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Stack Emissions Testing Report Commissioned by
PCME Ltd

Installation Name & Address
GPS PE Pipe Systems Ltd
St Peters Road
Huntingdon
Cambridgeshire
PE29 7DA

PPC Permit: B22/93

Stack Reference
Fluidised Bed Exhaust

Dates of the Monitoring Campaign
9th July 2018

Job Reference Number
CSE-0117

Report Written by
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Report Date
19th July 2018

Version
Version 1

Signature of Report Approver


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Executive Summary

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MONITORING OBJECTIVES

GPS PE Pipe Systems Ltd, Huntingdon

Fluidised Bed Exhaust

9th July 2018

Overall Aim of the Monitoring Campaign

Exova Catalyst, in partnership with PCME Ltd, were commissioned to carry out stack emissions testing on the Fluidised Bed Exhaust by GPS PE Pipe Systems Ltd at Huntingdon.

The aim of the monitoring campaign was to conduct stack emissions testing as part of PCME's calibration service in support of the PCME particulate monitor installed at the emissions point.

Special Requirements

Record the PCME Meter readings. These can be found on the back page of this Report.

Target Parameters

Total Particulate Matter, Total VOCs (as Carbon)

Executive Summary

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MONITORING RESULTS

GPS PE Pipe Systems Ltd, Huntingdon
Fluidised Bed Exhaust
9th July 2018

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	1.5	0.8	20	g/hr	21.9	11.3	-
Total VOCs (as Carbon)	¹ mg/m ³	0.3	0.8	20	g/hr	4.6	11.8	-
Water Vapour	% v/v	1.4	0.1					
Stack Gas Temperature	°C	100.3						
Stack Gas Velocity	m/s	29.7	2.68					
Volumetric Flow Rate (ACTUAL)	m ³ /hr	19251	1947					
Volumetric Flow Rate (REF)	¹ m ³ /hr	14207	1437					

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

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MONITORING DATE(S) & TIMES

GPS PE Pipe Systems Ltd, Huntingdon
Fluidised Bed Exhaust
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Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m ³	0.5	g/hr	6.7	09/07/2018	11:22 - 12:23	60
Total Particulate Matter	R2	mg/m ³	0.5	g/hr	6.7	09/07/2018	12:36 - 13:37	60
Total Particulate Matter	R3	mg/m ³	3.7	g/hr	52.4	09/07/2018	13:50 - 14:51	60
Total VOCs (as Carbon)	R1	mg/m ³	0.3	g/hr	4.6	09/07/2018	11:22 - 12:22	60
Velocity Traverse	R1					09/07/2018	10:30 - 10:40	

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

GPS PE Pipe Systems Ltd, Huntingdon

Fluidised Bed Exhaust

9th July 2018

Standard Operating Conditions

Parameter	Value
Process Status	Operational
Capacity (of 100%) and Tonnes / Hour	N/A
Continuous or Batch Process	Batch
Feedstock (if applicable)	Metal Components
Abatement System	Ceramic Filters + Afterburner
Abatement System Running Status	Operational
Fuel	Natural Gas
Plume Appearance	None Visible From Sampling Location

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MONITORING & ANALYTICAL METHODS

GPS PE Pipe Systems Ltd, Huntingdon

Fluidised Bed Exhaust

9th July 2018

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	0.12 mg/m ³
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.1 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.32 mg/m ³
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	Yes	CAT	Pitot Tube and Thermocouple				Yes	1.8 m/s

ANALYSIS LABORATORIES

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

Exova Catalyst (CAT)	ISO 17025 Accreditation Number: 4279
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SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
All	All	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	-	Rectangular
Depth	m	0.34
Width	m	0.53
Area	m ²	0.18
Port Depth	cm	10
Orientation of Duct	-	Vertical
Number of Ports	-	2
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	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	No
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	529.6		> 5 Pa	Yes
Mean Velocity	m/s	29.68		-	-
Lowest Gas Velocity	m/s	28.06		-	-
Highest Gas Velocity	m/s	31.99		-	-
Ratio of Above	: 1	1.14		< 3 : 1	Yes
Maximum Angle of Swirl	°	9		< 15°	Yes
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

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PLANT PHOTOS

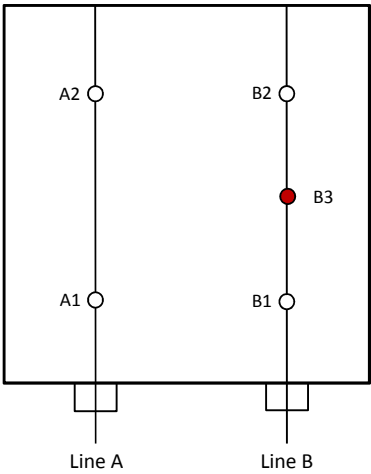
Photo 1



Photo 2



SAMPLE POINTS



- where

○ = isokinetic point sampled at

● = isokinetic point not sampled at

● = combustion gases sample point

○ = non-isokinetic sample point

APPENDIX CONTENTS

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

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

APPENDIX 3 - PCME Meter

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
Technician	Allan Kigozi	MCERTS Level 1	MM 16 1367	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 7.52	Horiba PG-250	-	Digital Manometer (1)	CAT 3.12
Control Box DGM (2)	-	Horiba PG-250	-	Digital Manometer (2)	-
Box Thermocouples (1)	-	Servomex 4900	-	Digital Temperature Meter	CAT 3.12
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.78
Umbilical (1)	CAT 3.128	ABB AO2020-URAS26	-	Barometer	CAT 13.37
Umbilical (2)	-	Servomex 5200MP	-	Stack Thermocouple (1)	CAT 4.805
Oven Box (1)	-	Ankersmid APS 313	-	Stack Thermocouple (2)	-
Oven Box (2)	-	Gasmet DX4000	-	Stack Thermocouple (3)	-
Heated Probe (1)	CAT 5.122	Gasmet Sampling System	-	2m Heated Line (1) (P&G)	-
Heated Probe (2)	-	Bernath 3006 FID	CAT 8.23	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.86	1m Heated Line (3)	-
S-Pitot (1)	CAT 21P.43	Mass Flow Controller (1)	CAT 6.51	5m Heated Line (1)	-
S-Pitot (2)	-	Mass Flow Controller (2)	CAT 6.52	10m Heated Line (1)	CAT 20.111
L-Pitot	-	Mass View (1)	CAT 25.48	20m Heated Line (1)	-
Site Balance	CAT 17.25	Mass View (2)	CAT 25.49	20m Heated Line (2)	-
500g / 1Kg Check Weights	CAT 17.25	Hioki 5043 (V)	CAT 11.91	Dual Channel Heater Controller	-
Last Impinger Arm	-	Hioki 5043 (V)	-	Single Channel Heater Controller	-
Callipers	CAT 23.29	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.9

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
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	0.34
Stack Width, W	m	0.53
Stack Area, A	m ²	0.18
Average Stack Gas Temperature, T _a	°C	100.3
Average Stack Gas Pressure	mmH ₂ O	60.5
Average Stack Static Pressure, P _{static}	kPa	0.010
Average Barometric Pressure, P _b	kPa	102.2
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	20.50	0.2080	32.00	1.4277	0.29696
N ₂	-	79.14	78.00	0.7914	28.01	1.2498	0.98913
Moisture (H ₂ O)	-	-	1.44	0.0144	18.02	0.8037	0.01160

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	1.280
Dry Density (Actual), P _{Actual}	kg/m ³	0.950
Average Wet Density (Actual), P _{ActualW}	kg/m ³	0.945

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	100.3	0.0
Total Pressure	kPa	102.2	101.3
Moisture	%	1.44	1.44

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	19251
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	14207
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	14002
Gas Volumetric Flowrate REF ¹	m ³ /hr	14207

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	09/07/2018
Time of Survey	-	10:30 - 10:40
Atmospheric Pressure	kPa	102.2
Average Stack Static Pressure	Pa	10
Result of Pitot Stagnation Test	-	Pass
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with Liquid Incline Manometer	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C _p	-	0.84
Number of Lines Available	-	1
Number of Lines Used	-	2

Sampling Line A											
Traverse Point	Depth m	ΔP mmH ₂ O	Temp °C	Wet Density kg/m³	Velocity m/s	Swirl °					
STATIC (Units: Pa)		10.0									
Mean		65.0	100.5	0.944	30.78		56.0	100.0	0.945	28.57	
1	0.09	60.0	100.0	0.945	29.58	9.0	54.0	100.0	0.945	28.06	4.0
2	0.26	70.0	101.0	0.943	31.99	5.0	58.0	100.0	0.945	29.08	7.0

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	$u(\Delta p_i)$	10.481	Pa
- Resolution	$u(res)$	0.52154	
- Calibration	$u(cal)$	36.652	
- Drift	$u(drift)$	1.096	
- Lack of Fit	$u(fit)$	70.576	
- Overall corrections to dynamic measurements	$u(C_f)$	108.845	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00003	-
- $\varphi_{O_2,w}$	-	20.500	
- $\varphi_{CO_2,w}$	-	0.059	
- Oxygen, dry	$u(\phi_{O_2,d})$	0.637	
- Carbon Dioxide, dry	$u(\phi_{CO_2,d})$	0.002	
- Water Vapour	$u(\phi_{H_2O})$	0.074	
- Oxygen, wet	$u(\phi_{O_2,w})$	0.628	
- Carbon Dioxide, wet	$u(\phi_{CO_2,w})$	0.002	
Standard uncertainty associated with the stack temperature	$u(T_c)$	1.904	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.848	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	7.411	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00509	-
Standard uncertainty associated with the local velocities	$u(v_i)$	2.622	Pa
Standard uncertainty associated with the mean velocity	$u(\bar{v})$	1.369	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	2.684	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	9.04	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV,w)$	1947.0	m ³ /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00266	
- $u^2(qV,w)$	-	986804	
- $u(qV,w)$	-	993.4	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV,w)$	10.11	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

GPS PE Pipe Systems Ltd, Huntingdon
Fluidised Bed Exhaust

Sample Runs

Parameter	Units	Run 1	Run 2	Run 3		Mean
Concentration	mg/m ³	0.47	0.47	3.69		1.54
Uncertainty	±mg/m ³	0.61	1.05	0.61		0.76
Mass Emission	g/hr	6.7	6.7	52.4		21.9
Uncertainty	±g/hr	8.6	15.0	10.2		11.3

NOTE: Where the maximum Blank concentration is higher than the Sample concentration, the maximum Blank concentration has been reported.

Parameter	Units	Run 1	Run 2	Run 3		Mean
Water Vapour	% v/v	2.04	1.52	0.77		1.44
Uncertainty	±% v/v	0.11	0.08	0.04		0.08

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.47		0.47

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	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 4	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1, A2 - B1, B2	

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	766.5	766.5	766.5	
Stack static pressure, P_{static}	mmH ₂ O	1.0	1.0	1.0	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	766.6	766.6	766.6	
Volume of water vapour collected, V_{wstd}					
Total mass collected in impingers (liquid trap)	g	17.1	14.1	0.2	
Total mass collected in impingers (silica trap)	g	10.1	5.0	9.7	
Total mass of liquid collected, V_{lc}	g	27.2	19.1	9.9	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0339	0.0238	0.0123	
Volume of gas metered dry, V_{mstd}					
Volume of gas sample through gas meter, V_m	m ³	1.8350	1.7600	1.8280	
Gas meter correction factor, Y_d	-	0.9830	0.9830	0.9830	
Average dry gas meter temperature, T_m	°C	34.1	39.4	41.3	
Average pressure drop across orifice, ΔH	mmH ₂ O	88.7	85.8	88.9	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	1.6308	1.5375	1.5878	
Moisture content, B_{wo} & R_{wv}					
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0204	0.0152	0.0077	
B_{wo} as a percentage	% v/v	2.04	1.52	0.77	
Reported Water Vapour, checked with Tables in EN 14790, R_{wv}	% v/v	2.04	1.52	0.77	
Volume of gas metered wet, V_{mstw}					
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	1.6647	1.5613	1.6001	
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	28.62	28.68	28.76	
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	64.25	61.17	63.17	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	8.02	7.82	7.95	
Average stack gas temperature, T_s	°C	101.7	102.2	103.0	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	30.77	30.01	30.49	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})					
Area of stack, A_s	m ²	0.18	0.18	0.18	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	332.7	324.5	329.7	
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	244.5	238.2	241.4	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	239.5	234.5	239.6	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	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, %					
Nozzle diameter, D_n	mm	5.01	5.01	5.01	
Nozzle area, A_n	mm ²	19.72	19.72	19.72	
Total sampling time, q	min	60	60	60	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	103.7	99.9	101.0	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	Run 2	Run 3	
Sampling Times	-	11:22 - 12:23	12:36 - 13:37	13:50 - 14:51	
Sampling Dates	-	09/07/2018	09/07/2018	09/07/2018	
Sampling Device	-	ISO	ISO	ISO	
Volume Sampled (REF)	m ³	1.6647	1.5613	1.6001	
Filter I.D. Number	-	47-51781	47-52195	47-52255	
Start Filter Mass	g	0.14459	0.14632	0.14516	
End Filter Mass	g	0.14484	0.14636	0.14517	
Total Mass on Filter	g	0.00025	0.00004	0.00001	
Probe Rinse I.D. Number	-	PR-47-51781	PR-47-52195	PR-47-52255	
Start Probe Rinse Mass	g	2.59480	2.56316	2.69786	
End Probe Rinse Mass	g	2.59527	2.56354	2.70376	
Total Mass in Probe Rinse	g	0.00047	0.00037	0.00589	
Total Mass Collected	mg	0.72	0.41	5.90	
Calculated Concentration	mg/m ³	0.43	0.26	3.69	
Balance Uncertainty / LOD	mg/m ³	0.11	0.12	0.12	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	09/07/2018	
Average Volume Sampled (REF)	m ³	1.6087	
Filter I.D. Number	-	47-49771	
Start Filter Mass	g	0.14909	
End Filter Mass	g	0.14928	
Total Mass on Filter	g	0.00019	
Probe Rinse I.D. Number	-	PR-47-49771	
Start Probe Rinse Mass	g	2.89626	
End Probe Rinse Mass	g	2.89682	
Total Mass in Probe Rinse	g	0.00056	
Total Mass Collected	mg	0.75	
Calculated Concentration	mg/m ³	0.47	
Balance Uncertainty / LOD	mg/m ³	0.12	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	Run 2	Run 3	
Mean Sampling Rate	l/min	30.06	28.83	29.95	
Pre-Sampling Leak Rate	l/min	0.10	0.10	0.10	
Post-Sampling Leak Rate	l/min	0.10	0.10	0.10	
Allowable Leak Rate	l/min	0.60	0.58	0.60	
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)	%	5.3	5.4	5.8	
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	%	103.7	99.9	101.0	
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	0.33	0.33	0.33	
Overall Weighing Uncertainty	± mg/m ³	0.20	0.21	0.20	
ELV [Daily ELV for IED]	mg/m ³	20.00	20.00	20.00	
Allowable Weighing Uncertainty	mg/m ³	1.00	1.00	1.00	
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	103	103	103	
Test Conditions	Units	Run 1	Run 2	Run 3	
Ambient Temperature Recorded?	-	Yes	Yes	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	18.00	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.36	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	2.0	
Blank Acceptable	-	Yes	

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

Method Deviations

Nature of Deviation	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.	x	x	x	

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value				Standard uncertainty				
	Symbol	Run 1	Run 2	Run 3	Symbol	Units	Run 1	Run 2	Run 3
Sampled Volume (Actual)	V _m	1.8350	1.7600	1.8280	uV _m	m ³	0.0367	0.0352	0.0366
Sampled Gas Temperature	T _m	307.1	312.4	314.3	uT _m	K	2.0	2.0	2.0
Sampled Gas Pressure	p _m	102.2	102.2	102.2	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	0.33	0.35	0.33	uL	%	-	-	-
Mass of Particulate	m	0.72	0.41	5.90	um	mg	0.19	0.19	0.19
Uncollected Mass	UCM	0.75	0.75	0.75	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	%	0.65	0.64	0.64	≤1%
Sampled Gas Pressure	%	0.49	0.49	0.49	≤1%
Sampled Gas Humidity	%	1.00	1.00	1.00	≤1%
Leak	%	0.33	0.35	0.33	≤2%
Mass of Particulate	%	0.62	1.08	0.59	<5% of ELV
Uncollected Mass	%	-	-	-	-

Measured Quantities	Uncertainty in Measurement Units					Sensitivity Coefficient			
	Symbol	Units	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3	
Sampled Volume (STP)	V _m	m ³	1.6308	1.5375	1.5878	0.29	0.30	2.32	
Leak	L	mg/m ³	0.001	0.001	0.007	1.00	1.00	1.00	
Mass of Particulate	L _r	mg	0.720	0.413	5.903	0.65	1.13	0.62	
Uncollected Mass	UCM	mg	0.43	0.43	0.43	0.65	1.13	0.62	

Measured Quantities	Uncertainty in Result			
	Units	Run 1	Run 2	Run 3
Sampled Volume (STP)	mg/m ³	0.012	0.012	0.097
Leak	mg/m ³	0.0009	0.0009	0.0071
Mass of Particulate	mg/m ³	0.1236	0.2153	0.1187
Uncollected Mass	mg/m ³	0.2829	0.4928	0.2718

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	0.31	0.54	0.31
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m ³	0.61	1.05	0.61
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	0.61	1.05	0.61
Reported Uncertainty	mg/m ³	0.61	1.05	0.61
Expanded uncertainty (95% confidence), without Oxygen Correction	%	129.3	225.1	16.6
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	N/A	N/A
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	129.3	225.1	16.6
Reported Uncertainty	%	129.3	225.1	16.6

TOTAL VOCs (as CARBON): RESULTS SUMMARY

GPS PE Pipe Systems Ltd, Huntingdon
Fluidised Bed Exhaust

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.33		0.33
Uncertainty	±mg/m ³	0.83		0.83
Mass Emission	g/hr	4.6		4.6
Uncertainty	±g/hr	11.8		11.8

General Sampling Information

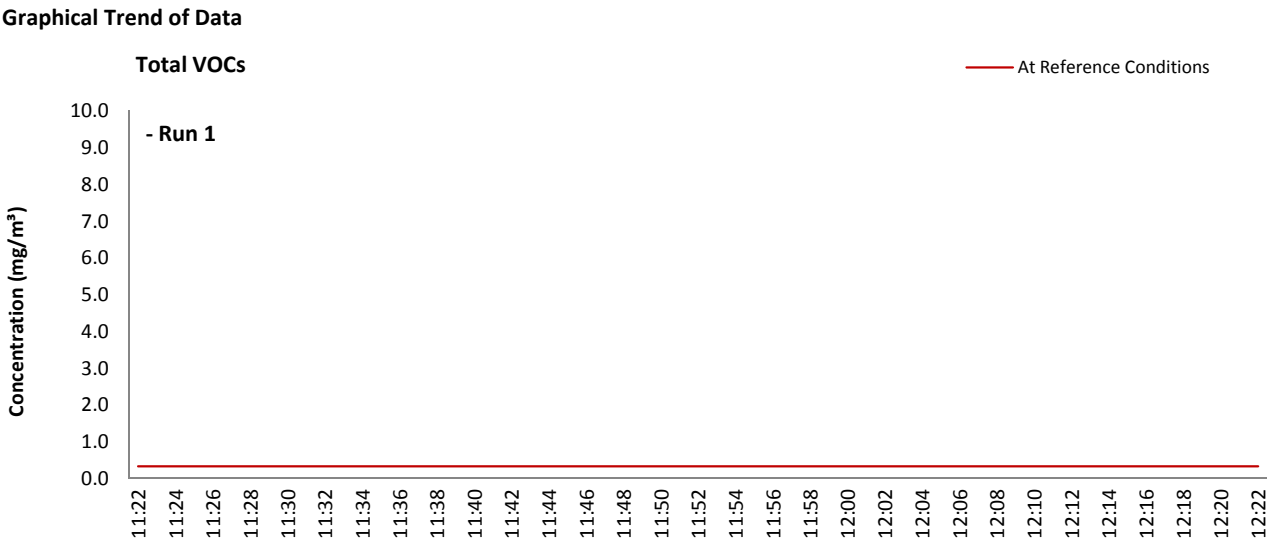
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Type	Propane In Synthetic Air (5 Grade)	
Span Gas Reference Number	1.0315a	
Span Gas Expiry Date	24/11/2022	
Span Gas Start Pressure (bar)	100	
Gas Cylinder Concentration (ppm)	81.8	
Span Gas Set Point (ppm)	81.80	
Span Gas Uncertainty (%)	2	
Zero Gas Type	Synthetic Air (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	B3	

Reference Conditions

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



TOTAL VOCs (as CARBON): DATA TREND



TOTAL VOCs (as CARBON): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1	
Sampling Times	-	11:22 - 12:22	
Sampling Dates	-	09/07/2018	
Instrument Range	ppm	100	
Span Gas Value	ppm	81.8	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	1.60	
	Zero Down Sampling Line (Post)	ppm	2.00	
	Zero Drift	ppm	0.40	
CAL 2	Zero Down Sampling Line (Pre)	ppm		
	Zero Down Sampling Line (Post)	ppm		
	Zero Drift	ppm		
CAL 3	Zero Down Sampling Line (Pre)	ppm		
	Zero Down Sampling Line (Post)	ppm		
	Zero Drift	ppm		
	Allowable Zero Drift	± ppm	4.09	
	Zero Drift Acceptable	-	Yes	

	Span Drift	Units	Run 1	
CAL 1	Span Down Sampling Line (Pre)	ppm	81.20	
	Span Down Sampling Line (Post)	ppm	80.00	
	Span Drift	ppm	-1.20	
CAL 2	Span Down Sampling Line (Pre)	ppm		
	Span Down Sampling Line (Post)	ppm		
	Span Drift	ppm		
CAL 3	Span Down Sampling Line (Pre)	ppm		
	Span Down Sampling Line (Post)	ppm		
	Span Drift	ppm		
	Allowable Span Drift	± ppm	4.09	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	14 - 18	

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/m ³ (REF)
TGN M2 Allowable MU	15.0		%
Measured concentration	0.33		mg/m ³ (STP, dry)
Range Used	100.0		ppm
Range Used [A]	160.6		mg/m ³
Cal gas conc.	81.8		ppm
Conversion	1.61		ppm to mg/m ³
MCERTS Range [B]	15.0		mg/m ³
Lower of [A] or [B]	15.0		mg/m ³
Cal gas conc.	131.4		mg/m ³

Performance characteristics	RUN 1		Units
Response time	45		seconds
Number of readings in measurement	60		-
Repeatability at zero	2.00		% full scale
Repeatability at span level	0.00		% full scale
Deviation from linearity	0.40		% of value
Zero drift	0.49		% full scale
Span drift	-1.48		% full scale
Volume or pressure flow dependence	1.60		% of full scale
Atmospheric pressure dependence	0.30		% of value/kPa
Ambient temperature dependence	1.40		% full scale/10K
Combined interference	0.45		% range
Dependence on voltage	0.50		% full scale/10V
Losses in the line (leak)	0.00		% of value
Uncertainty of calibration gas	2.00		% of value

Performance characteristic	RUN 1		Units
Standard deviation of repeatability at zero	use rep at span		mg/m ³
Standard deviation of repeatability at span level	0.00		mg/m ³
Lack of fit	0.03		mg/m ³
Drift	0.37		mg/m ³
Volume or pressure flow dependence	0.00		mg/m ³
Atmospheric pressure dependence	0.01		mg/m ³
Ambient temperature dependence	0.20		mg/m ³
Combined interference (from MCERTS Certificate)	0.04		mg/m ³
Dependence on voltage	0.06		mg/m ³
Losses in the line (leak)	0.00		mg/m ³
Uncertainty of calibration gas	0.00		mg/m ³

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		0.33	mg/m ³
Expanded uncertainty	k = 1.96	0.85	mg/m ³
Uncertainty corrected to std conds. (O ₂)		0.85	mg/m ³ (REF)

	RUN 1	Units
Expanded uncertainty (no O ₂) - at 95% Confidence	255.68	% of Value
Expanded uncertainty (no O ₂) - at 95% Confidence	4.23	% at ELV
Overall Allowable uncertainty (no O ₂) - at 95% Confidence	15.0	% at ELV
Result of Compliance with Uncertainty Requirement in M2	COMPLIANT	-

	RUN 1	Units
Expanded uncertainty (with O ₂) - at 95% Confidence	N/A	% of Value
Expanded uncertainty (with O ₂) - at 95% Confidence	N/A	% at ELV
Overall Allowable uncertainty (with O ₂) - at 95% Confidence	N/A	% at ELV
Result of Compliance with Uncertainty Requirement in M2	N/A	-

Requirement for SRM is that Uncertainty should be <15% of the value at the ELV, on a dry gas basis, or if O₂ correction is applied less than 15% + the uncertainty associated with the O₂ correction (using sqrt of sum squares to add uncertainty components). Ref EA TGN M2.

PCME METER

Contract Details	
Test House Job Number	CSE-0117
Company	GPS PE Pipe Systems Ltd
Site	Huntingdon
Stack	Fluidised Bed Exhaust
Sampling Date	09/07/2018
PCME Job Number	20023344

Stack Conditions	Value	Units
Stack Temperature	102.3	°C
Stack Humidity	1.4	% v/v
Stack Oxygen Content	N/A	% v/v
Stack Pressure	102.2	kPa

Current Instrument Settings	Type	Serial Number
Controller Type	MC	33619
Channel Type	-	-
Channel Number	Stack1	
Instrument Checks	Pass	
Current Calibration Factor	1.108	
Time on Display	11:56	
Time Difference - Meter v Actual	PCME 7 Mins fast	
GMT / BST?	BST	
Was Time Changed?	No	

Hardware Status	
Zero	-0.32
Span	94.44
Sensitivity	High
Purge	39
PCB Temperature	41.3
Tube Temperature	53
I	-

Summary of Test Data - Results of SRM vs CEM									
Run	Start Time	Finish Time	Instrument Average	Instrument Maximum	TPM Conc. STP WET	TPM Conc. STP DRY	TPM Conc. STP WET, % O ₂	TPM Conc. STP DRY, % O ₂	TPM Conc. ACTUAL
1	11:22	12:23	0.31	1.11	0.45	0.46	N/A	N/A	0.33
2	12:36	13:37	0.29	0.36	0.48	0.49	N/A	N/A	0.35
3	13:50	14:51	-	-	3.69	3.72	N/A	N/A	2.71
Mean			0.30		1.54	1.56	N/A	N/A	1.13

For all matters relating to the function, performance and calibration of the PCME Meter, please speak directly to PCME on 01480 468 200.

Times listed in the table above relate to the actual time of the tests, and not the times as read by the PCME meter.

As both the Isokinetic and PCME Results @ Stack Conditions were less than 3 mg/m³, it is advised that no change is applied to the current calibration factor as both results are extremely low.