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**Stack Emissions Testing Report Commissioned by**

SITA Healthcare Ltd

**Installation Name & Address**

SITA Healthcare Ltd

Wrexham Industrial Estate

Marlborough Road

Wrexham

LL13 9RJ

PPC Permit: AP3538SM

**Stack Reference**

A1 - Main Stack

**Dates of the Monitoring Campaign**

11th - 13th November 2014

**Job Reference Number**

CAT-2037

Report Written by
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Report Date
8th December 2014

Version
Version 1

Signature of Report Approver


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### APPENDIX 1 - Monitoring Personnel & List of Equipment

### APPENDIX 2 - Raw Data, Sampling Equations & Charts

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## Executive Summary

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### MONITORING OBJECTIVES

SITA Healthcare Ltd, Wrexham

A1 - Main Stack

11th - 13th November 2014

#### Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by SITA Healthcare Ltd to carry out stack emissions testing on the A1 - Main Stack at Wrexham.

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, Hydrogen Chloride, Cadmium & Thallium, Heavy Metals, Mercury, Dioxins & Furans, PCBs, PAHs, Sulphur Dioxide, Hydrogen Fluoride, Oxides of Nitrogen (as NO<sub>2</sub>), Carbon Monoxide

## Executive Summary

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### MONITORING RESULTS

SITA Healthcare Ltd, Wrexham

A1 - Main Stack

11th - 13th November 2014

where MU = Measurement Uncertainty associated with the Result

Parameter	Concentration				Mass Emission			
	Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Total Particulate Matter	<sup>1</sup> mg/m <sup>3</sup>	3.48	0.41	20	g/hr	21.8	2.6	-
Hydrogen Chloride	<sup>1</sup> mg/m <sup>3</sup>	0.07	0.01	30	g/hr	0.41	0.1	-
Cadmium & Thallium	<sup>1</sup> mg/m <sup>3</sup>	0.066	0.01	0.05	g/hr	0.41	0.070	-
Heavy Metals	<sup>1</sup> mg/m <sup>3</sup>	0.08	0.01	0.5	g/hr	0.53	0.09	-
Mercury	<sup>1</sup> mg/m <sup>3</sup>	0.01	0.001	0.05	g/hr	0.04	0.01	-
<b>Dioxins &amp; Furans Upper Limit (worst case where &lt;LOD = LOD)</b>								
Dioxins & Furans (NATO I-TEQ)	<sup>1</sup> ng/m <sup>3</sup>	0.018	0.004	0.1	µg/hr	0.110	0.02	-
Dioxins & Furans (WHO TEQ Humans / Mammals)	<sup>1</sup> ng/m <sup>3</sup>	0.016	0.003	-	µg/hr	0.101	0.02	-
Dioxins & Furans (WHO TEQ Fish)	<sup>1</sup> ng/m <sup>3</sup>	0.018	0.004	-	µg/hr	0.116	0.02	-
Dioxins & Furans (WHO TEQ Birds)	<sup>1</sup> ng/m <sup>3</sup>	0.033	0.007	-	µg/hr	0.207	0.04	-
<b>Dioxins &amp; Furans Upper Limit (best case where &lt;LOD = 0)</b>								
Dioxins & Furans (NATO I-TEQ)	<sup>1</sup> ng/m <sup>3</sup>	0.018	0.004	-	µg/hr	0.110	0.02	-
Dioxins & Furans (WHO TEQ Humans / Mammals)	<sup>1</sup> ng/m <sup>3</sup>	0.016	0.003	-	µg/hr	0.101	0.02	-
Dioxins & Furans (WHO TEQ Fish)	<sup>1</sup> ng/m <sup>3</sup>	0.018	0.004	-	µg/hr	0.116	0.02	-
Dioxins & Furans (WHO TEQ Birds)	<sup>1</sup> ng/m <sup>3</sup>	0.033	0.007	-	µg/hr	0.207	0.04	-
<b>PCBs Upper Limit (worst case where &lt;LOD = LOD)</b>								
PCBs (WHO TEQ Humans / Mammals)	<sup>1</sup> ng/m <sup>3</sup>	0.0028	0.0006	-	µg/hr	0.018	0.004	-
PCBs (WHO TEQ Fish)	<sup>1</sup> ng/m <sup>3</sup>	0.0001	0.00003	-	µg/hr	0.001	0.0002	-
PCBs (WHO TEQ Birds)	<sup>1</sup> ng/m <sup>3</sup>	0.0056	0.0012	-	µg/hr	0.035	0.008	-
<b>PCBs Upper Limit (best case where &lt;LOD = 0)</b>								
PCBs (WHO TEQ Humans / Mammals)	<sup>1</sup> ng/m <sup>3</sup>	0.0028	0.0006	-	µg/hr	0.02	0.004	-
PCBs (WHO TEQ Fish)	<sup>1</sup> ng/m <sup>3</sup>	0.0001	0.00003	-	µg/hr	0.001	0.0002	-
PCBs (WHO TEQ Birds)	<sup>1</sup> ng/m <sup>3</sup>	0.0056	0.0012	-	µg/hr	0.03	0.008	-
PAHs (see next page for individual breakdown)	<sup>1</sup> µg/m <sup>3</sup>	0.32	0.070	-	g/hr	0.002	0.0004	-
Sulphur Dioxide	<sup>1</sup> mg/m <sup>3</sup>	0.05	0.01	200	g/hr	0.34	0.06	-
Hydrogen Fluoride	<sup>1</sup> mg/m <sup>3</sup>	< 0.08	0.01	2	g/hr	< 0.52	0.08	-
Total VOCs (as Carbon)	<sup>1</sup> mg/m <sup>3</sup>	0.28	1.7	20	g/hr	1.7	10.5	-
Oxides of Nitrogen (as NO <sub>2</sub> )	<sup>1</sup> mg/m <sup>3</sup>	201	9.5	400	g/hr	1260	59.4	-
Carbon Monoxide	<sup>1</sup> mg/m <sup>3</sup>	7.5	1.9	100	g/hr	47.2	11.8	-
Oxygen	% v/v	Dry 14.1	0.47					
Water Vapour	% v/v	8.0	0.46					
Stack Gas Temperature	°C	145						
Stack Gas Velocity	m/s	13.0						
Volumetric Flow Rate (ACTUAL)	m <sup>3</sup> /hr	14645						
Volumetric Flow Rate (REF)	<sup>1</sup> m <sup>3</sup> /hr	6263						

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

<sup>1</sup> Reference Conditions (REF) are: 273K, 101.3kPa, dry gas, 11% oxygen.

## MONITORING RESULTS

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack  
11th - 13th November 2014

Parameter	Concentration				Mass Emission			
	Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
<b>Breakdown of PAHs</b>								
Naphthalene	µg/m <sup>3</sup>	0.25	0.05	-	g/hr	0.0016	0.0003	
Fluoranthene	µg/m <sup>3</sup>	0.03	0.008	-	g/hr	0.0002	0.00005	
Benzo(a)anthracene	µg/m <sup>3</sup>	0.004	0.001	-	g/hr	0.00003	0.00001	
Chrysene	µg/m <sup>3</sup>	0.01	0.003	-	g/hr	0.0001	0.00002	
Benzo(b)fluoranthene	µg/m <sup>3</sup>	0.01	0.001	-	g/hr	0.00004	0.00001	
Benzo(k)fluoranthene	µg/m <sup>3</sup>	0.002	0.001	-	g/hr	0.00002	0.00000	
Benzo(a)pyrene	µg/m <sup>3</sup>	< 0.001	0.0003	-	g/hr	< 0.00001	0.00000	
Indeno(1,2,3-cd)pyrene	µg/m <sup>3</sup>	< 0.001	0.0003	-	g/hr	< 0.00001	0.00000	
Dibenzo(a,h)anthracene	µg/m <sup>3</sup>	< 0.001	0.0003	-	g/hr	< 0.00001	0.00000	
Benzo(g,h,i)perylene	µg/m <sup>3</sup>	< 0.001	0.0003	-	g/hr	< 0.00001	0.00000	
Anthanthrene	µg/m <sup>3</sup>	< 0.001	0.0003	-	g/hr	< 0.00001	0.00000	
Benzo(b)naph(2,1-d)thiophene	µg/m <sup>3</sup>	< 0.001	0.0003	-	g/hr	< 0.00001	0.00000	
Benzo(c)phenanthrene	µg/m <sup>3</sup>	< 0.001	0.0003	-	g/hr	< 0.00001	0.00000	
Cholanthrene	µg/m <sup>3</sup>	< 0.001	0.0003	-	g/hr	< 0.00001	0.00000	
Cyclopenta(c,d)pyrene	µg/m <sup>3</sup>	< 0.001	0.0003	-	g/hr	< 0.00001	0.00000	
Dibenzo(ai)pyrene	µg/m <sup>3</sup>	< 0.001	0.0003	-	g/hr	< 0.00001	0.00000	
<b>TOTAL</b>	µg/m <sup>3</sup>	0.323	0.07	-	g/hr	0.0020	0.0004	

PAHs Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

## Executive Summary

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### MONITORING DATE(S) & TIMES

SITA Healthcare Ltd, Wrexham

A1 - Main Stack

11th - 13th November 2014

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m <sup>3</sup>	3.5	g/hr	21.8	13/11/2014	11:05 - 11:35, 11:36 - 12:06	60
Hydrogen Chloride	R1	mg/m <sup>3</sup>	0.07	g/hr	0.41	13/11/2014	11:05 - 11:35, 11:36 - 12:06	60
Cadmium & Thallium	R1	mg/m <sup>3</sup>	0.07	g/hr	0.41	12/11/2014	16:01 - 16:17, 16:18 - 16:34	32
Heavy Metals	R1	mg/m <sup>3</sup>	0.08	g/hr	0.53	12/11/2014	16:01 - 16:17, 16:18 - 16:34	32
Mercury	R1	mg/m <sup>3</sup>	0.01	g/hr	0.04	12/11/2014	16:01 - 16:17, 16:18 - 16:34	32
Dioxins & Furans (NATO)	R1	ng/m <sup>3</sup>	0.02	µg/hr	0.11	11/11/2014	11:39 - 14:39, 14:40 - 17:40	360
PCBs	R1	ng/m <sup>3</sup>	0.003	µg/hr	0.02	11/11/2014	11:39 - 14:39, 14:40 - 17:40	360
PAHs	R1	µg/m <sup>3</sup>	0.32	g/hr	0.00	12/11/2014	09:35 - 12:35, 12:37 - 15:37	360
Sulphur Dioxide	R1	mg/m <sup>3</sup>	0.05	g/hr	0.34	12/11/2014	10:00 - 14:00	240
Hydrogen Fluoride	R1	mg/m <sup>3</sup>	< 0.08	g/hr	< 0.52	11/11/2014	14:24 - 15:24	60
Total VOCs (as Carbon)	R1	mg/m <sup>3</sup>	0.28	g/hr	1.7	12/11/2014	10:00 - 14:00	240
Oxides of Nitrogen (as NO <sub>2</sub> )	R1	mg/m <sup>3</sup>	201	g/hr	1260	12/11/2014	10:00 - 14:00	240
Carbon Monoxide	R1	mg/m <sup>3</sup>	7.5	g/hr	47.2	12/11/2014	10:00 - 14:00	240
Oxygen	R1	% v/v	14.6			12/11/2014	10:00 - 14:00	240
Velocity & Volumetric Flow Rate	R1					11 /11/2014	10:52 - 10:59	

All results are expressed at the respective reference conditions.

PROCESS DETAILS

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack  
11th - 13th November 2014

Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	~700 - 1000 kg/hr
Continuous or Batch Process	Continuous
Feedstock (if applicable)	Clinical Waste
Abatement System	Bag Filter & Lime Addition
Abatement System Running Status	On
Fuel	Natural Gas
Plume Appearance	Not Visible from Sampling Location

## Executive Summary

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### MONITORING & ANALYTICAL METHODS

SITA Healthcare Ltd, Wrexham

A1 - Main Stack

11th - 13th November 2014

Parameter	Monitoring				Analysis				MCERTS Testing	LOD (Average)
	Standard	Technical Procedure	UKAS Testing	Testing Lab	Analytical Procedure	Analytical Technique	UKAS Analysis	Analysis Lab		
Total Particulate Matter	EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.14 mg/m <sup>3</sup>
Hydrogen Chloride	BS EN 1911	CAT-TP-11	Yes	CAT	CAT-AP-01	IC	Yes	CAT	Yes	0.019 mg/m <sup>3</sup>
Cadmium & Thallium	BS EN 14385	CAT-TP-06	Yes	CAT	M31	ICP-MS	Yes	RPS	Yes	0.002 mg/m <sup>3</sup>
Heavy Metals	BS EN 14385	CAT-TP-06	Yes	CAT	M31	ICP-MS	Yes	RPS	Yes	0.013 mg/m <sup>3</sup>
Mercury	BS EN 13211	CAT-TP-06	Yes	CAT	M112	CV-AFS	Yes	RPS	Yes	0.001 mg/m <sup>3</sup>
Dioxins & Furans	EN 1948	CAT-TP-07	Yes	CAT	WI 1122	GC-HRMS	Yes	MAR	Yes	0.0008 ng/m <sup>3</sup>
PCBs	EN 1948	CAT-TP-07	Yes	CAT	WI 1180	GC-HRMS	Yes	MAR	Yes	0.0001 ng/m <sup>3</sup>
PAHs	ISO 11338	CAT-TP-08	Yes	CAT	WI 1131	GC-HRMS	Yes	MAR	Yes	0.0197 µg/m <sup>3</sup>
Sulphur Dioxide	EN 14791	CAT-TP-09	Yes	CAT	CAT-AP-01	IC	Yes	CAT	Yes	0.038 mg/m <sup>3</sup>
Hydrogen Fluoride	ISO 15713	CAT-TP-10	Yes	CAT	CAT-AP-01	IC	Yes	CAT	Yes	0.083 mg/m <sup>3</sup>
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	0.16 mg/m <sup>3</sup>
Oxides of Nitrogen (as NO <sub>2</sub> )	EN 14792	CAT-TP-21	Yes	CAT	Chemiluminescence by Horiba PG-250				Yes	0.33 mg/m <sup>3</sup>
Carbon Monoxide	EN 15058	CAT-TP-21	Yes	CAT	NDIR by Horiba PG-250				Yes	0.67 mg/m <sup>3</sup>
Oxygen	EN 14789	CAT-TP-21	Yes	CAT	Dry Zirconia Cell by Horiba PG-250				Yes	0.01 %
Velocity & Vol. Flow Rate	EN 13284-1	CAT-TP-04	Yes	CAT	Pitot Tube and Thermocouple				Yes	N/A

### ANALYSIS LABORATORIES

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

Exova Catalyst (CAT)	UKAS Accreditation Number: 4279
RPS Laboratories Ltd (RPS)	UKAS Accreditation Number: 0605
Marchwood Scientific Services Ltd (MAR)	UKAS Accreditation Number: 1668

### SUMMARY OF SAMPLING DEVIATIONS

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



## SUITABILITY OF SAMPLING LOCATION

### Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.63
Width	m	-
Area	m <sup>2</sup>	0.31
Port Depth	cm	32
Orientation of Duct	-	Vertical
Sample Port Size	-	4" Tube

### 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	Yes
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

### Sampling Location / Platform Improvement Recommendations

The sampling location meets all the requirements specified in EA Guidance Note M1 and EN 15259, and therefore there are no improvement recommendations.

### EN 15259 Homogeneity Test Requirements

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

### Sampling Plane Validation Criteria (from EA Technical Guidance Document (Monitoring) M1)

Criteria in M1	Units	Traverse 1		Required	Compliant
Lowest Differential Pressure	Pa	91.3		> 5 Pa	Yes
Mean Velocity	m/s	13.62		-	-
Lowest Gas Velocity	m/s	12.70		-	-
Highest Gas Velocity	m/s	14.24		-	-
Ratio of Above	: 1	1.12		< 3 : 1	Yes
Maximum Angle of Swirl	°	3		< 15°	Yes
No Local Negative Flow	-	Yes		-	Yes

PLANT PHOTOS

Photo 1



Photo 2



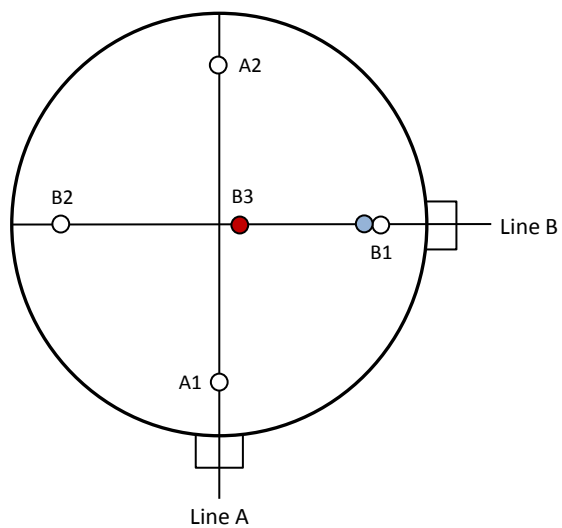
Photo 3



Photo 4



SAMPLE POINTS



where

○ = isokinetic point sampled at

● = isokinetic point not sampled at

● = 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

## STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Alex Powell	MCERTS Level 2	MM 10 1082	TE1 TE2 TE3 TE4
Technician	Antony Ward	MCERTS Level 1	MM 10 1096	TE1

## 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 7.27	Horiba PG-250	CAT 9.8	Digital Manometer (1)	CAT 3.30
Control Box DGM (2)	-	Horiba PG-250	-	Digital Manometer (2)	-
Box Thermocouples (1)	CAT 3.63	Servomex 4900	-	Digital Temperature Meter	CAT 3.3
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.53
Umbilical (1)	CAT 3.63	ABB AO2020-URAS26	-	Barometer	CAT 13.26
Umbilical (2)	-	Servomex 5200MP	-	Stack Thermocouple (1)	CAT 1.5m
Oven Box (1)	CAT ap	JCT JCC P1 Cooler	CAT 4.0207	Stack Thermocouple (2)	CAT 0.5m
Oven Box (2)	-	Gasmet DX4000	-	Stack Thermocouple (3)	CAT 4.541
Heated Probe (1)	CAT 1.5m	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	CAT 0.5m	Bernath 3006 FID	CAT 8.10	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	-	1m Heated Line (3)	-
S-Pitot (1)	CAT 21P.56	Mass Flow Controller (1)	CAT 6.23	5m Heated Line (1)	-
S-Pitot (2)	CAT 21S.41	Mass Flow Controller (2)	CAT 6.24	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	CAT 25.40	20m Heated Line (1)	CAT 20.70
500g Check Weight	CAT 17.23	Mass View (2)	CAT 25.41	20m Heated Line (2)	-
1Kg Check Weight	CAT 17.23	Easylogger EN-EL-12 Bit	CAT 11.45	Dual Channel Heater Controller	-
Last Impinger Arm	CAT 4.400	Easylogger EN-EL-12 Bit	-	Single Channel Heater Controller	-
Callipers	CAT 23.21			Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	-			Tape Measure	CAT 16.32

## METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
Hydrogen Chloride	BS EN 1911	CAT-TP-11
Cadmium & Thallium	BS EN 14385	CAT-TP-06
Heavy Metals	BS EN 14385	CAT-TP-06
Mercury	BS EN 13211	CAT-TP-06
Dioxins & Furans	EN 1948	CAT-TP-07
PCBs	EN 1948	CAT-TP-07
PAHs	ISO 11338	CAT-TP-08
Sulphur Dioxide	EN 14791	CAT-TP-09
Hydrogen Fluoride	ISO 15713	CAT-TP-10
Water Vapour	EN 14790	CAT-TP-05
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20
Oxides of Nitrogen (as NO <sub>2</sub> )	EN 14792	CAT-TP-21
Carbon Monoxide	EN 15058	CAT-TP-21
Oxygen	EN 14789	CAT-TP-21
Velocity & Vol. Flow Rate	EN 13284-1	CAT-TP-04

## PRELIMINARY STACK SURVEY: CALCULATIONS

### General Stack Details

Stack Details (from Traverse)	Units	Value
Stack Diameter / Depth, D	m	0.63
Stack Width, W	m	-
Stack Area, A	m <sup>2</sup>	0.31
Average Stack Gas Temperature, T <sub>a</sub>	°C	155.0
Average Stack Gas Pressure	Pa	105.1
Average Stack Static Pressure, P <sub>static</sub>	kPa	-0.111
Average Barometric Pressure, P <sub>b</sub>	kPa	98.9
Average Pitot Tube Calibration Coefficient, C <sub>p</sub>	-	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 <sup>3</sup> p	Conc kg/m <sup>3</sup> p <sub>i</sub>
CO <sub>2</sub> (Estimated)	-	6.50	5.98	0.0650	44.01	1.9635	0.1276
O <sub>2</sub>	-	14.07	12.95	0.1407	32.00	1.4277	0.2009
N <sub>2</sub>	-	79.43	73.10	0.7943	28.01	1.2498	0.9928
Moisture (H <sub>2</sub> O)	-	-	7.97	0.0797	18.02	0.8037	0.0640

Where:  $p = M / 22.41$

$p_i = r \times p$

### Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P <sub>STD</sub>	kg/m <sup>3</sup>	1.321
Wet Density (STP), P <sub>STW</sub>	kg/m <sup>3</sup>	1.280
Dry Density (Actual), P <sub>Actual</sub>	kg/m <sup>3</sup>	0.822
Average Wet Density (Actual), P <sub>ActualW</sub>	kg/m <sup>3</sup>	0.796

Where: P<sub>STD</sub> = sum of component concentrations, kg/m<sup>3</sup> (not including water vapour)

P<sub>STW</sub> = sum of all wet concentrations / 100 x density, kg/m<sup>3</sup> (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 <sup>1</sup>
Temperature	°C	155.0	0.0
Total Pressure	kPa	98.8	101.3
Moisture	%	7.97	0.00
Oxygen (Dry)	%	14.1	11.0

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m <sup>3</sup> /hr	15284
Gas Volumetric Flowrate (STP, Wet)	m <sup>3</sup> /hr	9507
Gas Volumetric Flowrate (STP, Dry)	m <sup>3</sup> /hr	8750
Gas Volumetric Flowrate REF <sup>1</sup>	m <sup>3</sup> /hr	6065

## PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE

(1 of 1)

Parameter	Units	Value
Date of Survey	-	11 /11/2014
Time of Survey	-	10:52 - 10:59
Atmospheric Pressure	kPa	98.9
Stack Static Pressure	Pa	-111
Type of Pitot Used	-	S-Type Pitot
Are Water Droplets Present?	-	No

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C <sub>p</sub>	-	0.84
Number of Lines Available	-	2
Number of Lines Used	-	2

Swirl Point (taken at the sampling points used during testing)																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Angle of Swirl (°)	3	2	3	2																

Sampling Line A						Sampling Line B			
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m <sup>3</sup>	Velocity m/s	ΔP Pa	Temp °C	Wet Density kg/m <sup>3</sup>	Velocity m/s
1	0.03	109.8	155.0	0.796	13.92	103.8	155.0	0.796	13.54
2	0.09	104.7	155.0	0.796	13.60	112.6	155.0	0.796	14.10
3	0.16	107.0	155.0	0.796	13.74	114.9	155.0	0.796	14.24
4	0.22	105.8	155.0	0.796	13.67	108.3	155.0	0.796	13.83
5	0.28	91.3	155.0	0.796	12.70	109.8	155.0	0.796	13.92
6	0.35	102.8	155.0	0.796	13.47	104.7	155.0	0.796	13.60
7	0.41	103.5	155.0	0.796	13.52	107.0	155.0	0.796	13.74
8	0.47	105.1	155.0	0.796	13.62	105.8	155.0	0.796	13.67
9	0.54	103.5	155.0	0.796	13.52	91.3	155.0	0.796	12.70
10	0.60	108.1	155.0	0.796	13.81	102.8	155.0	0.796	13.47
Mean		104.2	155.0	0.796	13.56	106.1	155.0	0.796	13.68

## TOTAL PARTICULATE MATTER: RESULTS SUMMARY

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

### Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m <sup>3</sup>	3.5		3.5
Uncertainty	±mg/m <sup>3</sup>	0.41		0.41
Mass Emission	g/hr	21.8		21.8
Uncertainty	±g/hr	2.6		2.6

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	9.1		9.1
Uncertainty	±% v/v	0.48		0.48

### Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m <sup>3</sup>	0.14		0.14

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	2 / 2
Number of Sampling Points Used	4 / 4
Sample Point I.D.'s	A1, A2, B1, B2

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

### Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

## TOTAL PARTICULATE MATTER: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
<b>Absolute pressure of stack gas, <math>P_s</math></b>			
Barometric pressure, $P_b$	mmHg	741.8	
Stack static pressure, $P_{static}$	mmH <sub>2</sub> O	-11.3	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	740.9	
<b>Volume of water vapour collected, <math>V_{wstd}</math></b>			
Total mass collected in impingers (liquid trap)	g	63.6	
Total mass collected in impingers (silica trap)	g	25.6	
Total mass of liquid collected, $V_{lc}$	g	89.2	
$V_{wstd} = (0.001246)(V_{lc})$	m <sup>3</sup>	0.1111	
<b>Volume of gas metered dry, <math>V_{mstd}</math></b>			
Volume of gas sample through gas meter, $V_m$	m <sup>3</sup>	1.2760	
Gas meter correction factor, $Y_d$	-	0.9810	
Average dry gas meter temperature, $T_m$	°C	28.0	
Average pressure drop across orifice, $\Delta H$	mmH <sub>2</sub> O	45.5	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m <sup>3</sup>	1.1132	
<b>Moisture content, <math>B_{wo}</math> &amp; <math>R_{wv}</math></b>			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m <sup>3</sup>	0.0908	
$B_{wo}$ as a percentage	% v/v	9.08	
Reported Water Vapour, checked with Tables in EN 14790, $R_{wv}$	% v/v	9.08	
<b>Volume of gas metered wet, <math>V_{mstw}</math></b>			
$V_{mstw} = (V_{mstd}) / (100 / (100 - R_{wv}))$	m <sup>3</sup>	1.2243	
<b>Volume of gas metered at Oxygen Reference Conditions, <math>V_{mstd@X\%O_2}</math> &amp; <math>V_{mstw@X\%O_2}</math></b>			
IED & Incinerates Hazardous Material? (Yes = no positive O <sub>2</sub> correction)	-	No	
% wet oxygen measured in gas stream, ACT%O <sub>2w</sub>	% v/v	11.85	
% dry oxygen measured in gas stream, ACT%O <sub>2d</sub>	% v/v	12.87	
% oxygen reference condition, REF%O <sub>2</sub>	% v/v	11.00	
O <sub>2</sub> Reference Factor wet ( $O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$ )	-	1.09	
O <sub>2</sub> Reference Factor dry ( $O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$ )	-	1.23	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m <sup>3</sup>	1.1204	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m <sup>3</sup>	0.9045	
<b>Molecular weight of dry gas stream, <math>M_d</math></b>			
CO <sub>2</sub> (Estimated)	% v/v	6.00	
O <sub>2</sub>	% v/v	12.87	
Total	% v/v	18.87	
N <sub>2</sub>	% v/v	81.13	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	29.47	
<b>Molecular weight of stack gas (wet), <math>M_s</math></b>			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.43	
<b>Velocity of stack gas, <math>V_s</math></b>			
Pitot tube velocity constant, $K_p$	-	34.97	
Velocity pressure coefficient, $C_p$	-	0.84	
Average of velocity heads, $\Delta P_{avg}$	mmH <sub>2</sub> O	10.23	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH <sub>2</sub> O	3.20	
Average stack gas temperature, $T_s$	°C	133.5	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	13.05	
<b>Total flow of stack gas: Actual (<math>Q_a</math>), Wet (<math>Q_{stw}</math>), Dry (<math>Q_{std}</math>), Wet@O<sub>2REF</sub> (<math>Q_{stwO_2}</math>), Dry@O<sub>2REF</sub> (<math>Q_{stdO_2}</math>)</b>			
Area of stack, $A_s$	m <sup>2</sup>	0.31	
$Q_a = (60)(A_s)(V_s)$	m <sup>3</sup> /min	244.2	
Conversion factor (K/mm.Hg), $C_f$	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m <sup>3</sup> /min	159.9	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m <sup>3</sup> /min	145.3	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m <sup>3</sup> /min	146.3	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m <sup>3</sup> /min	118.1	
<b>Percent isokinetic, %I</b>			
Nozzle diameter, $D_n$	mm	6.92	
Nozzle area, $A_n$	mm <sup>2</sup>	37.65	
Total sampling time, $q$	min	60	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	105.7	



## TOTAL PARTICULATE MATTER: SAMPLING DETAILS

### Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	11:05 - 11:35, 11:36 - 12:06	
Sampling Dates	-	13/11/2014	
Sampling Device	-	ISO	
Volume Sampled (REF)	m <sup>3</sup>	0.9045	
Filter I.D. Number	-	47-11730	
Start Filter Mass	g	0.15635	
End Filter Mass	g	0.15628	
Total Mass on Filter	g	-0.00007	
Probe Rinse I.D. Number	-	PR-47-11730	
Start Probe Rinse Mass	g	3.06604	
End Probe Rinse Mass	g	3.06926	
Total Mass in Probe Rinse	g	0.00322	
Total Mass Collected	mg	3.15	
Calculated Concentration	mg/m <sup>3</sup>	3.48	
Balance Uncertainty / LOD	mg/m <sup>3</sup>	0.14	

**Where:** ISO stands for Manual Isokinetic Sampling Train

### Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	13/11/2014	
Average Volume Sampled (REF)	m <sup>3</sup>	0.9045	
Filter I.D. Number	-	47-11725	
Start Filter Mass	g	0.15652	
End Filter Mass	g	0.15658	
Total Mass on Filter	g	0.00006	
Probe Rinse I.D. Number	-	PR-47-11725	
Start Probe Rinse Mass	g	2.99632	
End Probe Rinse Mass	g	2.99635	
Total Mass in Probe Rinse	g	0.00003	
Total Mass Collected	mg	0.09	
Calculated Concentration	mg/m <sup>3</sup>	0.10	
Balance Uncertainty / LOD	mg/m <sup>3</sup>	0.14	

## TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

### Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	20.86	
Pre-Sampling Leak Rate	l/min	0.12	
Post-Sampling Leak Rate	l/min	0.14	
Allowable Leak Rate	l/min	0.42	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	5.3	
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	%	105.7	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m <sup>3</sup>	0.27	
ELV [Daily ELV for IED]	mg/m <sup>3</sup>	20.00	
Allowable Weighing Uncertainty	mg/m <sup>3</sup>	1.00	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	134	
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	15.00	
Pre-Sampling Leak Rate	l/min	0.17	
Post-Sampling Leak Rate	l/min	0.19	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m <sup>3</sup>	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	
(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.	wx	

## TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	$V_m$	1.2760		$uV_m$	m <sup>3</sup>	0.0255	
Sampled Gas Temperature	$T_m$	301.0		$uT_m$	K	2.0	
Sampled Gas Pressure	$p_m$	98.8		$up_m$	kPa	0.5	
Sampled Gas Humidity	$H_m$	0.0		$uH_m$	% v/v	1.0	
Leak	L	0.67		uL	%	-	
Mass of Particulate	m	3.15		um	mg	0.13	
Uncollected Mass	UCM	0.09		uUCM	mg	-	

Measured Quantities	Uncertainty as a Percentage			Requirement of Standard
	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.66		≤1%
Sampled Gas Pressure	%	0.51		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	0.67		≤2%
Mass of Particulate	%	0.72		<5% of ELV
Uncollected Mass	%	-		-

Measured Quantities	Uncertainty in Measurement Units				Sensitivity Coefficient	
	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	$V_m$	m <sup>3</sup>	1.1132		3.13	
Leak	L	mg/m <sup>3</sup>	0.013		1.00	
Mass of Particulate	$L_r$	mg	3.150		1.11	
Uncollected Mass	UCM	mg	0.05		1.11	

Measured Quantities	Uncertainty in Result		
	Units	Run 1	
Sampled Volume (STP)	mg/m <sup>3</sup>	0.092	
Leak	mg/m <sup>3</sup>	0.0135	
Mass of Particulate	mg/m <sup>3</sup>	0.1437	
Uncollected Mass	mg/m <sup>3</sup>	0.0574	

Measured Quantities	Oxygen Correction Part of MU Budget		
	Units	Run 1	
O <sub>2</sub> Correction Factor	-	1.23	
Stack Gas O <sub>2</sub> Content	% v/v	12.87	
MU for O <sub>2</sub> Correction	-	0.08	
Overall MU For O <sub>2</sub> Measurement	%	6.15	

Parameter	Units	Run 1	
Combined uncertainty	mg/m <sup>3</sup>	0.18	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m <sup>3</sup>	0.35	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m <sup>3</sup>	0.41	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m <sup>3</sup>	0.41	
Reported Uncertainty	mg/m <sup>3</sup>	0.41	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	10.2	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	11.9	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	11.9	
Reported Uncertainty	%	11.9	

## HYDROGEN CHLORIDE: RESULTS SUMMARY

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

### Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m <sup>3</sup>	0.07		0.07
Uncertainty	±mg/m <sup>3</sup>	0.01		0.01
Mass Emission	g/hr	0.41		0.41
Uncertainty	±g/hr	0.06		0.06

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	9.1		9.1
Uncertainty	±% v/v	0.48		0.48

### Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m <sup>3</sup>	< 0.02		< 0.02

### General Sampling Information

Parameter	Value
Standard	BS EN 1911
Technical Procedure	CAT-TP-11
Name of Analytical Laboratory	CAT
Analytical Laboratory's Procedure	CAT-AP-01
UKAS Accredited Analysis?	Yes
Date of Sample Analysis	19/11/2014
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	2 / 2
Number of Sampling Points Used	4 / 4
Sample Point I.D.'s	A1, A2, B1, B2

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

### Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

## HYDROGEN CHLORIDE: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
<b>Absolute pressure of stack gas, <math>P_s</math></b>			
Barometric pressure, $P_b$	mmHg	741.8	
Stack static pressure, $P_{static}$	mmH <sub>2</sub> O	-11.3	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	740.9	
<b>Volume of water vapour collected, <math>V_{wstd}</math></b>			
Total mass collected in impingers (liquid trap)	g	63.6	
Total mass collected in impingers (silica trap)	g	25.6	
Total mass of liquid collected, $V_{lc}$	g	89.2	
$V_{wstd} = (0.001246)(V_{lc})$	m <sup>3</sup>	0.1111	
<b>Volume of gas metered dry, <math>V_{mstd}</math></b>			
Volume of gas sample through gas meter, $V_m$	m <sup>3</sup>	1.2760	
Gas meter correction factor, $Y_d$	-	0.9810	
Average dry gas meter temperature, $T_m$	°C	28.0	
Average pressure drop across orifice, $\Delta H$	mmH <sub>2</sub> O	45.5	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m <sup>3</sup>	1.1132	
<b>Moisture content, <math>B_{wo}</math> &amp; <math>R_{wv}</math></b>			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m <sup>3</sup>	0.0908	
$B_{wo}$ as a percentage	% v/v	9.08	
Reported Water Vapour, checked with Tables in EN 14790, $R_{wv}$	% v/v	9.08	
<b>Volume of gas metered wet, <math>V_{mstw}</math></b>			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m <sup>3</sup>	1.2243	
<b>Volume of gas metered at Oxygen Reference Conditions, <math>V_{mstd@X\%O_2}</math> &amp; <math>V_{mstw@X\%O_2}</math></b>			
IED & Incinerates Hazardous Material? (Yes = no positive O <sub>2</sub> correction)	-	No	
% wet oxygen measured in gas stream, ACT%O <sub>2w</sub>	% v/v	11.85	
% dry oxygen measured in gas stream, ACT%O <sub>2d</sub>	% v/v	12.87	
% oxygen reference condition, REF%O <sub>2</sub>	% v/v	11.00	
O <sub>2</sub> Reference Factor wet ( $O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$ )	-	1.09	
O <sub>2</sub> Reference Factor dry ( $O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$ )	-	1.23	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m <sup>3</sup>	1.1204	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m <sup>3</sup>	0.9045	
<b>Molecular weight of dry gas stream, <math>M_d</math></b>			
CO <sub>2</sub> (Estimated)	% v/v	6.00	
O <sub>2</sub>	% v/v	12.87	
Total	% v/v	18.87	
N <sub>2</sub>	% v/v	81.13	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	29.47	
<b>Molecular weight of stack gas (wet), <math>M_s</math></b>			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.43	
<b>Velocity of stack gas, <math>V_s</math></b>			
Pitot tube velocity constant, $K_p$	-	34.97	
Velocity pressure coefficient, $C_p$	-	0.84	
Average of velocity heads, $\Delta P_{avg}$	mmH <sub>2</sub> O	10.23	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH <sub>2</sub> O	3.20	
Average stack gas temperature, $T_s$	°C	133.5	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s + 273})) / (V(M_s)(P_s))$	m/s	13.05	
<b>Total flow of stack gas: Actual (<math>Q_a</math>), Wet (<math>Q_{stw}</math>), Dry (<math>Q_{std}</math>), Wet@O<sub>2REF</sub> (<math>Q_{stwO_2}</math>), Dry@O<sub>2REF</sub> (<math>Q_{stdO_2}</math>)</b>			
Area of stack, $A_s$	m <sup>2</sup>	0.31	
$Q_a = (60)(A_s)(V_s)$	m <sup>3</sup> /min	244.2	
Conversion factor (K/mm.Hg), $C_f$	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m <sup>3</sup> /min	159.9	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m <sup>3</sup> /min	145.3	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m <sup>3</sup> /min	146.3	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m <sup>3</sup> /min	118.1	
<b>Percent isokinetic, %I</b>			
Nozzle diameter, $D_n$	mm	6.92	
Nozzle area, $A_n$	mm <sup>2</sup>	37.65	
Total sampling time, q	min	60	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	105.7	

HYDROGEN CHLORIDE: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	11:05 - 11:35, 11:36 - 12:06	
Sampling Dates	-	13/11/2014	
Sampling Device	-	ISO	
Volume Sampled (REF)	m <sup>3</sup>	0.9045	
Laboratory Result for Front Impingers	µg/ml	0.22	
Laboratory Result for Back Impinger	µg/ml	0.05	
Volume in Front Impingers	ml	246.1	
Volume in Back Impinger	ml	106.5	
Mass in Front Impingers	µg	54.1	
Mass in Back Impinger	µg	< 5.3	
Total Mass Collected	µg	59.5	
Calculated Concentration	mg/m <sup>3</sup>	0.07	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	13/11/2014	
Average Volume Sampled (REF)	m <sup>3</sup>	0.9045	
Laboratory Result for Impingers	µg/ml	< 0.05	
Volume in Impingers	ml	323.4	
Total Mass Collected	µg	< 16.2	
Calculated Concentration	mg/m <sup>3</sup>	< 0.02	

## HYDROGEN CHLORIDE: QUALITY ASSURANCE

(PAGE 1 OF 2)

### Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	20.86	
Pre-Sampling Leak Rate	l/min	0.12	
Post-Sampling Leak Rate	l/min	0.14	
Allowable Leak Rate	l/min	0.42	
Leak Test Acceptable	-	Yes	
Absorption Efficiency	Units	Run 1	
Absorption Efficiency	%	100.0	
Allowable Absorption Efficiency	%	N/A	
Absorption Efficiency Acceptable	-	N/A	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	5.3	
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	%	105.7	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Maximum Filter Temperature	°C	134	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	



**HYDROGEN CHLORIDE: QUALITY ASSURANCE**

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Pre-Sampling Leak Rate	l/min	0.17	
Post-Sampling Leak Rate	l/min	0.19	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m <sup>3</sup>	3.0	
Blank Acceptable	-	Yes	

Method Deviations

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

## HYDROGEN CHLORIDE: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	$V_m$	1.2760		$uV_m$	m <sup>3</sup>	0.0255	
Sampled Gas Temperature	$T_m$	301.0		$uT_m$	K	2.0	
Sampled Gas Pressure	$p_m$	98.8		$up_m$	kPa	0.5	
Sampled Gas Humidity	$H_m$	0.0		$uH_m$	% v/v	1.0	
Leak	L	0.67		$uL$	%	-	
Laboratory Result	$L_r$	6.80		$uL_r$	%	-	

Measured Quantities	Uncertainty as a Percentage			Requirement of Standard
	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.66		≤1%
Sampled Gas Pressure	%	0.51		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	0.67		≤2%
Laboratory Result	%	6.80		No Requirement

Measured Quantities	Uncertainty in Measurement Units				Sensitivity Coefficient	
	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	$V_m$	m <sup>3</sup>	1.1132		0.06	
Leak	L	mg/m <sup>3</sup>	0.0003		1.00	
Laboratory Result	$L_r$	mg/m <sup>3</sup>	0.004		1.00	

Measured Quantities	Uncertainty in Result		
	Units	Run 1	
Sampled Volume (STP)	mg/m <sup>3</sup>	0.0017	
Leak	mg/m <sup>3</sup>	0.0003	
Laboratory Result	mg/m <sup>3</sup>	0.004	

Measured Quantities	Oxygen Correction Part of MU Budget		
	Units	Run 1	
O <sub>2</sub> Correction Factor	-	1.23	
Stack Gas O <sub>2</sub> Content	% v/v	12.87	
MU for O <sub>2</sub> Correction	-	0.08	
Overall MU For O <sub>2</sub> Measurement	%	6.15	

Parameter	Units	Run 1	
Combined uncertainty	mg/m <sup>3</sup>	0.005	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m <sup>3</sup>	0.01	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m <sup>3</sup>	0.01	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m <sup>3</sup>	0.01	
Reported Uncertainty	mg/m <sup>3</sup>	0.01	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	14.3	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	15.6	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	15.6	
Reported Uncertainty	%	15.6	

## CADMIUM & THALLIUM: RESULTS SUMMARY

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

### Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m <sup>3</sup>	0.07		0.07
Uncertainty	±mg/m <sup>3</sup>	0.01		0.01
Mass Emission	g/hr	0.41		0.41
Uncertainty	±g/hr	0.07		0.07

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	11.3		11.3
Uncertainty	±% v/v	0.60		0.60

### Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m <sup>3</sup>	0.0023		0.0023

### General Sampling Information

Parameter	Value
Standard	BS EN 14385
Technical Procedure	CAT-TP-06
Name of Analytical Laboratory	RPS
Analytical Laboratory's Procedure	M31
UKAS Accredited Analysis?	Yes
Date of Sample Analysis	21/11/2014
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	2 / 2
Number of Sampling Points Used	4 / 4
Sample Point I.D.'s	A1, A2, B1, B2

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

### Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

## CADMIUM & THALLIUM: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
<b>Absolute pressure of stack gas, <math>P_s</math></b>			
Barometric pressure, $P_b$	mmHg	741.8	
Stack static pressure, $P_{static}$	mmH <sub>2</sub> O	-13.8	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	740.7	
<b>Volume of water vapour collected, <math>V_{wstd}</math></b>			
Total mass collected in impingers (liquid trap)	g	55.2	
Total mass collected in impingers (silica trap)	g	6.1	
Total mass of liquid collected, $V_{lc}$	g	61.3	
$V_{wstd} = (0.001246)(V_{lc})$	m <sup>3</sup>	0.0764	
<b>Volume of gas metered dry, <math>V_{mstd}</math></b>			
Volume of gas sample through gas meter, $V_m$	m <sup>3</sup>	0.6880	
Gas meter correction factor, $Y_d$	-	0.9810	
Average dry gas meter temperature, $T_m$	°C	29.6	
Average pressure drop across orifice, $\Delta H$	mmH <sub>2</sub> O	47.5	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m <sup>3</sup>	0.5970	
<b>Moisture content, <math>B_{wo}</math> &amp; <math>R_{wv}</math></b>			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m <sup>3</sup>	0.1134	
$B_{wo}$ as a percentage	% v/v	11.34	
Reported Water Vapour, checked with Tables in EN 14790, $R_{wv}$	% v/v	11.34	
<b>Volume of gas metered wet, <math>V_{mstw}</math></b>			
$V_{mstw} = (V_{mstd}) / (100 / (100 - R_{wv}))$	m <sup>3</sup>	0.6734	
<b>Volume of gas metered at Oxygen Reference Conditions, <math>V_{mstd@X\%O_2}</math> &amp; <math>V_{mstw@X\%O_2}</math></b>			
IED & Incinerates Hazardous Material? (Yes = no positive O <sub>2</sub> correction)	-	No	
% wet oxygen measured in gas stream, ACT%O <sub>2w</sub>	% v/v	12.55	
% dry oxygen measured in gas stream, ACT%O <sub>2d</sub>	% v/v	13.63	
% oxygen reference condition, REF%O <sub>2</sub>	% v/v	11.00	
O <sub>2</sub> Reference Factor wet ( $O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$ )	-	1.18	
O <sub>2</sub> Reference Factor dry ( $O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$ )	-	1.36	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m <sup>3</sup>	0.5693	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m <sup>3</sup>	0.4399	
<b>Molecular weight of dry gas stream, <math>M_d</math></b>			
CO <sub>2</sub> (Estimated)	% v/v	6.00	
O <sub>2</sub>	% v/v	13.63	
Total	% v/v	19.63	
N <sub>2</sub>	% v/v	80.37	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	29.51	
<b>Molecular weight of stack gas (wet), <math>M_s</math></b>			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.20	
<b>Velocity of stack gas, <math>V_s</math></b>			
Pitot tube velocity constant, $K_p$	-	34.97	
Velocity pressure coefficient, $C_p$	-	0.84	
Average of velocity heads, $\Delta P_{avg}$	mmH <sub>2</sub> O	10.85	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH <sub>2</sub> O	3.29	
Average stack gas temperature, $T_s$	°C	141.6	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	13.63	
<b>Total flow of stack gas: Actual (<math>Q_a</math>), Wet (<math>Q_{stw}</math>), Dry (<math>Q_{std}</math>), Wet@O<sub>2REF</sub> (<math>Q_{stwO_2}</math>), Dry@O<sub>2REF</sub> (<math>Q_{stdO_2}</math>)</b>			
Area of stack, $A_s$	m <sup>2</sup>	0.31	
$Q_a = (60)(A_s)(V_s)$	m <sup>3</sup> /min	255.0	
Conversion factor (K/mm.Hg), $C_f$	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m <sup>3</sup> /min	163.6	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m <sup>3</sup> /min	145.1	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m <sup>3</sup> /min	138.3	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m <sup>3</sup> /min	106.9	
<b>Percent isokinetic, %I</b>			
Nozzle diameter, $D_n$	mm	6.92	
Nozzle area, $A_n$	mm <sup>2</sup>	37.65	
Total sampling time, $q$	min	32	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	106.5	

## CADMIUM & THALLIUM: SAMPLING DETAILS

### Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	16:01 - 16:17, 16:18 - 16:34	
Sampling Dates	-	12/11/2014	
Sampling Device	-	ISO	
Volume Sampled (REF)	m <sup>3</sup>	0.4399	
<b>Cadmium</b>			
Mass on Filter / in Rinse	µg	0.50	
Mass in Front Impingers	µg	0.06	
Mass in Back Impinger	µg	0.12	
Total Mass Collected	µg	0.68	
Calculated Concentration	mg/m <sup>3</sup>	0.0015	
Reported Concentration	mg/m <sup>3</sup>	0.0015	
Mass Emission	g/hr	0.01	
<b>Thallium</b>			
Mass on Filter / in Rinse	µg	28.00	
Mass in Front Impingers	µg	0.11	
Mass in Back Impinger	µg	0.09	
Total Mass Collected	µg	28.20	
Calculated Concentration	mg/m <sup>3</sup>	0.0641	
Reported Concentration	mg/m <sup>3</sup>	0.0641	
Mass Emission	g/hr	0.40	
<b>Cadmium &amp; Thallium Combined</b>			
Total Mass Collected	µg	28.88	
Calculated Concentration	mg/m <sup>3</sup>	0.0657	
Reported Concentration	mg/m <sup>3</sup>	0.0657	

**Where:** ISO stands for Manual Isokinetic Sampling Train

### Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	12/11/2014	
Average Volume Sampled (REF)	m <sup>3</sup>	0.4399	
<b>Cadmium</b>			
Mass on Filter / in Rinse	µg	0.50	
Mass in Front Impingers	µg	0.04	
Mass in Back Impinger	µg	0.02	
Total Mass Collected	µg	0.56	
Calculated Concentration	mg/m <sup>3</sup>	0.0013	
Reported Concentration	mg/m <sup>3</sup>	0.0013	
<b>Thallium</b>			
Mass on Filter / in Rinse	µg	0.40	
Mass in Front Impingers	µg	0.04	
Mass in Back Impinger	µg	0.02	
Total Mass Collected	µg	0.46	
Calculated Concentration	mg/m <sup>3</sup>	0.0011	
Reported Concentration	mg/m <sup>3</sup>	0.0011	
<b>Cadmium &amp; Thallium Combined</b>			
Total Mass Collected	µg	1.03	
Calculated Concentration	mg/m <sup>3</sup>	0.0023	
Reported Concentration	mg/m <sup>3</sup>	0.0023	

## CADMIUM & THALLIUM: QUALITY ASSURANCE

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### Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	21.09	
Pre-Sampling Leak Rate	l/min	0.09	
Post-Sampling Leak Rate	l/min	0.12	
Allowable Leak Rate	l/min	0.42	
Leak Test Acceptable	-	Yes	
Absorption Efficiency	Units	Run 1	
Cadmium	%	82.1	
Thallium	%	99.7	
Allowable Absorption Efficiency	%	90	
Absorption Efficiency Acceptable	-	No	
Detection Limit	Units	Run 1	
Cadmium	µg/m <sup>3</sup>	1.3	
Thallium	µg/m <sup>3</sup>	1.1	
Allowable Detection Limit	µg/m <sup>3</sup>	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)	%	5.3	
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	%	106.5	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Maximum Filter Temperature	°C	181	
Impingers Exit Temperature	Units	Run 1	
Maximum Temperature Recorded	°C	16	
Maximum Allowable Temperature	°C	30	
Exit Temperature Acceptable	-	Yes	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

CADMIUM & THALLIUM: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Pre-Sampling Leak Rate	l/min	0.18	
Post-Sampling Leak Rate	l/min	0.21	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m <sup>3</sup>	0.0050	
Blank Acceptable	-	Yes	

Method Deviations

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

## CADMIUM & THALLIUM: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	$V_m$	0.6880		$uV_m$	m <sup>3</sup>	0.0138	
Sampled Gas Temperature	$T_m$	302.6		$uT_m$	K	2.0	
Sampled Gas Pressure	$p_m$	98.8		$up_m$	kPa	0.5	
Sampled Gas Humidity	$H_m$	0.0		$uH_m$	% v/v	1.0	
Leak	L	0.57		uL	%	-	
Laboratory Result	$L_r$	7.50		$uL_r$	%	-	

Measured Quantities	Uncertainty as a Percentage			Requirement of Standard
	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.66		≤1%
Sampled Gas Pressure	%	0.51		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	0.57		≤2%
Laboratory Result	%	7.50		No Requirement

Measured Quantities	Uncertainty in Measurement Units				Sensitivity Coefficient	
	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	$V_m$	m <sup>3</sup>	0.5970		0.11	
Leak	L	mg/m <sup>3</sup>	0.0002		1.00	
Laboratory Result	$L_r$	mg/m <sup>3</sup>	0.0049		1.00	

Measured Quantities	Uncertainty in Result		
	Units	Run 1	
Sampled Volume (STP)	mg/m <sup>3</sup>	0.0017	
Leak	mg/m <sup>3</sup>	0.0002	
Laboratory Result	mg/m <sup>3</sup>	0.0049	

Measured Quantities	Oxygen Correction Part of MU Budget		
	Units	Run 1	
O <sub>2</sub> Correction Factor	-	1.36	
Stack Gas O <sub>2</sub> Content	% v/v	13.63	
MU for O <sub>2</sub> Correction	-	0.09	
Overall MU For O <sub>2</sub> Measurement	%	6.79	

Parameter	Units	Run 1	
Combined uncertainty	mg/m <sup>3</sup>	0.0052	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m <sup>3</sup>	0.0102	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m <sup>3</sup>	0.01	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m <sup>3</sup>	0.0112	
Reported Uncertainty	mg/m <sup>3</sup>	0.0112	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	15.6	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	17.0	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	17.0	
Reported Uncertainty	%	17.0	



## HEAVY METALS: RESULTS SUMMARY

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

### Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m <sup>3</sup>	0.08		0.08
Uncertainty	±mg/m <sup>3</sup>	0.01		0.01
Mass Emission	g/hr	0.53		0.53
Uncertainty	±g/hr	0.09		0.09

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	11.3		11.3
Uncertainty	±% v/v	0.60		0.60

### Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m <sup>3</sup>	0.01		0.01

### General Sampling Information

Parameter	Value
Standard	BS EN 14385
Technical Procedure	CAT-TP-06
Name of Analytical Laboratory	RPS
Analytical Laboratory's Procedure	M31
UKAS Accredited Analysis?	Yes
Date of Sample Analysis	21/11/2014
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	2 / 2
Number of Sampling Points Used	4 / 4
Sample Point I.D.'s	A1, A2, B1, B2

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

### Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

# HEAVY METALS: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
<b>Absolute pressure of stack gas, <math>P_s</math></b>			
Barometric pressure, $P_b$	mmHg	741.8	
Stack static pressure, $P_{static}$	mmH <sub>2</sub> O	-13.8	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	740.7	
<b>Volume of water vapour collected, <math>V_{wstd}</math></b>			
Total mass collected in impingers (liquid trap)	g	55.2	
Total mass collected in impingers (silica trap)	g	6.1	
Total mass of liquid collected, $V_{lc}$	g	61.3	
$V_{wstd} = (0.001246)(V_{lc})$	m <sup>3</sup>	0.0764	
<b>Volume of gas metered dry, <math>V_{mstd}</math></b>			
Volume of gas sample through gas meter, $V_m$	m <sup>3</sup>	0.6880	
Gas meter correction factor, $Y_d$	-	0.9810	
Average dry gas meter temperature, $T_m$	°C	29.6	
Average pressure drop across orifice, $\Delta H$	mmH <sub>2</sub> O	47.5	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m <sup>3</sup>	0.5970	
<b>Moisture content, <math>B_{wo}</math> &amp; <math>R_{wv}</math></b>			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m <sup>3</sup>	0.1134	
$B_{wo}$ as a percentage	% v/v	11.34	
Reported Water Vapour, checked with Tables in EN 14790, $R_{wv}$	% v/v	11.34	
<b>Volume of gas metered wet, <math>V_{mstw}</math></b>			
$V_{mstw} = (V_{mstd}) / (100 / (100 - R_{wv}))$	m <sup>3</sup>	0.6734	
<b>Volume of gas metered at Oxygen Reference Conditions, <math>V_{mstd@X\%O_2}</math> &amp; <math>V_{mstw@X\%O_2}</math></b>			
IED & Incinerates Hazardous Material? (Yes = no positive O <sub>2</sub> correction)	-	No	
% wet oxygen measured in gas stream, ACT%O <sub>2w</sub>	% v/v	12.55	
% dry oxygen measured in gas stream, ACT%O <sub>2d</sub>	% v/v	13.63	
% oxygen reference condition, REF%O <sub>2</sub>	% v/v	11.00	
O <sub>2</sub> Reference Factor wet ( $O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$ )	-	1.18	
O <sub>2</sub> Reference Factor dry ( $O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$ )	-	1.36	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m <sup>3</sup>	0.5693	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m <sup>3</sup>	0.4399	
<b>Molecular weight of dry gas stream, <math>M_d</math></b>			
CO <sub>2</sub> (Estimated)	% v/v	6.00	
O <sub>2</sub>	% v/v	13.63	
Total	% v/v	19.63	
N <sub>2</sub>	% v/v	80.37	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	29.51	
<b>Molecular weight of stack gas (wet), <math>M_s</math></b>			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.20	
<b>Velocity of stack gas, <math>V_s</math></b>			
Pitot tube velocity constant, $K_p$	-	34.97	
Velocity pressure coefficient, $C_p$	-	0.84	
Average of velocity heads, $\Delta P_{avg}$	mmH <sub>2</sub> O	10.85	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH <sub>2</sub> O	3.29	
Average stack gas temperature, $T_s$	°C	141.6	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	13.63	
<b>Total flow of stack gas: Actual (<math>Q_a</math>), Wet (<math>Q_{stw}</math>), Dry (<math>Q_{std}</math>), Wet@O<sub>2REF</sub> (<math>Q_{stwO_2}</math>), Dry@O<sub>2REF</sub> (<math>Q_{stdO_2}</math>)</b>			
Area of stack, $A_s$	m <sup>2</sup>	0.31	
$Q_a = (60)(A_s)(V_s)$	m <sup>3</sup> /min	255.0	
Conversion factor (K/mm.Hg), $C_f$	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m <sup>3</sup> /min	163.6	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m <sup>3</sup> /min	145.1	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m <sup>3</sup> /min	138.3	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m <sup>3</sup> /min	106.9	
<b>Percent isokinetic, %I</b>			
Nozzle diameter, $D_n$	mm	6.92	
Nozzle area, $A_n$	mm <sup>2</sup>	37.65	
Total sampling time, $q$	min	32	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	106.5	

## HEAVY METALS: SAMPLING DETAILS

(PAGE 1 OF 5)

### Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	16:01 - 16:17, 16:18 - 16:34	
Sampling Dates	-	12/11/2014	
Sampling Device	-	ISO	
Volume Sampled (REF)	m <sup>3</sup>	0.4399	
<b>Arsenic</b>			
Mass on Filter / in Rinse	µg	0.50	
Mass in Front Impingers	µg	< 0.09	
Mass in Back Impinger	µg	< 0.05	
Total Mass Collected	µg	0.64	
Calculated Concentration	mg/m <sup>3</sup>	0.0015	
Reported Concentration	mg/m <sup>3</sup>	0.0015	
Mass Emission	g/hr	0.01	
<b>Cobalt</b>			
Mass on Filter / in Rinse	µg	< 5.00	
Mass in Front Impingers	µg	0.06	
Mass in Back Impinger	µg	0.05	
Total Mass Collected	µg	5.11	
Calculated Concentration	mg/m <sup>3</sup>	0.0116	
Reported Concentration	mg/m <sup>3</sup>	0.0116	
Mass Emission	g/hr	0.07	
<b>Chromium</b>			
Mass on Filter / in Rinse	µg	2.00	
Mass in Front Impingers	µg	17.51	
Mass in Back Impinger	µg	0.87	
Total Mass Collected	µg	20.38	
Calculated Concentration	mg/m <sup>3</sup>	0.0463	
Reported Concentration	mg/m <sup>3</sup>	0.0463	
Mass Emission	g/hr	0.29	
<b>Copper</b>			
Mass on Filter / in Rinse	µg	1.00	
Mass in Front Impingers	µg	1.72	
Mass in Back Impinger	µg	0.69	
Total Mass Collected	µg	3.42	
Calculated Concentration	mg/m <sup>3</sup>	0.0078	
Reported Concentration	mg/m <sup>3</sup>	0.0078	
Mass Emission	g/hr	0.05	
<b>Manganese</b>			
Mass on Filter / in Rinse	µg	0.70	
Mass in Front Impingers	µg	0.57	
Mass in Back Impinger	µg	0.17	
Total Mass Collected	µg	1.45	
Calculated Concentration	mg/m <sup>3</sup>	0.0033	
Reported Concentration	mg/m <sup>3</sup>	0.0033	
Mass Emission	g/hr	0.02	

## HEAVY METALS: SAMPLING DETAILS

(PAGE 2 OF 5)

### Sample Runs (continued)

Parameter	Units	Run 1	
<b>Nickel</b>			
Mass on Filter / in Rinse	µg	2.00	
Mass in Front Impingers	µg	0.57	
Mass in Back Impinger	µg	0.03	
Total Mass Collected	µg	2.61	
Calculated Concentration	mg/m <sup>3</sup>	0.0059	
Reported Concentration	mg/m <sup>3</sup>	0.0059	
Mass Emission	g/hr	0.04	
<b>Lead</b>			
Mass on Filter / in Rinse	µg	0.60	
Mass in Front Impingers	µg	0.86	
Mass in Back Impinger	µg	0.87	
Total Mass Collected	µg	2.33	
Calculated Concentration	mg/m <sup>3</sup>	0.0053	
Reported Concentration	mg/m <sup>3</sup>	0.0053	
Mass Emission	g/hr	0.03	
<b>Antimony</b>			
Mass on Filter / in Rinse	µg	< 0.60	
Mass in Front Impingers	µg	< 0.06	
Mass in Back Impinger	µg	< 0.03	
Total Mass Collected	µg	< 0.69	
Calculated Concentration	mg/m <sup>3</sup>	< 0.0016	
Reported Concentration	mg/m <sup>3</sup>	< 0.0016	
Mass Emission	g/hr	< 0.01	
<b>Vanadium</b>			
Mass on Filter / in Rinse	µg	< 0.40	
Mass in Front Impingers	µg	0.11	
Mass in Back Impinger	µg	0.05	
Total Mass Collected	µg	0.57	
Calculated Concentration	mg/m <sup>3</sup>	0.0013	
Reported Concentration	mg/m <sup>3</sup>	0.0013	
Mass Emission	g/hr	0.01	

## HEAVY METALS: SAMPLING DETAILS

(PAGE 3 OF 5)

### Sample Runs (continued)

Parameter	Units	Run 1	
<b>Heavy Metals Combined</b>			
Total Mass Collected	µg	37.19	
Calculated Concentration	mg/m <sup>3</sup>	0.0845	
Reported Concentration	mg/m <sup>3</sup>	0.0845	

**Where:** ISO stands for Manual Isokinetic Sampling Train

### Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	12/11/2014	
Average Volume Sampled (REF)	m <sup>3</sup>	0.4399	
<b>Arsenic</b>			
Mass on Filter / in Rinse	µg	< 0.50	
Mass in Front Impingers	µg	< 0.06	
Mass in Back Impinger	µg	< 0.03	
Total Mass Collected	µg	< 0.60	
Calculated Concentration	mg/m <sup>3</sup>	< 0.0014	
Reported Concentration	mg/m <sup>3</sup>	< 0.0014	
<b>Cobalt</b>			
Mass on Filter / in Rinse	µg	< 0.50	
Mass in Front Impingers	µg	< 0.04	
Mass in Back Impinger	µg	< 0.02	
Total Mass Collected	µg	< 0.56	
Calculated Concentration	mg/m <sup>3</sup>	< 0.0013	
Reported Concentration	mg/m <sup>3</sup>	< 0.0013	

## HEAVY METALS: SAMPLING DETAILS

(PAGE 4 OF 5)

### Blank Runs (continued)

Parameter	Units	Blank 1	
<b>Chromium</b>			
Mass on Filter / in Rinse	µg	1.00	
Mass in Front Impingers	µg	0.02	
Mass in Back Impinger	µg	< 0.01	
Total Mass Collected	µg	1.03	
Calculated Concentration	mg/m <sup>3</sup>	0.0023	
Reported Concentration	mg/m <sup>3</sup>	0.0023	
<b>Copper</b>			
Mass on Filter / in Rinse	µg	< 0.60	
Mass in Front Impingers	µg	0.09	
Mass in Back Impinger	µg	< 0.04	
Total Mass Collected	µg	0.73	
Calculated Concentration	mg/m <sup>3</sup>	0.0017	
Reported Concentration	mg/m <sup>3</sup>	0.0017	
<b>Manganese</b>			
Mass on Filter / in Rinse	µg	< 0.40	
Mass in Front Impingers	µg	< 0.04	
Mass in Back Impinger	µg	< 0.02	
Total Mass Collected	µg	< 0.46	
Calculated Concentration	mg/m <sup>3</sup>	< 0.0011	
Reported Concentration	mg/m <sup>3</sup>	< 0.0011	
<b>Nickel</b>			
Mass on Filter / in Rinse	µg	< 0.60	
Mass in Front Impingers	µg	< 0.04	
Mass in Back Impinger	µg	< 0.02	
Total Mass Collected	µg	< 0.66	
Calculated Concentration	mg/m <sup>3</sup>	< 0.0015	
Reported Concentration	mg/m <sup>3</sup>	< 0.0015	
<b>Lead</b>			
Mass on Filter / in Rinse	µg	< 0.50	
Mass in Front Impingers	µg	< 0.04	
Mass in Back Impinger	µg	< 0.02	
Total Mass Collected	µg	< 0.56	
Calculated Concentration	mg/m <sup>3</sup>	< 0.0013	
Reported Concentration	mg/m <sup>3</sup>	< 0.0013	
<b>Antimony</b>			
Mass on Filter / in Rinse	µg	< 0.60	
Mass in Front Impingers	µg	< 0.04	
Mass in Back Impinger	µg	< 0.02	
Total Mass Collected	µg	< 0.66	
Calculated Concentration	mg/m <sup>3</sup>	< 0.0015	
Reported Concentration	mg/m <sup>3</sup>	< 0.0015	
<b>Vanadium</b>			
Mass on Filter / in Rinse	µg	< 0.40	
Mass in Front Impingers	µg	0.04	
Mass in Back Impinger	µg	0.02	
Total Mass Collected	µg	0.46	
Calculated Concentration	mg/m <sup>3</sup>	0.0011	
Reported Concentration	mg/m <sup>3</sup>	0.0011	



HEAVY METALS: SAMPLING DETAILS

(PAGE 5 OF 5)

Blank Runs (continued)

Parameter	Units	Blank 1	
Heavy Metals Combined			
Total Mass Collected	µg	5.75	
Calculated Concentration	mg/m³	0.0131	
Reported Concentration	mg/m³	0.0131	

## HEAVY METALS: QUALITY ASSURANCE

(PAGE 1 OF 2)

### Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	21.09	
Pre-Sampling Leak Rate	l/min	0.09	
Post-Sampling Leak Rate	l/min	0.12	
Allowable Leak Rate	l/min	0.42	
Leak Test Acceptable	-	Yes	

Absorption Efficiency	Units	Run 1	
Arsenic	%	100.0	
Cobalt	%	99.0	
Chromium	%	95.7	
Copper	%	79.7	
Manganese	%	88.0	
Nickel	%	98.7	
Lead	%	62.8	
Antimony	%	100.0	
Vanadium	%	90.8	
Allowable Absorption Efficiency	%	N/A	
Absorption Efficiency Acceptable	-	N/A	

Where the emissions are < 30% of the ELV, MID 14385 does not require the 90% absorption efficiency requirement to be applied

Detection Limit	Units	Run 1	
Arsenic	µg/m <sup>3</sup>	1.5	
Cobalt	µg/m <sup>3</sup>	1.3	
Chromium	µg/m <sup>3</sup>	1.5	
Copper	µg/m <sup>3</sup>	1.8	
Manganese	µg/m <sup>3</sup>	1.1	
Nickel	µg/m <sup>3</sup>	1.6	
Lead	µg/m <sup>3</sup>	1.3	
Antimony	µg/m <sup>3</sup>	1.6	
Vanadium	µg/m <sup>3</sup>	1.0	
Allowable Detection Limit	µg/m <sup>3</sup>	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)	%	5.3	
Allowable MU	%	20	
MU Acceptable	%	Yes	



## HEAVY METALS: QUALITY ASSURANCE

(PAGE 2 OF 2)

Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	106.5	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Maximum Filter Temperature	°C	181	
Impingers Exit Temperature	Units	Run 1	
Maximum Temperature Recorded	°C	16	
Maximum Allowable Temperature	°C	30	
Exit Temperature Acceptable	-	Yes	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

### Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Pre-Sampling Leak Rate	l/min	0.18	
Post-Sampling Leak Rate	l/min	0.21	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	
Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m³	0.0500	
Blank Acceptable	-	Yes	

### Method Deviations

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

## HEAVY METALS: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	$V_m$	0.6880		$uV_m$	m <sup>3</sup>	0.0138	
Sampled Gas Temperature	$T_m$	302.6		$uT_m$	K	2.0	
Sampled Gas Pressure	$p_m$	98.8		$up_m$	kPa	0.5	
Sampled Gas Humidity	$H_m$	0.0		$uH_m$	% v/v	1.0	
Leak	L	0.57		$uL$	%	-	
Laboratory Result	$L_r$	7.00		$uL_r$	%	-	

Measured Quantities	Uncertainty as a Percentage			Requirement of Standard
	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.66		≤1%
Sampled Gas Pressure	%	0.51		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	0.57		≤2%
Laboratory Result	%	7.00		No Requirement

Measured Quantities	Uncertainty in Measurement Units				Sensitivity Coefficient	
	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	$V_m$	m <sup>3</sup>	0.5970		0.14	
Leak	L	mg/m <sup>3</sup>	0.0003		1.00	
Laboratory Result	$L_r$	mg/m <sup>3</sup>	0.0059		1.00	

Measured Quantities	Uncertainty in Result		
	Units	Run 1	
Sampled Volume (STP)	mg/m <sup>3</sup>	0.0022	
Leak	mg/m <sup>3</sup>	0.0003	
Laboratory Result	mg/m <sup>3</sup>	0.0059	

Measured Quantities	Oxygen Correction Part of MU Budget		
	Units	Run 1	
O <sub>2</sub> Correction Factor	-	1.36	
Stack Gas O <sub>2</sub> Content	% v/v	13.63	
MU for O <sub>2</sub> Correction	-	0.09	
Overall MU For O <sub>2</sub> Measurement	%	6.79	

Parameter	Units	Run 1	
Combined uncertainty	mg/m <sup>3</sup>	0.0063	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m <sup>3</sup>	0.0124	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m <sup>3</sup>	0.01	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m <sup>3</sup>	0.0137	
Reported Uncertainty	mg/m <sup>3</sup>	0.0137	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	14.7	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	16.2	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	16.2	
Reported Uncertainty	%	16.2	

## MERCURY: RESULTS SUMMARY

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

### Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m <sup>3</sup>	0.006		0.006
Uncertainty	±mg/m <sup>3</sup>	0.001		0.001
Mass Emission	g/hr	0.04		0.04
Uncertainty	±g/hr	0.01		0.01

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	11.3		11.3
Uncertainty	±% v/v	0.60		0.60

### Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m <sup>3</sup>	< 0.0007		< 0.0007

### General Sampling Information

Parameter	Value
Standard	BS EN 13211
Technical Procedure	CAT-TP-06
Name of Analytical Laboratory	RPS
Analytical Laboratory's Procedure	M112
UKAS Accredited Analysis?	Yes
Date of Sample Analysis	21/11/2014
Probe Material	Titanium
Filter Housing Material	Borosilicate Glass
Impinger Material	Borosilicate Glass
Absorption Solution	Nitric Peroxide & Potassium Dichromate
Positioning of Filter	Out Stack
Filter Size and Material	47mm Quartz Fibre
Number of Sampling Lines Used	2 / 2
Number of Sampling Points Used	4 / 4
Sample Point I.D.'s	A1, A2, B1, B2

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

### Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

## MERCURY: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
<b>Absolute pressure of stack gas, <math>P_s</math></b>			
Barometric pressure, $P_b$	mmHg	741.8	
Stack static pressure, $P_{static}$	mmH <sub>2</sub> O	-13.8	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	740.7	
<b>Volume of water vapour collected, <math>V_{wstd}</math></b>			
Total mass collected in impingers (liquid trap)	g	55.2	
Total mass collected in impingers (silica trap)	g	6.1	
Total mass of liquid collected, $V_{lc}$	g	61.3	
$V_{wstd} = (0.001246)(V_{lc})$	m <sup>3</sup>	0.0764	
<b>Volume of gas metered dry, <math>V_{mstd}</math></b>			
Volume of gas sample through gas meter, $V_m$	m <sup>3</sup>	0.6880	
Gas meter correction factor, $Y_d$	-	0.9810	
Average dry gas meter temperature, $T_m$	°C	29.6	
Average pressure drop across orifice, $\Delta H$	mmH <sub>2</sub> O	47.5	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m <sup>3</sup>	0.5970	
<b>Moisture content, <math>B_{wo}</math> &amp; <math>R_{wv}</math></b>			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m <sup>3</sup>	0.1134	
$B_{wo}$ as a percentage	% v/v	11.34	
Reported Water Vapour, checked with Tables in EN 14790, $R_{wv}$	% v/v	11.34	
<b>Volume of gas metered wet, <math>V_{mstw}</math></b>			
$V_{mstw} = (V_{mstd}) / (100 / (100 - R_{wv}))$	m <sup>3</sup>	0.6734	
<b>Volume of gas metered at Oxygen Reference Conditions, <math>V_{mstd@X\%O_2}</math> &amp; <math>V_{mstw@X\%O_2}</math></b>			
IED & Incinerates Hazardous Material? (Yes = no positive O <sub>2</sub> correction)	-	No	
% wet oxygen measured in gas stream, ACT%O <sub>2w</sub>	% v/v	12.55	
% dry oxygen measured in gas stream, ACT%O <sub>2d</sub>	% v/v	13.63	
% oxygen reference condition, REF%O <sub>2</sub>	% v/v	11.00	
O <sub>2</sub> Reference Factor wet ( $O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$ )	-	1.18	
O <sub>2</sub> Reference Factor dry ( $O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$ )	-	1.36	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m <sup>3</sup>	0.5693	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m <sup>3</sup>	0.4399	
<b>Molecular weight of dry gas stream, <math>M_d</math></b>			
CO <sub>2</sub> (Estimated)	% v/v	6.00	
O <sub>2</sub>	% v/v	13.63	
Total	% v/v	19.63	
N <sub>2</sub>	% v/v	80.37	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	29.51	
<b>Molecular weight of stack gas (wet), <math>M_s</math></b>			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.20	
<b>Velocity of stack gas, <math>V_s</math></b>			
Pitot tube velocity constant, $K_p$	-	34.97	
Velocity pressure coefficient, $C_p$	-	0.84	
Average of velocity heads, $\Delta P_{avg}$	mmH <sub>2</sub> O	10.85	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH <sub>2</sub> O	3.29	
Average stack gas temperature, $T_s$	°C	141.6	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	13.63	
<b>Total flow of stack gas: Actual (<math>Q_a</math>), Wet (<math>Q_{stw}</math>), Dry (<math>Q_{std}</math>), Wet@O<sub>2REF</sub> (<math>Q_{stwO_2}</math>), Dry@O<sub>2REF</sub> (<math>Q_{stdO_2}</math>)</b>			
Area of stack, $A_s$	m <sup>2</sup>	0.31	
$Q_a = (60)(A_s)(V_s)$	m <sup>3</sup> /min	255.0	
Conversion factor (K/mm.Hg), $C_f$	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m <sup>3</sup> /min	163.6	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m <sup>3</sup> /min	145.1	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m <sup>3</sup> /min	138.3	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m <sup>3</sup> /min	106.9	
<b>Percent isokinetic, %I</b>			
Nozzle diameter, $D_n$	mm	6.92	
Nozzle area, $A_n$	mm <sup>2</sup>	37.65	
Total sampling time, $q$	min	32	
$\%I = (4.6398E^6)(T_s+273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	106.5	

MERCURY: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	16:01 - 16:17, 16:18 - 16:34	
Sampling Dates	-	12/11/2014	
Sampling Device	-	ISO	
Volume Sampled (REF)	m <sup>3</sup>	0.4399	
Mass on Filter / in Rinse	µg	0.07	
Mass in Front Impinger/s	µg	2.40	
Mass in Final Impinger	µg	< 0.10	
Total Mass Collected	µg	2.57	
Calculated Concentration	mg/m <sup>3</sup>	0.0058	
Reported Concentration	mg/m <sup>3</sup>	0.0058	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	12/11/2014	
Average Volume Sampled (REF)	m <sup>3</sup>	0.4399	
Mass on Filter / in Rinse	µg	< 0.03	
Mass in Front Impinger/s	µg	< 0.22	
Mass in Final Impinger	µg	< 0.06	
Total Mass Collected	µg	< 0.30	
Calculated Concentration	mg/m <sup>3</sup>	< 0.0007	
Reported Concentration	mg/m <sup>3</sup>	< 0.0007	

## MERCURY: QUALITY ASSURANCE

(PAGE 1 OF 2)

### Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	21.09	
Pre-Sampling Leak Rate	l/min	0.09	
Post-Sampling Leak Rate	l/min	0.12	
Allowable Leak Rate	l/min	0.42	
Leak Test Acceptable	-	Yes	

Absorption Efficiency	Units	Run 1	
Absorption Efficiency	%	100.0	
Allowable Absorption Efficiency	%	N/A	
Absorption Efficiency Acceptable	-	N/A	

Where the emissions are < 30% of the ELV, MID 14385 does not require the 95% absorption efficiency requirement to be applied

Concentration in Final Impinger	Units	Run 1	
Concentration in Final Impinger	µg/m <sup>3</sup>	0.23	
Allowable Concentration	µg/m <sup>3</sup>	2.0	
Concentration Acceptable	-	Yes	

Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	

MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	5.3	
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	%	106.5	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	

Filter Temperatures	Units	Run 1	
Maximum Filter Temperature	°C	181	

Impingers Exit Temperature	Units	Run 1	
Maximum Temperature Recorded	°C	16	
Maximum Allowable Temperature	°C	30	
Exit Temperature Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

MERCURY: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Pre-Sampling Leak Rate	l/min	0.18	
Post-Sampling Leak Rate	l/min	0.21	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m <sup>3</sup>	0.0050	
Blank Acceptable	-	Yes	

Method Deviations

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

## MERCURY: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	$V_m$	0.6880		$uV_m$	m <sup>3</sup>	0.0138	
Sampled Gas Temperature	$T_m$	302.6		$uT_m$	K	2.0	
Sampled Gas Pressure	$p_m$	98.8		$up_m$	kPa	0.5	
Sampled Gas Humidity	$H_m$	0.0		$uH_m$	% v/v	1.0	
Leak	L	0.57		$uL$	%	-	
Laboratory Result	$L_r$	6.00		$uL_r$	%	-	

Measured Quantities	Uncertainty as a Percentage			Requirement of Standard
	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.66		≤1%
Sampled Gas Pressure	%	0.51		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	0.57		≤2%
Laboratory Result	%	6.00		No Requirement

Measured Quantities	Uncertainty in Measurement Units				Sensitivity Coefficient	
	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	$V_m$	m <sup>3</sup>	0.5970		0.01	
Leak	L	mg/m <sup>3</sup>	0.00002		1.00	
Laboratory Result	$L_r$	mg/m <sup>3</sup>	0.0004		1.00	

Measured Quantities	Uncertainty in Result		
	Units	Run 1	
Sampled Volume (STP)	mg/m <sup>3</sup>	0.0002	
Leak	mg/m <sup>3</sup>	0.00002	
Laboratory Result	mg/m <sup>3</sup>	0.0004	

Measured Quantities	Oxygen Correction Part of MU Budget		
	Units	Run 1	
O <sub>2</sub> Correction Factor	-	1.36	
Stack Gas O <sub>2</sub> Content	% v/v	13.63	
MU for O <sub>2</sub> Correction	-	0.09	
Overall MU For O <sub>2</sub> Measurement	%	6.79	

Parameter	Units	Run 1	
Combined uncertainty	mg/m <sup>3</sup>	0.0004	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m <sup>3</sup>	0.0008	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m <sup>3</sup>	0.0009	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m <sup>3</sup>	0.0009	
Reported Uncertainty	mg/m <sup>3</sup>	0.0009	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	12.9	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	14.5	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	14.5	
Reported Uncertainty	%	14.5	



# DIOXINS & FURANS: RESULTS SUMMARY

(PAGE 1 OF 4)

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

## TEQ1 - UPPER LIMITS (worst case where <LOD = LOD)

### Sample Runs (UPPER NATO I-TEQ)

Parameter	Units	Run 1		Mean
Concentration	ng/m <sup>3</sup>	0.018		0.018
Uncertainty	±ng/m <sup>3</sup>	0.004		0.004
Mass Emission	µg/hr	0.11		0.11
Uncertainty	±µg/hr	0.02		0.02

### Sample Runs (UPPER WHO TEQ Humans / Mammals)

Parameter	Units	Run 1		Mean
Concentration	ng/m <sup>3</sup>	0.02		0.02
Uncertainty	±ng/m <sup>3</sup>	0.003		0.003
Mass Emission	µg/hr	0.10		0.10
Uncertainty	±µg/hr	0.02		0.02

### Sample Runs (UPPER WHO TEQ Fish)

Parameter	Units	Run 1		Mean
Concentration	ng/m <sup>3</sup>	0.018		0.018
Uncertainty	±ng/m <sup>3</sup>	0.004		0.004
Mass Emission	µg/hr	0.12		0.12
Uncertainty	±µg/hr	0.02		0.02

### Sample Runs (UPPER WHO TEQ Birds)

Parameter	Units	Run 1		Mean
Concentration	ng/m <sup>3</sup>	0.03		0.03
Uncertainty	±ng/m <sup>3</sup>	0.01		0.01
Mass Emission	µg/hr	0.21		0.21
Uncertainty	±µg/hr	0.04		0.04

## DIOXINS & FURANS: RESULTS SUMMARY

(PAGE 2 OF 4)

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

### TEQ2 - LOWER LIMITS (best case where <LOD = 0)

#### Sample Runs (LOWER NATO I-TEQ)

Parameter	Units	Run 1		Mean
Concentration	ng/m <sup>3</sup>	0.018		0.018
Uncertainty	±ng/m <sup>3</sup>	0.004		0.004
Mass Emission	µg/hr	0.11		0.11
Uncertainty	±µg/hr	0.02		0.02

#### Sample Runs (LOWER WHO TEQ Humans / Mammals)

Parameter	Units	Run 1		Mean
Concentration	ng/m <sup>3</sup>	0.016		0.016
Uncertainty	±ng/m <sup>3</sup>	0.003		0.003
Mass Emission	µg/hr	0.10		0.10
Uncertainty	±µg/hr	0.02		0.02

#### Sample Runs (LOWER WHO TEQ Fish)

Parameter	Units	Run 1		Mean
Concentration	ng/m <sup>3</sup>	0.018		0.018
Uncertainty	±ng/m <sup>3</sup>	0.004		0.004
Mass Emission	µg/hr	0.12		0.12
Uncertainty	±µg/hr	0.02		0.02

#### Sample Runs (LOWER WHO TEQ Birds)

Parameter	Units	Run 1		Mean
Concentration	ng/m <sup>3</sup>	0.033		0.033
Uncertainty	±ng/m <sup>3</sup>	0.007		0.007
Mass Emission	µg/hr	0.21		0.21
Uncertainty	±µg/hr	0.04		0.04

## DIOXINS & FURANS: RESULTS SUMMARY

(PAGE 3 OF 4)

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

### TEQ1 - UPPER LIMITS (worst case where <LOD = LOD)

#### Blank Runs (UPPER NATO I-TEQ)

Parameter	Units	Blank 1		Maximum
Concentration	ng/m <sup>3</sup>	0.0004		0.0004

#### Blank Runs (UPPER WHO TEQ Humans / Mammals)

Parameter	Units	Blank 1		Maximum
Concentration	ng/m <sup>3</sup>	0.0004		0.0004

#### Blank Runs (UPPER WHO TEQ Fish)

Parameter	Units	Blank 1		Maximum
Concentration	ng/m <sup>3</sup>	0.0004		0.0004

#### Blank Runs (UPPER WHO TEQ Birds)

Parameter	Units	Blank 1		Maximum
Concentration	ng/m <sup>3</sup>	0.0007		0.0007

### TEQ2 - LOWER LIMITS (best case where <LOD = 0)

#### Blank Runs (LOWER NATO I-TEQ)

Parameter	Units	Blank 1		Maximum
Concentration	ng/m <sup>3</sup>	0.0001		0.0001

#### Blank Runs (LOWER WHO TEQ Humans / Mammals)

Parameter	Units	Blank 1		Maximum
Concentration	ng/m <sup>3</sup>	0.0001		0.0001

#### Blank Runs (LOWER WHO TEQ Fish)

Parameter	Units	Blank 1		Maximum
Concentration	ng/m <sup>3</sup>	0.0001		0.0001

#### Blank Runs (LOWER WHO TEQ Birds)

Parameter	Units	Blank 1		Maximum
Concentration	ng/m <sup>3</sup>	0.0002		0.0002

## DIOXINS &amp; FURANS: RESULTS SUMMARY

(PAGE 4 OF 4)

SITA Healthcare Ltd, Wrexham

A1 - Main Stack

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	8.0		8.0
Uncertainty	±% v/v	0.46		0.46

## General Sampling Information

Parameter	Value
Standard	EN 1948
Technical Procedure	CAT-TP-07
Name of Analytical Laboratory	MAR
Analytical Laboratory's Procedure	WI 1122
UKAS Accredited Analysis?	Yes
Date of Sample Analysis	01/12/2014
Probe Material	Titanium
Filter Housing Material	Borosilicate Glass
Glassware Material	Borosilicate Glass
Absorption Material	XAD-2
Positioning of Filter	Out Stack
Filter Size and Material	90mm Quartz Fibre
Number of Sampling Lines Used	2 / 2
Number of Sampling Points Used	4 / 4
Sample Point I.D.'s	A1, A2, B1, B2

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

## Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

## DIOXINS & FURANS: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
<b>Absolute pressure of stack gas, P<sub>s</sub></b>			
Barometric pressure, P <sub>b</sub>	mmHg	741.8	
Stack static pressure, P <sub>static</sub>	mmH <sub>2</sub> O	-14.4	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	740.7	
<b>Volume of water vapour collected, V<sub>wstd</sub></b>			
Total mass collected in impingers (liquid trap)	g	316.4	
Total mass collected in impingers (silica trap)	g	74.6	
Total mass of liquid collected, V <sub>lc</sub>	g	391.0	
$V_{wstd} = (0.001246)(V_{lc})$	m <sup>3</sup>	0.4872	
<b>Volume of gas metered dry, V<sub>mstd</sub></b>			
Volume of gas sample through gas meter, V <sub>m</sub>	m <sup>3</sup>	6.4450	
Gas meter correction factor, Y <sub>d</sub>	-	0.9810	
Average dry gas meter temperature, T <sub>m</sub>	°C	29.6	
Average pressure drop across orifice, ΔH	mmH <sub>2</sub> O	36.5	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m <sup>3</sup>	5.5870	
<b>Moisture content, B<sub>wo</sub> &amp; R<sub>wv</sub></b>			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m <sup>3</sup>	0.0802	
B <sub>wo</sub> as a percentage	% v/v	8.02	
Reported Water Vapour, checked with Tables in EN 14790, R <sub>wv</sub>	% v/v	8.02	
<b>Volume of gas metered wet, V<sub>mstw</sub></b>			
$V_{mstw} = (V_{mstd}) / (100 / (100 - R_{wv}))$	m <sup>3</sup>	6.0740	
<b>Volume of gas metered at Oxygen Reference Conditions, V<sub>mstd@X%O<sub>2</sub></sub> &amp; V<sub>mstw@X%O<sub>2</sub></sub></b>			
IED & Incinerates Hazardous Material? (Yes = no positive O <sub>2</sub> correction)	-	No	
% wet oxygen measured in gas stream, ACT%O <sub>2w</sub>	% v/v	12.88	
% dry oxygen measured in gas stream, ACT%O <sub>2d</sub>	% v/v	13.99	
% oxygen reference condition, REF%O <sub>2</sub>	% v/v	11.00	
O <sub>2</sub> Reference Factor wet (O <sub>2REFw</sub> ) = (21 - REF%O <sub>2</sub> ) / (21 - ACT%O <sub>2w</sub> )	-	1.23	
O <sub>2</sub> Reference Factor dry (O <sub>2REFd</sub> ) = (21 - REF%O <sub>2</sub> ) / (21 - ACT%O <sub>2d</sub> )	-	1.43	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m <sup>3</sup>	4.9335	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m <sup>3</sup>	3.9153	
<b>Molecular weight of dry gas stream, M<sub>d</sub></b>			
CO <sub>2</sub> (Estimated)	% v/v	6.00	
O <sub>2</sub>	% v/v	13.99	
Total	% v/v	19.99	
N <sub>2</sub>	% v/v	80.01	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	29.52	
<b>Molecular weight of stack gas (wet), M<sub>s</sub></b>			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.60	
<b>Velocity of stack gas, V<sub>s</sub></b>			
Pitot tube velocity constant, K <sub>p</sub>	-	34.97	
Velocity pressure coefficient, C <sub>p</sub>	-	0.84	
Average of velocity heads, ΔP <sub>avg</sub>	mmH <sub>2</sub> O	8.73	
Average square root of velocity heads, √ΔP	√mmH <sub>2</sub> O	2.95	
Average stack gas temperature, T <sub>s</sub>	°C	160.9	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s + 273})) / (\sqrt{M_s}(P_s))$	m/s	12.42	
<b>Total flow of stack gas: Actual (Q<sub>a</sub>), Wet (Q<sub>stw</sub>), Dry (Q<sub>std</sub>), Wet@O<sub>2REF</sub> (Q<sub>stwO<sub>2</sub></sub>), Dry@O<sub>2REF</sub> (Q<sub>stdO<sub>2</sub></sub>)</b>			
Area of stack, A <sub>s</sub>	m <sup>2</sup>	0.31	
$Q_a = (60)(A_s)(V_s)$	m <sup>3</sup> /min	232.4	
Conversion factor (K/mm.Hg), C <sub>f</sub>	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m <sup>3</sup> /min	142.5	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m <sup>3</sup> /min	131.1	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m <sup>3</sup> /min	115.7	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m <sup>3</sup> /min	91.9	
<b>Percent isokinetic, %I</b>			
Nozzle diameter, D <sub>n</sub>	mm	6.92	
Nozzle area, A <sub>n</sub>	mm <sup>2</sup>	37.65	
Total sampling time, q	min	360	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	98.0	

## DIOXINS & FURANS: SAMPLING DETAILS

### RUN 1

Parameter	Units	Value
Sampling Times	-	11:39 - 14:39, 14:40 - 17:40
Sampling Dates	-	11/11/2014
Sampling Device	-	ISO
Volume Sampled (REF)	m <sup>3</sup>	3.9168

**Where:** ISO stands for Manual Isokinetic Sampling Train

Parameter	Units	Result	DL	NATO I-TEQ		WHO Humans / Mammals		WHO Fish		WHO Birds		% Rec
				TEQ1	TEQ2	TEQ1	TEQ2	TEQ1	TEQ2	TEQ1	TEQ2	
2378-TCDF	ng	0.0341	0.0037	0.0034	0.0034	0.0034	0.0034	0.0017	0.0017	0.0341	0.0341	80
12378-PCDF	ng	0.0292	0.0003	0.0015	0.0015	0.0009	0.0009	0.0015	0.0015	0.0029	0.0029	80
23478-PCDF	ng	0.0509	0.0003	0.0255	0.0255	0.0153	0.0153	0.0255	0.0255	0.0509	0.0509	128
123478-HxCDF	ng	0.0575	0.0011	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	80
123678-HxCDF	ng	0.0614	0.0009	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	91
234678-HxCDF	ng	0.0981	0.0010	0.0098	0.0098	0.0098	0.0098	0.0098	0.0098	0.0098	0.0098	79
123789-HxCDF	ng	0.0058	0.0011	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	126
1234678-HpCDF	ng	0.2198	0.0004	0.0022	0.0022	0.0022	0.0022	0.0022	0.0022	0.0022	0.0022	86
1234789-HpCDF	ng	0.0289	0.0004	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	102
OCDF	ng	0.1288	0.0003	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	82
Total Furans	ng	0.7145	-	0.0552	0.0552	0.0444	0.0444	0.0534	0.0534	0.1127	0.1127	-
2378-TCDD	ng	0.0048	0.0013	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	92
12378-PCDD	ng	0.0106	0.0005	0.0053	0.0053	0.0106	0.0106	0.0106	0.0106	0.0106	0.0106	111
123478-HxCDD	ng	0.0065	0.0014	0.0007	0.0007	0.0007	0.0007	0.0033	0.0033	0.0003	0.0003	94
123678-HxCDD	ng	0.0131	0.0016	0.0013	0.0013	0.0013	0.0013	0.0001	0.0001	0.0001	0.0001	87
123789-HxCDD	ng	0.0077	0.0016	0.0008	0.0008	0.0008	0.0008	0.0001	0.0001	0.0008	0.0008	-
1234678-HpCDD	ng	0.0669	0.0003	0.0007	0.0007	0.0007	0.0007	0.0001	0.0001	0.0001	0.0001	89
OCDD	ng	0.0801	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	91
Total Dioxins	ng	0.1897	-	0.0136	0.0136	0.0188	0.0188	0.0189	0.0189	0.0167	0.0167	-
Totals	ng	0.9042	-	0.0688	0.0688	0.0632	0.0632	0.0723	0.0723	0.1294	0.1294	-
Total Concentration	ng/m <sup>3</sup>	-	-	0.0176	0.0176	0.0161	0.0161	0.0185	0.0185	0.0330	0.0330	-
Limit of Detection	ng/m <sup>3</sup>	-	-	0.0008	-	0.0008	-	0.0008	-	0.0017	-	-

**Where:** ND stands for Non Detected  
DL stands for Analytical Detection Limit  
TEQ1 refers to Non Detected Congeners at the Detection Limit  
TEQ2 refers to Non Detected Congeners at Zero  
% Rec stands for the Recovery Percentage of the Sample

## DIOXINS & FURANS: QUALITY ASSURANCE

(PAGE 1 OF 2)

### Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	17.56	
Pre-Sampling Leak Rate	l/min	0.26	
Post-Sampling Leak Rate	l/min	0.34	
Allowable Leak Rate	l/min	0.88	
Leak Test Acceptable	-	Yes	
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	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	98.0	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Maximum Filter Temperature	°C	120	
Condenser Exit Temperature	Units	Run 1	
Maximum Temperature Recorded	°C	19	
Maximum Allowable Temperature	°C	20	
Exit Temperature Acceptable	-	Yes	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

DIOXINS & FURANS: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Sampling Leak Rate	l/min	0.28	
Allowable Leak Rate	l/min	0.75	
Leak Test Acceptable	-	Yes	

Validity of NATO I-TEQ Blank vs ELV	Units	Blank 1	
Allowable Blank	ng/m <sup>3</sup>	0.0100	
Blank Acceptable	-	Yes	

Method Deviations

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



## DIOXINS & FURANS (NATO I-TEQ): MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	$V_m$	6.4450		$uV_m$	m <sup>3</sup>	0.1289	
Sampled Gas Temperature	$T_m$	302.6		$uT_m$	K	2.0	
Sampled Gas Pressure	$p_m$	98.8		$up_m$	kPa	0.5	
Sampled Gas Humidity	$H_m$	0.0		$uH_m$	% v/v	1.0	
Leak	L	1.94		uL	%	-	
Laboratory Result	$L_r$	10.00		$uL_r$	%	-	

Measured Quantities	Uncertainty as a Percentage			Requirement of Standard
	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.66		≤1%
Sampled Gas Pressure	%	0.51		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	1.94		≤5%
Laboratory Result	%	10.00		No Requirement

Measured Quantities	Uncertainty in Measurement Units				Sensitivity Coefficient	
	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	$V_m$	m <sup>3</sup>	5.5891		0.003	
Leak	L	ng/m <sup>3</sup>	0.0002		1.00	
Laboratory Result	$L_r$	ng/m <sup>3</sup>	0.0018		1.00	

Measured Quantities	Uncertainty in Result		
	Units	Run 1	
Sampled Volume (STP)	ng/m <sup>3</sup>	0.0005	
Leak	ng/m <sup>3</sup>	0.0002	
Laboratory Result	ng/m <sup>3</sup>	0.0018	

Measured Quantities	Oxygen Correction Part of MU Budget		
	Units	Run 1	
O <sub>2</sub> Correction Factor	-	1.43	
Stack Gas O <sub>2</sub> Content	% v/v	13.99	
MU for O <sub>2</sub> Correction	-	0.10	
Overall MU For O <sub>2</sub> Measurement	%	7.13	

Parameter	Units	Run 1	
Combined uncertainty	ng/m <sup>3</sup>	0.0018	
Expanded uncertainty (95% confidence), without Oxygen Correction	ng/m <sup>3</sup>	0.0036	
Expanded uncertainty (95% confidence), with Oxygen Correction	ng/m <sup>3</sup>	0.0038	
Expanded uncertainty (95% confidence), estimated with Method Deviations	ng/m <sup>3</sup>	0.0038	
Reported Uncertainty	ng/m <sup>3</sup>	0.0038	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	20.4	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	21.6	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	21.6	
Reported Uncertainty	%	21.6	

## PCBs: RESULTS SUMMARY

(PAGE 1 OF 4)

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

### TEQ1 - UPPER LIMITS (worst case where <LOD = LOD)

#### Sample Runs (UPPER WHO TEQ Humans / Mammals)

Parameter	Units	Run 1		Mean
Concentration	ng/m <sup>3</sup>	0.003		0.003
Uncertainty	±ng/m <sup>3</sup>	0.001		0.001
Mass Emission	µg/hr	0.02		0.02
Uncertainty	±µg/hr	0.004		0.004

#### Sample Runs (UPPER WHO TEQ Fish)

Parameter	Units	Run 1		Mean
Concentration	ng/m <sup>3</sup>	0.00013		0.00013
Uncertainty	±ng/m <sup>3</sup>	0.00003		0.00003
Mass Emission	µg/hr	0.001		0.001
Uncertainty	±µg/hr	0.0002		0.0002

#### Sample Runs (UPPER WHO TEQ Birds)

Parameter	Units	Run 1		Mean
Concentration	ng/m <sup>3</sup>	0.006		0.006
Uncertainty	±ng/m <sup>3</sup>	0.001		0.001
Mass Emission	µg/hr	0.03		0.03
Uncertainty	±µg/hr	0.008		0.008

PCBs: RESULTS SUMMARY  
(PAGE 2 OF 4)

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

TEQ2 - LOWER LIMITS (best case where <LOD = 0)

Sample Runs (LOWER WHO TEQ Humans / Mammals)

Parameter	Units	Run 1		Mean
Concentration	ng/m³	0.0028		0.0028
Uncertainty	±ng/m³	0.0006		0.0006
Mass Emission	µg/hr	0.02		0.02
Uncertainty	±µg/hr	0.004		0.004

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

Sample Runs (LOWER WHO TEQ Fish)

Parameter	Units	Run 1		Mean
Concentration	ng/m³	0.00013		0.00013
Uncertainty	±ng/m³	0.00003		0.00003
Mass Emission	µg/hr	0.001		0.001
Uncertainty	±µg/hr	0.0002		0.0002

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

Sample Runs (LOWER WHO TEQ Birds)

Parameter	Units	Run 1		Mean
Concentration	ng/m³	0.005570		0.005570
Uncertainty	±ng/m³	0.001203		0.001203
Mass Emission	µg/hr	0.035		0.035
Uncertainty	±µg/hr	0.008		0.008

## PCBs: RESULTS SUMMARY

(PAGE 3 OF 4)

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

### TEQ1 - UPPER LIMITS (worst case where <LOD = LOD)

#### Blank Runs (UPPER WHO TEQ Humans / Mammals)

Parameter	Units	Blank 1		Maximum
Concentration	ng/m <sup>3</sup>	0.003		0.003

#### Blank Runs (UPPER WHO TEQ Fish)

Parameter	Units	Blank 1		Maximum
Concentration	ng/m <sup>3</sup>	0.0001		0.0001

#### Blank Runs (UPPER WHO TEQ Birds)

Parameter	Units	Blank 1		Maximum
Concentration	ng/m <sup>3</sup>	0.005		0.005

### TEQ2 - LOWER LIMITS (best case where <LOD = 0)

#### Blank Runs (LOWER WHO TEQ Humans / Mammals)

Parameter	Units	Blank 1		Maximum
Concentration	ng/m <sup>3</sup>	0.0028		0.0028

#### Blank Runs (LOWER WHO TEQ Fish)

Parameter	Units	Blank 1		Maximum
Concentration	ng/m <sup>3</sup>	0.0001		0.0001

#### Blank Runs (LOWER WHO TEQ Birds)

Parameter	Units	Blank 1		Maximum
Concentration	ng/m <sup>3</sup>	0.0050		0.0050

## PCBs: RESULTS SUMMARY

(PAGE 4 OF 4)

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	8.02		8.02
Uncertainty	±% v/v	0.46		0.46

### General Sampling Information

Parameter	Value
Standard	EN 1948
Technical Procedure	CAT-TP-07
Name of Analytical Laboratory	MAR
Analytical Laboratory's Procedure	WI 1180
UKAS Accredited Analysis?	Yes
Date of Sample Analysis	01/12/2014
Probe Material	Titanium
Filter Housing Material	Borosilicate Glass
Glassware Material	Borosilicate Glass
Absorption Material	XAD-2
Positioning of Filter	Out Stack
Filter Size and Material	90mm Quartz Fibre
Number of Sampling Lines Used	2 / 2
Number of Sampling Points Used	4 / 4
Sample Point I.D.'s	A1, A2, B1, B2

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

### Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

## PCBs: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
<b>Absolute pressure of stack gas, <math>P_s</math></b>			
Barometric pressure, $P_b$	mmHg	741.8	
Stack static pressure, $P_{static}$	mmH <sub>2</sub> O	-14.4	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	740.7	
<b>Volume of water vapour collected, <math>V_{wstd}</math></b>			
Total mass collected in impingers (liquid trap)	g	316.4	
Total mass collected in impingers (silica trap)	g	74.6	
Total mass of liquid collected, $V_{lc}$	g	391.0	
$V_{wstd} = (0.001246)(V_{lc})$	m <sup>3</sup>	0.4872	
<b>Volume of gas metered dry, <math>V_{mstd}</math></b>			
Volume of gas sample through gas meter, $V_m$	m <sup>3</sup>	6.4450	
Gas meter correction factor, $Y_d$	-	0.9810	
Average dry gas meter temperature, $T_m$	°C	29.6	
Average pressure drop across orifice, $\Delta H$	mmH <sub>2</sub> O	36.5	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m <sup>3</sup>	5.5870	
<b>Moisture content, <math>B_{wo}</math> &amp; <math>R_{wv}</math></b>			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m <sup>3</sup>	0.0802	
$B_{wo}$ as a percentage	% v/v	8.02	
Reported Water Vapour, checked with Tables in EN 14790, $R_{wv}$	% v/v	8.02	
<b>Volume of gas metered wet, <math>V_{mstw}</math></b>			
$V_{mstw} = (V_{mstd}) / (100 / (100 - R_{wv}))$	m <sup>3</sup>	6.0740	
<b>Volume of gas metered at Oxygen Reference Conditions, <math>V_{mstd@X\%O_2}</math> &amp; <math>V_{mstw@X\%O_2}</math></b>			
IED & Incinerates Hazardous Material? (Yes = no positive O <sub>2</sub> correction)	-	No	
% wet oxygen measured in gas stream, ACT%O <sub>2w</sub>	% v/v	12.88	
% dry oxygen measured in gas stream, ACT%O <sub>2d</sub>	% v/v	13.99	
% oxygen reference condition, REF%O <sub>2</sub>	% v/v	11.00	
O <sub>2</sub> Reference Factor wet ( $O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$ )	-	1.23	
O <sub>2</sub> Reference Factor dry ( $O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$ )	-	1.43	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m <sup>3</sup>	4.9335	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m <sup>3</sup>	3.9153	
<b>Molecular weight of dry gas stream, <math>M_d</math></b>			
CO <sub>2</sub> (Estimated)	% v/v	6.00	
O <sub>2</sub>	% v/v	13.99	
Total	% v/v	19.99	
N <sub>2</sub>	% v/v	80.01	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	29.52	
<b>Molecular weight of stack gas (wet), <math>M_s</math></b>			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.60	
<b>Velocity of stack gas, <math>V_s</math></b>			
Pitot tube velocity constant, $K_p$	-	34.97	
Velocity pressure coefficient, $C_p$	-	0.84	
Average of velocity heads, $\Delta P_{avg}$	mmH <sub>2</sub> O	8.73	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH <sub>2</sub> O	2.95	
Average stack gas temperature, $T_s$	°C	160.9	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	12.42	
<b>Total flow of stack gas: Actual (<math>Q_a</math>), Wet (<math>Q_{stw}</math>), Dry (<math>Q_{std}</math>), Wet@O<sub>2REF</sub> (<math>Q_{stwO_2}</math>), Dry@O<sub>2REF</sub> (<math>Q_{stdO_2}</math>)</b>			
Area of stack, $A_s$	m <sup>2</sup>	0.31	
$Q_a = (60)(A_s)(V_s)$	m <sup>3</sup> /min	232.4	
Conversion factor (K/mm.Hg), $C_f$	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m <sup>3</sup> /min	142.5	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m <sup>3</sup> /min	131.1	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m <sup>3</sup> /min	115.7	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m <sup>3</sup> /min	91.9	
<b>Percent isokinetic, %I</b>			
Nozzle diameter, $D_n$	mm	6.92	
Nozzle area, $A_n$	mm <sup>2</sup>	37.65	
Total sampling time, $q$	min	360	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	98.0	

## PCBs: SAMPLING DETAILS

### RUN 1

Parameter	Units	Value
Sampling Times	-	11:39 - 14:39, 14:40 - 17:40
Sampling Dates	-	11/11/2014
Sampling Device	-	ISO
Volume Sampled (REF)	m <sup>3</sup>	3.9168

**Where:** ISO stands for Manual Isokinetic Sampling Train

Parameter	Units	Result	DL	WHO Humans / Mammals		WHO Fish		WHO Birds		% Rec
				TEQ1	TEQ2	TEQ1	TEQ2	TEQ1	TEQ2	
PCB-81	ng	0.1093	0.0014	0.0000328	0.0000328	0.0000547	0.0000547	0.0109300	0.0109300	73
PCB-77	ng	0.1139	0.0014	0.0000114	0.0000114	0.0000114	0.0000114	0.0056950	0.0056950	74
PCB-123	ng	0.0158	0.0009	0.0000005	0.0000005	0.0000001	0.0000001	0.0000002	0.0000002	100
PCB-118	ng	0.2506	0.0010	0.0000075	0.0000075	0.0000013	0.0000013	0.0000025	0.0000025	94
PCB-114	ng	0.0288	0.0010	0.0000009	0.0000009	0.0000001	0.0000001	0.0000029	0.0000029	100
PCB-105	ng	0.1033	0.0011	0.0000031	0.0000031	0.0000005	0.0000005	0.0000103	0.0000103	100
PCB-126	ng	0.0515	0.0015	0.0051500	0.0051500	0.0002575	0.0002575	0.0051500	0.0051500	93
PCB-167	ng	0.0268	0.0020	0.0000008	0.0000008	0.0000001	0.0000001	0.0000003	0.0000003	90
PCB-156	ng	0.0626	0.0020	0.0000019	0.0000019	0.0000003	0.0000003	0.0000063	0.0000063	88
PCB-157	ng	0.0331	0.0021	0.0000010	0.0000010	0.0000002	0.0000002	0.0000033	0.0000033	84
PCB-169	ng	0.0150	0.0030	0.0004500	0.0004500	0.0000008	0.0000008	0.0000150	0.0000150	66
PCB-189	ng	0.0343	0.0007	0.0000010	0.0000010	0.0000002	0.0000002	0.0000003	0.0000003	69
Totals	ng	0.8450	-	0.005661	0.005661	0.000327	0.000327	0.021816	0.021816	-
Total Concentration	ng/m <sup>3</sup>	-	-	0.001445	0.001445	0.000084	0.000084	0.005570	0.005570	-
Limit of Detection	ng/m <sup>3</sup>	-	-	0.000062	-	0.000002	-	0.000093	-	-

**Where:** ND stands for Non Detected  
DL stands for Analytical Detection Limit  
TEQ1 refers to Non Detected Congeners at the Detection Limit  
TEQ2 refers to Non Detected Congeners at Zero  
% Rec stands for the Recovery Percentage of the Sample

## PCBs: QUALITY ASSURANCE

(PAGE 1 OF 2)

### Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	17.56	
Pre-Sampling Leak Rate	l/min	0.26	
Post-Sampling Leak Rate	l/min	0.34	
Allowable Leak Rate	l/min	0.88	
Leak Test Acceptable	-	Yes	
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	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	98.0	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Maximum Filter Temperature	°C	120	
Condenser Exit Temperature	Units	Run 1	
Maximum Temperature Recorded	°C	19	
Maximum Allowable Temperature	°C	20	
Exit Temperature Acceptable	-	Yes	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	



PCBs: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Sampling Leak Rate	l/min	0.28	
Allowable Leak Rate	l/min	0.75	
Leak Test Acceptable	-	Yes	

Validity of WHO TEQ H/M Blank vs ELV	Units	Blank 1	
Allowable Blank	ng/m <sup>3</sup>	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.	wx	

## PCBs (WHO TEQ HUMANS / MAMMALS): MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V <sub>m</sub>	6.4450		uV <sub>m</sub>	m <sup>3</sup>	0.1289	
Sampled Gas Temperature	T <sub>m</sub>	302.6		uT <sub>m</sub>	K	2.0	
Sampled Gas Pressure	p <sub>m</sub>	98.8		up <sub>m</sub>	kPa	0.5	
Sampled Gas Humidity	H <sub>m</sub>	0.0		uH <sub>m</sub>	% v/v	1.0	
Leak	L	1.94		uL	%	-	
Laboratory Result	L <sub>r</sub>	10.00		uL <sub>r</sub>	%	-	

Measured Quantities	Uncertainty as a Percentage			Requirement of Standard
	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.66		≤1%
Sampled Gas Pressure	%	0.51		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	1.94		≤5%
Laboratory Result	%	10.00		No Requirement

Measured Quantities	Uncertainty in Measurement Units				Sensitivity Coefficient	
	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	V <sub>m</sub>	m <sup>3</sup>	5.5891		5E-04	
Leak	L	ng/m <sup>3</sup>	3E-05		1.00	
Laboratory Result	L <sub>r</sub>	ng/m <sup>3</sup>	3E-04		1.00	

Measured Quantities	Uncertainty in Result		
	Units	Run 1	
Sampled Volume (STP)	ng/m <sup>3</sup>	7E-05	
Leak	ng/m <sup>3</sup>	3E-05	
Laboratory Result	ng/m <sup>3</sup>	3E-04	

Measured Quantities	Oxygen Correction Part of MU Budget		
	Units	Run 1	
O <sub>2</sub> Correction Factor	-	1.43	
Stack Gas O <sub>2</sub> Content	% v/v	13.99	
MU for O <sub>2</sub> Correction	-	0.10	
Overall MU For O <sub>2</sub> Measurement	%	7.13	

Parameter	Units	Run 1	
Combined uncertainty	ng/m <sup>3</sup>	0.00029	
Expanded uncertainty (95% confidence), without Oxygen Correction	ng/m <sup>3</sup>	0.00057	
Expanded uncertainty (95% confidence), with Oxygen Correction	ng/m <sup>3</sup>	0.0006	
Expanded uncertainty (95% confidence), estimated with Method Deviations	ng/m <sup>3</sup>	0.00061	
Reported Uncertainty	ng/m <sup>3</sup>	0.00061	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	20.4	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	21.6	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	21.6	
Reported Uncertainty	%	21.6	

## PAHs: RESULTS SUMMARY

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

### Sample Runs

Parameter	Units	Run 1		Mean
Concentration	µg/m <sup>3</sup>	0.32		0.32
Uncertainty	±µg/m <sup>3</sup>	0.07		0.07
Mass Emission	g/hr	0.0020		0.0020
Uncertainty	±g/hr	0.0004		0.0004

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	5.68		5.68
Uncertainty	±% v/v	0.32		0.32

### Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	µg/m <sup>3</sup>	0.07		0.07

### General Sampling Information

Parameter	Value
Standard	ISO 11338
Technical Procedure	CAT-TP-08
Name of Analytical Laboratory	MAR
Analytical Laboratory's Procedure	WI 1131
UKAS Accredited Analysis?	Yes
Date of Sample Analysis	26/11/2014
Probe Material	Titanium
Filter Housing Material	Borosilicate Glass
Glassware Material	Borosilicate Glass
Absorption Material	XAD-2
Positioning of Filter	Out Stack
Filter Size and Material	90mm Quartz Fibre
Number of Sampling Lines Used	2 / 2
Number of Sampling Points Used	4 / 4
Sample Point I.D.'s	A1, A2, B1, B2

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

### Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

# PAHs: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
<b>Absolute pressure of stack gas, P<sub>s</sub></b>			
Barometric pressure, P <sub>b</sub>	mmHg	741.8	
Stack static pressure, P <sub>static</sub>	mmH <sub>2</sub> O	12.7	
P <sub>s</sub> = (P <sub>b</sub> + (P <sub>static</sub> / 13.6))	mmHg	742.7	
<b>Volume of water vapour collected, V<sub>wstd</sub></b>			
Total mass collected in impingers (liquid trap)	g	243.4	
Total mass collected in impingers (silica trap)	g	49.4	
Total mass of liquid collected, V <sub>lc</sub>	g	292.8	
V <sub>wstd</sub> = (0.001246)(V <sub>lc</sub> )	m <sup>3</sup>	0.3648	
<b>Volume of gas metered dry, V<sub>mstd</sub></b>			
Volume of gas sample through gas meter, V <sub>m</sub>	m <sup>3</sup>	6.9860	
Gas meter correction factor, Y <sub>d</sub>	-	0.9810	
Average dry gas meter temperature, T <sub>m</sub>	°C	29.4	
Average pressure drop across orifice, ΔH	mmH <sub>2</sub> O	40.3	
V <sub>mstd</sub> = ((0.3592)(V <sub>m</sub> )(P <sub>b</sub> + (ΔH/13.6))(Y <sub>d</sub> )) / (T <sub>m</sub> + 273)	m <sup>3</sup>	6.0632	
<b>Moisture content, B<sub>wo</sub> &amp; R<sub>wv</sub></b>			
B <sub>wo</sub> = V <sub>wstd</sub> / (V <sub>mstd</sub> + V <sub>wstd</sub> )	m <sup>3</sup>	0.0568	
B <sub>wo</sub> as a percentage	% v/v	5.68	
Reported Water Vapour, checked with Tables in EN 14790, R <sub>wv</sub>	% v/v	5.68	
<b>Volume of gas metered wet, V<sub>mstw</sub></b>			
V <sub>mstw</sub> = (V <sub>mstd</sub> )/(100/(100 - R <sub>wv</sub> ))	m <sup>3</sup>	6.4280	
<b>Volume of gas metered at Oxygen Reference Conditions, V<sub>mstd@X%O<sub>2</sub></sub> &amp; V<sub>mstw@X%O<sub>2</sub></sub></b>			
IED & Incinerates Hazardous Material? (Yes = no positive O <sub>2</sub> correction)	-	No	
% wet oxygen measured in gas stream, ACT%O <sub>2w</sub>	% v/v	13.15	
% dry oxygen measured in gas stream, ACT%O <sub>2d</sub>	% v/v	14.29	
% oxygen reference condition, REF%O <sub>2</sub>	% v/v	11.00	
O <sub>2</sub> Reference Factor wet (O <sub>2REFw</sub> ) = (21 - REF%O <sub>2</sub> ) / (21 - ACT%O <sub>2w</sub> )	-	1.27	
O <sub>2</sub> Reference Factor dry (O <sub>2REFd</sub> ) = (21 - REF%O <sub>2</sub> ) / (21 - ACT%O <sub>2d</sub> )	-	1.49	
V <sub>mstw@X%oxygen</sub> = (V <sub>mstw</sub> ) / (O <sub>2REFw</sub> )	m <sup>3</sup>	5.0441	
V <sub>mstd@X%oxygen</sub> = (V <sub>mstd</sub> ) / (O <sub>2REFd</sub> )	m <sup>3</sup>	4.0676	
<b>Molecular weight of dry gas stream, M<sub>d</sub></b>			
CO <sub>2</sub> (Estimated)	% v/v	6.00	
O <sub>2</sub>	% v/v	14.29	
Total	% v/v	20.29	
N <sub>2</sub>	% v/v	79.71	
M <sub>d</sub> = 0.44(%CO <sub>2</sub> )+0.32(%O <sub>2</sub> )+0.28(%N <sub>2</sub> )	g/gmol	29.53	
<b>Molecular weight of stack gas (wet), M<sub>s</sub></b>			
M <sub>s</sub> = M <sub>d</sub> (1 - (R <sub>wv</sub> /100)) + 18(R <sub>wv</sub> /100)	g/gmol	28.88	
<b>Velocity of stack gas, V<sub>s</sub></b>			
Pitot tube velocity constant, K <sub>p</sub>	-	34.97	
Velocity pressure coefficient, C <sub>p</sub>	-	0.84	
Average of velocity heads, ΔP <sub>avg</sub>	mmH <sub>2</sub> O	9.32	
Average square root of velocity heads, √ΔP	√mmH <sub>2</sub> O	3.05	
Average stack gas temperature, T <sub>s</sub>	°C	146.4	
V <sub>s</sub> = ((K <sub>p</sub> )(C <sub>p</sub> )(√ΔP)(√T <sub>s</sub> + 273)) / (√(M <sub>s</sub> )(P <sub>s</sub> ))	m/s	12.54	
<b>Total flow of stack gas: Actual (Q<sub>a</sub>), Wet (Q<sub>stw</sub>), Dry (Q<sub>std</sub>), Wet@O<sub>2REF</sub> (Q<sub>stwO<sub>2</sub></sub>), Dry@O<sub>2REF</sub> (Q<sub>stdO<sub>2</sub></sub>)</b>			
Area of stack, A <sub>s</sub>	m <sup>2</sup>	0.31	
Q <sub>a</sub> = (60)(A <sub>s</sub> )(V <sub>s</sub> )	m <sup>3</sup> /min	234.6	
Conversion factor (K/mm.Hg), C <sub>f</sub>	-	0.3592	
Q <sub>stw</sub> = ((Q <sub>a</sub> )(P <sub>s</sub> )(C <sub>f</sub> )) / ((T <sub>s</sub> + 273)	m <sup>3</sup> /min	149.2	
Q <sub>std</sub> = ((Q <sub>a</sub> )(P <sub>s</sub> )(C <sub>f</sub> )(1 - (R <sub>wv</sub> /100))) / ((T <sub>s</sub> + 273)	m <sup>3</sup> /min	140.8	
Q <sub>stwO<sub>2</sub></sub> = ((Q <sub>a</sub> )(P <sub>s</sub> )(C <sub>f</sub> )) / ((T <sub>s</sub> + 273) / (O <sub>2REFw</sub> )	m <sup>3</sup> /min	117.1	
Q <sub>stdO<sub>2</sub></sub> = ((Q <sub>a</sub> )(P <sub>s</sub> )(C <sub>f</sub> )(1 - (R <sub>wv</sub> /100))) / ((T <sub>s</sub> + 273) / (O <sub>2REFd</sub> )	m <sup>3</sup> /min	94.4	
<b>Percent isokinetic, %I</b>			
Nozzle diameter, D <sub>n</sub>	mm	6.92	
Nozzle area, A <sub>n</sub>	mm <sup>2</sup>	37.65	
Total sampling time, q	min	360	
%I = (4.6398E <sup>6</sup> )(T <sub>s</sub> +273)(V <sub>mstd</sub> ) / (P <sub>s</sub> )(V <sub>s</sub> )(A <sub>n</sub> )(q)(1 - (R <sub>wv</sub> /100))	%	99.1	

## PAHs: SAMPLING DETAILS

### Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	09:35 - 12:35, 12:37 - 15:37	
Sampling Dates	-	12/11/2014	
Sampling Device	-	ISO	
Volume Sampled (REF)	m <sup>3</sup>	4.0676	
Naphthalene	µg	1.015	
Fluoranthene	µg	0.142	
Benzo(a)anthracene	µg	0.017	
Chrysene	µg	0.054	
Benzo(b)fluoranthene	µg	0.025	
Benzo(k)fluoranthene	µg	0.010	
Benzo(a)pyrene	µg	< 0.005	
Indeno(1,2,3-cd)pyrene	µg	< 0.005	
Dibenzo(a,h)anthracene	µg	< 0.005	
Benzo(g,h,i)perylene	µg	< 0.005	
Anthanthrene	µg	< 0.005	
Benzo(b)naph(2,1-d)thiophene	µg	< 0.005	
Benzo(c)phenanthrene	µg	< 0.005	
Cholanthrene	µg	< 0.005	
Cyclopenta(c,d)pyrene	µg	< 0.005	
Dibenzo(ai)pyrene	µg	< 0.005	
Total Mass Collected	µg	1.313	
Total Calculated Concentration	µg/m <sup>3</sup>	0.323	

**Where:** ISO stands for Manual Isokinetic Sampling Train

### Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	12/11/2014	
Average Volume Sampled (REF)	m <sup>3</sup>	4.068	
Naphthalene	µg	0.206	
Fluoranthene	µg	0.018	
Benzo(a)anthracene	µg	< 0.005	
Chrysene	µg	< 0.005	
Benzo(b)fluoranthene	µg	< 0.005	
Benzo(k)fluoranthene	µg	< 0.005	
Benzo(a)pyrene	µg	< 0.005	
Indeno(1,2,3-cd)pyrene	µg	< 0.005	
Dibenzo(a,h)anthracene	µg	< 0.005	
Benzo(g,h,i)perylene	µg	< 0.005	
Anthanthrene	µg	< 0.005	
Benzo(b)naph(2,1-d)thiophene	µg	< 0.005	
Benzo(c)phenanthrene	µg	< 0.005	
Cholanthrene	µg	< 0.005	
Cyclopenta(c,d)pyrene	µg	< 0.005	
Dibenzo(ai)pyrene	µg	< 0.005	
Total Mass Collected	µg	0.294	
Total Calculated Concentration	µg/m <sup>3</sup>	0.072	

## PAHs: QUALITY ASSURANCE

(PAGE 1 OF 2)

### Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	19.04	
Pre-Sampling Leak Rate	l/min	0.29	
Post-Sampling Leak Rate	l/min	0.32	
Allowable Leak Rate	l/min	0.95	
Leak Test Acceptable	-	Yes	

Detection Limit	Units	Run 1	
Naphthalene	µg/m <sup>3</sup>	0.001	
Fluoranthene	µg/m <sup>3</sup>	0.001	
Benzo(a)anthracene	µg/m <sup>3</sup>	0.001	
Chrysene	µg/m <sup>3</sup>	0.001	
Benzo(b)fluoranthene	µg/m <sup>3</sup>	0.001	
Benzo(k)fluoranthene	µg/m <sup>3</sup>	0.001	
Benzo(a)pyrene	µg/m <sup>3</sup>	0.001	
Indeno(1,2,3-cd)pyrene	µg/m <sup>3</sup>	0.001	
Dibenzo(a,h)anthracene	µg/m <sup>3</sup>	0.001	
Benzo(g,h,i)perylene	µg/m <sup>3</sup>	0.001	
Anthanthrene	µg/m <sup>3</sup>	0.001	
Benzo(b)naph(2,1-d)thiophene	µg/m <sup>3</sup>	0.001	
Benzo(c)phenanthrene	µg/m <sup>3</sup>	0.001	
Cholanthrene	µg/m <sup>3</sup>	0.001	
Cyclopenta(c,d)pyrene	µg/m <sup>3</sup>	0.001	
Dibenzo(ai)pyrene	µg/m <sup>3</sup>	0.001	
Total PAHs	µg/m <sup>3</sup>	0.020	

Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	

MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	5.6	
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	%	99.1	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	

Filter Temperatures	Units	Run 1	
Maximum Filter Temperature	°C	120	

Condenser Exit Temperature	Units	Run 1	
Maximum Temperature Recorded	°C	19	
Maximum Allowable Temperature	°C	20	
Exit Temperature Acceptable	-	Yes	

PAHs: QUALITY ASSURANCE

(PAGE 2 OF 2)

Sample Runs (continued)

Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.00	
Sampling Leak Rate	l/min	0.17	
Allowable Leak Rate	l/min	0.75	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	µg/m³	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.	wx	

## PAHs: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	$V_m$	6.9860		$uV_m$	m <sup>3</sup>	0.1397	
Sampled Gas Temperature	$T_m$	302.4		$uT_m$	K	2.0	
Sampled Gas Pressure	$p_m$	99.0		$up_m$	kPa	0.5	
Sampled Gas Humidity	$H_m$	0.0		$uH_m$	% v/v	1.0	
Leak	L	1.68		$uL$	%	-	
Laboratory Result	$L_r$	10.00		$uL_r$	%	-	

Measured Quantities	Uncertainty as a Percentage			Requirement of Standard
	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.66		≤1%
Sampled Gas Pressure	%	0.50		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	1.68		≤5%
Laboratory Result	%	10.00		No Requirement

Measured Quantities	Uncertainty in Measurement Units				Sensitivity Coefficient	
	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	$V_m$	m <sup>3</sup>	6.0632		0.05	
Leak	L	µg/m <sup>3</sup>	0.003		1.00	
Laboratory Result	$L_r$	µg/m <sup>3</sup>	0.032		1.00	

Measured Quantities	Uncertainty in Result		
	Units	Run 1	
Sampled Volume (STP)	µg/m <sup>3</sup>	0.009	
Leak	µg/m <sup>3</sup>	0.0031	
Laboratory Result	µg/m <sup>3</sup>	0.0323	

Measured Quantities	Oxygen Correction Part of MU Budget		
	Units	Run 1	
O <sub>2</sub> Correction Factor	-	1.49	
Stack Gas O <sub>2</sub> Content	% v/v	14.29	
MU for O <sub>2</sub> Correction	-	0.11	
Overall MU For O <sub>2</sub> Measurement	%	7.45	

Parameter	Units	Run 1	
Combined uncertainty	µg/m <sup>3</sup>	0.034	
Expanded uncertainty (95% confidence), without Oxygen Correction	µg/m <sup>3</sup>	0.066	
Expanded uncertainty (95% confidence), with Oxygen Correction	µg/m <sup>3</sup>	0.07	
Expanded uncertainty (95% confidence), estimated with Method Deviations	µg/m <sup>3</sup>	0.070	
Reported Uncertainty	µg/m <sup>3</sup>	0.070	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	20.4	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	21.7	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	21.7	
Reported Uncertainty	%	21.7	



## SULPHUR DIOXIDE: RESULTS SUMMARY

SITA Healthcare Ltd, Wrexham

A1 - Main Stack

### Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m <sup>3</sup>	0.05		0.05
Uncertainty	±mg/m <sup>3</sup>	0.01		0.01
Mass Emission	g/hr	0.34		0.34
Uncertainty	±g/hr	0.06		0.06

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	5.65		5.65
Uncertainty	±% v/v	0.25		0.25

### Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m <sup>3</sup>	< 0.04		< 0.04

### General Sampling Information

Parameter	Value
Standard	EN 14791
Technical Procedure	CAT-TP-09
Name of Analytical Laboratory	CAT
Analytical Laboratory's Procedure	CAT-AP-01
UKAS Accredited Analysis?	Yes
Date of Sample Analysis	20/11/2014
Probe Material	Titanium
Filter Housing Material	Titanium
Impinger Material	Polyethylene
Absorption Solution	0.3% Hydrogen Peroxide
Positioning of Filter	Out Stack
Filter Size and Material	47mm Quartz Fibre
Number of Sampling Lines Used	1 / 1
Number of Sampling Points Used	1 / 1
Sample Point I.D.'s	B1

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

### Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

## SULPHUR DIOXIDE: SAMPLING DETAILS

### Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	10:00 - 14:00	
Sampling Dates	-	12/11/2014	
Sampling Device	-	MFC / MV	
Duration	mins	240	
Volume Sampled (STP, Dry)	m <sup>3</sup>	0.6866	
Volume Sampled (STP, Wet)	m <sup>3</sup>	0.7278	
Volume Sampled (REF)	m <sup>3</sup>	0.4408	
Sample Flow Rate	l/min	2.80	
Laboratory Result for Front Impingers	µg/ml	0.08	
Laboratory Result for Back Impinger	µg/ml	0.05	
Volume in Front Impingers	ml	239.6	
Volume in Back Impinger	ml	99.5	
Mass in Front Impingers	µg	19.2	
Mass in Back Impinger	µg	< 5.0	
Total Mass Collected	µg	24.1	
Calculated Concentration	mg/m <sup>3</sup>	0.05	
Liquid Trap Start Mass	g	1257.8	
Liquid Trap End Mass	g	1284.6	
Silica Trap Start Mass	g	535.7	
Silica Trap End Mass	g	541.9	
Total Mass Of Water Vapour	g	33.0	
Calculated Water Vapour	% v/v	5.65	

**Where:** MFC stands for Mass Flow Controller, MV stands for Mass View Flowmeter

### Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	12/11/2014	
Average Volume Sampled (REF)	m <sup>3</sup>	0.4408	
Laboratory Result for Impingers	µg/ml	< 0.05	
Volume in Impingers	ml	319.2	
Total Mass Collected	µg	< 16.0	
Calculated Concentration	mg/m <sup>3</sup>	< 0.04	

## SULPHUR DIOXIDE: QUALITY ASSURANCE

### Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	2.80	
Pre-Sampling Leak Rate	l/min	0.05	
Post-Sampling Leak Rate	l/min	0.04	
Allowable Leak Rate	l/min	0.06	
Leak Test Acceptable	-	Yes	

Absorption Efficiency	Units	Run 1	
Absorption Efficiency	%	100.0	
Allowable Absorption Efficiency	%	N/A <sup>2</sup>	
Absorption Efficiency Acceptable	-	N/A <sup>2</sup>	

<sup>2</sup> The concentration is less than 30% of the ELV, therefore no assessment against an allowable efficiency is required.

Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	

MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	4.4	
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	5.00	
Pre-Sampling Leak Rate	l/min	0.01	
Post-Sampling Leak Rate	l/min	0.01	
Allowable Leak Rate	l/min	0.10	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m <sup>3</sup>	20.0	
Blank Acceptable	-	Yes	

### Method Deviations

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

## SULPHUR DIOXIDE: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (STP)	$V_m$	0.6866		$uV_m$	m <sup>3</sup>	0.0137	
Leak	L	1.43		$uL$	%	-	
Laboratory Result	$L_r$	7.00		$uL_r$	%	-	

Uncertainty as a Percentage				
Measured Quantities	Units	Run 1		Requirement of Standard
Sampled Volume (STP)	%	2.00		≤2%
Leak	%	1.43		≤2%
Laboratory Result	%	7.00		No Requirement

Uncertainty in Measurement Units				Sensitivity Coefficient	
Measured Quantities	Symbol	Units	Run 1	Run 1	
Sampled Volume (STP)	$V_m$	m <sup>3</sup>	0.6866	0.08	
Leak	L	mg/m <sup>3</sup>	0.0005	1.00	
Laboratory Result	$L_r$	mg/m <sup>3</sup>	0.004	1.00	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m <sup>3</sup>	0.0011	
Leak	mg/m <sup>3</sup>	0.0005	
Laboratory Result	mg/m <sup>3</sup>	0.0038	

Oxygen Correction Part of MU Budget			
Measured Quantities	Units	Run 1	
O <sub>2</sub> Correction Factor	-	1.56	
Stack Gas O <sub>2</sub> Content	% v/v	14.58	
MU for O <sub>2</sub> Correction	-	0.12	
Overall MU For O <sub>2</sub> Measurement	%	7.79	

Parameter	Units	Run 1	
Combined uncertainty	mg/m <sup>3</sup>	0.004	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m <sup>3</sup>	0.01	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m <sup>3</sup>	0.01	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m <sup>3</sup>	0.01	
Reported Uncertainty	mg/m <sup>3</sup>	0.01	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	14.4	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	16.3	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	16.3	
Reported Uncertainty	%	16.3	

## HYDROGEN FLUORIDE: RESULTS SUMMARY

SITA Healthcare Ltd, Wrexham

A1 - Main Stack

### Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m <sup>3</sup>	< 0.08		< 0.08
Uncertainty	±mg/m <sup>3</sup>	0.01		0.01
Mass Emission	g/hr	< 0.52		< 0.52
Uncertainty	±g/hr	0.08		0.08

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	8.08		8.08
Uncertainty	±% v/v	0.35		0.35

### Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m <sup>3</sup>	< 0.08		< 0.08

### General Sampling Information

Parameter	Value
Standard	ISO 15713
Technical Procedure	CAT-TP-10
Name of Analytical Laboratory	CAT
Analytical Laboratory's Procedure	CAT-AP-01
UKAS Accredited Analysis?	Yes
Date of Sample Analysis	18/11/2014
Probe Material	Monel
Filter Housing Material	Monel
Impinger Material	Quartz Glass
Absorption Solution	0.3% Hydrogen Peroxide
Positioning of Filter	Out Stack
Filter Size and Material	47mm Quartz Fibre
Number of Sampling Lines Used	1 / 1
Number of Sampling Points Used	1 / 1
Sample Point I.D.'s	B1

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

### Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

## HYDROGEN FLUORIDE: SAMPLING DETAILS

## Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	14:24 - 15:24	
Sampling Dates	-	11/11/2014	
Sampling Device	-	MFC / MV	
Duration	mins	60	
Volume Sampled (STP, Dry)	m <sup>3</sup>	0.3120	
Volume Sampled (STP, Wet)	m <sup>3</sup>	0.3394	
Volume Sampled (REF)	m <sup>3</sup>	0.2178	
Sample Flow Rate	l/min	5.09	
Laboratory Result for Front Impingers	µg/ml	< 0.05	
Laboratory Result for Back Impinger	µg/ml	< 0.05	
Volume in Front Impingers	ml	240.7	
Volume in Back Impinger	ml	118.8	
Mass in Front Impingers	µg	< 12.0	
Mass in Back Impinger	µg	< 5.9	
Total Mass Collected	µg	< 18.0	
Calculated Concentration	mg/m <sup>3</sup>	< 0.08	
Liquid Trap Start Mass	g	1763.2	
Liquid Trap End Mass	g	1780.6	
Silica Trap Start Mass	g	894.1	
Silica Trap End Mass	g	898.7	
Total Mass Of Water Vapour	g	22.0	
Calculated Water Vapour	% v/v	8.08	

**Where:** MFC stands for Mass Flow Controller, MV stands for Mass View Flowmeter

## Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	11/11/2014	
Average Volume Sampled (REF)	m <sup>3</sup>	0.2178	
Laboratory Result for Impingers	µg/ml	< 0.05	
Volume in Impingers	ml	341.4	
Total Mass Collected	µg	< 17.1	
Calculated Concentration	mg/m <sup>3</sup>	< 0.08	

## HYDROGEN FLUORIDE: QUALITY ASSURANCE

### Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	5.09	
Pre-Sampling Leak Rate	l/min	0.06	
Post-Sampling Leak Rate	l/min	0.04	
Allowable Leak Rate	l/min	0.10	
Leak Test Acceptable	-	Yes	

Absorption Efficiency	Units	Run 1	
Absorption Efficiency	%	100.0	
Allowable Absorption Efficiency	%	N/A <sup>2</sup>	
Absorption Efficiency Acceptable	-	N/A <sup>2</sup>	

<sup>2</sup> The concentration is less than 30% of the ELV, therefore no assessment against an allowable efficiency is required.

Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	

MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	4.3	
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	5.00	
Pre-Sampling Leak Rate	l/min	0.00	
Post-Sampling Leak Rate	l/min	0.00	
Allowable Leak Rate	l/min	0.10	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m <sup>3</sup>	0.2	
Blank Acceptable	-	Yes	

### Method Deviations

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

## HYDROGEN FLUORIDE: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (STP)	$V_m$	0.3120		$uV_m$	m <sup>3</sup>	0.0062	
Leak	L	0.79		$uL$	%	-	
Laboratory Result	$L_r$	7.05		$uL_r$	%	-	

Uncertainty as a Percentage				
Measured Quantities	Units	Run 1		Requirement of Standard
Sampled Volume (STP)	%	2.00		≤2%
Leak	%	0.79		≤2%
Laboratory Result	%	7.05		No Requirement

Uncertainty in Measurement Units				Sensitivity Coefficient	
Measured Quantities	Symbol	Units	Run 1	Run 1	
Sampled Volume (STP)	$V_m$	m <sup>3</sup>	0.3120	0.26	
Leak	L	mg/m <sup>3</sup>	0.0004	1.00	
Laboratory Result	$L_r$	mg/m <sup>3</sup>	0.006	1.00	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m <sup>3</sup>	0.0017	
Leak	mg/m <sup>3</sup>	0.0004	
Laboratory Result	mg/m <sup>3</sup>	0.0058	

Oxygen Correction Part of MU Budget			
Measured Quantities	Units	Run 1	
O <sub>2</sub> Correction Factor	-	1.43	
Stack Gas O <sub>2</sub> Content	% v/v	14.02	
MU for O <sub>2</sub> Correction	-	0.10	
Overall MU For O <sub>2</sub> Measurement	%	7.16	

Parameter	Units	Run 1	
Combined uncertainty	mg/m <sup>3</sup>	0.01	
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m <sup>3</sup>	0.01	
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m <sup>3</sup>	0.01	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m <sup>3</sup>	0.01	
Reported Uncertainty	mg/m <sup>3</sup>	0.01	
Expanded uncertainty (95% confidence), without Oxygen Correction	%	14.4	
Expanded uncertainty (95% confidence), with Oxygen Correction	%	16.1	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	16.1	
Reported Uncertainty	%	16.1	



## TOTAL VOCs (as CARBON): RESULTS SUMMARY

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

### Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m <sup>3</sup>	0.28		0.28
Uncertainty	±mg/m <sup>3</sup>	1.7		1.7
Mass Emission	g/hr	1.7		1.7
Uncertainty	±g/hr	10.5		10.5

### 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	CYL 1.0084
Span Gas Expiry Date	03/10/2018
Span Gas Start Pressure (bar)	80
Gas Cylinder Concentration (ppm)	80
Span Gas Set Point (ppm)	80.00
Span Gas Uncertainty (%)	N/A
Zero Gas Type	Synthetic Air (5 Grade)
Number of Sampling Lines Used	1 / 1
Number of Sampling Points Used	1 / 1
Sample Point I.D.'s	B3

FORMAT: Number Used / Number Required

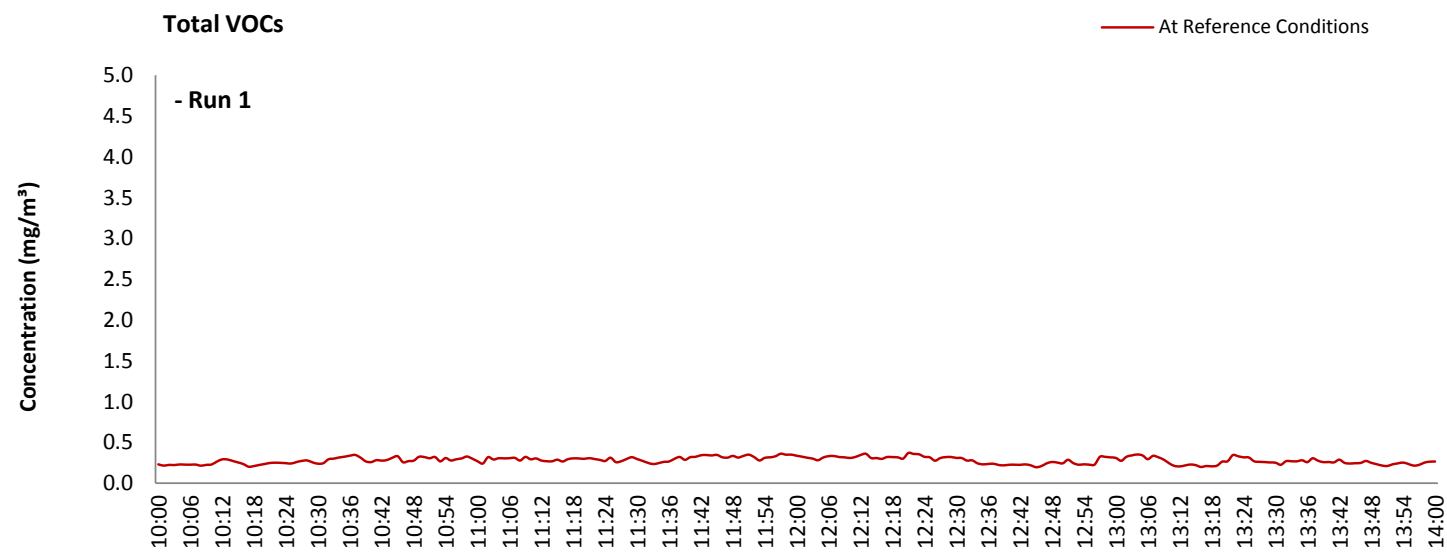
FORMAT: Number Used / Number Required

### Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

# TOTAL VOCs (as CARBON): DATA TREND

## Graphical Trend of Data



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

### Sampling Details

Parameter	Units	Run 1	
Sampling Times	-	10:00 - 14:00	
Sampling Dates	-	12/11/2014	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.0	

### Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.20	
	Zero Down Sampling Line (Post)	ppm	-0.07	
	Zero Drift	ppm	-0.27	
	Allowable Zero Drift	± ppm	4.00	
	Zero Drift Acceptable	-	Yes	

	Span Drift	Units	Run 1	
CAL 1	Span Down Sampling Line (Pre)	ppm	78.40	
	Span Down Sampling Line (Post)	ppm	74.80	
	Span Drift	ppm	-3.60	
	Allowable Span Drift	± ppm	4.00	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	19 - 25	

### 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 <sup>3</sup> (REF)
TGN M2 Allowable MU	15.0		%
Measured concentration	0.18		mg/m <sup>3</sup> (STP, dry)
Range Used	100.0		ppm
Range Used [A]	160.6		mg/m <sup>3</sup>
Cal gas conc.	80.0		ppm
Conversion	1.61		ppm to mg/m <sup>3</sup>
MCERTS Range [B]	15.0		mg/m <sup>3</sup>
Lower of [A] or [B]	15.0		mg/m <sup>3</sup>
Cal gas conc.	128.5		mg/m <sup>3</sup>

Performance characteristics	RUN 1		Units
Response time	45		seconds
Number of readings in measurement	240		-
Repeatability at zero	2.00		% full scale
Repeatability at span level	0.00		% full scale
Deviation from linearity	0.23		% of value
Zero drift	-0.34		% full scale
Span drift	-4.59		% 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	1.80		% range
Dependence on voltage	0.50		% full scale/10V
Losses in the line (leak)	2.00		% 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 <sup>3</sup>
Standard deviation of repeatability at span level	0.00		mg/m <sup>3</sup>
Lack of fit	0.02		mg/m <sup>3</sup>
Drift	-0.26		mg/m <sup>3</sup>
Volume or pressure flow dependence	0.001		mg/m <sup>3</sup>
Atmospheric pressure dependence	0.05		mg/m <sup>3</sup>
Ambient temperature dependence	0.40		mg/m <sup>3</sup>
Combined interference (from MCERTS Certificate)	0.16		mg/m <sup>3</sup>
Dependence on voltage	0.14		mg/m <sup>3</sup>
Losses in the line (leak)	0.00		mg/m <sup>3</sup>
Uncertainty of calibration gas	0.00		mg/m <sup>3</sup>

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		0.18	mg/m <sup>3</sup>
Expanded uncertainty	k = 1.96	0.55	mg/m <sup>3</sup>
Expanded uncertainty		1.08	mg/m <sup>3</sup>
Uncertainty corrected to std conds. (O <sub>2</sub> )		1.68	mg/m <sup>3</sup> (REF)

	RUN 1	Units
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence	604.15	% of Value
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence	5.40	% at ELV
Overall Allowable uncertainty (no O <sub>2</sub> ) - at 95% Confidence	15.0	% at ELV
<b>Result of Compliance with Uncertainty Requirement in M2</b>	N/A	-

	RUN 1	Units
Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence	604.16	% of Value
Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence	9.01	% at ELV
Overall Allowable uncertainty (with O <sub>2</sub> ) - at 95% Confidence	15.3	% at ELV
<b>Result of Compliance with Uncertainty Requirement in M2</b>	COMPLIANT	-

Requirement for SRM is that Uncertainty should be <15% of the value at the ELV, on a dry gas basis, or if O<sub>2</sub> correction is applied less than 15% + the uncertainty associated with the O<sub>2</sub> correction (using sqrt of sum squares to add uncertainty components). Ref EA TGN M2.

## OXIDES OF NITROGEN (as NO<sub>2</sub>): RESULTS SUMMARY

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

### Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m <sup>3</sup>	201		201
Uncertainty	±mg/m <sup>3</sup>	9.5		9.5
Mass Emission	g/hr	1260		1260
Uncertainty	±g/hr	59.4		59.4

### General Sampling Information

Parameter	Value
Standard	EN 14792
Technical Procedure	CAT-TP-21
Probe Material	Stainless Steel
Filtration Type / Size	0.1µm Glass Fibre
Heated Head Filter Used	Yes
Heated Line Temperature	180°C
Date & Result of Last Converter Check	23/01/2014 - 98%
Span Gas Type	Nitrogen Monoxide
Span Gas Reference Number	CYL 4.0106
Span Gas Expiry Date	15/10/2017
Span Gas Start Pressure (bar)	110
Gas Cylinder Concentration (ppm)	408.12
Span Gas Uncertainty (%)	2
Zero Gas Type	Nitrogen (5 Grade)
Number of Sampling Lines Used	1 / 1
Number of Sampling Points Used	1 / 1
Sample Point I.D.'s	B3

NOTE: Dilution performed to achieve correct span value

FORMAT: Number Used / Number Required

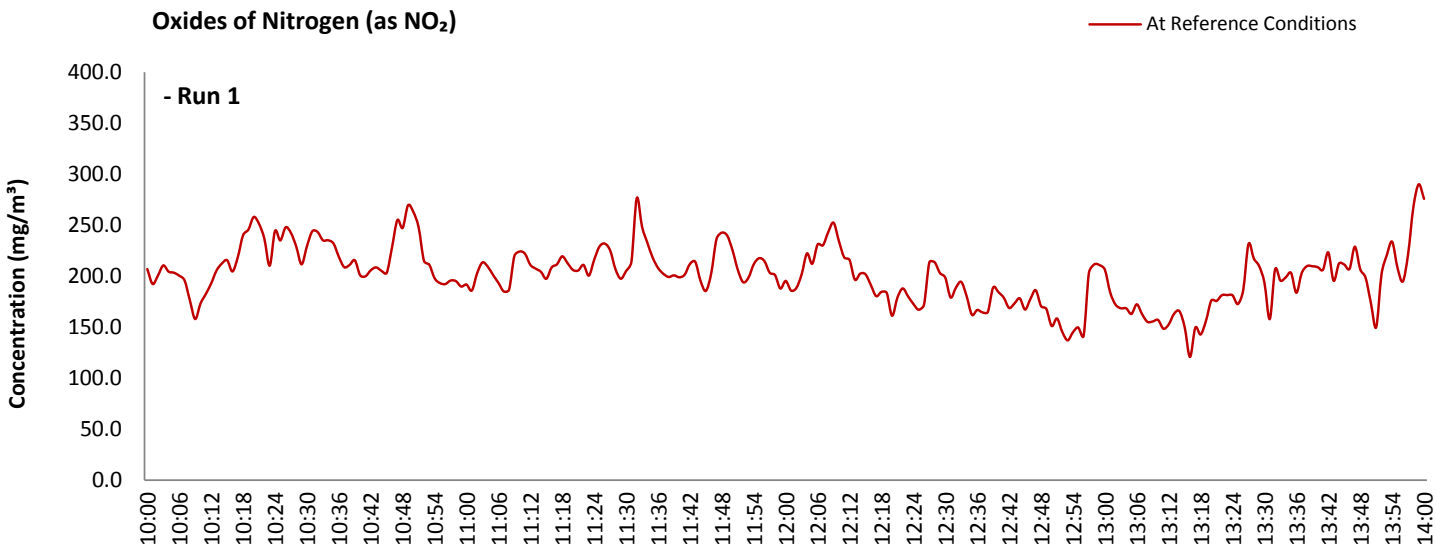
FORMAT: Number Used / Number Required

### Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

OXIDES OF NITROGEN (as NO<sub>2</sub>): DATA TREND

Graphical Trend of Data



## OXIDES OF NITROGEN (as NO<sub>2</sub>): SAMPLING DETAILS & QUALITY ASSURANCE

### Sampling Details

Parameter	Units	Run 1	
Sampling Times	-	10:00 - 14:00	
Sampling Dates	-	12/11/2014	
Instrument Range	ppm	250	
Span Gas Value	ppm	194.9	

### Quality Assurance

Conditioning Unit Temperature	Units	Run 1	
Average Temperature	°C	2.9	
Allowable Temperature	< °C	4.0	
Temperature Acceptable	-	Yes	

Zero Drift	Units	Run 1	
Zero Down Sampling Line (Pre)	ppm	1.10	
Zero Down Sampling Line (Post)	ppm	0.20	
Zero Drift	ppm	-0.90	
Allowable Zero Drift	± ppm	9.75	
Zero Drift Acceptable	-	Yes	

Span Drift	Units	Run 1	
Span Down Sampling Line (Pre)	ppm	194.40	
Span Down Sampling Line (Post)	ppm	197.00	
Span Drift	ppm	2.60	
Allowable Span Drift	± ppm	9.75	
Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	19 - 24	

### 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	

## OXIDES OF NITROGEN (as NO<sub>2</sub>): MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1		Units
Limit value	400.0		mg/m <sup>3</sup> (REF)
TGN M2 Allowable MU	10.0		%
Measured concentration	129.15		mg/m <sup>3</sup> (STP, dry)
Ration NO / NO <sub>2</sub>	5		%
Range Used	250.0		ppm
Range Used [A]	513.1		mg/m <sup>3</sup>
Cal gas conc.	194.9		ppm
Conversion	2.05		ppm to mg/m <sup>3</sup>
MCERTS Range [B]	125.0		mg/m <sup>3</sup>
Lower of [A] or [B]	125.0		mg/m <sup>3</sup>
Cal gas conc.	400.0		mg/m <sup>3</sup>

Performance characteristics	RUN 1		Units
Response time	60		seconds
Number of readings in measurement	240		-
Repeatability at zero	0.40		% full scale
Repeatability at span level	0.40		% full scale
Deviation from linearity	0.24		% of value
Zero drift	-0.46		% full scale
Span drift	1.34		% full scale
Volume or pressure flow dependence	0.40		% of full scale
Atmospheric pressure dependence	0.30		% of value/kPa
Ambient temperature dependence	0.18		% full scale/10K
Combined interference	1.20		% range
Dependence on voltage	0.40		% full scale/10V
Converter efficiency	98.0		%
Losses in the line (leak)	0.26		% of value
Uncertainty of calibration gas blending	1.40		% 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 <sup>3</sup>
Standard deviation of repeatability at span level	0.03		mg/m <sup>3</sup>
Lack of fit	0.17		mg/m <sup>3</sup>
Drift	-0.07		mg/m <sup>3</sup>
Volume or pressure flow dependence	0.003		mg/m <sup>3</sup>
Atmospheric pressure dependence	0.43		mg/m <sup>3</sup>
Ambient temperature dependence	0.05		mg/m <sup>3</sup>
Combined interference (from MCERTS Certificate)	0.87		mg/m <sup>3</sup>
Dependence on voltage	0.12		mg/m <sup>3</sup>
Converter efficiency	0.07		mg/m <sup>3</sup>
Losses in the line (leak)	0.19		mg/m <sup>3</sup>
Uncertainty of calibration gas blending	1.04		mg/m <sup>3</sup>
Uncertainty of calibration gas	1.49		mg/m <sup>3</sup>

		RUN 1		Units
Measurement uncertainty	Result	129.15		mg/m <sup>3</sup>
Combined uncertainty		2.26		mg/m <sup>3</sup>
Expanded uncertainty	k = 1.96	4.42		mg/m <sup>3</sup>
Uncertainty corrected to std conds. (O <sub>2</sub> )		6.89		mg/m <sup>3</sup> (REF)

	RUN 1		Units
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence	3.43		% of Value
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence	1.11		% at ELV
Overall Allowable uncertainty (no O <sub>2</sub> ) - at 95% Confidence	10.0		% at ELV
Result of Compliance with Uncertainty Requirement in M2	N/A		-

	RUN 1		Units
Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence	4.72		% of Value
Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence	3.67		% at ELV
Overall Allowable uncertainty (with O <sub>2</sub> ) - at 95% Confidence	10.5		% at ELV
Result of Compliance with Uncertainty Requirement in M2	COMPLIANT		-

Requirement for SRM is that Uncertainty should be <10% of the value at the ELV, on a dry gas basis, or if O<sub>2</sub> correction is applied less than 10% + the uncertainty associated with the O<sub>2</sub> correction (using sqrt of sum squares to add uncertainty components). Ref EA TGN M2.



## CARBON MONOXIDE: RESULTS SUMMARY

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

### Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m <sup>3</sup>	7.5		7.5
Uncertainty	±mg/m <sup>3</sup>	1.9		1.9
Mass Emission	g/hr	47.2		47.2
Uncertainty	±g/hr	11.8		11.8

### General Sampling Information

Parameter	Value
Standard	EN 15058
Technical Procedure	CAT-TP-21
Probe Material	Stainless Steel
Filtration Type / Size	0.1µm Glass Fibre
Heated Head Filter Used	Yes
Heated Line Temperature	180°C
Span Gas Type	Carbon Monoxide
Span Gas Reference Number	CYL 2.0074
Span Gas Expiry Date	31/07/2018
Span Gas Start Pressure (bar)	150
Gas Cylinder Concentration (ppm)	402.99
Span Gas Uncertainty (%)	2
Zero Gas Type	Nitrogen (5 Grade)
Number of Sampling Lines Used	1 / 1
Number of Sampling Points Used	1 / 1
Sample Point I.D.'s	B3

NOTE: Dilution performed to achieve correct span value

FORMAT: Number Used / Number Required

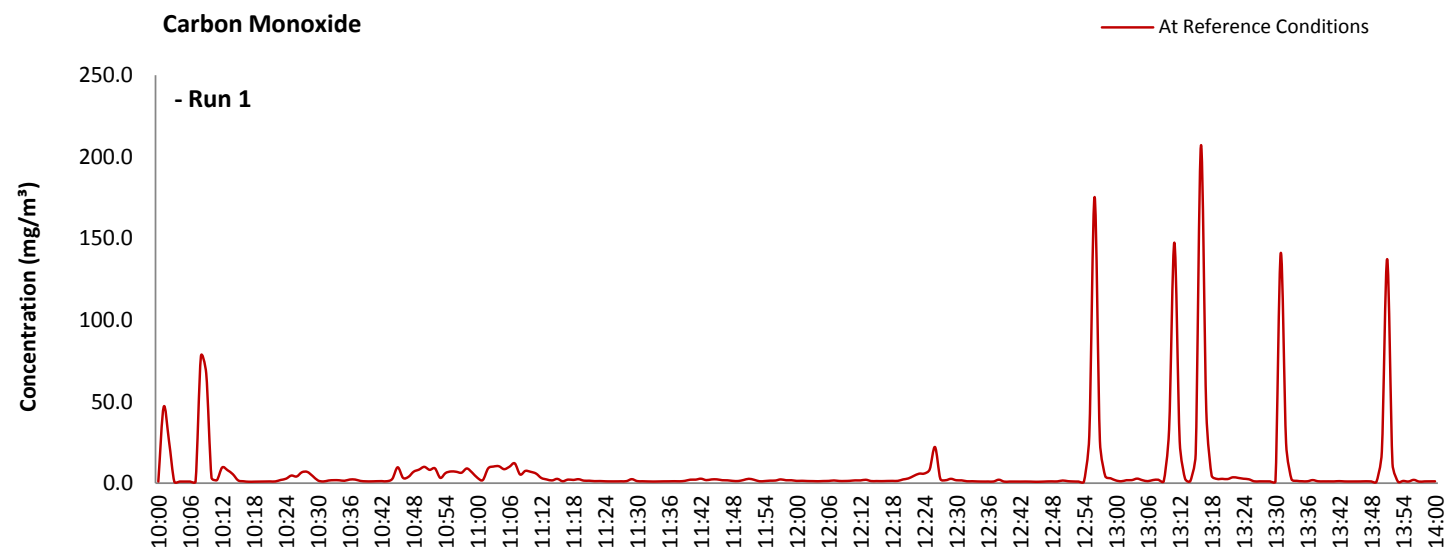
FORMAT: Number Used / Number Required

### Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

# CARBON MONOXIDE: DATA TREND

## Graphical Trend of Data



## CARBON MONOXIDE: SAMPLING DETAILS & QUALITY ASSURANCE

### Sampling Details

Parameter	Units	Run 1	
Sampling Times	-	10:00 - 14:00	
Sampling Dates	-	12/11/2014	
Instrument Range	ppm	200	
Span Gas Value	ppm	80.1	

### Quality Assurance

Conditioning Unit Temperature	Units	Run 1	
Average Temperature	°C	2.9	
Allowable Temperature	< °C	4.0	
Temperature Acceptable	-	Yes	

Zero Drift	Units	Run 1	
Zero Down Sampling Line (Pre)	ppm	0.00	
Zero Down Sampling Line (Post)	ppm	0.70	
Zero Drift	ppm	0.70	
Allowable Zero Drift	± ppm	4.00	
Zero Drift Acceptable	-	Yes	

Span Drift	Units	Run 1	
Span Down Sampling Line (Pre)	ppm	80.80	
Span Down Sampling Line (Post)	ppm	79.90	
Span Drift	ppm	-0.90	
Allowable Span Drift	± ppm	4.00	
Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	19 - 24	

### 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	

## CARBON MONOXIDE: MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1		Units
Limit value	100.0		mg/m <sup>3</sup> (REF)
TGN M2 Allowable MU	6.0		%
Measured concentration	4.83		mg/m <sup>3</sup> (STP, dry)
Range Used	200.0		ppm
Range Used [A]	249.8		mg/m <sup>3</sup>
Cal gas conc.	80.1		ppm
Conversion	1.25		ppm to mg/m <sup>3</sup>
MCERTS Range [B]	95.0		mg/m <sup>3</sup>
Lower of [A] or [B]	95.0		mg/m <sup>3</sup>
Cal gas conc.	100.0		mg/m <sup>3</sup>

Performance characteristics	RUN 1		Units
Response time	60		seconds
Number of readings in measurement	240		-
Repeatability at zero	0.40		% full scale
Repeatability at span level	0.40		% full scale
Deviation from linearity	0.27		% of value
Zero drift	0.87		% full scale
Span drift	-1.11		% full scale
Volume or pressure flow dependence	0.40		% of full scale
Atmospheric pressure dependence	0.30		% of value/kPa
Ambient temperature dependence	0.05		% full scale/10K
Combined interference	0.08		% range
Dependence on voltage	0.40		% full scale/10V
Losses in the line (leak)	0.00		% of value
Uncertainty of calibration gas blending	1.40		% 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 <sup>3</sup>
Standard deviation of repeatability at span level	0.03		mg/m <sup>3</sup>
Lack of fit	0.15		mg/m <sup>3</sup>
Drift	0.47		mg/m <sup>3</sup>
Volume or pressure flow dependence	0.002		mg/m <sup>3</sup>
Atmospheric pressure dependence	0.33		mg/m <sup>3</sup>
Ambient temperature dependence	0.01		mg/m <sup>3</sup>
Combined interference (from MCERTS Certificate)	0.04		mg/m <sup>3</sup>
Dependence on voltage	0.12		mg/m <sup>3</sup>
Losses in the line (leak)	0.00		mg/m <sup>3</sup>
Uncertainty of calibration gas blending	0.04		mg/m <sup>3</sup>
Uncertainty of calibration gas	0.06		mg/m <sup>3</sup>

		RUN 1		Units
Measurement uncertainty	Result	4.83		mg/m <sup>3</sup>
Combined uncertainty		0.61		mg/m <sup>3</sup>
Expanded uncertainty	k = 1.96	1.20		mg/m <sup>3</sup>
Uncertainty corrected to std conds. (O <sub>2</sub> )		1.86		mg/m <sup>3</sup> (REF)

	RUN 1		Units
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence	24.76		% of Value
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence	1.20		% at ELV
Overall Allowable uncertainty (no O <sub>2</sub> ) - at 95% Confidence	6.0		% at ELV
Result of Compliance with Uncertainty Requirement in M2	N/A		-

	RUN 1		Units
Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence	24.97		% of Value
Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence	3.74		% at ELV
Overall Allowable uncertainty (with O <sub>2</sub> ) - at 95% Confidence	6.8		% at ELV
Result of Compliance with Uncertainty Requirement in M2	COMPLIANT		-

Requirement for SRM is that Uncertainty should be <6% of the value at the ELV, on a dry gas basis, or if O<sub>2</sub> correction is applied less than 6% + the uncertainty associated with the O<sub>2</sub> correction (using sqrt of sum squares to add uncertainty components). Ref EA TGN M2.

OXYGEN: RESULTS SUMMARY

SITA Healthcare Ltd, Wrexham  
A1 - Main Stack

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	% v/v	14.6		14.6
Uncertainty	±% v/v	0.47		0.47

General Sampling Information

Parameter	Value
Standard	EN 14789
Technical Procedure	CAT-TP-21
Probe Material	Stainless Steel
Filtration Type / Size	0.1µm Glass Fibre
Heated Head Filter Used	Yes
Heated Line Temperature	180°C
Span Gas Type	Synthetic Air (5 Grade)
Span Gas Reference Number	CYL 11.0137
Span Gas Expiry Date	16/08/2018
Span Gas Start Pressure (bar)	140
Gas Cylinder Concentration (% v/v)	20.89
Span Gas Uncertainty (%)	2
Zero Gas Type	Nitrogen (5 Grade)
Number of Sampling Lines Used	1 / 1
Number of Sampling Points Used	1 / 1
Sample Point I.D.'s	B3

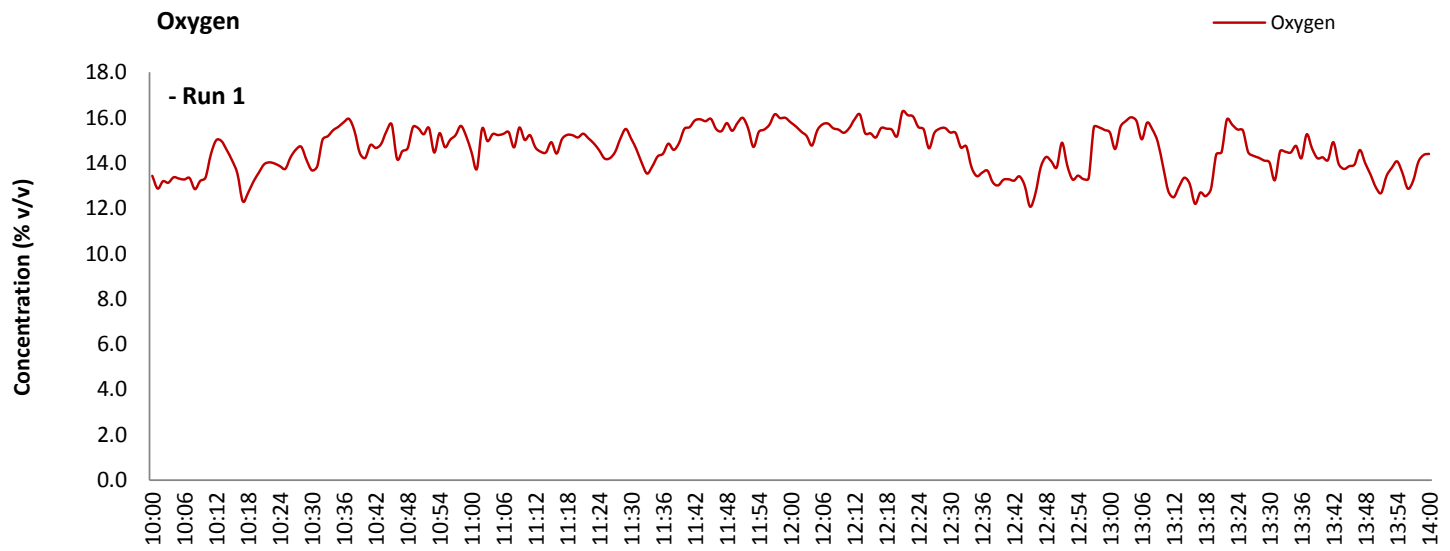
NOTE: Dilution performed to achieve correct span value

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

OXYGEN: DATA TREND

Graphical Trend of Data



## OXYGEN: SAMPLING DETAILS & QUALITY ASSURANCE

### Sampling Details

Parameter	Units	Run 1	
Sampling Times	-	10:00 - 14:00	
Sampling Dates	-	12/11/2014	
Instrument Range	% v/v	25	
Span Gas Value	% v/v	11.00	

### Quality Assurance

Conditioning Unit Temperature	Units	Run 1	
Average Temperature	°C	2.9	
Allowable Temperature	< °C	4.0	
Temperature Acceptable	-	Yes	

Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	% v/v	0.06
	Zero Down Sampling Line (Post)	% v/v	0.11
	Zero Drift	% v/v	0.05
	Allowable Zero Drift	± % v/v	0.55
	Zero Drift Acceptable	-	Yes

Span Drift	Units	Run 1	
CAL 1	Span Down Sampling Line (Pre)	% v/v	11.07
	Span Down Sampling Line (Post)	% v/v	11.12
	Span Drift	% v/v	0.05
	Allowable Span Drift	± % v/v	0.55
	Span Drift Acceptable	-	Yes

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	19 - 24	

### 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	

## OXYGEN: MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1		Units
Limit value	N/A		%vol
TGN M2 Allowable MU	6.0		%
Measured concentration	14.58		%vol
Range Used	25.0		%vol
Cal gas conc.	20.9		%vol

Performance characteristics	RUN 1		Units
Response time	60		seconds
Number of readings in measurement	240		-
Repeatability at zero	0.04		% full scale
Repeatability at span level	0.04		% full scale
Deviation from linearity	0.09		% of value
Zero drift	0.45		% full scale
Span drift	0.45		% full scale
Volume or pressure flow dependence	0.20		% of full scale
Atmospheric pressure dependence	0.30		% of value/kPa
Ambient temperature dependence	-0.07		% full scale/10K
Combined interference	0.56		% range
Dependence on voltage	0.02		% full scale/10V
Losses in the line (leak)	0.00		% of value
Uncertainty of calibration gas			% of value

Performance characteristic	RUN 1		Units
Standard deviation of repeatability at zero	use rep at span		%vol
Standard deviation of repeatability at span level	0.003		%vol
Lack of fit	0.01		%vol
Drift	0.09		%vol
Volume or pressure flow dependence	0.0003		%vol
Atmospheric pressure dependence	0.09		%vol
Ambient temperature dependence	-0.02		%vol
Combined interference (from MCERTS Certificate)	0.08		%vol
Dependence on voltage	0.01		%vol
Losses in the line (leak)	0.00		%vol
Uncertainty of calibration gas	0.17		%vol

Measurement uncertainty	Result	RUN 1		Units
Combined uncertainty		14.58		%vol
Expanded uncertainty		0.24		%vol
Expanded uncertainty	k = 1.96	0.47		%vol
		RUN 1		Units
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence		3.24		% of Value
Result of Compliance with Uncertainty Requirement in M2		COMPLIANT		-

Requirement for SRM is that Uncertainty should be 0.5%vol absolute or 6% relative whichever is the lower, on a dry gas basis. Ref EA TGN M2.