environmental consultants

Union Street
Hetton-le-Hole
Tyne & Wear
DH5 9HU

Tel: 01915208211
Fax: 01915208209
Email: info@epa-services.co.uk

REPORT FOR THE MONITORING OF EMISSIONS TO AIR FROM BAE SYSTEMS MARITIME - SUBMARINES, BARROW-IN-FURNESS, CUMBRIA, LA14 1AF

Part 1: Executive Summary

Permit /Authorisation Number:	PGN 6/23
Operator:	BAE Systems
Installation:	Maritime – Submarines, Barrow-In-Furness
Monitoring Dates:	05.08.13 – 09.08.13
Project Number:	EPA/JBN/13/514
For The Attention of:	Mr Terry Hughes
Client:	Leck Construction
Client Address:	Site Engineering Services Dept., Central Area, Barrow-In-Furness, Cumbria, LA14 1AF
Report Date:	28.08.13
Version:	1
Report Author:	Phillip Mothersdale
Report Approved By:	T Dodds
MCERTS Number:	MM 03 414
MCERTS Qualifications	Level 2 TE1, TE2, TE3 & TE4
Position:	Director
Signature:	

mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

UKAS TESTING
4039

Contents Page

1.1 Monitoring Objectives

EPA Limited were commissioned by Leck Construction to carry out emissions monitoring to determine the release of prescribed pollutants from varying release points (refer to Table 1) under normal operating conditions.

Table 1: Determinants to be Monitored From Varying Facilities

Emission Point Identification	Substances to be Monitored	
	Particulates	Total VOC's
RIF Hand Paint Enclosure Area D16	✓	✓
RIF Spray Paint Enclosure Area D16	✓	✓
Paint Shop Oven Vent Area D13	✓	✓
Paint Shop Spray Area D13	✓	✓
Paint Shop Shot Blast Area D13	✓	-
DDH Paint Extraction Area D34	✓	✓
NAS Annex Area A69	✓	✓
Tile Cutting Facility	✓	-
Contractors Paint Mixing Facility Area D00	✓	✓

1.2 Monitoring Results

Emission Point Reference	Substance to be Monitored	Emission Limit Value (30 min mean)	Periodic Monitoring Result (30 min mean)	Uncertainty	Units	Reference Conditions	Date of Sampling	Start and Stop Time	Monitoring Method Reference	Accreditation for use of Method	Operating Status
RIF Hand Paint Enclosure Area D16	Particulates	50mg/Nm^3	2.9	± 0.5	mgm^{-3}	STP (101.3kPa, 273K)	05.08.13	14:45 – 15:15	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	6.9	± 3.5	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 12619	UKAS/ MCERTS	Normal
RIF Spray Paint Enclosure Area D16	Particulates	50mg/Nm^3	2.0	± 0.3	mgm^{-3}	STP (101.3kPa, 273K)	07.08.13	15:43 – 16:13	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	1183.9	± 34.0	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 13526	UKAS/ MCERTS	Normal
Paint Shop Oven Vent Area D13	Particulates	50mg/Nm^3	3.2	± 0.3	mgm^{-3}	STP (101.3kPa, 273K)	06.08.13	10:54 – 11:24	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	22.4	± 3.5	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 13526	UKAS/ MCERTS	Normal
Paint Shop Spray Area D13	Particulates	50mg/Nm^3	1.5	± 0.3	mgm^{-3}	STP (101.3kPa, 273K)	06.08.13	13:59 – 14:35	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	4.9	± 0.4	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 12619	UKAS/ MCERTS	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value (30 min mean)	Periodic Monitoring Result (30 min mean)	Uncertainty	Units	Reference Conditions	Date of Sampling	Start and Stop Time	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Paint Shop Shot Blast Area D13	Particulates	50mg/Nm^3	0.9	± 0.2	mgm^{-3}	STP (101.3kPa, 273K)	06.8.13	15:54 – 16:26	BS EN 13284-1	UKAS/ MCERTS	Normal
DDH Paint Extraction Area D34	Particulates	50mg/Nm^3	1.3	± 0.2	mgm^{-3}	STP (101.3kPa, 273K)	07.08.13	11:28 – 12:02	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	250.4	± 36.5	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 13526	UKAS/ MCERTS	Normal
NAS Annex Paint Extraction Area A69	Particulates	50mg/Nm^3	4.1	± 0.5	mgm^{-3}	STP (101.3kPa, 273K)	09.08.13	10:28 – 11:02	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	622.3	± 33.9	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 13526	UKAS/ MCERTS	Normal
DDH Tile Cutting Facility	Particulates	50mg/Nm^3	2.9	± 0.4	mgm^{-3}	STP (101.3kPa, 273K)	08.08.13	10:38 – 11:08	BS EN 13284-1	UKAS/ MCERTS	Normal
Contractors Paint Mixing Facility	Particulates	50mg/Nm^3	4.7	± 0.5	mgm^{-3}	STP (101.3kPa, 273K)	08.08.13	14:22 – 14:52	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	206.1	± 35.3	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 13526	UKAS/ MCERTS	Normal

1.3 Operating Information

Emission Point Reference	Continuous or Batch Process	Details of Batch during Sampling (Type of paint used)	Feedstock	Abatement	Comparison of Operator CEMS and periodic Monitoring Results			
					Substance	CEM Results	Periodic Monitoring Results	Units
RIF Hand Paint Enclosure Area D16	Batch	Sigma Cover 400	Various Parts	N/A	N/A	N/A	N/A	N/A
RIF Spray Paint Enclosure Area D16	Batch	L574	N/A	N/A	N/A	N/A	N/A	N/A
Paint Shop Oven Vent Area D13	Batch	Trimite P8000	Various Parts	N/A	N/A	N/A	N/A	N/A
Paint Shop Spray Area D13	Batch	Trimite P8000	Various Parts	Filter System	N/A	N/A	N/A	N/A
Paint Shop Shot Blast Area D13	Batch	N/A	N/A	Bag Filter	N/A	N/A	N/A	N/A
DDH Paint Extraction Area D34	Batch	L574	N/A	N/A	N/A	N/A	N/A	N/A
NAS Annex Area A69	Batch	Primer L574	MDF	Bag Filter	N/A	N/A	N/A	N/A
Tile Cutting Facility	Batch	N/A	CTL 2Tiles	Bag Filter	N/A	N/A	N/A	N/A
Contractors Paint Mixing. Area D00	Batch	L574	Mix Tank	N/A	N/A	N/A	N/A	N/A

1.4 Monitoring Deviations

Emission Point Reference	Substances Not Monitored (including explanation)	Monitoring Deviations (including explanation)	Other Relevant Issues
RIF Hand Paint	-	Blank test slightly higher concentration than actual test due to overall low particulate concentrations	-
Paint Shop Shot Blast	-		-
DDH Tile Cutting Facility	-		-
Contractors Paint Mix Room	-		-

Part 2: Supporting Information

2.1 Appendix 1: General Information

2.1.1 Emissions Monitoring Team

Consultant	Charles Bell
MCERTS Accreditation	Level 2 TE1
MCERTS Number	MM 02 015
Degree	BSc Hons Energy Technology Management

Project Supervisor	Phillip Mothersdale
MCERTS Accreditation	Level 2 TE1, 2, 3 & 4
MCERTS Number	MM 05 596
Degree	BSc Hons Chemistry with Analytical Chemistry

2.1.2 Substances Monitored

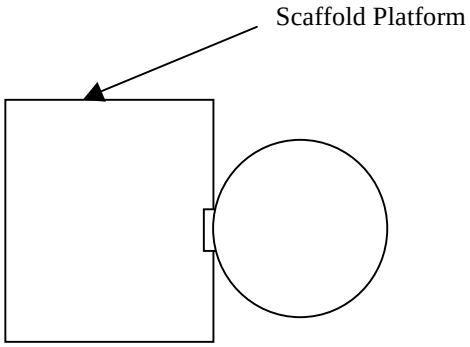
Substances Monitored	Standard Reference Method	EPA Method
Flow	BS EN 13284-1	EPA Method 1
Particulate	BS EN 13284-1	EPA Method 1
Total VOCs by FID	BS EN 12619	EPA Method 6

2.1.3 Site Equipment Log

Equipment Description	EPA Reference Number
Heated Line	EPA/HEAT/09,05
Pitot Tube	EPA/PITOT/10,18
Thermocouple Probe	EPA/TCP/01,51
Thermocouple Reader	EPA/MAN/19
Measuring Tape	EPA/TAPE/13
Vion Site Barometer	EPA/BAR/04
Sampling Probe	EPA/PROBE/08,09
Dry Gas Meter	EPA/DGM/02
Site Balance	EPA/MASS/03
Sampling Nozzle	EPA/N/3,16,17
Sick 3006 FID	EPA/FID/02
Sample Box	EPA/SAMP/09A

2.2 Appendix 2: RIF Hand Paint Enclosure

2.2.1 Sampling Location



Duct Characteristics

	Value	Units
Type of Duct	Circular	-
Diameter / Depth	0.285	m
Width	N/A	m
Area	0.064	m^2
Port Size	4	inch
Port Depth	70	mm
Orientation	Vertical	-

Sampling Platform

General Platform Information	
Permanent / Temporary	Temporary
Inside / Outside	Inside
Height of Platform from Ground Level	~7m
Size of Platform	1.0m x 1.5m
Does the Platform have a weather cover (roof)	N/A
Platform has 2 hand rails (approx 0.5m and 1.0m high)	Yes
Platform has vertical base boards (approx 0.25m high)	Yes
Platform has removable chains / self closing gates at the top of the ladder	Yes
Platform positioned relative to the access ports (free from obstruction that would hamper insertion and removal of the sampling equipment)	Yes
Depth of platform (length of probe + 1m)	No

2.2.2 Flow Criteria Measurements

Traverse Point	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**
Pressure (mm H_2O)	10.8	9.0	8.5	7.0	8.0	7.0
√ΔP	3.28	3.00	2.92	2.65	2.83	2.65
Temperature (ºC)	30	31	31	31	31	31

Static Pressure (mmH_2O)	11.5	**Barometric Pressure (mm Hg)**	760.8	**Duct Dimensions (m)**	0.285

Velocity (m/s) average	10.1	**Actual Flow of stack gas (m^3/hr)**	2310.8
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	2080.7
Dimensions (m)	0.285	**Flow (dry) at STP (m^3/hr)**	2036.6
Area (m^2)	0.064		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	8.4	10.8	7.0	1.5	Yes
√ΔP (mm H_2O)^{½}	2.89	3.28	2.65	1.2	Yes
Temperature (ºC)	30.8	31	30	1.0	Yes
Angle of flow	<15º				Yes
Local Negative Flow	No				Yes

2.2.3 Gas Measurements

	Mean
Oxygen (%)	20.90
Carbon Monoxide (ppm)	0
Carbon Dioxide (%)	0.03

2.2.4 Manual Method Calculations

Test Dates	05/08/13		
Company	BAE		
Contact	T Hughes		
Stack	RIF Hand		
	Blank	Test 1	Units
Sample Ref	EPA/13/514/01	EPA/13/514/02	-
Start Time	14:05	14:45	hr:mm
Stop Time	14:20	15:15	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	8.5	ml
B_{wo}	0.02	0.021	-
P_b	-	760.8	mm Hg
St	-	11.5	mm H_2O
T_s	-	29.83	ºC
$\sqrt{\Delta P}$	-	2.92	$(mm\ H_2O)^{½}$
Yd	-	1.352	-
Test Time	-	30	min
T_m	-	22.67	ºC
C_p	-	0.823	-
As	-	0.064	m^2
D_n	-	6.19	mm
ΔH ave	-	29.05	mm H_20
V_{mstd}	0.4886	0.4886	m^3
V_{wstd}	0.0106	0.0106	m^3
$Q_{std,wet}$	-	2052.2	Nm^3/h
Q_{act}	-	2271.7	Nm^3/h
Isokinetic Rate	-	103.2	%
Vs	-	9.89	m/s
Washings			
Sample Ref	EPA/13/514/01W	EPA/13/514/02W	-
Weight	1.1	0.6	mg
Filter			
Sample Ref	EPA/13/514/01F	EPA/13/514/02F	-
Weight	0.79	0.83	mg
Particulate Concentration (Dry, No O_2 Correction)	3.9	2.9	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	3.8	2.9	mg/Nm^3
Particulate Release Rate	-	5.88	g/hr
Reference Temp	273		K
Reference Pressure	101.3		kPa
Reference Moisture	No correction for moisture		-
Reference Oxygen	No correction for Oxygen		%

Particulates

	Filter (mg)	Washings (mg)
Blank	0.79	1.1
Run 1	0.83	0.6

2.2.5 Sampling Measurements

Date	05/08/13		**Impinger**	**Initial Wt (g)**	**Final Wt(g)**	**Wt Gained (g)**			**l/min**	**Vac (in Hg)**			
Start Time	14:45		**1**	247.5	247.3	-0.2		**Leak Check (Pre)**	0.2	15			
End Time	15:15		**2**	738.4	741.1	2.7		**Leak Check (Post)**	0.2	5			
Duration (mm.ss)	30.00		**3**	778.1	779.5	1.4							
Stack	RIF Hand		**4**	654.9	655.2	0.3		**Pitot ID**	Pitot 06			Velocity Head	
Run	1		**5**	715.0	719.3	4.3		**DGM ID**	DGM 02			Min	8.5
												Max	8.5
												Max:Min	1.00
								Nozzle ID	N3				
			Sample Ref	EPA/13/514/02				**Nozzle Diameter (mm)**	6.19				
K Factor	3.42		**Filter Number**	EPA/13/514/02F									
Stack Diameter (m)	0.29		**Probe Washing No**	EPA/13/514/02W									
							ΔH across orifice meter (mm H_2O)	**DGM (litres)**	**DGM Temp (°C)**		**Temp (°C)**		
Point	**Time**	**Vac**	**Stack Temp (°C)**	**Velocity Head (mmH_2O)**		**√ΔP**		7766.18	**In**	**Out**	**Probe**	**Filter**	**Impinger**
A1	0	3	30	8.5		2.92	29.05	7831	25	22	52	54	
A1	5	2	29	8.5		2.92	29.05	7896	23	22	57	56	
A1	10	2	30	8.5		2.92	29.05	7945	22	22	55	55	
A1	15	2	30	8.5		2.92	29.05	8026	22	22	55	55	
A1	20	2	31	8.5		2.92	29.05	8091	23	22	55	55	
A1	25	2	29	8.5		2.92	29.05	8156.06	25	22	55	55	
Total / Average		3.00	29.83	8.50		2.92	29.05	389.88	23.33	22.00	54.83	55.00	

2.2.6 Instrumental Gas Analyser Site Calibration Measurements

Zero Point

				Pre Test			Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Pre Span	Post Span	System	System	Zero Drift
VOC (ppm)	100	Ambient Air	0.00	0.12	0.20	1.53	0.29	-1.24

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	100	EPA/CGAS /78	82.40	82.42	83.72	83.79	0.07

2.2.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3 as C at Ref O_2%
05.08.2013	14:45:05	6.7	10.8	10.8
05.08.2013	14:45:20	7.9	12.7	12.7
05.08.2013	14:45:35	6.2	10.0	10.0
05.08.2013	14:45:50	4.4	7.1	7.1
05.08.2013	14:46:05	4.1	6.6	6.6
05.08.2013	14:46:20	3.9	6.3	6.3
05.08.2013	14:46:35	4.2	6.8	6.8
05.08.2013	14:46:50	5.1	8.2	8.2
05.08.2013	14:47:05	6.1	9.9	9.9
05.08.2013	14:47:20	5.4	8.6	8.6
05.08.2013	14:47:35	5.4	8.7	8.7
05.08.2013	14:47:50	5.1	8.2	8.2
05.08.2013	14:48:05	6.0	9.7	9.7
05.08.2013	14:48:20	5.5	8.9	8.9
05.08.2013	14:48:35	5.1	8.2	8.2
05.08.2013	14:48:50	4.5	7.3	7.3
05.08.2013	14:49:05	3.9	6.2	6.2
05.08.2013	14:49:20	3.7	5.9	5.9
05.08.2013	14:49:35	3.5	5.6	5.6
05.08.2013	14:49:50	3.3	5.3	5.3
05.08.2013	14:50:05	3.2	5.2	5.2
05.08.2013	14:50:20	4.4	7.0	7.0
05.08.2013	14:50:35	5.1	8.2	8.2
05.08.2013	14:50:50	5.0	8.1	8.1
05.08.2013	14:51:05	4.9	7.9	7.9
05.08.2013	14:51:20	5.5	8.8	8.8
05.08.2013	14:51:35	4.8	7.7	7.7
05.08.2013	14:51:50	5.8	9.3	9.3
05.08.2013	14:52:05	6.4	10.3	10.3
05.08.2013	14:52:20	6.7	10.8	10.8

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
05.08.2013	14:52:35	7.1	11.5	11.5
05.08.2013	14:52:50	8.5	13.6	13.6
05.08.2013	14:53:05	8.3	13.3	13.3
05.08.2013	14:53:20	8.0	12.9	12.9
05.08.2013	14:53:35	8.0	12.9	12.9
05.08.2013	14:53:50	7.3	11.7	11.7
05.08.2013	14:54:05	7.6	12.1	12.1
05.08.2013	14:54:20	7.7	12.4	12.4
05.08.2013	14:54:35	6.3	10.0	10.0
05.08.2013	14:54:50	5.2	8.4	8.4
05.08.2013	14:55:05	5.9	9.5	9.5
05.08.2013	14:55:20	6.0	9.7	9.7
05.08.2013	14:55:35	5.6	9.0	9.0
05.08.2013	14:55:50	5.2	8.4	8.4
05.08.2013	14:56:05	5.1	8.2	8.2
05.08.2013	14:56:20	4.4	7.0	7.0
05.08.2013	14:56:35	4.5	7.2	7.2
05.08.2013	14:56:50	4.2	6.7	6.7
05.08.2013	14:57:05	4.6	7.4	7.4
05.08.2013	14:57:20	4.8	7.7	7.7
05.08.2013	14:57:35	4.5	7.2	7.2
05.08.2013	14:57:50	4.0	6.4	6.4
05.08.2013	14:58:05	3.6	5.8	5.8
05.08.2013	14:58:20	3.3	5.3	5.3
05.08.2013	14:58:35	3.9	6.2	6.2
05.08.2013	14:58:50	3.9	6.3	6.3
05.08.2013	14:59:05	3.6	5.8	5.8
05.08.2013	14:59:20	3.2	5.1	5.1
05.08.2013	14:59:35	3.4	5.4	5.4
05.08.2013	14:59:50	2.9	4.6	4.6
05.08.2013	15:00:05	3.1	5.0	5.0
05.08.2013	15:00:20	3.2	5.1	5.1
05.08.2013	15:00:35	3.1	4.9	4.9
05.08.2013	15:00:50	3.3	5.2	5.2
05.08.2013	15:01:05	2.8	4.5	4.5
05.08.2013	15:01:20	3.1	4.9	4.9
05.08.2013	15:01:35	3.1	5.0	5.0
05.08.2013	15:01:50	2.9	4.7	4.7
05.08.2013	15:02:05	2.9	4.6	4.6
05.08.2013	15:02:20	3.2	5.1	5.1
05.08.2013	15:02:35	3.0	4.8	4.8
05.08.2013	15:02:50	3.0	4.8	4.8
05.08.2013	15:03:05	3.7	5.9	5.9
05.08.2013	15:03:20	4.1	6.6	6.6
05.08.2013	15:03:35	4.9	7.8	7.8
05.08.2013	15:03:50	5.4	8.7	8.7
05.08.2013	15:04:05	5.6	9.0	9.0
05.08.2013	15:04:20	4.9	7.8	7.8
05.08.2013	15:04:35	4.4	7.1	7.1
05.08.2013	15:04:50	4.4	7.0	7.0

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
05.08.2013	15:05:05	3.7	6.0	6.0
05.08.2013	15:05:20	4.4	7.1	7.1
05.08.2013	15:05:35	4.1	6.6	6.6
05.08.2013	15:05:50	4.0	6.4	6.4
05.08.2013	15:06:05	3.9	6.3	6.3
05.08.2013	15:06:20	4.7	7.5	7.5
05.08.2013	15:06:35	4.7	7.5	7.5
05.08.2013	15:06:50	4.9	7.9	7.9
05.08.2013	15:07:05	4.6	7.4	7.4
05.08.2013	15:07:20	4.0	6.4	6.4
05.08.2013	15:07:35	4.0	6.4	6.4
05.08.2013	15:07:50	4.0	6.4	6.4
05.08.2013	15:08:05	3.5	5.7	5.7
05.08.2013	15:08:20	3.4	5.4	5.4
05.08.2013	15:08:35	3.2	5.1	5.1
05.08.2013	15:08:50	3.2	5.2	5.2
05.08.2013	15:09:05	3.2	5.2	5.2
05.08.2013	15:09:20	2.9	4.7	4.7
05.08.2013	15:09:35	2.9	4.7	4.7
05.08.2013	15:09:50	3.2	5.1	5.1
05.08.2013	15:10:05	3.0	4.7	4.7
05.08.2013	15:10:20	3.0	4.8	4.8
05.08.2013	15:10:35	2.8	4.4	4.4
05.08.2013	15:10:50	3.0	4.9	4.9
05.08.2013	15:11:05	2.7	4.4	4.4
05.08.2013	15:11:20	2.7	4.4	4.4
05.08.2013	15:11:35	2.5	4.1	4.1
05.08.2013	15:11:50	2.5	4.1	4.1
05.08.2013	15:12:05	2.3	3.6	3.6
05.08.2013	15:12:20	2.6	4.2	4.2
05.08.2013	15:12:35	2.5	4.0	4.0
05.08.2013	15:12:50	2.3	3.6	3.6
05.08.2013	15:13:05	2.4	3.8	3.8
05.08.2013	15:13:20	2.4	3.8	3.8
05.08.2013	15:13:35	2.3	3.7	3.7
05.08.2013	15:13:50	2.3	3.6	3.6
05.08.2013	15:14:05	2.2	3.5	3.5
05.08.2013	15:14:20	2.3	3.6	3.6
05.08.2013	15:14:35	2.2	3.5	3.5
05.08.2013	15:14:50	2.2	3.5	3.5
Average		4.3	6.9	6.9
Max		8.5	13.6	13.6
Min		2.2	3.5	3.5

2.2.8 Uncertainty Calculations

Particulates

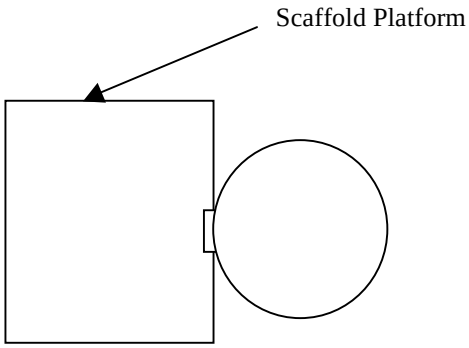
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	8.28		
O_2 Concentration	1.62		As % of result
Leak	1.15		16.71
Gas Temperature	1.02		
Pitot Co-efficient	0.50	8.61	As % of ELV
Humidity	0.50		0.98
Stack Diameter	0.35		As mg/m^3
Nozzle Diameter	0.23		0.48
Pressure	0.16		

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	0.82		
Temperature effect (zero)	0.48		
Barometric Pressure	0.41		2.27
Zero drift	0.36		
Span gas	0.32		
Temperature effect (span)	0.24	1.17	
Repeatability	0.07		**Expanded Uncertainty (95% Confidence limit) %**
Span drift	0.02		
Cross sensitivity CO (1.2 % vol)	0.00		
Cross sensitivity NO (127 mgm^{-3})	0.00		As % of Result
Cross sensitivity H_2O (sat 325K)	0.00		53.12
Cross sensitivity SO_2 (2767 mgm^{-3})	0.00		As mg/m^3 at ref conditions
Cross sensitivity CO_2 (15.2 % vol)	0.00		3.65

2.3 Appendix 3: RIF Spray Paint Enclosure

2.3.1 Sampling Location



Duct Characteristics

	Value	Units
Type of Duct	Circular	-
Diameter / Depth	0.295	m
Width	N/A	m
Area	0.068	m^2
Port Size	4	inch
Port Depth	70	mm
Orientation	Vertical	-

Sampling Platform

General Platform Information	
Permanent / Temporary	Temporary
Inside / Outside	Outside
Height of Platform from Ground Level	~12m
Size of Platform	1.5m x 2.0m
Does the Platform have a weather cover (roof)	No
Platform has 2 hand rails (approx 0.5m and 1.0m high)	Yes
Platform has vertical base boards (approx 0.25m high)	Yes
Platform has removable chains / self closing gates at the top of the ladder	Yes
Platform positioned relative to the access ports (free from obstruction that would hamper insertion and removal of the sampling equipment)	Yes
Depth of platform (length of probe + 1m)	Yes

2.3.2 Flow Criteria Measurements

Traverse Point	**A1**	**A2**	**A3**	**A4**
Pressure (mm H_2O)	1.0	1.3	1.3	1.3
$\sqrt{\Delta P}$	1.00	1.12	1.12	1.12
Temperature (ºC)	29	29	29	29

Static Pressure (mmH_2O)	1	**Barometric Pressure (mm Hg)**	766.0	**Duct Dimensions (m)**	0.295

Velocity (m/s) average	3.7	**Actual Flow of stack gas (m^3/hr)**	888.7
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	809.7
Dimensions (m)	0.295	**Flow (dry) at STP (m^3/hr)**	802.8
Area (m^2)	0.068		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	1.2	1.3	1.0	1.3	Yes
$\sqrt{\Delta P}$ (mm $H_2O)^{½}$	1.09	1.12	1.00	1.1	Yes
Temperature (ºC)	29.0	29	29	1.0	Yes
Angle of flow	<15º				Yes
Local Negative Flow	No				Yes

2.3.3 Gas Measurements

	Mean
Oxygen (%)	20.90
Carbon Monoxide (ppm)	0
Carbon Dioxide (%)	0.03

2.3.4 Manual Method Calculations

Test Dates	07/08/13		
Company	BAE		
Contact	T Hughes		
Stack	RIF Spray		
	Blank	Test 1	Units
Sample Ref	EPA/13/514/11	EPA/13/514/12	-
Start Time	15:20	15:43	hr:mm
Stop Time	15:25	16:13	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	6.9	ml
B_{wo}	0.01	0.009	-
P_b	-	766.0	mm Hg
St	-	1	mm H_2O
T_s	-	29.00	ºC
$\sqrt{\Delta P}$	-	1.41	$(mm\ H_2O)^{½}$
Yd	-	1.417	-
Test Time	-	30	min
T_m	-	26.83	ºC
C_p	-	0.826	-
As	-	0.066	m^2
D_n	-	12.65	mm
ΔH ave	-	115.39	mm H_20
V_{mstd}	0.9913	0.9913	m^3
V_{wstd}	0.0086	0.0086	m^3
$Q_{std,wet}$	-	1036.5	Nm^3/h
Q_{act}	-	1137.5	Nm^3/h
Isokinetic Rate	-	101.4	%
Vs	-	4.78	m/s
Washings			
Sample Ref	EPA/13/514/11W	EPA/13/514/12W	-
Weight	<0.5	0.5	mg
Filter			
Sample Ref	EPA/13/514/11F	EPA/13/514/12F	-
Weight	0.25	1.49	mg
Particulate Concentration (Dry, No O_2 Correction)	0.8	2.0	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	0.8	2.0	mg/Nm^3
Particulate Release Rate	-	2.06	g/hr
Reference Temp	273		K
Reference Pressure	101.3		kPa
Reference Moisture	No correction for moisture		-
Reference Oxygen	No correction for Oxygen		%

Particulates

	Filter (mg)	Washings (mg)
Blank	0.25	<0.5
Run 1	1.49	0.5

2.3.5 Sampling Measurements

Date	07/08/13		**Impinger**	**Initial Wt (g)**	**Final Wt(g)**	**Wt Gained (g)**			**l/min**	**Vac (in Hg)**			
Start Time	15:43		**1**	247.2	247.2	0.0		**Leak Check (Pre)**	0.1	10			
End Time	16:13		**2**	736.2	732.6	-3.6		**Leak Check (Post)**	0.1	5			
Duration (mm.ss)	30.00		**3**	779.7	779.1	-0.6							
Stack	RIF Spray		**4**	635.7	636.6	0.9		**Pitot ID**	Pitot 06			Velocity Head	
Run	1		**5**	674.4	684.6	10.2		**DGM ID**	DGM 02			Min	2
												Max	2
												Max:Min	1.00
								Nozzle ID	n16				
			Sample Ref	EPA/13/514/12				**Nozzle Diameter (mm)**	12.65				
K Factor	57.70		**Filter Number**	EPA/13/514/12F									
Stack Diameter (m)	0.29		**Probe Washing No**	EPA/13/514/12W									
							ΔH across orifice meter (mm H_2O)	**DGM (litres)**	**DGM Temp (°C)**		**Temp (°C)**		
Point	**Time**	**Vac**	**Stack Temp (°C)**	**Velocity Head (mmH_2O)**		**√ΔP**		450.42	**In**	**Out**	**Probe**	**Filter**	**Impinger**
A1	0 5	4	29	2		1.41	115.39	575	27	26	47	41	
A1	5 10	4	28	2		1.41	115.39	698	27	26	49	52	
A1	10 15	4	29	2		1.41	115.39	823	27	26	50	50	
A1	15 20	4	30	2		1.41	115.39	950	28	26	50	51	
A1	20 25	4	29	2		1.41	115.39	1075	28	26	50	50	
A1	25 30	4	29	2		1.41	115.39	1204.38	29	26	50	50	
Total / Average		4.00	29.00	2.00		1.41	115.39	753.96	27.67	26.00	49.33	49.00	

2.3.6 Instrumental Gas Analyser Site Calibration Measurements

Zero Point

				Pre Test			Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Pre Span	Post Span	System	System	Zero Drift
VOC (ppm)	1000	Ambient Air	0.00	0.49	0.47	0.11	4.64	4.53

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	1000	EPA/CGAS /72	805.00	805.10	798.70	796.40	-2.30

2.3.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
07.08.2013	15:43:21	308.2	495.3	495.3
07.08.2013	15:43:36	305.7	491.3	491.3
07.08.2013	15:43:51	268.6	431.7	431.7
07.08.2013	15:44:06	261.8	420.8	420.8
07.08.2013	15:44:21	245.2	394.1	394.1
07.08.2013	15:44:36	228.3	366.9	366.9
07.08.2013	15:44:51	288.4	463.5	463.5
07.08.2013	15:45:06	300.4	482.8	482.8
07.08.2013	15:45:21	331.1	532.1	532.1
07.08.2013	15:45:36	364.3	585.5	585.5
07.08.2013	15:45:51	857.1	1377.5	1377.5
07.08.2013	15:46:06	962.1	1546.2	1546.2
07.08.2013	15:46:21	446.4	717.4	717.4
07.08.2013	15:46:36	328.4	527.8	527.8
07.08.2013	15:46:51	316.5	508.7	508.7
07.08.2013	15:47:06	421.2	676.9	676.9
07.08.2013	15:47:21	446.9	718.2	718.2
07.08.2013	15:47:36	447.6	719.4	719.4
07.08.2013	15:47:51	461.8	742.2	742.2
07.08.2013	15:48:06	442.2	710.7	710.7
07.08.2013	15:48:21	452.0	726.4	726.4
07.08.2013	15:48:36	483.0	776.3	776.3
07.08.2013	15:48:51	550.9	885.4	885.4
07.08.2013	15:49:06	509.6	819.0	819.0
07.08.2013	15:49:21	475.0	763.4	763.4
07.08.2013	15:49:36	455.2	731.6	731.6
07.08.2013	15:49:51	488.9	785.7	785.7
07.08.2013	15:50:06	479.4	770.5	770.5
07.08.2013	15:50:21	524.3	842.6	842.6
07.08.2013	15:50:36	516.0	829.3	829.3
07.08.2013	15:50:51	839.1	1348.6	1348.6

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
07.08.2013	15:51:06	744.3	1196.2	1196.2
07.08.2013	15:51:21	758.5	1219.0	1219.0
07.08.2013	15:51:36	675.9	1086.3	1086.3
07.08.2013	15:51:51	597.8	960.8	960.8
07.08.2013	15:52:06	667.6	1072.9	1072.9
07.08.2013	15:52:21	747.3	1201.0	1201.0
07.08.2013	15:52:36	849.1	1364.6	1364.6
07.08.2013	15:52:51	687.9	1105.6	1105.6
07.08.2013	15:53:06	616.4	990.6	990.6
07.08.2013	15:53:21	675.9	1086.3	1086.3
07.08.2013	15:53:36	622.7	1000.8	1000.8
07.08.2013	15:53:51	615.4	989.0	989.0
07.08.2013	15:54:06	574.4	923.1	923.1
07.08.2013	15:54:21	538.7	865.8	865.8
07.08.2013	15:54:36	568.7	914.0	914.0
07.08.2013	15:54:51	607.6	976.5	976.5
07.08.2013	15:55:06	755.3	1213.9	1213.9
07.08.2013	15:55:21	754.1	1211.9	1211.9
07.08.2013	15:55:36	744.3	1196.2	1196.2
07.08.2013	15:55:51	682.8	1097.4	1097.4
07.08.2013	15:56:06	653.2	1049.8	1049.8
07.08.2013	15:56:21	717.5	1153.1	1153.1
07.08.2013	15:56:36	680.1	1093.0	1093.0
07.08.2013	15:56:51	713.6	1146.9	1146.9
07.08.2013	15:57:06	758.5	1219.0	1219.0
07.08.2013	15:57:21	641.0	1030.2	1030.2
07.08.2013	15:57:36	577.5	928.1	928.1
07.08.2013	15:57:51	601.0	965.9	965.9
07.08.2013	15:58:06	641.5	1031.0	1031.0
07.08.2013	15:58:21	715.8	1150.4	1150.4
07.08.2013	15:58:36	691.8	1111.8	1111.8
07.08.2013	15:58:51	758.7	1219.3	1219.3
07.08.2013	15:59:06	707.9	1137.7	1137.7
07.08.2013	15:59:21	722.6	1161.3	1161.3
07.08.2013	15:59:36	676.7	1087.6	1087.6
07.08.2013	15:59:51	781.4	1255.8	1255.8
07.08.2013	16:00:06	749.9	1205.2	1205.2
07.08.2013	16:00:21	719.2	1155.9	1155.9
07.08.2013	16:00:36	825.9	1327.3	1327.3
07.08.2013	16:00:51	794.6	1277.0	1277.0
07.08.2013	16:01:06	772.2	1241.0	1241.0
07.08.2013	16:01:21	770.7	1238.6	1238.6
07.08.2013	16:01:36	691.3	1111.0	1111.0
07.08.2013	16:01:51	670.1	1076.9	1076.9
07.08.2013	16:02:06	699.6	1124.4	1124.4
07.08.2013	16:02:21	803.4	1291.2	1291.2
07.08.2013	16:02:36	922.6	1482.8	1482.8
07.08.2013	16:03:36	1065.0	1711.6	1711.6
07.08.2013	16:03:51	947.5	1522.8	1522.8
07.08.2013	16:04:06	964.6	1550.3	1550.3

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
07.08.2013	16:04:21	993.9	1597.3	1597.3
07.08.2013	16:04:36	991.5	1593.5	1593.5
07.08.2013	16:04:51	981.7	1577.7	1577.7
07.08.2013	16:05:06	1013.0	1628.0	1628.0
07.08.2013	16:05:21	971.9	1562.0	1562.0
07.08.2013	16:05:36	964.6	1550.3	1550.3
07.08.2013	16:05:51	945.1	1518.9	1518.9
07.08.2013	16:06:06	984.1	1581.6	1581.6
07.08.2013	16:06:21	847.4	1361.9	1361.9
07.08.2013	16:06:36	920.6	1479.5	1479.5
07.08.2013	16:06:51	945.1	1518.9	1518.9
07.08.2013	16:07:06	871.8	1401.1	1401.1
07.08.2013	16:07:21	847.4	1361.9	1361.9
07.08.2013	16:07:36	952.4	1530.6	1530.6
07.08.2013	16:07:51	976.8	1569.9	1569.9
07.08.2013	16:08:06	1006.0	1616.8	1616.8
07.08.2013	16:08:21	991.5	1593.5	1593.5
07.08.2013	16:08:36	1021.0	1640.9	1640.9
07.08.2013	16:08:51	1118.0	1796.8	1796.8
07.08.2013	16:09:06	1197.0	1923.8	1923.8
07.08.2013	16:09:21	1148.0	1845.0	1845.0
07.08.2013	16:09:36	1123.0	1804.8	1804.8
07.08.2013	16:09:51	1040.0	1671.4	1671.4
07.08.2013	16:10:06	1072.0	1722.9	1722.9
07.08.2013	16:10:21	1109.0	1782.3	1782.3
07.08.2013	16:10:36	1026.0	1648.9	1648.9
07.08.2013	16:10:51	998.8	1605.2	1605.2
07.08.2013	16:11:06	903.5	1452.1	1452.1
07.08.2013	16:11:21	964.6	1550.3	1550.3
07.08.2013	16:11:36	989.0	1589.5	1589.5
07.08.2013	16:11:51	1026.0	1648.9	1648.9
07.08.2013	16:12:06	1062.0	1706.8	1706.8
07.08.2013	16:12:21	981.7	1577.7	1577.7
07.08.2013	16:12:36	888.9	1428.6	1428.6
07.08.2013	16:12:51	930.4	1495.3	1495.3
07.08.2013	16:13:06	969.5	1558.1	1558.1
07.08.2013	16:13:21	964.6	1550.3	1550.3
07.08.2013	16:13:36	925.5	1487.4	1487.4
07.08.2013	16:13:51	1009.0	1621.6	1621.6
Average		736.7	1183.9	1183.9
Max		1197.0	1923.8	1923.8
Min		228.3	366.9	366.9

2.3.8 Uncertainty Calculations

Particulates

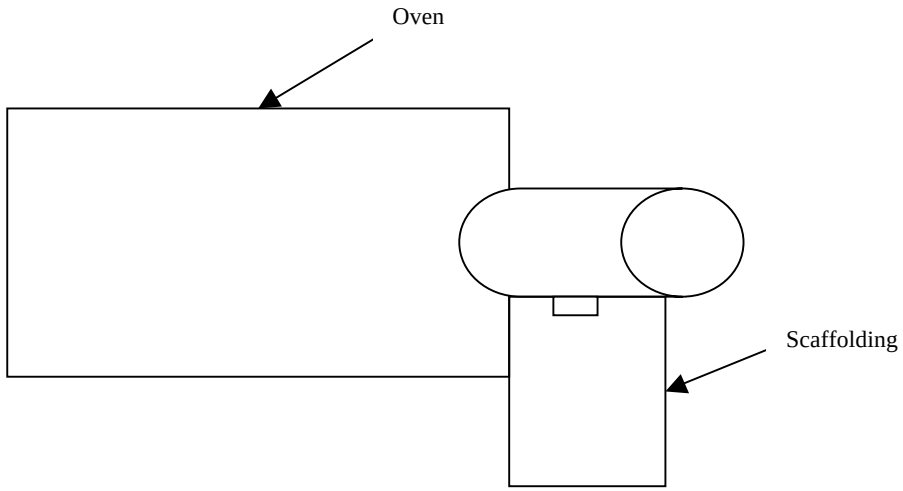
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	5.95		
O_2 Concentration	1.62		As % of result
Leak	1.15		12.38
Gas Temperature	0.86		
Pitot Co-efficient	0.50	6.38	As % of ELV
Humidity	0.50		0.50
Stack Diameter	0.34		As mg/m^3
Nozzle Diameter	0.11		0.25
Pressure	0.10		

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	8.05		
Temperature effect (zero)	4.65		
Barometric Pressure	4.03		21.09
Span gas	2.75		
Temperature effect (span)	2.32		
Zero drift	1.31	10.87	
Repeatability	0.70		**Expanded Uncertainty (95% Confidence limit) %**
Span drift	0.66		
Cross sensitivity CO (1.2 % vol)	0.00		
Cross sensitivity NO (127 mgm^{-3})	0.00		As % of Result
Cross sensitivity H_2O (sat 325K)	0.00		2.86
Cross sensitivity SO_2 (2767 mgm^{-3})	0.00		As mg/m^3 at ref conditions
Cross sensitivity CO_2 (15.2 % vol)	0.00		33.90

2.4 Appendix 4: Paint Shop Oven Vent

2.4.1 Sampling Location



Duct Characteristics

	Value	Units
Type of Duct	Circular	-
Diameter / Depth	0.19	m
Width	N/A	m
Area	0.028	m^2
Port Size	4	inch
Port Depth	40	mm
Orientation	Horizontal	-

Sampling Platform

General Platform Information	
Permanent / Temporary	Temporary
Inside / Outside	Inside
Height of Platform from Ground Level	~4m
Size of Platform	1.5m x 1.5m
Does the Platform have a weather cover (roof)	N/A
Platform has 2 hand rails (approx 0.5m and 1.0m high)	Yes
Platform has vertical base boards (approx 0.25m high)	Yes
Platform has removable chains / self closing gates at the top of the ladder	Yes
Platform positioned relative to the access ports (free from obstruction that would hamper insertion and removal of the sampling equipment)	Yes
Depth of platform (length of probe + 1m)	Yes

2.4.2 Flow Criteria Measurements

Traverse Point	**A1**	**A2**	**A3**	**A4**
Pressure (mm H_2O)	3.0	3.5	4.5	5.0
$\sqrt{\Delta P}$	1.73	1.87	2.12	2.24
Temperature (ºC)	215	217	218	218

Static Pressure (mmH_2O)	8.8	**Barometric Pressure (mm Hg)**	767.5	**Duct Dimensions (m)**	0.19

Velocity (m/s) average	8.8	**Actual Flow of stack gas (m^3/hr)**	893.7
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	503.0
Dimensions (m)	0.19	**Flow (dry) at STP (m^3/hr)**	490.5
Area (m^2)	0.028		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	4.0	5.0	3.0	1.7	Yes
$\sqrt{\Delta P}$ (mm $H_2O)^{½}$	1.99	2.24	1.73	1.3	Yes
Temperature (ºC)	217.0	218	215	1.0	Yes
Angle of flow	<15º				Yes
Local Negative Flow	No				Yes

2.3.3 Gas Measurements

	Mean
Oxygen (%)	20.90
Carbon Monoxide (ppm)	0
Carbon Dioxide (%)	0.03

2.4.4 Manual Method Calculations

Test Dates	06/08/13		
Company	BAE		
Contact	T Hughes		
Stack	Paint Oven Shop		
	Blank	Test 1	Units
Sample Ref	EPA/13/514/03	EPA/13/514/04	-
Start Time	10:17	10:54	hr:mm
Stop Time	10:32	11:24	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	17.3	ml
B_{wo}	0.02	0.025	-
P_b	-	767.5	mm Hg
St	-	4	mm H_2O
T_s	-	207.33	ºC
√ΔP	-	2.74	$(mm\ H_2O)^{½}$
Yd	-	1.385	-
Test Time	-	30	min
T_m	-	24.50	ºC
C_p	-	0.823	-
As	-	0.028	m^2
D_n	-	9.49	mm
ΔH ave	-	87.15	mm H_20
V_{mstd}	0.8451	0.8451	m^3
V_{wstd}	0.0215	0.0215	m^3
$Q_{std,wet}$	-	683.4	Nm^3/h
Q_{act}	-	1190.3	Nm^3/h
Isokinetic Rate	-	101.7	%
Vs	-	11.66	m/s
Washings			
Sample Ref	EPA/13/514/03W	EPA/13/514/04W	-
Weight	1.2	1.1	mg
Filter			
Sample Ref	EPA/13/514/03F	EPA/13/514/04F	-
Weight	<0.1	1.7	mg
Particulate Concentration (Dry, No O_2 Correction)	1.5	3.3	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	1.5	3.2	mg/Nm^3
Particulate Release Rate	-	2.21	g/hr
Reference Temp	273		K
Reference Pressure	101.3		kPa
Reference Moisture	No correction for moisture		-
Reference Oxygen	No correction for Oxygen		%

Particulates

	Filter (mg)	Washings (mg)
Blank	<0.1	1.2
Run 1	1.7	1.1

2.4.5 Sampling Measurements

Date	06/08/13		**Impinger**	**Initial Wt (g)**	**Final Wt(g)**	**Wt Gained (g)**			**l/min**	**Vac (in Hg)**			
Start Time	10:54		**1**	247.4	247.4	0.0		**Leak Check (Pre)**	0.2	15			
End Time	11:24		**2**	741.3	747.4	6.1		**Leak Check (Post)**	0.2	10			
Duration (mm.ss)	30.00		**3**	780.0	783.2	3.2							
Stack	Paint Oven Shop		**4**	635.0	635.7	0.7		**Pitot ID**	Pitot 06			Velocity Head	
Run	1		**5**	713.4	720.7	7.3		**DGM ID**	DGM 02			Min	7.25
												Max	8
												Max:Min	1.10
								Nozzle ID	n17				
			Sample Ref	EPA/13/514/04				**Nozzle Diameter (mm)**	9.49				
K Factor	11.62		**Filter Number**	EPA/13/514/04F									
Stack Diameter (m)	0.19		**Probe Washing No**	EPA/13/514/04W									
							ΔH across orifice meter (mm H_2O)	**DGM (litres)**	**DGM Temp (°C)**		**Temp (°C)**		
Point	**Time**	**Vac**	**Stack Temp (°C)**	**Velocity Head (mmH_2O)**		**√ΔP**		8160.31	**In**	**Out**	**Probe**	**Filter**	**Impinger**
A1	0 5	4	204	8		2.83	92.96	8271	23	23	105	104	
A1	5 10	4	215	7.25		2.69	84.24	8377	24	23	109	106	
A1	10 15	3	217	7.25		2.69	84.24	8484	25	23	113	105	
A1	15 20	3	206	7.5		2.74	87.15	8593	26	23	114	102	
A1	20 25	3	201	7.5		2.74	87.15	8703	27	24	111	100	
A1	25 30	3	201	7.5		2.74	87.15	8813.44	28	25	109	101	
Total / Average		4.00	207.33	7.50		2.74	87.15	653.13	25.50	23.50	110.17	103.00	

2.4.6 Instrumental Gas Analyser Site Calibration Measurements

Zero Point

				Pre Test			Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Pre Span	Post Span	System	System	Zero Drift
VOC (ppm)	100	Ambient Air	0.00	0.15	0.24	0.73	1.10	0.37

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	100	EPA/CGAS /78	82.40	82.37	81.97	81.52	-0.45

2.4.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
06.08.2013	10:54:05	11.6	18.6	18.6
06.08.2013	10:54:20	6.3	10.0	10.0
06.08.2013	10:54:35	5.8	9.3	9.3
06.08.2013	10:54:50	5.6	9.0	9.0
06.08.2013	10:55:05	6.0	9.6	9.6
06.08.2013	10:55:20	7.9	12.7	12.7
06.08.2013	10:55:35	10.4	16.7	16.7
06.08.2013	10:55:50	12.6	20.3	20.3
06.08.2013	10:56:05	14.2	22.8	22.8
06.08.2013	10:56:20	15.6	25.1	25.1
06.08.2013	10:56:35	16.8	27.0	27.0
06.08.2013	10:56:50	17.9	28.8	28.8
06.08.2013	10:57:05	18.8	30.2	30.2
06.08.2013	10:57:20	19.6	31.5	31.5
06.08.2013	10:57:35	20.2	32.5	32.5
06.08.2013	10:57:50	20.8	33.4	33.4
06.08.2013	10:58:05	21.3	34.2	34.2
06.08.2013	10:58:20	21.6	34.7	34.7
06.08.2013	10:58:35	22.0	35.4	35.4
06.08.2013	10:58:50	22.3	35.8	35.8
06.08.2013	10:59:05	22.5	36.2	36.2
06.08.2013	10:59:20	22.5	36.2	36.2
06.08.2013	10:59:35	21.8	35.0	35.0
06.08.2013	10:59:50	21.1	33.9	33.9
06.08.2013	11:00:05	20.7	33.3	33.3
06.08.2013	11:00:20	19.9	32.0	32.0
06.08.2013	11:00:35	19.3	31.0	31.0
06.08.2013	11:00:50	19.2	30.9	30.9
06.08.2013	11:01:05	19.3	31.0	31.0

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
06.08.2013	11:01:20	18.5	29.7	29.7
06.08.2013	11:01:35	18.2	29.3	29.3
06.08.2013	11:01:50	18.1	29.1	29.1
06.08.2013	11:02:05	18.2	29.3	29.3
06.08.2013	11:02:20	17.6	28.3	28.3
06.08.2013	11:02:35	17.5	28.1	28.1
06.08.2013	11:02:50	17.5	28.1	28.1
06.08.2013	11:03:05	17.1	27.5	27.5
06.08.2013	11:03:20	16.8	27.0	27.0
06.08.2013	11:03:35	16.5	26.5	26.5
06.08.2013	11:03:50	16.4	26.4	26.4
06.08.2013	11:04:05	15.8	25.4	25.4
06.08.2013	11:04:20	15.7	25.2	25.2
06.08.2013	11:04:35	15.6	25.1	25.1
06.08.2013	11:04:50	15.1	24.3	24.3
06.08.2013	11:05:05	14.7	23.6	23.6
06.08.2013	11:05:20	14.7	23.6	23.6
06.08.2013	11:05:35	14.4	23.1	23.1
06.08.2013	11:05:50	13.8	22.2	22.2
06.08.2013	11:06:05	13.5	21.7	21.7
06.08.2013	11:06:20	13.4	21.5	21.5
06.08.2013	11:06:35	13.0	20.9	20.9
06.08.2013	11:06:50	12.8	20.6	20.6
06.08.2013	11:07:05	12.9	20.7	20.7
06.08.2013	11:07:20	12.7	20.4	20.4
06.08.2013	11:07:35	12.6	20.3	20.3
06.08.2013	11:07:50	12.4	19.9	19.9
06.08.2013	11:08:05	12.3	19.8	19.8
06.08.2013	11:08:20	12.1	19.4	19.4
06.08.2013	11:08:35	12.1	19.4	19.4
06.08.2013	11:08:50	12.1	19.4	19.4
06.08.2013	11:09:05	12.0	19.3	19.3
06.08.2013	11:09:20	11.8	19.0	19.0
06.08.2013	11:09:35	11.6	18.6	18.6
06.08.2013	11:09:50	11.7	18.8	18.8
06.08.2013	11:10:05	11.9	19.1	19.1
06.08.2013	11:10:20	11.9	19.1	19.1
06.08.2013	11:10:35	11.8	19.0	19.0
06.08.2013	11:10:50	11.9	19.1	19.1
06.08.2013	11:11:05	12.2	19.6	19.6
06.08.2013	11:11:20	12.3	19.8	19.8
06.08.2013	11:11:35	12.2	19.6	19.6
06.08.2013	11:11:50	12.5	20.1	20.1
06.08.2013	11:12:05	12.3	19.8	19.8
06.08.2013	11:12:20	12.5	20.1	20.1
06.08.2013	11:12:35	12.6	20.3	20.3
06.08.2013	11:12:50	12.9	20.7	20.7
06.08.2013	11:13:05	13.0	20.9	20.9
06.08.2013	11:13:20	12.8	20.6	20.6
06.08.2013	11:13:35	13.0	20.9	20.9

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
06.08.2013	11:13:50	13.4	21.5	21.5
06.08.2013	11:14:05	13.1	21.1	21.1
06.08.2013	11:14:20	13.1	21.1	21.1
06.08.2013	11:14:35	13.3	21.4	21.4
06.08.2013	11:14:50	13.7	22.0	22.0
06.08.2013	11:15:05	13.7	22.0	22.0
06.08.2013	11:15:20	13.5	21.7	21.7
06.08.2013	11:15:35	13.5	21.7	21.7
06.08.2013	11:15:50	13.4	21.5	21.5
06.08.2013	11:16:05	13.1	21.1	21.1
06.08.2013	11:16:20	13.1	21.1	21.1
06.08.2013	11:16:35	12.9	20.7	20.7
06.08.2013	11:16:50	13.0	20.9	20.9
06.08.2013	11:17:05	13.0	20.9	20.9
06.08.2013	11:17:20	13.0	20.9	20.9
06.08.2013	11:17:35	13.0	20.9	20.9
06.08.2013	11:17:50	12.9	20.7	20.7
06.08.2013	11:18:05	12.9	20.7	20.7
06.08.2013	11:18:20	12.8	20.6	20.6
06.08.2013	11:18:35	12.6	20.3	20.3
06.08.2013	11:18:50	12.3	19.8	19.8
06.08.2013	11:19:05	12.1	19.4	19.4
06.08.2013	11:19:20	12.5	20.1	20.1
06.08.2013	11:19:35	12.4	19.9	19.9
06.08.2013	11:19:50	12.5	20.1	20.1
06.08.2013	11:20:05	12.6	20.3	20.3
06.08.2013	11:20:20	12.8	20.6	20.6
06.08.2013	11:20:35	10.3	16.6	16.6
06.08.2013	11:20:50	6.0	9.6	9.6
06.08.2013	11:21:05	5.9	9.5	9.5
06.08.2013	11:21:20	6.2	10.0	10.0
06.08.2013	11:21:35	5.9	9.4	9.4
06.08.2013	11:21:50	5.7	9.2	9.2
06.08.2013	11:22:05	6.7	10.8	10.8
06.08.2013	11:22:20	8.8	14.1	14.1
06.08.2013	11:22:35	11.0	17.7	17.7
06.08.2013	11:22:50	12.9	20.7	20.7
06.08.2013	11:23:05	14.4	23.1	23.1
06.08.2013	11:23:20	15.6	25.1	25.1
06.08.2013	11:23:35	16.5	26.5	26.5
06.08.2013	11:23:50	17.4	28.0	28.0
Average		13.9	22.4	22.4
Max		22.5	36.2	36.2
Min		5.6	9.0	9.0

2.4.8 Uncertainty Calculations

Particulates

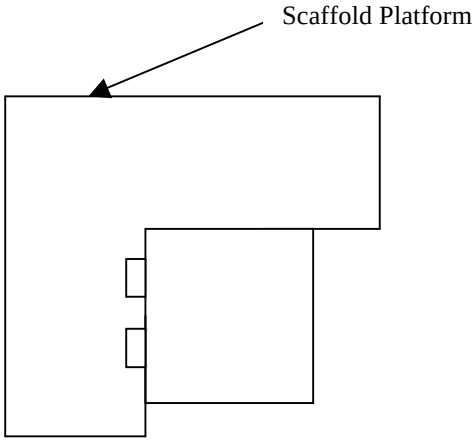
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	4.23		
O_2 Concentration	1.62		As % of result
Leak	1.15		9.41
Gas Temperature	0.94		
Stack Diameter	0.53	4.85	As % of ELV
Pitot Co-efficient	0.50		0.62
Humidity	0.50		As mg/m^3
Nozzle Diameter	0.15		0.30
Pressure	0.11		

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	0.82		
Temperature effect (zero)	0.48		
Barometric Pressure	0.41		2.18
Span gas	0.32		
Temperature effect (span)	0.24		
Span drift	0.13	1.13	
Zero drift	0.11		**Expanded Uncertainty (95% Confidence limit) %**
Repeatability	0.07		
Cross sensitivity CO (1.2 % vol)	0.00		
Cross sensitivity NO (127 mgm^{-3})	0.00		As % of Result
Cross sensitivity H_2O (sat 325K)	0.00		15.66
Cross sensitivity SO_2 (2767 mgm^{-3})	0.00		As mg/m^3 at ref conditions
Cross sensitivity CO_2 (15.2 % vol)	0.00		3.51

2.5 Appendix 5: Paint Shop Spray Area

2.5.1 Sampling Location



Duct Characteristics

	Value	Units
Type of Duct	Rectangular	-
Diameter / Depth	0.74	m
Width	0.74	m
Area	0.548	m^2
Port Size	4	inch
Port Depth	90	mm
Orientation	Vertical	-

Sampling Platform

General Platform Information	
Permanent / Temporary	Temporary
Inside / Outside	Outside
Height of Platform from Ground Level	~ 10m
Size of Platform	2m x 1.5m
Does the Platform have a weather cover (roof)	No
Platform has 2 hand rails (approx 0.5m and 1.0m high)	Yes
Platform has vertical base boards (approx 0.25m high)	Yes
Platform has removable chains / self closing gates at the top of the ladder	Yes
Platform positioned relative to the access ports (free from obstruction that would hamper insertion and removal of the sampling equipment)	Yes
Depth of platform (length of probe + 1m)	Yes

2.5.2 Flow Criteria Measurements

Traverse Point	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**
Pressure (mm H_2O)	11.0	8.5	7.5	10.0	11.0	11.5	11.5	11.5	12.0	11.5
$\sqrt{\Delta P}$	3.32	2.92	2.74	3.16	3.32	3.39	3.39	3.39	3.46	3.39
Temperature (ºC)	23	23	23	23	23	23	23	23	23	23
Traverse Point	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**B8**	**B9**	**B10**
Pressure (mm H_2O)	8.5	7.0	8.5	8.5	6.3	5.5	6.8	8.0	7.5	8.0
$\sqrt{\Delta P}$	2.92	2.65	2.92	2.92	2.50	2.35	2.60	2.83	2.74	2.83
Temperature (ºC)	23	23	23	23	23	23	23	23	23	23

Static Pressure (mmH_2O)	20	**Barometric Pressure (mm Hg)**	765.3	**Duct Dimensions (m)**	0.74 x 0.74

Velocity (m/s) average	10.2	**Actual Flow of stack gas (m^3/hr)**	20187.7
Stack Geometry	Rectangular	**Flow (wet) at STP (m^3/hr)**	18783.8
Dimensions (m)	0.74 x 0.74	**Flow (dry) at STP (m^3/hr)**	18716.5
Area (m^2)	0.548		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	6.0	11.5	3.5	3.3	Yes
$\sqrt{\Delta P}$ (mm $H_2O)^{½}$	2.41	3.39	1.87	1.8	Yes
Temperature (ºC)	19.0	19	19	1.0	Yes
Angle of flow	<15º				Yes
Local Negative Flow	No				Yes

2.5.3 Gas Measurements

	Mean
Oxygen (%)	20.90
Carbon Monoxide (ppm)	0
Carbon Dioxide (%)	0.03

2.5.4 Manual Method Calculations

Test Dates	06/08/13		
Company	BAE		
Contact	T Hughes		
Stack	Paint Shop Spray Area		
	Blank	Test 1	Units
Sample Ref	EPA/13/514/05	EPA/13/514/06	-
Start Time	13:32	13:59	hr:mm
Stop Time	13:47	14:35	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	1.5	ml
B_{wo}	0.00	0.004	-
P_b	-	765.3	mm Hg
St	-	20	mm H_2O
T_s	-	23.13	ºC
$\sqrt{\Delta P}$	-	2.87	$(mm\ H_2O)^{½}$
Yd	-	1.352	-
Test Time	-	32	min
T_m	-	26.63	ºC
C_p	-	0.822	-
As	-	0.548	m^2
D_n	-	6.19	mm
ΔH ave	-	28.89	mm H_20
V_{mstd}	0.5196	0.5196	m^3
V_{wstd}	0.0019	0.0019	m^3
$Q_{std,wet}$	-	17508.2	Nm^3/h
Q_{act}	-	18824.8	Nm^3/h
Isokinetic Rate	-	101.7	%
Vs	-	9.55	m/s
Washings			
Sample Ref	EPA/13/514/05W	EPA/13/514/06W	-
Weight	<0.5	<0.5	mg
Filter			
Sample Ref	EPA/13/514/05F	EPA/13/514/06F	-
Weight	0.08	0.26	mg
Particulate Concentration (Dry, No O_2 Correction)	1.1	1.5	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	1.1	1.5	mg/Nm^3
Particulate Release Rate	-	25.52	g/hr
Reference Temp	273		K
Reference Pressure	101.3		kPa
Reference Moisture	No correction for moisture		-
Reference Oxygen	No correction for Oxygen		%

Particulates

	Filter (mg)	Washings (mg)
Blank	0.08	<0.5
Run 1	0.26	<0.5

2.5.5 Sampling Measurements

Date	06/08/13		**Impinger**	**Initial Wt (g)**	**Final Wt(g)**	**Wt Gained (g)**			**l/min**	**Vac (in Hg)**			
Start Time	13:59		**1**	247.4	247.1	-0.3		**Leak Check (Pre)**	0.15	15			
End Time	14:35		**2**	747.4	743.5	-3.9		**Leak Check (Post)**	0.1	5			
Duration (mm.ss)	32.00		**3**	783.2	781.9	-1.3							
Stack	Paint Shop Spray Area		**4**	635.7	635.0	-0.7		**Pitot ID**	Pitot 12			Velocity Head	
Run	1		**5**	720.7	728.4	7.7		**DGM ID**	DGM 02			Min	7.5
												Max	9.5
												Max:Min	1.27
								Nozzle ID	n3				
			Sample Ref	EPA/13/514/06				**Nozzle Diameter (mm)**	6.19				
K Factor	3.50		**Filter Number**	EPA/13/514/06F									
Stack Diameter (m)	0.74		**Probe Washing No**	EPA/13/514/06W									
							ΔH across orifice meter (mm H_2O)	**DGM (litres)**	**DGM Temp (ºC)**		**Temp (ºC)**		
Point	**Time**	**Vac**	**Stack Temp (ºC)**	**Velocity Head (mmH_2O)**		**√ΔP**		8825.11	**In**	**Out**	**Probe**	**Filter**	**Impinger**
A1	0 4	3	25	7.5		2.74	26.27	8873	26	26	50		
A1	4 8	3	22	7.5		2.74	26.27	8921	26	26	50		
A2	8 12	3	23	9.5		3.08	33.27	8979	26	26	49		
A2	12 16	3	23	9.5		3.08	33.27	9036	27	26	48		
B1	16 20	3	23	7.5		2.74	26.27	9085	27	26	50		
B1	20 24	3	23	7.5		2.74	26.27	9134	28	26	50		
B2	24 28	3	23	8.5		2.92	29.77	9187	28	27	52		
B2	28 32	3	23	8.5		2.92	29.77	9242.84	28	27	50		
Total / Average		3.00	23.13	8.25		2.87	28.89	417.73	27.00	26.25	49.88		

2.5.6 Instrumental Gas Analyser Site Calibration Measurements

Zero Point

				Pre Test			Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Pre Span	Post Span	System	System	Zero Drift
VOC (ppm)	100	Ambient Air	0.00	0.03	0.09	0.23	0.15	-0.08

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	100	EPA/CGAS /73	8.40	8.39	8.29	8.21	-0.08

2.5.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
06.08.2013	14:06:20	0.1	0.2	0.2
06.08.2013	14:06:35	0.1	0.2	0.2
06.08.2013	14:06:50	0.1	0.2	0.2
06.08.2013	14:07:05	0.1	0.2	0.2
06.08.2013	14:07:20	0.1	0.1	0.1
06.08.2013	14:07:35	0.1	0.2	0.2
06.08.2013	14:07:50	0.1	0.1	0.1
06.08.2013	14:08:05	0.1	0.1	0.1
06.08.2013	14:08:20	0.1	0.1	0.1
06.08.2013	14:08:35	0.1	0.1	0.1
06.08.2013	14:08:50	0.1	0.1	0.1
06.08.2013	14:09:05	0.1	0.2	0.2
06.08.2013	14:09:20	0.1	0.1	0.1
06.08.2013	14:09:35	0.1	0.1	0.1
06.08.2013	14:09:50	0.1	0.1	0.1
06.08.2013	14:10:05	0.1	0.2	0.2
06.08.2013	14:10:20	0.1	0.2	0.2
06.08.2013	14:10:35	0.2	0.3	0.3
06.08.2013	14:10:50	1.1	1.8	1.8
06.08.2013	14:11:05	1.5	2.4	2.4
06.08.2013	14:11:20	1.4	2.2	2.2
06.08.2013	14:11:35	1.2	1.9	1.9
06.08.2013	14:11:50	1.0	1.6	1.6
06.08.2013	14:12:05	0.9	1.4	1.4
06.08.2013	14:12:20	0.9	1.4	1.4
06.08.2013	14:12:35	0.5	0.8	0.8
06.08.2013	14:12:50	0.8	1.3	1.3
06.08.2013	14:13:05	1.3	2.0	2.0
06.08.2013	14:13:20	1.3	2.0	2.0

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
06.08.2013	14:13:35	1.0	1.6	1.6
06.08.2013	14:13:50	1.8	2.9	2.9
06.08.2013	14:14:05	2.6	4.2	4.2
06.08.2013	14:14:20	2.8	4.6	4.6
06.08.2013	14:14:35	3.0	4.9	4.9
06.08.2013	14:14:50	3.8	6.1	6.1
06.08.2013	14:15:05	3.8	6.0	6.0
06.08.2013	14:15:20	3.3	5.2	5.2
06.08.2013	14:15:35	6.7	10.8	10.8
06.08.2013	14:15:50	8.3	13.3	13.3
06.08.2013	14:16:05	8.2	13.1	13.1
06.08.2013	14:16:20	7.6	12.2	12.2
06.08.2013	14:16:35	7.1	11.4	11.4
06.08.2013	14:16:50	6.7	10.7	10.7
06.08.2013	14:17:05	6.5	10.4	10.4
06.08.2013	14:17:20	5.3	8.6	8.6
06.08.2013	14:17:35	1.8	2.9	2.9
06.08.2013	14:17:50	0.6	1.0	1.0
06.08.2013	14:18:05	3.4	5.5	5.5
06.08.2013	14:18:20	4.9	7.9	7.9
06.08.2013	14:18:35	6.1	9.7	9.7
06.08.2013	14:18:50	5.8	9.2	9.2
06.08.2013	14:19:05	5.5	8.9	8.9
06.08.2013	14:19:20	5.5	8.8	8.8
06.08.2013	14:19:35	5.5	8.9	8.9
06.08.2013	14:19:50	5.3	8.4	8.4
06.08.2013	14:20:05	5.5	8.8	8.8
06.08.2013	14:20:20	5.3	8.5	8.5
06.08.2013	14:20:35	4.3	6.9	6.9
06.08.2013	14:20:50	5.1	8.1	8.1
06.08.2013	14:21:05	5.1	8.3	8.3
06.08.2013	14:21:20	4.0	6.4	6.4
06.08.2013	14:21:35	3.7	6.0	6.0
06.08.2013	14:21:50	3.9	6.3	6.3
06.08.2013	14:22:05	3.4	5.5	5.5
06.08.2013	14:22:20	2.6	4.2	4.2
06.08.2013	14:22:35	3.0	4.9	4.9
06.08.2013	14:22:50	5.5	8.8	8.8
06.08.2013	14:23:05	6.8	10.9	10.9
06.08.2013	14:23:20	6.3	10.1	10.1
06.08.2013	14:23:35	6.0	9.6	9.6
06.08.2013	14:23:50	5.1	8.3	8.3
06.08.2013	14:24:05	3.6	5.8	5.8
06.08.2013	14:24:20	2.3	3.6	3.6
06.08.2013	14:24:35	1.9	3.1	3.1
06.08.2013	14:24:50	2.1	3.3	3.3
06.08.2013	14:25:05	2.4	3.8	3.8
06.08.2013	14:25:20	2.8	4.5	4.5
06.08.2013	14:25:35	2.7	4.4	4.4
06.08.2013	14:25:50	2.6	4.2	4.2

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
06.08.2013	14:26:05	2.2	3.5	3.5
06.08.2013	14:26:20	2.2	3.5	3.5
06.08.2013	14:26:35	2.1	3.3	3.3
06.08.2013	14:26:50	2.1	3.3	3.3
06.08.2013	14:27:05	2.1	3.3	3.3
06.08.2013	14:27:20	2.2	3.5	3.5
06.08.2013	14:27:35	2.3	3.7	3.7
06.08.2013	14:27:50	2.4	3.8	3.8
06.08.2013	14:28:05	2.6	4.2	4.2
06.08.2013	14:28:20	2.9	4.7	4.7
06.08.2013	14:28:35	2.9	4.6	4.6
06.08.2013	14:28:50	2.9	4.6	4.6
06.08.2013	14:29:05	3.2	5.1	5.1
06.08.2013	14:29:20	3.1	5.0	5.0
06.08.2013	14:29:35	3.1	5.0	5.0
06.08.2013	14:29:50	3.1	5.0	5.0
06.08.2013	14:30:05	3.4	5.4	5.4
06.08.2013	14:30:20	3.5	5.7	5.7
06.08.2013	14:30:35	3.8	6.1	6.1
06.08.2013	14:30:50	3.6	5.8	5.8
06.08.2013	14:31:05	3.4	5.5	5.5
06.08.2013	14:31:20	3.3	5.3	5.3
06.08.2013	14:31:35	3.7	5.9	5.9
06.08.2013	14:31:50	3.8	6.0	6.0
06.08.2013	14:32:05	3.6	5.7	5.7
06.08.2013	14:32:20	3.9	6.3	6.3
06.08.2013	14:32:35	4.0	6.5	6.5
06.08.2013	14:32:50	4.8	7.7	7.7
06.08.2013	14:33:05	4.5	7.2	7.2
06.08.2013	14:33:20	3.9	6.3	6.3
06.08.2013	14:33:35	4.5	7.2	7.2
06.08.2013	14:33:50	4.4	7.0	7.0
06.08.2013	14:34:05	3.7	6.0	6.0
06.08.2013	14:34:20	4.0	6.4	6.4
06.08.2013	14:34:35	3.6	5.9	5.9
06.08.2013	14:34:50	3.6	5.9	5.9
06.08.2013	14:35:05	3.8	6.1	6.1
06.08.2013	14:35:20	4.0	6.4	6.4
06.08.2013	14:35:35	3.8	6.1	6.1
06.08.2013	14:35:50	3.8	6.1	6.1
Average		3.1	4.9	4.9
Max		8.3	13.3	13.3
Min		0.1	0.1	0.1

2.5.8 Uncertainty Calculations

Particulates

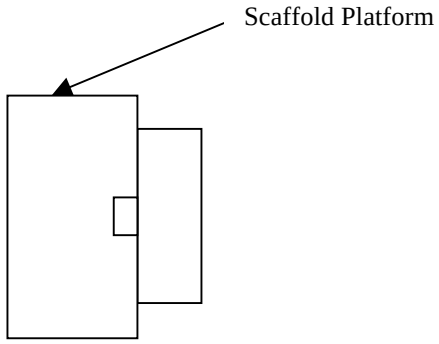
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	11.02		
O_2 Concentration	1.62		As % of result
Leak	1.15		21.82
Gas Temperature	0.87		
Humidity	0.50	11.25	As % of ELV
Gas Volume	0.30		0.64
Nozzle Diameter	0.23		
Pressure	0.16		As mg/m^3
Stack Diameter	0.14		0.32

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	0.08		
Span gas	0.08		
Temperature effect (zero)	0.05		0.27
Barometric Pressure	0.04		
Temperature effect (span)	0.02		
Zero drift	0.02	0.14	
Span drift	0.02		**Expanded Uncertainty (95% Confidence limit) %**
Repeatability	0.01		
Cross sensitivity CO (1.2 % vol)	0.00		
Cross sensitivity NO (127 mgm^{-3})	0.00		As % of Result
Cross sensitivity H_2O (sat 325K)	0.00		8.69
Cross sensitivity SO_2 (2767 mgm^{-3})	0.00		As mg/m^3 at ref conditions
Cross sensitivity CO_2 (15.2 % vol)	0.00		0.43

2.6 Appendix 6: Paint Shop Shot Blast

2.6.1 Sampling Location



Duct Characteristics

	Value	Units
Type of Duct	Rectangular	-
Diameter / Depth	0.25	m
Width	0.85	m
Area	0.213	m^2
Port Size	4	inch
Port Depth	90	mm
Orientation	Vertical	-

Sampling Platform

General Platform Information	
Permanent / Temporary	Temporary
Inside / Outside	Outside
Height of Platform from Ground Level	~5m
Size of Platform	2.5m x 1.5m
Does the Platform have a weather cover (roof)	No
Platform has 2 hand rails (approx 0.5m and 1.0m high)	Yes
Platform has vertical base boards (approx 0.25m high)	Yes
Platform has removable chains / self closing gates at the top of the ladder	Yes
Platform positioned relative to the access ports (free from obstruction that would hamper insertion and removal of the sampling equipment)	Yes
Depth of platform (length of probe + 1m)	Yes

2.6.2 Flow Criteria Measurements

Traverse Point	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**
Pressure (mm H_2O)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
$\sqrt{\Delta P}$	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73
Temperature (ºC)	27	27	27	27	27	27	27	27	27	27

Static Pressure (mmH_2O)	3	**Barometric Pressure (mm Hg)**	766.0	**Duct Dimensions (m)**	0.25 x 0.85

Velocity (m/s) average	5.9	**Actual Flow of stack gas (m^3/hr)**	4533.6
Stack Geometry	Rectangular	**Flow (wet) at STP (m^3/hr)**	4159.4
Dimensions (m)	0.25 x 0.85	**Flow (dry) at STP (m^3/hr)**	4140.5
Area (m^2)	0.213		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	3.0	3.0	3.0	1.0	Yes
$\sqrt{\Delta P}$ (mm $H_2O)^{½}$	1.73	1.73	1.73	1.0	Yes
Temperature (ºC)	27.0	27	27	1.0	Yes
Angle of flow	<15º				Yes
Local Negative Flow	No				Yes

2.6.3 Gas Measurements

	Mean
Oxygen (%)	20.90
Carbon Monoxide (ppm)	0
Carbon Dioxide (%)	0.03

2.6.4 Manual Method Calculations

Test Dates	06/08/13		
Company	BAE		
Contact	T Hughes		
Stack	Shot Blast		
	Blank	Test 1	Units
Sample Ref	EPA/13/514/08	EPA/13/514/07	-
Start Time	16:35	15:54	hr:mm
Stop Time	16:50	16:26	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	2.7	ml
B_{wo}	0.005	0.005	-
P_b	-	766.0	mm Hg
St	-	3	mm H_2O
T_s	-	26.75	ºC
$\sqrt{\Delta P}$	-	1.73	$(mm\ H_2O)^{½}$
Yd	-	1.385	-
Test Time	-	32	min
T_m	-	24.94	ºC
C_p	-	0.826	-
As	-	0.213	m^2
D_n	-	9.49	mm
ΔH ave	-	55.18	mm H_20
V_{mstd}	0.7386	0.7386	m^3
V_{wstd}	0.0034	0.0034	m^3
$Q_{std,wet}$	-	4096.5	Nm^3/h
Q_{act}	-	4461.3	Nm^3/h
Isokinetic Rate	-	102.1	%
Vs	-	5.83	m/s
Washings			
Sample Ref	EPA/13/514/08W	EPA/13/514/07W	-
Weight	0.7	<0.5	mg
Filter			
Sample Ref	EPA/13/514/08F	EPA/13/514/07F	-
Weight	<0.04	0.2	mg
Particulate Concentration (Dry, No O_2 Correction)	1.0	0.9	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	1.0	0.9	mg/Nm^3
Particulate Release Rate	-	3.86	g/hr
Reference Temp	273		K
Reference Pressure	101.3		kPa
Reference Moisture	No correction for moisture		-
Reference Oxygen	No correction for Oxygen		%

Particulates

	Filter (mg)	Washings (mg)
Blank	<0.04	0.7
Run 1	0.2	<0.5

2.6.5 Sampling Measurements

Date	06/08/13		**Impinger**	**Initial Wt (g)**	**Final Wt(g)**	**Wt Gained (g)**			**l/min**	**Vac (in Hg)**			
Start Time	15:54		**1**	247.1	247.2	0.1		**Leak Check (Pre)**	0.3	15			
End Time	16:26		**2**	743.5	738.0	-5.5		**Leak Check (Post)**	0.3	3			
Duration (mm.ss)	32.00		**3**	781.9	780.8	-1.1							
Stack	Shot Blast		**4**	635.0	634.6	-0.4		**Pitot ID**	Pitot 06			Velocity Head	
Run	1		**5**	715.4	725.0	9.6		**DGM ID**	DGM 02			Min	3
												Max	3
												Max:Min	1.00
								Nozzle ID	N17				
			Sample Ref	EPA/13/514/07				**Nozzle Diameter (mm)**	9.49				
K Factor	18.39		**Filter Number**	EPA/13/514/07F									
Stack Diameter (m)	0.25		**Probe Washing No**	EPA/13/514/07W									
							ΔH across orifice meter (mm H_2O)	**DGM (litres)**	**DGM Temp (ºC)**		**Temp (ºC)**		
Point	**Time**	**Vac**	**Stack Temp (ºC)**	**Velocity Head (mmH_2O)**		**√ΔP**		9249.76	**In**	**Out**	**Probe**	**Filter**	**Impinger**
A1	0 4	3	26	3		1.73	55.18	9322	25	25	44		
A2	4 8	3	27	3		1.73	55.18	9394	25	25	43		
A3	8 12	3	27	3		1.73	55.18	9466	24	24	44		
A4	12 16	3	27	3		1.73	55.18	9537	25	24	44		
A5	16 20	3	27	3		1.73	55.18	9609	25	25	44		
A6	20 24	3	27	3		1.73	55.18	9680	26	24	44		
A7	24 28	3	27	3		1.73	55.18	9753	26	25	44		
A8	28 32	3	26	3		1.73	55.18	9824.29	26	25	44		
Total / Average		3.00	26.75	3.00		1.73	55.18	574.53	25.25	24.63	43.88		

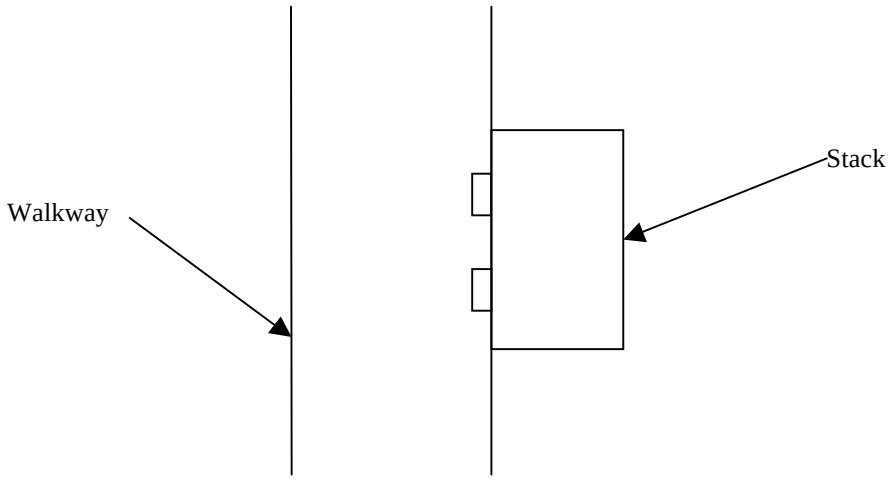
2.6.6 Uncertainty Calculations

Particulates

Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	11.96		
O_2 Concentration	1.62		As % of result
Leak	1.15		23.63
Gas Temperature	0.93		
Humidity	0.50	12.18	As % of ELV
Stack Diameter	0.40		0.45
Gas Volume	0.30		
Nozzle Diameter	0.15		As mg/m^3
Pressure	0.12		0.22

2.7 Appendix 7: DDH Hall Paint Extract

2.7.1 Sampling Location



Duct Characteristics

	Value	Units
Type of Duct	Rectangular	-
Diameter / Depth	0.40	m
Width	0.59	m
Area	0.236	m^2
Port Size	4	inch
Port Depth	40	mm
Orientation	Vertical	-

Sampling Platform

General Platform Information	
Permanent / Temporary	Permament
Inside / Outside	Inside
Height of Platform from Ground Level	~35m
Size of Platform	N/A
Does the Platform have a weather cover (roof)	N/A
Platform has 2 hand rails (approx 0.5m and 1.0m high)	Yes
Platform has vertical base boards (approx 0.25m high)	Yes
Platform has removable chains / self closing gates at the top of the ladder	N/A
Platform positioned relative to the access ports (free from obstruction that would hamper insertion and removal of the sampling equipment)	Yes
Depth of platform (length of probe + 1m)	Yes

2.7.2 Flow Criteria Measurements

Traverse Point	**A1**	**A2**	**A3**	**A4**
Pressure (mm H_2O)	3.8	3.8	4.3	4.3
√ΔP	1.94	1.94	2.06	2.06
Temperature (ºC)	24	24	24	24
Traverse Point	**B1**	**B2**	**B3**	**B4**
Pressure (mm H_2O)	3.8	4.0	4.3	4.5
√ΔP	1.94	2.00	2.06	2.12
Temperature (ºC)	24	24	24	24

Static Pressure (mmH_2O)	6	**Barometric Pressure (mm Hg)**	765.7	**Duct Dimensions (m)**	0.40 x 0.59

Velocity (m/s) average	6.9	**Actual Flow of stack gas (m^3/hr)**	5870.4
Stack Geometry	Rectangular	**Flow (wet) at STP (m^3/hr)**	5436.5
Dimensions (m)	0.40 x 0.59	**Flow (dry) at STP (m^3/hr)**	5372.2
Area (m^2)	0.236		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	4.1	4.5	3.8	1.2	Yes
√ΔP (mm H_2O)^{½}	2.01	2.12	1.94	1.1	Yes
Temperature (ºC)	24.0	24	24	1.0	Yes
Angle of flow	<15º				Yes
Local Negative Flow	No				Yes

2.7.3 Gas Measurements

	Mean
Oxygen (%)	20.90
Carbon Monoxide (ppm)	0
Carbon Dioxide (%)	0.03

2.7.4 Manual Method Calculations

Test Dates	07/08/13		
Company	BAE		
Contact	T Hughes		
Stack	DDH Paint Extract		
	Blank	Test 1	Units
Sample Ref	EPA/13/514/09	EPA/13/514/10	-
Start Time	10:55	11:28	hr:mm
Stop Time	11:10	12:02	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	7.7	ml
B_{wo}	0.01	0.012	-
P_b	-	765.3	mm Hg
St	-	6	mm H_2O
T_s	-	24.63	ºC
$\sqrt{\Delta P}$	-	1.94	$(mm\ H_2O)^{½}$
Yd	-	1.385	-
Test Time	-	32	min
T_m	-	22.69	ºC
C_p	-	0.824	-
As	-	0.236	m^2
D_n	-	9.49	mm
ΔH ave	-	69.35	mm H_20
V_{mstd}	0.8014	0.8014	m^3
V_{wstd}	0.0096	0.0096	m^3
$Q_{std,wet}$	-	5097.5	Nm^3/h
Q_{act}	-	5516.0	Nm^3/h
Isokinetic Rate	-	99.6	%
Vs	-	6.49	m/s
Washings			
Sample Ref	EPA/13/514/09W	EPA/13/514/10W	-
Weight	<0.5	0.5	mg
Filter			
Sample Ref	EPA/13/514/09F	EPA/13/514/10F	-
Weight	<0.04	0.59	mg
Particulate Concentration (Dry, No O_2 Correction)	<0.67	1.4	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	<0.66	1.3	mg/Nm^3
Particulate Release Rate	-	6.85	g/hr
Reference Temp	273		K
Reference Pressure	101.3		kPa
Reference Moisture	No correction for moisture		-
Reference Oxygen	No correction for Oxygen		%

Particulates

	Filter (mg)	Washings (mg)
Blank	<0.04	<0.5
Run 1	0.59	0.5

2.7.5 Sampling Measurements

Date	07/08/13		**Impinger**	**Initial Wt (g)**	**Final Wt(g)**	**Wt Gained (g)**			**l/min**	**Vac (in Hg)**			
Start Time	11:28		**1**	247.2	247.2	0.0		**Leak Check (Pre)**	0.1	15			
End Time	12:02		**2**	738.4	736.2	-2.2		**Leak Check (Post)**	0.1	5			
Duration (mm.ss)	32.00		**3**	780.2	779.7	-0.5							
Stack	DDH Paint Extract		**4**	635.0	635.7	0.7		**Pitot ID**	Pitot 06			Velocity Head	
Run	1		**5**	664.7	674.4	9.7		**DGM ID**	DGM 02			Min	3.75
												Max	3.75
												Max:Min	1.00
								Nozzle ID	N17				
			Sample Ref	EPA/13/514/10				**Nozzle Diameter (mm)**	9.49				
K Factor	18.49		**Filter Number**	EPA/13/514/10F									
Stack Diameter (m)	0.40		**Probe Washing No**	EPA/13/514/10W									
							ΔH across orifice meter (mm H_2O)	**DGM (litres)**	**DGM Temp (ºC)**		**Temp (ºC)**		
Point	**Time**	**Vac**	**Stack Temp (ºC)**	**Velocity Head (mmH_2O)**		**√ΔP**		9828.76	**In**	**Out**	**Probe**	**Filter**	**Impinger**
A1	0 4	3	25	3.75		1.94	69.35	9909	23	23	44		
A1	4 8	3	25	3.75		1.94	69.35	9986	21	21	44		
A2	8 12	3	24	3.75		1.94	69.35	10061	22	21	44		
A2	12 16	3	24	3.75		1.94	69.35	10131	23	22	44		
B1	16 20	3	24	3.75		1.94	69.35	10220	23	22	44		
B1	20 24	3	25	3.75		1.94	69.35	10299	23	22	44		
B2	24 28	3	25	3.75		1.94	69.35	10371	25	23	44		
B2	28 32	3	25	3.75		1.94	69.35	10447.21	26	23	44		
Total / Average		3.00	24.63	3.75		1.94	69.35	618.45	23.25	22.13	44.00		

2.7.6 Instrumental Gas Analyser Site Calibration Measurements

Zero Point

				Pre Test			Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Pre Span	Post Span	System	System	Zero Drift
VOC (ppm)	1000	Ambient Air	0.00	0.24	0.48	0.73	0.98	0.25

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	1000	EPA/CGAS /72	805.00	804.00	808.00	824.00	16.00

2.7.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
07.08.2013	11:31:21	62.8	100.9	100.9
07.08.2013	11:31:36	65.0	104.5	104.5
07.08.2013	11:31:51	71.8	115.4	115.4
07.08.2013	11:32:06	87.7	140.9	140.9
07.08.2013	11:32:21	93.3	149.9	149.9
07.08.2013	11:32:36	90.4	145.3	145.3
07.08.2013	11:32:51	107.4	172.6	172.6
07.08.2013	11:33:06	107.7	173.1	173.1
07.08.2013	11:33:21	106.0	170.4	170.4
07.08.2013	11:33:36	99.1	159.3	159.3
07.08.2013	11:33:51	98.2	157.8	157.8
07.08.2013	11:34:06	102.6	164.9	164.9
07.08.2013	11:34:21	107.7	173.1	173.1
07.08.2013	11:34:36	146.3	235.1	235.1
07.08.2013	11:34:51	156.0	250.7	250.7
07.08.2013	11:35:06	129.9	208.8	208.8
07.08.2013	11:35:21	120.4	193.5	193.5
07.08.2013	11:35:36	128.9	207.2	207.2
07.08.2013	11:35:51	126.3	203.0	203.0
07.08.2013	11:36:06	124.5	200.1	200.1
07.08.2013	11:36:21	148.0	237.9	237.9
07.08.2013	11:36:36	150.4	241.7	241.7
07.08.2013	11:36:51	150.7	242.2	242.2
07.08.2013	11:37:06	150.7	242.2	242.2
07.08.2013	11:37:21	162.6	261.3	261.3
07.08.2013	11:37:36	163.4	262.6	262.6
07.08.2013	11:37:51	153.6	246.9	246.9
07.08.2013	11:38:06	167.8	269.7	269.7
07.08.2013	11:38:21	158.2	254.3	254.3
07.08.2013	11:38:36	152.6	245.3	245.3
07.08.2013	11:38:51	149.2	239.8	239.8

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
07.08.2013	11:39:06	163.1	262.1	262.1
07.08.2013	11:39:21	158.0	253.9	253.9
07.08.2013	11:39:36	163.6	262.9	262.9
07.08.2013	11:39:51	165.8	266.5	266.5
07.08.2013	11:40:06	156.5	251.5	251.5
07.08.2013	11:40:21	153.1	246.1	246.1
07.08.2013	11:40:36	154.8	248.8	248.8
07.08.2013	11:40:51	174.6	280.6	280.6
07.08.2013	11:41:06	167.8	269.7	269.7
07.08.2013	11:41:21	148.7	239.0	239.0
07.08.2013	11:41:36	150.4	241.7	241.7
07.08.2013	11:41:51	154.3	248.0	248.0
07.08.2013	11:42:06	161.7	259.9	259.9
07.08.2013	11:42:21	160.9	258.6	258.6
07.08.2013	11:42:36	140.4	225.6	225.6
07.08.2013	11:42:51	136.0	218.6	218.6
07.08.2013	11:43:06	135.5	217.8	217.8
07.08.2013	11:43:21	146.3	235.1	235.1
07.08.2013	11:43:36	176.8	284.1	284.1
07.08.2013	11:43:51	189.5	304.6	304.6
07.08.2013	11:44:06	176.1	283.0	283.0
07.08.2013	11:44:21	166.3	267.3	267.3
07.08.2013	11:44:36	176.8	284.1	284.1
07.08.2013	11:44:51	180.7	290.4	290.4
07.08.2013	11:45:06	175.8	282.5	282.5
07.08.2013	11:45:21	177.0	284.5	284.5
07.08.2013	11:45:36	167.0	268.4	268.4
07.08.2013	11:45:51	164.3	264.1	264.1
07.08.2013	11:46:06	182.4	293.1	293.1
07.08.2013	11:46:21	180.7	290.4	290.4
07.08.2013	11:46:36	168.7	271.1	271.1
07.08.2013	11:46:51	178.3	286.6	286.6
07.08.2013	11:47:06	209.8	337.2	337.2
07.08.2013	11:47:21	211.0	339.1	339.1
07.08.2013	11:47:36	190.7	306.5	306.5
07.08.2013	11:47:51	195.6	314.4	314.4
07.08.2013	11:48:06	195.8	314.7	314.7
07.08.2013	11:48:21	199.8	321.1	321.1
07.08.2013	11:48:36	194.9	313.2	313.2
07.08.2013	11:48:51	202.2	325.0	325.0
07.08.2013	11:49:06	211.2	339.4	339.4
07.08.2013	11:49:21	202.0	324.6	324.6
07.08.2013	11:49:36	196.3	315.5	315.5
07.08.2013	11:49:51	194.1	311.9	311.9
07.08.2013	11:50:06	206.3	331.6	331.6
07.08.2013	11:50:21	196.3	315.5	315.5
07.08.2013	11:50:36	158.5	254.7	254.7
07.08.2013	11:50:51	143.6	230.8	230.8
07.08.2013	11:51:06	141.4	227.3	227.3
07.08.2013	11:51:21	136.5	219.4	219.4

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
07.08.2013	11:51:36	124.5	200.1	200.1
07.08.2013	11:51:51	114.5	184.0	184.0
07.08.2013	11:52:06	118.7	190.8	190.8
07.08.2013	11:52:21	132.6	213.1	213.1
07.08.2013	11:52:36	121.9	195.9	195.9
07.08.2013	11:52:51	111.6	179.4	179.4
07.08.2013	11:53:06	111.8	179.7	179.7
07.08.2013	11:53:21	129.4	208.0	208.0
07.08.2013	11:53:36	152.9	245.7	245.7
07.08.2013	11:53:51	153.8	247.2	247.2
07.08.2013	11:54:06	144.6	232.4	232.4
07.08.2013	11:54:21	135.0	217.0	217.0
07.08.2013	11:54:36	148.2	238.2	238.2
07.08.2013	11:54:51	152.9	245.7	245.7
07.08.2013	11:55:06	158.2	254.3	254.3
07.08.2013	11:55:21	162.1	260.5	260.5
07.08.2013	11:55:36	175.1	281.4	281.4
07.08.2013	11:55:51	168.5	270.8	270.8
07.08.2013	11:56:06	171.9	276.3	276.3
07.08.2013	11:56:21	174.4	280.3	280.3
07.08.2013	11:56:36	172.4	277.1	277.1
07.08.2013	11:56:51	174.4	280.3	280.3
07.08.2013	11:57:06	174.6	280.6	280.6
07.08.2013	11:57:21	175.6	282.2	282.2
07.08.2013	11:57:36	175.3	281.7	281.7
07.08.2013	11:57:51	171.9	276.3	276.3
07.08.2013	11:58:06	169.7	272.7	272.7
07.08.2013	11:58:21	173.6	279.0	279.0
07.08.2013	11:58:36	169.7	272.7	272.7
07.08.2013	11:58:51	167.3	268.9	268.9
07.08.2013	11:59:06	174.8	280.9	280.9
07.08.2013	11:59:21	179.2	288.0	288.0
07.08.2013	11:59:36	182.4	293.1	293.1
07.08.2013	11:59:51	186.3	299.4	299.4
07.08.2013	12:00:06	186.8	300.2	300.2
07.08.2013	12:00:21	196.1	315.2	315.2
07.08.2013	12:00:36	197.8	317.9	317.9
07.08.2013	12:00:51	188.5	302.9	302.9
07.08.2013	12:01:06	143.6	230.8	230.8
Average		155.8	250.4	250.4
Max		211.2	339.4	339.4
Min		62.8	100.9	100.9

2.7.8 Uncertainty Calculations

Particulates

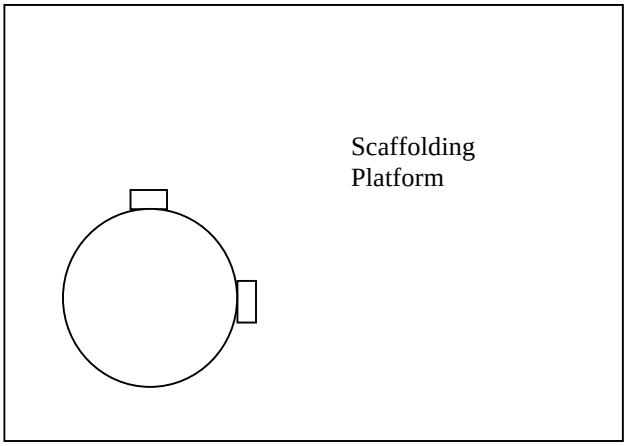
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	7.68		
O_2 Concentration	1.62		As % of result
Leak	1.15		15.57
Gas Temperature	1.02		
Humidity	0.50	8.03	As % of ELV
Gas Volume	0.30		0.42
Stack Diameter	0.25		
Nozzle Diameter	0.15		As mg/m^3
Pressure	0.12		0.21

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	8.05		
Temperature effect (zero)	4.65		
Span drift	4.62		22.74
Barometric Pressure	4.03		
Span gas	2.75		
Temperature effect (span)	2.32	11.72	
Repeatability	0.70		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.07		
Cross sensitivity CO (1.2 % vol)	0.00		
Cross sensitivity NO (127 mgm^{-3})	0.00		As % of Result
Cross sensitivity H_2O (sat 325K)	0.00		14.59
Cross sensitivity SO_2 (2767 mgm^{-3})	0.00		As mg/m^3 at ref conditions
Cross sensitivity CO_2 (15.2 % vol)	0.00		36.54

2.8 Appendix 8: NAS Annex

2.8.1 Sampling Location



Duct Characteristics

	Value	Units
Type of Duct	Circular	-
Diameter / Depth	0.45	m
Width	-	m
Area	0.159	m^2
Port Size	4	inch
Port Depth	95	mm
Orientation	Vertical	-

Sampling Platform

General Platform Information	
Permanent / Temporary	Temporary
Inside / Outside	Inside
Height of Platform from Ground Level	~20m
Size of Platform	2.5m x 2.5m
Does the Platform have a weather cover (roof)	Yes
Platform has 2 hand rails (approx 0.5m and 1.0m high)	Yes
Platform has vertical base boards (approx 0.25m high)	Yes
Platform has removable chains / self closing gates at the top of the ladder	Yes
Platform positioned relative to the access ports (free from obstruction that would hamper insertion and removal of the sampling equipment)	Yes
Depth of platform (length of probe + 1m)	Yes

2.8.2 Flow Criteria Measurements

Traverse Point	**A1**	**A2**	**A3**	**A4**
Pressure (mm H_2O)	3.8	4.0	4.0	3.0
√ΔP	1.94	2.00	2.00	1.73
Temperature (ºC)	25	26	26	26
Traverse Point	**B1**	**B2**	**B3**	**B4**
Pressure (mm H_2O)	3.8	3.5	3.8	3.8
√ΔP	1.94	1.87	1.94	1.94
Temperature (ºC)	25	26	26	26

Static Pressure (mmH_2O)	3	**Barometric Pressure (mm Hg)**	766.8	**Duct Dimensions (m)**	0.45

Velocity (m/s) average	6.6	**Actual Flow of stack gas (m^3/hr)**	3775.9
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	3482.1
Dimensions (m)	0.45	**Flow (dry) at STP (m^3/hr)**	3419.2
Area (m^2)	0.159		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	3.7	4.0	3.0	1.3	Yes
√ΔP (mm $H_2O)^{½}$	1.92	2.00	1.73	1.2	Yes
Temperature (ºC)	25.8	26	25	1.0	Yes
Angle of flow	<15º				Yes
Local Negative Flow	No				Yes

2.8.3 Gas Measurements

	Mean
Oxygen (%)	20.90
Carbon Monoxide (ppm)	0
Carbon Dioxide (%)	0.03

2.8.4 Manual Method Calculations

Test Dates	09/08/13		
Company	BAE		
Contact	T Hughes		
Stack	NAS Annex		
	Blank	Test 1	Units
Sample Ref	EPA/13/514/18	EPA/13/514/17	-
Start Time	11:16	10:28	hr:mm
Stop Time	11:31	11:02	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	5.3	ml
B_{wo}	0.02	0.018	-
P_b	-	766.8	mm Hg
St	-	3	mm H_2O
T_s	-	26.00	ºC
$\sqrt{\Delta P}$	-	1.94	$(mm\ H_2O)^{½}$
Yd	-	1.345	-
Test Time	-	32	min
T_m	-	19.44	ºC
C_p	-	0.824	-
As	-	0.159	m^2
D_n	-	6.19	mm
ΔH ave	-	13.14	mm H_20
V_{mstd}	0.3588	0.3588	m^3
V_{wstd}	0.0066	0.0066	m^3
$Q_{std,wet}$	-	3434.3	Nm^3/h
Q_{act}	-	3727.1	Nm^3/h
Isokinetic Rate	-	105.5	%
Vs	-	6.51	m/s
Washings			
Sample Ref	EPA/13/514/18W	EPA/13/514/17W	-
Weight	0.5	0.5	mg
Filter			
Sample Ref	EPA/13/514/18F	EPA/13/514/17F	-
Weight	0.26	0.99	mg
Particulate Concentration (Dry, No O_2 Correction)	2.1	4.2	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	2.1	4.1	mg/Nm^3
Particulate Release Rate	-	14.00	g/hr
Reference Temp	273		K
Reference Pressure	101.3		kPa
Reference Moisture	No correction for moisture		-
Reference Oxygen	No correction for Oxygen		%

Particulates

	Filter (mg)	Washings (mg)
Blank	0.26	0.5
Run 1	0.99	0.5

2.8.5 Sampling Measurements

Date	09/08/13		**Impinger**	**Initial Wt (g)**	**Final Wt(g)**	**Wt Gained (g)**			**l/min**	**Vac (in Hg)**			
Start Time	10:28		**1**	247.2	247.3	0.1		**Leak Check (Pre)**	0.2	15			
End Time	11:02		**2**	733.0	733.8	0.8		**Leak Check (Post)**	0.2	5			
Duration (mm.ss)	32.00		**3**	778.2	778.1	-0.1							
Stack	NAS Annex		**4**	636.0	636.6	0.6		**Pitot ID**	Pitot 06			Velocity Head	
Run	1		**5**	682.3	686.2	3.9		**DGM ID**	DGM 02			Min	3.75
												Max	3.75
												Max:Min	1.00
								Nozzle ID	N3				
			Sample Ref	EPA/13/514/17				**Nozzle Diameter (mm)**	6.19				
K Factor	3.50		**Filter Number**	EPA/13/514/17F									
Stack Diameter (m)	0.45		**Probe Washing No**	EPA/13/514/17W									
							ΔH across orifice meter (mm H_2O)	**DGM (litres)**	**DGM Temp (ºC)**		**Temp (ºC)**		
Point	**Time**	**Vac**	**Stack Temp (ºC)**	**Velocity Head (mmH_2O)**		**√ΔP**		1954.56	**In**	**Out**	**Probe**	**Filter**	**Impinger**
A1	0 4	3	26	3.75		1.94	13.14	1991	19	19	50		
A1	4 8	3	26	3.75		1.94	13.14	2027	19	19	50		
A2	8 12	3	26	3.75		1.94	13.14	2062	19	19	50		
A2	12 16	3	26	3.75		1.94	13.14	2097	19	19	51		
B1	16 20	3	26	3.75		1.94	13.14	2132	20	20	50		
B1	20 24	3	26	3.75		1.94	13.14	2167	20	20	50		
B2	24 28	3	26	3.75		1.94	13.14	2203	20	20	50		
B2	28 32	3	26	3.75		1.94	13.14	2237.47	20	19	50		
Total / Average		3.00	26.00	3.75		1.94	13.14	282.91	19.50	19.38	50.13		

2.8.6 Instrumental Gas Analyser Site Calibration Measurements

Zero Point

				Pre Test			Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Pre Span	Post Span	System	System	Zero Drift
VOC (ppm)	1000	Ambient Air	0.00	0.24	0.49	0.49	3.18	2.69

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	1000	EPA/CGAS /72	805.00	805.13	809.97	805.70	-4.27

2.8.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
09.08.2013	10:28:12	453.2	728.4	728.4
09.08.2013	10:28:27	449.6	722.6	722.6
09.08.2013	10:28:42	561.9	903.1	903.1
09.08.2013	10:28:57	664.2	1067.5	1067.5
09.08.2013	10:29:12	550.2	884.3	884.3
09.08.2013	10:29:27	542.1	871.2	871.2
09.08.2013	10:29:42	514.0	826.1	826.1
09.08.2013	10:29:57	387.1	622.1	622.1
09.08.2013	10:30:12	328.9	528.6	528.6
09.08.2013	10:30:27	286.4	460.3	460.3
09.08.2013	10:30:42	227.6	365.8	365.8
09.08.2013	10:30:57	235.9	379.1	379.1
09.08.2013	10:31:12	259.6	417.2	417.2
09.08.2013	10:31:27	211.7	340.2	340.2
09.08.2013	10:31:42	278.9	448.2	448.2
09.08.2013	10:31:57	395.1	635.0	635.0
09.08.2013	10:32:12	506.2	813.5	813.5
09.08.2013	10:32:27	494.7	795.1	795.1
09.08.2013	10:32:42	431.0	692.7	692.7
09.08.2013	10:32:57	428.6	688.8	688.8
09.08.2013	10:33:12	546.3	878.0	878.0
09.08.2013	10:33:27	591.5	950.6	950.6
09.08.2013	10:33:42	622.5	1000.4	1000.4
09.08.2013	10:33:57	579.2	930.9	930.9
09.08.2013	10:34:12	546.5	878.3	878.3
09.08.2013	10:34:27	503.3	808.9	808.9
09.08.2013	10:34:42	426.6	685.6	685.6
09.08.2013	10:34:57	367.0	589.8	589.8
09.08.2013	10:35:12	297.9	478.8	478.8
09.08.2013	10:35:27	214.2	344.3	344.3
09.08.2013	10:35:42	328.2	527.5	527.5

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
09.08.2013	10:35:57	313.3	503.5	503.5
09.08.2013	10:36:12	318.4	511.7	511.7
09.08.2013	10:36:27	365.1	586.8	586.8
09.08.2013	10:36:42	459.8	739.0	739.0
09.08.2013	10:36:57	422.7	679.3	679.3
09.08.2013	10:37:12	468.9	753.6	753.6
09.08.2013	10:37:27	457.9	735.9	735.9
09.08.2013	10:37:42	428.8	689.1	689.1
09.08.2013	10:37:57	391.9	629.8	629.8
09.08.2013	10:38:12	364.6	586.0	586.0
09.08.2013	10:38:27	473.3	760.7	760.7
09.08.2013	10:38:42	458.1	736.2	736.2
09.08.2013	10:38:57	395.6	635.8	635.8
09.08.2013	10:39:12	345.5	555.3	555.3
09.08.2013	10:39:27	351.9	565.6	565.6
09.08.2013	10:39:42	308.9	496.4	496.4
09.08.2013	10:39:57	251.0	403.4	403.4
09.08.2013	10:40:12	247.9	398.4	398.4
09.08.2013	10:40:27	242.0	388.9	388.9
09.08.2013	10:40:42	231.3	371.7	371.7
09.08.2013	10:40:57	270.1	434.1	434.1
09.08.2013	10:41:12	276.2	443.9	443.9
09.08.2013	10:41:27	267.2	429.4	429.4
09.08.2013	10:41:42	266.2	427.8	427.8
09.08.2013	10:41:57	239.8	385.4	385.4
09.08.2013	10:42:12	359.7	578.1	578.1
09.08.2013	10:42:27	376.6	605.3	605.3
09.08.2013	10:42:42	323.3	519.6	519.6
09.08.2013	10:42:57	394.9	634.7	634.7
09.08.2013	10:43:12	371.2	596.6	596.6
09.08.2013	10:43:27	346.8	557.4	557.4
09.08.2013	10:43:42	353.6	568.3	568.3
09.08.2013	10:43:57	330.2	530.7	530.7
09.08.2013	10:44:12	250.1	401.9	401.9
09.08.2013	10:44:27	313.8	504.3	504.3
09.08.2013	10:44:42	309.9	498.1	498.1
09.08.2013	10:44:57	365.3	587.1	587.1
09.08.2013	10:45:12	459.8	739.0	739.0
09.08.2013	10:45:27	474.5	762.6	762.6
09.08.2013	10:45:42	407.8	655.4	655.4
09.08.2013	10:45:57	400.7	644.0	644.0
09.08.2013	10:46:12	375.1	602.8	602.8
09.08.2013	10:46:27	355.1	570.7	570.7
09.08.2013	10:46:42	312.6	502.4	502.4
09.08.2013	10:46:57	297.7	478.4	478.4
09.08.2013	10:47:12	256.7	412.6	412.6
09.08.2013	10:47:27	246.2	395.7	395.7
09.08.2013	10:47:42	270.8	435.2	435.2
09.08.2013	10:47:57	295.2	474.4	474.4
09.08.2013	10:48:12	261.3	419.9	419.9

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
09.08.2013	10:48:27	220.5	354.4	354.4
09.08.2013	10:48:42	213.9	343.8	343.8
09.08.2013	10:48:57	398.3	640.1	640.1
09.08.2013	10:49:12	587.5	944.2	944.2
09.08.2013	10:49:27	638.8	1026.6	1026.6
09.08.2013	10:49:42	678.1	1089.8	1089.8
09.08.2013	10:49:57	597.1	959.6	959.6
09.08.2013	10:50:12	577.8	928.6	928.6
09.08.2013	10:50:27	621.7	999.2	999.2
09.08.2013	10:50:42	537.0	863.0	863.0
09.08.2013	10:50:57	493.8	793.6	793.6
09.08.2013	10:51:12	523.1	840.7	840.7
09.08.2013	10:51:27	593.7	954.2	954.2
09.08.2013	10:51:42	645.2	1036.9	1036.9
09.08.2013	10:51:57	492.3	791.2	791.2
09.08.2013	10:52:12	452.5	727.2	727.2
09.08.2013	10:52:27	454.2	730.0	730.0
09.08.2013	10:52:42	460.1	739.4	739.4
09.08.2013	10:52:57	454.2	730.0	730.0
09.08.2013	10:53:12	412.5	662.9	662.9
09.08.2013	10:53:27	385.6	619.7	619.7
09.08.2013	10:53:42	338.9	544.7	544.7
09.08.2013	10:53:57	295.5	474.9	474.9
09.08.2013	10:54:12	310.4	498.9	498.9
09.08.2013	10:54:27	310.6	499.2	499.2
09.08.2013	10:54:42	246.6	396.3	396.3
09.08.2013	10:54:57	292.8	470.6	470.6
09.08.2013	10:55:12	405.9	652.3	652.3
09.08.2013	10:55:27	418.8	673.1	673.1
09.08.2013	10:55:42	384.4	617.8	617.8
09.08.2013	10:55:57	393.9	633.1	633.1
09.08.2013	10:56:12	463.7	745.2	745.2
09.08.2013	10:56:27	352.6	566.7	566.7
09.08.2013	10:56:42	298.4	479.6	479.6
09.08.2013	10:56:57	266.4	428.1	428.1
09.08.2013	10:57:12	211.7	340.2	340.2
09.08.2013	10:57:27	220.3	354.1	354.1
09.08.2013	10:57:42	224.2	360.3	360.3
09.08.2013	10:57:57	235.9	379.1	379.1
Average		387.2	622.3	622.3
Max		678.1	1089.8	1089.8
Min		211.7	340.2	340.2

2.8.8 Uncertainty Calculations

Particulates

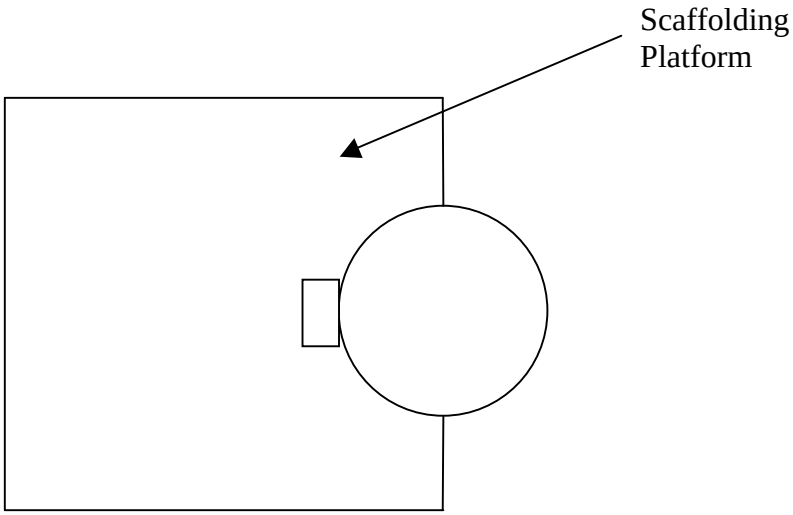
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	5.62		
O_2 Concentration	1.62		As % of result
Gas Temperature	1.19		11.87
Leak	1.15		
Humidity	0.50	6.12	As % of ELV
Gas Volume	0.31		1.23
Pressure	0.24		
Nozzle Diameter	0.23		As mg/m^3
Stack Diameter	0.22		0.48

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	8.05		
Temperature effect (zero)	4.65		
Barometric Pressure	4.03		21.09
Span gas	2.75		
Temperature effect (span)	2.32		
Span drift	1.23	10.87	
Zero drift	0.78		**Expanded Uncertainty (95% Confidence limit) %**
Repeatability	0.70		
Cross sensitivity CO (1.2 % vol)	0.00		
Cross sensitivity NO (127 mgm^{-3})	0.00		As % of Result
Cross sensitivity H_2O (sat 325K)	0.00		5.45
Cross sensitivity SO_2 (2767 mgm^{-3})	0.00		As mg/m^3 at ref conditions
Cross sensitivity CO_2 (15.2 % vol)	0.00		33.89

2.9 Appendix 9: DDH Tile Cutting Facility

2.9.1 Sampling Location



Duct Characteristics

	Value	Units
Type of Duct	Circular	-
Diameter / Depth	0.245	m
Width	-	m
Area	0.047	m^2
Port Size	4	inch
Port Depth	45	mm
Orientation	Vertical	-

Sampling Platform

General Platform Information	
Permanent / Temporary	Temporary
Inside / Outside	Outside
Height of Platform from Ground Level	~8m
Size of Platform	2.5m x 2.5m
Does the Platform have a weather cover (roof)	No
Platform has 2 hand rails (approx 0.5m and 1.0m high)	Yes
Platform has vertical base boards (approx 0.25m high)	Yes
Platform has removable chains / self closing gates at the top of the ladder	Yes
Platform positioned relative to the access ports (free from obstruction that would hamper insertion and removal of the sampling equipment)	Yes
Depth of platform (length of probe + 1m)	Yes

2.9.2 Flow Criteria Measurements

Traverse Point	A1	A2	A3	A4	A5
Pressure (mm H_2O)	10.0	9.0	9.0	9.0	10.0
$\sqrt{\Delta P}$	3.16	3.00	3.00	3.00	3.16
Temperature (ºC)	28	28	28	28	28

Static Pressure (mmH_2O)	10	Barometric Pressure (mm Hg)	768.3	Duct Dimensions (m)	0.245

Velocity (m/s) average	10.6	Actual Flow of stack gas (m^3/hr)	1796.6
Stack Geometry	Circular	Flow (wet) at STP (m^3/hr)	1648.7
Dimensions (m)	0.245	Flow (dry) at STP (m^3/hr)	1618.5
Area (m^2)	0.047		

	Average	Max	Min	Ratio Max/Min	Compliance
Pressure (mm H_2O)	9.4	10.0	9.0	1.1	Yes
$\sqrt{\Delta P}$ (mm $H_2O)^{½}$	3.06	3.16	3.00	1.1	Yes
Temperature (ºC)	28.0	28	28	1.0	Yes
Angle of flow	<15º				Yes
Local Negative Flow	No				Yes

2.9.3 Gas Measurements

	Mean
Oxygen (%)	20.90
Carbon Monoxide (ppm)	0
Carbon Dioxide (%)	0.03

2.9.4 Manual Method Calculations

Test Dates	08/08/13		
Company	BAE		
Contact	T Hughes		
Stack	Tile Cutting Facility		
	Blank	Test 1	Units
Sample Ref	EPA/13/514/13	EPA/13/514/14	-
Start Time	09:51	10:38	hr:mm
Stop Time	10:06	11:08	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	8.3	ml
B_{wo}	0.02	0.018	-
P_b	-	768.3	mm Hg
St	-	10	mm H_2O
T_s	-	29.17	ºC
$\sqrt{\Delta P}$	-	3.28	$(mm\ H_2O)^{½}$
Yd	-	1.352	-
Test Time	-	30	min
T_m	-	21.08	ºC
C_p	-	0.823	-
As	-	0.047	m^2
D_n	-	6.19	mm
ΔH ave	-	36.47	mm H_20
V_{mstd}	0.5527	0.5527	m^3
V_{wstd}	0.0103	0.0103	m^3
$Q_{std,wet}$	-	1714.8	Nm^3/h
Q_{act}	-	1875.8	Nm^3/h
Isokinetic Rate	-	103.0	%
Vs	-	11.05	m/s
Washings			
Sample Ref	EPA/13/514/13W	EPA/13/514/14W	-
Weight	1.7	0.9	mg
Filter			
Sample Ref	EPA/13/514/13F	EPA/13/514/14F	-
Weight	1.03	0.71	mg
Particulate Concentration (Dry, No O_2 Correction)	4.9	2.9	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	4.8	2.9	mg/Nm^3
Particulate Release Rate	-	4.90	g/hr
Reference Temp	273		K
Reference Pressure	101.3		kPa
Reference Moisture	No correction for moisture		-
Reference Oxygen	No correction for Oxygen		%

Particulates

	Filter (mg)	Washings (mg)
Blank	1.03	1.7
Run 1	0.71	0.9

2.9.5 Sampling Measurements

Date	08/08/13		**Impinger**	**Initial Wt (g)**	**Final Wt(g)**	**Wt Gained (g)**			**l/min**	**Vac (in Hg)**			
Start Time	10:38		**1**	247.2	247.2	0.0		**Leak Check (Pre)**	0.15	15			
End Time	11:08		**2**	731.3	732.9	1.6		**Leak Check (Post)**	0.1	5			
Duration (mm.ss)	30.00		**3**	777.9	778	0.1							
Stack	Tile Cutting Facility		**4**	635.4	636	0.6		**Pitot ID**	Pitot 06			Velocity Head	
Run	1		**5**	710.0	716.0	6.0		**DGM ID**	DGM 02			Min	10.75
												Max	10.75
												Max:Min	1.00
								N3	N3				
			Sample Ref	EPA/13/514/14				**Nozzle Diameter (mm)**	6.19				
K Factor	3.39		**Filter Number**	EPA/13/514/14F									
Stack Diameter (m)	0.25		**Probe Washing No**	EPA/13/514/14W									
							ΔH across orifice meter (mm H_2O)	**DGM (litres)**	**DGM Temp (°C)**		**Temp (°C)**		
Point	**Time**	**Vac**	**Stack Temp (°C)**	**Velocity Head (mmH_2O)**		**√ΔP**		1218.05	**In**	**Out**	**Probe**	**Filter**	**Impinger**
A1	0 5	2	29	10.75		3.28	36.47	1291	21	21	50	50	
A1	5 10	2	29	10.75		3.28	36.47	1369	20	20	51	50	
A1	10 15	2	29	10.75		3.28	36.47	1436	21	21	51	51	
A1	15 20	2	29	10.75		3.28	36.47	1508	22	20	50	50	
A1	20 25	2	30	10.75		3.28	36.47	1580	22	21	50	50	
A1	25 30	2	29	10.75		3.28	36.47	1652.15	23	21	50	50	
Total / Average		2.00	29.17	10.75		3.28	36.47	434.10	21.50	20.67	50.33	50.17	

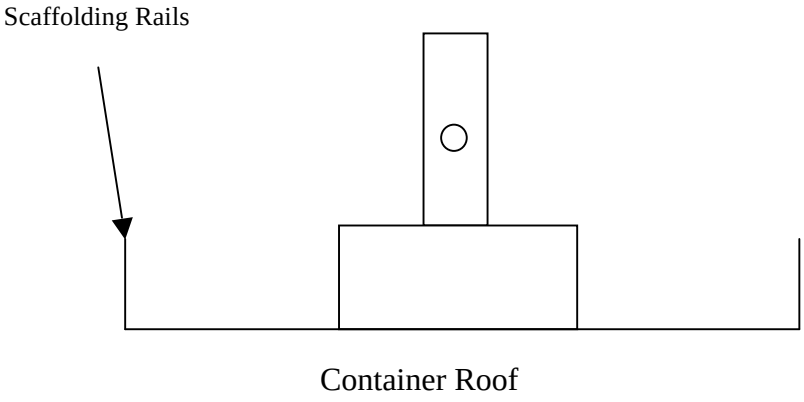
2.9.6 Uncertainty Calculations

Particulates

Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	7.35		
O_2 Concentration	1.62		As % of result
Leak	1.15		15.02
Gas Temperature	1.10		
Pitot Co-efficient	0.50	7.74	As % of ELV
Humidity	0.50		0.88
Stack Diameter	0.41		As mg/m^3
Nozzle Diameter	0.23		0.43
Pressure	0.14		

2.10 Appendix 10: Contractors Paint Mixing Facility

2.10.1 Sampling Location



Duct Characteristics

	Value	Units
Type of Duct	Circular	-
Diameter / Depth	0.29	m
Width	-	m
Area	0.066	m^2
Port Size	4	inch
Port Depth	45	mm
Orientation	Vertical	-

Sampling Platform

General Platform Information	
Permanent / Temporary	Temporary
Inside / Outside	Outside
Height of Platform from Ground Level	~ 5m
Size of Platform	~ 6m x 3m
Does the Platform have a weather cover (roof)	No
Platform has 2 hand rails (approx 0.5m and 1.0m high)	Yes
Platform has vertical base boards (approx 0.25m high)	Yes
Platform has removable chains / self closing gates at the top of the ladder	Yes
Platform positioned relative to the access ports (free from obstruction that would hamper insertion and removal of the sampling equipment)	Yes
Depth of platform (length of probe + 1m)	Yes

2.10.2 Flow Criteria Measurements

Traverse Point	**A1**	**A2**	**A3**	**A4**
Pressure (mm H_2O)	9.5	5.8	5.0	4.8
$\sqrt{\Delta P}$	3.08	2.40	2.24	2.18
Temperature (ºC)	26	26	26	26

Static Pressure (mmH_2O)	28	**Barometric Pressure (mm Hg)**	762.3	**Duct Dimensions (m)**	0.29

Velocity (m/s) average	8.5	**Actual Flow of stack gas (m^3/hr)**	2026.4
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	1860.7
Dimensions (m)	0.29	**Flow (dry) at STP (m^3/hr)**	1860.0
Area (m^2)	0.066		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	6.3	9.5	4.8	2.0	Yes
$\sqrt{\Delta P}$ (mm $H_2O)^{½}$	2.47	3.08	2.18	1.4	Yes
Temperature (ºC)	26.0	26	26	1.0	Yes
Angle of flow	<15º				Yes
Local Negative Flow	No				Yes

2.10.3 Gas Measurements

	Mean
Oxygen (%)	20.90
Carbon Monoxide (ppm)	0
Carbon Dioxide (%)	0.03

2.10.4 Manual Method Calculations

Test Dates	08/08/13		
Company	BAE		
Contact	T Hughes		
Stack	Contractors Paint Mixing Facility		
	Blank	Test 1	Units
Sample Ref	EPA/13/514/15	EPA/13/514/16	-
Start Time	13:46	14:22	hr:mm
Stop Time	14:01	14:52	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	0.1	ml
B_{wo}	0.00	0.000	-
P_b	-	762.3	mm Hg
St	-	28	mm H_2O
T_s	-	25.50	ºC
$\sqrt{\Delta P}$	-	2.18	$(mm\ H_2O)^{½}$
Yd	-	1.352	-
Test Time	-	30	min
T_m	-	35.83	ºC
C_p	-	0.824	-
As	-	0.066	m^2
D_n	-	6.19	mm
ΔH ave	-	16.56	mm H_20
V_{mstd}	0.3524	0.3524	m^3
V_{wstd}	0.0001	0.0001	m^3
$Q_{std,wet}$	-	1598.4	Nm^3/h
Q_{act}	-	1737.9	Nm^3/h
Isokinetic Rate	-	96.9	%
Vs	-	7.31	m/s
Washings			
Sample Ref	EPA/13/514/15W	EPA/13/514/16W	-
Weight	<0.5	0.6	mg
Filter			
Sample Ref	EPA/13/514/15F	EPA/13/514/16F	-
Weight	1.85	1.07	mg
Particulate Concentration (Dry, No O_2 Correction)	6.7	4.7	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	6.7	4.7	mg/Nm^3
Particulate Release Rate	-	7.57	g/hr
Reference Temp	273		K
Reference Pressure	101.3		kPa
Reference Moisture	No correction for moisture		-
Reference Oxygen	No correction for Oxygen		%

Particulates

	Filter (mg)	Washings (mg)
Blank	1.85	<0.5
Run 1	1.07	0.6

2.10.5 Sampling Measurements

Date	08/08/13		**Impinger**	**Initial Wt (g)**	**Final Wt(g)**	**Wt Gained (g)**			**l/min**	**Vac (in Hg)**			
Start Time	14:22		**1**	247.2	247.2	0.0		**Leak Check (Pre)**	0.2	15			
End Time	14:52		**2**	732.9	732.0	-0.9		**Leak Check (Post)**	0.2	5			
Duration (mm.ss)	30.00		**3**	778.0	776.9	-1.1							
Stack	Contractors Paint Mix Room		**4**	636.0	635.2	-0.8		**Pitot ID**	Pitot 06			Velocity Head	
Run	1		**5**	716.0	718.9	2.9		**DGM ID**	DGM 02			Min	4.75
												Max	4.75
												Max:Min	1.00
								Nozzle ID	N3				
			Sample Ref	EPA/13/514/16				**Nozzle Diameter (mm)**	6.19				
K Factor	3.49		**Filter Number**	EPA/13/514/16F									
Stack Diameter (m)	0.29		**Probe Washing No**	EPA/13/514/16W									
							ΔH across orifice meter (mm H_2O)	**DGM (litres)**	**DGM Temp (ºC)**		**Temp (ºC)**		
Point	**Time**	**Vac**	**Stack Temp (ºC)**	**Velocity Head (mmH_2O)**		**√ΔP**		1654.66	**In**	**Out**	**Probe**	**Filter**	**Impinger**
A1	0 5	2	25	4.75		2.18	16.56	1704	36	36	49		
A1	5 10	2	25	4.75		2.18	16.56	1753	36	36	50		
A1	10 15	2	25	4.75		2.18	16.56	1802	35	35	50		
A1	15 20	2	26	4.75		2.18	16.56	1853	36	36	50		
A1	20 25	2	26	4.75		2.18	16.56	1899	36	36	50		
A1	25 30	2	26	4.75		2.18	16.56	1948.19	36	36	50		
Total / Average		2.00	25.50	4.75		2.18	16.56	293.53	35.83	35.83	49.83		

2.10.6 Instrumental Gas Analyser Site Calibration Measurements

Zero Point

				Pre Test			Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Pre Span	Post Span	System	System	Zero Drift
VOC (ppm)	1000	Ambient Air	0.00	0.56	0.64	1.02	0.73	-0.29

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	1000	EPA/CGAS /72	805.00	805.80	804.80	792.90	-11.90

2.10.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
08.08.2013	14:22:07	121.4	195.1	195.1
08.08.2013	14:22:22	136.5	219.4	219.4
08.08.2013	14:22:37	134.1	215.5	215.5
08.08.2013	14:22:52	132.4	212.8	212.8
08.08.2013	14:23:07	129.9	208.8	208.8
08.08.2013	14:23:22	135.5	217.8	217.8
08.08.2013	14:23:37	139.9	224.8	224.8
08.08.2013	14:23:52	139.9	224.8	224.8
08.08.2013	14:24:07	136.3	219.1	219.1
08.08.2013	14:24:22	126.5	203.3	203.3
08.08.2013	14:24:37	131.1	210.7	210.7
08.08.2013	14:24:52	132.1	212.3	212.3
08.08.2013	14:25:07	130.9	210.4	210.4
08.08.2013	14:25:22	128.7	206.8	206.8
08.08.2013	14:25:37	129.7	208.4	208.4
08.08.2013	14:25:52	122.1	196.2	196.2
08.08.2013	14:26:07	127.2	204.4	204.4
08.08.2013	14:26:22	135.0	217.0	217.0
08.08.2013	14:26:37	105.0	168.8	168.8
08.08.2013	14:26:52	117.5	188.8	188.8
08.08.2013	14:27:07	125.5	201.7	201.7
08.08.2013	14:27:22	125.8	202.2	202.2
08.08.2013	14:27:37	126.5	203.3	203.3
08.08.2013	14:27:52	155.8	250.4	250.4
08.08.2013	14:28:07	125.0	200.9	200.9
08.08.2013	14:28:22	128.2	206.0	206.0
08.08.2013	14:28:37	117.9	189.5	189.5
08.08.2013	14:28:52	113.1	181.8	181.8
08.08.2013	14:29:07	103.1	165.7	165.7
08.08.2013	14:29:22	108.7	174.7	174.7
08.08.2013	14:29:37	114.8	184.5	184.5

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
08.08.2013	14:29:52	112.3	180.5	180.5
08.08.2013	14:30:07	111.4	179.0	179.0
08.08.2013	14:30:22	99.4	159.8	159.8
08.08.2013	14:30:37	109.2	175.5	175.5
08.08.2013	14:30:52	125.8	202.2	202.2
08.08.2013	14:31:07	136.0	218.6	218.6
08.08.2013	14:31:22	134.1	215.5	215.5
08.08.2013	14:31:37	126.7	203.6	203.6
08.08.2013	14:31:52	134.1	215.5	215.5
08.08.2013	14:32:07	141.1	226.8	226.8
08.08.2013	14:32:22	187.3	301.0	301.0
08.08.2013	14:32:37	182.2	292.8	292.8
08.08.2013	14:32:52	141.6	227.6	227.6
08.08.2013	14:33:07	136.5	219.4	219.4
08.08.2013	14:33:22	136.3	219.1	219.1
08.08.2013	14:33:37	140.9	226.4	226.4
08.08.2013	14:33:52	154.6	248.5	248.5
08.08.2013	14:34:07	121.1	194.6	194.6
08.08.2013	14:34:22	139.7	224.5	224.5
08.08.2013	14:34:37	140.9	226.4	226.4
08.08.2013	14:34:52	132.4	212.8	212.8
08.08.2013	14:35:07	137.5	221.0	221.0
08.08.2013	14:35:22	127.5	204.9	204.9
08.08.2013	14:35:37	126.7	203.6	203.6
08.08.2013	14:35:52	114.3	183.7	183.7
08.08.2013	14:36:07	121.4	195.1	195.1
08.08.2013	14:36:22	126.0	202.5	202.5
08.08.2013	14:36:37	121.9	195.9	195.9
08.08.2013	14:36:52	138.2	222.1	222.1
08.08.2013	14:37:07	145.1	233.2	233.2
08.08.2013	14:37:22	130.6	209.9	209.9
08.08.2013	14:37:37	128.0	205.7	205.7
08.08.2013	14:37:52	127.7	205.2	205.2
08.08.2013	14:38:07	119.7	192.4	192.4
08.08.2013	14:38:22	107.4	172.6	172.6
08.08.2013	14:38:37	105.7	169.9	169.9
08.08.2013	14:38:52	122.1	196.2	196.2
08.08.2013	14:39:07	117.2	188.4	188.4
08.08.2013	14:39:22	128.0	205.7	205.7
08.08.2013	14:39:37	131.9	212.0	212.0
08.08.2013	14:39:52	138.5	222.6	222.6
08.08.2013	14:40:07	147.7	237.4	237.4
08.08.2013	14:40:22	144.3	231.9	231.9
08.08.2013	14:40:37	146.5	235.4	235.4
08.08.2013	14:40:52	155.3	249.6	249.6
08.08.2013	14:41:07	138.5	222.6	222.6
08.08.2013	14:41:22	137.5	221.0	221.0
08.08.2013	14:41:37	128.4	206.4	206.4
08.08.2013	14:41:52	128.0	205.7	205.7
08.08.2013	14:42:07	138.5	222.6	222.6

Date	Time	VOC ppm	VOC mg/m^3 as C	VOC mg/m^3as C at Ref O_2%
08.08.2013	14:42:22	152.9	245.7	245.7
08.08.2013	14:42:37	159.0	255.5	255.5
08.08.2013	14:42:52	164.6	264.5	264.5
08.08.2013	14:43:07	171.4	275.5	275.5
08.08.2013	14:43:22	186.6	299.9	299.9
08.08.2013	14:43:37	152.9	245.7	245.7
08.08.2013	14:43:52	153.8	247.2	247.2
08.08.2013	14:44:07	142.9	229.7	229.7
08.08.2013	14:44:22	144.1	231.6	231.6
08.08.2013	14:44:37	141.4	227.3	227.3
08.08.2013	14:44:52	143.6	230.8	230.8
08.08.2013	14:45:07	142.6	229.2	229.2
08.08.2013	14:45:22	126.3	203.0	203.0
08.08.2013	14:45:37	132.6	213.1	213.1
08.08.2013	14:45:52	131.1	210.7	210.7
08.08.2013	14:46:07	115.5	185.6	185.6
08.08.2013	14:46:22	90.8	145.9	145.9
08.08.2013	14:46:37	111.6	179.4	179.4
08.08.2013	14:46:52	116.0	186.4	186.4
08.08.2013	14:47:07	122.6	197.0	197.0
08.08.2013	14:47:22	112.6	181.0	181.0
08.08.2013	14:47:37	115.8	186.1	186.1
08.08.2013	14:47:52	109.9	176.6	176.6
08.08.2013	14:48:07	95.5	153.5	153.5
08.08.2013	14:48:22	89.1	143.2	143.2
08.08.2013	14:48:37	76.7	123.3	123.3
08.08.2013	14:48:52	77.4	124.4	124.4
08.08.2013	14:49:07	79.4	127.6	127.6
08.08.2013	14:49:22	90.1	144.8	144.8
08.08.2013	14:49:37	121.9	195.9	195.9
08.08.2013	14:49:52	119.2	191.6	191.6
08.08.2013	14:50:07	118.4	190.3	190.3
08.08.2013	14:50:22	129.9	208.8	208.8
08.08.2013	14:50:37	133.6	214.7	214.7
08.08.2013	14:50:52	127.2	204.4	204.4
08.08.2013	14:51:07	107.7	173.1	173.1
08.08.2013	14:51:22	109.6	176.1	176.1
08.08.2013	14:51:37	114.3	183.7	183.7
08.08.2013	14:51:52	98.4	158.1	158.1
Average		128.2	206.1	206.1
Max		187.3	301.0	301.0
Min		76.7	123.3	123.3

2.10.8 Uncertainty Calculations

Particulates

Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	5.01		
O_2 Concentration	1.62		As % of result
Leak	1.15		10.64
Gas Temperature	0.64		
Humidity	0.50	5.48	As % of ELV
Stack Diameter	0.34		1.01
Gas Volume	0.31		
Nozzle Diameter	0.23		As mg/m^3
Pressure	0.21		0.50

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	8.05		
Temperature effect (zero)	4.65		
Barometric Pressure	4.03		21.94
Span drift	3.44		
Span gas	2.75		
Temperature effect (span)	2.32	11.31	
Repeatability	0.70		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.08		
Cross sensitivity CO (1.2 % vol)	0.00		
Cross sensitivity NO (127 mgm^{-3})	0.00		As % of Result
Cross sensitivity H_2O (sat 325K)	0.00		17.11
Cross sensitivity SO_2 (2767 mgm^{-3})	0.00		As mg/m^3 at ref conditions
Cross sensitivity CO_2 (15.2 % vol)	0.00		35.25

2.11 Certificates of Analysis

RPS Laboratories

UKAS TESTING 0605

Test Certificate

Date 22/08/2013

Client	EPA Union Street Hetton Le Hole Sunderland Tyne & Wear DH5 9HU	**Order No.**	EPA/13/032
		Certificate No.	**WK13-5044**
		Issue No.	1
Contact	Charles Bell	**Date Received**	14/08/2013
Description	18 filters and 18 washes for TPM	**Technique**	Gravimetric Stack

Sample No.	**755711**	**EPA/13/514/01F**	**Method**
Total particulate matter		0.79 mg	D9(U)
Sample No.	**755712**	**EPA/13/514/02F**	**Method**
Total particulate matter		0.83 mg	D9(U)
Sample No.	**755713**	**EPA/13/514/03F**	**Method**
Total particulate matter		<0.1 mg	D9(U)
Sample No.	**755714**	**EPA/13/514/04F**	**Method**
Total particulate matter		1.7 mg	D9(U)
Sample No.	**755715**	**EPA/13/514/05F**	**Method**
Total particulate matter		0.08 mg	D9(U)
Sample No.	**755716**	**EPA/13/514/06F**	**Method**
Total particulate matter		0.26 mg	D9(U)
Sample No.	**755717**	**EPA/13/514/07F**	**Method**
Total particulate matter		0.20 mg	D9(U)
Sample No.	**755718**	**EPA/13/514/08F**	**Method**
Total particulate matter		<0.04 mg	D9(U)

RPS Laboratories Ltd. Unit 12. Waters Edge Business Park. Modwen Road. Salford. M5 3EZ
Tel: (0161) 872 2443 Fax: (0161) 877 3959

UKAS TESTING 0605

Date 22/08/2013

Test Certificate

Client	EPA		**Certificate No.**	**WK13-5044**
			Issue No.	1
Sample No.	**755719**	**EPA/13/514/09F**		**Method**
Total particulate matter		<0.04 mg		D9(U)
Sample No.	**755720**	**EPA/13/514/10F**		**Method**
Total particulate matter		0.59 mg		D9(U)
Sample No.	**755721**	**EPA/13/514/11F**		**Method**
Total particulate matter		0.25 mg		D9(U)
Sample No.	**755722**	**EPA/13/514/12F**		**Method**
Total particulate matter		1.49 mg		D9(U)
Sample No.	**755723**	**EPA/13/514/13F**		**Method**
Total particulate matter		1.03 mg		D9(U)
Sample No.	**755724**	**EPA/13/514/14F**		**Method**
Total particulate matter		0.71 mg		D9(U)
Sample No.	**755725**	**EPA/13/514/15F**		**Method**
Total particulate matter		1.85 mg		D9(U)
Sample No.	**755726**	**EPA/13/514/16F**		**Method**
Total particulate matter		1.07 mg		D9(U)
Sample No.	**755727**	**EPA/13/514/17F**		**Method**
Total particulate matter		0.99 mg		D9(U)
Sample No.	**755728**	**EPA/13/514/18F**		**Method**
Total particulate matter		0.26 mg		D9(U)
Sample No.	**755729**	**EPA/13/514/01W**		**Method**
Total particulate matter		1.1 mg		D9(U)

Page 2 of 5

RPS Laboratories Ltd. Unit 12. Waters Edge Business Park. Modwen Road. Salford. M5 3EZ
Tel: (0161) 872 2443 Fax: (0161) 877 3959

UKAS TESTING 0605

Date 22/08/2013

Test Certificate

Client	EPA		Certificate No.	WK13-5044
			Issue No.	1
Sample No.	**755730**	**EPA/13/514/02W**		**Method**
Total particulate matter		0.6 mg		D9(U)
Sample No.	**755731**	**EPA/13/514/03W**		**Method**
Total particulate matter		1.2 mg		D9(U)
Sample No.	**755732**	**EPA/13/514/04W**		**Method**
Total particulate matter		1.1 mg		D9(U)
Sample No.	**755733**	**EPA/13/514/05W**		**Method**
Total particulate matter		<0.5 mg		D9(U)
Sample No.	**755734**	**EPA/13/514/06W**		**Method**
Total particulate matter		<0.5 mg		D9(U)
Sample No.	**755735**	**EPA/13/514/07W**		**Method**
Total particulate matter		<0.5 mg		D9(U)
Sample No.	**755736**	**EPA/13/514/08W**		**Method**
Total particulate matter		0.7 mg		D9(U)
Sample No.	**755737**	**EPA/13/514/09W**		**Method**
Total particulate matter		<0.5 mg		D9(U)
Sample No.	**755738**	**EPA/13/514/10W**		**Method**
Total particulate matter		0.5 mg		D9(U)
Sample No.	**755739**	**EPA/13/514/11W**		**Method**
Total particulate matter		<0.5 mg		D9(U)
Sample No.	**755740**	**EPA/13/514/12W**		**Method**
Total particulate matter		0.5 mg		D9(U)

RPS Laboratories Ltd. Unit 12. Waters Edge Business Park. Modwen Road. Salford. M5 3EZ
Tel: (0161) 872 2443 Fax: (0161) 877 3959

UKAS TESTING 0605

Date 22/08/2013

Test Certificate

Client	EPA		Certificate No.	WK13-5044
			Issue No.	1
Sample No.	**755741**	**EPA/13/514/13W**		**Method**
Total particulate matter		1.7 mg		D9(U)
Sample No.	**755742**	**EPA/13/514/14W**		**Method**
Total particulate matter		0.9 mg		D9(U)
Sample No.	**755743**	**EPA/13/514/15W**		**Method**
Total particulate matter		<0.5 mg		D9(U)
Sample No.	**755744**	**EPA/13/514/16W**		**Method**
Total particulate matter		0.6 mg		D9(U)
Sample No.	**755745**	**EPA/13/514/17W**		**Method**
Total particulate matter		<0.5 mg		D9(U)
Sample No.	**755746**	**EPA/13/514/18W**		**Method**
Total particulate matter		0.5 mg		D9(U)

RPS Laboratories Ltd. Unit 12. Waters Edge Business Park. Modwen Road. Salford. M5 3EZ
Tel: (0161) 872 2443 Fax: (0161) 877 3959

UKAS TESTING 0605

Date 22/08/2013

Test Certificate

Client EPA

Certificate No. WK13-5044

Issue No. 1

Tested By Kirstie Davenport — Date 20/08/2013
Ashley Lunt — 21/08/2013

Approved By — Date 22/08/2013

Joanne Dewhurst
Laboratory Manager

For and on authority of RPS Laboratories Ltd.

Method Symbols (U) Analysis is UKAS Accredited
(N) Analysis is not UKAS Accredited

Concentration values (mg/m3 and ppm) are provided to assist with interpretation only, they are not covered by the scope of UKAS accreditation.

Results stated as ml are refering to the sample volume.

RPS Laboratories terms and conditions apply - a copy is available on request.

Analysis carried out on samples 'as received'

RPS Laboratories Ltd. Unit 12. Waters Edge Business Park. Modwen Road. Salford. M5 3EZ
Tel: (0161) 872 2443 Fax: (0161) 877 3959

2.12 Calibration Certificates

CERTIFIED REFERENCE MATERIAL
CERTIFICATE OF CALIBRATION

Component	Nominal Concentration	Certified Concentration	Absolute Uncertainty	Relative Uncertainty	Analysis Technique
PROPANE	800 ppm	805 ppm	+/-6 ppm	0.7 %	FID
SYNTHETIC AIR	Balance				

All concentrations are molar

EPA /CGAS/72

Cylinder Number: 219877
Production Order Number: 2397875
Issuing Laboratory: UKAS Accredited Calibration Laboratory 0408 & Reference Material Producer 4183

Page 2 of 2

UKAS 1316733 HR/QS807/MPUK/1000/SM

BOC
Member of The Linde Group

CERTIFIED REFERENCE MATERIAL
CERTIFICATE OF CALIBRATION

Component	Nominal Concentration	Certified Concentration	Absolute Uncertainty	Relative Uncertainty	Analysis Technique
PROPANE	8 ppm	8.40 ppm	+/-0.16 ppm	1.9 %	FID
SYNTHETIC AIR	Balance				

All concentrations are molar

EPA/CGAS/73

Cylinder Number: 219883 Production Order Number: 2398078
Issuing Laboratory: UKAS Accredited Calibration Laboratory 0408 & Reference Material Producer 4183

Page 2 of 2

UKAS: 13162753 HQ/380860/APVK/1008/SM

BOC
Member of The Linde Group

CERTIFIED REFERENCE MATERIAL
CERTIFICATE OF CALIBRATION

Component	Nominal Concentration	Certified Concentration	Absolute Uncertainty	Relative Uncertainty	Analysis Technique
PROPANE	80 ppm	82.4 ppm	+/-0.6 ppm	0.8 %	FID
SYNTHETIC AIR	Balance				

All concentrations are molar

EPA/CGAS/78

Cylinder Number: 219881 Production Order Number: 2397927
Issuing Laboratory: UKAS Accredited Calibration Laboratory 0408 & Reference Material Producer 4183

Page 2 of 2

BOC
Member of The Linde Group