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Stack Emissions Testing Report Commissioned by
PCME Ltd

Installation Name & Address
Clark-Drain Ltd
Station Road
Yaxley
Peterbourough
Cambridgeshire
PE7 3EQ

EPR Permit: A12/92; Variation: PPC 20/09

Stack Reference
Galvanising Plant

Dates of the Monitoring Campaign
27th January 2015

Job Reference Number
CSW-1625

Report Written by
Wayne Gurbuz Technician MCERTS Level 1 MM 13 1252 None

Report Approved by
Rob Hester Team Leader MCERTS Level 2 MM 06 766 TE1 TE2 TE3 TE4

Report Date
17th February 2015

Version
Version 1

Signature of Report Approver


CONTENTS

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

Executive Summary

MONITORING OBJECTIVES

Clark-Drain Ltd , Yaxley
Galvanising Plant
27th January 2015

Overall Aim of the Monitoring Campaign

Exova Catalyst, in partnership with PCME Ltd, were commissioned to carry out stack emissions testing on the Galvanising Plant by Clark-Drain Ltd at Yaxley.

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

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

Target Parameters

Total Particulate Matter, Lead, Hydrogen Chloride

Executive Summary

(Page 2 of 7)

MONITORING RESULTS

Clark-Drain Ltd , Yaxley
Galvanising Plant
27th January 2015

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	5.0	0.33	15	g/hr	89.8	8.8	-
Lead [1]	mg/m³	0.0084	0.0022	-	g/hr	0.15	0.04	-
Hydrogen Chloride [1]	mg/m³	0.11	0.016	-	g/hr	2.1	0.33	-
Water Vapour	% v/v	1.1	0.06					
Stack Gas Temperature	°C	24						
Stack Gas Velocity	m/s	13.2	0.74					
Volumetric Flow Rate (ACTUAL)	m³/hr	19323	1395					
Volumetric Flow Rate (REF) [1]	m³/hr	18012	1300					

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

Executive Summary

MONITORING DATE(S) & TIMES

Clark-Drain Ltd , Yaxley
Galvanising Plant
27th January 2015

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	4.4	g/hr	79.6	27/01/2015	11:00 - 12:00	60
Total Particulate Matter	R2	mg/m³	6.9	g/hr	124	27/01/2015	13:30 - 14:30	60
Total Particulate Matter	R3	mg/m³	3.6	g/hr	65.7	27/01/2015	14:41 - 15:41	60
Lead	R1	mg/m³	0.01	g/hr	0.15	27/01/2015	12:19 - 13:19	60
Hydrogen Chloride	R1	mg/m³	0.11	g/hr	2.1	27/01/2015	14:41 - 15:41	60
Velocity & Volumetric Flow Rate	R1					27/01/2015	10:00 - 10:10	

All results are expressed at the respective reference conditions.

PROCESS DETAILS

Clark-Drain Ltd , Yaxley
Galvanising Plant
27th January 2015

Standard Operating Conditions

Parameter	Value
Process Status	Normal
Capacity (of 100%) and Tonnes / Hour	100% Throughput
Continuous or Batch Process	Batch
Feedstock (if applicable)	Steel Components
Abatement System	Wet Scrubber
Abatement System Running Status	On - Normal
Fuel	N/A
Plume Appearance	No Plume Visible

Executive Summary

(Page 5 of 7)

MONITORING & ANALYTICAL METHODS

Clark-Drain Ltd , Yaxley
Galvanising Plant
27th January 2015

	Monitoring				Analysis					
Parameter	**Standard**	**Technical Procedure**	**ISO 17025 Testing**	**Testing Lab**	**Analytical Procedure**	**Analytical Technique**	**ISO 17025 Analysis**	**Analysis Lab**	**MCERTS Testing**	**LOD (Average)**
Total Particulate Matter	EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.1 mg/m³
Lead	EN 14385	CAT-TP-06	Yes	CAT	M31	ICP-MS	Yes	RPS	Yes	0.0004 mg/m³
Hydrogen Chloride	EN 1911	CAT-TP-11	Yes	CAT	CAT-AP-01	IC	Yes	CAT	Yes	0.016 mg/m³
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.1 % v/v
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
RPS Laboratories Ltd (RPS)	ISO 17025 Accreditation Number: 0605

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter, Lead	All	One out of two sampling lines was used due to sampling location restrictions, however the number of sample points used on the available line were increased to meet the requirements of the Standard.

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.72
Width	m	-
Area	m^2	0.41
Port Depth	cm	9
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	Permanent
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	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	127.5		> 5 Pa	Yes
Mean Velocity	m/s	13.18		-	-
Lowest Gas Velocity	m/s	12.39		-	-
Highest Gas Velocity	m/s	14.58		-	-
Ratio of Above	: 1	1.18		< 3 : 1	Yes
Maximum Angle of Swirl	°	3		< 15°	Yes
No Local Negative Flow	-	Yes		-	Yes

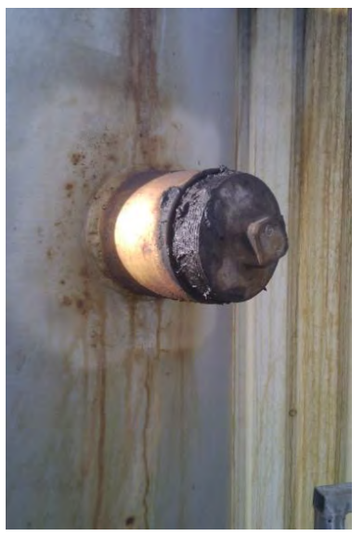
PLANT PHOTOS

Photo 1

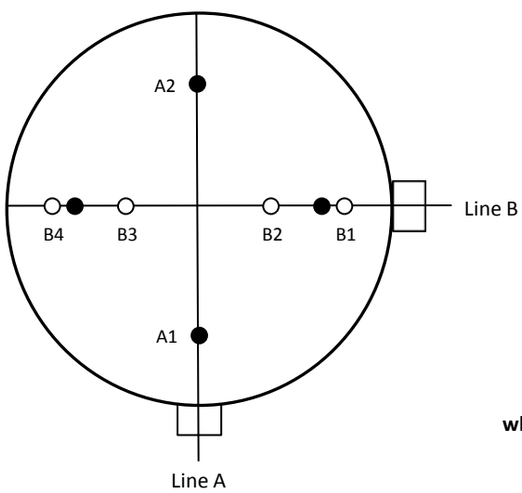
Photo 2

Photo 3

Photo 4



SAMPLE POINTS



where ○ = isokinetic point sampled at
● = isokinetic point not sampled at

APPENDIX CONTENTS

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Robert Hester	MCERTS Level 2	MM 06 766	TE1 TE2 TE3 TE4
Technician	Wayne Gurbuz	MCERTS Level 1	MM 13 1252	None

LIST OF EQUIPMENT

Extractive Sampling	
Equipment Type	**Equipment I.D.**
Control Box DGM (1)	CAT 7.8
Control Box DGM (2)	-
Box Thermocouples (1)	CAT 3.21
Box Thermocouples (2)	-
Umbilical (1)	CAT 3.21
Umbilical (2)	-
Oven Box (1)	CAT 12.96
Oven Box (2)	-
Heated Probe (1)	CAT 5.99
Heated Probe (2)	-
Heated Probe (3)	-
S-Pitot (1)	CAT 21S.61
S-Pitot (2)	-
L-Pitot	-
500g Check Weight	CAT 17.5
1Kg Check Weight	CAT 17.5
Last Impinger Arm	CAT 4.891
Callipers	CAT 23.15
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)	-
Easylogger EN-EL-12 Bit	-
Easylogger EN-EL-12 Bit	-
Bioaerosols Temperature Logger	-
Electronic Refrigerator	-

Miscellaneous Items	
Equipment Type	**Equipment I.D.**
Digital Manometer (1)	-
Digital Manometer (2)	-
Digital Temperature Meter	CAT 3.23
Stopwatch	CAT 14.53
Barometer	CAT 13.19
Stack Thermocouple (1)	CAT 4.581
Stack Thermocouple (2)	-
Stack Thermocouple (3)	-
1m Heated Line (1)	-
1m Heated Line (2)	-
1m Heated Line (3)	-
5m Heated Line (1)	-
15m Heated Line (1)	-
20m Heated Line (1)	-
20m Heated Line (2)	-
Dual Channel Heater Controller	-
Single Channel Heater Controller	-
Laboratory Balance	CAT 1.18 / 1.18a
Tape Measure	CAT 16.17

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
Lead	EN 14385	CAT-TP-06
Hydrogen Chloride	EN 1911	CAT-TP-11
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	0.7
Stack Width, W	m	-
Stack Area, A	m^2	0.41
Average Stack Gas Temperature, T_a	°C	24
Average Stack Gas Pressure	mmH_2O	14.8
Average Stack Static Pressure, P_{static}	kPa	0.23
Average Barometric Pressure, P_b	kPa	102.5
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)	-	20.8	20.57	0.208	32	1.4277	0.29696
N_2	-	79.14	78.27	0.7914	28.01	1.2498	0.98913
Moisture (H_2O)	-	-	1.10	0.0110	18.02	0.8037	0.00887

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	1.282
Dry Density (Actual), P_{Actual}	kg/m³	1.2
Average Wet Density (Actual), $P_{ActualW}$	kg/m³	1.195

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	24	0
Total Pressure	kPa	102.7	101.3
Moisture	%	1.10	1.10

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m³/hr	19323
Gas Volumetric Flowrate (STP, Wet)	m³/hr	18012
Gas Volumetric Flowrate (STP, Dry)	m³/hr	17813
Gas Volumetric Flowrate REF [1]	m³/hr	18012

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

(1 of 1)

Parameter	Units	Value
Date of Survey	-	27/01/2015
Time of Survey	-	10:00 - 10:10
Atmospheric Pressure	kPa	102.5
Average Stack Static Pressure	Pa	230
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	-	0.85
Number of Lines Available	-	2
Number of Lines Used	-	1

		Sampling Line A - Cap Stuck					Sampling Line B				
Traverse Point	**Depth m**	**ΔP**	**Temp °C**	**Wet Density kg/m³**	**Velocity m/s**	**Swirl °**	**ΔP mmH₂O**	**Temp °C**	**Wet Density kg/m³**	**Velocity m/s**	**Swirl °**
STATIC (Units: Pa)							*230.0*				
Mean							**14.8**	**24**	**1.195**	**13.18**	
1	0.05						13	24	1.195	12.39	2
2	0.18						13.2	24	1.195	12.49	2
3	0.54						14.9	24	1.195	13.27	3
4	0.67						18	24	1.195	14.58	1

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)	1.618	Pa
- Resolution	u(res)	0.52154	
- Calibration	u(cal)	0	
- Drift	u(drift)	1.096	
- Lack of Fit	u(fit)	0	
- Overall corrections to dynamic measurements	u(Cf)	1.618	
Standard uncertainty associated with the molar mass of the gas	u(M)	0.00003	-
- $\varphi O_2,w$	-	20.570	
- $\varphi CO_2,w$	-	0.059	
- Oxygen, dry	u(ϕO_2,d)	0.637	
- Carbon Dioxide, dry	u(ϕCO_2,d)	0.002	
- Water Vapour	u(ϕH_2O)	0.056	
- Oxygen, wet	u(ϕO_2,w)	0.63	
- Carbon Dioxide, wet	u(ϕCO_2,w)	0.002	
Standard uncertainty associated with the stack temperature	u(Tc)	1.515	K
Standard uncertainty associated with the absolute pressure in the duct	u(pc)	175.699	Pa
- Atmospheric Pressure	u(patm)	175.692	
- Static Pressure	u(pstat)	1.618	
Standard uncertainty associated with the density in the duct	u(ρ)	0.00643	-
Standard uncertainty associated with the local velocities	u(vi)	0.735	Pa
Standard uncertainty associated with the mean velocity	u(v)	0.378	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	Uc(v)	0.741	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	Uc,rel(v)	5.62	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	Uc(qV,w)	1394.9	m^3/hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00136	
- $u^2(qV,w)$	-	506481	
- u(qV,w)	-	711.7	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	Uc,rel(qV,w)	7.22	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

Clark-Drain Ltd , Yaxley
Galvanising Plant

Sample Runs

Parameter	Units	Run 1	Run 2	Run 3		Mean
Concentration	mg/m³	4.4	6.9	3.6		5.0
Uncertainty	±mg/m³	0.3	0.42	0.27		0.33
Mass Emission	g/hr	79.6	124	65.7		89.8
Uncertainty	±g/hr	7.8	11.7	6.8		8.8

Parameter	Units	Run 1	Run 2	Run 3		Mean
Water Vapour	% v/v	0.73	1.2	0.90		0.95
Uncertainty	±% v/v	0.04	0.07	0.05		0.05

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m³	0.10		0.10

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

General Sampling Information

Parameter	Value	
Standard	EN 13284-1	
Technical Procedure	CAT-TP-01	
Probe Material	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 / 4	FORMAT: Number Used / Number Required
Sample Point I.D.'s	B1, B2, B3, B4	

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	768.8	
Stack static pressure, P_{static}	mmH_2O	23.5	23.5	23.5	
$P_s = (P_b + (P_{static} / 13.6)$	mmHg	770.5	769.7	770.5	
Volume of water vapour collected, V_{wstd}					
Total mass collected in impingers (liquid trap)	g	-0.3	6.4	5.8	
Total mass collected in impingers (silica trap)	g	7.9	4.6	3.7	
Total mass of liquid collected, V_{lc}	g	7.6	11	9.5	
$V_{wstd} = (0.001246)(V_{lc})$	m^3	0.0095	0.0137	0.0118	
Volume of gas metered dry, V_{mstd}					
Volume of gas sample through gas meter, V_m	m^3	1.2115	1.068	1.238	
Gas meter correction factor, Y_d	-	1.098	1.098	1.098	
Average dry gas meter temperature, T_m	°C	14.6	16.8	17.4	
Average pressure drop across orifice, ΔH	mmH_2O	50.4	44.6	54.1	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m^3	1.2832	1.1205	1.2992	
Moisture content, B_{wo} & R_{wv}					
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m^3	0.0073	0.0121	0.009	
B_{wo} as a percentage	% v/v	0.73	1.21	0.9	
Reported Water Vapour, checked with Tables in EN 14790, Rwv	% v/v	0.73	1.21	0.9	
Volume of gas metered wet, V_{mstw}					
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m^3	1.2927	1.1342	1.311	
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	20.8	20.8	20.8	
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	28.76	28.71	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	-	0.85	0.85	0.85	
Average of velocity heads, ΔP_{avg}	mmH_2O	14.13	12.45	15.18	
Average square root of velocity heads, √ΔP	$\sqrt{mmH_2O}$	3.76	3.53	3.9	
Average stack gas temperature, T_s	°C	30.9	31.6	34.5	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s} + 273)) / (\sqrt{(M_s)(P_s)})$	m/s	13.08	12.3	13.65	
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	0.41	0.41	0.41	
$Q_a = (60)(A_s)(V_s)$	m^3/min	319.7	300.9	333.4	
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	291.1	273.1	300.1	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m^3/min	289	269.8	297.4	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	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	6.04	6.04	6.04	
Nozzle area, A_n	mm^2	28.69	28.69	28.69	
Total sampling time, q	min	60	60	60	
$\%I = (4.6398E^{6})(T_s+273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	105	98.3	103.3	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	Run 2	Run 3	
Sampling Times	-	11:00 - 12:00	13:30 - 14:30	14:41 - 15:41	
Sampling Dates	-	27/01/2015	27/01/2015	27/01/2015	
Sampling Device	-	ISO	ISO	ISO	
Volume Sampled (REF)	m^3	1.2927	1.1342	1.311	
Filter I.D. Number	-	47-23815	47-23816	47-23817	
Start Filter Mass	g	0.1519	0.14974	0.15084	
End Filter Mass	g	0.15724	0.15712	0.15293	
Total Mass on Filter	g	0.00534	0.00738	0.00209	
Probe Rinse I.D. Number	-	PR-47-23815	PR-47-23816	PR-47-23817	
Start Probe Rinse Mass	g	3.09671	2.95757	3.05832	
End Probe Rinse Mass	g	3.09708	2.958	3.06101	
Total Mass in Probe Rinse	g	0.00037	0.00043	0.00269	
Total Mass Collected	mg	5.71	7.81	4.78	
Calculated Concentration	mg/m^3	4.42	6.89	3.65	
Balance Uncertainty / LOD	mg/m^3	0.1	0.11	0.1	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	27/01/2015	
Average Volume Sampled (REF)	m^3	1.2460	
Filter I.D. Number	-	47-23807	
Start Filter Mass	g	0.15306	
End Filter Mass	g	0.15311	
Total Mass on Filter	g	0.00005	
Probe Rinse I.D. Number	-	PR-47-23807	
Start Probe Rinse Mass	g	2.92795	
End Probe Rinse Mass	g	2.92801	
Total Mass in Probe Rinse	g	0.00006	
Total Mass Collected	mg	0.11	
Calculated Concentration	mg/m^3	0.09	
Balance Uncertainty / LOD	mg/m^3	0.10	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

Sample Runs

Leak Test Results	Units	Run 1	Run 2	Run 3	
Mean Sampling Rate	l/min	22.17	19.54	22.66	
Pre-Sampling Leak Rate	l/min	0.08	0.3	0.35	
Post-Sampling Leak Rate	l/min	0.07	0.3	0.18	
Allowable Leak Rate	l/min	0.44	0.39	0.45	
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	5.6	5.6	
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	%	105	98.3	103.3	
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	0.24	0.24	0.24	
Overall Weighing Uncertainty	± mg/m³	0.19	0.21	0.18	
ELV [Daily ELV for IED]	mg/m³	15	15	15	
Allowable Weighing Uncertainty	mg/m³	0.75	0.75	0.75	
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	31	32	35	

Test Conditions	Units	Run 1	Run 2	Run 3	
Ambient Temperature Recorded?	-	Yes	Yes	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	20	
Pre-Sampling Leak Rate	l/min	0.1	
Post-Sampling Leak Rate	l/min	0.11	
Allowable Leak Rate	l/min	0.4	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m³	1.5	
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	2	3	
One out of two sampling lines was used due to sampling location restrictions, however the number of sample points used on the available line were increased to meet the requirements of the Standard.	x	x	x	

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

		Value					Standard uncertainty					
Measured Quantities	**Symbol**	**Run 1**	**Run 2**	**Run 3**		**Symbol**	**Units**	**Run 1**	**Run 2**	**Run 3**	
Sampled Volume (Actual)	V_m	1.2115	1.068	1.238		uV_m	m^3	0.0242	0.0214	0.0248	
Sampled Gas Temperature	T_m	287.6	289.8	290.4		uT_m	K	2	2	2	
Sampled Gas Pressure	ρ_m	102.7	102.6	102.7		$u\rho_m$	kPa	0.5	0.5	0.5	
Sampled Gas Humidity	H_m	0.0000	0.0000	0.0000		uH_m	% v/v	1	1	1	
Leak	L	0.32	1.54	0.79		uL	%	-	-	-	
Mass of Particulate	m	5.71	7.81	4.78		um	mg	0.13	0.13	0.13	
Uncollected Mass	UCM	0.11	0.11	0.11		uUCM	mg	-	-	-	

	Uncertainty as a Percentage					
Measured Quantities	**Units**	**Run 1**	**Run 2**	**Run 3**		**Requirement of Standard**
Sampled Volume (Actual)	%	2	2	2		≤2%
Sampled Gas Temperature	%	0.7	0.69	0.69		≤1%
Sampled Gas Pressure	%	0.49	0.49	0.49		≤1%
Sampled Gas Humidity	%	1	1	1		≤1%
Leak	%	0.32	1.54	0.79		≤2%
Mass of Particulate	%	0.67	0.76	0.66		<5% of ELV
Uncollected Mass	%	-	-	-		-

		Uncertainty in Measurement Units						Sensitivity Coefficient			
Measured Quantities	**Symbol**	**Units**	**Run 1**	**Run 2**	**Run 3**			**Run 1**	**Run 2**	**Run 3**	
Sampled Volume (STP)	V_m	m^3	1.2832	1.1205	1.2992			3.44	6.15	2.81	
Leak	L	mg/m^3	0.008	0.061	0.017			1	1	1	
Mass of Particulate	L_r	mg	5.71	7.81	4.78			0.77	0.88	0.76	
Uncollected Mass	UCM	mg	0.06	0.06	0.06			0.77	0.88	0.76	

	Uncertainty in Result				
Measured Quantities	**Units**	**Run 1**	**Run 2**	**Run 3**	
Sampled Volume (STP)	mg/m^3	0.102	0.159	0.084	
Leak	mg/m^3	0.0081	0.0611	0.0167	
Mass of Particulate	mg/m^3	0.1006	0.1146	0.0992	
Uncollected Mass	mg/m^3	0.0491	0.0560	0.0484	

	Oxygen Correction Part of MU Budget				
Measured Quantities	**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	0.15	0.21	0.14	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m^3	0.3	0.42	0.27	
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	0.3	0.42	0.27	
Reported Uncertainty	mg/m^3	0.3	0.42	0.27	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	6.7	6.1	7.5	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	N/A	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	6.7	6.1	7.5	
Reported Uncertainty	%	6.7	6.1	7.5	

LEAD: RESULTS SUMMARY

Clark-Drain Ltd , Yaxley
Galvanising Plant

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	0.0084		0.0084
Uncertainty	±mg/m³	0.0022		0.0022
Mass Emission	g/hr	0.15		0.15
Uncertainty	±g/hr	0.04		0.04

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	1.5		1.5
Uncertainty	±% v/v	0.07		0.07

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m³	0.0012		0.0012

General Sampling Information

Parameter	Value	
Standard	EN 14385	
Technical Procedure	CAT-TP-06	
Name of Analytical Laboratory	RPS	
Analytical Laboratory's Procedure	M31	
ISO 17025 Accredited Analysis?	Yes	
Date of Sample Analysis	10/02/2015	
Probe Material	Titanium	
Filter Housing Material	Borosilicate Glass	
Impinger Material	Borosilicate Glass	
Absorption Solution	Nitric Peroxide	
Positioning of Filter	Out Stack	
Filter Size and Material	47mm Quartz Fibre	
Number of Sampling Lines Used	1 / 2	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 4	FORMAT: Number Used / Number Required
Sample Point I.D.'s	B1, B2, B3, B4	

Reference Conditions

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

LEAD: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
Absolute pressure of stack gas, P_s			
Barometric pressure, P_b	mmHg	765	
Stack static pressure, P_{static}	mmH_2O	23.5	
$P_s = (P_b + (P_{static} / 13.6)$	mmHg	766.7	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	6	
Total mass collected in impingers (silica trap)	g	10	
Total mass of liquid collected, V_{lc}	g	16	
$V_{wstd} = (0.001246)(V_{lc})$	m^3	0.0199	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m^3	1.2865	
Gas meter correction factor, Y_d	-	1.098	
Average dry gas meter temperature, T_m	°C	16.5	
Average pressure drop across orifice, ΔH	mmH_2O	52.6	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m^3	1.3478	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m^3	0.0146	
B_{wo} as a percentage	% v/v	1.46	
Reported Water Vapour, checked with Tables in EN 14790, Rwv	% v/v	1.46	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m^3	1.3677	
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	20.8	
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	28.68	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.85	
Average of velocity heads, ΔP_{avg}	mmH_2O	14.73	
Average square root of velocity heads, √ΔP	$\sqrt{mmH_2O}$	3.84	
Average stack gas temperature, T_s	°C	32.1	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s} + 273)) / (\sqrt{(M_s)(P_s)})$	m/s	13.43	
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	0.41	
$Q_a = (60)(A_s)(V_s)$	m^3/min	328.2	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m^3/min	296.3	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m^3/min	292	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	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	6.04	
Nozzle area, A_n	mm^2	28.69	
Total sampling time, q	min	60	
$\%I = (4.6398E^{6})(T_s+273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	109.2	

LEAD: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	12:19 - 13:19	
Sampling Dates	-	27/01/2015	
Sampling Device	-	ISO	
Volume Sampled (REF)	m^3	1.3677	
Mass on Filter / in Rinse	µg	9	
Mass in Front Impingers	µg	2.3	
Mass in Back Impinger	µg	0.16	
Total Mass Collected	µg	11.46	
Calculated Concentration	mg/m^3	0.0084	
Reported Concentration	mg/m^3	0.0084	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	27/01/2015	
Average Volume Sampled (REF)	m^3	1.3677	
Mass on Filter / in Rinse	µg	1	
Mass in Front Impingers	µg	0.4	
Mass in Back Impinger	µg	0.28	
Total Mass Collected	µg	1.67	
Calculated Concentration	mg/m^3	0.0012	
Reported Concentration	mg/m^3	0.0012	

LEAD: QUALITY ASSURANCE

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	23.54	
Pre-Sampling Leak Rate	l/min	0.25	
Post-Sampling Leak Rate	l/min	0.12	
Allowable Leak Rate	l/min	0.47	
Leak Test Acceptable	-	Yes	

Absorption Efficiency	Units	Run 1	
Absorption Efficiency	%	98.6	
Allowable Absorption Efficiency	%	90	
Absorption Efficiency Acceptable	-	Yes	

Detection Limit	Units	Run 1	
Detection Limit	µg/m³	0.4	
Allowable Detection Limit	µg/m³	5	
Detection Limit Acceptable	-	Yes	

Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	

MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	5	
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	%	109.2	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	

Filter Temperatures	Units	Run 1	
Maximum Filter Temperature	°C	190	

Impingers Exit Temperature	Units	Run 1	
Maximum Temperature Recorded	°C	13	
Maximum Allowable Temperature	°C	30	
Exit Temperature Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

LEAD: QUALITY ASSURANCE

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	20	
Pre-Sampling Leak Rate	l/min	0.3	
Post-Sampling Leak Rate	l/min	0.28	
Allowable Leak Rate	l/min	0.4	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m^3	N/A	
Blank Acceptable	-	N/A	

Method Deviations

Nature of Deviation (x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	Run Number 1	
One out of two sampling lines was used due to sampling location restrictions, however the number of sample points used on the available line were increased to meet the requirements of the Standard.	x	

LEAD: MEASUREMENT UNCERTAINTY CALCULATIONS

	Value			Standard uncertainty			
Measured Quantities	**Symbol**	**Run 1**		**Symbol**	**Units**	**Run 1**	
Sampled Volume (Actual)	V_m	1.2865		uV_m	m^3	0.0257	
Sampled Gas Temperature	T_m	289.5		uT_m	K	2	
Sampled Gas Pressure	ρ_m	102.2		$u\rho_m$	kPa	0.5	
Sampled Gas Humidity	H_m	0		uH_m	% v/v	1	
Leak	L	0.51		uL	%	-	
Laboratory Result	L_r	13		uL_r	%	-	

	Uncertainty as a Percentage			
Measured Quantities	**Units**	**Run 1**		**Requirement of Standard**
Sampled Volume (Actual)	%	2		≤2%
Sampled Gas Temperature	%	0.69		≤1%
Sampled Gas Pressure	%	0.49		≤1%
Sampled Gas Humidity	%	1		≤1%
Leak	%	0.51		≤2%
Laboratory Result	%	13		No Requirement

	Uncertainty in Measurement Units				Sensitivity Coefficient	
Measured Quantities	**Symbol**	**Units**	**Run 1**		**Run 1**	
Sampled Volume (STP)	V_m	m^3	1.3478		0.01	
Leak	L	mg/m^3	0.00002		1	
Laboratory Result	L_r	mg/m^3	0.0011		1	

	Uncertainty in Result		
Measured Quantities	**Units**	**Run 1**	
Sampled Volume (STP)	mg/m^3	0.0002	
Leak	mg/m^3	0.00002	
Laboratory Result	mg/m^3	0.0011	

	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	0.0011	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m^3	0.0022	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m^3	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m^3	0.0022	
Reported Uncertainty	mg/m^3	0.0022	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	25.9	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	25.9	
Reported Uncertainty	%	25.9	

HYDROGEN CHLORIDE: RESULTS SUMMARY

Clark-Drain Ltd , Yaxley
Galvanising Plant

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	0.11		0.11
Uncertainty	±mg/m³	0.02		0.02
Mass Emission	g/hr	2.1		2.1
Uncertainty	±g/hr	0.33		0.33

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	0.91		0.91
Uncertainty	±% v/v	0.05		0.05

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m³	< 0.01		< 0.01

General Sampling Information

Parameter	Value	
Standard	EN 1911	
Technical Procedure	CAT-TP-11	
Name of Analytical Laboratory	CAT	
Analytical Laboratory's Procedure	CAT-AP-01	
ISO 17025 Accredited Analysis?	Yes	
Date of Sample Analysis	04/02/2015	
Probe Material	Titanium	
Filter Housing Material	Titanium	
Impinger Material	Polyethylene	
Absorption Solution	HPLC Grade Water	
Positioning of Filter	In Stack	
Filter Size and Material	47mm Glass Fibre	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	B1, B2, B3, B4	

Reference Conditions

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

HYDROGEN CHLORIDE: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	14:41 - 15:41	
Sampling Dates	-	27/01/2015	
Sampling Device	-	DGM	
Duration	mins	60	
DGM Start Volume	m^3	6.74	
DGM End Volume	m^3	7.978	
DGM Start Temperature	°C	16	
DGM End Temperature	°C	20	
Start ΔH	mmH_2O	50.2	
End ΔH	mmH_2O	50.2	
DGM Y_d	-	1.098	
Barometric Pressure	kPa	102.5	
Volume Sampled (STP, Dry)	m^3	1.2961	
Volume Sampled (STP, Wet)	m^3	1.3079	
Volume Sampled (REF)	m^3	1.3079	
Sample Flow Rate	l/min	22.66	
Laboratory Result for Front Impingers	µg/ml	0.51	
Laboratory Result for Back Impinger	µg/ml	0.05	
Volume in Front Impingers	ml	281.6	
Volume in Back Impinger	ml	125	
Mass in Front Impingers	µg	143.6	
Mass in Back Impinger	µg	< 6.3	
Total Mass Collected	µg	149.9	
Calculated Concentration	mg/m^3	0.11	
Liquid Trap Start Mass	g	1454	
Liquid Trap End Mass	g	1459.8	
Silica Trap Start Mass	g	1510.2	
Silica Trap End Mass	g	1513.9	
Total Mass Of Water Vapour	g	9.5	
Calculated Water Vapour	% v/v	0.91	

Where: DGM stands for Dry Gas Meter

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	27/01/2015	
Average Volume Sampled (REF)	m^3	1.3079	
Laboratory Result for Impingers	µg/ml	< 0.05	
Volume in Impingers	ml	303.7	
Total Mass Collected	µg	< 15.2	
Calculated Concentration	mg/m^3	< 0.01	

HYDROGEN CHLORIDE: QUALITY ASSURANCE

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	22.66	
Pre-Sampling Leak Rate	l/min	0.35	
Post-Sampling Leak Rate	l/min	0.18	
Allowable Leak Rate	l/min	0.45	
Leak Test Acceptable	-	Yes	

Absorption Efficiency	Units	Run 1	
Absorption Efficiency	%	100	
Allowable Absorption Efficiency	%	N/A [1]	
Absorption Efficiency Acceptable	-	N/A [1]	

[1] The concentration in the last absorber was less than 5 times the analytical detection limit.

Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	

MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	5.7	
Allowable MU	%	20	
MU Acceptable	%	Yes	

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

Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	20	
Pre-Sampling Leak Rate	l/min	0.1	
Post-Sampling Leak Rate	l/min	0.11	
Allowable Leak Rate	l/min	0.4	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m^3	N/A	
Blank Acceptable	-	N/A	

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	
There are no deviations associated with the sampling employed.	x	

HYDROGEN CHLORIDE: MEASUREMENT UNCERTAINTY CALCULATIONS

	Value			Standard uncertainty			
Measured Quantities	**Symbol**	**Run 1**		**Symbol**	**Units**	**Run 1**	
Sampled Volume (Actual)	V_m	1.238		uV_m	m^3	0.0248	
Sampled Gas Temperature	T_m	291		uT_m	K	2	
Sampled Gas Pressure	ρ_m	102.5		$u\rho_m$	kPa	0.5	
Sampled Gas Humidity	H_m	0.0000		uH_m	% v/v	1.000	
Leak	L	0.79		uL	%	-	
Laboratory Result	L_r	6.8		uL_r	%	-	

	Uncertainty as a Percentage			
Measured Quantities	**Units**	**Run 1**		**Requirement of Standard**
Sampled Volume (Actual)	%	2		≤2%
Sampled Gas Temperature	%	0.69		≤1%
Sampled Gas Pressure	%	0.49		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	0.79		≤2%
Laboratory Result	%	6.8		No Requirement

	Uncertainty in Measurement Units				Sensitivity Coefficient	
Measured Quantities	**Symbol**	**Units**	**Run 1**		**Run 1**	
Sampled Volume (STP)	V_m	m^3	1.2961		0.09	
Leak	L	mg/m^3	0.001		1.000	
Laboratory Result	L_r	mg/m^3	0.008		1.000	

	Uncertainty in Result		
Measured Quantities	**Units**	**Run 1**	
Sampled Volume (STP)	mg/m^3	0.003	
Leak	mg/m^3	0.0005	
Laboratory Result	mg/m^3	0.0078	

	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	0.01	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m^3	0.02	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m^3	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m^3	0.02	
Reported Uncertainty	mg/m^3	0.02	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	14.1	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	N/A	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	14.1	
Reported Uncertainty	%	14.1	

PCME METER

Contract Details	
Test House Job Number	CSW-1625
Company	**Clark-Drain Ltd**
Site	Yaxley
Stack	Galvanising Plant
Sampling Date	27/01/2015
PCME Job Number	**J34A16570**

Stack Conditions	Value	Units
Stack Temperature	32.35	°C
Stack Humidity	0.95	% v/v
Stack Oxygen Content	N/A	% v/v
Stack Pressure	102.7	kPa

Current Instrument Settings	Type	Serial Number
Controller Type	IM	34304
Channel Type	DT 373	34303
Channel Number	Stack1 Dust	
Instrument Checks	Pass	
Current Calibration Factor	7.66	
Time on Display	10:32	
Time Difference - Meter v Actual	PCME 29 minutes fast	
GMT / BST?	GMT	
Was Time Changed?	No	

Hardware Status	
Zero	19
Span	10016
S/C	10031
Contamination Ring	N/A
Comms Check	Pass

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	11:00	12:00	3.60	36.55	4.42	4.45	N/A	N/A	4.00
2	13:30	14:26	4.51	33.33	6.89	6.97	N/A	N/A	6.24
3	14:41	15:41	1.91	7.56	3.65	3.68	N/A	N/A	3.3
Mean			**3.34**		**4.98**	**5.03**	**N/A**	**N/A**	**4.52**

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.