Replacing Metals with Advanced Composites

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Coventry City Council
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01 February 2012

Dear Neil,

RE: PPC/190 NP Aerospace - Emissions Testing Results (Sites 1 and 3)

Please find attached the results of a recent emissions testing programme at NP Aerospaces Foleshill Road Site, In Coventry.

Please accept our apologies for not getting this report to you late last year, however a combination of emissions monitoring contractor delays, reporting delays and production plant availability has meant that despite the work all being scheduled to take place prior to the October deadline, did not take place until later in the year. Please also note that a significant proportion of the production within the Site 1 has been relocated to Site 3 and as such, a number of the regulated operations (namely A1, A2 and A3) have not been in regular use during 2011.

We would like to make you aware of a breach in the emission levels of VOC for emission point A1. The sampling indicated that the average emissions of VOC from A1 were 374mg/m^3 against an ELV of 100mg/m^3. As you are aware Spray Booth 1 is the newest and most modern booth on site and has an integral carbon filtration (VOC abatement) fitted as an integral part of the extraction system. This emission level is therefore anomalous and completely unexpected.

Upon discovery of this situation, NP Aerospace have immediately called in the OEM maintenance engineer and carried out an internal investigation of which the findings are provided below:

Condition of filters: All of the filters were removed and inspected. The maintenance schedule for the carbon cartridges requires that they are replaced approximately every six months. All carbon filters were inspected and did not appear to be in poor / unserviceable condition. All filters were replaced with new units as a precautionary measure.

Condition of booth: The booth was dismantled and all filters removed. A couple of minor air gaps were noted along the edges of the filter mounts. Although these gaps are unlikely to be causing a significant preferential pathway , they have been sealed to ensure that extracted air cannot by-pass the carbon filter bank.

Sampling Technique: It has come to light that the sampling was carried out during both the spray-cycle and the baking cycle. Due to the configuration and design of the spray booth, emissions are only extracted and released to atmosphere during the spray cycle. A concern was raised

Sampling during the bake cycle is likely to give very unrepresentative results as the pitot tube flow measurements used to calculate the emissions concentrations and sampling rates prior to the commencement of sampling (during extraction) will not represent the conditions during the baking cycle (when there is no flow or releases). Understandable this would give rise to a very significant error in the concentrations calculated for the process.

Therefore it is the conclusion of this investigation that likely cause for the breach in emissions is not due to a maintenance or equipment failure, but instead due to the fact that the sampling was carried out during the bake cycle and not actually whilst the plant was extracting to atmosphere. This conclusion has been supported by the service engineer that was called out to attend the immediate maintenance of the plant.

NP Aerospace will notify their sampling contractor of these findings and ensure that in future all sampling is carried out during the next monitoring period.

We hope that this letter meets with your requirements, should you have any questions please do not hesitate to contact us.

Yours sincerely,

[redacted]

G Sandhu

Quality Manager

EMISSIONS MONITORING SURVEY
(Annual Compliance – Site 1 & Site 3)

Prepared for:

NP Aerospace Ltd
Foleshill Road
Coventry
West Midlands
CV6 5AQ

Permit Number	**: PPC 189 & PPC 190**
Job Number	**: P1098**
Report Number	**: R001**
Report Issue Date	**: 07/02/12**
Survey Dates:	**: 23/08/11, 13/09/11 & 28/11/11**

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	
Name:	Jonathan Litterick	***Name:***	Andy Barnes
		MCERTS No:	MM 03 235
		Signature:	[redacted]
Date:	05/02/12	***Date:***	07/02/12

This report is not to be used for contractual or engineering purposes unless this approval sheet is signed where indicated by the approver and the report is designated "FINAL".

mCERTS
THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

UKAS TESTING
2499

This report has been prepared by Environmental Compliance Limited (ECL) in their professional capacity as Environmental Consultants. The contents of the report reflect the conditions that prevailed and the information available or supplied at the time of its preparation. The report, and the information contained therein, is provided by ECL solely for use and reliance by the Client in performance of ECLs duties and liabilities under its contract with the Client. Until ECL has received payment in full as detailed in the quotation or contract the contents of this report remain the legal property of ECL. The contents of the report do not, in any way, purport to include any manner of legal advice or opinion.

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Opinions and Interpretation expressed within this report are outside the scope of the UKAS accreditation.

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 **NP Aerospace Ltd** to undertake an emission monitoring survey at their **Site 1 and Site 3 Factories, in Coventry.** This report presents the findings of the study.

The monitoring at this installation was carried out in accordance with our quotation reference **PC/P1098/Q001**, 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	
	SITE 1	
	Spray Booth (A1)	Prep Booth (A2)
Particulates	• U	• U
Total Organic Carbon (TOC)	• U	

Substances to be monitored	Emission Point Identification	
	SITE 1	
	LineX Booth (A3)	Wet Backed Booth (A5)
Particulates	• U	• U
Total Organic Carbon (TOC)	• U	• U

Substances to be monitored	Emission Point Identification	
	SITE 3	
	Degreasing Booth (A1)	LineX Booth (A2)
Particulates		• U
Total Organic Carbon (TOC)	• U	• U
Isocyanates		•

• 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: *"None."*

1.1 Monitoring Results

Emission Point Reference	Substance to b Monitored	Emission Limit Value	Periodic Monitoring Result	Uncertainty %	Units	Reference Conditions 273 K, 101.3 kPa	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Tick if non-conforming test (see Sections 2 & 5)	Operating Status
Site 1 A1	Particulates $	50	1.90	30	mg/m^3	STP Wet	28/11/11	11:06 – 11:39	BS EN 13284-1	UKAS / MCERTS	✓	Spray
			0.32	100				11:46 – 12:19			✓	Bake
	TOCs as Carbon	100	**122.63**	8				11:20 – 11:40	BS EN 13526	UKAS / MCERTS		Spray
	TOCs as Carbon	100	**498.13**	11				11:20 – 12:20	BS EN 13526	UKAS / MCERTS		Bake
Site 1 A2	Particulates $	50	0.26	100	mg/m^3	STP Wet	28/11/11	13:10 – 13:43	BS EN 13284-1	UKAS / MCERTS	✓	Normal
			0.28	100				14:06 – 14:39				
Site 1 A5	Particulates $	50	0.28	100	mg/m^3	STP Wet	13/09/11	14:00 – 14:41	BS EN 13284-1	UKAS / MCERTS		Normal
			0.43	100				14:46 – 15:27				
	TOCs as Carbon	100	24.2	11				14:15 – 15:15	BS EN 13526	UKAS / MCERTS		
Site 3 A1	TOCs as Carbon	75	40.5	19	mg/m^3	STP Wet	23/08/11	10:53 – 12:23	BS EN 13526	UKAS / MCERTS		Normal
Site 3 A2	Particulates $	50	1.28	37	mg/m^3	STP Wet	23/08/11	13:00 – 13:33	BS EN 13284-1	NU	✓	Normal
			0.52	87				13:45 – 14:18				
	TOCs as Carbon	75	3.5	44				12:35 – 14:15	BS EN 13526	UKAS / MCERTS		
	Isocyanates $	0.1	<0.002	>100				13:00 – 14:00	MDHS 25	NA		

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

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
Site 1 – A1	Batch	Various	n/a	n/a	Dry Filter	Normal	...	...	...	NP	...	...
Site 1 – A2	Batch	Various	n/a	n/a	Dry Filter	Normal	...	...	...	NP	...	...
Site 1 – A5	Batch	Various	n/a	n/a	Wet Filter	Normal	...	...	...	NP	...	...
Site 3 – A1	Batch	Various	n/a	n/a	Dry Filter	Normal	...	...	...	NP	...	...
Site 3 – A2	Batch	Various	n/a	n/a	Dry Filter	Normal	...	...	...	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: PPC 189 & PPC 190** where UKAS and MCERTS accreditation has and could be claimed for the testing in the monitoring results table.

There were substance deviations from the original and agreed emissions monitoring schedule:-

- **Site 1 – A3:** Plant was not running on scheduled test dates, and has not been run for most of the year, it therefore could not be tested.

Non-conforming tests/ sample locations are as follows:-

- **Site 1 – A1 & A2:** Flow profiles do not conform to the requirements of the SRM. This is because swirl was measured at greater than 15° at a number of points on the sample plane. (Particulate sampling took place on points where swirl was below 15°)
- **Site 1 – A1:** Due to the high duct velocities, a nozzle diameter of less than 6mm had to be used to achieve isokinetic sample rates during particulate samples.
- **Site 3 – A1:** Flow profile does not conform to the requirements of the SRM. This is because swirl was measured at greater than 15° at a number of points on the sample plane.
- **Site 3 – A1 & A2:** Flow profiles do not conform to the requirements of the SRM. This is because the ratio of highest to lowest pitot readings was greater than 9:1.

Homogeneity tests have not been completed for pollutants at any of the sampling locations. Tests are not applicable to these locations and were not requested by client.

PART 2 – SUPPORTING INFORMATION

3 SAMPLING STAFF DETAILS

Site Sampling Team

Names of Site Team	Dates on Site	MCERTS No.	LEVEL	Technical Endorsements
Paul Calland	23/08/11	MM 03 212	2	TE1, TE2, TE3, TE4
Jonathan Litterick	23/08/11 13/09/11	MM 03 236	2	TE1, TE2, TE3, TE4
Robert Jones	28/11/11	MM 04 482	2	TE1, TE2, TE3, TE4
Andrew Osborne	13/09/11 28/11/11	MM 07 842	1	...

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):- VOCs, CO, NOx, SO2.

4 SAMPLING PROTOCOLS / METHODOLOGIES

TOCs as Carbon

Testing was carried out using a Signal 3030PM FID and heated gas transport system with reference to the manufacturer's operation handbook **BS EN 13526** and in-house technical procedure **ECL/TPD/032**. The analyser was calibrated pre and post the sample period using span gas and nitrogen / zero scrubbed air. Data was corrected by molecular weight to VOCs as total carbon.

Data was recorded as minute averages over each test period. The minute averaged data is presented in the Figures Section and the minute averaged data is detailed in the Tables Section.

Particulates

Testing was carried out using a Manual Stack Sampling system in accordance with **BS EN 13284-1 & MID** and In-house technical procedure **ECL/TPD/027a**.

Isokinetic particulate sampling is achieved when the velocity of gas entering the sampling nozzle is exactly equal to the velocity of the approaching gas stream within the stack.

A measured volume of sample gas is withdrawn from the stack isokinetically through a sampling nozzle and through a pre-weighed filter positioned in an unheated housing inserted into the stack.

Particulate matter is collected on the filter. Following testing the front half of the filter housing and the sample nozzle are rinsed to remove any particulate matter which, may have impacted on the surfaces during testing. The filters and rinses are subsequently analysed to determine the amount of particulate matter captured.

Scientific Analysis Laboratories Ltd (SAL) who are situated in Manchester carried out the analysis of the samples. **SAL** are UKAS accredited for all analysis conducted. In addition to the survey samples, a field blank is submitted as part of the technical procedure.

Isocyanates

Testing was carried out in accordance with **MDHS 25/3.** In this method a measured volume of stack gases is removed from the duct and first passed through a filter, pre treated with 1-2 MP in Toluene, then passed through a series of impingers containing 1-2 MP in Toluene. After sampling the filter is combined with the impinger solution for analysis.

ECL are not UKAS accredited for this sampling method.

Scientific Analysis Laboratories Ltd (SAL) who are situated in **Manchester** carried out the analysis of the samples. **SAL** are UKAS accredited for this analysis.

In addition to the survey samples, a field blank is submitted as part of the procedure.

Pressure, Temperature and Velocity

Testing was carried out using a sampling system in accordance with **BS EN 13284-1 & MID** and In-house technical procedure **ECL/TPD/022.**

Temperature was recorded using a thermocouple and digital temperature reader. Velocity and pressure was recorded using an "L" type pitot and digital manometer, data being recorded in Pascals.

5 SAMPLE POINT DESCRIPTIONS

The sample locations that were monitored are detailed below:-

Site 1 – Spray Booth (A1)

The sampling location does not meet the requirements detailed in *Technical Guidance Note (Monitoring) M1"Sampling requirements for stack-emission monitoring" Environment Agency,* and BS EN 13284-1 due to the flow profile (Swirl of greater than 15° was measured in areas of the sample plane).The stack dimensions are 0.60m by 0.60m and the sample platform (a temporary scaffold) was 1.5m wide behind the sample ports. Two sample ports are located on one side of the square duct and are located on the same plane. These sample ports are located at a height of approximately 1.0m from the working sample platform. Sampling for Particulates was carried out using an in-stack filter system.

Samples for particulates are non-conforming, due to the fact that the flow profile does not conform to the SRM. Swirl was measured at greater than 15° at a number of points on the sample plane. (Particulate sampling took place at points where swirl was below 15°)

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

Site 1 – Prep Booth (A2)

The sampling location does not meet the requirements detailed in *Technical Guidance Note (Monitoring) M1"Sampling requirements for stack-emission monitoring" Environment Agency,* and BS EN 13284-1 due to the flow profile (Swirl of greater than 15° was measured in areas of the sample plane).The stack dimensions are 0.60m by 0.60m and the sample platform (a temporary scaffold) was 2.0m wide behind the sample ports. Two sample ports are located on one side of the square duct and are located on the same plane. These sample ports are located at a height of approximately 1.0m from the working sample platform. Sampling for Particulates was carried out using an in-stack filter system.

Samples for particulates are non-conforming, due to the fact that the flow profile does not conform to the SRM. Swirl was measured at greater than 15° at a number of points on the sample plane. (Particulate sampling took place at points where swirl was below 15°)

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

Site 1 – Wet Back Booth (A5)

The stack dimensions are 0.58m by 0.58m and the sample platform (a temporary scaffold) was 1.5m wide behind the sample ports. Two sample ports are located on one side of the square duct and are located on the same plane. These sample ports are located at a height of approximately 1.0m from the working sample platform.

Sampling for Particulates was carried out using an in-stack filter system.

Site 3 – Degreasing Booth (A1)

The sampling location does not meet the requirements detailed in *Technical Guidance Note (Monitoring) M1"Sampling requirements for stack-emission monitoring" Environment Agency,* and BS EN 13284-1 due to the flow profile (Swirl of greater than 15° was measured in areas of the sample plane and ratio of highest to lowest pitot reading was greater than 9:1).

The stack diameter is 0.8m and the sample platform width back from the sample port is 2.0m. Two sample ports are located on the stack at 90 degrees to each other and are located on the same plane.

The sample location is non-conforming, due to the fact that the flow profile does not conform to the SRM. Swirl was measured at greater than 15° at a number of points on the sample plane, also the ratio of highest to lowest pitot readings exceeded 9:1.

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

Site 3 – LineX Booth (A2)

The sampling location does not meet the requirements detailed in *Technical Guidance Note (Monitoring) M1"Sampling requirements for stack-emission monitoring" Environment Agency,* and BS EN 13284-1 due to the flow profile (Ratio of highest to lowest pitot reading was greater than 9:1).

The stack diameter is 0.8m and the sample platform width back from the sample port is 2.0m. Two sample ports are located on the stack at 90 degrees to each other and are located on the same plane.

Sampling for Particulates was carried out using an in-stack filter system.

Samples for particulates are non-conforming, due to the fact that the ratio of highest to lowest pitot readings exceeded 9:1. As a consequence of this deviation, UKAS/MCERTS accreditation cannot be claimed for the particulate samples.

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

EQUIPMENT IDs
(Pre site checklist from SSP)

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								
MST Nozzle set									
MST "S" Type Pitot									
MST Probe									
MST Hot Box									
MST Impinger Arm									
Barometer		205	628	352					
Site Balance									
Site Check weights									
Horiba	E002								
Heated Probe									
Chiller									
Sonimix									
Heated Line									
FID	E003	211	304	516					
Heated Line		432	433	212	213				
Testo	E004								
FTIR	E005								
Heated Probe									
Heated Line									
Stackmite	E006	367	366						
"L" Type Pitot		487	488						
Digital Manometer		356	357						
Stack Thermocouple		466	468						
Thermocouple Reader		370	358						
Nozzle Set		801	802	800					
Workhorse Pumps	E007	P7							
Low Flow Pumps									

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

FIGURES

Figure 1

**Continuous VOC Emissions Data recorded from Spray Booth (A1) - Site 1 NP Aerospace.
between 11:20 - 11:40, on 28/11/2011. (SPRAYING)
Reference Conditions (273K, 101.3kPa, & Wet Gas)**

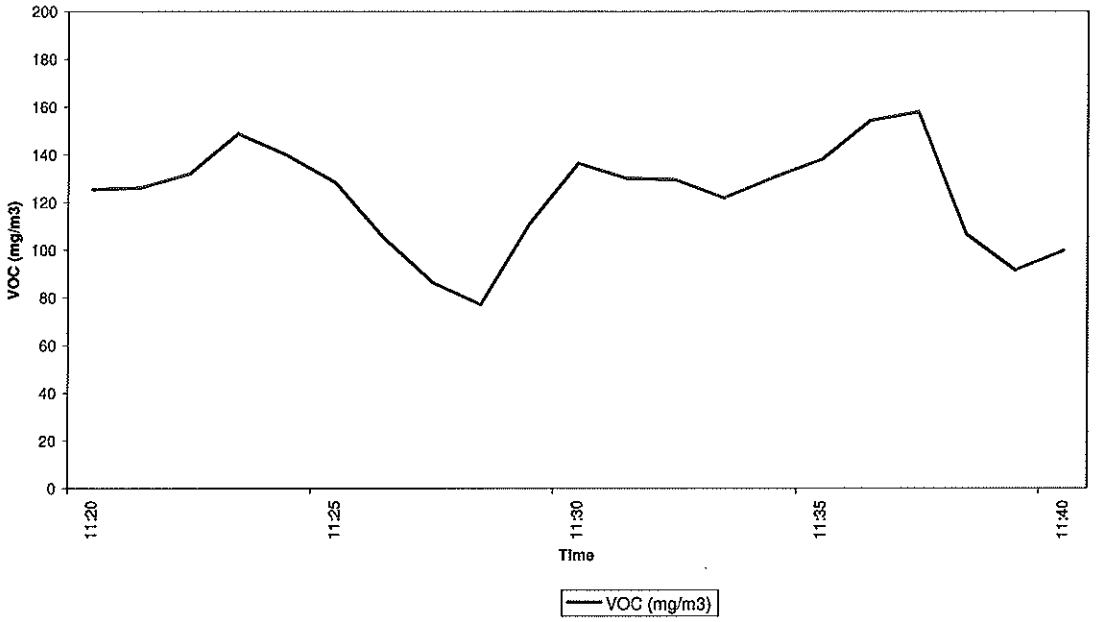


Figure 2

**Continuous VOC Emissions Data recorded from Spray Booth (A1) - Site 1 NP Aerospace.
between 11:20 - 12:20, on 28/11/2011. (Bake Cycle)
Reference Conditions (273K, 101.3kPa, & Wet Gas)**

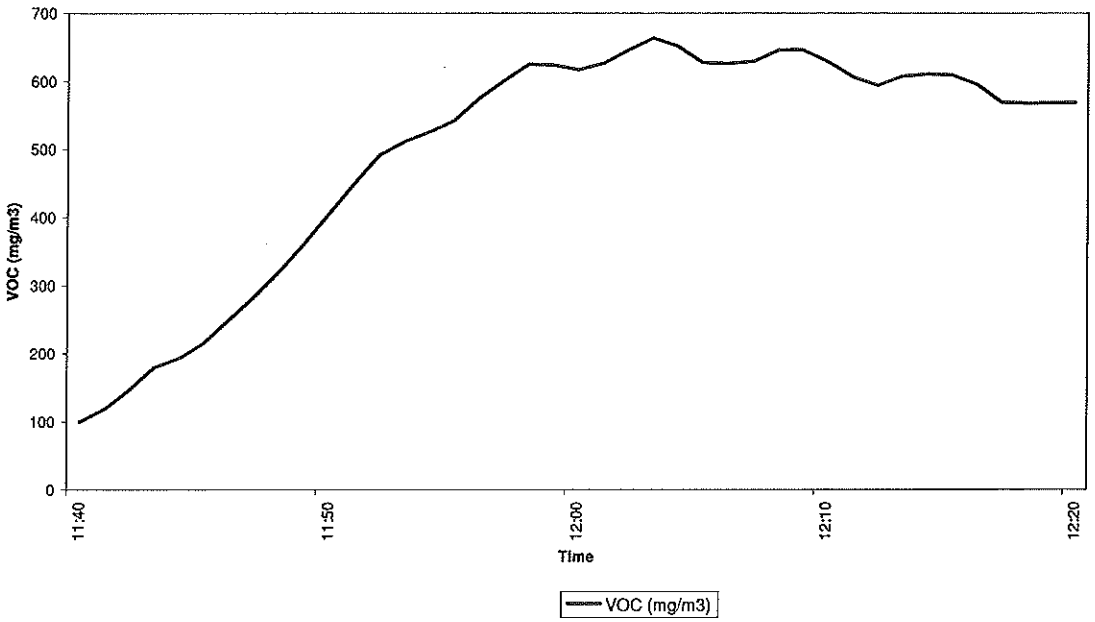


Figure 3

**Continuous VOC Emissions Data recorded from Wet Backed Booth (A5) - Site 1 NP Aerospace.
between 14:15 - 15:15, on 13/09/2011.
Reference Conditions (273K, 101.3kPa, & Wet Gas)**

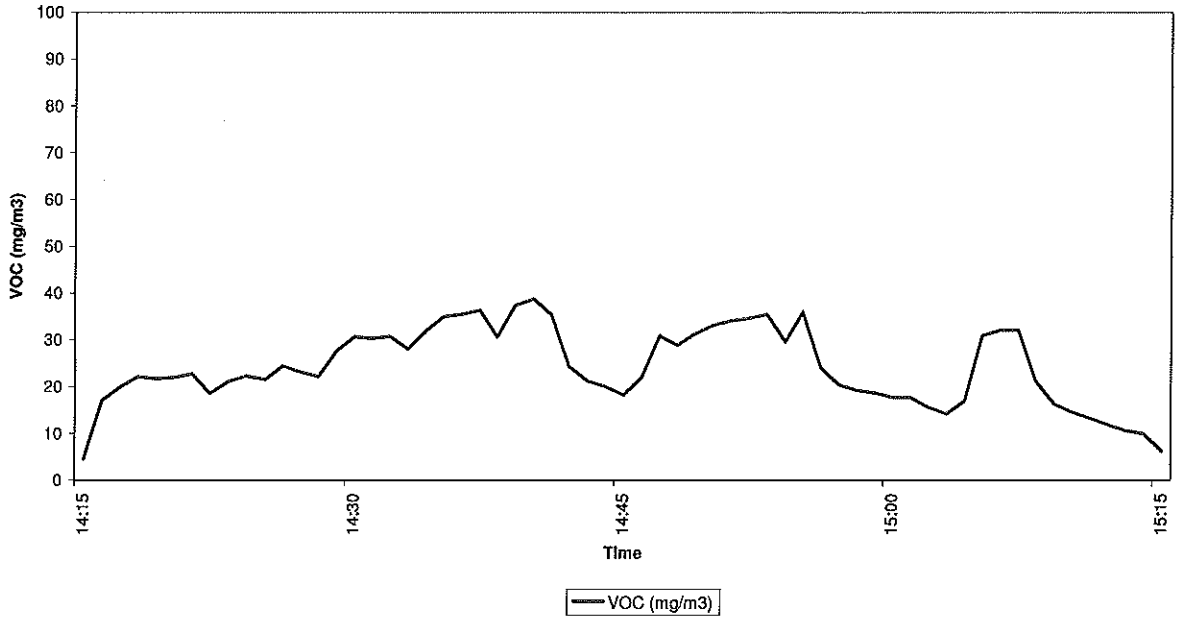


Figure 4

**Continuous VOC Emissions Data recorded from Degreasing Booth (A1) - Site 3, NP Aerospace.
between 10:53 - 12:23, on 23/08/2011.
Reference Conditions (273K, 101.3kPa, & Wet Gas)**

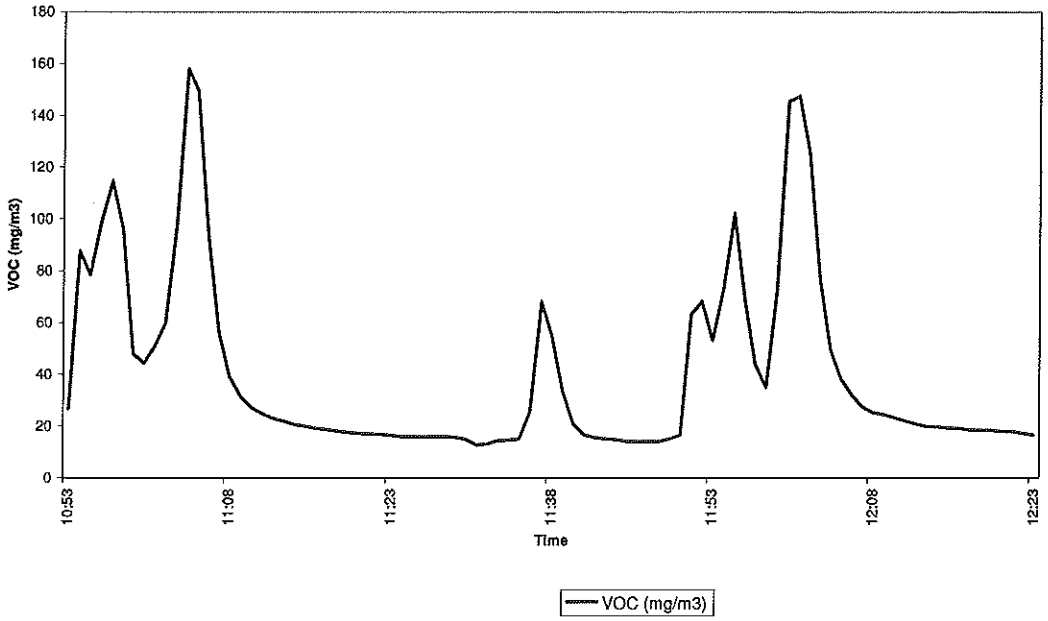
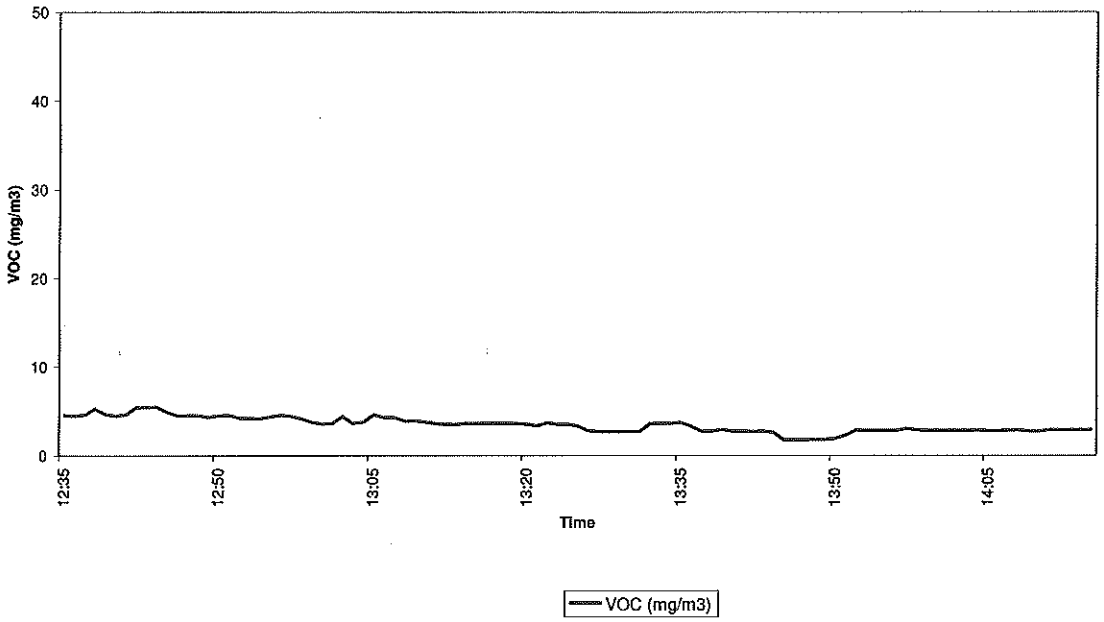


Figure 5

**Continuous VOC Emissions Data recorded from LineX booth (A2) - Site 3, NP Aerospace.
between 12:35 - 14:15, on 23/08/2011.
Reference Conditions (273K, 101.3kPa, & Wet Gas)**



TABLES

Table 1

Data Recorded from Spray Booth (A1) – Site 1, NP Aerospace
Sample Period: 11:20 – 12:20 on the 28th November 2011.
(Spraying 11:20 to 11:40, Baking 11:40 to 12:20)

Volumetric Flowrate (Reference Conditions) = 4.74 m^3/sec *

	Average	Emission Rate
	mg/m^3	Kg/hr
VOCs (as carbon) (Spraying)	122.63	2.09
VOCs (as carbon) (Baking)	498.13	8.50

Data expressed at (273K, 101.3 kPa, & Wet Gas)

Table 2

Data Recorded from Wet Backed Booth (A5) – Site 1, NP Aerospace
Sample Period: 14:15 – 15:15 on the 13th September 2011

Volumetric Flowrate (Reference Conditions) = 1.87 m^3/sec *

	Average	Emission Rate
	mg/m^3	Kg/hr
VOCs (as carbon)	24.2	0.16

Data expressed at (273K, 101.3 kPa, & Wet Gas)

Table 3

Data Recorded from Degreasing Booth (A1) – Site 3, NP Aerospace Sample Period: 10:53 – 12:23 on the 23rd August 2011

Volumetric Flowrate (Reference Conditions) = 2.76 m^3/sec *

	Average	Emission Rate
	mg/m^3	Kg/hr
VOCs (as carbon)	40.5	0.40

Data expressed at (273K, 101.3 kPa, & Wet Gas)

Table 4

Data Recorded from LineX Booth (A2) – Site 3, NP Aerospace Sample Period: 12:35 – 14:15 on the 23rd August 2011

Volumetric Flowrate (Reference Conditions) = 3.08 m^3/sec *

	Average	Emission Rate
	mg/m^3	Kg/hr
VOCs (as carbon)	3.5	0.04

Data expressed at (273K, 101.3 kPa, & Wet Gas)

Table 5 – Particulates

Data Recorded from Site 1 - Spray Booth (A1)

Emission Parameter	Units	TPM-1	Blank
Duct Length	metres	0.60	...
Duct Width	metres	0.60	...
Area of Sample Plane	m^2	0.360	...
Moisture Content	%	0.02	...
Oxygen Content	%	20.90	...
Stack Temperature	°C	16	...
Gas Velocity (at Stack Conditions)	m/sec	14.06	...
Gas Velocity (Reference Conditions)	m/sec*	13.16	...
Volumetric Flowrate (Stack Conditions)	m^3/sec	5.06	...
Volumetric Flowrate (Reference Conditions)	m^3/sec*	4.74	...
Sample Date	...	28/11/2011	...
Sample Period	...	11:06 - 11:39	...
Sample Volume (at Stack)	m^3	0.57	...
Sample Volume (reference Conditions)	m^3*	0.54	0.54
Isokinetic Sampling Rate	%	107.2	...
Sample Reference (ECL ID)	ECL/11/	6819 & 6820	6823 & 6824
Mass of Particulate Matter Collected	mg	1.02	0.15
Concentration of Particulate Matter	mg/m^3*	**1.90**	0.28
Emission Rate of Particulate Matter	g/hr	32.46	...
Expanded Uncertainty (%Relative)	%	30	...
Emission Limit Value (ELV)	mg/m^3*	50	...
Blank Concentration as Percentage of ELV	%	...	<1.00%

*Reference Conditions (273K, 101.3kPa, Wet Gas)

Table 6 – Particulates

Data Recorded from Site 1 - Spray Booth (A1)

Emission Parameter	Units	TPM-2	Blank
Duct Length	metres	0.60	...
Duct Width	metres	0.60	...
Area of Sample Plane	m^2	0.360	...
Moisture Content	%	0.02	...
Oxygen Content	%	20.90	...
Stack Temperature	°C	16	...
Gas Velocity (at Stack Conditions)	m/sec	14.06	...
Gas Velocity (Reference Conditions)	m/sec*	13.16	...
Volumetric Flowrate (Stack Conditions)	m^3/sec	5.06	...
Volumetric Flowrate (Reference Conditions)	m^3/sec*	4.74	...
Sample Date	...	28/11/2011	...
Sample Period	...	11:46 - 12:19	...
Sample Volume (at Stack)	m^3	0.57	...
Sample Volume (reference Conditions)	m^{3*}	0.53	0.53
Isokinetic Sampling Rate	%	106.2	...
Sample Reference (ECL ID)	ECL/11/	6821 & 6822	6823 & 6824
Mass of Particulate Matter Collected	mg	0.17	0.15
Concentration of Particulate Matter	mg/m^{3*}	**0.32**	0.28
Emission Rate of Particulate Matter	g/hr	5.46	...
Expanded Uncertainty (%Relative)	%	179	...
Emission Limit Value (ELV)	mg/m^{3*}	50	...
Blank Concentration as Percentage of ELV	%	...	<1.00%

*Reference Conditions (273K, 101.3kPa, Wet Gas)

Table 7 – Particulates

Data Recorded from Site 1 - Prep Booth (A2)

Emission Parameter	Units	TPM - 1	Blank
Duct Length	metres	0.60	...
Duct Width	metres	0.60	...
Area of Sample Plane	m^2	0.360	...
Moisture Content	%	0.02	...
Oxygen Content	%	20.90	...
Stack Temperature	°C	12	...
Gas Velocity (at Stack Conditions)	m/sec	5.47	...
Gas Velocity (Reference Conditions)	m/sec*	5.19	...
Volumetric Flowrate (Stack Conditions)	m^3/sec	1.97	...
Volumetric Flowrate (Reference Conditions)	m^3/sec*	1.87	...
Sample Date	...	28/11/2011	...
Sample Period	...	13:10 - 13:43	...
Sample Volume (at Stack)	m^3	0.60	...
Sample Volume (reference Conditions)	m^{3*}	0.57	0.57
Isokinetic Sampling Rate	%	108.3	...
Sample Reference (ECL ID)	ECL/11/	6825 & 6826	6829 & 6830
Mass of Particulate Matter Collected	mg	0.15	0.15
Concentration of Particulate Matter	mg/m^{3*}	**0.26**	0.26
Emission Rate of Particulate Matter	g/hr	1.77	...
Expanded Uncertainty (% Relative)	%	>100%	...
Emission Limit Value (ELV)	mg/m^{3*}	50	...
Blank Concentration as Percentage of ELV	%	...	<1.00%

*Reference Conditions (273K, 101.3kPa, Wet Gas)

Table 8 – Particulates

Data Recorded from Site 1 - Prep Booth (A2)

Emission Parameter	Units	TPM - 2	Blank
Duct Length	metres	0.60	...
Duct Width	metres	0.60	...
Area of Sample Plane	m^2	0.360	...
Moisture Content	%	0.02	...
Oxygen Content	%	20.90	...
Stack Temperature	°C	16	...
Gas Velocity (at Stack Conditions)	m/sec	5.51	...
Gas Velocity (Reference Conditions)	m/sec*	5.16	...
Volumetric Flowrate (Stack Conditions)	m^3/sec	1.98	...
Volumetric Flowrate (Reference Conditions)	m^3/sec*	1.86	...
Sample Date	...	28/11/2011	...
Sample Period	...	14:06 - 14:39	...
Sample Volume (at Stack)	m^3	0.58	...
Sample Volume (reference Conditions)	m^{3*}	0.54	0.54
Isokinetic Sampling Rate	%	103.4	...
Sample Reference (ECL ID)	ECL/11/	6827 & 6828	6829 & 6830
Mass of Particulate Matter Collected	mg	0.15	0.15
Concentration of Particulate Matter	mg/m^{3*}	0.28	0.28
Emission Rate of Particulate Matter	g/hr	1.86	...
Expanded Uncertainty (% Relative)	%	>100%	...
Emission Limit Value (ELV)	mg/m^{3*}	50	...
Blank Concentration as Percentage of ELV	%	...	<1.00%

*Reference Conditions (273K, 101.3kPa, Wet Gas)

Table 9 – Particulates

Data Recorded from Site 1 - Wet Back Booth (A5)

Emission Parameter	Units	TPM - 1	Blank
Duct Length	metres	0.58	...
Duct Width	metres	0.58	...
Area of Sample Plane	m^2	0.336	...
Moisture Content	%	0.02	...
Oxygen Content	%	20.90	...
Stack Temperature	°C	16	...
Gas Velocity (at Stack Conditions)	m/sec	10.16	...
Gas Velocity (Reference Conditions)	m/sec*	9.46	...
Volumetric Flowrate (Stack Conditions)	m^3/sec	3.42	...
Volumetric Flowrate (Reference Conditions)	m^3/sec*	3.18	...
Sample Date	...	13/09/2011	...
Sample Period	...	14:00 - 14:41	...
Sample Volume (at Stack)	m^3	0.78	...
Sample Volume (reference Conditions)	m^{3*}	0.73	0.73
Isokinetic Sampling Rate	%	110.6	...
Sample Reference (ECL ID)	ECL/11/	4829 & 4830	4833 & 4834
Mass of Particulate Matter Collected	mg	0.20	0.15
Concentration of Particulate Matter	mg/m^{3*}	0.28	0.21
Emission Rate of Particulate Matter	g/hr	3.16	...
Expanded Uncertainty (% Relative)	%	152	...
Emission Limit Value (ELV)	mg/m^{3*}	50	...
Blank Concentration as Percentage of ELV	%	...	<1.00%

*Reference Conditions (273K, 101.3kPa, Wet Gas)

Table 10 – Particulates

Data Recorded from Site 1 - Wet Back Booth (A5)

Emission Parameter	Units	TPM - 2	Blank
Duct Length	metres	0.58	...
Duct Width	metres	0.58	...
Area of Sample Plane	m^2	0.336	...
Moisture Content	%	0.02	...
Oxygen Content	%	20.90	...
Stack Temperature	°C	16	...
Gas Velocity (at Stack Conditions)	m/sec	10.16	...
Gas Velocity (Reference Conditions)	m/sec*	9.46	...
Volumetric Flowrate (Stack Conditions)	m^3/sec	3.42	...
Volumetric Flowrate (Reference Conditions)	m^3/sec*	3.18	...
Sample Date	...	13/09/2011	...
Sample Period	...	14:46 - 15:27	...
Sample Volume (at Stack)	m^3	0.73	...
Sample Volume (reference Conditions)	m^{3*}	0.68	0.68
Isokinetic Sampling Rate	%	103.7	...
Sample Reference (ECL ID)	ECL/11/	4831 & 4832	4833 & 4834
Mass of Particulate Matter Collected	mg	0.29	0.15
Concentration of Particulate Matter	mg/m^{3*}	**0.43**	0.22
Emission Rate of Particulate Matter	g/hr	4.89	...
Expanded Uncertainty (% Relative)	%	105	...
Emission Limit Value (ELV)	mg/m^{3*}	50	...
Blank Concentration as Percentage of ELV	%	...	<1.00%

*Reference Conditions (273K, 101.3kPa, Wet Gas)

Table 11 – Particulates

Data Recorded from Site 3 - LineX Booth (A2)

Emission Parameter	Units	TPM - 1	Blank
Stack Diameter	metres	0.70	...
			...
Area of Sample Plane	m^2	0.385	...
Moisture Content	%	0.00	...
Oxygen Content	%	20.90	...
Stack Temperature	°C	21	...
Gas Velocity (at Stack Conditions)	m/sec	8.71	...
Gas Velocity (Reference Conditions)	m/sec*	8.00	...
Volumetric Flowrate (Stack Conditions)	m^3/sec	3.35	...
Volumetric Flowrate (Reference Conditions)	m^3/sec*	3.08	...
Sample Date	...	23/08/2011	...
Sample Period	...	13:00 - 13:33	...
Sample Volume (at Stack)	m^3	0.72	...
Sample Volume (reference Conditions)	m^{3*}	0.66	0.66
Isokinetic Sampling Rate	%	109.3	...
Sample Reference (ECL ID)	ECL/11/	4349 & 4350	4353 & 4354
Mass of Particulate Matter Collected	mg	0.85	0.30
Concentration of Particulate Matter	mg/m^{3*}	**1.28**	0.45
Emission Rate of Particulate Matter	g/hr	14.17	...
Expanded Uncertainty (%Relative)	%	37	...
Emission Limit Value (ELV)	mg/m^{3*}	50	...
Blank Concentration as Percentage of ELV	%	...	<1.00%

*Reference Conditions (273K, 101.3kPa, Wet Gas)

Table 12 – Particulates

Data Recorded from Site 3 - LineX Booth (A2)

Emission Parameter	Units	TPM-2	Blank
Stack Diameter	metres	0.70	...
			...
Area of Sample Plane	m^2	0.385	...
Moisture Content	%	0.00	...
Oxygen Content	%	20.90	...
Stack Temperature	°C	22	...
Gas Velocity (at Stack Conditions)	m/sec	8.73	...
Gas Velocity (Reference Conditions)	m/sec*	7.98	...
Volumetric Flowrate (Stack Conditions)	m^3/sec	3.36	...
Volumetric Flowrate (Reference Conditions)	m^3/sec*	3.07	...
Sample Date	...	23/08/2011	...
Sample Period	...	13:45 - 14:18	...
Sample Volume (at Stack)	m^3	0.74	...
Sample Volume (reference Conditions)	m^3*	0.67	0.67
Isokinetic Sampling Rate	%	110.9	...
Sample Reference (ECL ID)	ECL/11/	4351 & 4352	4353 & 4354
Mass of Particulate Matter Collected	mg	0.35	0.30
Concentration of Particulate Matter	mg/m^3*	0.52	0.45
Emission Rate of Particulate Matter	g/hr	5.75	...
Expanded Uncertainty (%Relative)	%	87	...
Emission Limit Value (ELV)	mg/m^3*	50	...
Blank Concentration as Percentage of ELV	%	...	<1.00%

*Reference Conditions (273K, 101.3kPa, Wet Gas)

VELOCITY TRAVERSE PROFILES

Environmental Compliance Limited	Traverse Data Profoma	Date of Measurement	28/11/2011

Company	NP Aerospace	Stack Diameter (mm)		Pitot tube coefficient	0.82
Site	Coventry	Port Length (mm)	100	Pitot ID	488
Location	Site 1	Duct Length (mm) A	600	Stack Thermocouple ID	466
Stack	Spray Booth (A1)	Duct width (mm) B	600	Stack Thermocouple Reader ID	370
Job No	P1098	Barometric Pressure. (mb)	1002	Manometer ID	356
Operators	RFJ & AO	Static Pressure. (mm H_20) (= Pa/9.81)	15.3	Barometer ID	205

	Distance to Point (mm)	Port	Temp. (°C)	(ΔP) (Pa)	Swirl Test ° From Reference	Port	Temp. (°C)	(ΔP) (Pa)	Swirl Test ° From Reference
	30	A1	16.0	100.0	8	B1	16.0	130.0	11
	90	A2	16.0	90.0	5	B2	16.0	130.0	7
	150	A3	16.0	80.0	3	B3	16.0	130.0	6
	210	A4	16.0	110.0	5	B4	16.0	130.0	5
	270	A5	16.0	120.0	6	B5	16.0	130.0	7
	330	A6	16.0	130.0	8	B6	16.0	120.0	7
	390	A7	16.0	150.0	9	B7	16.0	110.0	9
	450	A8	16.0	150.0	7	B8	16.0	100.0	14
	510	A9	16.0	170.0	6	B9	16.0	90.0	18
	570	A10	16.0	190.0	4	B10	16.0	80.0	20
Total			160				160		
Max			16	190.0			16	130.0	
Min			16	80.0			16	80.0	
Average			16.0	129.0			16.00	115.00	

Average temp (K)	289

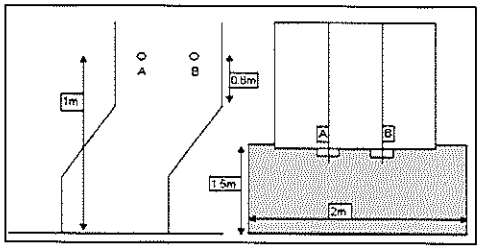
Suitability of Sampling Position	Actual Stack Conditons
Permitted highest:lowest flow pressure ratio =9:1	2.38:1
Average deviation of flow from axis <15°	OK
X-sectional area for stacks= πr^2	0.00 m^2
X-sectional area for ducts = L x B	0.360 m^2
Suitability of Position for Sampling	Ok

Stack Moisture	0.1	%
Measured Oxygen	20.9	%
Measured Carbon Dioxide		%
Dry Gas Molecular Weight	28.836	g/g mole

Gas Velocity (as Measured)	11.60	m/sec
Gas Velocity (Reference Conditions)	10.85	m/sec*
Volumetric Flowrate (as Measured)	4.1745	m^3/sec
Volumetric Flowrate (Reference Conditions)	3.9064	m^3/sec*

*Reference Conditions: 273K, 101.3kPa, Wet Gas

Diagram/ Description of Cross Section of Stack/Duct



Deviations from procedure/ non - conformities

Swirl Exceeds 15 degrees
Nozzle <6mm diameter

Compliance With Positional Requirements?

Height of sample ports from Platform	1m
Number of sample ports	2
Width of platform (port back to handrail)	1.5m

Nearest downstream disturbance	Exit	1m
Nearest upstream disturbance	Bend	0.8m
Disturbances are classed as bends, fans or diameter variations		

Environmental Compliance Limited	Traverse Data Profoma	Date of Measurement	28/11/2011

Company	NP Aerospace	Stack Diameter (mm)		Pitot tube coefficient	1.00
Site	Coventry	Port Length (mm)	100	Pitot ID	488
Location	Site 1	Duct Length (mm) A	600	Stack Thermocouple ID	466
Stack	Prep Booth (A2)	Duct width (mm) B	600	Stack Thermocouple Reader ID	370
Job No	P1098	Barometric Pressure. (mb)	1002	Manometer ID	356
Operators	RFJ+AO	Static Pressure. (mm H_2O) (= Pa/9.81)	15	Barometer ID	205

	Distance to Point (mm)	Port	Temp. (°C)	(ΔP) (Pa)	Swirl Test ° From Reference	Port	Temp. (°C)	(ΔP) (Pa)	Swirl Test ° From Reference
	30	A1	12.0	10.0	8	B1	12.0	10.0	60
	90	A2	12.0	15.0	10	B2	12.0	10.0	50
	150	A3	12.0	20.0	12	B3	12.0	12.0	50
	210	A4	12.0	20.0	14	B4	12.0	12.0	45
	270	A5	12.0	40.0	18	B5	12.0	10.0	22
	330	A6	12.0	40.0	22	B6	12.0	10.0	28
	390	A7	12.0	50.0	12	B7	12.0	12.0	14
	450	A8	12.0	55.0	10	B8	12.0	12.0	12
	510	A9	12.0	35.0	7	B9	12.0	14.0	10
	570	A10	12.0	30.0	8	B10	12.0	16.0	12
Total			120				120		
Max			12	55.0			12	16.0	
Min			12	10.0			12	10.0	
Average			12.0	31.5			12.00	11.80	

Average temp (K)	285

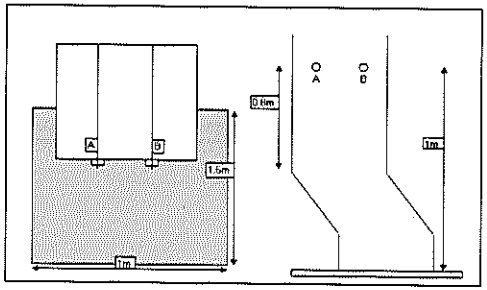
Suitability of Sampling Position	Actual Stack Conditons
Permitted highest:lowest flow pressure ratio =9:1	5.5:1
Average deviation of flow from axis <15°	<21
X-sectional area for stacks= πr^2	0.00 m^2
X-sectional area for ducts = L x B	0.360 m^2
Suitabilty of Position for Sampling	OK

Stack Moisture	0.1	%
Measured Oxygen	20.9	%
Measured Carbon Dioxide		%
Dry Gas Molecular Weight	28.836	g/g mole

Gas Velocity (as Measured)	5.68	m/sec
Gas Velocity (Reference Conditions)	5.39	m/sec*
Volumetric Flowrate (as Measured)	2.0445	m^3/sec
Volumetric Flowrate (Reference Conditions)	1.9400	m^3/sec*

*Reference Conditions: 273K, 101.3kPa, Wet Gas

Diagram/ Description of Cross Section of Stack/Duct



Deviations from procedure/ non - conformities

Swirl Exceeds 15 Degrees

Compliance With Positional Requirements?

Height of sample ports from Platform		1m
Number of sample ports		2m
Width of platform (port back to handrail)		2m
Nearest downstream disturbance	Exit	1m
Nearest upstream disturbance	Bend	0.8m
Disturbances are classed as bends, fans or diameter variations		

Environmental Compliance Limited	Traverse Data Proforma	Date of Measurement	13/09/2011

Company	NP Aerospace	Stack Diameter (mm)		Pitot tube coefficient	1.00
Site	Coventry	Port Length (mm)	100	Pitot ID	488
Location	Site 1	Duct Length (mm) A	580	Stack Thermocouple ID	468
Stack	Wet Back Booth (A5)	Duct width (mm) B	580	Stack Thermocouple Reader ID	358
Job No	P1098	Barometric Pressure. (mb)	998	Manometer ID	357
Operators	JL+AO	Static Pressure. (mm H_2O) (= Pa/9.81)	7.14	Barometer ID	352

	Distance to Point (mm)	Port	Temp. (°C)	(ΔP) (Pa)	Swirl Test °FromReference	Port	Temp. (°C)	(ΔP) (Pa)	Swirl Test °FromReference
	29	A1	15.0	40.0	5	B1	15.0	110.0	4
	87	A2	15.0	30.0	6	B2	15.0	115.0	5
	145	A3	15.0	20.0	9	B3	15.0	140.0	10
	203	A4	15.0	40.0	9	B4	15.0	120.0	9
	261	A5	15.0	50.0	10	B5	15.0	120.0	7
	219	A6	15.0	80.0	5	B6	15.0	95.0	6
	377	A7	15.0	70.0	4	B7	15.0	50.0	4
	435	A8	15.0	60.0	5	B8	15.0	50.0	8
	493	A9	15.0	50.0	7	B9	15.0	30.0	6
	551	A10	15.0	37.0	10	B10	15.0	20.0	4
Total			150				150		
Max			15	80.0			15	140.0	
Min			15	20.0			15	20.0	
Average			15.0	47.7			15.00	85.00	

Average temp (K)	288

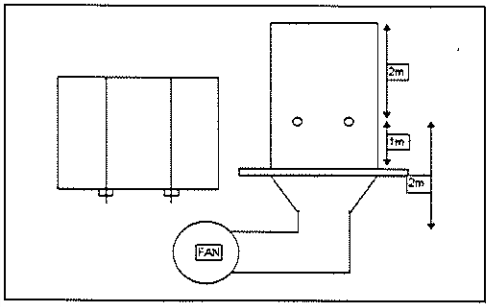
Suitability of Sampling Position	Actual Stack Conditons
Permitted highest:lowest flow:pressure ratio =9:1	7:1
Average deviation of flow from axis <15°	<7
X-sectional area for stacks = πr^2	0.00 m^2
X-sectional area for ducts = L x B	0.336 m^2
Suitabilty of Position for Sampling	OK

Stack Moisture	0.1	%
Measured Oxygen	20.9	%
Measured Carbon Dioxide		%
Dry Gas Molecular Weight	28.836	g/g mole

Gas Velocity (as Measured)	10.10	m/sec
Gas Velocity (Reference Conditions)	9.44	m/sec*
Volumetric Flowrate (as Measured)	3.3981	m^3/sec
Volumetric Flowrate (Reference Conditions)	3.1757	m^3/sec*

*Reference Conditions: 273K, 101.3kPa, Wet Gas

Diagram/ Description of Cross Section of Stack/Duct



Deviations from procedure/ non-conformities

Compliance With Positional Requirements?

Height of sample ports from Platform	1
Number of sample ports	2
Width of platform (port back to handrail)	1.5

Nearest downstream disturbance	Fan	2
Nearest upstream disturbance	Exit	2
Disturbances are classed as bends, fans or diameter variations		

Environmental Compliance Limited	Traverse Data Profoma	Date of Measurement	23/08/2011

Company	NP Aerospace	Stack Diameter (mm)	800	Pitot tube coefficient	1
Site	Coventry	Port Length (mm)	904	Pitot Id	487
Location	Site 3	Duct Length (mm) A		Stack Thermocouple ID	466
Stack	Degreaser (A1)	Duct width (mm) B		Stack Temp Reader ID	370
Job No	P1098	Barometric Pressure. (mb)	1001	Manometer ID	356
Operators	PC/JL	Static Pressure. (mm H_20)	8.15	Barometer ID	628

	Distance to Point (mm)	Port	Temp. (°C)	(ΔP) (Pa)	Swirl Test ° From Reference	Port	Temp. (°C)	(ΔP) (Pa)	Swirl Test ° From Reference
	50	A1	21.0	1.0	25	B1	21.0	1.0	25
	125	A2	21.0	1.0	25	B2	21.0	1.0	25
	208	A3	21.0	1.0	25	B3	21.0	1.0	25
	291	A4	21.0	19.0	25	B4	21.0	19.0	25
	374	A5	21.0	19.0	25	B5	21.0	20.0	25
	457	A6	21.0	19.0	50	B6	21.0	20.0	50
	540	A7	21.0	20.0	50	B7	21.0	20.0	50
	623	A8	21.0	60.0	50	B8	21.0	70.0	50
	706	A9	21.0	70.0	50	B9	21.0	70.0	50
	750	A10	21.0	80.0	50	B10	21.0	80.0	50
Total			210				210		
Max			21	80.0			21	80.0	
Min			21	1.0			21	1.0	
Average			21.0	29.0			21.00	30.20	

Average temp (K)	294

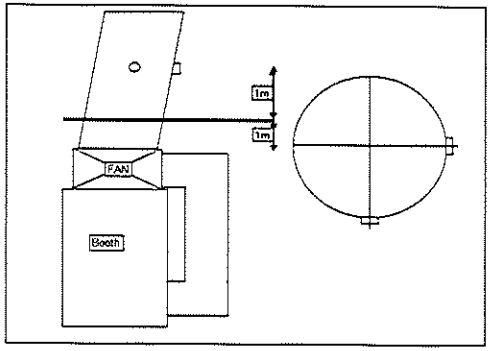
Suitability of Sampling Position	Actual Stack Conditons
Permitted highest:lowest flow pressure ratio =9:1	30.7
Average deviation of flow from axis <15°	<38
X-sectional area for stacks= πr^2	0.50 m^2
X-sectional area for ducts = L x B	0.000 m^2
Suitability of Position for Sampling	NO

Stack Moisture	0	%
Measured Oxygen	20.9	%
Measured Carbon Dioxide	0	%
Dry Gas Molecular Weight	28.836	g/g mole

Gas Velocity (as Measured)	5.99	m/sec
Gas Velocity (Reference Conditions)	5.50	m/sec*
Volumetric Flowrate (as Measured)	3.01	m^3/sec
Volumetric Flowrate (Reference Conditions)	2.76	m^3/sec*

*Reference Conditions: 273K, 101.3kPa, Wet Gas

Diagram/ Description of Cross Section of Stack/Duct



Swirl exceeds 15 degrees
Highest to lowest pitot ratiok exceeds 9:1

Compliance With Positional Requirements?	
Height of sample ports from Platform	1.5m
Number of sample ports	2
Width of platform (port back to handrail)	2m

Nearest downstream disturbance	FAN	2m
Nearest upstream disturbance	EXIT	>5m
Disturbances are classed as bends, fans or diameter variations		

Environmental Compliance Limited	Traverse Data Profoma	Date of Measurement	23/08/2011

Company	NP Aerospace	Stack Diameter (mm)	700	Pitot tube coefficient	1.00
Site	Coventry	Port Length (mm)	90	Pitot ID	487
Location	Site 3	Duct Length (mm) A		Stack Thermocouple ID	466
Stack	LineX Booth (A2)	Duct width (mm) B		Stack Thermocouple Reader ID	370
Job No	P1098	Barometric Pressure. (mb)	1001	Manometer ID	356
Operators	PC / JL	Static Pressure. (mm H_20) (= Pa/9.81)	1.5	Barometer ID	628

	Distance to Point (mm)	Port	Temp. (°C)	(ΔP) (Pa)	Swirl Test ° From Reference	Port	Temp. (°C)	(ΔP) (Pa)	Swirl Test ° From Reference
	35	A1	21.0	60.0	10	B1	21.0	60.0	10
	105	A2	21.0	40.0	10	B2	21.0	45.0	10
	175	A3	21.0	36.0	10	B3	21.0	20.0	6
	245	A4	21.0	15.0	1	B4	21.0	10.0	5
	315	A5	21.0	3.0	1	B5	21.0	11.0	1
	385	A6	21.0	3.0	1	B6	21.0	1.0	1
	455	A7	21.0	20.0	1	B7	21.0	10.0	5
	525	A8	21.0	35.0	10	B8	21.0	35.0	10
	595	A9	21.0	45.0	10	B9	21.0	50.0	10
	665	A10	21.0	50.0	10	B10	21.0	70.0	10
Total			210				210		
Max			21	60.0			21	70.0	
Min			21	3.0			21	1.0	
Average			21.0	30.7			21.00	31.20	

Average temp (K)	294

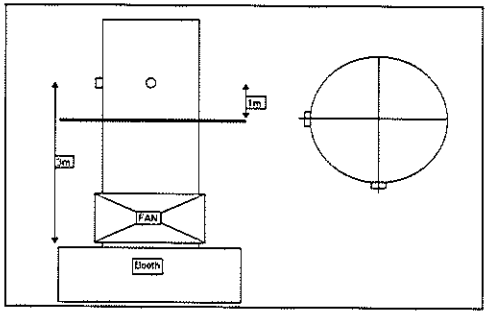
Suitability of Sampling Position	Actual Stack Conditons
Permitted highest:lowest flow pressure ratio =9:1	70:1
Average deviation of flow from axis <15°	OK
X-sectional area for stacks= πr^2	0.38 m^2
X-sectional area for ducts = L x B	0.000 m^2
Suitability of Position for Sampling	No

Stack Moisture	0.1	%
Measured Oxygen	20.9	%
Measured Carbon Dioxide		%
Dry Gas Molecular Weight	28.836	g/g mole

Gas Velocity (as Measured)	6.67	m/sec
Gas Velocity (Reference Conditions)	6.12	m/sec*
Volumetric Flowrate (as Measured)	2.5665	m^3/sec
Volumetric Flowrate (Reference Conditions)	2.3553	m^3/sec*

*Reference Conditions: 273K, 101.3kPa, Wet Gas

Diagram/ Description of Cross Section of Stack/Duct



Deviations from procedure/ non - conformities

Highest to lowest pitot ratio exceeds 9:1

Compliance With Positional Requirements?

Height of sample ports from Platform	1.5m
Number of sample ports	2
Width of platform (port back to handrail)	2.0m

Nearest downstream disturbance	FAN	2m
Nearest upstream disturbance	EXIT	>5m
Disturbances are classed as bends, fans or diameter variations		

FIELD CALIBRATION AND SAMPLING DATA

Environmental Compliance Limited		PARTICULATE DATA SAMPLING PROFORMA		Date of Measurement	28/11/2011		
ECL/TPD	27a	Time taken to change Ports	1	Start Time	11:06	End Time	11:39	Duration (mins)	32

Client	NP Aerospace	Stack Profile	Rectangular	Pitot ID	488	Stack Thermocouple ID	486	Impingers	n/a
Site	Coventry	Stack Area (m²)	0.36	Manometer ID	368	Stack Temp Reader ID	300	SOL/	n/a
Location	Site 1	Barometric Pressure (mb)	1002	Barometer ID	205	Meter Thermocouple ID	366c	Start Weight (g)	0.00
Stack ID	Spray Booth (A6)	Stat Press. (mmH2O (Pa*9.81)	15.3	DGM Kit	1.0003	Meter Temp Reader ID	300	End Weight (g)	0.10
Test No.	TPM - 1	Pitot coefficient	1	Nozzle ID	800	Dry Gas Meter ID	366a	Total weight (g)	0.10
Job No	P1098	Balance ID	...	Nozzle Size (mm)	5.02	Timer ID	366d		
ECL Site Staff	RFJ & AO	Console ID	366	Filter ID	758	Rotameter ID	366b		

If moisture was not measured and gas was dried before entering the gas meter, impinger weights must be included to produce the moisture concentration used in the isokinetic calculations. If the gas was not dried before it entered the gas meter then impinger weights may be included to produce a nominal 0.1% moisture value.

	Sample	Leak 1	Leak 2	Leak 3	Leak 4
Start Volume	1095643.0				
Final Volume	1096200.0				
Total Volume	557.0	0.0	0.0	0.0	0.0

Total	Volume (litres) @STP Dry	
	Expected Sample Volume	469.89
	Actual Sample Volume	535.70
557.0	Isokinetic Percentage	107.16

Leak Check	First	Second	Third	Final
Leak Rate l/min	0			0
Set Rate (l/min)	25			25
Time Of Leak Check	11:00			11:40
Leak %of set rate	0.0			0.0

Maximum allowed leak rate is 2% of the set rate

Measured O_2	20.90	Moisture	0.02
Measured CO_2 %		Ref O_2	20.9
Measured CO ppm		Dry Gas Molecular Weight	28.84

Traverse Point	A1	A1	A2	A2	B1	B1	B2	B2	Total
Time Interval (mins)	4	4	4	4	4	4	4	4	
Time Point (mins)	0 - 4	4 - 8	8 - 12	12 - 16	16 - 20	20 - 24	24 - 28	28 - 32	
ΔP (Pa)	100	100	100	100	100	100	100	100	1200
Velocity at Stack (m/s)	12.88	12.88	15.78	15.78	14.69	14.69	12.88	12.88	
Sample Rate (m³/s) 101.3 mbar, Tm, Dry Gas	15.4	15.4	18.9	18.9	17.6	17.6	15.6	15.6	16.9
Meter (Tm)	20	20	22	22	22	24	24	24	22.3
Stack Temp (Ts)	16	16	16	16	16	16	16	16	16.0

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (m³/s) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (m³/s) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Acetone SOL	1628
DI Rinse SOL	1646

Original Flowrate Settings	
Tm	40
Ts	16
%moisture	0.1

Environmental Compliance Limited		PARTICULATE DATA SAMPLING PROFORMA		Date of Measurement	28/11/2011		
ECL/TPD	27a	Time taken to change Ports	1	Start Time	11:46	End Time	12:19	Duration (mins)	32

Client	NP Aerospace	Stack Profile	Rectangular	Pitot ID	488	Stack Thermocouple ID	486	Impingers	n/a
Site	Coventry	Stack Area (m²)	0.36	Manometer ID	368	Stack Temp Reader ID	300	SOL/	n/a
Location	Site 1	Barometric Pressure (mb)	1002	Barometer ID	205	Meter Thermocouple ID	366c	Start Weight (g)	0.00
Stack ID	Spray Booth (A6)	Stat Press. (mmH2O (Pa*9.81)	15	DGM Kit	1.0003	Meter Temp Reader ID	300	End Weight (g)	0.10
Test No.	TPM - 2	Pitot coefficient	1	Nozzle ID	800	Dry Gas Meter ID	366a	Total weight (g)	0.10
Job No	P1098	Balance ID	...	Nozzle Size (mm)	5.02	Timer ID	366d		
ECL Site Staff	RFJ & AO	Console ID	366	Filter ID	758	Rotameter ID	366b		

Impingers are not used for UKAS/MCERTS sampling of particulate to ECL TPD 27a as method is for dry stacks only (& wet gas reporting). In these cases moisture is entered into calculations as 0.1%

	Sample	Leak 1	Leak 2	Leak 3	Leak 4
Start Volume	1096142.0				
Final Volume	1096725.0				
Total Volume	583.0	0.0	0.0	0.0	0.0

Total	Volume (litres) @STP Dry	
	Expected Sample Volume	489.91
	Actual Sample Volume	610.90
583.0	Isokinetic Percentage	106.20

Leak Check	First	Second	Third	Final
Leak Rate l/min	0			0
Set Rate (l/min)	25			25
Time Of Leak Check	11:45			12:27
Leak %of set rate	0.0			0.0

Maximum allowed leak rate is 2% of the set rate

Measured O_2	20.90	Moisture	0.02
Measured CO_2 %		Ref O_2	20.9
Measured CO ppm		Dry Gas Molecular Weight	28.84

Traverse Point	A1	A1	A2	A2	B1	B1	B2	B2	Total
Time Interval (mins)	4	4	4	4	4	4	4	4	
Time Point (mins)	0 - 4	4 - 8	8 - 12	12 - 16	16 - 20	20 - 24	24 - 28	28 - 32	
ΔP (Pa)	100	100	100	100	100	100	100	100	1200
Velocity at Stack (m/s)	12.88	12.88	15.78	15.78	14.69	14.69	12.88	12.88	
Sample Rate (m³/s) 101.3 mbar, Tm, Dry Gas	15.4	15.7	19.3	19.3	18.1	18.2	15.9	16.0	17.2
Meter (Tm)	20	27	27	28	29	31	31	32	29.1
Stack Temp (Ts)	16	16	16	16	16	16	16	16	16.0

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (m³/s) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (m³/s) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Acetone SOL	1628
DI Rinse SOL	1646

Original Flowrate Settings	
Tm	40
Ts	16
%moisture	0.1

Environmental Compliance Limited		PARTICULATE DATA SAMPLING PROFORMA		Date of Measurement	28/11/2011		
EQL/TPD/	27a	Time taken to change Ports	1	Start Time	13:10	End Time	13:43	Duration (mins)	32

Client	NP Aerospace	Stack Profile	Rectangular	Pitot ID	468	Stack Thermocouple ID	468	Impingers	n/a
Site	Coventry	Stack Area (m²)	0.36	Manometer ID	366	Stack Temp Reader ID	370	SCL/	n/a
Location	Site 1	Barometric Pressure (mb)	1002	Barometer ID	205	Meter Thermocouple ID	366c	Start Weight (g)	0.00
Stack ID	Prep Booth (A2)	Stat Pres. (mmH²0) (Pa*9.81)	15	DGM Y/I	1.0003	Meter Temp Reader ID	370	End Weight (g)	0.10
Test No.	TPM-1	Pitot coefficient	1	Nozzle ID	600	Dry Gas Meter ID	366a	Total weight (g)	0.10
Job No	P1098	Balance ID	...	Nozzle Size (mm)	8.19	Timer ID	366d		
EQL Site Staff	RFU+AD	Console ID	366	Filter ID	930	Polarmeter ID	366b		

Impingers are not used for UKAS/MCERTS sampling of particulate to EQL TPD 27a as method is for dry stacks only (& wet gas reporting). In these cases moisture is entered into calculations as 0.1%

	Sample	Leak 1	Leak 2	Leak 3	Leak 4
Start Volume	1099612.0				
Final Volume	1100215.0				
Total Volume	603.0	0.0	0.0	0.0	0.0

Total	Volume (litres) @STP Dry	
	Expected Sample Volume	625.03
	Actual Sample Volume	599.76
603.0	Isokinetic Percentage	100.33

Leak Check	First	Second	Third	Final
Leak Rate l/min	0			0
Set Rate (l/min)	25			25
Time Of Leak Check	12:30			13:45
Leak % of set rate	0.0			0.0

Maximum allowed leak rate is 2% of the set rate

Measured O_2	20.80	Moisture	0.02
Measured CO_2 %		Ref O_2	20.9
Measured CO ppm		Dry Gas Molecular Weight	28.84

Acetone SCL	1638
DI Rinse SCL	1645

Traverse Point	A1	A1	A2	A2	B1	B1	B2	B2	Total
Time Interval (mins)	4	4	4	4	4	4	4	4	
Time Point (mins)	0 - 4	4 - 8	8 - 12	12 - 16	16 - 20	20 - 24	24 - 28	28 - 32	
ΔP (Pa)	20	20	30	30	10	10	16	16	19.0
Velocity at Stack (m/s)	5.72	5.72	7.01	7.01	4.05	4.05	5.12	5.12	
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas	18.7	18.8	23.1	23.2	13.4	13.4	17.0	17.0	18.1
Meter (Tm)	25	26	27	28	28	29	29	30	27.8
Stack Temp (Ts)	12	12	12	12	12	12	12	12	12.0

Original Flowrate Settings	
Tm	40
Ts	12
%moisture	0.1

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Environmental Compliance Limited		PARTICULATE DATA SAMPLING PROFORMA		Date of Measurement	28/11/2011		
EQL/TPD/	27a	Time taken to change Ports	1	Start Time	14:05	End Time	14:39	Duration (mins)	32

Client	NP Aerospace	Stack Profile	Rectangular	Pitot ID	468	Stack Thermocouple ID	468	Impingers	n/a
Site	Coventry	Stack Area (m²)	0.36	Manometer ID	366	Stack Temp Reader ID	370	SCL/	n/a
Location	Site 1	Barometric Pressure (mb)	1002	Barometer ID	205	Meter Thermocouple ID	366c	Start Weight (g)	0.00
Stack ID	Prep Booth (A2)	Stat Pres. (mmH²0) (Pa*9.81)	15	DGM Y/I	1.0003	Meter Temp Reader ID	370	End Weight (g)	0.10
Test No.	TPM-2	Pitot coefficient	1	Nozzle ID	600	Dry Gas Meter ID	366a	Total weight (g)	0.10
Job No	P1098	Balance ID	...	Nozzle Size (mm)	8.19	Timer ID	366d		
EQL Site Staff	RFU+AD	Console ID	366	Filter ID	930	Polarmeter ID	366b		

Impingers are not used for UKAS/MCERTS sampling of particulate to EQL TPD 27a as method is for dry stacks only (& wet gas reporting). In these cases moisture is entered into calculations as 0.1%

	Sample	Leak 1	Leak 2	Leak 3	Leak 4
Start Volume	1100450.0				
Final Volume	1101030.0				
Total Volume	572.0	0.0	0.0	0.0	0.0

Total	Volume (litres) @STP Dry	
	Expected Sample Volume	621.70
	Actual Sample Volume	639.30
572.0	Isokinetic Percentage	103.37

Leak Check	First	Second	Third	Final
Leak Rate l/min	0			0
Set Rate (l/min)	25			25
Time Of Leak Check	13:49			14:42
Leak % of set rate	0.0			0.0

Maximum allowed leak rate is 2% of the set rate

Measured O_2	20.80	Moisture	0.02
Measured CO_2 %		Ref O_2	20.9
Measured CO ppm		Dry Gas Molecular Weight	28.84

Acetone SCL	1638
DI Rinse SCL	1645

Traverse Point	A1	A1	A2	A2	B1	B1	B2	B2	Total
Time Interval (mins)	4	4	4	4	4	4	4	4	
Time Point (mins)	0 - 4	4 - 8	8 - 12	12 - 16	16 - 20	20 - 24	24 - 28	28 - 32	
ΔP (Pa)	20	20	30	30	10	10	16	16	19.0
Velocity at Stack (m/s)	5.76	5.76	7.06	7.06	4.07	4.07	5.15	5.15	
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas	18.6	18.7	22.9	23.0	13.3	13.4	16.9	16.9	18.0
Meter (Tm)	25	26	27	28	28	29	30	30	27.9
Stack Temp (Ts)	16	16	16	15	16	15	15	15	15.6

Original Flowrate Settings	
Tm	40
Ts	12
%moisture	0.1

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Environmental Compliance Limited		PARTICULATE DATA SAMPLING PROFORMA		Date of Measurement	13/09/2011		
ECL/TPD	27a	Time taken to change Ports	1	Start Time	14:00	End Time	14:41	Duration (mins)	40

Client	NP Aerospace	Stack Profile	Rectangular	Pitot ID	468	Stack Thermocouple ID	468	Impingers	n/a
Site	Coventry	Stack Area (m^2)	0.34	Manometer ID	357	Stack Temp Reader ID	358	SOL/	n/a
Location	Site 1	Barometric Pressure (mb)	998	Barometer ID	352	Meter Thermocouple ID	366c	Start Weight (g)	0.00
Stack ID	Wet Back Booth (A5)	Stat Pres. (mm H^2O) (Pa 9.81)	7.14	DGM Yd	1.0503	Meter Temp Reader ID	468	End Weight (g)	0.10
Test No.	TPM - 1	Pitot coefficient	1	Nozzle ID	601	Dry Gas Meter ID	366a	Total weight (g)	0.10
Job No	P1098	Balance ID	--	Nozzle Size (mm)	6.06	Timer ID	366d		
ECL Site Staff	JL+AO	Console ID	366	Filter ID	606	Rotameter ID	366b		

Impingers are not used for UKAS/MCERTS sampling of particulate to ECL TPD 27a as method is for dry stacks only (& wet gas reporting). In these cases moisture is entered into calculations as 0.1%.

	Sample	Leak 1	Leak 2	Leak 3	Leak 4
Start Volume	988717.0				
Final Volume	989458.0				
Total Volume	769.0	0.0	0.0	0.0	0.0

Total	Volume (litres) @ STP Dry	
	Expected Sample Volume	655.56
	Actual Sample Volume	725.19
769.0	Isokinetic Percentage	110.62

Leak Check	First	Second	Third	Final
Leak Rate l/min	0	0		
Set Rate (l/min)	25	25		
Time Of Leak Check	13:59	14:42		
Leak % of set rate	0.0	0.0		

Maximum allowed leak rate is 2% of the set rate

Measured O_2	20.93	Moisture	0.02
Measured CO_2 %		Ref O_2	20.9
Measured CO ppm		Dry Gas Molecular Weight	28.84

Acetone SOL/	1415
DI Rinse SOL/	1482

Traverse Point	A1	A1	A2	A2	B1	B1	B2	B2	Total
Time Interval (mins)	5	5	5	5	5	5	5	5	
Time Point (mins)	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 - 30	30 - 35	35 - 40	
ΔP (Pa)	30	30	60	60	125	125	50	50	66.3
Velocity at Stack (m/s)	7.07	7.07	10.00	10.00	14.44	14.44	9.13	9.13	
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas	12.4	12.4	17.6	17.7	25.8	25.7	16.3	16.4	18.0
Meter (Tm)	23	24	25	26	27	28	30	31	26.8
Stack Temp (Ts)	16	16	16	16	16	16	16	16	16.0

Original Flowrate Settings	
Tm	35
Ts	15
% moisture	0.1

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Environmental Compliance Limited		PARTICULATE DATA SAMPLING PROFORMA		Date of Measurement	13/09/2011		
ECL/TPD	27a	Time taken to change Ports	1	Start Time	14:46	End Time	15:27	Duration (mins)	40

Client	NP Aerospace	Stack Profile	Rectangular	Pitot ID	468	Stack Thermocouple ID	468	Impingers	n/a
Site	Coventry	Stack Area (m^2)	0.34	Manometer ID	357	Stack Temp Reader ID	358	SOL/	n/a
Location	Site 1	Barometric Pressure (mb)	998	Barometer ID	352	Meter Thermocouple ID	366c	Start Weight (g)	0.00
Stack ID	Wet Back Booth (A5)	Stat Pres. (mm H^2O) (Pa 9.81)	7.135575943	DGM Yd	1.0503	Meter Temp Reader ID	468	End Weight (g)	0.10
Test No.	TPM - 2	Pitot coefficient	1	Nozzle ID	601	Dry Gas Meter ID	366a	Total weight (g)	0.10
Job No	P1098	Balance ID	--	Nozzle Size (mm)	6.06	Timer ID	366d		
ECL Site Staff	JL+AO	Console ID	366	Filter ID	606	Rotameter ID	366b		

Impingers are not used for UKAS/MCERTS sampling of particulate to ECL TPD 27a as method is for dry stacks only (& wet gas reporting). In these cases moisture is entered into calculations as 0.1%.

	Sample	Leak 1	Leak 2	Leak 3	Leak 4
Start Volume	989909.0				
Final Volume	990249.0				
Total Volume	740.0	0.0	0.0	0.0	0.0

Total	Volume (litres) @ STP Dry	
	Expected Sample Volume	655.87
	Actual Sample Volume	680.25
740.0	Isokinetic Percentage	103.72

Leak Check	First	Second	Third	Final
Leak Rate l/min	0	0		
Set Rate (l/min)	25	25		
Time Of Leak Check	14:45	15:00		
Leak % of set rate	0.0	0.0		

Maximum allowed leak rate is 2% of the set rate

Measured O_2	20.93	Moisture	0.02
Measured CO_2 %		Ref O_2	20.9
Measured CO ppm		Dry Gas Molecular Weight	28.84

Acetone SOL/	1415
DI Rinse SOL/	1482

Traverse Point	A1	A1	A2	A2	B1	B1	B2	B2	Total
Time Interval (mins)	5	5	5	5	5	5	5	5	
Time Point (mins)	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 - 30	30 - 35	35 - 40	
ΔP (Pa)	30	30	60	60	125	125	50	50	66.3
Velocity at Stack (m/s)	7.07	7.07	10.00	10.00	14.44	14.44	9.13	9.13	
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas	12.7	12.7	18.1	18.2	26.3	26.3	16.7	16.8	18.5
Meter (Tm)	30	31	33	35	36	36	37	38	34.5
Stack Temp (Ts)	16	16	16	16	16	16	16	16	16.0

Original Flowrate Settings	
Tm	35
Ts	15
% moisture	0.1

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Environmental Compliance Limited		PARTICULATE DATA SAMPLING PROFORMA		Date of Measurement	23/09/2011		
ECL/TPD	27a	Time taken to change Ports	1	Start Time	13:00	End Time	13:33	Duration (mins)	32

Client	NP Aerospace	Stack Profile	Circular	Pitot ID	467	Stack Thermocouple ID	466	Impingers	n/a
Site	Coventry	Stack Area (m²)	0.38	Manometer ID	368	Stack Temp Reader ID	370	SGL/	n/a
Location	Site 3	Barometric Pressure (mb)	1001	Barometer ID	628	Meter Thermocouple ID	367c	Start Weight (g)	0.00
Stack ID	LinsX Booth (A2)	Stat Pres. (mm H2O (Pa*9.81)	1.5	DGM Yd	1.0099	Meter Temp Reader ID	370	End Weight (g)	0.00
Test No.	TPM - 1	Pitot coefficient	1	Nozzle ID	601	Dry Gas Meter ID	367d	Total weight (g)	0.00
Job No	P1098	Balance ID	...	Nozzle Size (mm)	7.10	Timer ID	367b		
ECL Site Staff	PC/JL	Console ID	367	Filter ID	393	Rotameter ID	367a		

	Sample	Leak 1	Leak 2	Leak 3	Leak 4
Start Volume	955578.0				
Final Volume	956287.0				
Total Volume	709.0	0.0	0.0	0.0	0.0

Total	Volume (litres) @STP Dry	
	Expected Sample Volume	638.10
	Actual Sample Volume	664.51
709.0	Isokinetic Percentage	109.29

If moisture was not measured and gas was dried before entering the gas meter, impinger weights must be included to produce the moisture concentration used in the isokinetic calculations. If the gas was not dried before it entered the gas meter then impinger weights may be included to produce a nominal 0.1% moisture value.

Leak Check	First	Second	Third	Final
Leak Rate l/min	0			0
Set Rate (l/min)	25			24
Time Of Leak Check	12:00			13:36
Leak % of set rate	0.0			0.0

Maximum allowed leak rate is 2% of the set rate

Measured O_2	20.90	Moisture	0.00
Measured CO_2 %		Pct O_2	20.9
Measured CO ppm		Dry Gas Molecular Weight	28.84

Traverse Point	A1	A1	A2	A2	B1	B1	B2	B2	Total
Time Interval (mins)	4	4	4	4	4	4	4	4	
Time Point (mins)	0 - 4	4 - 8	8 - 12	12 - 16	16 - 20	20 - 24	24 - 28	28 - 32	
ΔP (Pa)	40	40	40	40	50	50	50	50	45.0
Velocity at Stack (m/s)	8.23	8.23	8.23	8.23	9.20	9.20	9.20	9.20	
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas	19.4	19.4	19.5	19.6	22.0	22.0	22.0	22.2	20.8
Meter (Tm)	22	23	24	25	26	26	27	27	25.3
Stack Temp (Ts)	21	21	21	21	21	21	21	21	21.0

Acetone SGL	13.96
DI Rinse SGL	1.499

Original Flowrate Settings	
Tm	30
Ts	21
%moisture	0.1

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Environmental Compliance Limited		PARTICULATE DATA SAMPLING PROFORMA		Date of Measurement	23/09/2011		
ECL/TPD	27a	Time taken to change Ports	1	Start Time	13:45	End Time	14:18	Duration (mins)	32

Client	NP Aerospace	Stack Profile	Circular	Pitot ID	467	Stack Thermocouple ID	466	Impingers	n/a
Site	Coventry	Stack Area (m²)	0.38	Manometer ID	368	Stack Temp Reader ID	370	SGL/	n/a
Location	Site 3	Barometric Pressure (mb)	1001	Barometer ID	628	Meter Thermocouple ID	367c	Start Weight (g)	0.00
Stack ID	LinsX Booth (A2)	Stat Pres. (mm H2O (Pa*9.81)	1.5	DGM Yd	1.0099	Meter Temp Reader ID	370	End Weight (g)	0.00
Test No.	TPM - 2	Pitot coefficient	1	Nozzle ID	601	Dry Gas Meter ID	367d	Total weight (g)	0.00
Job No	P1098	Balance ID	...	Nozzle Size (mm)	7.10	Timer ID	367b		
ECL Site Staff	PC/JL	Console ID	367	Filter ID	394	Rotameter ID	367a		

	Sample	Leak 1	Leak 2	Leak 3	Leak 4
Start Volume	956347.0				
Final Volume	957091.0				
Total Volume	744.0	0.0	0.0	0.0	0.0

Total	Volume (litres) @STP Dry	
	Expected Sample Volume	637.12
	Actual Sample Volume	671.15
744.0	Isokinetic Percentage	110.89

If moisture was not measured and gas was dried before entering the gas meter, impinger weights must be included to produce the moisture concentration used in the isokinetic calculations. If the gas was not dried before it entered the gas meter then impinger weights may be included to produce a nominal 0.1% moisture value.

Leak Check	First	Second	Third	Final
Leak Rate l/min	0			0
Set Rate (l/min)	25			24
Time Of Leak Check	13:42			14:23
Leak % of set rate	0.0			0.0

Maximum allowed leak rate is 2% of the set rate

Measured O_2	20.90	Moisture	0.00
Measured CO_2 %		Pct O_2	20.9
Measured CO ppm		Dry Gas Molecular Weight	28.84

Traverse Point	A1	A1	A2	A2	B1	B1	B2	B2	Total
Time Interval (mins)	4	4	4	4	4	4	4	4	
Time Point (mins)	0 - 4	4 - 8	8 - 12	12 - 16	16 - 20	20 - 24	24 - 28	28 - 32	
ΔP (Pa)	40	40	40	40	50	50	50	50	45.0
Velocity at Stack (m/s)	8.34	8.34	8.34	8.34	9.22	9.22	9.22	9.22	
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas	19.9	20.0	20.2	20.3	22.7	22.8	22.9	22.9	21.5
Meter (Tm)	31	32	35	37	37	38	39	39	35.0
Stack Temp (Ts)	22	22	22	22	22	22	22	22	22.0

Acetone SGL	13.96
DI Rinse SGL	1.499

Original Flowrate Settings	
Tm	30
Ts	21
%moisture	0.1

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Traverse Point									Total
Time Interval (mins)									
Time Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

Site 1- Spray Booth (A1)

		TOC ppm	O2 %	
Analyser Range		4000	25	
Repeatability at Zero		40		
Span Gas Concentration Applied		909.3	10	
Zero Gas Concentration Applied		0	0	
Direct Cal	Zero	51.54		
	Span	1002.76		
	Zero	62.50		
Difference (Zero)		10.95588235		
<2×Repeatability @ Zero?		YES		
Pre Test	Zero	71.14		
	Span	1002.70		
Difference (Zero)		8.639705882		
<5% (2% for O_2) Relative to Direct Span		YES		If Red CONTACT QM
Difference (Span)		0.051020408		
<5% (2% for O_2) Relative to Direct Span		YES		If Red CONTACT QM
Post Test	Zero	62.64		
	Span	1072.83		
Difference (Zero)		8.603		
<2% of Analyser Range		YES		If Red apply Drift
Difference (Span)		19.872		
<2% of Analyser Range		YES		If Red apply Drift
Drift <5% of Analyser Range?		YES		If Red CONTACT QM

Note* TOC is logged in mA NOT ppm - Zero Offset is likely

Site 1 – Wet Back Booth (A5)

		TOC ppm	O2 %	
Analyser Range		400	25	
Repeatability at Zero		4		
Span Gas Concentration Applied		68.96	16	
Zero Gas Concentration Applied		0	0	
Direct Cal	Zero	7.52		
	Span	68.77		
	Zero	7.50		
Difference (Zero)		0.018382353		
<2×Repeatability @ Zero?		YES		
Pre Test	Zero	7.57		
	Span	68.71		
Difference (Zero)		0.073529412		
<5% (2% for O_2) Relative to Direct Span		YES		If Red CONTACT QM
Difference (Span)		0.060457516		
<5% (2% for O_2) Relative to Direct Span		YES		If Red CONTACT QM
Post Test	Zero	8.75		
	Span	69.94		
Difference (Zero)		1.176		
<2% of Analyser Range		YES		If Red apply Drift
Difference (Span)		1.224		
<2% of Analyser Range		YES		If Red apply Drift
Drift <5% of Analyser Range?		YES		If Red CONTACT QM

Note* TOC is logged in mA NOT ppm - Zero Offset is likely

Site 3 – Degreasing Booth (A1)

		TOC ppm	O2 %	
Analyser Range		100	25	
Repeatability at Zero		1		
Span Gas Concentration Applied		49.9	19	
Zero Gas Concentration Applied		0	0	
Direct Cal	Zero	0.88		
	Span	68.66		
	Zero	1.24		
Difference (Zero)		0.357056909		
<2×Repeatability @ Zero?		YES		
Pre Test	Zero	1.29		
	Span	67.37		
Difference (Zero)		0.045955882		
<5% (2% for O_2) Relative to Direct Span		YES		If Red CONTACT QM
Difference (Span)		1.235294118		
<5% (2% for O_2) Relative to Direct Span		YES		If Red CONTACT QM
Post Test	Zero	0.60		
	Span	67.37		
Difference (Zero)		0.684		
<2% of Analyser Range		YES		If Red apply Drift
Difference (Span)		0.955		
<2% of Analyser Range		YES		If Red apply Drift
Drift <5% of Analyser Range?		YES		If Red CONTACT QM

Note* TOC is logged in mA NOT ppm - Zero Offset is likely

Site 3 – LineX Booth (A2)

		TOC ppm	O2 %	
Analyser Range		100	25	
Repeatability at Zero		1		
Span Gas Concentration Applied		49.9	16	
Zero Gas Concentration Applied		0	0	
Direct Cal	Zero	0.88		
	Span	69.66		
	Zero	1.24		
Difference (Zero)		0.357056909		
<2×Repeatability @ Zero?		YES		
Pre Test	Zero	1.29		
	Span	69.92		
Difference (Zero)		0.045955882		
<5% (2% for O_2) Relative to Direct Span		YES		If Red CONTACT QM
Difference (Span)		1.235294118		
<5% (2% for O_2) Relative to Direct Span		YES		If Red CONTACT QM
Post Test	Zero	0.60		
	Span	61.37		
Difference (Zero)		0.684		
<2% of Analyser Range		YES		If Red apply Drift
Difference (Span)		0.955		
<2% of Analyser Range		YES		If Red apply Drift
Drift <5% of Analyser Range?		YES		If Red CONTACT QM

Note* TOC is logged in mA NOT ppm - Zero Offset is likely

LABORATORY ANALYSIS RESULTS

Scientific Analysis Laboratories is a limited company registered in England and Wales (No 2514723) whose address is at Hadfield House, Hadfield Street, Manchester M18 6FE

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Scientific Analysis Laboratories Ltd

Certificate of Analysis

Report Number: 249753-1

Date of Report: 16-Sep-2011

Customer: Environmental Compliance Ltd
Unit G1
Main Avenue
Treforest Industrial Estate
Pontypridd
CF37 5YL.

Customer Contact: Mr John Litterick

Customer Job Reference: P1098
Customer Purchase Order: P8963
Date Job Received at SAL: 07-Sep-2011
Date Analysis Started: 08-Sep-2011
Date Analysis Completed: 13-Sep-2011

The results reported relate to samples received in the laboratory
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UKAS TESTING
1549

Report checked and authorised by :
Kayleigh McCann
Project Manager

Issued by : Validity unknown
Digitally signed by Kayleigh McCann
Date: 2011.09.16 15:34:09 BST
Reason: Issued
Location: SAL

SAL Reference: 249753
Customer Reference: P1098

Filter Quartz 37mm Analysed as Filter Quartz 37mm
Miscellaneous

				SAL Reference	249753 001	249753 003	249753 005
				Customer Sample Reference	ECL/11/4349	ECL/11/4351	ECL/11/4353
				Test Sample	AR	AR	AR
Determinand	Method	LOD	Units	Symbol			
Particulates (Total)	Grav (5 Dec)	0.05	mg	U	0.75	0.25	0.20

SAL Reference: 249753
Customer Reference: P1098

Wash(Acetone) Analysed as Wash(Acetone)
Miscellaneous

				SAL Reference	249753 002	249753 004	249753 006
				Customer Sample Reference	ECL/11/4350	ECL/11/4352	ECL/11/4354
				Test Sample	AR	AR	AR
Determinand	Method	LOD	Units	Symbol			
Particulates (Total)	Grav	0.1	mg	U	<0.1	<0.1	<0.1

Index to symbols used in 249753-1

Value	Description
AR	As Received
U	Analysis is UKAS accredited

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Scientific Analysis Laboratories Ltd

Certificate of Analysis

Report Number: 250919-1

Date of Report: 04-Oct-2011

Customer: Environmental Compliance Ltd
Unit G1
Main Avenue
Treforest Industrial Estate
Pontypridd
CF37 5YL.

Customer Contact: Mr John Litterick

Customer Job Reference: P1098
Customer Purchase Order: P9050
Date Job Received at SAL: 19-Sep-2011
Date Analysis Started: 20-Sep-2011
Date Analysis Completed: 04-Oct-2011

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and authorised by :
Ms Jennifer Hughes
Customer Service Manager
(Air Division)

Issued by :
Ms Jennifer Hughes
Customer Service Manager
(Air Division)

Validity unknown
Jennifer Hughes
Date: 2012.02.07 09:52:12 GMT
Reason: I have reviewed this document
Location: SAL

SAL Reference: 250919
Customer Reference: P1098

Wash(Acetone) Analysed as Wash(Acetone)
Miscellaneous

					SAL Reference	250919 002	250919 004	250919 006
					Customer Sample Reference	ECL/11/4830	ECL/11/4832	ECL/11/4834
					Test Sample	AR	AR	AR
Determinand	Method	LOD	Units	Symbol				
Particulates (Total)	Grav	0.1	mg	U		<0.1	<0.1	<0.1

SAL Reference: 250919
Customer Reference: P1098

Filter Quartz 37mm Analysed as Filter Quartz 37mm
Miscellaneous

					SAL Reference	250919 001	250919 003	250919 005
					Customer Sample Reference	ECL/11/4829	ECL/11/4831	ECL/11/4833
					Test Sample	AR	AR	AR
Determinand	Method	LOD	Units	Symbol				
Particulates (Total)	Grav (5 Dec)	0.05	mg	U		0.10	0.19	<0.05

Index to symbols used in 250919-1

Value	Description
AR	As Received
U	Analysis is UKAS accredited

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Scientific Analysis Laboratories Ltd

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Certificate of Analysis

Report Number: 260106-1

Date of Report: 12-Dec-2011

Customer: Environmental Compliance Ltd
Unit G1
Main Avenue
Treforest Industrial Estate
Pontypridd
CF37 5YL.

Customer Contact: Mr Robert Jones

Customer Job Reference: P1098
Date Job Received at SAL: 05-Dec-2011
Date Analysis Started: 06-Dec-2011
Date Analysis Completed: 12-Dec-2011

The results reported relate to samples received in the laboratory
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Report checked
and authorised by :
Ms Jennifer Hughes
Customer Service Manager
(Air Division)

Issued by :
Ms Jennifer Hughes
Customer Service Manager
(Air Division)

Validity unknown
Digitally signed by Jennifer Hughes
Date: 2011.12.14 17:10:18 GMT
Reason: Issued
Location: SAL

SAL Reference: 260106
Customer Reference: P1098

Filter GFA 37mm Analysed as Filter GFA 37mm
Miscellaneous

				SAL Reference	260106 001	260106 003	260106 005	260106 007	260106 009
				Customer Sample Reference	ECL/11/6819 799	ECL/11/6821 798	ECL/11/6823 914	ECL/11/6825 930	ECL/11/6827 928
				Test Sample	AR	AR	AR	AR	AR
Determinand	Method	LOD	Units	Symbol					
Particulates (Total)	Grav (5 Dec)	0.05	mg	U	0.12	0.07	<0.05	<0.05	<0.05

SAL Reference: 260106
Customer Reference: P1098

Filter GFA 37mm Analysed as Filter GFA 37mm
Miscellaneous

				SAL Reference	260106 011	
				Customer Sample Reference	ECL/11/6829 919	
				Test Sample	AR	
Determinand	Method	LOD	Units	Symbol		
Particulates (Total)	Grav (5 Dec)	0.05	mg	U	<0.05	

SAL Reference: 260106
Customer Reference: P1098

Wash(Acetone) Analysed as Wash(Acetone)
Miscellaneous

				SAL Reference	260106 002	260106 004	260106 006	260106 008	260106 010
				Customer Sample Reference	ECL/11/6820	ECL/11/6822	ECL/11/6824	ECL/11/6826	ECL/11/6828
				Test Sample	AR	AR	AR	AR	AR
Determinand	Method	LOD	Units	Symbol					
Particulates (Total)	Grav	0.1	mg	U	0.9	<0.1	<0.1	<0.1	<0.1

SAL Reference: 260106
Customer Reference: P1098

Wash(Acetone) Analysed as Wash(Acetone)
Miscellaneous

				SAL Reference	260106 012	
				Customer Sample Reference	ECL/11/6930	
				Test Sample	AR	
Determinand	Method	LOD	Units	Symbol		
Particulates (Total)	Grav	0.1	mg	U	0.1	

Index to symbols used in 260106-1

Value	Description
AR	As Received
U	Analysis is UKAS accredited

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Scientific Analysis Laboratories Ltd

Certificate of Analysis

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Report Number: 249752-1

Date of Report: 19-Sep-2011

Customer: Environmental Compliance Ltd
Unit G1
Main Avenue
Treforest Industrial Estate
Pontypridd
CF37 5YL.

Customer Contact: Mr John Litterick

Customer Job Reference: P1098
Customer Purchase Order: P8963
Date Job Received at SAL: 07-Sep-2011
Date Analysis Started: 14-Sep-2011
Date Analysis Completed: 19-Sep-2011

The results reported relate to samples received in the laboratory
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Report checked and authorised by :
Kayleigh McCann
Project Manager

Issued by : Validity unknown
Digitally signed by Kayleigh McCann
Date: 2011.09.19 12:38:23 BST
Reason: Issued
Location: SAL

SAL Reference: 249752
Customer Reference: P1098

Impinger — Analysed as Impinger
Miscellaneous

					SAL Reference	249752 001	249752 002
					Customer Sample Reference	ECU1144355	ECU1144356
					Test Sample	AR	AR
Determinand	Method	LOD	Units	Symbol			
Methyl di-isocyanate	HPLC	0.2	µg	U	(163) <0.2	(163) <0.2	
Total Isocyanate Polymer	Calc (MDHS 25/3)	0.20	µg	N	(139,163,12) <0.20	(139,12,163) <0.20	

Index to symbols used in 249752-1

Value	Description
AR	As Received
163	Expressed as NCO
12	Isocyanate polymers are based on a calculation which is defined in MDHS 25/3
139	Excluding Targets
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

UNCERTAINTY CALCULATIONS

Site: NP Aerospace, Coventry
Location: Site 1, Stack ID: Spray Booth (A1)

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

Determinand	Filter mg	Solution mg	Recovered Mass mg	LAB Method Uncert (%) K=2 Filter mg	LAB Method Uncert (%) K=2 Solution mg	Standard Uncertainty Filter mg	Standard Uncertainty Solution mg	Combined Uncertainty mg
			TPM-1					
Particulates	0.12	0.90	1.02	0.14	0.27	0.0700	0.14	0.15

	TPM-1			Standard Uncertainty @95%	
Sampled Volume (V_m)	0.56	m^3	uV_m	0.001	m^3
Meter Correction Factor (Yd)	1.05	...		...	...
Meter Temperature (T_m)	295.40	k	uT_m	1.5	k
Static Pressure of Stack P_{static}	15.30	mmH_2O	uP_{static}	0.25	mmH_2O
Absolute Stack Pressure p_s	751.56	mmHg	up_s	0.8	mmHg
Barometric Pressure p_b	751.75	mmHg	up_b	3.8	mmHg
Average Differential Pressure (ΔH)	12.24	mmH_2O	$u\Delta H$	0.25	mmH_2O
Oxygen content ($O_{2,m}$)	20.90	%by volume	$uO_{2,m} = \sigma/\sqrt{n}$	0.00	%by volume
Moisture Content (H_2O)	0.0231	%by volume	uH_2O	0.28	%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 th 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:

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

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured static pressure uncertainty component (uPstatic) & measured temperature of dry gas

$$f_s = \frac{273}{760} \times \frac{P_b + \frac{\Delta H}{13.6}}{T_m} \times Y_d = \quad 0.961$$

	Maximum	Minimum	Sensitivity	ufstp
$u\Delta H$	0.50	0.50	0.0000488	0.0000122
up_b	0.50	0.50	0.000664	0.00249
uT_m	0.50	0.50	0.000879	0.00132
H_2O	0.50	0.50	0.00500	0.00142

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{\sqrt{(u\Delta H)^2 + (up_b)^2}}{(P_m/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.0199$$

Uncertainty in volume @STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.5365$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty (m^3)
Effect of uf_s	0.55	0.52	0.56	0.0111
Effect of uV_m	0.54	0.53	0.96	0.000961

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uV_{std}}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.00624$$

Uncertainty of correction factor to reference oxygen due to measured oxygen uncertainty component (uf_{O2}) & Uncertainty in final measurement @ reference conditions due to uncertainty component arising from leak and/or loss (assumed 2%max) in the sample system (uL)

$$f_{o_2} = \frac{20.9\% - O_{2,ref}}{20.9\% - O_{2,measured}} = \quad 1.00$$

	Maximum	Minimum	Sensitivity	Standard Uncertainty
uf_{o_2}	...	...	...	...

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}} = \quad \text{mg/Nm}^3 \quad 0.0220$$

Uncertainty in final measurement @ reference conditions due to mass uncertainty component (uM), oxygen correction uncertainty component (uf_{O_2}) and STP volume uncertainty component (uVstp)

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}} = \quad 1.90$$

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	u mg/Nm³
uM	2.19	1.62	1.87	0.28
uO_2	...	...	...	...
uV_{stp}	1.93	1.88	3.56	0.0222

Combined Uncertainty

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uf_{O_2})^2 + (uV_{stp})^2}$$

Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
0.29	0.57	1.90	30.0%

Site: NP Aerospace, Coventry
Location: Site 1 , Stack ID: Spray Booth (A1)

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

Determinand	Filter mg	Solution mg	Recovered Mass mg	LAB Method Uncert (%) K=2 Filter mg	LAB Method Uncert (%) K=2 Solution mg	Standard Uncertainty Filter mg	Standard Uncertainty Solution mg	Combined Uncertainty mg
			TPM-2					
Particulates	0.0700	0.10	0.17	0.14	0.27	0.0700	0.14	0.15

	TPM-2			Standard Uncertainty @95%	
Sampled Volume (V_m)	0.56	m^3	uV_m	0.001	m^3
Meter Correction Factor (Yd)	1.05	...		...	...
Meter Temperature (T_m)	301.28	k	uT_m	1.5	k
Static Pressure of Stack P_{static}	15.00	mmH_2O	uP_{static}	0.25	mmH_2O
Absolute Stack Pressure p_s	751.56	mmHg	up_s	0.8	mmHg
Barometric Pressure p_b	751.75	mmHg	up_b	3.8	mmHg
Average Differential Pressure (ΔH)	12.24	mmH_2O	$u\Delta H$	0.25	mmH_2O
Oxygen content ($O_{2,m}$)	20.90	%by volume	$uO_{2,m} = \sigma/\sqrt{n}$	0.00	%by volume
Moisture Content (H_2O)	0.0234	%by volume	uH_2O	0.29	%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 th 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:

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

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured static pressure uncertainty component (uPstatic) & measured temperature of dry gas

$$f_s = \frac{273}{760} \times \frac{P_b + \frac{\Delta H}{13.6}}{T_m} \times Y_d = \quad 0.943$$

	Maximum	Minimum	Sensitivity	ufstp
$u\Delta H$	0.49	0.49	0.0000483	0.0000121
up_b	0.50	0.49	0.000657	0.00246
uT_m	0.50	0.49	0.000861	0.00129
H_2O	0.50	0.49	0.00495	0.00141

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{\sqrt{(u\Delta H)^2 + (uP_s)^2}}{(P_m/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.0193$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.5308$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty (m^3)
Effect of uf_s	0.54	0.52	0.56	0.0109
Effect of uV_m	0.53	0.53	0.94	0.000943

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uV_{std}}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.00619$$

Uncertainty of correction factor to reference oxygen due to measured oxygen uncertainty component (uf_{O2}) & Uncertainty in final measurement @ reference conditions due to uncertainty component arising from leak and/or loss (assumed 2%max) in the sample system (uL)

$$f_{O_2} = \frac{20.9\% - O_{2,ref}}{20.9\% - O_{2,measured}} = \quad 1.00$$

	Maximum	Minimum	Sensitivity	Standard Uncertainty
uf_{O_2}	...	...	...	...

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}} = \quad \text{mg/Nm}^3 \quad 0.00370$$

Uncertainty in final measurement @ reference conditions due to mass uncertainty component (uM), oxygen correction uncertainty component (uf_{Oxy}) and STP volume uncertainty component (uVstp)

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}} = \quad 0.32$$

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	u mg/Nm³
uM	0.61	0.0338	1.88	0.29
uO_2	...	...	...	...
uV_{stp}	0.32	0.32	0.60	0.00373

Combined Uncertainty

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

Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
0.29	0.57	0.32	178.9%

Site: NP Aerospace, Coventry
Location: Site 1 , Stack ID: Prep Booth (A2)

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

Determinand	Filter mg	Solution mg	Recovered Mass mg	LAB Method Uncert (%) K=2 Filter mg	Solution mg	Standard Uncertainty Filter mg	Solution mg	Combined Uncertainty mg
				TPM - 1				
Particulates	0.0500	0.10	0.15	0.14	0.27	0.0700	0.14	0.15

	TPM - 1			Standard Uncertainty @ 95%		
Sampled Volume (V_m)	0.60	m^3	uV_m	0.001	m^3	
Meter Correction Factor (Yd)	1.05	...		...	...	
Meter Temperature (T_m)	300.90	k	uT_m	1.5	k	
Static Pressure of Stack P_{static}	15.00	mmH_2O	uP_{static}	0.25	mmH_2O	
Absolute Stack Pressure p_s	751.56	mmHg	up_s	0.8	mmHg	
Barometric Pressure p_b	751.75	mmHg	up_b	3.8	mmHg	
Average Differential Pressure (ΔH)	1.94	mmH_2O	$u\Delta H$	0.25	mmH_2O	
Oxygen content ($O_{2,m}$)	20.90	% by volume	$uO_{2,m} = \sigma/\sqrt{n}$	0.00	% by volume	
Moisture Content (H_2O)	0.0218	% by volume	uH_2O	0.27	% 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 th 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:

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

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured static pressure uncertainty component (uPstatic) & measured temperature of dry gas

$$f_s = \frac{273}{760} \times \frac{P_b + \frac{\Delta H}{13.6}}{T_m} \times Y_d = \quad 0.943$$

	Maximum	Minimum	Sensitivity	ufstp
$u\Delta H$	0.49	0.49	0.0000483	0.0000121
up_b	0.50	0.49	0.000658	0.00247
uT_m	0.50	0.49	0.000861	0.00129
H_2O	0.50	0.49	0.00495	0.00132

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{\sqrt{(u\Delta H)^2 + (uP_s)^2}}{(P_m/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.12$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.5686$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty (m^3)
Effect of uf_s	0.64	0.50	0.60	0.0733
Effect of uV_m	0.57	0.57	0.94	0.000943

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uV_{std}}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0442$$

Uncertainty of correction factor to reference oxygen due to measured oxygen uncertainty component (uf_{O2}) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$f_{o_2} = \frac{20.9\% - O_{2,ref}}{20.9\% - O_{2,measured}} = \quad 1.00$$

	Maximum	Minimum	Sensitivity	Standard Uncertainty
uf_{o_2}	...	...	...	...

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}} = \quad 0.00305 \ mg/Nm^3$$

Uncertainty in final measurement @ reference conditions due to mass uncertainty component (uM), oxygen correction uncertainty component (uf_{Oxy}) and STP volume uncertainty component (uVstp)

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}} = \quad 0.26$$

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	u mg/Nm³
uM	0.53	-3.639E-03	1.76	0.27
uO_2	...	...	...	...
uV_{stp}	0.29	0.24	0.47	0.0206

Combined Uncertainty

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

Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
0.27	0.54	0.26	203.4%

Site: NP Aerospace, Coventry
Location: Site 1 , Stack ID: Prep Booth (A2)

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

Determinand	Filter mg	Solution mg	Recovered Mass mg	LAB Method Uncert (%) K=2 Filter mg	LAB Method Uncert (%) K=2 Solution mg	Standard Uncertainty Filter mg	Standard Uncertainty Solution mg	Combined Uncertainty mg
			TPM - 2					
Particulates	0.0500	0.10	0.15	0.14	0.27	0.0700	0.14	0.15

	TPM - 2		Standard Uncertainty @ 95%		
Sampled Volume (V_m)	0.57	m^3	uV_m	0.001	m^3
Meter Correction Factor (Yd)	1.05	...		...	...
Meter Temperature (T_m)	301.03	k	uT_m	1.5	k
Static Pressure of Stack P_{static}	15.00	mmH_2O	uP_{static}	0.25	mmH_2O
Absolute Stack Pressure p_s	751.56	mmHg	up_s	0.8	mmHg
Barometric Pressure p_b	751.75	mmHg	up_b	3.8	mmHg
Average Differential Pressure (ΔH)	1.94	mmH_2O	$u\Delta H$	0.25	mmH_2O
Oxygen content ($O_{2,m}$)	20.90	% by volume	$uO_{2,n} = \sigma/\sqrt{n}$	0.00	% by volume
Moisture Content (H_2O)	0.0230	% by volume	uH_2O	0.28	% 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 th 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:

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

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured static pressure uncertainty component (uPstatic) & measured temperature of dry gas

$$f_s = \frac{273}{760} \times \frac{P_b + \frac{\Delta H}{13.6}}{T_m} \times Y_d = \quad 0.943$$

	Maximum	Minimum	Sensitivity	ufstp
$u\Delta H$	0.49	0.49	0.0000483	0.0000121
up_b	0.50	0.49	0.000657	0.00247
uT_m	0.50	0.49	0.000861	0.00129
H_2O	0.50	0.49	0.00494	0.00139

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{\sqrt{(u\Delta H)^2 + (uP_s)^2}}{(P_m/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.12$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.5392$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty (m^3)
Effect of uf_s	0.61	0.47	0.57	0.0695
Effect of uV_m	0.54	0.54	0.94	0.000943

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uV_{std}}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0398$$

Uncertainty of correction factor to reference oxygen due to measured oxygen uncertainty component (uf_{O2}) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$f_{o_2} = \frac{20.9\% - O_{2,ref}}{20.9\% - O_{2,measured}} = \quad 1.00$$

	Maximum	Minimum	Sensitivity	Standard Uncertainty
uf_{o_2}	...	...	...	...

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}} = \quad \text{mg/Nm}^3 \quad 0.00321$$

Uncertainty in final measurement @ reference conditions due to mass uncertainty component (uM), oxygen correction uncertainty component (uf_{Oxy}) and STP volume uncertainty component (uVstp)

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}} = \quad 0.28$$

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	u mg/Nm³
uM	0.56	-3.838E-03	1.85	0.28
uO_2	...	...	...	...
uV_{stp}	0.30	0.26	0.52	0.0206

Combined Uncertainty

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

Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
0.28	0.57	0.28	203.3%

Site: NP Aerospace, Coventry
Location: Site 1 , Stack ID: Wet Back Booth (A5)

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

Determinand	Filter mg	Solution mg	Recovered Mass mg	RPS Method Uncert (%) K=2 Filter mg	Solution mg	Standard Uncertainty Filter mg	Solution mg	Combined Uncertainty mg
				TPM-1				
Particulates	0.10	0.10	0.20	0.14	0.27	0.0700	0.14	0.15

	TPM-1			Standard Uncertainty @95%	
Sampled Volume (V_m)	0.77	m^3	uV_m	0.001	m^3
Meter Correction Factor (Yd)	1.05	...		...	...
Meter Temperature (T_m)	299.90	k	uT_m	1.5	k
Static Pressure of Stack P_{static}	7.14	mmH_2O	uP_{static}	0.25	mmH_2O
Absolute Stack Pressure p_s	748.56	mmHg	up_s	0.8	mmHg
Barometric Pressure p_b	748.75	mmHg	up_b	3.8	mmHg
Average Differential Pressure (ΔH)	6.76	mmH_2O	$u\Delta H$	0.25	mmH_2O
Oxygen content ($O_{2,m}$)	20.90	%by volume	$uO_{2,m} = \sigma/\sqrt{n}$	0.00	%by volume
Moisture Content (H_2O)	0.0171	%by volume	uH_2O	0.21	%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 th 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:

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

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured static pressure uncertainty component (uPstatic) & measured temperature of dry gas

$$f_s = \frac{273}{760} \times \frac{P_b + \frac{\Delta H}{13.6}}{T_m} \times Y_d = \quad 0.943$$

	Maximum	Minimum	Sensitivity	ufstp
$u\Delta H$	0.49	0.49	0.0000484	0.0000121
up_b	0.50	0.49	0.000669	0.00247
uT_m	0.49	0.49	0.000861	0.00129
H_2O	0.49	0.49	0.00494	0.00103

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{\sqrt{(u\Delta H)^2 + (uP_s)^2}}{(P_m/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.0349$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.7250$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty (m^3)
Effect of uf_s	0.75	0.70	0.77	0.0289
Effect of uV_m	0.73	0.72	0.94	0.000943

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uV_{std}}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0207$$

Uncertainty of correction factor to reference oxygen due to measured oxygen uncertainty component (uf_{O2}) & Uncertainty in final measurement @ reference conditions due to uncertainty component arising from leak and/or loss (assumed 2%max) in the sample system (uL)

$$f_{o_2} = \frac{20.9\% - O_{2,ref}}{20.9\% - O_{2,measured}} = \quad 1.00$$

	Maximum	Minimum	Sensitivity	Standard Uncertainty
uf_{o_2}	...	...	...	...

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}} = \quad \text{mg/Nm}^3 \quad 0.00319$$

Uncertainty in final measurement @ reference conditions due to mass uncertainty component (uM), oxygen correction uncertainty component (uf_{Oxy}) and STP volume uncertainty component (uVstp)

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}} = \quad 0.28$$

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	u mg/Nm³
uM	0.49	0.0861	1.38	0.21
uO_2	...	...	...	...
uV_{stp}	0.28	0.27	0.38	0.00788

Combined Uncertainty

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

Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
0.21	0.42	0.28	152.2%

Site: NP Aerospace, Coventry
Location: Site 1 , Stack ID: Wet Back Booth (A5)

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

Determinand	Filter mg	Solution mg	Recovered Mass mg	RPS Method Uncert (%) K=2 Filter mg	RPS Method Uncert (%) K=2 Solution mg	Standard Uncertainty Filter mg	Standard Uncertainty Solution mg	Combined Uncertainty mg
			TPM-2					
Particulates	0.19	0.10	0.29	0.14	0.27	0.0700	0.14	0.15

	TPM-2			Standard Uncertainty @95%	
Sampled Volume (V_m)	0.74	m^3	uV_m	0.001	m^3
Meter Correction Factor (Yd)	1.05	...		...	...
Meter Temperature (T_m)	307.65	k	uT_m	1.5	k
Static Pressure of Stack P_{static}	7.14	mmH_2O	uP_{static}	0.25	mmH_2O
Absolute Stack Pressure p_s	748.56	mmHg	up_s	0.8	mmHg
Barometric Pressure p_b	748.75	mmHg	up_b	3.8	mmHg
Average Differential Pressure (ΔH)	6.76	mmH_2O	$u\Delta H$	0.25	mmH_2O
Oxygen content ($O_{2,m}$)	20.90	%by volume	$uO_{2,m} = \sigma/\sqrt{n}$	0.00	%by volume
Moisture Content (H_2O)	0.0182	%by volume	uH_2O	0.22	%by volume

Note: In the following calculations, the sensitivity coefficient (C_i) 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 th 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:

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

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured static pressure uncertainty component (uPstatic) & measured temperature of dry gas

$$f_s = \frac{273}{760} \times \frac{P_b + \frac{\Delta H}{13.6}}{T_m} \times Y_d = \quad 0.919$$

	Maximum	Minimum	Sensitivity	ufstp
$u\Delta H$	0.49	0.49	0.0000478	0.0000119
up_b	0.49	0.48	0.000850	0.00244
uT_m	0.49	0.49	0.000839	0.00126
H_2O	0.49	0.49	0.00487	0.00109

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{\sqrt{(u\Delta H)^2 + (uP_s)^2}}{(P_m/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.0036$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.6800$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty (m^3)
Effect of uf_s	0.70	0.66	0.74	0.0249
Effect of uV_m	0.68	0.68	0.92	0.000919

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uV_{std}}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0184$$

Uncertainty of correction factor to reference oxygen due to measured oxygen uncertainty component (uf_{O2}) & Uncertainty in final measurement @ reference conditions due to uncertainty component arising from leak and/or loss (assumed 2%max) in the sample system (uL)

$$f_{o_2} = \frac{20.9\% - O_{2,ref}}{20.9\% - O_{2,measured}} = \quad 1.00$$

	Maximum	Minimum	Sensitivity	Standard Uncertainty
uf_{o_2}	...	...	...	...

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}} = \quad \text{mg/Nm}^3 \quad 0.00492$$

Uncertainty in final measurement @ reference conditions due to mass uncertainty component (uM), oxygen correction uncertainty component (uf_{O2}) and STP volume uncertainty component (uVstp)

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{o_2}} = \quad 0.43$$

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	u mg/Nm³
uM	0.65	0.20	1.47	0.22
uO_2	...	...	...	...
uV_{stp}	0.44	0.42	0.63	0.0116

Combined Uncertainty

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uf_{O_2})^2 + (uV_{stp})^2}$$

Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
0.22	0.45	0.43	105.0%

Site: NP Aerospace, Coventry
Location: Site 3, Stack ID: LineX Booth (A2)

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

Determinand	Filter mg	Solution mg	Recovered Mass mg	LAB Method Uncert (%) K=2 Filter mg	Solution mg	Standard Uncertainty Filter mg	Solution mg	Combined Uncertainty mg
			TPM-1					
Particulates	0.75	0.10	0.85	0.14	0.27	0.0700	0.14	0.15

	TPM-1		Standard Uncertainty @95%		
Sampled Volume (V_m)	0.71	m^3	uV_m	0.001	m^3
Meter Correction Factor (Yd)	1.04	...		...	...
Meter Temperature (T_m)	298.40	k	uT_m	1.5	k
Static Pressure of Stack P_{static}	1.50	mmH_2O	uP_{static}	0.25	mmH_2O
Absolute Stack Pressure p_s	750.81	mmHg	up_s	0.8	mmHg
Barometric Pressure p_b	751.00	mmHg	up_b	3.8	mmHg
Average Differential Pressure (ΔH)	4.59	mmH_2O	$u\Delta H$	0.25	mmH_2O
Oxygen content ($O_{2,m}$)	20.90	%by volume	$uO_{2,m} = \sigma/\sqrt{n}$	0.00	%by volume
Moisture Content (H_2O)	0.000187	%by volume	uH_2O	0.23	%by volume

Note: In the following calculations, the sensitivity coefficient (C_i) 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 th 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:

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

Uncertainty in correction factor to STP due to measured barometric presure uncertainty component (upb), measured static pressure uncertainty component (uPstatic) & measured temperature of dry gas

$$f_s = \frac{273}{760} \times \frac{P_b + \frac{\Delta H}{13.6}}{T_m} \times Y_d = \quad 0.937$$

	Maximum	Minimum	Sensitivity	ufstp
$u\Delta H$	0.49	0.49	0.0000479	0.0000120
up_b	0.49	0.49	0.000651	0.00244
uT_m	0.49	0.49	0.000856	0.00128
H_2O	0.49	0.49	0.00489	0.00112

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{\sqrt{(u\Delta H)^2 + (uP_s)^2}}{(P_m/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.0605$$

Uncertainty in volume @STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.6643$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty (m^3)
Effect of uf_s	0.70	0.63	0.71	0.0368
Effect of uV_m	0.67	0.66	0.94	0.000937

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uV_{std}}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0254$$

Uncertainty of correction factor to reference oxygen due to measured oxygen uncertainty component (uf_{O2}) & Uncertainty in final measurement @ reference conditions due to uncertainty component arising from leak and/or loss (assumed 2%max) in the sample system (uL)

$$f_{o_2} = \frac{20.9\% - O_{2,ref}}{20.9\% - O_{2,measured}} = \quad 1.00$$

	Maximum	Minimum	Sensitivity	Standard Uncertainty
uf_{o_2}	...	...	...	...

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}} = \quad mg/Nm^3 \quad 0.0148$$

Uncertainty in final measurement @ reference conditions due to mass uncertainty component (uM), oxygen correction uncertainty component (uf_{Oxy}) and STP volume uncertainty component (uVstp)

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}} = \quad 1.28$$

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	u mg/Nm³
uM	1.51	1.05	1.51	0.23
uO_2	...	...	...	...
uV_{stp}	1.33	1.23	1.93	0.0490

Combined Uncertainty

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

Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
0.23	0.47	1.28	36.7%

Site: NP Aerospace, Coventry
Location: Site 3, Stack ID: LineX Booth (A2)

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

Determinand	Filter mg	Solution mg	Recovered Mass mg	LAB Method Uncert (%) K=2 Filter mg	Solution mg	Standard Uncertainty Filter mg	Solution mg	Combined Uncertainty mg
				TPM-2				
Particulates	0.25	0.10	0.35	0.14	0.27	0.0700	0.14	0.15

	TPM-2				
			Standard Uncertainty @95%		
Sampled Volume (V_m)	0.74	m^3	uV_m	0.001	m^3
Meter Correction Factor (Yd)	1.04	...		...	...
Meter Temperature (T_m)	309.15	k	uT_m	1.5	k
Static Pressure of Stack P_{static}	1.50	mmH_2O	uP_{static}	0.25	mmH_2O
Absolute Stack Pressure p_s	750.81	mmHg	up_s	0.8	mmHg
Barometric Pressure p_b	751.00	mmHg	up_b	3.8	mmHg
Average Differential Pressure (ΔH)	4.59	mmH_2O	$u\Delta H$	0.25	mmH_2O
Oxygen content ($O_{2,m}$)	20.90	%by volume	$uO_{2,m} = \sigma/\sqrt{n}$	0.00	%by volume
Moisture Content (H_2O)	0.000184	%by volume	uH_2O	0.23	%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 th 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:

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

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured static pressure uncertainty component (uPstatic) & measured temperature of dry gas

$$f_s = \frac{273}{760} \times \frac{P_b + \frac{\Delta H}{13.6}}{T_m} \times Y_d = \quad 0.904$$

	Maximum	Minimum	Sensitivity	ufstp
$u\Delta H$	0.48	0.48	0.0000470	0.0000117
up_b	0.48	0.48	0.000839	0.00240
uT_m	0.48	0.48	0.000825	0.00124
H_2O	0.48	0.48	0.00480	0.00108

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{\sqrt{(u\Delta H)^2 + (uP_s)^2}}{(P_m/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.0479$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.6728$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty (m^3)
Effect of uf_s	0.71	0.64	0.74	0.0356
Effect of uV_m	0.67	0.67	0.90	0.000904

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uV_{std}}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0265$$

Uncertainty of correction factor to reference oxygen due to measured oxygen uncertainty component (uf_{O2}) & Uncertainty in final measurement @ reference conditions due to uncertainty component arising from leak and/or loss (assumed 2%max) in the sample system (uL)

$$f_{o_2} = \frac{20.9\% - O_{2,ref}}{20.9\% - O_{2,measured}} = \quad 1.00$$

	Maximum	Minimum	Sensitivity	Standard Uncertainty
uf_{o_2}	...	...	...	...

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}} = \quad \text{mg/Nm}^3 \quad 0.00601$$

Uncertainty in final measurement @ reference conditions due to mass uncertainty component (uM), oxygen correction uncertainty component (uf_{O2}) and STP volume uncertainty component (uVstp)

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{o_2}} = \quad 0.52$$

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	u mg/Nm³
uM	0.75	0.29	1.49	0.23
uO_2	...	...	...	...
uV_{stp}	0.54	0.50	0.77	0.0205

Combined Uncertainty

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uf_{O_2})^2 + (uV_{stp})^2}$$

Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
0.23	0.45	0.52	87.3%