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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:	PPC/B/05
Operator:	BAE Systems
Installation:	Maritime – Submarines, Barrow-In-Furness
Monitoring Dates:	20th July – 24th July 2015
Project Number:	EPA/JBN/15/511
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:	01/09/15
Version:	1
Report Author:	T Dodds
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

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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	✓	-
Paint Shop Dryer Area D13	✓	✓
DDH Paint Extraction Area D34	✓	✓
DDH Tile Adhesive Facility Area D34	✓	✓
NAS Annex Area A69	✓	✓
Tile Cutting Facility	✓	-
Paint Mixing Facility Area D24	✓	✓

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	± 0.35	mgm^{-3}	STP (101.3kPa, 273K)	20/07/15	10:51 – 11:21	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	49.0	± 3.84	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 12619	UKAS/ MCERTS	Normal
RIF Spray Paint Enclosure Area D16	Particulates	50mg/Nm^3	4.5	± 0.37	mgm^{-3}	STP (101.3kPa, 273K)	21/07/15	14:29 – 14:59	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	1262.0	± 38.0	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 12619	UKAS/ MCERTS	Normal
Paint Shop Oven Vent Area D13	Particulates	50mg/Nm^3	2.4	± 0.28	mgm^{-3}	STP (101.3kPa, 273K)	22/07/15	11:48 – 12:18	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	26.0	± 3.80	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 12619	UKAS/ MCERTS	Normal
Paint Shop Spray Area D13	Particulates	50mg/Nm^3	10.9	± 0.51	mgm^{-3}	STP (101.3kPa, 273K)	22/07/15	10:19 – 10:51	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	0.8	± 0.46	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	1.3	± 0.30	mgm^{-3}	STP (101.3kPa, 273K)	20/07/15	14:42 – 15:14	BS EN 13284-1	UKAS/ MCERTS	Normal
Paint Shop Dryer Area D13	Particulates	50mg/Nm^3	4.6	± 0.48	mgm^{-3}	STP (101.3kPa, 273K)	22/07/15	13:54 – 14:24	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	7.1	± 0.46	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 12619	UKAS/ MCERTS	Normal
DDH Paint Extraction Area D34	Particulates	50mg/Nm^3	3.1	± 0.28	mgm^{-3}	STP (101.3kPa, 273K)	23/07/15	10:23 – 11:55	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	643.1	± 38.59	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 12619	UKAS/ MCERTS	Normal
DDH Tile Adhesive Facility Area D34	Particulates	50mg/Nm^3	1.2	± 0.29	mgm^{-3}	STP (101.3kPa, 273K)	23/07/15	12:48 – 13:18	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	9.0	± 3.89	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 12619	UKAS/ MCERTS	Normal
NAS Annex Paint Extraction Area A69	Particulates	50mg/Nm^3	1.7	± 0.25	mgm^{-3}	STP (101.3kPa, 273K)	24/07/15	11:02 – 11:35	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	289.4	± 38.14	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
DDH Tile Cutting Facility	Particulates	50mg/Nm^3	1.7	± 0.33	mgm^{-3}	STP (101.3kPa, 273K)	21/07/15	10:40 – 11:10	BS EN 13284-1	UKAS/ MCERTS	Normal
Paint Mixing Facility	Particulates	50mg/Nm^3	2.0	± 0.21	mgm^{-3}	STP (101.3kPa, 273K)	23/07/15	14:43 – 15:15	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	39.0	± 3.97	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 12619	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	524 Black	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	Epoxy P8000	Various Parts	N/A	N/A	N/A	N/A	N/A
Paint Shop Spray Area D13	Batch	Epoxy 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
Paint Shop Dryer Area D13	Batch	524, 425, 574, sigma 400	Various Parts	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
DDH Tile Adhesive Facility Area D34	Batch	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NAS Annex Area A69	Batch	L574	MDF	Bag Filter	N/A	N/A	N/A	N/A

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
DDH Tile Cutting Facility	Batch	N/A	CTL 2Tiles	Bag Filter	N/A	N/A	N/A	N/A
Paint Mixing. Area D24	Batch	L574	Mix Tank	Carbon Filter	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
Paint Shop Spray	-	Only one port available, number of sample points doubled	-
Paint Shop Shot Blast	-	Only one sample line, number of sample points doubled	-
Tile Cutting Facility	-	Blank test slightly higher concentration than actual test	-
Mix Room	-	Blank test slightly higher concentration than actual test	-
Tile Adhesive	-	Blank test slightly higher concentration than actual test	

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 Manager	Tracy Dodds
MCERTS Accreditation	Level 2 TE1, 2, 3 & 4
MCERTS Number	MM 03 414
Degree	BSc Hons Environmental Management & Technology

2.1.2 Substances Monitored

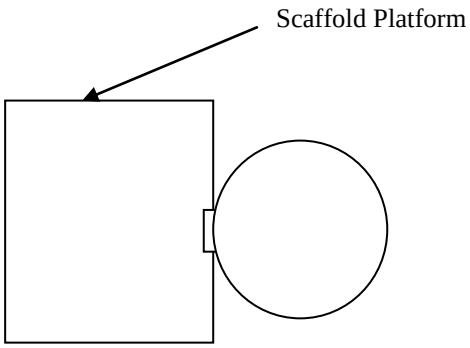
Substances Monitored	Standard Reference Method	EPA Method
Flow	BS EN 16911	EPA Method 19
Particulate	BS EN 13284-1	EPA Method 1
Total VOCs by FID	BS EN 12619	EPA Method 6

2.1.3 Site Equipment Log

Equipment Description	EPA Reference Number
Heated Line	EPA/HEAT/04, 05 09
Pitot Tube	EPA/PITOT/10,11
Thermocouple Probe	EPA/TCP/55, 65
Thermocouple Reader	EPA/MAN/07
Measuring Tape	EPA/TAPE/13
Vion Site Barometer	EPA/BAR/04
Sampling Probe	EPA/PROBE/08, 10
Dry Gas Meter	EPA/DGM/09
Site Balance	EPA/MASS/02
Sampling Nozzle	EPA/N/6, 30, 34, 36
Sick 3006 FID	EPA/FID/01
Sample Box	EPA/SAMP/09A, 01A

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**		
Pressure (mm H_2O)	10.0	10.0	10.0
√ΔP	3.16	3.16	3.16
Temperature (ºC)	25	25	25

Static Pressure (mmH_2O)	11.5	**Barometric Pressure (mm Hg)**	760.0	**Duct Dimensions (m)**	0.285

Velocity (m/s) average	11.1	**Actual Flow of stack gas (m^3/hr)**	2545
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	2334
Dimensions (m)	0.285	**Flow (dry) at STP (m^3/hr)**	2284
Area (m^2)	0.064		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	10.0	10.0	10.0	1.0	Yes
√ΔP (mm $H_2O)^{½}$	3.16	3.16	3.16	1.0	Yes
Temperature (ºC)	25.0	25.0	25.0	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	20/07/15		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	RIF Hand		
	Blank	Test 1	Units
Sample Ref	epa.15.511.02	epa.15.511.01	-
Start Time	11:30	10:51	hr:mm
Stop Time	11:35	11:21	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	12.3	ml
B_{wo}	0.02	0.021	-
P_b	-	760.0	mm Hg
St	-	11.5	mm H_2O
T_s	-	27.00	ºC
√ΔP	-	3.16	$(mm\ H_2O)^{½}$
Yd	-	1.013	-
Test Time	5	30	min
T_m	-	19.75	ºC
C_p	-	0.828	-
As	-	0.064	m^2
D_n	-	7.09	mm
ΔH ave	-	55.58	mm H_20
V_{mstd}	0.6998	0.6998	m^3
V_{wstd}	0.0153	0.0153	m^3
$Q_{std,wet}$	-	2249.0	Nm^3/h
Q_{act}	-	2468.7	Nm^3/h
Isokinetic Rate	-	102.8	%
Vs	-	10.75	m/s
Washings			
Sample Ref	epa.15.511.02W	epa.15.511.01W	-
Weight	<0.5	2	mg
Filter			
Sample Ref	epa.15.511.02F	epa.15.511.01F	-
Weight	0.6	<0.1	mg
Particulate Concentration (Dry, No O_2 Correction)	1.6	3.0	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	1.5	2.9	mg/Nm^3
Particulate Release Rate	-	6.60	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	0.6	<0.5
Run 1	<0.1	2

2.2.5 Sampling Measurements

Date	20.07.15		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	10:51		1	844.4	845.8	1.4		**Leak Check (Pre)**	0.12	10			
End Time	11:21		2	824.2	826.1	1.9		**Leak Check (Post)**	0.09	7			
Duration (mm.ss)	30.00		3	687.9	689.8	1.9							
Stack	RIF Hand Spray		4	748.1	755.2	7.1		**Pitot ID**	Pitot 06			Velocity Head	
Run	1		5	252.7	252.7	0.0		**DGM ID**	DGM 09			Min	10
												Max	10
												Max:Min	1.00
								n36	n36	n36			
			Sample Ref	epa.15.511.01				**Nozzle Diameter (mm)**	7.09	7.09	7.09		
K Factor	5.56		**Filter Number**	epa.15.511.01F									
Stack Diameter (m)	0.29		**Probe Washing No**	epa.15.511.01W									
							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**		2605.81	**In**	**Out**	**Probe**	**Filter**	**Impinger**
a1	0 5	4	27	10		3.16	55.58	2730	19	19	161	160	
a1	5 10	4	27	10		3.16	55.58	2855	19	19	160	160	
a1	10 15	4	27	10		3.16	55.58	2980	20	19	160	160	
a1	15 20	4	27	10		3.16	55.58	3119	21	19	160	161	
a1	20 25	4	27	10		3.16	55.58	3221	22	19	160	160	
a1	25 30	4	27	10		3.16	55.58	3343.01	22	19	160	160	
Total / Average		4.00	27.00	10.00		3.16	55.58	737.20	20.50	19.00	160.17	160.17	

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	0.00	0.00	0.00	0.00	0.00

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	100	EPA/CGAS/98	80.20	80.29	81.03	80.37	-0.66

2.2.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
20.07.2015	10:51:11	25.9	41.6	41.6
20.07.2015	10:51:26	27.2	43.7	43.7
20.07.2015	10:51:41	27.7	44.5	44.5
20.07.2015	10:51:56	28.4	45.6	45.6
20.07.2015	10:52:11	27.1	43.6	43.6
20.07.2015	10:52:26	25.7	41.3	41.3
20.07.2015	10:52:41	25.2	40.5	40.5
20.07.2015	10:52:56	26.8	43.1	43.1
20.07.2015	10:53:11	27.9	44.8	44.8
20.07.2015	10:53:26	27.7	44.5	44.5
20.07.2015	10:53:41	27.5	44.2	44.2
20.07.2015	10:53:56	27.4	44.0	44.0
20.07.2015	10:54:11	27.9	44.8	44.8
20.07.2015	10:54:26	27.5	44.2	44.2
20.07.2015	10:54:41	27.2	43.7	43.7
20.07.2015	10:54:56	27.7	44.5	44.5
20.07.2015	10:55:11	27.9	44.8	44.8
20.07.2015	10:55:26	28.4	45.6	45.6
20.07.2015	10:55:41	29.2	46.9	46.9
20.07.2015	10:55:56	28.9	46.4	46.4
20.07.2015	10:56:11	28.6	46.0	46.0
20.07.2015	10:56:26	28.5	45.8	45.8
20.07.2015	10:56:41	29.3	47.1	47.1
20.07.2015	10:56:56	28.7	46.1	46.1
20.07.2015	10:57:11	29.3	47.1	47.1
20.07.2015	10:57:26	30.0	48.2	48.2
20.07.2015	10:57:41	30.1	48.4	48.4
20.07.2015	10:57:56	31.2	50.1	50.1
20.07.2015	10:58:11	31.0	49.8	49.8
20.07.2015	10:58:26	29.9	48.1	48.1
20.07.2015	10:58:41	29.4	47.3	47.3

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
20.07.2015	10:58:56	27.9	44.8	44.8
20.07.2015	10:59:11	28.3	45.5	45.5
20.07.2015	10:59:26	27.8	44.7	44.7
20.07.2015	10:59:41	27.7	44.5	44.5
20.07.2015	10:59:56	26.4	42.4	42.4
20.07.2015	11:00:11	25.6	41.1	41.1
20.07.2015	11:00:26	25.5	41.0	41.0
20.07.2015	11:00:41	25.8	41.5	41.5
20.07.2015	11:00:56	26.3	42.3	42.3
20.07.2015	11:01:11	26.4	42.4	42.4
20.07.2015	11:01:26	25.8	41.5	41.5
20.07.2015	11:01:41	27.0	43.4	43.4
20.07.2015	11:01:56	27.4	44.0	44.0
20.07.2015	11:02:11	27.2	43.7	43.7
20.07.2015	11:02:26	27.9	44.8	44.8
20.07.2015	11:02:41	28.4	45.6	45.6
20.07.2015	11:02:56	28.4	45.6	45.6
20.07.2015	11:03:11	29.1	46.8	46.8
20.07.2015	11:03:26	29.7	47.7	47.7
20.07.2015	11:03:41	28.9	46.4	46.4
20.07.2015	11:03:56	28.1	45.2	45.2
20.07.2015	11:04:11	29.5	47.4	47.4
20.07.2015	11:04:26	30.6	49.2	49.2
20.07.2015	11:04:41	29.4	47.3	47.3
20.07.2015	11:04:56	29.8	47.9	47.9
20.07.2015	11:05:11	31.3	50.3	50.3
20.07.2015	11:05:26	31.7	50.9	50.9
20.07.2015	11:05:41	32.8	52.7	52.7
20.07.2015	11:05:56	33.7	54.2	54.2
20.07.2015	11:06:11	32.3	51.9	51.9
20.07.2015	11:06:26	31.3	50.3	50.3
20.07.2015	11:06:41	30.7	49.3	49.3
20.07.2015	11:06:56	29.4	47.3	47.3
20.07.2015	11:07:11	32.6	52.4	52.4
20.07.2015	11:07:26	33.2	53.4	53.4
20.07.2015	11:07:41	31.3	50.3	50.3
20.07.2015	11:07:56	30.3	48.7	48.7
20.07.2015	11:08:11	29.8	47.9	47.9
20.07.2015	11:08:26	29.2	46.9	46.9
20.07.2015	11:08:41	28.4	45.6	45.6
20.07.2015	11:08:56	28.4	45.6	45.6
20.07.2015	11:09:11	28.4	45.6	45.6
20.07.2015	11:09:26	28.5	45.8	45.8
20.07.2015	11:09:41	27.8	44.7	44.7
20.07.2015	11:09:56	25.9	41.6	41.6
20.07.2015	11:10:11	27.3	43.9	43.9
20.07.2015	11:10:26	29.3	47.1	47.1
20.07.2015	11:10:41	30.1	48.4	48.4

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
20.07.2015	11:10:56	31.0	49.8	49.8
20.07.2015	11:11:11	33.4	53.7	53.7
20.07.2015	11:11:26	34.1	54.8	54.8
20.07.2015	11:11:41	33.2	53.4	53.4
20.07.2015	11:11:56	33.2	53.4	53.4
20.07.2015	11:12:11	33.7	54.2	54.2
20.07.2015	11:12:26	33.7	54.2	54.2
20.07.2015	11:12:41	33.2	53.4	53.4
20.07.2015	11:12:56	32.8	52.7	52.7
20.07.2015	11:13:11	34.2	55.0	55.0
20.07.2015	11:13:26	33.7	54.2	54.2
20.07.2015	11:13:41	32.6	52.4	52.4
20.07.2015	11:13:56	33.4	53.7	53.7
20.07.2015	11:14:11	35.4	56.9	56.9
20.07.2015	11:14:26	36.3	58.3	58.3
20.07.2015	11:14:41	36.1	58.0	58.0
20.07.2015	11:14:56	35.6	57.2	57.2
20.07.2015	11:15:11	35.2	56.6	56.6
20.07.2015	11:15:26	37.7	60.6	60.6
20.07.2015	11:15:41	35.7	57.4	57.4
20.07.2015	11:15:56	33.0	53.0	53.0
20.07.2015	11:16:11	32.4	52.1	52.1
20.07.2015	11:16:26	33.4	53.7	53.7
20.07.2015	11:16:41	33.0	53.0	53.0
20.07.2015	11:16:56	33.6	54.0	54.0
20.07.2015	11:17:11	33.0	53.0	53.0
20.07.2015	11:17:26	33.8	54.3	54.3
20.07.2015	11:17:41	33.5	53.8	53.8
20.07.2015	11:17:56	33.0	53.0	53.0
20.07.2015	11:18:11	32.3	51.9	51.9
20.07.2015	11:18:26	31.2	50.1	50.1
20.07.2015	11:18:41	31.1	50.0	50.0
20.07.2015	11:18:56	30.5	49.0	49.0
20.07.2015	11:19:11	31.5	50.6	50.6
20.07.2015	11:19:26	32.5	52.2	52.2
20.07.2015	11:19:41	33.4	53.7	53.7
20.07.2015	11:19:56	33.7	54.2	54.2
20.07.2015	11:20:11	33.8	54.3	54.3
20.07.2015	11:20:26	34.3	55.1	55.1
20.07.2015	11:20:41	33.7	54.2	54.2
20.07.2015	11:20:56	33.9	54.5	54.5
20.07.2015	11:21:11	34.0	54.6	54.6
20.07.2015	11:21:26	35.0	56.3	56.3
20.07.2015	11:21:41	36.2	58.2	58.2
20.07.2015	11:21:56	35.7	57.4	57.4
Mean		30.5	49.0	49.0
Max		37.7	60.6	60.6
Min		25.2	40.5	40.5

2.2.8 Uncertainty Calculations

Particulates

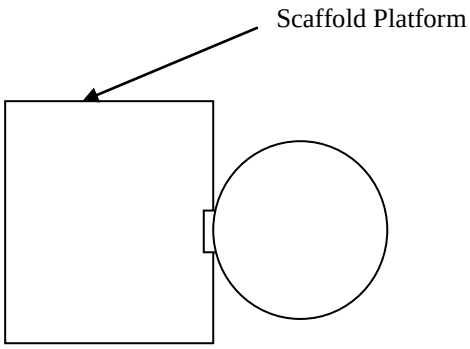
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	5.64		
O_2 Concentration	1.62		As % of result
Gas Temperature	1.17		11.72
Pitot Co-efficient	0.50		
Humidity	0.50	6.04	As % of ELV
Stack Diameter	0.35		0.70
Leak	0.28		As mg/m^3
Nozzle Diameter	0.20		0.35
Pressure	0.12		

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	0.96		
Temperature effect (zero)	0.46		
Barometric Pressure	0.40		2.39
Span gas	0.35		
Temperature effect (span)	0.23		
Span drift	0.19	1.23	
Repeatability	0.07		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.00		
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		7.85
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		3.84

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**		
Pressure (mm H_2O)	1.5	1.5	1.5
√ΔP	1.22	1.22	1.22
Temperature (ºC)	25	25	25

Static Pressure (mmH_2O)	1	**Barometric Pressure (mm Hg)**	752.5	**Duct Dimensions (m)**	0.295

Velocity (m/s) average	4.3	**Actual Flow of stack gas (m^3/hr)**	1049
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	952
Dimensions (m)	0.295	**Flow (dry) at STP (m^3/hr)**	940
Area (m^2)	0.068		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	1.5	1.5	1.5	1.0	Yes
√ΔP (mm H_2O)^{½}	1.22	1.22	1.22	1.0	Yes
Temperature (ºC)	25.0	25.0	25.0	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	21/07/15		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	RIF Spray		
	Blank	Test 1	Units
Sample Ref	epa.15.511.07	epa.15.511.08	-
Start Time	13:34	14:29	hr:mm
Stop Time	13:39	14:59	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	7.5	ml
B_{wo}	0.01	0.012	-
P_b	-	752.5	mm Hg
St	-	1	mm H_2O
T_s	-	25.00	ºC
$\sqrt{\Delta P}$	-	1.22	$(mm\ H_2O)^{½}$
Yd	-	1.013	-
Test Time	5	30	min
T_m	-	19.33	ºC
C_p	-	0.833	-
As	-	0.068	m^2
D_n	-	11.68	mm
ΔH ave	-	62.08	mm H_20
V_{mstd}	0.7391	0.7391	m^3
V_{wstd}	0.0093	0.0093	m^3
$Q_{std,wet}$	-	935.3	Nm^3/h
Q_{act}	-	1031.0	Nm^3/h
Isokinetic Rate	-	102.1	%
Vs	-	4.19	m/s
Washings			
Sample Ref	epa.15.511.07W	epa.15.511.08W	-
Weight	2.1	2.5	mg
Filter			
Sample Ref	epa.15.511.07F	epa.15.511.08F	-
Weight	<0.1	0.9	mg
Particulate Concentration (Dry, No O_2 Correction)	3.0	4.6	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	2.9	4.5	mg/Nm^3
Particulate Release Rate	-	4.25	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	2.1
Run 1	0.9	2.5

2.3.5 Sampling Measurements

Date	21.07.15		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	14:29		1	895.8	896.2	0.4		**Leak Check (Pre)**	0.14	10			
End Time	14:59		2	900.5	901.3	0.8		**Leak Check (Post)**	0.12	7			
Duration (mm.ss)	30.00		3	683.0	683.4	0.4							
Stack	RIF Spray Paint		4	754.1	760.0	5.9		**Pitot ID**	pitot 06			Velocity Head	
Run	1		5	252.8	252.8	0.0		**DGM ID**	dgm 09			Min	1.5
												Max	1.5
												Max:Min	1.00
								n34	n34	n34			
			Sample Ref	epa.15.511.08				**Nozzle Diameter (mm)**	11.68	11.68	11.68		
K Factor	41.39		**Filter Number**	epa.15.511.08F									
Stack Diameter (m)	0.30		**Probe Washing No**	epa.15.511.08W									
							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		4987.35	In	Out	Probe	Filter	**Impinger**
a1	0 5	4	25	1.5		1.22	62.08	5128	18	18	160	160	
a1	5 10	4	25	1.5		1.22	62.08	5251	18	18	160	160	
a1	10 15	4	25	1.5		1.22	62.08	5380	20	19	160	160	
a1	15 20	4	25	1.5		1.22	62.08	5501	20	19	160	160	
a1	20 25	4	25	1.5		1.22	62.08	5661	21	20	160	160	
a1	25 30	4	25	1.5		1.22	62.08	5772.12	21	20	160	160	
Total / Average		4.00	25.00	1.5		1.22	62.08	784.77	19.67	19.00	160.00	160.00	

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	0.00	0.00	0.00	0.08	0.08

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	1000	EPA/CGAS/97	802.0	802.62	800.98	802.44	1.46

2.3.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
21.07.2015	14:29:08	840.0	1350.0	1350.0
21.07.2015	14:29:23	962.1	1546.2	1546.2
21.07.2015	14:29:38	913.3	1467.8	1467.8
21.07.2015	14:29:53	898.7	1444.3	1444.3
21.07.2015	14:30:08	813.2	1306.9	1306.9
21.07.2015	14:30:23	1055.0	1695.5	1695.5
21.07.2015	14:30:38	1104.0	1774.3	1774.3
21.07.2015	14:30:53	818.1	1314.8	1314.8
21.07.2015	14:31:08	1053.0	1692.3	1692.3
21.07.2015	14:31:23	815.6	1310.8	1310.8
21.07.2015	14:31:38	1050.0	1687.5	1687.5
21.07.2015	14:31:53	1023.0	1644.1	1644.1
21.07.2015	14:32:08	932.8	1499.1	1499.1
21.07.2015	14:32:23	971.9	1562.0	1562.0
21.07.2015	14:32:38	959.7	1542.4	1542.4
21.07.2015	14:32:53	820.5	1318.7	1318.7
21.07.2015	14:33:08	786.3	1263.7	1263.7
21.07.2015	14:33:23	930.4	1495.3	1495.3
21.07.2015	14:33:38	925.5	1487.4	1487.4
21.07.2015	14:33:53	1016.0	1632.9	1632.9
21.07.2015	14:34:08	588.5	945.8	945.8
21.07.2015	14:34:23	779.0	1252.0	1252.0
21.07.2015	14:34:38	727.7	1169.5	1169.5
21.07.2015	14:34:53	869.4	1397.3	1397.3
21.07.2015	14:35:08	796.1	1279.4	1279.4
21.07.2015	14:35:23	781.4	1255.8	1255.8
21.07.2015	14:35:38	522.6	839.9	839.9
21.07.2015	14:35:53	774.1	1244.1	1244.1
21.07.2015	14:36:08	730.2	1173.5	1173.5
21.07.2015	14:36:23	771.7	1240.2	1240.2

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
21.07.2015	14:36:38	1053.0	1692.3	1692.3
21.07.2015	14:36:53	974.4	1566.0	1566.0
21.07.2015	14:37:08	1079.0	1734.1	1734.1
21.07.2015	14:37:23	698.4	1122.4	1122.4
21.07.2015	14:37:38	940.2	1511.0	1511.0
21.07.2015	14:37:53	781.4	1255.8	1255.8
21.07.2015	14:38:08	573.9	922.3	922.3
21.07.2015	14:38:23	642.2	1032.1	1032.1
21.07.2015	14:38:38	385.8	620.0	620.0
21.07.2015	14:38:53	352.4	566.4	566.4
21.07.2015	14:39:08	236.9	380.7	380.7
21.07.2015	14:39:23	766.3	1231.6	1231.6
21.07.2015	14:39:38	791.2	1271.6	1271.6
21.07.2015	14:39:53	798.5	1283.3	1283.3
21.07.2015	14:40:08	644.7	1036.1	1036.1
21.07.2015	14:40:23	693.5	1114.6	1114.6
21.07.2015	14:40:38	686.2	1102.8	1102.8
21.07.2015	14:40:53	659.3	1059.6	1059.6
21.07.2015	14:41:08	632.5	1016.5	1016.5
21.07.2015	14:41:23	588.5	945.8	945.8
21.07.2015	14:41:38	544.6	875.3	875.3
21.07.2015	14:41:53	603.2	969.4	969.4
21.07.2015	14:42:08	730.2	1173.5	1173.5
21.07.2015	14:42:23	720.4	1157.8	1157.8
21.07.2015	14:42:38	693.5	1114.6	1114.6
21.07.2015	14:42:53	896.2	1440.3	1440.3
21.07.2015	14:43:08	998.8	1605.2	1605.2
21.07.2015	14:43:23	810.7	1302.9	1302.9
21.07.2015	14:43:38	884.0	1420.7	1420.7
21.07.2015	14:43:53	674.0	1083.2	1083.2
21.07.2015	14:44:08	656.9	1055.7	1055.7
21.07.2015	14:44:23	774.1	1244.1	1244.1
21.07.2015	14:44:38	757.0	1216.6	1216.6
21.07.2015	14:44:53	1033.0	1660.2	1660.2
21.07.2015	14:45:08	703.3	1130.3	1130.3
21.07.2015	14:45:23	676.4	1087.1	1087.1
21.07.2015	14:45:38	512.8	824.1	824.1
21.07.2015	14:45:53	820.5	1318.7	1318.7
21.07.2015	14:46:08	774.1	1244.1	1244.1
21.07.2015	14:46:23	676.4	1087.1	1087.1
21.07.2015	14:46:38	627.6	1008.6	1008.6
21.07.2015	14:46:53	754.6	1212.8	1212.8
21.07.2015	14:47:08	766.8	1232.4	1232.4
21.07.2015	14:47:23	771.7	1240.2	1240.2
21.07.2015	14:47:38	683.8	1099.0	1099.0
21.07.2015	14:47:53	632.5	1016.5	1016.5
21.07.2015	14:48:08	893.8	1436.5	1436.5
21.07.2015	14:48:23	717.9	1153.8	1153.8
21.07.2015	14:48:38	786.3	1263.7	1263.7

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
21.07.2015	14:48:53	666.7	1071.5	1071.5
21.07.2015	14:49:08	634.9	1020.4	1020.4
21.07.2015	14:49:23	437.1	702.5	702.5
21.07.2015	14:49:38	710.6	1142.0	1142.0
21.07.2015	14:49:53	766.8	1232.4	1232.4
21.07.2015	14:50:08	498.2	800.7	800.7
21.07.2015	14:50:23	893.8	1436.5	1436.5
21.07.2015	14:50:38	674.0	1083.2	1083.2
21.07.2015	14:50:53	659.3	1059.6	1059.6
21.07.2015	14:51:08	612.9	985.0	985.0
21.07.2015	14:51:23	769.2	1236.2	1236.2
21.07.2015	14:51:38	1009.0	1621.6	1621.6
21.07.2015	14:51:53	1033.0	1660.2	1660.2
21.07.2015	14:52:08	974.4	1566.0	1566.0
21.07.2015	14:52:23	1033.0	1660.2	1660.2
21.07.2015	14:52:38	857.1	1377.5	1377.5
21.07.2015	14:52:53	923.1	1483.6	1483.6
21.07.2015	14:53:08	810.7	1302.9	1302.9
21.07.2015	14:53:23	737.5	1185.3	1185.3
21.07.2015	14:53:38	823.0	1322.7	1322.7
21.07.2015	14:53:53	896.2	1440.3	1440.3
21.07.2015	14:54:08	903.5	1452.1	1452.1
21.07.2015	14:54:23	566.5	910.4	910.4
21.07.2015	14:54:38	945.1	1518.9	1518.9
21.07.2015	14:54:53	600.7	965.4	965.4
21.07.2015	14:55:08	615.4	989.0	989.0
21.07.2015	14:55:23	842.5	1354.0	1354.0
21.07.2015	14:55:38	495.7	796.7	796.7
21.07.2015	14:55:53	930.4	1495.3	1495.3
21.07.2015	14:56:08	827.8	1330.4	1330.4
21.07.2015	14:56:23	847.4	1361.9	1361.9
21.07.2015	14:56:38	832.7	1338.3	1338.3
21.07.2015	14:56:53	576.3	926.2	926.2
21.07.2015	14:57:08	849.8	1365.8	1365.8
21.07.2015	14:57:23	898.7	1444.3	1444.3
21.07.2015	14:57:38	730.2	1173.5	1173.5
21.07.2015	14:57:53	862.0	1385.4	1385.4
21.07.2015	14:58:08	998.8	1605.2	1605.2
21.07.2015	14:58:23	952.4	1530.6	1530.6
21.07.2015	14:58:38	957.3	1538.5	1538.5
21.07.2015	14:58:53	920.6	1479.5	1479.5
21.07.2015	14:59:08	1126.0	1809.6	1809.6
21.07.2015	14:59:23	752.1	1208.7	1208.7
21.07.2015	14:59:38	576.3	926.2	926.2
21.07.2015	14:59:53	757.0	1216.6	1216.6
Mean		785.2	1262.0	1262.0
Max		1126.0	1809.6	1809.6
Min		236.9	380.7	380.7

2.3.8 Uncertainty Calculations

Particulates

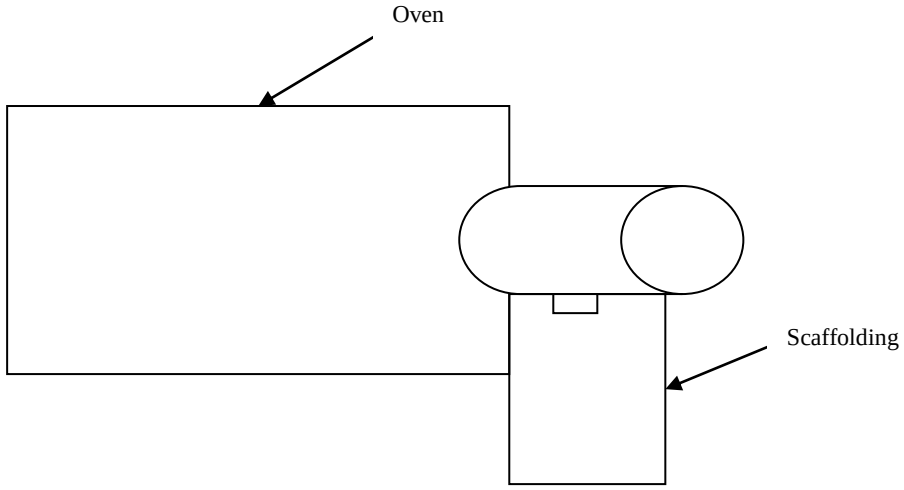
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	3.48		
O_2 Concentration	1.62		As % of result
Gas Temperature	1.19		7.98
Pitot Co-efficient	0.50		
Humidity	0.50	4.11	As % of ELV
Stack Diameter	0.34		0.73
Leak	0.31		As mg/m^3
Nozzle Diameter	0.12		0.37
Pressure	0.12		

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	9.62		
Temperature effect (zero)	4.63		
Barometric Pressure	4.01		23.65
Span gas	3.52		
Temperature effect (span)	2.32		
Repeatability	0.69	12.19	
Span drift	0.42		**Expanded Uncertainty (95% Confidence limit) %**
Zero 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		3.01
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		38.00

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**		
Pressure (mm H_2O)	7.0	7.0	7.0
$\sqrt{\Delta P}$	2.65	2.65	2.65
Temperature (ºC)	195	195	195

Static Pressure (mmH_2O)	9.0	**Barometric Pressure (mm Hg)**	758.4	**Duct Dimensions (m)**	0.19

Velocity (m/s) average	11.7	**Actual Flow of stack gas (m^3/hr)**	1189
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	692
Dimensions (m)	0.19	**Flow (dry) at STP (m^3/hr)**	689
Area (m^2)	0.028		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	7.0	7.0	7.0	1.0	Yes
$\sqrt{\Delta P}$ (mm H_2O)^{½}	2.65	2.65	2.65	1.0	Yes
Temperature (ºC)	195.0	195.0	195.0	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	22/07/15		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	Paint Oven Shop		
	Blank	Test 1	Units
Sample Ref	epa.15.511.11	epa.15.511.12	-
Start Time	11:33	11:48	hr:mm
Stop Time	11:38	12:18	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	3.5	ml
B_{wo}	0.00	0.005	-
P_b	-	757.7	mm Hg
St	-	9	mm H_2O
T_s	-	208.17	ºC
√ΔP	-	2.58	$(mm\ H_2O)^{½}$
Yd	-	1.013	-
Test Time	5	30	min
T_m	-	24.00	ºC
C_p	-	0.832	-
As	-	0.028	m^2
D_n	-	9.67	mm
ΔH ave	-	82.41	mm H_20
V_{mstd}	0.8670	0.8670	m^3
V_{wstd}	0.0044	0.0044	m^3
$Q_{std,wet}$	-	644.4	Nm^3/h
Q_{act}	-	1138.2	Nm^3/h
Isokinetic Rate	-	104.4	%
Vs	-	11.15	m/s
Washings			
Sample Ref	epa.15.511.11W	epa.15.511.12W	-
Weight	<0.5	1.2	mg
Filter			
Sample Ref	epa.15.511.11F	epa.15.511.12F	-
Weight	0.5	0.9	mg
Particulate Concentration (Dry, No O_2 Correction)	1.2	2.4	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	1.1	2.4	mg/Nm^3
Particulate Release Rate	-	1.55	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	0.5	<0.5
Run 1	0.9	1.2

2.4.5 Sampling Measurements

Date	22.07.15		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	11:48		1	894.9	894.5	-0.4		**Leak Check (Pre)**	0.12	10			
End Time	12:18		2	901.0	899.5	-1.5		**Leak Check (Post)**	0.11	8			
Duration (mm.ss)	30.00		3	683.3	683.1	-0.2							
Stack	Paint Spray		4	753.7	759.3	5.6		**Pitot ID**	Pitot 06			Velocity Head	
Run	1		5	252.8	252.8	0.0		**DGM ID**	DGM 09			Min	6.5
												Max	7
												Max:Min	1.08
								n6	n6	n6			
			Sample Ref	epa.15.511.12				**Nozzle Diameter (mm)**	9.67	9.67	9.67		
K Factor	12.36		**Filter Number**	epa.15.511.12F									
Stack Diameter (m)	0.19		**Probe Washing No**	epa.15.511.12W									
							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		6627.71	In	Out	Probe	Filter	**Impinger**
a1	0 5	4	185	7		2.65	86.53	6779	23	23	160	160	
a1	5 10	4	223	7		2.65	86.53	6957	23	23	160	160	
a1	10 15	4	230	6.5		2.55	80.35	7090	23	32	160	161	
a1	15 20	4	204	6.5		2.55	80.35	7237	24	23	160	160	
a1	20 25	4	201	6.5		2.55	80.35	7388	24	23	160	160	
a1	25 30	4	206	6.5		2.55	80.35	7554.62	24	23	160	160	
Total / Average		4.00	208.17	6.67		2.58	82.41	926.91	23.50	24.50	160.00	160.17	

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	0.00	0.00	0.00	0.00	0.00

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	100	EPA/CGAS/98	80.20	80.90	81.17	81.37	0.20

2.4.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
22.07.2015	11:48:03	7.5	12.0	12.0
22.07.2015	11:48:18	9.6	15.3	15.3
22.07.2015	11:48:33	11.7	18.8	18.8
22.07.2015	11:48:48	13.7	22.0	22.0
22.07.2015	11:49:03	15.3	24.6	24.6
22.07.2015	11:49:18	16.7	26.8	26.8
22.07.2015	11:49:33	17.7	28.4	28.4
22.07.2015	11:49:48	18.6	29.9	29.9
22.07.2015	11:50:03	19.5	31.3	31.3
22.07.2015	11:50:18	20.3	32.6	32.6
22.07.2015	11:50:33	21.0	33.8	33.8
22.07.2015	11:50:48	21.3	34.2	34.2
22.07.2015	11:51:03	21.7	34.9	34.9
22.07.2015	11:51:18	22.1	35.5	35.5
22.07.2015	11:51:33	22.5	36.2	36.2
22.07.2015	11:51:48	22.7	36.5	36.5
22.07.2015	11:52:03	23.0	37.0	37.0
22.07.2015	11:52:18	23.3	37.4	37.4
22.07.2015	11:52:33	23.6	37.9	37.9
22.07.2015	11:52:48	23.6	37.9	37.9
22.07.2015	11:53:03	23.6	37.9	37.9
22.07.2015	11:53:18	23.6	37.9	37.9
22.07.2015	11:53:33	23.5	37.8	37.8
22.07.2015	11:53:48	23.5	37.8	37.8
22.07.2015	11:54:03	23.5	37.8	37.8
22.07.2015	11:54:18	23.6	37.9	37.9
22.07.2015	11:54:33	23.1	37.1	37.1
22.07.2015	11:54:48	23.0	37.0	37.0

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
22.07.2015	11:55:03	23.1	37.1	37.1
22.07.2015	11:55:18	23.1	37.1	37.1
22.07.2015	11:55:33	22.9	36.8	36.8
22.07.2015	11:55:48	22.7	36.5	36.5
22.07.2015	11:56:03	22.8	36.6	36.6
22.07.2015	11:56:18	22.3	35.8	35.8
22.07.2015	11:56:33	22.4	36.0	36.0
22.07.2015	11:56:48	22.2	35.7	35.7
22.07.2015	11:57:03	22.1	35.5	35.5
22.07.2015	11:57:18	21.8	35.0	35.0
22.07.2015	11:57:33	21.6	34.7	34.7
22.07.2015	11:57:48	21.4	34.4	34.4
22.07.2015	11:58:03	21.0	33.8	33.8
22.07.2015	11:58:18	20.5	32.9	32.9
22.07.2015	11:58:33	20.2	32.5	32.5
22.07.2015	11:58:48	19.7	31.7	31.7
22.07.2015	11:59:03	19.2	30.9	30.9
22.07.2015	11:59:18	18.7	30.1	30.1
22.07.2015	11:59:33	18.0	28.9	28.9
22.07.2015	11:59:48	17.3	27.8	27.8
22.07.2015	12:00:03	16.9	27.2	27.2
22.07.2015	12:00:18	16.5	26.5	26.5
22.07.2015	12:00:33	15.9	25.6	25.6
22.07.2015	12:00:48	15.3	24.6	24.6
22.07.2015	12:01:03	14.6	23.5	23.5
22.07.2015	12:01:18	14.0	22.5	22.5
22.07.2015	12:01:33	13.6	21.9	21.9
22.07.2015	12:01:48	13.3	21.4	21.4
22.07.2015	12:02:03	13.0	20.9	20.9
22.07.2015	12:02:18	12.6	20.3	20.3
22.07.2015	12:02:33	12.4	19.9	19.9
22.07.2015	12:02:48	12.1	19.4	19.4
22.07.2015	12:03:03	11.9	19.1	19.1
22.07.2015	12:03:18	11.7	18.8	18.8
22.07.2015	12:03:33	11.6	18.6	18.6
22.07.2015	12:03:48	11.4	18.3	18.3
22.07.2015	12:04:03	11.3	18.2	18.2
22.07.2015	12:04:18	11.2	18.0	18.0
22.07.2015	12:04:33	11.2	18.0	18.0
22.07.2015	12:04:48	11.2	18.0	18.0
22.07.2015	12:05:03	11.2	18.0	18.0
22.07.2015	12:05:18	11.3	18.2	18.2
22.07.2015	12:05:33	11.5	18.5	18.5
22.07.2015	12:05:48	11.8	19.0	19.0
22.07.2015	12:06:03	11.8	19.0	19.0
22.07.2015	12:06:18	11.9	19.1	19.1
22.07.2015	12:06:33	12.1	19.4	19.4
22.07.2015	12:06:48	12.3	19.8	19.8
22.07.2015	12:07:03	12.4	19.9	19.9

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
22.07.2015	12:07:18	12.6	20.3	20.3
22.07.2015	12:07:33	13.1	21.1	21.1
22.07.2015	12:07:48	13.6	21.9	21.9
22.07.2015	12:08:03	13.5	21.7	21.7
22.07.2015	12:08:18	13.7	22.0	22.0
22.07.2015	12:08:33	14.2	22.8	22.8
22.07.2015	12:08:48	14.5	23.3	23.3
22.07.2015	12:09:03	14.6	23.5	23.5
22.07.2015	12:09:18	14.9	23.9	23.9
22.07.2015	12:09:33	15.1	24.3	24.3
22.07.2015	12:09:48	15.1	24.3	24.3
22.07.2015	12:10:03	15.1	24.3	24.3
22.07.2015	12:10:18	15.4	24.8	24.8
22.07.2015	12:10:33	15.6	25.1	25.1
22.07.2015	12:10:48	15.4	24.8	24.8
22.07.2015	12:11:03	15.5	24.9	24.9
22.07.2015	12:11:18	15.8	25.4	25.4
22.07.2015	12:11:33	15.7	25.2	25.2
22.07.2015	12:11:48	15.5	24.9	24.9
22.07.2015	12:12:03	15.4	24.8	24.8
22.07.2015	12:12:18	15.6	25.1	25.1
22.07.2015	12:12:33	15.5	24.9	24.9
22.07.2015	12:12:48	15.3	24.6	24.6
22.07.2015	12:13:03	15.3	24.6	24.6
22.07.2015	12:13:18	15.1	24.3	24.3
22.07.2015	12:13:33	14.8	23.8	23.8
22.07.2015	12:13:48	14.6	23.5	23.5
22.07.2015	12:14:03	14.4	23.1	23.1
22.07.2015	12:14:18	14.2	22.8	22.8
22.07.2015	12:14:33	13.8	22.2	22.2
22.07.2015	12:14:48	13.7	22.0	22.0
22.07.2015	12:15:03	13.4	21.5	21.5
22.07.2015	12:15:18	13.2	21.2	21.2
22.07.2015	12:15:33	12.9	20.7	20.7
22.07.2015	12:15:48	12.7	20.4	20.4
22.07.2015	12:16:03	12.6	20.3	20.3
22.07.2015	12:16:18	12.5	20.1	20.1
22.07.2015	12:16:33	12.3	19.8	19.8
22.07.2015	12:16:48	12.2	19.6	19.6
22.07.2015	12:17:03	12.0	19.3	19.3
22.07.2015	12:17:18	12.0	19.3	19.3
22.07.2015	12:17:33	12.1	19.4	19.4
22.07.2015	12:17:48	12.1	19.4	19.4
22.07.2015	12:18:03	12.0	19.3	19.3
22.07.2015	12:18:18	12.0	19.3	19.3
22.07.2015	12:18:33	12.2	19.6	19.6
22.07.2015	12:18:48	12.4	19.9	19.9
Mean		16.2	26.0	26.0
Max		23.6	37.9	37.9

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
Min		7.5	12.0	12.0

2.4.8 Uncertainty Calculations

Particulates

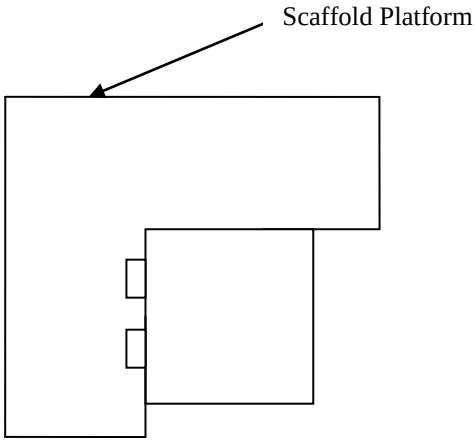
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	5.64		
O_2 Concentration	1.62		As % of result
Gas Temperature	0.96		11.67
Stack Diameter	0.53		
Pitot Co-efficient	0.50	6.01	As % of ELV
Humidity	0.50		0.57
Leak	0.23		As mg/m^3
Nozzle Diameter	0.15		0.28
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	0.96		
Temperature effect (zero)	0.46		
Barometric Pressure	0.40		2.37
Span gas	0.35		
Temperature effect (span)	0.23		
Repeatability	0.07	1.22	
Span drift	0.06		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.00		
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		14.60
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		3.80

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**		
Pressure (mm H_2O)	10.0	10.0	10.0	8.0	8.0	8.0	8.0	8.0	8.0	10.0	10.0	10.0
$\sqrt{\Delta P}$	3.16	3.16	3.16	2.83	2.83	2.83	2.83	2.83	2.83	3.16	3.16	3.16
Temperature (ºC)	21	21	21	21	21	21	21	21	21	21	21	21
Traverse Point	**A5**			**A6**			**A7**			**A8**		
Pressure (mm H_2O)	12.0	12.0	12.0	12.0	12.0	12.0	11.0	11.0	11.0	11.0	11.0	11.0
$\sqrt{\Delta P}$	3.46	3.46	3.46	3.46	3.46	3.46	3.32	3.32	3.32	3.32	3.32	3.32
Temperature (ºC)	21	21	21	21	21	21	21	21	21	21	21	21

Static Pressure (mmH_2O)	22	**Barometric Pressure (mm Hg)**	757.7	**Duct Dimensions (m)**	0.74 x 0.74

Velocity (m/s) average	11.1	**Actual Flow of stack gas (m^3/hr)**	21929
Stack Geometry	Rectangular	**Flow (wet) at STP (m^3/hr)**	20346
Dimensions (m)	0.74 x 0.74	**Flow (dry) at STP (m^3/hr)**	19871
Area (m^2)	0.548		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	10.3	12.0	8.0	1.5	Yes
$\sqrt{\Delta P}$ (mm $H_2O)^{½}$	3.19	3.46	2.83	1.2	Yes
Temperature (ºC)	21.0	21.0	21.0	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	22/07/15		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	Paint Shop Spray Area		
	Blank	Test 1	Units
Sample Ref	epa.15.511.09	epa.15.511.10	-
Start Time	10:00	10:19	hr:mm
Stop Time	10:05	10:51	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	14.5	ml
B_{wo}	0.02	0.023	-
P_b	-	757.7	mm Hg
St	-	22	mm H_2O
T_s	-	21.00	ºC
$\sqrt{\Delta P}$	-	3.27	$(mm\ H_2O)^{½}$
Yd	-	1.013	-
Test Time	5	32	min
T_m	-	18.75	ºC
C_p	-	0.825	-
As	-	0.548	m^2
D_n	-	7.09	mm
ΔH ave	-	60.18	mm H_20
V_{mstd}	0.7558	0.7558	m^3
V_{wstd}	0.0180	0.0180	m^3
$Q_{std,wet}$	-	20099.9	Nm^3/h
Q_{act}	-	21664.1	Nm^3/h
Isokinetic Rate	-	100.1	%
Vs	-	10.99	m/s
Washings			
Sample Ref	epa.15.511.09W	epa.15.511.10W	-
Weight	0.8	5.3	mg
Filter			
Sample Ref	epa.15.511.09F	epa.15.511.10F	-
Weight	0.06	3.1	mg
Particulate Concentration (Dry, No O_2 Correction)	1.1	11.1	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	1.1	10.9	mg/Nm^3
Particulate Release Rate	-	218.17	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	0.06	0.8
Run 1	3.1	5.3

2.5.5 Sampling Measurements

Date	01/07/14		**Impinger**	**Initial Wt (g)**	**Final Wt(g)**	**Wt Gained (g)**			**l/min**	**Vac (in Hg)**			
Start Time	12:48		**1**	789.2	789.0	-0.2		**Leak Check (Pre)**	0.07	10			
End Time	13:20		**2**	739.3	742.8	3.5		**Leak Check (Post)**	0.07	10			
Duration (mm.ss)	32.00		**3**	666.4	666.3	-0.1							
Stack	Paint Shop Spray Area		**4**	754.6	761.5	6.9		**Pitot ID**	pitot 14			Velocity Head	
Run	1		**5**	246.8	246.8	0.0		**DGM ID**	dgm 09			Min	8
												Max	12
												Max:Min	1.50
								n36	n36	n36			
			Sample Ref	EPA/14/515/06				**Nozzle Diameter (mm)**	7.09	7.09	7.09		
K Factor	3.21		**Filter Number**	EPA/14/515/06F									
Stack Diameter (m)	0.74		**Probe Washing No**	EPA/14/515/06W									
							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**		5808.81	In	Out	Probe	**Filter**	**Impinger**
a1	0 4	4	21	11		3.32	61.58	5905	17	17	70		
a2	4 8	4	21	11		3.32	61.58	6015	17	17	70		
a3	8 12	4	21	10		3.16	55.98	6111	19	19	70		
a4	12 16	4	21	8		2.83	44.79	6219	19	19	70		
a5	16 20	4	21	11		3.32	61.58	6313	19	19	70		
a6	20 24	4	21	11		3.32	61.58	6403	19	19	70		
a7	24 28	5	21	12		3.46	67.18	6520	20	20	70		
a8	28 32	5	21	12		3.46	67.18	6604.33	20	20	70		
Total / Average		5.00	21.00	10.75		3.27	60.18	795.52	18.75	18.75	70.00		

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)	10	Ambient Air	0.00	0.00	0.00	0.00	0.01	0.01

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	10	EPA/CGAS /88	8.32	8.31	8.36	8.25	-0.11

2.5.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
22.07.2015	10:19:05	0.0	0.0	0.0
22.07.2015	10:19:20	0.0	0.0	0.0
22.07.2015	10:19:35	0.0	0.0	0.0
22.07.2015	10:19:50	0.1	0.2	0.2
22.07.2015	10:20:05	0.2	0.3	0.3
22.07.2015	10:20:20	0.3	0.5	0.5
22.07.2015	10:20:35	0.4	0.7	0.7
22.07.2015	10:20:50	0.3	0.5	0.5
22.07.2015	10:21:05	0.3	0.5	0.5
22.07.2015	10:21:20	0.4	0.7	0.7
22.07.2015	10:21:35	0.3	0.5	0.5
22.07.2015	10:21:50	0.3	0.5	0.5
22.07.2015	10:22:05	0.3	0.5	0.5
22.07.2015	10:22:20	0.2	0.4	0.4
22.07.2015	10:22:35	0.2	0.4	0.4
22.07.2015	10:22:50	0.5	0.9	0.9
22.07.2015	10:23:05	0.3	0.5	0.5
22.07.2015	10:23:20	0.5	0.9	0.9
22.07.2015	10:23:35	0.3	0.5	0.5
22.07.2015	10:23:50	0.2	0.4	0.4
22.07.2015	10:24:05	0.3	0.5	0.5
22.07.2015	10:24:20	0.3	0.5	0.5
22.07.2015	10:24:35	0.4	0.7	0.7
22.07.2015	10:24:50	0.7	1.1	1.1
22.07.2015	10:25:05	0.2	0.4	0.4
22.07.2015	10:25:20	0.5	0.7	0.7
22.07.2015	10:25:35	0.4	0.7	0.7
22.07.2015	10:25:50	0.5	0.7	0.7
22.07.2015	10:26:05	0.5	0.9	0.9
22.07.2015	10:26:20	0.5	0.8	0.8

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
22.07.2015	10:26:35	0.5	0.9	0.9
22.07.2015	10:26:50	0.5	0.9	0.9
22.07.2015	10:27:05	0.5	0.9	0.9
22.07.2015	10:27:20	0.5	0.9	0.9
22.07.2015	10:27:35	0.5	0.9	0.9
22.07.2015	10:27:50	0.5	0.8	0.8
22.07.2015	10:28:05	0.5	0.9	0.9
22.07.2015	10:28:20	0.5	0.8	0.8
22.07.2015	10:28:35	0.5	0.8	0.8
22.07.2015	10:28:50	0.5	0.8	0.8
22.07.2015	10:29:05	0.5	0.8	0.8
22.07.2015	10:29:20	0.5	0.8	0.8
22.07.2015	10:29:35	0.5	0.8	0.8
22.07.2015	10:29:50	0.5	0.8	0.8
22.07.2015	10:30:05	0.5	0.8	0.8
22.07.2015	10:30:20	0.5	0.9	0.9
22.07.2015	10:30:35	0.5	0.9	0.9
22.07.2015	10:30:50	0.5	0.8	0.8
22.07.2015	10:31:05	0.5	0.8	0.8
22.07.2015	10:31:20	0.5	0.8	0.8
22.07.2015	10:31:35	0.5	0.8	0.8
22.07.2015	10:31:50	0.5	0.8	0.8
22.07.2015	10:32:05	0.5	0.8	0.8
22.07.2015	10:32:20	0.5	0.8	0.8
22.07.2015	10:32:35	0.5	0.8	0.8
22.07.2015	10:32:50	0.5	0.8	0.8
22.07.2015	10:33:05	0.5	0.8	0.8
22.07.2015	10:33:20	0.5	0.8	0.8
22.07.2015	10:33:35	0.5	0.8	0.8
22.07.2015	10:33:50	0.5	0.8	0.8
22.07.2015	10:34:05	0.5	0.8	0.8
22.07.2015	10:34:20	0.5	0.8	0.8
22.07.2015	10:34:35	0.5	0.8	0.8
22.07.2015	10:34:50	0.5	0.8	0.8
22.07.2015	10:35:05	0.5	0.8	0.8
22.07.2015	10:35:20	0.5	0.8	0.8
22.07.2015	10:35:35	0.5	0.8	0.8
22.07.2015	10:35:50	0.5	0.8	0.8
22.07.2015	10:36:05	0.5	0.8	0.8
22.07.2015	10:36:20	0.5	0.9	0.9
22.07.2015	10:36:35	0.6	0.9	0.9
22.07.2015	10:36:50	0.6	0.9	0.9
22.07.2015	10:37:05	0.6	1.0	1.0
22.07.2015	10:37:20	0.6	1.0	1.0
22.07.2015	10:37:35	0.6	1.0	1.0
22.07.2015	10:37:50	0.6	1.0	1.0
22.07.2015	10:38:05	0.6	1.0	1.0
22.07.2015	10:38:20	0.6	1.0	1.0
22.07.2015	10:38:35	0.6	1.0	1.0

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
22.07.2015	10:38:50	0.6	0.9	0.9
22.07.2015	10:39:05	0.6	1.0	1.0
22.07.2015	10:39:20	0.6	0.9	0.9
22.07.2015	10:39:35	0.6	0.9	0.9
22.07.2015	10:39:50	0.9	1.4	1.4
22.07.2015	10:40:05	1.1	1.8	1.8
22.07.2015	10:40:20	0.6	0.9	0.9
22.07.2015	10:40:35	0.6	0.9	0.9
22.07.2015	10:40:50	0.6	1.0	1.0
22.07.2015	10:41:05	0.7	1.1	1.1
22.07.2015	10:41:20	0.7	1.1	1.1
22.07.2015	10:41:35	0.6	1.0	1.0
22.07.2015	10:41:50	0.6	0.9	0.9
22.07.2015	10:42:05	0.6	0.9	0.9
22.07.2015	10:42:20	0.5	0.9	0.9
22.07.2015	10:42:35	0.5	0.9	0.9
22.07.2015	10:42:50	0.5	0.8	0.8
22.07.2015	10:43:05	0.5	0.8	0.8
22.07.2015	10:43:20	0.5	0.8	0.8
22.07.2015	10:43:35	0.5	0.8	0.8
22.07.2015	10:43:50	0.5	0.8	0.8
22.07.2015	10:44:05	0.5	0.8	0.8
22.07.2015	10:44:20	0.5	0.8	0.8
22.07.2015	10:44:35	0.5	0.8	0.8
22.07.2015	10:44:50	0.5	0.7	0.7
22.07.2015	10:45:05	0.5	0.8	0.8
22.07.2015	10:45:20	0.5	0.8	0.8
22.07.2015	10:45:35	0.5	0.8	0.8
22.07.2015	10:45:50	0.5	0.8	0.8
22.07.2015	10:46:05	0.5	0.8	0.8
22.07.2015	10:46:20	0.5	0.8	0.8
22.07.2015	10:46:35	0.5	0.8	0.8
22.07.2015	10:46:50	0.5	0.7	0.7
22.07.2015	10:47:05	0.5	0.7	0.7
22.07.2015	10:47:20	0.5	0.7	0.7
22.07.2015	10:47:35	0.5	0.7	0.7
22.07.2015	10:47:50	0.5	0.7	0.7
22.07.2015	10:48:05	0.5	0.7	0.7
22.07.2015	10:48:20	0.5	0.8	0.8
22.07.2015	10:48:35	0.5	0.7	0.7
22.07.2015	10:48:50	0.5	0.7	0.7
22.07.2015	10:49:05	0.5	0.7	0.7
22.07.2015	10:49:20	0.5	0.7	0.7
22.07.2015	10:49:35	0.5	0.8	0.8
22.07.2015	10:49:50	0.5	0.8	0.8
22.07.2015	10:50:05	0.5	0.8	0.8
22.07.2015	10:50:20	0.5	0.7	0.7
22.07.2015	10:50:35	0.5	0.7	0.7
22.07.2015	10:50:50	0.5	0.7	0.7

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
22.07.2015	10:51:05	0.5	0.7	0.7
22.07.2015	10:51:20	0.5	0.7	0.7
22.07.2015	10:51:35	0.5	0.7	0.7
22.07.2015	10:51:50	0.5	0.7	0.7
Mean		0.5	0.8	0.8
Max		1.1	1.8	1.8
Min		0.0	0.0	0.0

2.5.8 Uncertainty Calculations

Particulates

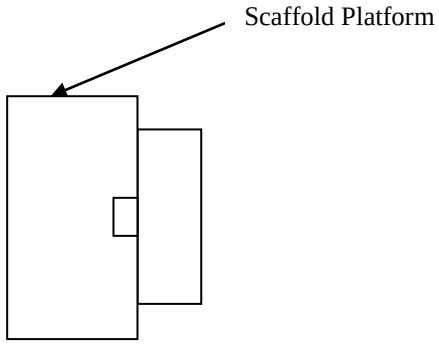
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
O_2 Concentration	1.62		
Gas Temperature	1.23		As % of result
Mass of Particulate	1.00		4.58
Humidity	0.50		
Gas Volume	0.30	2.36	As % of ELV
Nozzle Diameter	0.20		1.02
Leak	0.16		
Stack Diameter	0.14		As mg/m^3
Pressure	0.12		0.51

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	0.10		
Span gas	0.08		
Temperature effect (zero)	0.05		0.29
Barometric Pressure	0.04		
Span drift	0.03		
Temperature effect (span)	0.02	0.15	
Repeatability	0.01		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.00		
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		60.17
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		0.46

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**		
Pressure (mm H_2O)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
√ΔP	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73
Temperature (ºC)	20	20	20	20	20	20	20	20	20	20	20	20
Traverse Point	**A5**			**A6**			**A7**			**A8**		
Pressure (mm H_2O)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
√ΔP	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73
Temperature (ºC)	20	20	20	20	20	20	20	20	20	20	20	20

Static Pressure (mmH_2O)	2.5	**Barometric Pressure (mm Hg)**	760.2	**Duct Dimensions (m)**	0.25 x 0.85

Velocity (m/s) average	6.0	**Actual Flow of stack gas (m^3/hr)**	4552
Stack Geometry	Rectangular	**Flow (wet) at STP (m^3/hr)**	4242
Dimensions (m)	0.25 x 0.85	**Flow (dry) at STP (m^3/hr)**	4164
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
√ΔP (mm H_2O)^{½}	1.73	1.73	1.73	1.0	Yes
Temperature (ºC)	20.0	20.0	20.0	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	20/07/15		
Company	Leack Construction (BAE Systems)		
Contact	T Hughes		
Stack	Shot Blast		
	Blank	Test 1	Units
Sample Ref	epa.15.510.03	epa.15.511.04	-
Start Time	14:15	14:42	hr:mm
Stop Time	14:20	15:14	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	11.7	ml
B_{wo}	0.02	0.019	-
P_b	-	760.0	mm Hg
St	-	2.5	mm H_2O
T_s	-	25.00	ºC
$\sqrt{\Delta P}$	-	1.73	$(mm\ H_2O)^{½}$
Yd	-	1.013	-
Test Time	5	32	min
T_m	-	20.31	ºC
C_p	-	0.833	-
As	-	0.213	m^2
D_n	-	9.67	mm
ΔH ave	-	59.34	mm H_20
V_{mstd}	0.7715	0.7715	m^3
V_{wstd}	0.0146	0.0146	m^3
$Q_{std,wet}$	-	4137.9	Nm^3/h
Q_{act}	-	4515.7	Nm^3/h
Isokinetic Rate	-	103.1	%
Vs	-	5.90	m/s
Washings			
Sample Ref	epa.15.510.03W	epa.15.511.04W	-
Weight	<0.5	0.9	mg
Filter			
Sample Ref	epa.15.510.03F	epa.15.511.04F	-
Weight	<0.1	<0.1	mg
Particulate Concentration (Dry, No O_2 Correction)	<0.78	1.3	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	<0.77	1.3	mg/Nm^3
Particulate Release Rate	-	5.26	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	<0.5
Run 1	<0.1	0.9

2.6.5 Sampling Measurements

Date	20.07.15		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	14:42		1	894.9	895.2	0.3		**Leak Check (Pre)**	0.14	10			
End Time	15:14		2	899.8	903.2	3.4		**Leak Check (Post)**	0.08	6			
Duration (mm.ss)	32.00		3	689.8	690.1	0.3							
Stack	Paint Shop Shot Blast		4	755.2	762.9	7.7		**Pitot ID**	pitot 06			Velocity Head	
Run	1		5	252.7	252.7	0.0		**DGM ID**	dgm 09			Min	3
												Max	3
												Max:Min	1.00
								n6	n6	n6			
			Sample Ref	epa.15.511.04				**Nozzle Diameter (mm)**	9.67	9.67	9.67		
K Factor	19.78		**Filter Number**	epa.15.511.04F									
Stack Diameter (m)	0.25		**Probe Washing No**	epa.15.511.04W									
							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		3410.18	In	Out	Probe	Filter	**Impinger**
a1	0 4	4	25	3		1.73	59.34	3514	20	20	160	161	
a2	4 8	4	25	3		1.73	59.34	3602	20	20	160	160	
a3	8 12	4	25	3		1.73	59.34	3710	20	20	160	160	
a4	12 16	4	25	3		1.73	59.34	3812	21	20	161	160	
a5	16 20	4	25	3		1.73	59.34	3924	21	20	160	160	
a6	20 24	4	25	3		1.73	59.34	4018	21	20	160	160	
a7	24 28	4	25	3		1.73	59.34	4118	21	20	160	160	
a8	28 32	4	25	3		1.73	59.34	4224.23	21	20	160	160	
Total / Average		4.00	25.00	3.00		1.73	59.34	814.05	20.63	20.00	160.13	160.13	

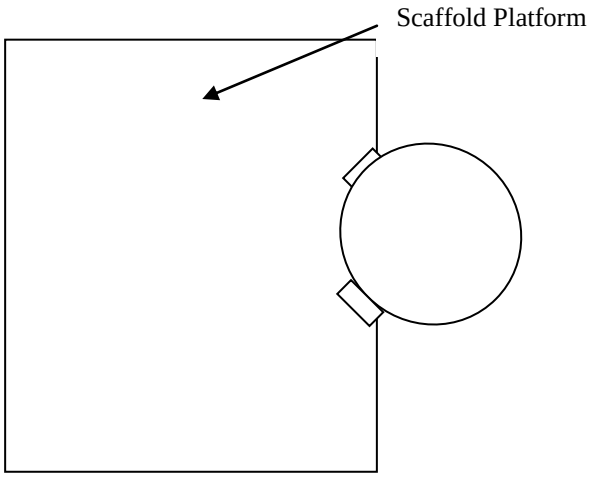
2.6.6 Uncertainty Calculations

Particulates

Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	11.84		
O_2 Concentration	1.62		As % of result
Gas Temperature	1.14		23.34
Pitot Co-efficient	0.50		
Humidity	0.50	12.03	As % of ELV
Stack Diameter	0.40		0.61
Leak	0.29		As mg/m^3
Nozzle Diameter	0.15		0.30
Pressure	0.12		

2.7 Appendix 7: Paint Shop Dryer

2.7.1 Sampling Location



Duct Characteristics

	Value	Units
Type of Duct	Circular	-
Diameter / Depth	0.35	m
Area	0.096	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	~1.5m
Size of Platform	$2.5m^2$
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

2.7.2 Flow Criteria Measurements

Traverse Point	**A1**		
Pressure (mm H_2O)	6.0	6.0	6.0
$\sqrt{\Delta P}$	2.45	2.45	2.45
Temperature (ºC)	28	28	28

Static Pressure (mmH_2O)	3	**Barometric Pressure (mm Hg)**	575.7	**Duct Dimensions (m)**	0.35

Velocity (m/s) average	8.7	**Actual Flow of stack gas (m^3/hr)**	2997
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	2711
Dimensions (m)	0.35	**Flow (dry) at STP (m^3/hr)**	2672
Area (m^2)	0.096		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	6.0	6.0	6.0	1.0	Yes
$\sqrt{\Delta P}$ (mm H_2O)^{½}	2.45	2.45	2.45	1.0	Yes
Temperature (ºC)	28.0	28.0	28.0	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	22/07/15		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	Paint Shop Dryer		
	Blank	Test 1	Units
Sample Ref	14:35	13:54	-
Start Time	14:40	14:24	hr:mm
Stop Time	20.90	20.90	hr:mm
% O_2	0.03	0.03	%
% CO_2	-	79.07	%
%N_2	-	6.2	%
V_{lc}	0.01	0.014	ml
B_{wo}	14:35	13:54	-
P_b	-	757.7	mm Hg
St	-	3	mm H_2O
T_s	-	23.50	ºC
√ΔP	-	2.45	$(mm\ H_2O)^{½}$
Yd	-	0.983	-
Test Time	-	30	min
T_m	-	23.00	ºC
C_p	-	0.823	-
As	-	0.096	m^2
D_n	-	7.09	mm
ΔH ave	-	33.48	mm H_20
V_{mstd}	0.5313	0.5313	m^3
V_{wstd}	0.0077	0.0077	m^3
$Q_{std,wet}$	-	2618.4	Nm^3/h
Q_{act}	-	2851.4	Nm^3/h
Isokinetic Rate	-	100.3	%
Vs	-	8.23	m/s
Washings			
Sample Ref	epa.15.511.14W	epa.15.511.13W	-
Weight	<0.5	2.4	mg
Filter			
Sample Ref	epa.15.511.14F	epa.15.511.13F	-
Weight	0.08	0.07	mg
Particulate Concentration (Dry, No O_2 Correction)	1.1	4.6	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	1.1	4.6	mg/Nm^3
Particulate Release Rate	-	12.00	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	0.08	<0.5
Run 1	0.07	2.4

2.7.5 Sampling Measurements

Date	22.07.15		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	13:54		1	894.5	895.3	0.8		**Leak Check (Pre)**	0.11	10			
End Time	14:24		2	899.5	899.7	0.2		**Leak Check (Post)**	0.08	7			
Duration (mm.ss)	30.00		3	683.1	683.8	0.7							
Stack	Paint Spray		4	759.3	763.8	4.5		**Pitot ID**	pitot 14			Velocity Head	
Run	1		5	252.8	252.8	0.0		**DGM ID**	dgm 09			Min	6
												Max	6
												Max:Min	1.00
								n36	n36	n36			
			Sample Ref	epa.15.511.13				**Nozzle Diameter (mm)**	7.09	7.09	7.09		
K Factor	5.58		**Filter Number**	epa.15.511.13F									
Stack Diameter (m)	0.35		**Probe Washing No**	epa.15.511.13W									
							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		7579.18	In	Out	Probe	**Filter**	**Impinger**
a1	0 5	4	25	6		2.45	33.48	7682	24	24	70		
a1	5 10	4	24	6		2.45	33.48	7777	23	23	70		
a1	10 15	4	23	6		2.45	33.48	7880	24	23	70		
a1	15 20	4	23	6		2.45	33.48	7972	23	22	70		
a1	20 25	4	23	6		2.45	33.48	8064	23	22	70		
a1	25 30	4	23	6		2.45	33.48	8164.89	23	22	70		
Total / Average		4.00	23.50	6.00		2.45	33.48	585.71	23.33	22.67	70.00		

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)	10	Ambient Air	0.00	0.00	0.00	0.00	0.08	0.08

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	10	EPA/CGAS/88	8.32	8.33	8.36	8.36	0.00

2.7.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
22.07.2015	13:54:07	0.5	0.9	0.9
22.07.2015	13:54:22	0.5	0.9	0.9
22.07.2015	13:54:37	4.9	7.9	7.9
22.07.2015	13:54:52	5.6	9.0	9.0
22.07.2015	13:55:07	5.6	9.0	9.0
22.07.2015	13:55:22	5.4	8.7	8.7
22.07.2015	13:55:37	5.3	8.5	8.5
22.07.2015	13:55:52	4.8	7.7	7.7
22.07.2015	13:56:07	4.5	7.2	7.2
22.07.2015	13:56:22	4.5	7.3	7.3
22.07.2015	13:56:37	4.6	7.3	7.3
22.07.2015	13:56:52	4.5	7.3	7.3
22.07.2015	13:57:07	4.5	7.3	7.3
22.07.2015	13:57:22	4.3	7.0	7.0
22.07.2015	13:57:37	5.4	8.7	8.7
22.07.2015	13:57:52	4.6	7.3	7.3
22.07.2015	13:58:07	4.5	7.3	7.3
22.07.2015	13:58:22	4.7	7.5	7.5
22.07.2015	13:58:37	5.3	8.6	8.6
22.07.2015	13:58:52	5.3	8.6	8.6
22.07.2015	13:59:07	5.4	8.7	8.7
22.07.2015	13:59:22	5.6	8.9	8.9
22.07.2015	13:59:37	5.3	8.6	8.6
22.07.2015	13:59:52	5.1	8.2	8.2
22.07.2015	14:00:07	5.1	8.2	8.2
22.07.2015	14:00:22	5.1	8.2	8.2
22.07.2015	14:00:37	5.2	8.3	8.3
22.07.2015	14:00:52	5.6	9.0	9.0
22.07.2015	14:01:07	5.0	8.0	8.0
22.07.2015	14:01:22	5.0	8.0	8.0

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
22.07.2015	14:01:37	5.0	8.0	8.0
22.07.2015	14:01:52	2.2	3.5	3.5
22.07.2015	14:02:07	4.7	7.6	7.6
22.07.2015	14:02:22	4.8	7.6	7.6
22.07.2015	14:02:37	4.7	7.6	7.6
22.07.2015	14:02:52	4.6	7.4	7.4
22.07.2015	14:03:07	29.1	46.8	46.8
22.07.2015	14:03:22	4.6	7.3	7.3
22.07.2015	14:03:37	4.5	7.2	7.2
22.07.2015	14:03:52	4.5	7.2	7.2
22.07.2015	14:04:07	5.2	8.3	8.3
22.07.2015	14:04:22	4.2	6.8	6.8
22.07.2015	14:04:37	4.3	7.0	7.0
22.07.2015	14:04:52	4.4	7.1	7.1
22.07.2015	14:05:07	4.4	7.1	7.1
22.07.2015	14:05:22	4.4	7.1	7.1
22.07.2015	14:05:37	4.7	7.5	7.5
22.07.2015	14:05:52	4.8	7.7	7.7
22.07.2015	14:06:07	4.7	7.5	7.5
22.07.2015	14:06:22	3.1	5.0	5.0
22.07.2015	14:06:37	4.4	7.1	7.1
22.07.2015	14:06:52	4.2	6.7	6.7
22.07.2015	14:07:07	4.1	6.6	6.6
22.07.2015	14:07:22	4.1	6.7	6.7
22.07.2015	14:07:37	4.5	7.3	7.3
22.07.2015	14:07:52	4.8	7.7	7.7
22.07.2015	14:08:07	4.4	7.1	7.1
22.07.2015	14:08:22	4.2	6.8	6.8
22.07.2015	14:08:37	4.0	6.3	6.3
22.07.2015	14:08:52	4.2	6.7	6.7
22.07.2015	14:09:07	4.1	6.6	6.6
22.07.2015	14:09:22	4.1	6.5	6.5
22.07.2015	14:09:37	4.2	6.8	6.8
22.07.2015	14:09:52	4.3	6.9	6.9
22.07.2015	14:10:07	6.8	10.9	10.9
22.07.2015	14:10:22	3.7	6.0	6.0
22.07.2015	14:10:37	4.1	6.6	6.6
22.07.2015	14:10:52	7.3	11.8	11.8
22.07.2015	14:11:07	3.8	6.1	6.1
22.07.2015	14:11:22	3.8	6.2	6.2
22.07.2015	14:11:37	3.9	6.2	6.2
22.07.2015	14:11:52	4.0	6.4	6.4
22.07.2015	14:12:07	3.9	6.3	6.3
22.07.2015	14:12:22	2.0	3.2	3.2
22.07.2015	14:12:37	3.4	5.5	5.5
22.07.2015	14:12:52	3.6	5.8	5.8
22.07.2015	14:13:07	3.4	5.5	5.5
22.07.2015	14:13:22	3.3	5.3	5.3
22.07.2015	14:13:37	3.3	5.4	5.4

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
22.07.2015	14:13:52	3.3	5.3	5.3
22.07.2015	14:14:07	3.2	5.2	5.2
22.07.2015	14:14:22	3.2	5.1	5.1
22.07.2015	14:14:37	4.7	7.5	7.5
22.07.2015	14:14:52	3.1	5.0	5.0
22.07.2015	14:15:07	3.1	5.0	5.0
22.07.2015	14:15:22	3.1	5.0	5.0
22.07.2015	14:15:37	3.1	4.9	4.9
22.07.2015	14:15:52	3.0	4.9	4.9
22.07.2015	14:16:07	3.0	4.8	4.8
22.07.2015	14:16:22	2.8	4.5	4.5
22.07.2015	14:16:37	2.7	4.4	4.4
22.07.2015	14:16:52	2.9	4.6	4.6
22.07.2015	14:17:07	3.4	5.5	5.5
22.07.2015	14:17:22	3.3	5.3	5.3
22.07.2015	14:17:37	3.7	6.0	6.0
22.07.2015	14:17:52	4.3	7.0	7.0
22.07.2015	14:18:07	1.9	3.0	3.0
22.07.2015	14:18:22	4.0	6.4	6.4
22.07.2015	14:18:37	4.1	6.6	6.6
22.07.2015	14:18:52	4.0	6.4	6.4
22.07.2015	14:19:07	4.1	6.7	6.7
22.07.2015	14:19:22	4.2	6.7	6.7
22.07.2015	14:19:37	4.5	7.3	7.3
22.07.2015	14:19:52	4.2	6.7	6.7
22.07.2015	14:20:07	4.5	7.3	7.3
22.07.2015	14:20:22	4.5	7.3	7.3
22.07.2015	14:20:37	4.9	7.9	7.9
22.07.2015	14:20:52	4.6	7.3	7.3
22.07.2015	14:21:07	4.5	7.2	7.2
22.07.2015	14:21:22	4.4	7.1	7.1
22.07.2015	14:21:37	4.4	7.0	7.0
22.07.2015	14:21:52	4.3	7.0	7.0
22.07.2015	14:22:07	4.2	6.8	6.8
22.07.2015	14:22:22	4.2	6.7	6.7
22.07.2015	14:22:37	4.0	6.4	6.4
22.07.2015	14:22:52	4.0	6.4	6.4
22.07.2015	14:23:07	4.0	6.4	6.4
22.07.2015	14:23:22	4.1	6.5	6.5
22.07.2015	14:23:37	4.2	6.8	6.8
22.07.2015	14:23:52	4.3	7.0	7.0
22.07.2015	14:24:07	4.5	7.2	7.2
22.07.2015	14:24:22	4.2	6.8	6.8
22.07.2015	14:24:37	3.9	6.2	6.2
22.07.2015	14:24:52	3.6	5.8	5.8
Mean		4.4	7.1	7.1
Max		29.1	46.8	46.8
Min		0.5	0.9	0.9

2.7.8 Uncertainty Calculations

Particulates

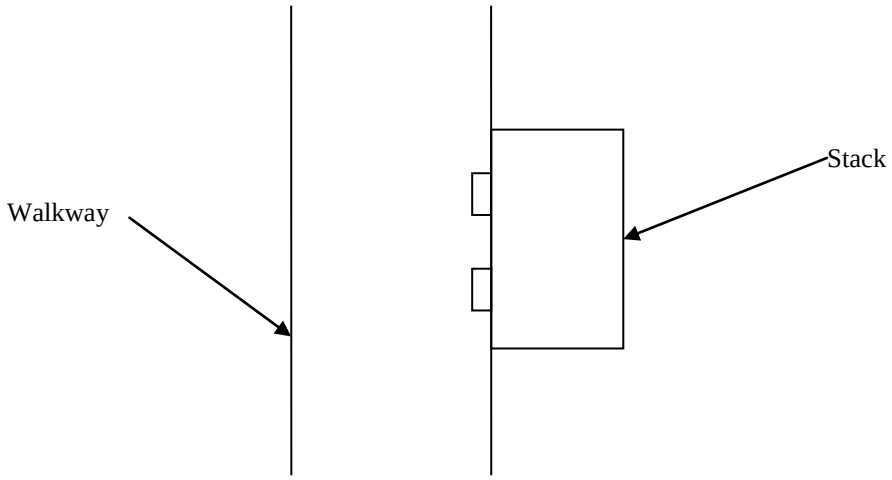
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	4.79		
O_2 Concentration	1.62		As % of result
Leak	1.15		10.37
Gas Temperature	1.00		
Pitot Co-efficient	0.50	5.35	As % of ELV
Humidity	0.50		0.96
Stack Diameter	0.29		As mg/m^3
Nozzle Diameter	0.20		0.48
Pressure	0.15		

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	0.10		
Span gas	0.08		
Temperature effect (zero)	0.05		0.29
Barometric Pressure	0.04		
Temperature effect (span)	0.02		
Zero drift	0.02	0.15	
Repeatability	0.01		**Expanded Uncertainty (95% Confidence limit) %**
Span drift	0.00		
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		6.49
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		0.46

2.8 Appendix 8: DDH Hall Paint Extract

2.8.1 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

2.8.2 Flow Criteria Measurements

Traverse Point	**A1**			**A2**		
Pressure (mm H_2O)	1.0	1.0	1.0	1.0	1.0	1.0
√ΔP	1.00	1.00	1.00	1.00	1.00	1.00
Temperature (ºC)	21	21	21	21	21	21
Traverse Point	**B1**			**B2**		
Pressure (mm H_2O)	1.0	1.0	1.0	1.0	1.0	1.0
√ΔP	1.00	1.00	1.00	1.00	1.00	1.00
Temperature (ºC)	21	21	21	21	21	21

Static Pressure (mmH_2O)	2.01	**Barometric Pressure (mm Hg)**	757.7	**Duct Dimensions (m)**	0.40 x 0.65

Velocity (m/s) average	3.4	**Actual Flow of stack gas (m^3/hr)**	2928
Stack Geometry	Rectangular	**Flow (wet) at STP (m^3/hr)**	2712
Dimensions (m)	0.40 x 0.59	**Flow (dry) at STP (m^3/hr)**	2676
Area (m^2)	0.236		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	1.0	1.0	1.0	1.0	Yes
√ΔP (mm $H_2O)^{½}$	1.00	1.00	1.00	1.0	Yes
Temperature (ºC)	21.0	21.0	21.0	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	23/07/15		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	DDH Paint Extract		
	Blank	Test 1	Units
Sample Ref	epa.15.511.15	epa.15.511.16	-
Start Time	09:16	10:23	hr:mm
Stop Time	09:21	11:55	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	0.013	-
P_b	-	757.7	mm Hg
St	-	2	mm H_2O
T_s	-	25.00	ºC
$\sqrt{\Delta P}$	-	1.00	$(mm\ H_2O)^{½}$
Yd	-	0.983	-
Test Time	-	32	min
T_m	-	22.19	ºC
C_p	-	0.833	-
As	-	0.236	m^2
D_n	-	11.68	mm
ΔH ave	-	43.10	mm H_20
V_{mstd}	0.6402	0.6402	m^3
V_{wstd}	0.0086	0.0086	m^3
$Q_{std,wet}$	-	2646.6	Nm^3/h
Q_{act}	-	2896.9	Nm^3/h
Isokinetic Rate	-	101.2	%
Vs	-	3.41	m/s
Washings			
Sample Ref	epa.15.511.15W	epa.15.511.16W	-
Weight	1	1.5	mg
Filter			
Sample Ref	epa.15.511.15F	epa.15.511.16F	-
Weight	0.04	0.5	mg
Particulate Concentration (Dry, No O_2 Correction)	1.6	3.1	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	1.6	3.1	mg/Nm^3
Particulate Release Rate	-	8.16	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	1
Run 1	0.5	1.5

2.8.5 Sampling Measurements

Date	23.07.15		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	10:23		1	895.5	894.9	-0.6		**Leak Check (Pre)**	0.12	10			
End Time	11:55		2	898.7	898.9	0.2		**Leak Check (Post)**	0.09	7			
Duration (mm.ss)	32.00		3	683.5	683.9	0.4							
Stack	DDH Hall spray paint		4	751.5	758.4	6.9		**Pitot ID**	pitot 06			Velocity Head	
Run	1		5	252.8	252.8	0.0		**DGM ID**	dgm 09			Min	1
												Max	1
												Max:Min	1.00
								n34	n34	n34			
			Sample Ref	epa.15.511.16				**Nozzle Diameter (mm)**	11.68	11.68	11.68		
K Factor	43.10		**Filter Number**	epa.15.511.16F									
Stack Diameter (m)	0.40		**Probe Washing No**	epa.15.511.16W									
							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		8225.61	In	Out	Probe	**Filter**	**Impinger**
a1	0 4	4	25	1		1.00	43.10	8316	21	21	70		
a1	4 8	4	25	1		1.00	43.10	8399	21	21	70		
a2	8 12	4	25	1		1.00	43.10	8487	21	21	70		
a2	12 16	4	25	1		1.00	43.10	8574	22	21	70		
b1	16 20	4	25	1		1.00	43.10	8660	23	21	70		
b1	20 24	4	25	1		1.00	43.10	8749	24	22	70		
b2	24 28	4	25	1		1.00	43.10	8834	25	23	70		
b2	28 32	4	25	1		1.00	43.10	8928.82	25	23	70		
Total / Average		4.00	25.00	1.00		1.00	43.10	703.21	22.75	21.63	70.00		

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	0.00	0.00	0.00	0.00	0.00

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	1000	EPA/CGAS/97	802.0	802.67	801.71	809.28	7.57

2.8.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
23.07.2015	10:23:14	220.8	354.9	354.9
23.07.2015	10:23:29	119.9	192.7	192.7
23.07.2015	10:23:44	250.5	402.6	402.6
23.07.2015	10:23:59	305.3	490.7	490.7
23.07.2015	10:24:14	332.1	533.7	533.7
23.07.2015	10:24:29	329.4	529.4	529.4
23.07.2015	10:24:44	343.6	552.2	552.2
23.07.2015	10:24:59	320.4	514.9	514.9
23.07.2015	10:25:14	329.7	529.9	529.9
23.07.2015	10:25:29	294.3	473.0	473.0
23.07.2015	10:25:44	397.6	639.0	639.0
23.07.2015	10:25:59	343.6	552.2	552.2
23.07.2015	10:26:14	284.0	456.4	456.4
23.07.2015	10:26:29	284.2	456.8	456.8
23.07.2015	10:26:44	254.2	408.5	408.5
23.07.2015	10:26:59	206.6	332.0	332.0
23.07.2015	10:27:14	304.0	488.6	488.6
23.07.2015	10:27:29	225.2	361.9	361.9
23.07.2015	10:27:44	223.7	359.5	359.5
23.07.2015	10:27:59	333.3	535.7	535.7
23.07.2015	10:28:14	365.6	587.6	587.6
23.07.2015	10:28:29	466.2	749.3	749.3
23.07.2015	10:28:44	434.2	697.8	697.8
23.07.2015	10:28:59	361.4	580.8	580.8
23.07.2015	10:29:14	355.1	570.7	570.7
23.07.2015	10:29:29	389.7	626.3	626.3
23.07.2015	10:29:44	411.5	661.3	661.3
23.07.2015	10:29:59	461.3	741.4	741.4
23.07.2015	10:30:14	480.1	771.6	771.6
23.07.2015	10:30:29	423.2	680.1	680.1

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
23.07.2015	10:30:44	426.6	685.6	685.6
23.07.2015	10:30:59	498.7	801.5	801.5
23.07.2015	10:31:14	370.7	595.8	595.8
23.07.2015	10:31:29	269.8	433.6	433.6
23.07.2015	10:31:44	348.7	560.4	560.4
23.07.2015	10:31:59	503.3	808.9	808.9
23.07.2015	10:32:14	422.7	679.3	679.3
23.07.2015	10:32:29	368.3	591.9	591.9
23.07.2015	10:32:44	442.2	710.7	710.7
23.07.2015	10:32:59	392.9	631.4	631.4
23.07.2015	10:33:14	444.2	713.9	713.9
23.07.2015	10:33:29	520.1	835.9	835.9
23.07.2015	10:33:44	390.5	627.6	627.6
23.07.2015	10:33:59	436.6	701.7	701.7
23.07.2015	10:34:14	487.9	784.1	784.1
23.07.2015	10:34:29	448.1	720.2	720.2
23.07.2015	10:34:44	412.2	662.5	662.5
23.07.2015	10:34:59	489.6	786.9	786.9
23.07.2015	10:35:14	495.0	795.5	795.5
23.07.2015	10:35:29	503.8	809.7	809.7
23.07.2015	10:35:44	469.6	754.7	754.7
23.07.2015	10:35:59	346.0	556.1	556.1
23.07.2015	10:36:14	501.8	806.5	806.5
23.07.2015	10:36:29	597.8	960.8	960.8
23.07.2015	10:36:44	546.3	878.0	878.0
23.07.2015	10:36:59	516.7	830.4	830.4
23.07.2015	10:37:14	573.9	922.3	922.3
23.07.2015	10:37:29	565.8	909.3	909.3
23.07.2015	10:37:44	588.3	945.5	945.5
23.07.2015	10:37:59	642.7	1032.9	1032.9
23.07.2015	10:38:14	665.0	1068.8	1068.8
23.07.2015	10:38:29	446.2	717.1	717.1
23.07.2015	10:38:44	304.3	489.1	489.1
23.07.2015	10:38:59	302.8	486.6	486.6
23.07.2015	10:39:14	355.6	571.5	571.5
23.07.2015	10:39:29	293.8	472.2	472.2
23.07.2015	10:42:44	336.3	540.5	540.5
23.07.2015	10:42:59	421.7	677.7	677.7
23.07.2015	10:43:14	517.2	831.2	831.2
23.07.2015	10:43:29	546.8	878.8	878.8
23.07.2015	10:43:44	621.0	998.0	998.0
23.07.2015	10:43:59	588.0	945.0	945.0
23.07.2015	10:44:14	274.7	441.5	441.5
23.07.2015	10:44:29	129.7	208.4	208.4
23.07.2015	10:44:44	104.5	167.9	167.9
23.07.2015	10:44:59	271.1	435.7	435.7
23.07.2015	10:45:14	415.1	667.1	667.1
23.07.2015	10:45:29	440.3	707.6	707.6
23.07.2015	10:45:44	526.0	845.4	845.4

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
23.07.2015	10:45:59	485.0	779.5	779.5
23.07.2015	10:46:14	348.7	560.4	560.4
23.07.2015	10:46:29	271.1	435.7	435.7
23.07.2015	10:46:44	316.2	508.2	508.2
23.07.2015	10:46:59	339.7	545.9	545.9
23.07.2015	10:47:14	322.8	518.8	518.8
23.07.2015	10:47:29	273.3	439.2	439.2
23.07.2015	10:47:44	273.0	438.8	438.8
23.07.2015	10:47:59	268.6	431.7	431.7
23.07.2015	10:48:14	246.2	395.7	395.7
23.07.2015	10:48:29	237.9	382.3	382.3
23.07.2015	10:48:44	252.5	405.8	405.8
23.07.2015	10:48:59	246.9	396.8	396.8
23.07.2015	10:49:14	244.2	392.5	392.5
23.07.2015	10:49:29	283.5	455.6	455.6
23.07.2015	10:49:44	306.7	492.9	492.9
23.07.2015	10:49:59	310.9	499.7	499.7
23.07.2015	10:50:14	373.6	600.4	600.4
23.07.2015	10:50:29	419.3	673.9	673.9
23.07.2015	10:50:44	389.7	626.3	626.3
23.07.2015	10:50:59	475.2	763.7	763.7
23.07.2015	10:51:14	505.3	812.1	812.1
23.07.2015	10:51:29	491.6	790.1	790.1
23.07.2015	10:51:44	485.5	780.3	780.3
23.07.2015	10:51:59	494.7	795.1	795.1
23.07.2015	10:52:14	518.7	833.6	833.6
23.07.2015	10:52:29	541.9	870.9	870.9
23.07.2015	10:52:44	526.5	846.2	846.2
23.07.2015	10:52:59	468.4	752.8	752.8
23.07.2015	10:53:14	551.9	887.0	887.0
23.07.2015	10:53:29	550.2	884.3	884.3
23.07.2015	10:53:44	506.0	813.2	813.2
23.07.2015	10:53:59	591.2	950.1	950.1
23.07.2015	10:54:14	586.6	942.8	942.8
23.07.2015	10:54:29	485.0	779.5	779.5
23.07.2015	10:54:44	468.9	753.6	753.6
23.07.2015	10:54:59	551.4	886.2	886.2
23.07.2015	10:55:14	537.0	863.0	863.0
23.07.2015	10:55:29	568.3	913.3	913.3
23.07.2015	10:55:44	612.0	983.6	983.6
23.07.2015	10:55:59	536.8	862.7	862.7
23.07.2015	10:56:14	508.9	817.9	817.9
23.07.2015	10:56:29	536.5	862.2	862.2
23.07.2015	10:56:44	377.5	606.7	606.7
23.07.2015	10:56:59	444.0	713.6	713.6
23.07.2015	10:57:14	351.6	565.1	565.1
23.07.2015	10:57:29	182.9	293.9	293.9
23.07.2015	10:57:44	74.5	119.7	119.7
23.07.2015	10:57:59	74.0	118.9	118.9

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
23.07.2015	10:58:14	398.5	640.4	640.4
23.07.2015	10:58:29	428.8	689.1	689.1
23.07.2015	10:58:44	346.8	557.4	557.4
23.07.2015	10:58:59	402.2	646.4	646.4
Mean		400.2	643.1	643.1
Max		665.0	1068.8	1068.8
Min		74.0	118.9	118.9

2.8.8 Uncertainty Calculations

Particulates

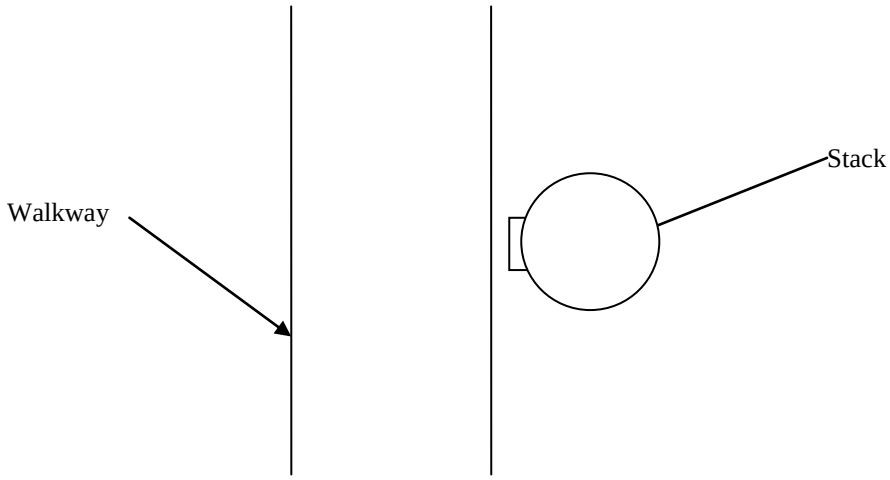
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	4.19		
O_2 Concentration	1.62		As % of result
Gas Temperature	1.04		9.05
Humidity	0.50		
Gas Volume	0.30	4.66	As % of ELV
Leak	0.28		0.57
Stack Diameter	0.25		
Pressure	0.13		As mg/m^3
Nozzle Diameter	0.12		0.28

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	9.62		
Temperature effect (zero)	4.63		
Barometric Pressure	4.01		24.01
Span gas	3.52		
Temperature effect (span)	2.32		
Span drift	2.19	12.38	
Repeatability	0.69		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.00		
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		6.00
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		38.59

2.9 Appendix 9: DDH Hall Tile Adhesive

2.9.1 Sampling Location



Duct Characteristics

	Value	Units
Type of Duct	Circular	-
Diameter / Depth	0.29	m
Area	0.066	m^2
Port Size	4	inch
Port Depth	50	mm
Orientation	Vertical	-

Sampling Platform

General Platform Information	
Permanent / Temporary	Permament
Inside / Outside	Inside
Height of Platform from Ground Level	~25m
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

2.9.2 Flow Criteria Measurements

Traverse Point	**A1**		
Pressure (mm H_2O)	21.0	21.0	21.0
$\sqrt{\Delta P}$	4.58	4.58	4.58
Temperature (ºC)	23	23	23

Static Pressure (mmH_2O)	70.0	**Barometric Pressure (mm Hg)**	757.7	**Duct Dimensions (m)**	0.29

Velocity (m/s) average	15.9	**Actual Flow of stack gas (m^3/hr)**	3792
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	3510
Dimensions (m)	0.29	**Flow (dry) at STP (m^3/hr)**	3472
Area (m^2)	0.066		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	21.0	21.0	21.0	1.0	Yes
$\sqrt{\Delta P}$ (mm H_2O)^{½}	4.58	4.58	4.58	1.0	Yes
Temperature (ºC)	23.0	23.0	23.0	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	23/07/15		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	DDH Tile Adhesive		
	Blank	Test 1	Units
Sample Ref	epa.15.511.17	epa.15.511.18	-
Start Time	12:15	12:48	hr:mm
Stop Time	12:20	13:18	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	7.1	ml
B_{wo}	0.01	0.011	-
P_b	-	757.7	mm Hg
St	-	70	mm H_2O
T_s	-	23.67	ºC
$\sqrt{\Delta P}$	-	4.85	$(mm\ H_2O)^{½}$
Yd	-	1.013	-
Test Time	-	30	min
T_m	-	23.83	ºC
C_p	-	0.825	-
As	-	0.066	m^2
D_n	-	6.21	mm
ΔH ave	-	77.26	mm H_20
V_{mstd}	0.8084	0.8084	m^3
V_{wstd}	0.0088	0.0088	m^3
$Q_{std,wet}$	-	3573.3	Nm^3/h
Q_{act}	-	3868.3	Nm^3/h
Isokinetic Rate	-	99.7	%
Vs	-	16.27	m/s
Washings			
Sample Ref	epa.15.511.17W	epa.15.511.18W	-
Weight	0.8	0.8	mg
Filter			
Sample Ref	epa.15.511.17F	epa.15.511.18F	-
Weight	0.3	0.2	mg
Particulate Concentration (Dry, No O_2 Correction)	1.4	1.2	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	1.4	1.2	mg/Nm^3
Particulate Release Rate	-	4.37	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	0.3	0.8
Run 1	0.2	0.8

2.9.5 Sampling Measurements

Date	23.07.15		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	12:48		1	894.9	895.3	0.4		**Leak Check (Pre)**	0.12	10			
End Time	13:18		2	898.9	898.9	0.0		**Leak Check (Post)**	0.11	10			
Duration (mm.ss)	30.00		3	683.9	684.7	0.8							
Stack	Tile Adhesive		4	758.4	764.3	5.9		**Pitot ID**	pitot 06			Velocity Head	
Run	1		5	252.8	252.8	0.0		**DGM ID**	dgm 09			Min	21
												Max	24
												Max:Min	1.14
								Nozzle ID	n30				
			Sample Ref	epa.15.511.18				**Nozzle Diameter (mm)**	6.21				
K Factor	3.29		**Filter Number**	epa.15.511.18F									
Stack Diameter (m)	0.29		**Probe Washing No**	epa.15.511.18W									
							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		8976.51	In	Out	Probe	**Filter**	**Impinger**
a1	0 5	5	24	21		4.58	69.04	9110	23	23	160		
a1	5 10	5	23	24		4.90	78.91	9250	23	23	160		
a1	10 15	5	23	24		4.90	78.91	9428	24	24	160		
a1	15 20	5	24	24		4.90	78.91	9552	24	24	160		
a1	20 25	5	24	24		4.90	78.91	9694	25	24	160		
a1	25 30	5	24	24		4.90	78.91	9840.72	25	24	160		
a1	0 5	5	24	21		4.58	69.04	9110	23	23	160		
a1	5 10	5	23	24		4.90	78.91	9250	23	23	160		
Total / Average		5.00	23.67	23.50		4.85	77.26	864.21	24.00	23.67	160.00		

2.9.6 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	0.00	0.00	0.00	0.00	0.00

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	100	EPA/CGAS/98	80.20	80.57	79.12	80.08	0.96

2.9.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
23.07.2015	12:48:08	57.0	91.6	91.6
23.07.2015	12:48:23	61.7	99.2	99.2
23.07.2015	12:48:38	38.6	62.0	62.0
23.07.2015	12:48:53	34.9	56.1	56.1
23.07.2015	12:49:08	30.6	49.2	49.2
23.07.2015	12:49:23	24.8	39.9	39.9
23.07.2015	12:49:38	28.3	45.5	45.5
23.07.2015	12:49:53	21.7	34.9	34.9
23.07.2015	12:50:08	19.7	31.7	31.7
23.07.2015	12:50:23	18.4	29.6	29.6
23.07.2015	12:50:38	15.3	24.6	24.6
23.07.2015	12:50:53	13.2	21.2	21.2
23.07.2015	12:51:08	11.8	19.0	19.0
23.07.2015	12:51:23	14.3	23.0	23.0
23.07.2015	12:51:38	12.6	20.3	20.3
23.07.2015	12:51:53	8.7	14.0	14.0
23.07.2015	12:52:08	8.9	14.4	14.4
23.07.2015	12:52:23	9.8	15.8	15.8
23.07.2015	12:52:38	8.3	13.3	13.3
23.07.2015	12:52:53	7.2	11.6	11.6
23.07.2015	12:53:08	8.5	13.7	13.7
23.07.2015	12:53:23	7.2	11.5	11.5
23.07.2015	12:53:38	8.1	13.1	13.1
23.07.2015	12:53:53	6.7	10.8	10.8
23.07.2015	12:54:08	5.5	8.9	8.9
23.07.2015	12:54:23	7.5	12.1	12.1
23.07.2015	12:54:38	6.1	9.9	9.9
23.07.2015	12:54:53	5.6	9.0	9.0
23.07.2015	12:55:08	5.5	8.9	8.9
23.07.2015	12:55:23	5.8	9.3	9.3

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
23.07.2015	12:55:38	5.9	9.4	9.4
23.07.2015	12:55:53	5.5	8.8	8.8
23.07.2015	12:56:08	6.2	10.0	10.0
23.07.2015	12:56:23	5.3	8.5	8.5
23.07.2015	12:56:38	4.5	7.2	7.2
23.07.2015	12:56:53	4.1	6.6	6.6
23.07.2015	12:57:08	4.4	7.1	7.1
23.07.2015	12:57:23	4.7	7.6	7.6
23.07.2015	12:57:38	4.1	6.6	6.6
23.07.2015	12:57:53	3.6	5.8	5.8
23.07.2015	12:58:08	5.1	8.2	8.2
23.07.2015	12:58:23	3.5	5.7	5.7
23.07.2015	12:58:38	3.9	6.2	6.2
23.07.2015	12:58:53	3.3	5.3	5.3
23.07.2015	12:59:08	3.2	5.1	5.1
23.07.2015	12:59:23	3.0	4.9	4.9
23.07.2015	12:59:38	3.2	5.1	5.1
23.07.2015	12:59:53	3.0	4.8	4.8
23.07.2015	13:00:08	3.2	5.1	5.1
23.07.2015	13:00:23	4.0	6.5	6.5
23.07.2015	13:00:38	3.3	5.4	5.4
23.07.2015	13:00:53	2.7	4.4	4.4
23.07.2015	13:01:08	2.8	4.5	4.5
23.07.2015	13:01:23	2.7	4.3	4.3
23.07.2015	13:01:38	2.8	4.5	4.5
23.07.2015	13:01:53	2.1	3.3	3.3
23.07.2015	13:02:08	2.7	4.4	4.4
23.07.2015	13:02:23	2.0	3.3	3.3
23.07.2015	13:02:38	2.1	3.3	3.3
23.07.2015	13:02:53	2.1	3.4	3.4
23.07.2015	13:03:08	2.5	4.1	4.1
23.07.2015	13:03:23	1.9	3.0	3.0
23.07.2015	13:03:38	2.1	3.4	3.4
23.07.2015	13:03:53	1.9	3.0	3.0
23.07.2015	13:04:08	2.5	4.1	4.1
23.07.2015	13:04:23	1.9	3.1	3.1
23.07.2015	13:04:38	1.9	3.0	3.0
23.07.2015	13:04:53	2.0	3.2	3.2
23.07.2015	13:05:08	1.6	2.5	2.5
23.07.2015	13:05:23	1.9	3.1	3.1
23.07.2015	13:05:38	1.9	3.0	3.0
23.07.2015	13:05:53	1.6	2.6	2.6
23.07.2015	13:06:08	1.9	3.0	3.0
23.07.2015	13:06:23	1.8	3.0	3.0
23.07.2015	13:06:38	1.6	2.5	2.5
23.07.2015	13:06:53	1.5	2.4	2.4
23.07.2015	13:07:08	1.5	2.4	2.4
23.07.2015	13:07:23	1.3	2.1	2.1
23.07.2015	13:07:38	1.0	1.5	1.5

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
23.07.2015	13:07:53	1.4	2.2	2.2
23.07.2015	13:08:08	1.5	2.5	2.5
23.07.2015	13:08:23	1.3	2.1	2.1
23.07.2015	13:08:38	1.2	1.8	1.8
23.07.2015	13:08:53	1.2	1.9	1.9
23.07.2015	13:09:08	1.2	2.0	2.0
23.07.2015	13:09:23	1.1	1.7	1.7
23.07.2015	13:09:38	1.1	1.7	1.7
23.07.2015	13:09:53	1.1	1.8	1.8
23.07.2015	13:10:08	1.4	2.3	2.3
23.07.2015	13:10:23	1.2	1.9	1.9
23.07.2015	13:10:38	1.1	1.8	1.8
23.07.2015	13:10:53	1.2	1.9	1.9
23.07.2015	13:11:08	1.3	2.1	2.1
23.07.2015	13:11:23	1.4	2.2	2.2
23.07.2015	13:11:38	1.4	2.3	2.3
23.07.2015	13:11:53	1.2	1.9	1.9
23.07.2015	13:12:08	1.1	1.8	1.8
23.07.2015	13:12:23	0.9	1.5	1.5
23.07.2015	13:12:38	0.9	1.4	1.4
23.07.2015	13:12:53	1.0	1.7	1.7
23.07.2015	13:13:08	1.1	1.7	1.7
23.07.2015	13:13:23	0.9	1.4	1.4
23.07.2015	13:13:38	0.8	1.3	1.3
23.07.2015	13:13:53	0.6	1.0	1.0
23.07.2015	13:14:08	0.7	1.1	1.1
23.07.2015	13:14:23	0.8	1.2	1.2
23.07.2015	13:14:38	0.8	1.3	1.3
23.07.2015	13:14:53	0.6	0.9	0.9
23.07.2015	13:15:08	0.7	1.2	1.2
23.07.2015	13:15:23	0.9	1.4	1.4
23.07.2015	13:15:38	0.6	0.9	0.9
23.07.2015	13:15:53	0.6	0.9	0.9
23.07.2015	13:16:08	0.8	1.4	1.4
23.07.2015	13:16:23	0.7	1.1	1.1
23.07.2015	13:16:38	0.5	0.8	0.8
23.07.2015	13:16:53	0.7	1.1	1.1
23.07.2015	13:17:08	0.6	0.9	0.9
23.07.2015	13:17:23	0.6	0.9	0.9
23.07.2015	13:17:38	0.4	0.7	0.7
23.07.2015	13:17:53	0.6	0.9	0.9
23.07.2015	13:18:08	0.5	0.8	0.8
23.07.2015	13:18:23	0.6	1.0	1.0
23.07.2015	13:18:38	0.5	0.8	0.8
23.07.2015	13:18:53	0.6	0.9	0.9
Mean		5.6	9.0	9.0
Max		61.7	99.2	99.2
Min		0.4	0.7	0.7

2.9.8 Uncertainty Calculations

Particulates

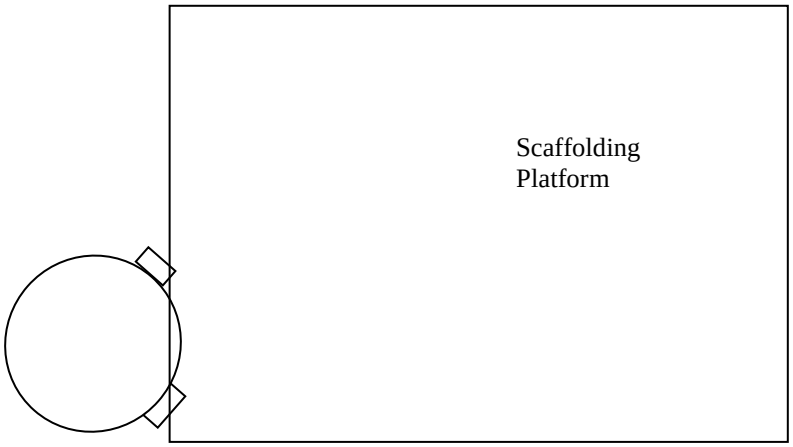
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	11.84		
O_2 Concentration	1.62		As % of result
Gas Temperature	0.97		23.31
Pitot Co-efficient	0.50		
Humidity	0.50	12.02	As % of ELV
Stack Diameter	0.34		0.58
Leak	0.24		As mg/m^3
Nozzle Diameter	0.23		0.29
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	0.96		
Temperature effect (zero)	0.46		
Barometric Pressure	0.40		2.42
Span gas	0.35		
Span drift	0.28		
Temperature effect (span)	0.23	1.25	
Repeatability	0.07		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.00		
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		43.14
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		3.89

2.10 Appendix 8: NAS Annex

2.10.1 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	50	mm
Orientation	Vertical	-

Sampling Platform

General Platform Information	
Permanent / Temporary	Temporary
Inside / Outside	Inside
Height of Platform from Ground Level	~8m
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

2.10.2 Flow Criteria Measurements

Traverse Point	**A1**			**A2**		
Pressure (mm H_2O)	10.0	10.0	10.0	8.0	8.0	8.0
$\sqrt{\Delta P}$	3.16	3.16	3.16	2.83	2.83	2.83
Temperature (ºC)	25	25	25	25	25	25
Traverse Point	**B1**			**B2**		
Pressure (mm H_2O)	8.0	8.0	8.0	9.0	9.0	9.0
$\sqrt{\Delta P}$	2.83	2.83	2.83	3.00	3.00	3.00
Temperature (ºC)	25	25	25	25	25	25

Static Pressure (mmH_2O)	21	**Barometric Pressure (mm Hg)**	757.7	**Duct Dimensions (m)**	0.45

Velocity (m/s) average	10.4	**Actual Flow of stack gas (m^3/hr)**	5934
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	5431
Dimensions (m)	0.45	**Flow (dry) at STP (m^3/hr)**	5305
Area (m^2)	0.159		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	8.8	10.0	8.0	1.3	Yes
$\sqrt{\Delta P}$ (mm $H_2O)^{½}$	2.95	3.16	2.83	1.1	Yes
Temperature (ºC)	25.0	25.0	25.0	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	24/07/15		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	NAS Annex		
	Blank	Test 1	Units
Sample Ref	epa.15.511.21	epa.15.511.22	-
Start Time	10:46	11:02	hr:mm
Stop Time	10:51	11:35	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	13.21	ml
B_{wo}	0.02	0.023	-
P_b	-	757.7	mm Hg
St	-	21	mm H_2O
T_s	-	27.63	ºC
$\sqrt{\Delta P}$	-	2.91	$(mm\ H_2O)^{½}$
Yd	-	1.013	-
Test Time	5	32	min
T_m	-	21.81	ºC
C_p	-	0.825	-
As	-	0.159	m^2
D_n	-	7.09	mm
ΔH ave	-	46.94	mm H_20
V_{mstd}	0.6903	0.6903	m^3
V_{wstd}	0.0164	0.0164	m^3
$Q_{std,wet}$	-	5139.6	Nm^3/h
Q_{act}	-	5665.0	Nm^3/h
Isokinetic Rate	-	103.9	%
Vs	-	9.89	m/s
Washings			
Sample Ref	epa.15.511.21W	epa.15.511.22W	-
Weight	<0.5	0.9	mg
Filter			
Sample Ref	epa.15.511.21F	epa.15.511.22F	-
Weight	0.07	0.3	mg
Particulate Concentration (Dry, No O_2 Correction)	0.8	1.7	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	0.8	1.7	mg/Nm^3
Particulate Release Rate	-	8.73	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	0.07	<0.5
Run 1	0.3	0.9

2.10.5 Sampling Measurements

Date	24.07.15		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	11:02		1	887.7	888.3	0.6		**Leak Check (Pre)**	0.09	10			
End Time	11:35		2	896.0	897.0	1.0		**Leak Check (Post)**	0.07	6			
Duration (mm.ss)	32.00		3	682.8	684.8	2.0							
Stack	Nas Annex		4	775.2	784.8	9.6		**Pitot ID**	pitot 14			Velocity Head	
Run	1		5	252.8	252.8	0.0		**DGM ID**	dgm 09			Min	8
												Max	9
												Max:Min	1.13
Break Start	11:18							Nozzle ID	n36				
Break Stop	11:19		**Sample Ref**	epa.15.511.22				**Nozzle Diameter (mm)**	7.09				
K Factor	5.52		**Filter Number**	epa.15.511.22F									
Stack Diameter (m)	0.45		**Probe Washing No**	epa.15.511.22W									
							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**		772.21	In	Out	Probe	**Filter**	**Impinger**
a1	0 4	4	28	8		2.83	44.18	863	21	21	70		
a1	4 8	4	28	8		2.83	44.18	964	21	21	70		
a2	8 12	4	28	9		3.00	49.70	1048	22	22	70		
a2	12 16	4	27	9		3.00	49.70	1144	22	22	70		
b1	16 20	4	27	9		3.00	49.70	1235	22	22	70		
b1	20 24	4	27	9		3.00	49.70	1325	22	22	70		
b2	24 28	4	28	8		2.83	44.18	1411	22	22	70		
b2	28 32	4	28	8		2.83	44.18	1507.35	23	22	70		
Total / Average		4.00	27.63	8.50		2.91	46.94	735.14	21.88	21.75	70.00		

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	0.00	0.00	0.00	0.00	0.00

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	1000	EPA/CGAS/97	802.0	807.57	810.26	814.16	3.90

2.10.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
24.07.2015	11:02:13	297.9	478.8	478.8
24.07.2015	11:02:28	290.4	466.7	466.7
24.07.2015	11:02:43	214.9	345.4	345.4
24.07.2015	11:02:58	208.3	334.8	334.8
24.07.2015	11:03:13	189.5	304.6	304.6
24.07.2015	11:03:28	184.9	297.2	297.2
24.07.2015	11:03:43	157.0	252.3	252.3
24.07.2015	11:03:58	166.8	268.1	268.1
24.07.2015	11:04:13	182.4	293.1	293.1
24.07.2015	11:04:28	163.6	262.9	262.9
24.07.2015	11:04:43	189.5	304.6	304.6
24.07.2015	11:04:58	207.6	333.6	333.6
24.07.2015	11:05:13	213.9	343.8	343.8
24.07.2015	11:05:28	199.3	320.3	320.3
24.07.2015	11:05:43	190.7	306.5	306.5
24.07.2015	11:05:58	176.6	283.8	283.8
24.07.2015	11:06:13	180.2	289.6	289.6
24.07.2015	11:06:28	202.9	326.1	326.1
24.07.2015	11:06:43	198.8	319.5	319.5
24.07.2015	11:06:58	172.4	277.1	277.1
24.07.2015	11:07:13	190.0	305.4	305.4
24.07.2015	11:07:28	200.0	321.4	321.4
24.07.2015	11:07:43	194.6	312.8	312.8
24.07.2015	11:07:58	186.8	300.2	300.2
24.07.2015	11:08:13	165.8	266.5	266.5
24.07.2015	11:08:28	192.4	309.2	309.2
24.07.2015	11:08:43	190.7	306.5	306.5
24.07.2015	11:08:58	200.2	321.8	321.8
24.07.2015	11:09:13	203.2	326.6	326.6
24.07.2015	11:09:28	174.6	280.6	280.6

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
24.07.2015	11:09:43	181.7	292.0	292.0
24.07.2015	11:09:58	204.9	329.3	329.3
24.07.2015	11:10:13	224.7	361.1	361.1
24.07.2015	11:10:28	183.9	295.6	295.6
24.07.2015	11:10:43	141.9	228.1	228.1
24.07.2015	11:10:58	180.2	289.6	289.6
24.07.2015	11:11:13	205.9	330.9	330.9
24.07.2015	11:11:28	173.6	279.0	279.0
24.07.2015	11:11:43	166.3	267.3	267.3
24.07.2015	11:11:58	142.6	229.2	229.2
24.07.2015	11:12:13	196.3	315.5	315.5
24.07.2015	11:12:28	221.0	355.2	355.2
24.07.2015	11:12:43	218.1	350.5	350.5
24.07.2015	11:12:58	232.2	373.2	373.2
24.07.2015	11:13:13	179.7	288.8	288.8
24.07.2015	11:13:28	202.2	325.0	325.0
24.07.2015	11:13:43	184.9	297.2	297.2
24.07.2015	11:13:58	164.6	264.5	264.5
24.07.2015	11:14:13	170.9	274.7	274.7
24.07.2015	11:14:28	163.6	262.9	262.9
24.07.2015	11:14:43	152.4	244.9	244.9
24.07.2015	11:14:58	181.4	291.5	291.5
24.07.2015	11:15:13	236.4	379.9	379.9
24.07.2015	11:15:28	218.1	350.5	350.5
24.07.2015	11:15:43	222.7	357.9	357.9
24.07.2015	11:15:58	205.4	330.1	330.1
24.07.2015	11:16:13	204.9	329.3	329.3
24.07.2015	11:16:28	114.0	183.2	183.2
24.07.2015	11:16:43	171.4	275.5	275.5
24.07.2015	11:16:58	154.6	248.5	248.5
24.07.2015	11:17:13	147.0	236.3	236.3
24.07.2015	11:17:28	134.3	215.8	215.8
24.07.2015	11:17:43	180.5	290.1	290.1
24.07.2015	11:17:58	209.8	337.2	337.2
24.07.2015	11:18:13	155.8	250.4	250.4
24.07.2015	11:18:28	167.8	269.7	269.7
24.07.2015	11:19:43	138.9	223.2	223.2
24.07.2015	11:19:58	168.5	270.8	270.8
24.07.2015	11:20:13	141.9	228.1	228.1
24.07.2015	11:20:28	152.1	244.4	244.4
24.07.2015	11:20:43	154.3	248.0	248.0
24.07.2015	11:20:58	184.9	297.2	297.2
24.07.2015	11:21:13	154.1	247.7	247.7
24.07.2015	11:21:28	159.5	256.3	256.3
24.07.2015	11:21:43	132.4	212.8	212.8
24.07.2015	11:21:58	162.4	261.0	261.0
24.07.2015	11:22:13	170.9	274.7	274.7
24.07.2015	11:22:28	193.2	310.5	310.5
24.07.2015	11:22:43	138.9	223.2	223.2

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
24.07.2015	11:22:58	109.2	175.5	175.5
24.07.2015	11:23:13	123.3	198.2	198.2
24.07.2015	11:23:28	116.5	187.2	187.2
24.07.2015	11:23:43	145.5	233.8	233.8
24.07.2015	11:23:58	155.3	249.6	249.6
24.07.2015	11:24:13	145.3	233.5	233.5
24.07.2015	11:24:28	168.0	270.0	270.0
24.07.2015	11:24:43	193.4	310.8	310.8
24.07.2015	11:24:58	174.6	280.6	280.6
24.07.2015	11:25:13	181.9	292.3	292.3
24.07.2015	11:25:28	172.2	276.8	276.8
24.07.2015	11:25:43	185.6	298.3	298.3
24.07.2015	11:25:58	175.3	281.7	281.7
24.07.2015	11:26:13	159.0	255.5	255.5
24.07.2015	11:26:28	197.3	317.1	317.1
24.07.2015	11:26:43	204.4	328.5	328.5
24.07.2015	11:26:58	224.4	360.6	360.6
24.07.2015	11:27:13	169.5	272.4	272.4
24.07.2015	11:27:28	174.8	280.9	280.9
24.07.2015	11:27:43	168.7	271.1	271.1
24.07.2015	11:27:58	202.0	324.6	324.6
24.07.2015	11:28:13	155.6	250.1	250.1
24.07.2015	11:28:28	193.7	311.3	311.3
24.07.2015	11:28:43	223.4	359.0	359.0
24.07.2015	11:28:58	194.6	312.8	312.8
24.07.2015	11:29:13	72.5	116.5	116.5
24.07.2015	11:29:28	133.1	213.9	213.9
24.07.2015	11:29:43	203.2	326.6	326.6
24.07.2015	11:29:58	189.5	304.6	304.6
24.07.2015	11:30:13	201.7	324.2	324.2
24.07.2015	11:30:28	201.5	323.8	323.8
24.07.2015	11:30:43	198.8	319.5	319.5
24.07.2015	11:30:58	192.4	309.2	309.2
24.07.2015	11:31:13	196.8	316.3	316.3
24.07.2015	11:31:28	168.5	270.8	270.8
24.07.2015	11:31:43	164.6	264.5	264.5
24.07.2015	11:31:58	167.8	269.7	269.7
24.07.2015	11:32:13	202.2	325.0	325.0
24.07.2015	11:32:28	165.6	266.1	266.1
24.07.2015	11:32:43	152.1	244.4	244.4
24.07.2015	11:32:58	127.7	205.2	205.2
24.07.2015	11:33:13	184.4	296.4	296.4
24.07.2015	11:33:28	207.6	333.6	333.6
24.07.2015	11:33:43	180.2	289.6	289.6
24.07.2015	11:33:58	170.7	274.3	274.3
24.07.2015	11:34:13	193.7	311.3	311.3
24.07.2015	11:34:28	209.8	337.2	337.2
24.07.2015	11:34:43	149.7	240.6	240.6
24.07.2015	11:34:58	208.5	335.1	335.1

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C @ Ref O_2 mg/m^3
24.07.2015	11:35:13	192.4	309.2	309.2
24.07.2015	11:35:28	178.3	286.6	286.6
24.07.2015	11:35:43	150.4	241.7	241.7
24.07.2015	11:35:58	158.7	255.1	255.1
Mean		180.1	289.4	289.4
Max		297.9	478.8	478.8
Min		72.5	116.5	116.5

2.10.8 Uncertainty Calculations

Particulates

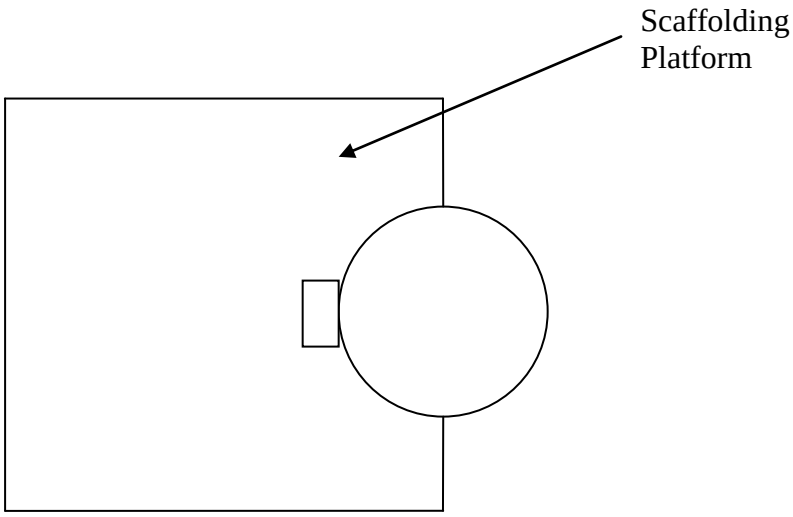
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	6.98		
O_2 Concentration	1.62		As % of result
Gas Temperature	1.06		14.11
Humidity	0.50		
Gas Volume	0.30	7.27	As % of ELV
Stack Diameter	0.22		0.49
Leak	0.21		
Nozzle Diameter	0.20		As mg/m^3
Pressure	0.13		0.25

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	9.62		
Temperature effect (zero)	4.63		
Barometric Pressure	4.01		23.73
Span gas	3.52		
Temperature effect (span)	2.32		
Span drift	1.13	12.23	
Repeatability	0.69		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.00		
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		13.18
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		38.14

2.11 Appendix 11: DDH Tile Cutting Facility

2.11.1 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

2.11.2 Flow Criteria Measurements

Traverse Point	**A1**		
Pressure (mm H_2O)	9.4	9.4	9.4
√ΔP	3.07	3.07	3.07
Temperature (ºC)	25	25	25

Static Pressure (mmH_2O)	12.0	**Barometric Pressure (mm Hg)**	752.5	**Duct Dimensions (m)**	0.245

Velocity (m/s) average	10.8	**Actual Flow of stack gas (m^3/hr)**	1832
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	1664
Dimensions (m)	0.245	**Flow (dry) at STP (m^3/hr)**	1566
Area (m^2)	0.047		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	9.4	9.4	9.4	1.0	Yes
√ΔP (mm H_2O)^{½}	3.07	3.07	3.07	1.0	Yes
Temperature (ºC)	25.0	25.0	25.0	1.0	Yes
Angle of flow	<15º				Yes
Local Negative Flow	No				Yes

2.11.3 Gas Measurements

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

2.11.4 Manual Method Calculations

Test Dates	21/07/15		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	Tile Cutting Facility		
	Blank	Test 1	Units
Sample Ref	epa/15/511/05	epa/15/511/06	-
Start Time	10:10	10:40	hr:mm
Stop Time	10:15	11:10	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	33.9	ml
B_{wo}	0.06	0.059	-
P_b	-	752.5	mm Hg
St	-	12	mm H_2O
T_s	-	26.00	ºC
$\sqrt{\Delta P}$	-	3.07	$(mm\ H_2O)^{½}$
Yd	-	1.013	-
Test Time	-	30	min
T_m	-	18.92	ºC
C_p	-	0.828	-
As	-	0.047	m^2
D_n	-	7.09	mm
ΔH ave	-	52.25	mm H_20
V_{mstd}	0.6747	0.6747	m^3
V_{wstd}	0.0422	0.0422	m^3
$Q_{std,wet}$	-	1617.7	Nm^3/h
Q_{act}	-	1787.3	Nm^3/h
Isokinetic Rate	-	105.8	%
Vs	-	10.53	m/s
Washings			
Sample Ref	epa/15/511/05W	epa/15/511/06W	-
Weight	0.9	<0.5	mg
Filter			
Sample Ref	epa/15/511/05F	epa/15/511/06F	-
Weight	0.5	0.7	mg
Particulate Concentration (Dry, No O_2 Correction)	2.1	1.8	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	2.1	1.7	mg/Nm^3
Particulate Release Rate	-	2.71	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	0.5	0.9
Run 1	0.7	<0.5

2.11.5 Sampling Measurements

Date	21.07.15		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	10:40		1	892.7	895.9	3.2		**Leak Check (Pre)**	0.08	10			
End Time	11:10		2	898.3	900.3	2.0		**Leak Check (Post)**	0.08	10			
Duration (mm.ss)	30.00		3	688.8	689.7	0.9							
Stack	Tile Cutting		4	748.5	756.3	7.8		**Pitot ID**	Pitot 06			Velocity Head	
Run	1		5	252.7	272.7	20.0		**DGM ID**	DGM 09			Min	9.4
												Max	9.4
												Max:Min	1.00
								N3	N36				
			Sample Ref	epa/15/511/06				**Nozzle Diameter (mm)**	7.09				
K Factor	5.56		**Filter Number**	epa/15/511/06F									
Stack Diameter (m)	0.25		**Probe Washing No**	epa/15/511/06W									
							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**		4242.35	In	Out	Probe	Filter	**Impinger**
a1	0 5	3	26	9.4		3.07	52.25	4357	18	18	160	160	
a1	5 10	3	26	9.4		3.07	52.25	4476	19	18	160	160	
a1	10 15	3	26	9.4		3.07	52.25	4590	19	18	160	160	
a1	15 20	3	26	9.4		3.07	52.25	4708	20	19	160	160	
a1	20 25	3	26	9.4		3.07	52.25	4831	20	19	160	160	
a1	25 30	3	26	9.4		3.07	52.25	4958.35	20	19	160	160	
Total / Average		3.00	26.00	9.40		3.07	52.25	716.00	19.33	18.50	160.00	160.00	

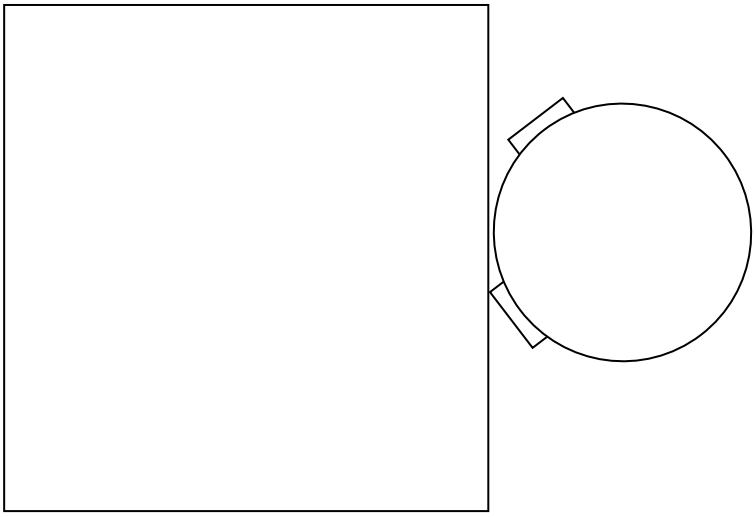
2.11.6 Uncertainty Calculations

Particulates

Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	9.86		
O_2 Concentration	1.62		As % of result
Gas Temperature	1.22		19.61
Pitot Co-efficient	0.50		
Humidity	0.50	10.11	As % of ELV
Stack Diameter	0.41		0.70
Nozzle Diameter	0.20		As mg/m^3
Leak	0.20		0.33
Pressure	0.13		

2.12 Appendix 12: Paint Mixing Facility

2.12.1 Sampling Location



Duct Characteristics

	Value	Units
Type of Duct	Circular	-
Diameter / Depth	0.56	m
Width	-	m
Area	0.246	m^2
Port Size	4	inch
Port Depth	80	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

2.12.2 Flow Criteria Measurements

Traverse Point	**A1**			**A2**		
Pressure (mm H_2O)	22.0	22.0	22.0	24.0	24.0	24.0
$\sqrt{\Delta P}$	4.69	4.69	4.69	4.90	4.90	4.90
Temperature (ºC)	20	20	20	20	20	20
Traverse Point	**B1**			**B2**		
Pressure (mm H_2O)	22.0	22.0	22.0	24.0	24.0	24.0
$\sqrt{\Delta P}$	4.69	4.69	4.69	4.90	4.90	4.90
Temperature (ºC)	20	20	20	20	20	20

Static Pressure (mmH_2O)	48.0	**Barometric Pressure (mm Hg)**	757.7	**Duct Dimensions (m)**	0.56

Velocity (m/s) average	16.61	**Actual Flow of stack gas (m^3/hr)**	147337
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	13751
Dimensions (m)	0.56	**Flow (dry) at STP (m^3/hr)**	13628
Area (m^2)	0.246		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	23.0	24.0	22.0	1.1	Yes
$\sqrt{\Delta P}$ (mm $H_2O)^{½}$	4.79	4.90	4.69	1.0	Yes
Temperature (ºC)	20.0	20.0	20.0	1.0	Yes
Angle of flow	<15º				Yes
Local Negative Flow	No				Yes

2.12.3 Gas Measurements

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

2.12.4 Manual Method Calculations

Test Dates	23/07/15		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	Paint Mixing Facility		
	Blank	Test 1	Units
Sample Ref	epa.15.511.19	epa.15.511.20	-
Start Time	14:28	14:43	hr:mm
Stop Time	14:33	15:15	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	6.1	ml
B_{wo}	0.01	0.009	-
P_b	-	757.7	mm Hg
St	-	48	mm H_2O
T_s	-	21.00	ºC
$\sqrt{\Delta P}$	-	4.77	$(mm\ H_2O)^{½}$
Yd	-	1.013	-
Test Time	-	32	min
T_m	-	22.38	ºC
C_p	-	0.823	-
As	-	0.246	m^2
D_n	-	6.21	mm
ΔH ave	-	75.04	mm H_20
V_{mstd}	0.8431	0.8431	m^3
V_{wstd}	0.0076	0.0076	m^3
$Q_{std,wet}$	-	13119.9	Nm^3/h
Q_{act}	-	14105.4	Nm^3/h
Isokinetic Rate	-	98.9	%
Vs	-	15.91	m/s
Washings			
Sample Ref	epa.15.511.19W	epa.15.511.20W	-
Weight	2	1.7	mg
Filter			
Sample Ref	epa.15.511.19F	epa.15.511.20F	-
Weight	0.06	<0.04	mg
Particulate Concentration (Dry, No O_2 Correction)	2.4	2.1	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	2.4	2.0	mg/Nm^3
Particulate Release Rate	-	26.84	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	0.06	2
Run 1	<0.04	1.7

2.12.5 Sampling Measurements

Date	23.07.15		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	14:43		1	890.6	888.7	-1.9		**Leak Check (Pre)**	0.09	10			
End Time	15:15		2	898.6	899.5	0.9		**Leak Check (Post)**	0.07	7			
Duration (mm.ss)	32.00		3	683.7	683.9	0.2							
Stack	Paint Mix		4	765.7	772.6	6.9		**Pitot ID**	Pitot 14			Velocity Head	
Run	1		5	252.8	252.8	0.0		**DGM ID**	DGM 09			Min	22
												Max	24
Break Start	14:59											Max:Min	1.09
Break Stop	15:02							**Nozzle ID**	N30				
			Sample Ref	epa.15.511.20				**Nozzle Diameter (mm)**	6.21				
K Factor	3.30		**Filter Number**	epa.15.511.20F									
Stack Diameter (m)	0.56		**Probe Washing No**	epa.15.511.20W									
							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**		9849.32	In	Out	Probe	**Filter**	**Impinger**
a1	0 4	4	21	22		4.69	72.56	9964	21	21	70		
a1	4 8	4	21	24		4.90	79.16	10098	22	22	70		
a2	8 12	4	21	24		4.90	79.16	10197	22	22	70		
a2	12 16	4	21	24		4.90	79.16	10310	22	22	70		
b1	16 20	4	21	22		4.69	72.56	10422	23	22	70		
b1	20 24	4	21	22		4.69	72.56	10527	23	22	70		
b2	24 28	4	21	22		4.69	72.56	10643	24	23	70		
b2	28 32	4	21	22		4.69	72.56	10746.42	24	23	70		
Total / Average		4.00	21.00	22.75		4.77	75.04	897.10	22.63	22.13	70.00		

2.12.6 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	0.00	0.00	0.00	0.00	0.00

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	100	EPA/CGAS /98	80.20	80.32	80.34	81.61	1.27

2.12.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C mg/m^3
23.07.2015	14:43:34	30.3	48.7	48.7
23.07.2015	14:43:49	31.3	50.3	50.3
23.07.2015	14:44:04	33.9	54.5	54.5
23.07.2015	14:44:19	36.7	59.0	59.0
23.07.2015	14:44:34	31.5	50.6	50.6
23.07.2015	14:44:49	37.7	60.6	60.6
23.07.2015	14:45:04	35.1	56.4	56.4
23.07.2015	14:45:19	30.2	48.5	48.5
23.07.2015	14:45:34	25.1	40.3	40.3
23.07.2015	14:45:49	22.9	36.8	36.8
23.07.2015	14:46:04	18.6	29.9	29.9
23.07.2015	14:46:19	24.3	39.1	39.1
23.07.2015	14:46:34	19.6	31.5	31.5
23.07.2015	14:46:49	20.2	32.5	32.5
23.07.2015	14:47:04	20.0	32.1	32.1
23.07.2015	14:47:19	19.5	31.3	31.3
23.07.2015	14:47:34	23.4	37.6	37.6
23.07.2015	14:47:49	20.5	32.9	32.9
23.07.2015	14:48:04	27.1	43.6	43.6
23.07.2015	14:48:19	28.8	46.3	46.3
23.07.2015	14:48:34	29.3	47.1	47.1
23.07.2015	14:48:49	30.6	49.2	49.2
23.07.2015	14:49:04	29.0	46.6	46.6
23.07.2015	14:49:19	26.1	41.9	41.9
23.07.2015	14:49:34	26.4	42.4	42.4
23.07.2015	14:49:49	26.8	43.1	43.1
23.07.2015	14:50:04	26.1	41.9	41.9
23.07.2015	14:50:19	17.9	28.8	28.8
23.07.2015	14:50:34	14.5	23.3	23.3
23.07.2015	14:50:49	16.4	26.4	26.4

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C mg/m^3
23.07.2015	14:51:04	18.6	29.9	29.9
23.07.2015	14:51:19	17.1	27.5	27.5
23.07.2015	14:51:34	30.7	49.3	49.3
23.07.2015	14:51:49	35.3	56.7	56.7
23.07.2015	14:52:04	27.9	44.8	44.8
23.07.2015	14:52:19	36.7	59.0	59.0
23.07.2015	14:52:34	35.0	56.3	56.3
23.07.2015	14:52:49	31.3	50.3	50.3
23.07.2015	14:53:04	26.0	41.8	41.8
23.07.2015	14:53:19	28.7	46.1	46.1
23.07.2015	14:53:34	29.9	48.1	48.1
23.07.2015	14:53:49	33.1	53.2	53.2
23.07.2015	14:54:04	27.6	44.4	44.4
23.07.2015	14:54:19	28.0	45.0	45.0
23.07.2015	14:54:34	30.7	49.3	49.3
23.07.2015	14:54:49	24.7	39.7	39.7
23.07.2015	14:55:04	27.5	44.2	44.2
23.07.2015	14:55:19	29.1	46.8	46.8
23.07.2015	14:55:34	24.1	38.7	38.7
23.07.2015	14:55:49	26.0	41.8	41.8
23.07.2015	14:56:04	20.3	32.6	32.6
23.07.2015	14:56:19	20.8	33.4	33.4
23.07.2015	14:56:34	14.3	23.0	23.0
23.07.2015	14:56:49	17.0	27.3	27.3
23.07.2015	14:57:04	24.4	39.2	39.2
23.07.2015	14:57:19	25.6	41.1	41.1
23.07.2015	14:57:34	27.1	43.6	43.6
23.07.2015	14:57:49	24.9	40.0	40.0
23.07.2015	14:58:04	22.2	35.7	35.7
23.07.2015	14:58:19	25.4	40.8	40.8
23.07.2015	14:58:34	25.0	40.2	40.2
23.07.2015	14:58:49	25.6	41.1	41.1
23.07.2015	14:59:04	25.0	40.2	40.2
23.07.2015	14:59:19	24.6	39.5	39.5
23.07.2015	14:59:34	20.4	32.8	32.8
23.07.2015	14:59:49	19.9	32.0	32.0
23.07.2015	15:02:34	21.4	34.4	34.4
23.07.2015	15:02:49	23.1	37.1	37.1
23.07.2015	15:03:04	24.1	38.7	38.7
23.07.2015	15:03:19	24.8	39.9	39.9
23.07.2015	15:03:34	23.6	37.9	37.9
23.07.2015	15:03:49	22.1	35.5	35.5
23.07.2015	15:04:04	21.1	33.9	33.9
23.07.2015	15:04:19	19.0	30.5	30.5
23.07.2015	15:04:34	20.1	32.3	32.3
23.07.2015	15:04:49	20.4	32.8	32.8
23.07.2015	15:05:04	20.1	32.3	32.3
23.07.2015	15:05:19	18.9	30.4	30.4
23.07.2015	15:05:34	18.1	29.1	29.1

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C mg/m^3
23.07.2015	15:05:49	18.2	29.3	29.3
23.07.2015	15:06:04	18.2	29.3	29.3
23.07.2015	15:06:19	16.6	26.7	26.7
23.07.2015	15:06:34	16.6	26.7	26.7
23.07.2015	15:06:49	17.5	28.1	28.1
23.07.2015	15:07:04	18.1	29.1	29.1
23.07.2015	15:07:19	15.8	25.4	25.4
23.07.2015	15:07:34	14.5	23.3	23.3
23.07.2015	15:07:49	16.0	25.7	25.7
23.07.2015	15:08:04	23.7	38.1	38.1
23.07.2015	15:08:19	27.8	44.7	44.7
23.07.2015	15:08:34	29.4	47.3	47.3
23.07.2015	15:08:49	27.6	44.4	44.4
23.07.2015	15:09:04	27.9	44.8	44.8
23.07.2015	15:09:19	25.6	41.1	41.1
23.07.2015	15:09:34	24.7	39.7	39.7
23.07.2015	15:09:49	25.3	40.7	40.7
23.07.2015	15:10:04	26.1	41.9	41.9
23.07.2015	15:10:19	24.9	40.0	40.0
23.07.2015	15:10:34	27.0	43.4	43.4
23.07.2015	15:10:49	25.4	40.8	40.8
23.07.2015	15:11:04	27.1	43.6	43.6
23.07.2015	15:11:19	24.0	38.6	38.6
23.07.2015	15:11:34	25.7	41.3	41.3
23.07.2015	15:11:49	27.3	43.9	43.9
23.07.2015	15:12:04	25.7	41.3	41.3
23.07.2015	15:12:19	24.2	38.9	38.9
23.07.2015	15:12:34	25.1	40.3	40.3
23.07.2015	15:12:49	23.6	37.9	37.9
23.07.2015	15:13:04	23.8	38.3	38.3
23.07.2015	15:13:19	23.3	37.4	37.4
23.07.2015	15:13:34	23.3	37.4	37.4
23.07.2015	15:13:49	20.0	32.1	32.1
23.07.2015	15:14:04	21.0	33.8	33.8
23.07.2015	15:14:19	22.4	36.0	36.0
23.07.2015	15:14:34	22.1	35.5	35.5
23.07.2015	15:14:49	22.0	35.4	35.4
23.07.2015	15:15:04	21.6	34.7	34.7
23.07.2015	15:15:19	20.7	33.3	33.3
23.07.2015	15:15:34	24.3	39.1	39.1
23.07.2015	15:15:49	25.4	40.8	40.8
23.07.2015	15:16:04	26.6	42.8	42.8
23.07.2015	15:16:19	26.3	42.3	42.3
23.07.2015	15:16:34	23.5	37.8	37.8
23.07.2015	15:16:49	22.7	36.5	36.5
23.07.2015	15:17:04	23.6	37.9	37.9
23.07.2015	15:17:19	24.9	40.0	40.0
23.07.2015	15:17:34	21.7	34.9	34.9
23.07.2015	15:17:49	20.6	33.1	33.1

Date	Time	VOC ppm	VOC as C mg/m^3	VOC as C mg/m^3
23.07.2015	15:18:04	22.6	36.3	36.3
23.07.2015	15:18:19	21.2	34.1	34.1
23.07.2015	15:18:34	20.4	32.8	32.8
23.07.2015	15:18:49	21.9	35.2	35.2
Mean		24.3	39.0	39.0
Max		37.7	60.6	60.6
Min		14.3	23.0	23.0

2.12.8 Uncertainty Calculations

Particulates

Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Mass of Particulate	4.81		
O_2 Concentration	1.62		As % of result
Gas Temperature	1.03		10.14
Humidity	0.50		
Gas Volume	0.30	5.23	As % of ELV
Nozzle Diameter	0.23		0.42
Leak	0.18		
Stack Diameter	0.18		As mg/m^3
Pressure	0.11		0.21

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	0.96		
Temperature effect (zero)	0.46		
Barometric Pressure	0.40		2.47
Span drift	0.37		
Span gas	0.35		
Temperature effect (span)	0.23	1.27	
Repeatability	0.07		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.00		
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		10.17
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		3.97

2.13 Certificates of Analysis

RPS

UKAS TESTING 0605

Test Certificate

Date 06/08/2015

Client	EPA Union Street Hetton Le Hole Sunderland Tyne & Wear DH5 9HU	**Order No.**	EPA.15.024
		Certificate No.	**WK15-4228**
		Issue No.	1
Contact	Tracy Dodds	**Date Received**	28/07/2015
Description	22 filters & 22 washes for TPM	**Technique**	Gravimetric Stack

Sample No.	**845540**	**EPA.15.511.01f**	**Method**
Total particulate matter		<0.1 mg	D9(U)
Sample No.	**845541**	**EPA.15.511.02f**	**Method**
Total particulate matter		0.6 mg	D9(U)
Sample No.	**845542**	**EPA.15.511.03f**	**Method**
Total particulate matter		<0.1 mg	D9(U)
Sample No.	**845543**	**EPA.15.511.04f**	**Method**
Total particulate matter		<0.1 mg	D9(U)
Sample No.	**845544**	**EPA.15.511.05f**	**Method**
Total particulate matter		0.5 mg	D9(U)
Sample No.	**845545**	**EPA.15.511.06f**	**Method**
Total particulate matter		0.7 mg	D9(U)
Sample No.	**845546**	**EPA.15.511.07f**	**Method**
Total particulate matter		<0.1 mg	D9(U)
Sample No.	**845547**	**EPA.15.511.08f**	**Method**
Total particulate matter		0.9 mg	D9(U)

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UKAS TESTING 0605

Date 06/08/2015

Test Certificate

Client	EPA		**Certificate No.**	**WK15-4228**
			Issue No.	1
Sample No.	**845548**	**EPA.15.511.09f**		**Method**
Total particulate matter		0.06 mg		D9(U)
Sample No.	**845549**	**EPA.15.511.10f**		**Method**
Total particulate matter		3.1 mg		D9(U)
Sample No.	**845550**	**EPA.15.511.11f**		**Method**
Total particulate matter		0.5 mg		D9(U)
Sample No.	**845551**	**EPA.15.511.12f**		**Method**
Total particulate matter		0.9 mg		D9(U)
Sample No.	**845552**	**EPA.15.511.13f**		**Method**
Total particulate matter		0.07 mg		D9(U)
Sample No.	**845553**	**EPA.15.511.14f**		**Method**
Total particulate matter		0.08 mg		D9(U)
Sample No.	**845554**	**EPA.15.511.15f**		**Method**
Total particulate matter		0.04 mg		D9(U)
Sample No.	**845555**	**EPA.15.511.16f**		**Method**
Total particulate matter		0.5 mg		D9(U)
Sample No.	**845556**	**EPA.15.511.17f**		**Method**
Total particulate matter		0.3 mg		D9(U)
Sample No.	**845557**	**EPA.15.511.18f**		**Method**
Total particulate matter		0.2 mg		D9(U)
Sample No.	**845558**	**EPA.15.511.19f**		**Method**
Total particulate matter		0.06 mg		D9(U)

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Date 06/08/2015

Test Certificate

Client	EPA		**Certificate No.**	**WK15-4228**
			Issue No.	1
Sample No.	**845559**	**EPA.15.511.20f**		**Method**
Total particulate matter		<0.04 mg		D9(U)
Sample No.	**845560**	**EPA.15.511.21f**		**Method**
Total particulate matter		0.07 mg		D9(U)
Sample No.	**845561**	**EPA.15.511.22f**		**Method**
Total particulate matter		0.3 mg		D9(U)
Sample No.	**845562**	**EPA.15.511.01w**		**Method**
Total particulate matter		2.0 mg		D9(U)
Sample No.	**845563**	**EPA.15.511.02w**		**Method**
Total particulate matter		<0.5 mg		D9(U)
Sample No.	**845564**	**EPA.15.511.03w**		**Method**
Total particulate matter		<0.5 mg		D9(U)
Sample No.	**845565**	**EPA.15.511.04w**		**Method**
Total particulate matter		0.9 mg		D9(U)
Sample No.	**845566**	**EPA.15.511.05w**		**Method**
Total particulate matter		0.9 mg		D9(U)
Sample No.	**845567**	**EPA.15.511.06w**		**Method**
Total particulate matter		<0.5 mg		D9(U)
Sample No.	**845568**	**EPA.15.511.07w**		**Method**
Total particulate matter		2.1 mg		D9(U)
Sample No.	**845569**	**EPA.15.511.08w**		**Method**
Total particulate matter		2.5 mg		D9(U)

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Date 06/08/2015

Test Certificate

Client	EPA		**Certificate No.**	**WK15-4228**
			Issue No.	1
Sample No.	**845570**	**EPA.15.511.09w**		**Method**
Total particulate matter		0.8 mg		D9(U)
Sample No.	**845571**	**EPA.15.511.10w**		**Method**
Total particulate matter		5.3 mg		D9(U)
Sample No.	**845572**	**EPA.15.511.11w**		**Method**
Total particulate matter		<0.5 mg		D9(U)
Sample No.	**845573**	**EPA.15.511.12w**		**Method**
Total particulate matter		1.2 mg		D9(U)
Sample No.	**845574**	**EPA.15.511.13w**		**Method**
Total particulate matter		2.4 mg		D9(U)
Sample No.	**845575**	**EPA.15.511.14w**		**Method**
Total particulate matter		<0.5 mg		D9(U)
Sample No.	**845576**	**EPA.15.511.15w**		**Method**
Total particulate matter		1.0 mg		D9(U)
Sample No.	**845577**	**EPA.15.511.16w**		**Method**
Total particulate matter		1.5 mg		D9(U)
Sample No.	**845578**	**EPA.15.511.17w**		**Method**
Total particulate matter		0.8 mg		D9(U)
Sample No.	**845579**	**EPA.15.511.18w**		**Method**
Total particulate matter		0.8 mg		D9(U)
Sample No.	**845580**	**EPA.15.511.19w**		**Method**
Total particulate matter		2.0 mg		D9(U)

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Date 06/08/2015

Test Certificate

Client	EPA		**Certificate No.**	**WK15-4228**
			Issue No.	1
Sample No.	**845581**	**EPA.15.511.20w**		**Method**
Total particulate matter		1.7 mg		D9(U)
Sample No.	**845582**	**EPA.15.511.21w**		**Method**
Total particulate matter		<0.5 mg		D9(U)
Sample No.	**845583**	**EPA.15.511.22w**		**Method**
Total particulate matter		0.9 mg		D9(U)

Tested By Ashley Lunt Date 05/08/2015

Approved By Date 06/08/2015

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 calculated on the basis of information provided by the customer.
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'

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2.14 Calibration Certificates

CERTIFIED REFERENCE MATERIAL
CERTIFICATE OF CALIBRATION

Component	Nominal Concentration	Certified Concentration	Absolute Uncertainty	Relative Uncertainty	Analysis Technique
PROPANE	8 ppm	8.32 ppm	+/-0.17 ppm	2.0 %	NDIR
SYNTHETIC AIR	Balance				

All concentrations are molar

EPA/CGAS/88

Cylinder Number: 233372 Production Order Number: 2457419
Issuing Laboratory: UKAS Accredited Calibration Laboratory 0408 & Reference Material Producer 4183

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UKAS 13162753 HHQ/388660/APUK/1008/SM

CERTIFIED REFERENCE MATERIAL
CERTIFICATE OF CALIBRATION

Component	Nominal Concentration	Certified Concentration	Absolute Uncertainty	Relative Uncertainty	Analysis Technique
PROPANE	800 ppm	802 ppm	+/-7 ppm	0.9 %	FID
SYNTHETIC AIR	Balance				

All concentrations are molar

EPA/C GAS/97

Cylinder Number: 244929 Production Order Number: 2556462
Issuing Laboratory: UKAS Accredited Calibration Laboratory 0408 & Reference Material Producer 4183

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UKAS: 13162753 HIQ/308860/APUK/0611/10M

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CERTIFIED REFERENCE MATERIAL
CERTIFICATE OF CALIBRATION

Component	Nominal Concentration	Certified Concentration	Absolute Uncertainty	Relative Uncertainty	Analysis Technique
PROPANE	80 ppm	80.2 ppm	+/-0.7 ppm	0.9 %	FID
SYNTHETIC AIR	Balance				

All concentrations are molar

EPA/CGAS/98

Cylinder Number: 244931 Production Order Number: 2556463
Issuing Laboratory: UKAS Accredited Calibration Laboratory 0408 & Reference Material Producer 4183

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