EMISSIONS MONITORING SURVEY

Prepared for:

Babcock & Wilcox Volund Limited.

Margam Green Energy Plant
Harbour Way
Margam
Port Talbot
Neath Port Talbot
SA13 2NW

Permit Number	**: EPR/DP3137EG**
Variation Number	**: ...**
Installation	**: A1 Incinerator**
Visit Details	**: PM10 & 2.5 - November 2020 Visit**
Job Number	**: P4246**
Report Number	**: R004**
Report Issue Date	**: 15th January 2021**
Survey Dates	**: 25th November 2020**

Prepared by:

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Report Issue:		**FINAL**	
Report Prepared by:		**Report Reviewed & Approved by** **MCERTS Level Two** **Technical Endorsements TE1, TE2, TE3 & TE4**	
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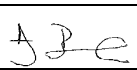
		Signature:	
Date:	5th January 2021	***Date:***	15th January 2021

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MCERTS requirements mean that comparison of results with emissions limit values is not permitted within this report.

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PART 1 - EXECUTIVE SUMMARY

1 Monitoring Objectives

Environmental Compliance Ltd (ECL) was commissioned by **Babcock & Wilcox Volund Limited** to undertake an emission monitoring survey at their **Margam Green Energy Plant**. This report presents the findings of the study.

The monitoring at this installation was carried out in accordance with our quotation reference **DHFB/P4246/Q002**, for compliance check monitoring of emissions to air. The substances requested for monitoring at each emissions point are listed below:

Substances to be monitored	Emission Point Identification
	A1
Velocity / Flowrate	● U
Oxygen	● U
PM10/ PM2.5	● U

● Denotes the substances to be monitored.

U **Denotes UKAS accreditation is held for monitoring that substance, but does not mean that it has been claimed which will depend on whether the testing could be completed in accordance with the Standard Reference Method.**

Special Requirements: During Normal Operation.

Babcock & Wilcox Volund Limited
Permit No : EPR/DP3137EG
Variation No : ...
Report Ref : P4246 : R004

Installation Name : A1 Incinerator
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1.1 Monitoring Results

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty %	Reference Conditions 273 K, 101.3 kPa	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation Claimed For Test Result	Tick if non-conforming test (see Section 2	Operating Status
A1	Volumetric Flowrate	...	88.47338	m^3/sec	4	Stack Conditions	23/11/2020	12:00 – 13:05	BS EN 16911-1:2013 & MID	UKAS / MCERTS		Normal
	Volumetric Flowrate	...	51.27988	m^3/sec	6	Dry & 6% O_2	23/11/2020	12:00 – 13:05	BS EN 16911-1:2013 & MID	UKAS / MCERTS		
	Particulate Fraction < PM_{10} $	...	0.74	mg/m^3	8	Dry & 6% O_2	25/11/2020	09:20 – 12:20	BS EN ISO 23210:2009	UKAS / MCERTS		
	Particulate Fraction < $PM_{2.5}$ $	...	0.64	mg/m^3	8	Dry & 6% O_2	25/11/2020	09:20 – 12:20	BS EN ISO 23210:2009	UKAS / MCERTS		
	Particulate Fraction < PM_{10} $	...	0.66	mg/m^3	8	Dry & 6% O_2	25/11/2020	13:00 – 16:00	BS EN ISO 23210:2009	UKAS / MCERTS		
	Particulate Fraction < $PM_{2.5}$ $	...	0.55	mg/m^3	8	Dry & 6% O_2	25/11/2020	13:00 – 16:00	BS EN ISO 23210:2009	UKAS / MCERTS		

The volumetric flowrate shown above is that from the initial pitot traverse.
Any other flow measurements made during isokinetic sampling and/ or repeat traverses are shown later in the tables section.

Notes

Emission Limit Value	The emission limit value is that stated in the permit and will be expressed as a concentration or a mass emission.
Periodic Monitoring Result	The result given is expressed in the same terms and units as the emission limit value.
Uncertainty	The uncertainty associated with the quoted result is at the 95% confidence interval. The Uncertainty results **DO NOT** take into account the effect of the sample location limitations.
Reference Conditions	All results are expressed at 273 K and 101.3kPa. The oxygen and moisture corrections are stated.
Monitoring Method Reference	The method stated is in accordance with the Environment Agency Technical Guidance Note M2, or other method approved by the Environment Agency.
Accreditation for use of Method	**The details indicate the accreditation for the use of the complete monitoring method, e.g. MCERTs, UKAS. If use of the method is not accredited " NA" is stated.**
Operating Status	The details indicate the feedstock and the loading rate of the plant during monitoring.
$	Chemical Analysis on sample reagents was performed by an External Laboratory as detailed in Section 4
NU	UKAS Accreditation Held but UKAS Accreditation cannot be claimed for the test as sampling did not comply with the Standard Reference Method (SRM), see section 2 & 5
NA	**Method is NOT UKAS Accredited.**

1.2 Operating Information

Any operating information and CEMS data below has been supplied by the client.

Emission Point Reference	Process Type	Process Duration	Fuel	Feedstock	Abatement	Load	Comparison of Operator CEMS and Periodic Monitoring Results					
							Parameter	Date	Time	CEMS Results	Periodic Monitoring Results	Units
A1	Continuous	Continuous	Wood	Wood Grade 2-4	PAC, Lime & SNCR Injection, NH_3	100%	...	...	...	NP	...	...

Notes:

Process Type	State whether the process is a continuous or batch process.
Process Duration	If a batch process, state the duration, frequency and details of the portion of the batch sampled. If continuous state "NA"
Fuel	If applicable, state the fuel type If not applicable state "NA"
Feedstock	State the feedstock type
Abatement	State the type and whether operational during monitoring. If not applicable state "NA"
Load	State the normal load, throughput or rating of the plant
CEMS Data	Enter this data for each CEM installed if it is has been provided by operator otherwise state “NP” (NOT PROVIDED)

2 Monitoring Deviations

The objective of the survey was to measure the concentrations of pollutants from the processes / locations as detailed in Section 1. This survey meets the requirements of the site's **PPC Permit Number: EPR/DP3137EG** where UKAS and MCERTS accreditation has and could be claimed for the testing in the monitoring results table.

There were no modifications to the sampling procedures (TPDs) listed in section 4.

There were no substance deviations from the original and agreed emissions monitoring schedule.

There were no non-conforming tests.

The Uncertainty of the reported concentrations for these pollutant results DOES NOT take into account the effect of non-conformities or sample location limitations

Homogeneity tests have not been completed for pollutants at the following locations: **A1.** Such tests were not requested by the client.

PART 2 – SUPPORTING INFORMATION

3 SAMPLING STAFF DETAILS

Site Sampling Team

Names of Site Team	Dates on Site	MCERTS No.	LEVEL	Technical Endorsements
Harry Round	25th November 2020	MM 14 1278	2	TE1, TE2, TE3, TE4
Scott Hackett		MM 07 889	2	TE1, TE2, TE3, TE4
Peter Brockway		MM 17 1459	2	TE1, TE4
Zac Watkinson		MM 20 1612	Trainee	...

Report Reviewer

Name	MCERTS No.	LEVEL	Technical Endorsements
Andy Barnes	MM 03 235	2	TE1, TE2, TE3, TE4

Technical Endorsement Key:-

TE1 – **Isokinetic** Particulates, Temperature & Velocity Profiles, Oxygen.
TE2 – **Isokinetic** Extractive Pollutants:- Metals, Dioxin & Furans, PAHs, PCBs, HCl, HF.
TE3 – **Non-Isokinetic** Extractive Pollutants:- Speciated VOCs, HF, HCl, Cyanide.
TE4 – **Continuous Analysers** (Combustion Gases):- TVOC, CO, NOx, SO2.

4 SAMPLING PROTOCOLS / METHODOLOGIES

Details of the substances monitored, the standard methods used and the Environmental Compliance Limited Technical Procedures used during this survey are shown in the table below. Detailed sampling protocols are included in a separate document which will be sent with the report.

In all cases, where analysis of collected samples was required, the analysis was by a subcontract laboratory. Details of the sub-contract laboratory are shown on the analysis certificates in this report. The UKAS/MCERTs accreditation status of the analysis is also indicated on the certificates.

Any required modifications to the Technical Procedure Documents (TPDs) specified below will be detailed in section 2 of this report.

Determinand	External Reference Method	ECL Technical Procedure Number
Velocity and Flowrate	BS EN 16911-1:2013 & MID	ECL/ TPD/ 022A
Oxygen (PG350)	BS EN 14789: 2017	ECL / TPD / 033D
PM 10 & PM 2.5	EN ISO 23210:2009	ECL / TPD / 095
Moisture	BS EN 14790: 2017	ECL / TPD / 082

5 SAMPLE POINT DESCRIPTIONS

The homogeneity test is applicable to combustion processes, but may also be requested by the regulator for non-combustion processes.

Homogeneity testing has not been completed at this location.

The test is not usually required for stacks with sampling plane areas of $<1m^2$ (below 1.13m in diameter for circular ducts).

The Uncertainty of the reported concentrations for these pollutant results DOES NOT take into account the effect of non-conformities or sample location limitations.

The sample location that was monitored is detailed below:

A1

The stack diameter is 2.40m and the sample platform width back from the sample port is 4m.

Two sample ports are located on the stack at 90 degrees to each other and are located on the same plane.

These sample ports are located at a height of approximately 1.2m from the working sample platform.

Access to the sample platform was attained by means of permanent ladder accessed from outside the main production building. Platform is approximately 45m from ground level. Two scaffold shelters were constructed, one at the base of the stack and one on the stack's platform.

Two transformers, with 6 x 110v (4x16amp, 2x32amp) sockets on each, are supplied at the base of the stack on request.

EQUIPMENT IDs
(Pre site checklist from SSP)

Babcock & Wilcox Volund Limited
Permit No : EPR/DP3137EG
Variation No : ...
Report Ref : P4246 : R004

Installation Name : A1 Incinerator
Visit Details : PM10 & 2.5 - November 2020 Visit
Survey Dates : 25th November 2020
Report Issue Date. : 15th January 2021

PRE SITE EQUIPMENT CHECKLIST/ EQUIPMENT USED

(Completed before departure to site and when on site in full)

Equipment	Equip. Type	ID No:	ID No:	ID No:	ID No:	ID No:	ID No:	ID No:	ID No:
MST console/pump	E001	U010							
MST Nozzle set		905							
MST "S" Type Pitot		666	769						
MST Probe		143							
MST Hot Box		390							
MST Impinger Arm		391							
		...							
Barometer		627							
Site Balance		1069							
Site Check weights		190							
		191							
Horiba	E002	1065							
Heated Probe / Filter		632							
Chiller		970							
MFC									
Heated Line		875							
FID	E003								
Heated Line									
Heated Probe / Filter									
Testo	E004								
FTIR	E005								
Heated Probe / Filter									
Heated Line									
Stackmite	E006								
"L" Type Pitot									
Digital Manometer									
Stack Thermocouple		1198	857						
Thermocouple Reader									
Nozzle Set									
Workhorse Pumps	E007								
Stack Thermocouple									
Tube Thermocouple									
Meter Thermocouple									
High Vac Gauge									
Dioxin Thermocouple									

Quantity of Ice Required / Used for Survey	8	Bags (2kg bags)

TABLES

Babcock & Wilcox Volund Limited
Permit No : EPR/DP3137EG
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Installation Name : A1 Incinerator
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Table 1 – PM10 / 2.5

Data Recorded from A1 - Incinerator

Emission Parameter	Units	PM 10 & 2.5 - 1	PM 10 & 2.5 - 2	Blank
Stack Diameter	metres	2.40		...
Area of Sample Plane	m^2	4.524		...
Moisture Content	%	17.13	16.55	...
Oxygen Content	%	5.77	5.60	...
Stack Temperature	^oC	118	118	...
Gas Velocity (as Measured, adjusted for wall texture)	m/sec	19.9207	19.5681	...
Gas Velocity (Reference Conditions)	m/sec*	11.6722	11.6723	...
Volumetric Flowrate (as Measured)	m^3/sec	90.1192	88.5241	...
Volumetric Flowrate (Reference Conditions)	m^3/sec*	52.8037	52.8043	...
Sample Date	...	25/11/2020	25/11/2020	...
Sample Period	...	09:20 - 12:20	13:00 - 16:00	...
Sample Volume (reference Conditions)	m^3*	5.276	5.183	5.229
Isokinetic Sampling Rate	%	109.16	107.23	...
Sample Reference (ECL ID)	ECL/20/	6333 & 6332	6336 & 6335	6339 & 6338
Mass of PM 10 Collected	mg	3.91	3.41	0.08
Concentration of PM 10	**mg/m^3***	**0.74**	**0.66**	**0.02**
Emission Rate of PM 10	g/hr	140.88	125.07	...
Mass of PM 2.5 Collected	mg	3.38	2.83	0.04
Concentration of PM 2.5	**mg/m^3***	**0.64**	**0.55**	**0.01**
Emission Rate of PM 2.5	g/hr	121.78	103.80	...
Expanded Uncertainty (% Relative)	%	8	8	...

***Reference Conditions (273K, 101.3kPa, 6% Oxygen, Dry Gas)**

VELOCITY TRAVERSE PROFILES

Environmental Compliance Limited

Babcock & Wilcox Volund Limited
Permit No : EPR/DP3137EG
Variation No : ...
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Installation Name : A1 Incinerator
Visit Details : PM10 & 2.5 - November 2020 Visit
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Environmental Compliance Limited	Traverse Data Profoma	Date of Measurement	23/11/2020

Company	B&W Volund Ltd	Stack Diameter Port A (mm)	2400	Average Stack Diameter (mm)	2400	Pitot tube coefficient	0.85
Site	Margam	Stack Diameter Port B (mm)	2400	Port Length (mm)	250	Pitot Id	769
Location	Incinerator	Duct Length Port A (mm)		Average Duct Length (mm) L		Stack Thermocouple ID	1198
Stack	A1	Duct Length Port B (mm)		Duct width (mm) B		Stack Temp Reader ID	121
Job No	P4246	Duct Length Port C (mm)		Barometric Pressure. (mb)	1007	Manometer ID	120
Operators	HR / PB / ZW	Duct Length Port D (mm)		Ave Static Press. (mm H_2O)	-19.00	Barometer ID	627

Pre - Traverse Checks Carried Out	Time	Pass/ Fail
Pre - Traverse PITOT Visual Inspection	12:00:00	Pass
Pre - Traverse PITOT Leak Check	12:02:00	Pass

Smooth Walls

Static Pressure Readings (mm H_2O)			
Port A	Port B	Port C	Port D
-19.00	-19.00		

Port/ Point	Distance to Point (mm)	Time	Temperature Readings (°C) 1	2	3	(ΔP) Pitot Readings (mm H_2O) 1	2	3	Average Temp. (°C)	Average (ΔP) (mm H_2O)	Swirl Test ° From Reference
A1	78	12:06:00	118.0	118.0	118.0	16.00	17.00	16.50	118.0	16.50	11
A2	251	12:09:00	118.0	118.0	118.0	17.50	17.50	17.00	118.0	17.33	11
A3	465	12:12:00	118.0	118.0	118.0	20.00	19.50	20.00	118.0	19.83	10
A4	776	12:15:00	118.0	118.0	118.0	24.50	24.00	25.00	118.0	24.50	9
A5	1624	12:18:00	118.0	118.0	118.0	30.00	30.00	30.00	118.0	30.00	9
A6	1935	12:21:00	118.0	118.0	118.0	32.00	32.00	32.00	118.0	32.00	10
A7	2149	12:24:00	118.0	118.0	118.0	32.00	32.00	30.00	118.0	31.33	9
A8	2322	12:27:00	118.0	118.0	118.0	30.00	30.00	30.00	118.0	30.00	10
B1	78	12:30:00	118.0	118.0	118.0	16.00	16.00	16.00	118.0	16.00	12
B2	251	12:33:00	118.0	118.0	118.0	17.00	17.00	16.50	118.0	16.83	11
B3	465	12:36:00	118.0	118.0	118.0	19.00	20.00	20.00	118.0	19.67	11
B4	776	12:39:00	118.0	118.0	118.0	22.00	23.00	23.00	118.0	22.67	11
B5	1624	12:42:00	118.0	118.0	118.0	25.00	24.50	24.50	118.0	24.67	9
B6	1935	12:45:00	118.0	118.0	118.0	25.00	25.00	25.00	118.0	25.00	10
B7	2149	12:48:00	118.0	118.0	118.0	30.00	30.00	30.00	118.0	30.00	10
B8	2322	12:51:00	118.0	118.0	118.0	30.00	30.00	32.00	118.0	30.67	9
									1888.0	387.0	Total
Blockage Check @ A1 (L-Type Pitot Only)			Mean			Mean			118.0	32.0	Max
			Difference <5% from Initial ?			Difference <5% from Initial ?			118.0	16.0	Min
									118.0	24.2	Average

Stagnation Check (S-type Pitot Only)	Time	Reading
Static Pressure Via Positive Leg (mm H_2O)	12:55:00	-19.00
Static Pressure Via Negative Leg (mm H_2O)	12:58:00	-19.00
Difference (Pa) < 1 mm H_2O ?		0.00

Post - Traverse Checks Carried Out	Time	Pass/ Fail
Post - Traverse PITOT Visual Inspection	13:02:00	Pass
Post - Traverse PITOT Leak Check	13:05:00	Pass

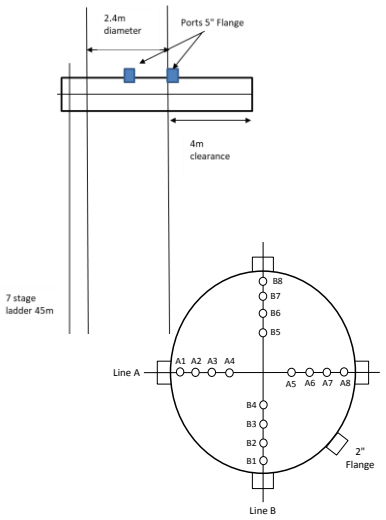
Average temp (K)	391.000

Suitability of Sampling Position	Actual Stack Conditions
Highest:lowest flow pressure ratio < 9:1?	2:1
Maximum deviation of flow from axis < 15° ?	12
X-sectional area for stacks = πr2	4.52 m^2
X-sectional area for ducts = L x B	m^2
Suitability of Position for Sampling	OK

Stack Moisture	18.15	%	Gas Velocity (as Measured) Adjusted for Smooth Walls	19.55691	m/sec
Measured Oxygen	5.67	%	Gas Velocity (Reference Conditions) Adjusted for Smooth Walls	11.33534	m/sec*
Measured Carbon Dioxide	14.48	%	Volumetric Flowrate (as Measured) Adjusted for Smooth Walls	88.47338	m^3/sec
Dry Gas Molecular Weight	30.54360	g/g mole	Volumetric Flowrate (Ref Cond) Adjusted for Smooth Walls	51.27988	m^3/sec*

*Reference Conditions: 273K, 101.3kPa, 6% Oxygen, Dry Gas NOTE: Velocity / volume flowrate calculations exclude contributions from the measurement point(s) where swirl > 15°

Diagram/ Description of Cross Section of Stack/Duct



Notes
Including expected or actual deviations from procedures / non-conformities

Compliance With Positional Requirements?

Height of sample ports from Platform	1.2m
Number of sample ports	2
Width of platform (port back to handrail)	4m

Nearest downstream disturbance	Inlet	15m
Nearest upstream disturbance	Exit	20m

Disturbances are classed as bends, fans or diameter variations

FIELD CALIBRATION AND SAMPLING DATA

Babcock & Wilcox Volund Limited			**Installation Name**	**: A1 Incinerator**
Permit No	**: EPR/DP3137EG**		**Visit Details**	**: PM10 & 2.5 - November 2020 Visit**
Variation No	**: ...**		**Survey Dates**	**: 25th November 2020**
Report Ref	**: P4246**	**: R004**	**Report Issue Date.**	**: 15th January 2021**

PM10 / 2.5 - Test 1

Environmental Compliance Limited	PM10/2.5 DATA SAMPLING PROFORMA	Date of Measurement	25/11/2020

ECL/TPD/	095	Stoppages? (min)	0	Start Time	09:20	End Time	12:20
				Test Duration	180	mins	

Client	B & W Volund Ltd	Stack Profile	Circular	Console id	U010	Barometer id	628
Site	Margam	Stack Area (m^2)	4.52	Pump id	U010	Nozzle Id	905
Location	Incinerator	Barometric Pressure (mb)	1011	Probe id	143	Nozzle size	6.97
Stack ID	A1	Static Pres. (mm H^20)	-19	DGM Yd	0.9786	Impactor 1 Filter ID	1989-213206
Test No.	PM 10 & 2.5 - 1	Pitot coefficient	0.86	ΔH@	48.32	Impactor 2 Filter ID	1989-213207
Job No	P4246	Probe Heater Setting (^OC)	160	Impinger Id	391	Back Up Filter ID	1989-213232
ECL Site Staff	SH, HR, PB & ZW	Hot Box Setting (^OC)	160	Balance Id	1069	Pitot ID	666
	Visible deposits on internal walls in front of first nozzle plate? (Y/N)		N	Smooth Walls		Silica < 50% Spent at End of Test?	YES
	Sampling Head Orientation (Vertical or Horizontal)		H				
	Sample	Head heated outside stack (due to moisture saturation ?) (y/n)	N	Total		FIXED ΔH Settings	
Start Volume	2018267.8	If yes - Heater Box ID and set temp (C)	N/A	N/A		Meter Temp.	20
Final Volume	2023872.2	Heating start and finish time	N/A	N/A		Stack Temp	120
Total Volume	5604.4	Equilibration in-stack start and finish time	09:10	09:20	5604.4	%Moisture	19.03

Leak Check	First	Leak check is only performed before sampling NOT during or after sampling.	Measured O_2 (☐ Atmospheric)	5.77	Fixed ΔH	93.3
Rate l/min	0		Measured Carbon Dioxide %	14.48	Reference Oxygen Percentage	6
Vacuum "Hg	-15					
Time of Check	09:08					

Traverse Point	A4	A4	A4	A4	A4	A4	A4	A4	Total
Time/Point (mins)	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80	
ΔΠ (mm H20)	30.00	24.80	23.20	23.40	23.00	24.80	25.80	25.60	25.08
K factor	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Fixed ΔH (Orifice)	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30
Meter (Tm in)	9.00	11.00	13.00	15.00	18.00	19.00	20.00	19.00	15.50
Meter (Tm out)	9.00	11.00	13.00	15.00	18.00	19.00	20.00	19.00	15.50
Stack Temp (Ts)	117.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	117.88
Impinger T Outlet	8.00	8.00	9.00	9.00	10.00	10.00	11.00	14.00	9.88
Vacuum (" Hg)	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00

Traverse Point	A4	A4	A4	A4	A4	A4	A4	A4	Total
Time/Point (mins)	80 - 90	90 - 100	100 - 110	110 - 120	120 - 130	130 - 140	140 - 150	150 - 160	
ΔΠ (mm H20)	25.00	24.50	24.00	24.00	23.00	22.50	22.50	24.00	23.69
K factor	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Fixed ΔH (Orifice)	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30
Meter (Tm in)	19.00	19.00	19.00	19.00	18.00	18.00	18.00	18.00	18.50
Meter (Tm out)	19.00	19.00	19.00	19.00	18.00	18.00	18.00	18.00	18.50
Stack Temp (Ts)	118.00	118.00	117.00	117.00	117.00	117.00	117.00	117.00	117.25
Impinger T Outlet	8.00	9.00	9.00	12.00	14.00	9.00	9.00	10.00	10.00
Vacuum (" Hg)	-5.00	-6.00	-6.00	-6.00	-6.00	-6.00	-6.00	-6.00	-5.88

Traverse Point	A4	A4							Total
Time/Point (mins)	160 - 170	170 - 180							
ΔΠ (mm H20)	23.20	25.80							24.50
K factor	n/a	n/a							
Fixed ΔH (Orifice)	93.30	93.30							93.30
Meter (Tm in)	18.00	18.00							18.00
Meter (Tm out)	18.00	18.00							18.00
Stack Temp (Ts)	117.00	117.00							117.00
Impinger T Outlet	11.00	12.00							11.50
Vacuum (" Hg)	-6.00	-6.00							-6.00

Traverse Point									Total
Time/Point (mins)									
ΔΠ (mm H20)									
K factor									
Fixed ΔH (Orifice)									
Meter (Tm in)									
Meter (Tm out)									
Stack Temp (Ts)									
Impinger T Outlet									
Vacuum (" Hg)									

	Impinger 1	Impinger 2	Impinger3	Impinger 4	Impinger 5	Impinger 6	Impinger 7	Impinger 8
	DI H_2O	DI H_2O	DI H_2O	Empty	Silica			
SOL/	4165	4165	4165					
Start Weight (g)	628.8	702.6	718.6	535.5	902.4			
End Weight (g)	862.7	941.3	911.3	707.3	928.4			
Total weight (g)	233.9	238.7	192.7	171.8	26	0	0	0

Total (g)	863.10

Rinse Solutions used	
Solution	SOL NO
DI Water	4165
Acetone	4139

Additional Moisture Weighings

Item Name								
Start Weight (g)								
End Weight (g)								
Total weight (g)	0	0	0	0	0	0	0	0

PRE-Sample PITOT Visual Inspection	
Time	09:03
Pass ? (Y/N)	Y

PRE-Sample PITOT Leak Check	
Time	09:05
Pass ? (Y/N)	Y

Post-Sample Blockage Check (L-type)	
Time	
Reading (mm H_2O)	
Pass (<5%) ?	

Post-Sample PITOT Visual Inspection	
Time	12:22
Pass ? (Y/N)	Y

Post-Sample PITOT Leak Check	
Time	12:24
Pass ? (Y/N)	Y

PM10 / 2.5 - Test 2

	PM10/2.5 DATA SAMPLING PROFORMA	Date of Measurement	25/11/2020

ECL/TP	095	Stoppages? (min)	0	Start Time	13:00	End Time	16:00
				Test Duration	180	mins	

Client	B & W Volund Ltd	Stack Profile	Circular	Console id	U010	Barometer id	628
Site	Margam	Stack Area (m^2)	4.52	Pump id	U010	Nozzle Id	905
Location	Incinerator	Barometric Pressure (mb)	1011	Probe id	143	Nozzle size	6.97
Stack ID	A1	Static Pres. (mm H^20)	-19	DGM Yd	0.9786	Impactor 1 Filter ID	1989-213202
Test No.	PM 10 & 2.5 - 2	Pitot coefficient	0.86	ΔH@	48.32	Impactor 2 Filter ID	1989-213205
Job No	P4246	Probe Heater Setting (^OC)	160	Impinger Id	391	Back Up Filter ID	1991-213234
ECL Site Staff	SH, HR, PB & ZW	Hot Box Setting (^OC)	160	Balance Id	1069	Pitot ID	666
	Visible deposits on internal walls in front of first nozzle plate? (Y/N)		N	Smooth Walls		Silica < 50% Spent at End of Test?	Yes
	Sampling Head Orientation (Vertical or Horizontal)		H				
	Sample	Head heated outside stack (due to moisture saturation ?) (y/n)	N	Total		FIXED ΔH Settings	
Start Volume	2025253.6	If yes - Heater Box ID and set temp (C)	N/A	N/A		Meter Temp.	20
Final Volume	2030784.8	Heating start and finish time	N/A	N/A		Stack Temp	120
Total Volume	5531.2	Equilibration in-stack start and finish time	12:50	13:00	5531.2	%Moisture	19.03

Leak Check	First	Leak check is only performed before sampling NOT during or after sampling.	Measured O_2 (☐ Atmospheric)	5.60	Fixed DH	93.3
Rate l/min	0		Measured Carbon Dioxide %	14.48	Reference Oxygen Percentage	6
Vacuum "Hg	-8					
Time of Check	12:47					

Traverse Point	B4	B4	B4	B4	B4	B4	B4	B4	Total
Time/Point (mins)	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80	
ΔΠ (mm H20)	24.20	23.00	23.40	22.78	23.80	22.80	23.20	24.00	23.40
K factor	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Fixed ΔH (Orifice)	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30
Meter (Tm in)	20.00	20.00	20.00	21.00	21.00	22.00	22.00	23.00	21.13
Meter (Tm out)	20.00	20.00	20.00	21.00	21.00	22.00	22.00	23.00	21.13
Stack Temp (Ts)	117.00	117.00	117.00	117.00	117.00	117.00	117.00	118.00	117.13
Impinger T Outlet	10.00	10.00	11.00	11.00	12.00	13.00	14.00	15.00	12.00
Vacuum (" Hg)	-6.00	-6.00	-6.00	-6.00	-6.00	-6.00	-6.00	-6.00	-6.00

Traverse Point	B4	B4	B4	B4	B4	B4	B4	B4	Total
Time/Point (mins)	80 - 90	90 - 100	100 - 110	110 - 120	120 - 130	130 - 140	140 - 150	150 - 160	
ΔΠ (mm H20)	24.20	24.20	25.20	23.80	24.00	22.80	21.80	22.80	23.60
K factor	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Fixed ΔH (Orifice)	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30
Meter (Tm in)	23.00	23.00	23.00	23.00	23.00	22.00	22.00	21.00	22.50
Meter (Tm out)	23.00	23.00	23.00	23.00	23.00	22.00	22.00	21.00	22.50
Stack Temp (Ts)	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00
Impinger T Outlet	16.00	16.00	18.00	15.00	12.00	9.00	10.00	10.00	13.25
Vacuum (" Hg)	-6.00	-6.00	-6.00	-6.00	-6.00	-6.00	-6.00	-6.00	-6.00

Traverse Point	B4	B4							Total
Time/Point (mins)	160 - 170	170 - 180							
ΔΠ (mm H20)	24.00	24.60							24.30
K factor	n/a	n/a							
Fixed ΔH (Orifice)	93.30	93.30							93.30
Meter (Tm in)	21.00	21.00							21.00
Meter (Tm out)	21.00	21.00							21.00
Stack Temp (Ts)	118.00	118.00							118.00
Impinger T Outlet	10.00	11.00							10.50
Vacuum (" Hg)	-6.00	-6.00							-6.00

Traverse Point									Total
Time/Point (mins)									
ΔΠ (mm H20)									
K factor									
Fixed ΔH (Orifice)									
Meter (Tm in)									
Meter (Tm out)									
Stack Temp (Ts)									
Impinger T Outlet									
Vacuum (" Hg)									

	Impinger 1	Impinger 2	Impinger3	Impinger 4	Impinger 5	Impinger 6	Impinger 7	Impinger 8
	DI H_2O	DI H_2O	DI H_2O	Empty	Silica			
SOL/	4165	4165	4165					
Start Weight (g)	613.2	703.5	724	536	732.8			
End Weight (g)	846.2	921.7	897.2	695.2	753.5			
Total weight (g)	233	218.2	173.2	159.2	20.7	0	0	0

Total (g)	804.30

Rinse Solutions used	
Solution	SOL NO
DI Water	4165
Acetone	4139

Additional Moisture Weighings

Item Name								
Start Weight (g)								
End Weight (g)								
Total weight (g)	0	0	0	0	0	0	0	0

PRE-Sample PITOT Visual Inspection	
Time	12:22
Pass ? (Y/N)	Y

PRE-Sample PITOT Leak Check	
Time	12:24
Pass ? (Y/N)	Y

Post-Sample Blockage Check (L-type)	
Time	
Reading (mm H_2O)	
Pass (<5%) ?	

Post-Sample PITOT Visual Inspection	
Time	16:06
Pass ? (Y/N)	Y

Post-Sample PITOT Leak Check	
Time	16:08
Pass ? (Y/N)	Y

Babcock & Wilcox Volund Limited			Installation Name	: A1 Incinerator
Permit No	: EPR/DP3137EG		Visit Details	: PM10 & 2.5 - November 2020 Visit
Variation No	: ...		Survey Dates	: 25th November 2020
Report Ref	: P4246	: R004	Report Issue Date.	: 15th January 2021

Oxygen Calibration Summary – 25th November 2020

	Horiba PG 350 Measurement Ranges:
	O_2
	25
Units	%Vol
	Zero Values (Direct)
Mean Initial Direct Zero	-0.01
Mean Confirmation Direct Zero	-0.02
Difference in Direct Zero	0.01
Repeatability at Zero	0.20
<2 x Repeatability at Zero?	YES
	Pre Zero Values (System)
Mean Pre Test Zero	0.10
% of Measurement Range?	0.40%
Detection Limit (LOD)	0.20
	Applied Span:
	O_2
Actual Applied Span Concentration	14.89
	Pre Test System Zero Values
Mean Pre Test System Zero	0.10
Difference ≤ ± 2% of Span Value?	0.68%
	Post Test Direct Zero Values
Mean Post Test Direct Zero	0.00
% of Certified Range?	0.00%
Zero Drift ≤ ± 5% of Applied Span?	0.03%
	Pre Test System Span Values
Mean Pre Test System Span	14.86
Difference ≤ ± 2% of Span Value ?	0.20%
	Post Test Direct Span Values
Mean Post Test Direct Span	14.90
Span Drift ≤ ± 5% Span Value?	0.08%

LABORATORY ANALYSIS RESULTS

Laboratory analysis for particulate matter was subcontracted to RPS laboratories, a UKAS Accredited Testing Laboratory, Number 0605. RPS DO hold UKAS & MCERTS accreditation for this analysis. As required by the MCERTS Performance Standard for Organisations, the analysis results are shown below.

Sample No. **1160461** **ECL/20/6332**

Total particulate matter	3.38 mg

Sample No. **1160462** **ECL/20/6333**

Total particulate matter	0.53 mg

Sample No. **1160463** **ECL/20/6334**

Total particulate matter	<0.04 mg

Sample No. **1160464** **ECL/20/6335**

Total particulate matter	2.83 mg

Sample No. **1160465** **ECL/20/6336**

Total particulate matter	0.58 mg

Sample No. **1160466** **ECL/20/6337**

Total particulate matter	0.54 mg

Sample No. **1160467** **ECL/20/6338**

Total particulate matter	<0.04 mg

Sample No. **1160468** **ECL/20/6339**

Total particulate matter	<0.04 mg

Sample No. **1160469** **ECL/20/6340**

Total particulate matter	<0.04 mg

UNCERTAINTY CALCULATIONS

Babcock & Wilcox Volund Limited
Permit No : EPR/DP3137EG
Variation No : ...
Report Ref : P4246 : R004

Installation Name : A1 Incinerator
Visit Details : PM10 & 2.5 - November 2020 Visit
Survey Dates : 25th November 2020
Report Issue Date. : 15th January 2021

Site: Margam
Location: A1

$$u_{mass} = \sqrt{\sum (u_{filter})^2 + (u_{solution})^2}$$

Determinand	Impactor 2 mg	Back Up mg	Recovered Mass mg	LAB Method Uncert (%) K=2 Impactor 2 mg	LAB Method Uncert (%) K=2 Back Up mg	Standard Uncertainty Impactor 2 mg	Standard Uncertainty Back Up mg	Combined Uncertainty mg
PM 10 & 2.5 - 1								
PM10 & 2.5	0.53	3.38	3.91	0.0800	0.0800	0.0400	0.0400	0.0566
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
PM 10 & 2.5 - 2								
PM10 & 2.5	0.58	2.83	3.41	0.0800	0.0800	0.0400	0.0400	0.0566
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...

	PM 10 & 2.5 - 1	PM 10 & 2.5 - 2		Standard Uncertainty @ 95%			
Sampled Volume (V_m)	5.60	5.53	m^3	**uV_m**	0.001	m^3	
Meter Correction Factor (Yd)	0.98	0.98	...		...	...	
Meter Temperature (T_m)	290.11	294.72	k	**uT_m**	1.5	k	
Average Differential Pressure (ΔH)	93.30	93.30	mmH_2O	**uΔH**	0.25	mmH_2O	
Barometric Pressure (ρ_b)	758.31	758.31	mmHg	**up_b**	3.8	mmHg	
ΔH + ρs (ρ_m)	102.01	102.01	kPa		...	...	
Oxygen content ($O_{2,m}$)	5.77	5.60	% by volume	$uO_{2,m} = \sigma/\sqrt{n}$	0.0803	0.0167	% by volume
Moisture Content (H_2O)	17.13	16.55	% by volume	**uH_2O**	0.45	0.43	% by volume

Note: In the following calculations, the sensitivity coefficient (C) is estimated using: $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C_i u_i$ where C is the sensitivity coefficient, u is the standard uncertainty and i is the index identifying the contributing factor e.g. i = uV_m, uT_m etc.

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

PM 10 & 2.5 - 1:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = \quad 1.00$$

PM 10 & 2.5 - 2:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = \quad 1.00$$

Uncertainty in correction factor to STP due to measured ΔH uncertainty component (uΔH), measured stack pressure uncertainty component (up_s) & measured temperature of dry gas uncertainty component ($uT_{m\ Dry}$)

PM 10 & 2.5 - 1:

$$f_s = \frac{273}{760} \times \frac{P_b + \frac{\Delta H}{13.6}}{T_m} \times Y_d = \quad 0.927$$

	Maximum	Minimum	Sensitivity	ufstp
uΔH	0.93	0.93	0.0000891	0.0000223
up_b	0.93	0.92	0.00121	0.00454
uT_m	0.93	0.92	0.00320	0.00479
H_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{\sqrt{(u\Delta H)^2 + (uP_s)^2}}{(P_m/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.00592$$

PM 10 & 2.5 - 2:

$$f_s = \frac{273}{760} \times \frac{P_b + \frac{\Delta H}{13.6}}{T_m} \times Y_d = \quad 0.913$$

	Maximum	Minimum	Sensitivity	ufstp
uΔH	0.91	0.91	0.0000877	0.0000219
up_b	0.92	0.91	0.00119	0.00447
uT_m	0.92	0.91	0.00310	0.00465
H_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{\sqrt{(u\Delta H)^2 + (uP_s)^2}}{(P_m/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.00565$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uV_{std}) & volume uncertainty component (uV_m)

PM 10 & 2.5 - 1:

$$V_{std} = V_{measured} \times f_s = \quad 5.196$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty (m^3)
Effect of uV_{std}	5.23	5.16	5.60	0.0332
Effect of uV_m	5.20	5.20	0.93	0.000927

Combined Standard Uncertainty

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uV_{std}}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.19$$

PM 10 & 2.5 - 2:

$$V_{std} = V_{measured} \times f_s = \quad 5.048$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty (m^3)
Effect of uV_{std}	5.08	5.02	5.53	0.0312
Effect of uV_m	5.05	5.05	0.91	0.000913

Combined Standard Uncertainty

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uV_{std}}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.17$$

Babcock & Wilcox Volund Limited		**Installation Name**	**: A1 Incinerator**
Permit No	**: EPR/DP3137EG**	**Visit Details**	**: PM10 & 2.5 - November 2020 Visit**
Variation No	**: ...**	**Survey Dates**	**: 25th November 2020**
Report Ref	**: P4246 : R004**	**Report Issue Date.**	**: 15th January 2021**

Uncertainty in final measurement @ reference conditions due to mass uncertainty component (uM)

Determinand	PM 10 & 2.5 - 1:				PM 10 & 2.5 - 2:			
	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	uM mg/Nm^3	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	uM mg/Nm^3
PM 10 & 2.5	0.76	0.74	0.19	0.01	0.69	0.66	0.20	0.01
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...

Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

Determinand	PM 10 & 2.5 - 1:	PM 10 & 2.5 - 2:
	uL mg/Nm^3	uL mg/Nm^3
PM 10 & 2.5	0.01	0.01
...	...	...
...	...	...
...	...	...

Uncertainty in final measurement @ Reference Conditions due to uVstp

Determinand	PM 10 & 2.5 - 1:				PM 10 & 2.5 - 2:			
	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	uVstp mg/Nm^3	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	uVstp mg/Nm^3
PM 10 & 2.5	0.78	0.73	0.15	0.0269	0.70	0.65	0.13	0.0231
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...

Combined Uncertainty excluding oxygen contribution

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Determinand	PM 10 & 2.5 - 1:				PM 10 & 2.5 - 2:			
	Combined Uncertainty mg/Nm^3	Expanded Uncertainty mg/Nm^3	Measured Concentration mg/Nm^3	Percent of Measured Concentration	Combined Uncertainty mg/Nm^3	Expanded Uncertainty mg/Nm^3	Measured Concentration mg/Nm^3	Percent of Measured Concentration
PM 10 & 2.5	0.0303	0.0607	0.75	8.06	0.0269	0.0537	0.68	7.95
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...

Uncertainty of Oxygen Correction Factor (%):-

PM 10 & 2.5 - 1:

$$f_{o_2} = \frac{20.9\% - O_{2,ref}}{20.9\% - O_{2,measured}} = 0.98$$

$$uCorr^n{}_{o_2} = \frac{20.9\% - O_{2,ref}}{(20.9\% - O_{2,measured}) x (20.9\% - O_{2,measured})} x Uncertainty\ of\ O_2\ Measurement = 0.0234$$

$$uf_{o_2} = \frac{uCorr^n{}_{o_2}}{f_{o_2}} x100 = 2.38\ \%$$

Uncertainty of Oxygen Correction Factor (%):-

PM 10 & 2.5 - 2:

$$f_{o_2} = \frac{20.9\% - O_{2,ref}}{20.9\% - O_{2,measured}} =$$

$$uCorr^n{}_{o_2} = \frac{20.9\% - O_{2,ref}}{(20.9\% - O_{2,measured}) x (20.9\% - O_{2,measured})} x Uncertainty\ of\ O_2\ Measurement =$$

$$uf_{o_2} = \frac{uCorr^n{}_{o_2}}{f_{o_2}} x100 =$$

Combined Uncertainty including oxygen contribution

$$u_{combined} = \sqrt{\sum (uf_{o_2})^2 + (Uncertainty\ of\ Measurement\ of\ Determinand)^2}$$

Determinand	PM 10 & 2.5 - 1:			PM 10 & 2.5 - 2:		
	Measurement Uncertainty of Determinand	Measurement Uncertainty of Oxygen Corr^n Factor	Overall Measurement Uncertainty inc O_2 Corr^n factor ($U_{combined}$)	Measurement Uncertainty of Determinand	Measurement Uncertainty of Oxygen Corr^n Factor	Overall Measurement Uncertainty inc O_2 Corr^n factor ($U_{combined}$)
PM 10 & 2.5	8.06	2.38	8.41	7.95	2.38	8.30
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...

Babcock & Wilcox Volund Limited		Installation Name	: A1 Incinerator
Permit No	: EPR/DP3137EG	Visit Details	: PM10 & 2.5 - November 2020 Visit
Variation No	: ...	Survey Dates	: 25th November 2020
Report Ref	: P4246 : R004	Report Issue Date.	: 15th January 2021

Stack Reference A1

Measurement Uncertainty Calculations - Velocity at Stack Conditions

Contribution From	Standard u/c (mm H_2O)	
Pitot Calibration Uncertainty Contribution	0.121	A
Manometer Calibration Uncertainty Contribution	0.121	B
Variation in Actual Pitot reading at sample points	0.31	C
Combined u/c (mm H_2O) =	**Combined u/c (mm H_2O)**	
SQRT $(A/\sqrt{3})^2 + (B/\sqrt{3})^2 + (C/\sqrt{3})^2$	0.21	
Expanded Uncertainty of Flow Measurements (mm H_2O)	**0.41**	
	Standard u/c (K)	
Temperature Calibration (K)	1.96	D
Variation in Actual Temp reading at sample points	0.00	E
Combined u/c of Temp (K)	**Combined u/c (K)**	
SQRT $((D/\sqrt{3^2}) + (E/\sqrt{3})^2)$	1.13	
Expanded Uncertainty of Temp Measurements (K)	**2.26**	
Measured Average Velocity (m/s) at Stack Conds	19.66	
Maximum Average Velocity (m/s) at Stack Conds	19.88	
Standard Uncertainty Velocity at Stack Conditions (%)	1.14	
Expanded Uncertainty Velocity (at Stack Conditions)	**2.27 (%)**	

Measurement Uncertainty Calculations - Flowrate at Stack Conditions

Contribution From	Standard u/c (m^2)
Area (m2)	0.04524
Measured Average Flowrate (m^3/s) at Stack Conds	88.92
Maximum Average Flowrate (m^3/s) at Stack Conds	90.83
Standard Uncertainty Flowrate (m^3/s) at Stack Conditions (%)	2.15
Expanded Uncertainty Flowrate (m^3/s) at Stack Conditions	**4.30 (%)**

Measurement Uncertainty Calculations - Flowrate at STP & Wet Gas

Contribution From	Standard u/c (%)
Temperature Calibration (K)	0.5
Barometer Calibration	0.5
Measured Average Flowrate (m^3/s) at STP Wet	61.72
Maximum Average Flowrate (m^3/s) at STP Wet	63.26
Standard Uncertainty Flowrate (m^3/s) at STP Wet	2.50
Expanded Uncertainty Flowrate (m^3/s) at STP Wet	**5.01 (%)**

Measurement Uncertainty Calculations - Flowrate at STP & Dry Gas

Contribution From	Standard u/c (%)
Moisture Uncertainty (% v/v)	0.25
Measured Average Flowrate (m^3/s) at STP Dry	50.51
Maximum Average Flowrate (m^3/s) at STP Dry	51.94
Standard Uncertainty Flowrate (m^3/s) at STP Dry	2.82
Expanded Uncertainty Flowrate (m^3/s) at STP Dry	**5.64 (%)**

Measurement Uncertainty Calculations - Flowrate at STP, Dry Gas & Ref Oxygen

Contribution From	Standard u/c (%)
Oxygen Uncertainty (% v/v)	0.057
Measured Average Flowrate (m^3/s) at STP Dry & Ref Oxygen	51.63
Maximum Average Flowrate (m^3/s) at STP Dry & Ref Oxygen	53.28
Standard Uncertainty Flowrate (m^3/s) at STP Dry & Ref Oxygen	3.20
Expanded Uncertainty Flowrate (m^3/s) at STP Dry & Ref O_2	**6.40 (%)**