6	g/hr	671	04/07/2019	14:00 - 14:32	32
Velocity Traverse	R1					04/07/2019	13:35 - 13:55	

All results are expressed at the respective reference conditions.

PROCESS DETAILS

Sundown Products Ltd, Tilbrook
S2 - Cooler Plant
4th July 2019

Standard Operating Conditions

Parameter	Value
Process Status	Operational
Capacity (of 100%) and Tonnes / Hour	-
Continuous or Batch Process	Continuous Batch
Feedstock (if applicable)	Animal Bedding
Abatement System	Cyclone
Abatement System Running Status	Operational
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

MONITORING & ANALYTICAL METHODS

Sundown Products Ltd, Tilbrook
S2 - Cooler Plant
4th July 2019

	Monitoring				Analysis					
Parameter	**Standard**	**Technical Procedure**	**ISO 17025 Testing**	**Testing Lab**	**Analytical Procedure**	**Analytical Technique**	**ISO 17025 Analysis**	**Analysis Lab**	**MCERTS Testing**	**LOD (Average)**
Total Particulate Matter	EN 13284-1	CAT-TP-01	Yes	EET	CAT-TP-03	Gravimetric	Yes	EET	Yes	0.3 mg/m³
Water Vapour	EN 14790	CAT-TP-05	Yes	EET	CAT-TP-05	Gravimetric	Yes	EET	Yes	0.1 % v/v
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	Yes	EET	Pitot Tube and Thermocouple				Yes	1.2 m/s

ANALYSIS LABORATORIES

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

Element Stockport (EET)	ISO 17025 Accreditation Number: 4279

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter	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
		The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	1.00
Width	m	-
Area	m^2	0.79
Port Depth	cm	10
Orientation of Duct	-	Vertical
Number of Ports	-	1
Sample Port Size	-	4" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	Permanent
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	No
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	No
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)

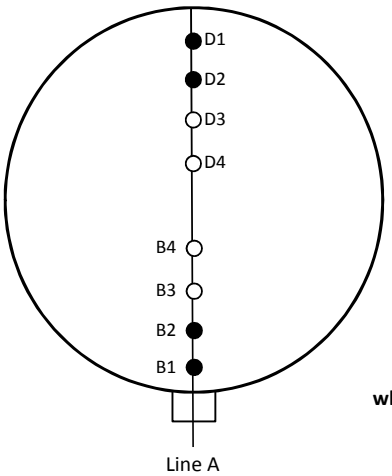
Criteria in EN 15259	Units	Traverse 1	Required	Compliant
Lowest Differential Pressure	Pa	22.0	> 5 Pa	Yes
Mean Velocity	m/s	9.99	-	-
Lowest Gas Velocity	m/s	5.26	-	-
Highest Gas Velocity	m/s	13.97	-	-
Ratio of Above	: 1	2.65	< 3 : 1	Yes
Maximum Angle of Swirl	°	46.00	< 15°	No
No Local Negative Flow	-	Yes	-	Yes

PLANT PHOTOS

Photo 1

Photo 2

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	Neil Teixeira	MCERTS Level 2	MM 05 583	TE1 TE2 TE3 TE4
Trainee	Dan Croxford	MCERTS Trainee	MM 19 1539	None

LIST OF EQUIPMENT

Extractive Sampling	
Equipment Type	**Equipment I.D.**
Control Box DGM (1)	CAT 7.101
Control Box DGM (2)	-
Box Thermocouples (1)	CAT 3.205
Box Thermocouples (2)	-
Umbilical (1)	CAT 3.205
Umbilical (2)	-
Oven Box (1)	-
Oven Box (2)	-
Heated Probe (1)	-
Heated Probe (2)	CAT 5.111
Heated Probe (3)	-
S-Pitot (1)	CAT 21p166
S-Pitot (2)	CAT 21S.68
L-Pitot	-
Site Balance	CAT 17.59
500g / 1Kg Check Weights	CAT 17.59
Last Impinger Arm	-
Callipers	-
Tubes Kit Thermocouple	-

Instrumental Analysers	
Equipment Type	**Equipment I.D.**
Horiba PG-250	-
Horiba PG-250	-
Servomex 4900	-
Eco Physics CLD 822Mh	-
ABB AO2020-URAS26	-
Servomex 5200MP	-
JCT JCC P1 Cooler	-
Gasmet DX4000	-
Gasmet Sampling System	-
Bernath 3006 FID	-
M&C PSS	-
Mass Flow Controller (1)	-
Mass Flow Controller (2)	-
Mass View (1)	-
Mass View (2)	-
Hioki 5043 (V)	-
Hioki 5043 (V)	-
Bioaerosols Temperature Logger	-
Electronic Refrigerator	-

Miscellaneous Items	
Equipment Type	**Equipment I.D.**
Digital Manometer (1)	CAT 3.232
Digital Manometer (2)	-
Digital Temperature Meter	CAT 3.232
Stopwatch	CAT 14.53
Barometer	CAT 13.51
Stack Thermocouple (1)	-
Stack Thermocouple (2)	CAT 4.1164
Stack Thermocouple (3)	-
2m Heated Line (1) (P&G)	-
1m Heated Line (2)	-
1m Heated Line (3)	-
5m Heated Line (1)	-
10m Heated Line (1)	-
20m Heated Line (1)	-
20m Heated Line (2)	-
Dual Channel Heater Controller	-
Single Channel Heater Controller	-
Laboratory Balance	CAT 1.18, 1.18a, 1.18b
Tape Measure	CAT 16.55

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	1.00
Stack Width, W	m	-
Stack Area, A	m^2	0.79
Average Stack Gas Temperature, T_a	°C	31.9
Average Stack Gas Pressure	Pa	85.9
Average Stack Static Pressure, P_{static}	kPa	0.030
Average Barometric Pressure, P_b	kPa	101.2
Average Pitot Tube Calibration Coefficient, C_p	-	0.85

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 (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	78.74	0.7914	28.01	1.2498	0.98913
Moisture (H_2O)	-	-	0.50	0.0050	18.02	0.8037	0.00405

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	1.287
Wet Density (STP), P_{STW}	kg/m³	1.285
Dry Density (Actual), P_{Actual}	kg/m³	1.152
Average Wet Density (Actual), $P_{ActualW}$	kg/m³	1.151

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	31.9	0.0
Total Pressure	kPa	101.2	101.3
Moisture	%	0.50	0.50

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m³/hr	28236
Gas Volumetric Flowrate (STP, Wet)	m³/hr	25267
Gas Volumetric Flowrate (STP, Dry)	m³/hr	25139
Gas Volumetric Flowrate REF [1]	m³/hr	25267

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	04/07/2019
Time of Survey	-	13:35 - 13:55
Atmospheric Pressure	kPa	101.2
Average Stack Static Pressure	Pa	30
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	-	0.85
Number of Lines Available	-	1
Number of Lines Used	-	1

Sampling Line A

Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m³	Velocity m/s	Swirl °
STATIC (Units: Pa)		*30.0*				
Mean		**85.9**	**31.9**	**1.151**	**9.99**	
1	0.03	155.0	36.0	1.134	13.97	40.0
2	0.11	122.0	36.0	1.134	12.40	35.0
3	0.19	84.0	36.0	1.134	10.29	14.0
4	0.32	54.0	3.0	1.270	7.80	10.0
5	0.68	22.0	36.0	1.134	5.26	11.0
6	0.81	45.0	36.0	1.134	7.53	13.0
7	0.90	84.0	36.0	1.134	10.29	43.0
8	0.97	121.0	36.0	1.134	12.35	46.0

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)	1.763	Pa
- Resolution	u(res)	0.00087	
- Calibration	u(cal)	0.768	
- Drift	u(drift)	0.083	
- Lack of Fit	u(fit)	1.258	
- Overall corrections to dynamic measurements	u(Cf)	2.110	
Standard uncertainty associated with the molar mass of the gas	u(M)	0.00003	-
- $\varphi O_2,w$	-	20.695	
- $\varphi CO_2,w$	-	0.060	
- Oxygen, dry	u(ϕO_2,d)	0.637	
- Carbon Dioxide, dry	u(ϕCO_2,d)	0.002	
- Water Vapour	u(ϕH_2O)	0.026	
- Oxygen, wet	u(ϕO_2,w)	0.634	
- Carbon Dioxide, wet	u(ϕCO_2,w)	0.002	
Standard uncertainty associated with the stack temperature	u(Tc)	1.555	K
Standard uncertainty associated with the absolute pressure in the duct	u(pc)	175.701	Pa
- Atmospheric Pressure	u(patm)	175.692	
- Static Pressure	u(pstat)	1.763	
Standard uncertainty associated with the density in the duct	u(ρ)	0.00620	-
Standard uncertainty associated with the local velocities	u(vi)	0.136	Pa
Standard uncertainty associated with the mean velocity	u(v)	0.073	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	Uc(v)	0.143	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	Uc,rel(v)	1.43	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	Uc(qV,w)	1340.6	m^3/hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00059	
- $u^2(qV,w)$	-	467843	
- $u(qV,w)$	-	684.0	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	Uc,rel(qV,w)	4.75	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

Sundown Products Ltd, Tilbrook
S2 - Cooler Plant

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	26.6		26.6
Uncertainty	±mg/m³	2.7		2.7
Mass Emission	g/hr	671		671
Uncertainty	±g/hr	74.9		74.9

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	0.50		0.50
Uncertainty	±% v/v	0.058		0.058

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m³	0.91		0.91

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	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 8	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1 - A8	

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	759.0
Stack static pressure, P_{static}	mmH_2O	3.1
$P_s = (P_b + (P_{static} / 13.6)$	mmHg	759.2
Volume of water vapour collected, V_{wstd}		
Total mass collected in impingers (liquid trap)	g	-0.9
Total mass collected in impingers (silica trap)	g	3.2
Total mass of liquid collected, V_{lc}	g	2.3
$V_{wstd} = (0.001246)(V_{lc})$	m^3	0.0029
Volume of gas metered dry, V_{mstd}		
Volume of gas sample through gas meter, V_m	m^3	0.6060
Gas meter correction factor, Y_d	-	1.0290
Average dry gas meter temperature, T_m	°C	28.8
Average pressure drop across orifice, ΔH	mmH_2O	34.1
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m^3	0.5653
Moisture content, B_{wo} & R_{wv}		
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m^3	0.0050
B_{wo} as a percentage	% v/v	0.50
Reported Water Vapour, checked with Tables in EN 14790, Rwv	% v/v	0.50
Volume of gas metered wet, V_{mstw}		
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m^3	0.5681
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	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	-	0.83
Average of velocity heads, ΔP_{avg}	mmH_2O	10.00
Average square root of velocity heads, √ΔP	$\sqrt{mmH_2O}$	3.16
Average stack gas temperature, T_s	°C	38.0
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s} + 273)) / (\sqrt{(M_s)(P_s)})$	m/s	10.91
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	0.79
$Q_a = (60)(A_s)(V_s)$	m^3/min	514.2
Conversion factor (K/mm.Hg), C_f	-	0.3592
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m^3/min	450.9
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m^3/min	448.6
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m^3/min	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
Percent isokinetic, %I		
Nozzle diameter, D_n	mm	6.01
Nozzle area, A_n	mm^2	28.37
Total sampling time, q	min	32
$\%I = (4.6398E^6)(T_s+273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	109.0

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1
Sampling Times	-	14:00 - 14:32
Sampling Dates	-	04/07/2019
Sampling Device	-	ISO
Volume Sampled (REF)	m^3	0.5681
Filter I.D. Number	-	47-62799
Start Filter Mass	g	0.14620
End Filter Mass	g	0.15377
Total Mass on Filter	g	0.00757
Probe Rinse I.D. Number	-	PR-47-62799
Start Probe Rinse Mass	g	2.96216
End Probe Rinse Mass	g	2.96968
Total Mass in Probe Rinse	g	0.00752
Total Mass Collected	mg	15.09
Calculated Concentration	mg/m^3	26.56
Balance Uncertainty / LOD	mg/m^3	0.30

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1
Blank Dates	-	04/07/2019
Average Volume Sampled (REF)	m^3	0.5681
Filter I.D. Number	-	47-62800
Start Filter Mass	g	0.14807
End Filter Mass	g	0.14822
Total Mass on Filter	g	0.00015
Probe Rinse I.D. Number	-	PR-47-62800
Start Probe Rinse Mass	g	3.02664
End Probe Rinse Mass	g	3.02701
Total Mass in Probe Rinse	g	0.00037
Total Mass Collected	mg	0.52
Calculated Concentration	mg/m^3	0.91
Balance Uncertainty / LOD	mg/m^3	0.30

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

Sample Runs

Leak Test Results	Units	Run 1
Mean Sampling Rate	l/min	19.5
Pre-Sampling Leak Rate	l/min	0.20
Post-Sampling Leak Rate	l/min	
Allowable Leak Rate	l/min	0.36
Leak Test Acceptable	-	Yes

Water Droplets	Units	Run 1
Are Water Droplets Present	-	No

MU (Concurrent Water Vapour)	Units	Run 1
Measurement Uncertainty (MU)	%	11.4
Allowable MU	%	20.0
MU Acceptable	%	Yes

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

Isokinetic Criterion Compliance	Units	Run 1
Isokinetic Variation	%	109.0
Allowable Isokinetic Range	%	95 - 115
Isokineticity Acceptable	-	Yes

Weighing Uncertainty Criteria	Units	Run 1
Overall Weighing Uncertainty	± mg	0.32
Overall Weighing Uncertainty	± mg/m³	0.56
ELV [Daily ELV for IED]	mg/m³	150.00
Allowable Weighing Uncertainty	mg/m³	7.50
Weighing Uncertainty Acceptable	-	Yes

Filter Temperatures	Units	Run 1
Pre-Conditioning Temperature	°C	180
Post-Conditioning Temperature	°C	160
Maximum Filter Temperature	°C	38

Test Conditions	Units	Run 1
Ambient Temperature Recorded?	-	Yes

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1
Expected Sampling Rate	l/min	19.0
Pre-Sampling Leak Rate	l/min	0.20
Post-Sampling Leak Rate	l/min	
Allowable Leak Rate	l/min	0.38
Leak Test Acceptable	-	Yes

Validity of Blank vs ELV	Units	Blank 1
Allowable Blank	mg/m^3	15.0
Blank Acceptable	-	Yes

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

Method Deviations

Nature of Deviation (x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	Run Number 1	
Only one out of two required sampling lines was available, however the number of sample points used on the available line were increased to the minimum required by the Standard	x	
The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl points after this increase were omitted.	x	

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

	Value		Standard uncertainty		
Measured Quantities	**Symbol**	**Run 1**	**Symbol**	**Units**	**Run 1**
Sampled Volume (Actual)	V_m	0.6060	uV_m	m^3	0.0121
Sampled Gas Temperature	T_m	301.8	uT_m	K	2.0
Sampled Gas Pressure	ρ_m	101.2	$u\rho_m$	kPa	0.5
Sampled Gas Humidity	H_m	0.0	uH_m	% v/v	1.0
Leak	L	1.03	uL	%	-
Mass of Particulate	m	15.09	um	mg	0.17
Uncollected Mass	UCM	0.52	uUCM	mg	-

	Uncertainty as a Percentage		
Measured Quantities	**Units**	**Run 1**	**Requirement of Standard**
Sampled Volume (Actual)	%	2.00	≤2%
Sampled Gas Temperature	%	0.66	≤1%
Sampled Gas Pressure	%	0.49	≤1%
Sampled Gas Humidity	%	1.00	≤1%
Leak	%	1.03	≤2%
Mass of Particulate	%	0.20	<5% of ELV
Uncollected Mass	%	-	-

	Uncertainty in Measurement Units			Sensitivity Coefficient
Measured Quantities	**Symbol**	**Units**	**Run 1**	**Run 1**
Sampled Volume (STP)	V_m	m^3	0.5653	46.99
Leak	L	mg/m^3	0.157	1.00
Mass of Particulate	L_r	mg	15.090	1.76
Uncollected Mass	UCM	mg	0.30	1.76

	Uncertainty in Result	
Measured Quantities	**Units**	**Run 1**
Sampled Volume (STP)	mg/m^3	0.666
Leak	mg/m^3	0.1574
Mass of Particulate	mg/m^3	0.2992
Uncollected Mass	mg/m^3	0.5250

	Oxygen Correction Part of MU Budget	
Measured Quantities	**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	0.91
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m^3	1.79
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m^3	N/A
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m^3	2.68
Reported Uncertainty	mg/m^3	2.68
Expanded uncertainty (95% confidence), without Oxygen Correction	%	6.7
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	10.1
Reported Uncertainty	%	10.1