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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:	27th July – 2nd August 2016
Project Number:	EPA/JBN/16/511
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:	01/09/16
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	1.8	± 0.30	mgm^{-3}	STP (101.3kPa, 273K)	27/06/16	10:41 – 11:11	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	203.0	± 38.0	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 12619	UKAS/ MCERTS	Normal
RIF Spray Paint Enclosure Area D16	Particulates	50mg/Nm^3	94.0	± 15.56	mgm^{-3}	STP (101.3kPa, 273K)	270/6/16	13:30 – 14:00	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	5974.4	± 38.0	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 12619	UKAS/ MCERTS	Normal
Paint Shop Oven Vent Area D13	Particulates	50mg/Nm^3	1.0	± 0.17	mgm^{-3}	STP (101.3kPa, 273K)	28/06/16	13:44 – 14:14	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	39.3	± 3.80	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 12619	UKAS/ MCERTS	Normal
Paint Shop Spray Area D13	Particulates	50mg/Nm^3	0.9	± 0.11	mgm^{-3}	STP (101.3kPa, 273K)	28/06/16	12:25 – 12:59	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	1.1	± 0.44	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	1.0	± 0.11	mgm^{-3}	STP (101.3kPa, 273K)	28/06/16	10:29 – 11:01	BS EN 13284-1	UKAS/ MCERTS	Normal
Paint Shop Dryer Area D13	Particulates	50mg/Nm^3	1.3	± 0.18	mgm^{-3}	STP (101.3kPa, 273K)	28/06/16	15:05 – 15:35	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	13.4	± 0.44	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 12619	UKAS/ MCERTS	Normal
DDH Paint Extraction Area D34	Particulates	50mg/Nm^3	5.1	± 0.63	mgm^{-3}	STP (101.3kPa, 273K)	29/06/16	14:31 – 15:05	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	1741.3	± 38.04	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 12619	UKAS/ MCERTS	Normal
DDH Tile Adhesive Facility Area D34	Particulates	50mg/Nm^3	<0.59	± 0.06	mgm^{-3}	STP (101.3kPa, 273K)	30/06/16	14:04 – 14:34	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	16.0	± 3.80	mgm^{-3}	STP (101.3kPa, 273K)			BS EN 12619	UKAS/ MCERTS	Normal
NAS Annex Paint Extraction Area A69	Particulates	50mg/Nm^3	<0.62	± 0.07	mgm^{-3}	STP (101.3kPa, 273K)	02/08/16	10:39 – 11:13	BS EN 13284-1	UKAS/ MCERTS	Normal
	Total VOC's	N/A	508.3	± 38.67	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	<0.67	± 0.07	mgm^{-3}	STP (101.3kPa, 273K)	30/06/16	10:25 – 10:55	BS EN 13284-1	UKAS/ MCERTS	Normal
Paint Mixing Facility	Particulates	50mg/Nm^3	<0.63	± 0.07	mgm^{-3}	STP (101.3kPa, 273K)	30/06/16	11:51 – 12:25	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	L524 L574	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,	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 Shot Blast	-	Only one sample line, number of sample points doubled Blank test slightly higher concentration than actual test	-
Paint Shop Oven	-	Blank test slightly higher concentration than actual test	-
Paint Shop Spray	-	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

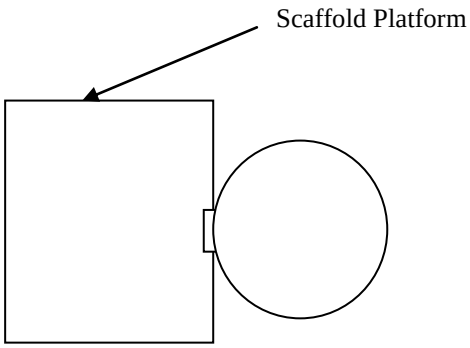
Substances Monitored	Standard Reference Method	EPA Method
Flow	BS EN 16911	EPA Method 19
Particulate	BS EN 13284-1	EPA Method 1
Total VOCs by FID	BS EN 12619	EPA Method 6

2.1.3 Site Equipment Log

Equipment Description	EPA Reference Number
Heated Line	EPA/HEAT/04, 05, 06 09
Pitot Tube	EPA/PITOT/10,11
Thermocouple Probe	EPA/TCP/55, 65
Thermocouple Reader	EPA/MAN/07
Measuring Tape	EPA/TAPE/14
Vion Site Barometer	EPA/BAR/04
Sampling Probe	EPA/PROBE/08, 09
Dry Gas Meter	EPA/DGM/09
Site Balance	EPA/MASS/02
Sampling Nozzle	EPA/N/6, 14, 32, 35, 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)	8.5	8.5	8.5
√ΔP	2.92	2.92	2.92
Temperature (ºC)	29	29	29

Static Pressure (mmH_2O)	12.0	**Barometric Pressure (mm Hg)**	756.2	**Duct Dimensions (m)**	0.285

Velocity (m/s) average	10.3	**Actual Flow of stack gas (m^3/hr)**	2359.4
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	2124.8
Dimensions (m)	0.285	**Flow (dry) at STP (m^3/hr)**	2073.3
Area (m^2)	0.064		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	8.5	8.5	8.5	1.0	Yes
√ΔP (mm H_2O)^{½}	2.92	2.92	2.92	1.0	Yes
Temperature (ºC)	29.0	29.0	29.0	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	27/06/16		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	RIF Hand		
	Blank	Test 1	Units
Sample Ref	epa.16.511.01	epa.16.511.02	-
Start Time	10:22	10:41	hr:mm
Stop Time	10:27	11:11	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	12.5	ml
B_{wo}	0.02	0.024	-
P_b	-	756.2	mm Hg
St	-	12	mm H_2O
T_s	-	28.00	ºC
$\sqrt{\Delta P}$	-	2.92	$(mm\ H_2O)^{½}$
Yd	-	1.021	-
Test Time	-	30	min
T_m	-	19.25	ºC
C_p	-	0.827	-
As	-	0.064	m^2
D_n	-	7.09	mm
ΔH ave	-	47.76	mm H_20
V_{mstd}	0.6261	0.6261	m^3
V_{wstd}	0.0156	0.0156	m^3
$Q_{std,wet}$	-	2063.6	Nm^3/h
Q_{act}	-	2283.9	Nm^3/h
Isokinetic Rate	-	100.5	%
Vs	-	9.94	m/s
Washings			
Sample Ref	epa.16.511.01W	epa.16.511.02W	-
Weight	1.07	1.06	mg
Filter			
Sample Ref	epa.16.511.01F	epa.16.511.02F	-
Weight	<0.1	<0.1	mg
Particulate Concentration (Dry, No O_2 Correction)	1.9	1.9	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	1.8	1.8	mg/Nm^3
Particulate Release Rate	-	3.73	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	<0.1	1.07
Run 1	<0.1	1.06

2.2.5 Sampling Measurements

Date	27.06.16		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	10:41		1	741.6	741.9	0.3		**Leak Check (Pre)**	0.09	10			
End Time	11:11		2	728.4	729.0	0.6		**Leak Check (Post)**	0.08	7			
Duration (mm.ss)	30.00		3	668.2	669.7	1.5							
Stack	RIF Hand		4	722.6	732.7	10.1		**Pitot ID**	Pitot 06			Velocity Head	
Run	1		5	241.7	241.7	0.0		**DGM ID**	DGM 09			Min	8.5
												Max	8.5
												Max:Min	1.00
								Nozzle ID	n36				
			Sample Ref	epa.16.511.01				**Nozzle Diameter (mm)**	7.09				
K Factor	5.62		**Filter Number**	epa.16.511.01F									
Stack Diameter (m)	0.29		**Probe Washing No**	epa.16.511.01W									
							ΔH across orifice meter (mm H_2O)	**DGM (litres)**	**DGM Temp (ºC)**		**Temp (ºC)**		
Point	**Time**	Vac	Stack Temp	**Velocity Head (mmH_2O)**		**√ΔP**		6842.55	**In**	**Out**	**Probe**	**Filter**	**Impinger**
a1	0 5	3	28	8.5		2.92	47.76	6958	19	19	160	160	
a1	5 10	3	28	8.5		2.92	47.76	7060	19	19	160	160	
a1	10 15	3	28	8.5		2.92	47.76	7205	19	19	160	160	
a1	15 20	3	28	8.5		2.92	47.76	7282	20	19	160	160	
a1	20 25	3	28	8.5		2.92	47.76	7390	20	19	160	160	
a1	25 30	3	28	8.5		2.92	47.76	7499.25	20	19	160	160	
Total / Average		3.00	28.00	8.50		2.92	47.76	656.70	19.50	19.00	160.00	160.00	

2.2.6 Instrumental Gas Analyser Site Calibration Measurements

Zero Point

				Pre Test			Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Pre Span	Post Span	System	System	Zero Drift
VOC (ppm)	100	Ambient Air	0.00	0.00	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	Ref VOC as C mg/m^3
27.06.2016	10:41:07	4.5	7.2	7.2
27.06.2016	10:41:22	4.4	7.1	7.1
27.06.2016	10:41:37	4.5	7.2	7.2
27.06.2016	10:41:52	4.5	7.2	7.2
27.06.2016	10:42:07	4.7	7.6	7.6
27.06.2016	10:42:22	4.8	7.7	7.7
27.06.2016	10:42:37	4.6	7.4	7.4
27.06.2016	10:42:52	4.6	7.4	7.4
27.06.2016	10:43:07	6.0	9.6	9.6
27.06.2016	10:43:22	5.8	9.3	9.3
27.06.2016	10:43:37	5.4	8.7	8.7
27.06.2016	10:43:52	5.3	8.4	8.4
27.06.2016	10:44:07	5.1	8.2	8.2
27.06.2016	10:44:22	5.2	8.4	8.4
27.06.2016	10:44:37	5.4	8.6	8.6
27.06.2016	10:44:52	5.8	9.4	9.4
27.06.2016	10:45:07	7.1	11.4	11.4
27.06.2016	10:45:22	12.2	19.6	19.6
27.06.2016	10:45:37	15.2	24.4	24.4
27.06.2016	10:45:52	17.3	27.8	27.8
27.06.2016	10:46:07	18.3	29.4	29.4
27.06.2016	10:46:22	18.3	29.4	29.4
27.06.2016	10:46:37	19.2	30.9	30.9
27.06.2016	10:46:52	24.7	39.7	39.7
27.06.2016	10:47:07	21.3	34.2	34.2
27.06.2016	10:47:22	29.7	47.7	47.7
27.06.2016	10:47:37	40.7	65.4	65.4
27.06.2016	10:47:52	38.9	62.5	62.5
27.06.2016	10:48:07	44.2	71.0	71.0
27.06.2016	10:48:22	44.4	71.4	71.4
27.06.2016	10:48:37	45.8	73.6	73.6
27.06.2016	10:48:52	46.2	74.3	74.3

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
27.06.2016	10:49:07	52.6	84.5	84.5
27.06.2016	10:49:22	56.3	90.5	90.5
27.06.2016	10:49:37	58.9	94.7	94.7
27.06.2016	10:49:52	61.2	98.4	98.4
27.06.2016	10:50:07	71.4	114.8	114.8
27.06.2016	10:50:22	67.6	108.6	108.6
27.06.2016	10:50:37	63.3	101.7	101.7
27.06.2016	10:50:52	62.8	100.9	100.9
27.06.2016	10:51:07	56.8	91.3	91.3
27.06.2016	10:51:22	58.4	93.9	93.9
27.06.2016	10:51:37	62.3	100.1	100.1
27.06.2016	10:51:52	68.3	109.8	109.8
27.06.2016	10:52:07	65.4	105.1	105.1
27.06.2016	10:52:22	66.9	107.5	107.5
27.06.2016	10:52:37	75.9	122.0	122.0
27.06.2016	10:52:52	79.0	127.0	127.0
27.06.2016	10:53:07	82.9	133.2	133.2
27.06.2016	10:53:22	78.5	126.2	126.2
27.06.2016	10:53:37	82.3	132.3	132.3
27.06.2016	10:53:52	88.7	142.6	142.6
27.06.2016	10:54:07	91.9	147.7	147.7
27.06.2016	10:54:22	99.9	160.6	160.6
27.06.2016	10:54:37	102.1	164.1	164.1
27.06.2016	10:54:52	101.2	162.6	162.6
27.06.2016	10:55:07	105.3	169.2	169.2
27.06.2016	10:55:22	104.2	167.5	167.5
27.06.2016	10:55:37	107.2	172.3	172.3
27.06.2016	10:55:52	108.0	173.6	173.6
27.06.2016	10:56:07	109.2	175.5	175.5
27.06.2016	10:56:22	121.9	195.9	195.9
27.06.2016	10:56:37	135.3	217.4	217.4
27.06.2016	10:56:52	141.9	228.1	228.1
27.06.2016	10:57:07	141.1	226.8	226.8
27.06.2016	10:57:22	134.1	215.5	215.5
27.06.2016	10:57:37	137.5	221.0	221.0
27.06.2016	10:57:52	141.1	226.8	226.8
27.06.2016	10:58:07	166.1	266.9	266.9
27.06.2016	10:58:22	233.5	375.3	375.3
27.06.2016	10:58:37	248.8	399.9	399.9
27.06.2016	10:58:52	254.7	409.3	409.3
27.06.2016	10:59:07	237.1	381.1	381.1
27.06.2016	10:59:22	215.9	347.0	347.0
27.06.2016	10:59:37	207.1	332.8	332.8
27.06.2016	10:59:52	199.0	319.8	319.8
27.06.2016	11:00:07	191.7	308.1	308.1
27.06.2016	11:00:22	191.9	308.4	308.4
27.06.2016	11:00:37	189.0	303.8	303.8
27.06.2016	11:00:52	187.1	300.7	300.7
27.06.2016	11:01:07	186.1	299.1	299.1

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
27.06.2016	11:01:22	187.8	301.8	301.8
27.06.2016	11:01:37	185.3	297.8	297.8
27.06.2016	11:01:52	185.3	297.8	297.8
27.06.2016	11:02:07	185.6	298.3	298.3
27.06.2016	11:02:22	185.1	297.5	297.5
27.06.2016	11:02:37	187.8	301.8	301.8
27.06.2016	11:02:52	192.9	310.0	310.0
27.06.2016	11:03:07	191.0	307.0	307.0
27.06.2016	11:03:22	192.7	309.7	309.7
27.06.2016	11:03:37	191.7	308.1	308.1
27.06.2016	11:03:52	190.5	306.2	306.2
27.06.2016	11:04:07	189.0	303.8	303.8
27.06.2016	11:04:22	188.5	302.9	302.9
27.06.2016	11:04:37	185.3	297.8	297.8
27.06.2016	11:04:52	185.1	297.5	297.5
27.06.2016	11:05:07	185.1	297.5	297.5
27.06.2016	11:05:22	185.3	297.8	297.8
27.06.2016	11:05:37	183.2	294.4	294.4
27.06.2016	11:05:52	189.7	304.9	304.9
27.06.2016	11:06:07	188.0	302.1	302.1
27.06.2016	11:06:22	192.9	310.0	310.0
27.06.2016	11:06:37	200.7	322.6	322.6
27.06.2016	11:06:52	203.9	327.7	327.7
27.06.2016	11:07:07	203.9	327.7	327.7
27.06.2016	11:07:22	209.5	336.7	336.7
27.06.2016	11:07:37	214.7	345.1	345.1
27.06.2016	11:07:52	213.4	343.0	343.0
27.06.2016	11:08:07	206.6	332.0	332.0
27.06.2016	11:08:22	209.8	337.2	337.2
27.06.2016	11:08:37	224.4	360.6	360.6
27.06.2016	11:08:52	236.9	380.7	380.7
27.06.2016	11:09:07	252.3	405.5	405.5
27.06.2016	11:09:22	249.6	401.1	401.1
27.06.2016	11:09:37	228.3	366.9	366.9
27.06.2016	11:09:52	235.9	379.1	379.1
27.06.2016	11:10:07	250.1	401.9	401.9
27.06.2016	11:10:22	265.2	426.2	426.2
27.06.2016	11:10:37	271.6	436.5	436.5
27.06.2016	11:10:52	272.3	437.6	437.6
27.06.2016	11:11:07	268.1	430.9	430.9
27.06.2016	11:11:22	274.5	441.2	441.2
27.06.2016	11:11:37	275.9	443.4	443.4
27.06.2016	11:11:52	276.7	444.7	444.7
Mean		126.3	203.0	203.0
Max		276.7	444.7	444.7
Min		4.4	7.1	7.1

2.2.8 Uncertainty Calculations

Particulates

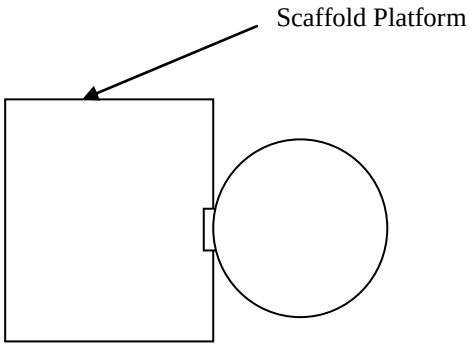
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Pressure	7.86	8.21	As % of result 15.93
Gas Volume	2.23		
Gas Temperature	0.69		
Humidity	0.50		As % of ELV 0.59
Washing Weighing	0.05		
Filter Weighing	0.00		
Leak	0.00		As mg/m^3 0.30
O_2 Concentration	0.00		

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	9.62	12.19	23.65
Temperature effect (zero)	4.63		
Barometric Pressure	4.01		
Span gas	3.52		
Temperature effect (span)	2.32		
Repeatability	0.69		
Span drift	0.41		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.03		
Cross sensitivity CO (1.2 % vol)	0.00		
Cross sensitivity NO (127 mgm^{-3})	0.00		As % of Result 18.72
Cross sensitivity H_2O (sat 325K)	0.00		
Cross sensitivity SO_2 (2767 mgm^{-3})	0.00		As mg/m^3 at ref conditions 38.00
Cross sensitivity CO_2 (15.2 % vol)	0.00		

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)	8.0	8.0	8.0
$\sqrt{\Delta P}$	2.83	2.83	2.83
Temperature (ºC)	24	24	24

Static Pressure (mmH_2O)	2.0	**Barometric Pressure (mm Hg)**	756.2	**Duct Dimensions (m)**	0.295

Velocity (m/s) average	9.9	**Actual Flow of stack gas (m^3/hr)**	2433.2
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	2226.0
Dimensions (m)	0.295	**Flow (dry) at STP (m^3/hr)**	2207.2
Area (m^2)	0.068		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	8.0	8.0	8.0	1.0	Yes
$\sqrt{\Delta P}$ (mm H_2O)^{½}	2.83	2.83	2.83	1.0	Yes
Temperature (ºC)	24.0	24.0	24.0	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	27/06/16		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	RIF Spray		
	Blank	Test 1	Units
Sample Ref	epa.16.511.03	epa.16.511.04	-
Start Time	13:00	13:30	hr:mm
Stop Time	13:05	14:00	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	4.4	ml
B_{wo}	0.01	0.008	-
P_b	-	756.2	mm Hg
St	-	2	mm H_2O
T_s	-	24.67	ºC
$\sqrt{\Delta P}$	-	2.91	$(mm\ H_2O)^{½}$
Yd	-	1.021	-
Test Time	-	30	min
T_m	-	19.83	ºC
C_p	-	0.827	-
As	-	0.068	m^2
D_n	-	7.09	mm
ΔH ave	-	48.51	mm H_20
V_{mstd}	0.6447	0.6447	m^3
V_{wstd}	0.0055	0.0055	m^3
$Q_{std,wet}$	-	2214.6	Nm^3/h
Q_{act}	-	2426.2	Nm^3/h
Isokinetic Rate	-	101.7	%
Vs	-	9.86	m/s
Washings			
Sample Ref	epa.16.511.03W	epa.16.511.04W	-
Weight	0.83	47.63	mg
Filter			
Sample Ref	epa.16.511.03F	epa.16.511.04F	-
Weight	<0.1	13.47	mg
Particulate Concentration (Dry, No O_2 Correction)	1.4	94.8	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	1.4	94.0	mg/Nm^3
Particulate Release Rate	-	208.10	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	0.83
Run 1	13.47	47.63

2.3.5 Sampling Measurements

Date	27.06.16		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	13:30		1	919.3	916.0	-3.3		**Leak Check (Pre)**	0.09	10			
End Time	14:00		2	807.5	808.7	1.2		**Leak Check (Post)**	0.07	7			
Duration (mm.ss)	30.00		3	669.7	668.6	-1.1							
Stack	RIF spray		4	732.7	740.3	7.6		**Pitot ID**	pitot 06			Velocity Head	
Run	1		5	241.7	241.7	0.0		**DGM ID**	dgm 09			Min	8
												Max	9
												Max:Min	1.13
								Nozzle ID	n36				
			Sample Ref	epa.16.511.04				**Nozzle Diameter (mm)**	7.09				
K Factor	5.71		**Filter Number**	epa.16.511.04F									
Stack Diameter (m)	0.30		**Probe Washing No**	epa.16.511.04W									
							ΔH across orifice meter (mm H_2O)	**DGM (litres)**	**DGM Temp (ºC)**		**Temp (ºC)**		
Point	Time	Vac	Stack Temp	**Velocity Head (mmH_2O)**		√ΔP		7541.87	In	Out	Probe	Filter	**Impinger**
a1	0 5	4	25	9		3.00	51.37	7681	19	19	160	160	
a1	5 10	4	25	9		3.00	51.37	7777	20	20	160	160	
a1	10 15	4	25	9		3.00	51.37	7898	20	20	160	160	
a1	15 20	4	25	8		2.83	45.66	8001	20	20	160	160	
a1	20 25	4	24	8		2.83	45.66	8108	20	20	160	160	
a1	25 30	4	24	8		2.83	45.66	8219.42	20	20	160	160	
Total / Average		4.00	24.67	8.50		2.91	48.51	677.55	19.83	19.83	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	0.12	0.12

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	801.72	801.55	800.12	-1.43

2.3.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
27.06.2016	13:30:14	611.0	982.0	982.0
27.06.2016	13:30:29	876.7	1409.0	1409.0
27.06.2016	13:30:44	1116.0	1793.6	1793.6
27.06.2016	13:30:59	1758.0	2825.4	2825.4
27.06.2016	13:31:14	2637.0	4238.0	4238.0
27.06.2016	13:31:29	2999.0	4819.8	4819.8
27.06.2016	13:31:44	3060.0	4917.9	4917.9
27.06.2016	13:31:59	3429.0	5510.9	5510.9
27.06.2016	13:32:14	3665.0	5890.2	5890.2
27.06.2016	13:32:29	3626.0	5827.5	5827.5
27.06.2016	13:32:44	4100.0	6589.3	6589.3
27.06.2016	13:32:59	4029.0	6475.2	6475.2
27.06.2016	13:33:14	4198.0	6746.8	6746.8
27.06.2016	13:33:29	4103.0	6594.1	6594.1
27.06.2016	13:33:44	4151.0	6671.3	6671.3
27.06.2016	13:33:59	4029.0	6475.2	6475.2
27.06.2016	13:34:14	3844.0	6177.9	6177.9
27.06.2016	13:34:29	3739.0	6009.1	6009.1
27.06.2016	13:34:44	3949.0	6346.6	6346.6
27.06.2016	13:34:59	4029.0	6475.2	6475.2
27.06.2016	13:35:14	3709.0	5960.9	5960.9
27.06.2016	13:35:29	3619.0	5816.3	5816.3
27.06.2016	13:35:44	4015.0	6452.7	6452.7
27.06.2016	13:35:59	4383.0	7044.1	7044.1
27.06.2016	13:36:14	4203.0	6754.8	6754.8
27.06.2016	13:36:29	4022.0	6463.9	6463.9
27.06.2016	13:36:44	4261.0	6848.0	6848.0
27.06.2016	13:36:59	3966.0	6373.9	6373.9
27.06.2016	13:37:14	3829.0	6153.8	6153.8
27.06.2016	13:37:29	3643.0	5854.8	5854.8

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
27.06.2016	13:37:44	3653.0	5870.9	5870.9
27.06.2016	13:37:59	3983.0	6401.3	6401.3
27.06.2016	13:38:14	3866.0	6213.2	6213.2
27.06.2016	13:38:29	3880.0	6235.7	6235.7
27.06.2016	13:38:44	3949.0	6346.6	6346.6
27.06.2016	13:38:59	3902.0	6271.1	6271.1
27.06.2016	13:39:14	3993.0	6417.3	6417.3
27.06.2016	13:39:29	4308.0	6923.6	6923.6
27.06.2016	13:39:44	3810.0	6123.2	6123.2
27.06.2016	13:39:59	3773.0	6063.8	6063.8
27.06.2016	13:40:14	4078.0	6553.9	6553.9
27.06.2016	13:40:29	4305.0	6918.8	6918.8
27.06.2016	13:40:44	3675.0	5906.3	5906.3
27.06.2016	13:40:59	3866.0	6213.2	6213.2
27.06.2016	13:41:14	4164.0	6692.1	6692.1
27.06.2016	13:41:29	4310.0	6926.8	6926.8
27.06.2016	13:41:44	4195.0	6742.0	6742.0
27.06.2016	13:41:59	4046.0	6502.5	6502.5
27.06.2016	13:42:14	4215.0	6774.1	6774.1
27.06.2016	13:42:29	4310.0	6926.8	6926.8
27.06.2016	13:42:44	4603.0	7397.7	7397.7
27.06.2016	13:42:59	4564.0	7335.0	7335.0
27.06.2016	13:43:14	4232.0	6801.4	6801.4
27.06.2016	13:43:29	3712.0	5965.7	5965.7
27.06.2016	13:43:44	3890.0	6251.8	6251.8
27.06.2016	13:43:59	4122.0	6624.6	6624.6
27.06.2016	13:44:14	3932.0	6319.3	6319.3
27.06.2016	13:44:29	4305.0	6918.8	6918.8
27.06.2016	13:44:44	4376.0	7032.9	7032.9
27.06.2016	13:44:59	4195.0	6742.0	6742.0
27.06.2016	13:45:14	3785.0	6083.0	6083.0
27.06.2016	13:45:29	4159.0	6684.1	6684.1
27.06.2016	13:45:44	4552.0	7315.7	7315.7
27.06.2016	13:45:59	4518.0	7261.1	7261.1
27.06.2016	13:46:14	4127.0	6632.7	6632.7
27.06.2016	13:46:29	4103.0	6594.1	6594.1
27.06.2016	13:46:44	4408.0	7084.3	7084.3
27.06.2016	13:46:59	3954.0	6354.6	6354.6
27.06.2016	13:47:14	3324.0	5342.1	5342.1
27.06.2016	13:47:29	2879.0	4627.0	4627.0
27.06.2016	13:47:44	2957.0	4752.3	4752.3
27.06.2016	13:47:59	3011.0	4839.1	4839.1
27.06.2016	13:48:14	2806.0	4509.6	4509.6
27.06.2016	13:48:29	2950.0	4741.1	4741.1
27.06.2016	13:48:44	3021.0	4855.2	4855.2
27.06.2016	13:48:59	3739.0	6009.1	6009.1
27.06.2016	13:49:14	4000.0	6428.6	6428.6
27.06.2016	13:49:29	4037.0	6488.0	6488.0

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
27.06.2016	13:49:44	4154.0	6676.1	6676.1
27.06.2016	13:49:59	4352.0	6994.3	6994.3
27.06.2016	13:50:14	4234.0	6804.6	6804.6
27.06.2016	13:50:29	4361.0	7008.8	7008.8
27.06.2016	13:50:44	4598.0	7389.6	7389.6
27.06.2016	13:50:59	4332.0	6962.1	6962.1
27.06.2016	13:51:14	4352.0	6994.3	6994.3
27.06.2016	13:51:29	4161.0	6687.3	6687.3
27.06.2016	13:51:44	3871.0	6221.3	6221.3
27.06.2016	13:51:59	3429.0	5510.9	5510.9
27.06.2016	13:52:14	3573.0	5742.3	5742.3
27.06.2016	13:52:29	3785.0	6083.0	6083.0
27.06.2016	13:52:44	4090.0	6573.2	6573.2
27.06.2016	13:52:59	4349.0	6989.5	6989.5
27.06.2016	13:53:14	4530.0	7280.4	7280.4
27.06.2016	13:53:29	4647.0	7468.4	7468.4
27.06.2016	13:53:44	4212.0	6769.3	6769.3
27.06.2016	13:53:59	3800.0	6107.1	6107.1
27.06.2016	13:54:14	3573.0	5742.3	5742.3
27.06.2016	13:54:29	3687.0	5925.5	5925.5
27.06.2016	13:54:44	4366.0	7016.8	7016.8
27.06.2016	13:54:59	4098.0	6586.1	6586.1
27.06.2016	13:55:14	4139.0	6652.0	6652.0
27.06.2016	13:55:29	4559.0	7327.0	7327.0
27.06.2016	13:55:44	4361.0	7008.8	7008.8
27.06.2016	13:55:59	3722.0	5981.8	5981.8
27.06.2016	13:56:14	3961.0	6365.9	6365.9
27.06.2016	13:56:29	4230.0	6798.2	6798.2
27.06.2016	13:56:44	4484.0	7206.4	7206.4
27.06.2016	13:56:59	4105.0	6597.3	6597.3
27.06.2016	13:57:14	3834.0	6161.8	6161.8
27.06.2016	13:57:29	4071.0	6542.7	6542.7
27.06.2016	13:57:44	4205.0	6758.0	6758.0
27.06.2016	13:57:59	4220.0	6782.1	6782.1
27.06.2016	13:58:14	4300.0	6910.7	6910.7
27.06.2016	13:58:29	4110.0	6605.4	6605.4
27.06.2016	13:58:44	3768.0	6055.7	6055.7
27.06.2016	13:58:59	2801.0	4501.6	4501.6
27.06.2016	13:59:14	2239.0	3598.4	3598.4
27.06.2016	13:59:29	1963.0	3154.8	3154.8
27.06.2016	13:59:44	1770.0	2844.6	2844.6
27.06.2016	13:59:59	1621.0	2605.2	2605.2
27.06.2016	14:00:14	1543.0	2479.8	2479.8
27.06.2016	14:00:29	1477.0	2373.8	2373.8
27.06.2016	14:00:44	1419.0	2280.5	2280.5
27.06.2016	14:00:59	1360.0	2185.7	2185.7
Mean		3717.4	5974.4	5974.4
Max		4647.0	7468.4	7468.4

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
Min		611.0	982.0	982.0

2.3.8 Uncertainty Calculations

Particulates

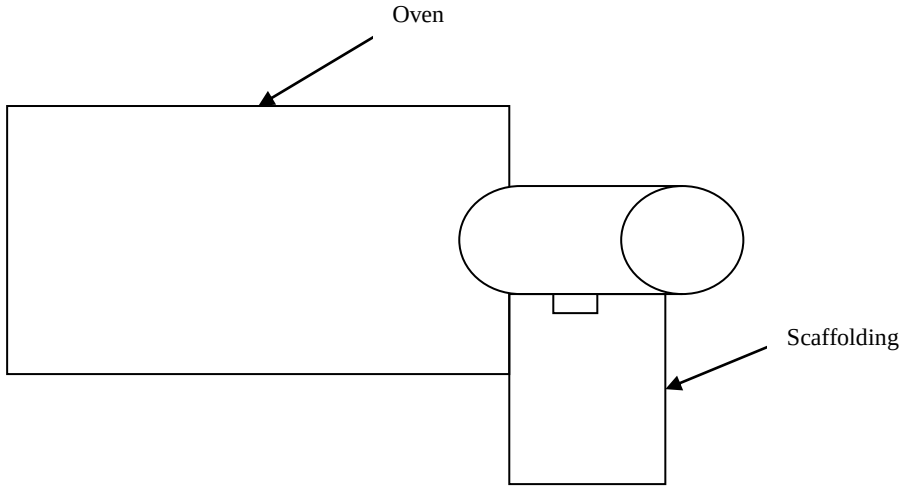
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Pressure	7.73		
Washing Weighing	2.33		As % of result
Gas Volume	2.30		16.42
Gas Temperature	0.69		
Filter Weighing	0.58	8.46	As % of ELV
Humidity	0.50		31.13
Leak	0.19		As mg/m^3
O_2 Concentration	0.00		15.56

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	0.41		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.03		
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		0.64
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)	3.5	3.5	3.5
$\sqrt{\Delta P}$	1.87	1.87	1.87
Temperature (ºC)	193	193	193

Static Pressure (mmH_2O)	5.0	**Barometric Pressure (mm Hg)**	754.0	**Duct Dimensions (m)**	0.19

Velocity (m/s) average	8.2	**Actual Flow of stack gas (m^3/hr)**	841.3
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	489.2
Dimensions (m)	0.19	**Flow (dry) at STP (m^3/hr)**	481.9
Area (m^2)	0.028		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	3.5	3.5	3.5	1.0	Yes
$\sqrt{\Delta P}$ (mm H_2O)^{½}	1.87	1.87	1.87	1.0	Yes
Temperature (ºC)	193.0	193.0	193.0	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	28.06.16		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	Paint Oven Shop		
	Blank	Test 1	Units
Sample Ref	epa.16.511.09	epa.16.511.10	-
Start Time	13:31	13:44	hr:mm
Stop Time	13:36	14:14	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	7.3	ml
B_{wo}	0.01	0.015	-
P_b	-	754.0	mm Hg
St	-	5	mm H_2O
T_s	-	199.50	ºC
$\sqrt{\Delta P}$	-	1.87	$(mm\ H_2O)^{½}$
Yd	-	1.021	-
Test Time	5	30	min
T_m	-	23.83	ºC
C_p	-	0.829	-
As	-	0.028	m^2
D_n	-	9.71	mm
ΔH ave	-	45.74	mm H_20
V_{mstd}	0.5998	0.5998	m^3
V_{wstd}	0.0091	0.0091	m^3
$Q_{std,wet}$	-	469.2	Nm^3/h
Q_{act}	-	818.1	Nm^3/h
Isokinetic Rate	-	99.4	%
Vs	-	8.02	m/s
Washings			
Sample Ref	epa.16.511.09W	epa.16.511.10W	-
Weight	0.73	0.53	mg
Filter			
Sample Ref	epa.16.511.09F	epa.16.511.10F	-
Weight	<0.1	<0.1	mg
Particulate Concentration (Dry, No O_2 Correction)	1.4	1.1	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	1.4	1.0	mg/Nm^3
Particulate Release Rate	-	0.49	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	0.73
Run 1	<0.1	0.53

2.4.5 Sampling Measurements

Date	28.06.16		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	13:44		1	919.5	928.5	9.0		**Leak Check (Pre)**	0.12	10			
End Time	14:14		2	810.5	809.6	-0.9		**Leak Check (Post)**	0.11	7			
Duration (mm.ss)	30.00		3	674.2	671.8	-2.4							
Stack	Paint Shop Spray oven		4	728.3	729.9	1.6		**Pitot ID**	Pitot 06			Velocity Head	
Run	1		5	241.7	241.7	0.0		**DGM ID**	DGM 09			Min	3.5
												Max	3.5
												Max:Min	1.00
								Nozzle ID	n6				
			Sample Ref	epa.16.511.10				**Nozzle Diameter (mm)**	9.71				
K Factor	13.07		**Filter Number**	epa.16.511.10F									
Stack Diameter (m)	0.19		**Probe Washing No**	epa.16.511.10W									
							ΔH across orifice meter (mm H_2O)	**DGM (litres)**	**DGM Temp (ºC)**		**Temp (ºC)**		
Point	**Time**	**Vac**	**Stack Temp (ºC)**	**Velocity Head (mmH_2O)**		√ΔP		148.32	In	Out	Probe	Filter	**Impinger**
a1	0 5	3	191	3.5		1.87	45.74	256	24	23	160	160	
a1	5 10	3	201	3.5		1.87	45.74	357	24	23	160	160	
a1	10 15	3	202	3.5		1.87	45.74	462	24	23	160	160	
a1	15 20	3	201	3.5		1.87	45.74	587	24	23	160	160	
a1	20 25	3	204	3.5		1.87	45.74	677	25	24	160	160	
a1	25 30	3	198	3.5		1.87	45.74	789.32	25	24	160	160	
Total / Average		3.00	199.50	3.50		1.87	45.74	641.00	24.33	23.33	160.00	160.00	

2.4.6 Instrumental Gas Analyser Site Calibration Measurements

Zero Point

				Pre Test			Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Pre Span	Post Span	System	System	Zero Drift
VOC (ppm)	100	Ambient Air	0.00	0.00	0.00	0.17	0.12	-0.05

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	80.22	80.59	80.42	-0.17

2.4.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
28.06.2016	13:44:06	26.7	42.9	42.9
28.06.2016	13:44:21	27.7	44.5	44.5
28.06.2016	13:44:36	28.6	46.0	46.0
28.06.2016	13:44:51	29.2	46.9	46.9
28.06.2016	13:45:06	29.9	48.1	48.1
28.06.2016	13:45:21	30.6	49.2	49.2
28.06.2016	13:45:36	31.4	50.5	50.5
28.06.2016	13:45:51	31.8	51.1	51.1
28.06.2016	13:46:06	32.2	51.8	51.8
28.06.2016	13:46:21	32.6	52.4	52.4
28.06.2016	13:46:36	32.8	52.7	52.7
28.06.2016	13:46:51	33.3	53.5	53.5
28.06.2016	13:47:06	33.0	53.0	53.0
28.06.2016	13:47:21	32.8	52.7	52.7
28.06.2016	13:47:36	32.9	52.9	52.9
28.06.2016	13:47:51	33.2	53.4	53.4
28.06.2016	13:48:06	33.4	53.7	53.7
28.06.2016	13:48:21	33.5	53.8	53.8
28.06.2016	13:48:36	33.7	54.2	54.2
28.06.2016	13:48:51	33.8	54.3	54.3
28.06.2016	13:49:06	33.9	54.5	54.5
28.06.2016	13:49:21	34.1	54.8	54.8
28.06.2016	13:49:36	34.1	54.8	54.8
28.06.2016	13:49:51	34.2	55.0	55.0
28.06.2016	13:50:06	33.9	54.5	54.5
28.06.2016	13:50:21	33.8	54.3	54.3
28.06.2016	13:50:36	33.6	54.0	54.0
28.06.2016	13:50:51	33.2	53.4	53.4

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
28.06.2016	13:51:06	32.8	52.7	52.7
28.06.2016	13:51:21	32.7	52.6	52.6
28.06.2016	13:51:36	32.1	51.6	51.6
28.06.2016	13:51:51	31.5	50.6	50.6
28.06.2016	13:52:06	31.1	50.0	50.0
28.06.2016	13:52:21	30.6	49.2	49.2
28.06.2016	13:52:36	29.7	47.7	47.7
28.06.2016	13:52:51	29.3	47.1	47.1
28.06.2016	13:53:06	28.6	46.0	46.0
28.06.2016	13:53:21	27.8	44.7	44.7
28.06.2016	13:53:36	27.3	43.9	43.9
28.06.2016	13:53:51	26.7	42.9	42.9
28.06.2016	13:54:06	26.1	41.9	41.9
28.06.2016	13:54:21	25.1	40.3	40.3
28.06.2016	13:54:36	24.5	39.4	39.4
28.06.2016	13:54:51	24.1	38.7	38.7
28.06.2016	13:55:06	23.6	37.9	37.9
28.06.2016	13:55:21	23.2	37.3	37.3
28.06.2016	13:55:36	22.7	36.5	36.5
28.06.2016	13:55:51	22.2	35.7	35.7
28.06.2016	13:56:06	21.7	34.9	34.9
28.06.2016	13:56:21	21.4	34.4	34.4
28.06.2016	13:56:36	21.1	33.9	33.9
28.06.2016	13:56:51	20.6	33.1	33.1
28.06.2016	13:57:06	20.2	32.5	32.5
28.06.2016	13:57:21	20.1	32.3	32.3
28.06.2016	13:57:36	20.0	32.1	32.1
28.06.2016	13:57:51	19.8	31.8	31.8
28.06.2016	13:58:06	19.7	31.7	31.7
28.06.2016	13:58:21	20.0	32.1	32.1
28.06.2016	13:58:36	19.8	31.8	31.8
28.06.2016	13:58:51	19.8	31.8	31.8
28.06.2016	13:59:06	19.9	32.0	32.0
28.06.2016	13:59:21	20.1	32.3	32.3
28.06.2016	13:59:36	20.1	32.3	32.3
28.06.2016	13:59:51	20.3	32.6	32.6
28.06.2016	14:00:06	20.4	32.8	32.8
28.06.2016	14:00:21	20.7	33.3	33.3
28.06.2016	14:00:36	20.8	33.4	33.4
28.06.2016	14:00:51	21.0	33.8	33.8
28.06.2016	14:01:06	21.2	34.1	34.1
28.06.2016	14:01:21	21.7	34.9	34.9
28.06.2016	14:01:36	21.9	35.2	35.2
28.06.2016	14:01:51	22.0	35.4	35.4
28.06.2016	14:02:06	22.3	35.8	35.8
28.06.2016	14:02:21	22.9	36.8	36.8
28.06.2016	14:02:36	22.7	36.5	36.5
28.06.2016	14:02:51	22.8	36.6	36.6

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
28.06.2016	14:03:06	23.1	37.1	37.1
28.06.2016	14:03:21	23.2	37.3	37.3
28.06.2016	14:03:36	23.0	37.0	37.0
28.06.2016	14:03:51	23.0	37.0	37.0
28.06.2016	14:04:06	23.2	37.3	37.3
28.06.2016	14:04:21	23.1	37.1	37.1
28.06.2016	14:04:36	23.0	37.0	37.0
28.06.2016	14:04:51	23.0	37.0	37.0
28.06.2016	14:05:06	22.7	36.5	36.5
28.06.2016	14:05:21	22.7	36.5	36.5
28.06.2016	14:05:36	22.4	36.0	36.0
28.06.2016	14:05:51	22.3	35.8	35.8
28.06.2016	14:06:06	22.2	35.7	35.7
28.06.2016	14:06:21	21.8	35.0	35.0
28.06.2016	14:06:36	21.4	34.4	34.4
28.06.2016	14:06:51	21.4	34.4	34.4
28.06.2016	14:07:06	21.1	33.9	33.9
28.06.2016	14:07:21	20.8	33.4	33.4
28.06.2016	14:07:36	20.6	33.1	33.1
28.06.2016	14:07:51	20.5	32.9	32.9
28.06.2016	14:08:06	20.3	32.6	32.6
28.06.2016	14:08:21	20.2	32.5	32.5
28.06.2016	14:08:36	20.1	32.3	32.3
28.06.2016	14:08:51	19.9	32.0	32.0
28.06.2016	14:09:06	19.6	31.5	31.5
28.06.2016	14:09:21	19.4	31.2	31.2
28.06.2016	14:09:36	19.4	31.2	31.2
28.06.2016	14:09:51	19.3	31.0	31.0
28.06.2016	14:10:06	19.2	30.9	30.9
28.06.2016	14:10:21	19.2	30.9	30.9
28.06.2016	14:10:36	19.2	30.9	30.9
28.06.2016	14:10:51	19.3	31.0	31.0
28.06.2016	14:11:06	19.3	31.0	31.0
28.06.2016	14:11:21	19.4	31.2	31.2
28.06.2016	14:11:36	19.3	31.0	31.0
28.06.2016	14:11:51	19.2	30.9	30.9
28.06.2016	14:12:06	19.2	30.9	30.9
28.06.2016	14:12:21	19.3	31.0	31.0
28.06.2016	14:12:36	19.4	31.2	31.2
28.06.2016	14:12:51	19.5	31.3	31.3
28.06.2016	14:13:06	19.7	31.7	31.7
28.06.2016	14:13:21	19.7	31.7	31.7
28.06.2016	14:13:36	19.6	31.5	31.5
28.06.2016	14:13:51	19.5	31.3	31.3
28.06.2016	14:14:06	19.5	31.3	31.3
28.06.2016	14:14:21	19.8	31.8	31.8
28.06.2016	14:14:36	19.8	31.8	31.8
28.06.2016	14:14:51	19.6	31.5	31.5

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
Mean		24.5	39.3	39.3
Max		34.2	55.0	55.0
Min		19.2	30.9	30.9

2.4.8 Uncertainty Calculations

Particulates

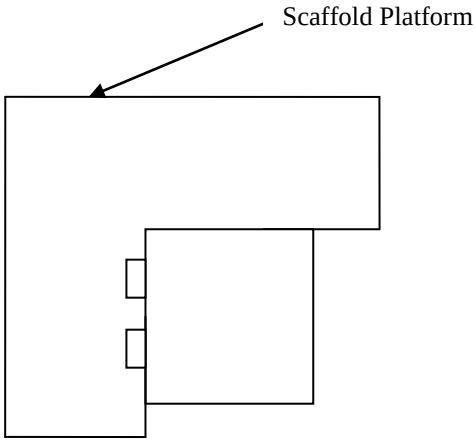
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Pressure	8.20	8.53	As % of result 16.54
Gas Volume	2.18		
Gas Temperature	0.68		
Humidity	0.50		As % of ELV 0.35
Washing Weighing	0.03		
Leak	0.00		
Filter Weighing	0.00		As mg/m^3 0.17
O_2 Concentration	0.00		

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	0.96	1.22	2.37
Temperature effect (zero)	0.46		
Barometric Pressure	0.40		
Span gas	0.35		
Temperature effect (span)	0.23		
Repeatability	0.07		
Span drift	0.05		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.01		
Cross sensitivity CO (1.2 % vol)	0.00		
Cross sensitivity NO (127 mgm^{-3})	0.00		As % of Result 9.67
Cross sensitivity H_2O (sat 325K)	0.00		
Cross sensitivity SO_2 (2767 mgm^{-3})	0.00		As mg/m^3 at ref conditions 3.80
Cross sensitivity CO_2 (15.2 % vol)	0.00		

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**		
Pressure (mm H_2O)	14.0	14.0	14.0	13.0	13.0	13.0
√ΔP	3.74	3.74	3.74	3.61	3.61	3.61
Temperature (ºC)	14	14	14	14	14	14
Traverse Point	**B1**			**B2**		
Pressure (mm H_2O)	14.0	14.0	13.0	13.0	13.0	13.0
√ΔP	3.74	3.74	3.61	3.61	3.61	3.61
Temperature (ºC)	14	14	14	14	14	14

Static Pressure (mmH_2O)	22	**Barometric Pressure (mm Hg)**	754.0	**Duct Dimensions (m)**	0.74 x 0.74

Velocity (m/s) average	12.6	**Actual Flow of stack gas (m^3/hr)**	25502.1
Stack Geometry	Rectangular	**Flow (wet) at STP (m^3/hr)**	24118.1
Dimensions (m)	0.74 x 0.74	**Flow (dry) at STP (m^3/hr)**	23277.9
Area (m^2)	0.548		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	13.4	14.0	13.0	1.1	Yes
√ΔP (mm H_2O)^{½}	3.66	3.74	3.61	1.0	Yes
Temperature (ºC)	14.0	14.0	14.0	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	28.06.16		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	Paint Shop Spray Area		
	Blank	Test 1	Units
Sample Ref	epa.16.511.07	epa.16.511.08	-
Start Time	12:07	12:25	hr:mm
Stop Time	12:12	12:59	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	25.1	ml
B_{wo}	0.03	0.035	-
P_b	-	754.0	mm Hg
St	-	22	mm H_2O
T_s	-	14.00	ºC
$\sqrt{\Delta P}$	-	3.60	$(mm\ H_2O)^{½}$
Yd	-	1.021	-
Test Time	5	32	min
T_m	-	21.38	ºC
C_p	-	0.830	-
As	-	0.563	m^2
D_n	-	7.09	mm
ΔH ave	-	78.00	mm H_20
V_{mstd}	0.8653	0.8653	m^3
V_{wstd}	0.0312	0.0312	m^3
$Q_{std,wet}$	-	23143.4	Nm^3/h
Q_{act}	-	24471.4	Nm^3/h
Isokinetic Rate	-	103.5	%
Vs	-	12.08	m/s
Washings			
Sample Ref	epa.16.511.07W	epa.16.511.08W	-
Weight	1.57	0.5	mg
Filter			
Sample Ref	epa.16.511.07F	epa.16.511.08F	-
Weight	<0.04	0.34	mg
Particulate Concentration (Dry, No O_2 Correction)	1.9	1.0	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	1.8	0.9	mg/Nm^3
Particulate Release Rate	-	21.68	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	1.57
Run 1	0.34	0.5

2.5.5 Sampling Measurements

Date	28.06.16		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	12:25		1	912.3	919.5	7.2		**Leak Check (Pre)**	0.11	10			
End Time	12:59		2	805.7	810.5	4.8		**Leak Check (Post)**	0.09	7			
Duration (mm.ss)	32.00		3	669.7	674.2	4.5							
Stack	Paint Shop Spray		4	719.7	728.3	8.6		**Pitot ID**	pitot 12			Velocity Head	
Run	1		5	241.7	241.7	0.0		**DGM ID**	dgm 09			Min	12
												Max	14
												Max:Min	1.17
								Nozzle ID	n36				
			Sample Ref	epa.16.511.08				**Nozzle Diameter (mm)**	7.09				
K Factor	6.00		**Filter Number**	epa.16.511.08F									
Stack Diameter (m)	0.75		**Probe Washing No**	epa.16.511.08W									
							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**		9202.11	In	Out	Probe	**Filter**	**Impinger**
a1	0 4	4	14	14		3.74	84.00	9318	21	21	50		
a1	4 8	4	14	14		3.74	84.00	9434	21	21	50		
a2	8 12	4	14	13		3.61	78.00	9547	22	21	50		
a2	12 16	4	14	13		3.61	78.00	9663	22	21	50		
b1	16 20	4	14	12		3.46	72.00	9771	22	21	50		
b1	20 24	4	14	12		3.46	72.00	9881	22	21	50		
b2	24 28	4	14	13		3.61	78.00	9995	22	21	50		
b2	28 32	4	14	13		3.61	78.00	10116.32	22	21	50		
Total / Average		4.00	14.00	13.00		3.60	78.00	914.21	21.75	21.00	50.00		

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	0.01	0.03	0.02	-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 /101	7.93	8.02	7.95	7.97	0.02

2.5.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
28.06.2016	12:25:06	0.5	0.8	0.8
28.06.2016	12:25:21	0.5	0.8	0.8
28.06.2016	12:25:36	0.5	0.8	0.8
28.06.2016	12:25:51	0.5	0.8	0.8
28.06.2016	12:26:06	0.5	0.7	0.7
28.06.2016	12:26:21	0.4	0.7	0.7
28.06.2016	12:26:36	0.5	0.7	0.7
28.06.2016	12:26:51	0.4	0.7	0.7
28.06.2016	12:27:06	0.5	0.7	0.7
28.06.2016	12:27:21	0.4	0.7	0.7
28.06.2016	12:27:36	0.4	0.7	0.7
28.06.2016	12:27:51	0.4	0.7	0.7
28.06.2016	12:28:06	0.4	0.7	0.7
28.06.2016	12:28:21	0.4	0.6	0.6
28.06.2016	12:28:36	0.4	0.7	0.7
28.06.2016	12:28:51	0.4	0.7	0.7
28.06.2016	12:29:06	0.4	0.7	0.7
28.06.2016	12:29:21	0.4	0.7	0.7
28.06.2016	12:29:36	0.4	0.6	0.6
28.06.2016	12:29:51	0.4	0.6	0.6
28.06.2016	12:30:06	0.4	0.6	0.6
28.06.2016	12:30:21	0.4	0.6	0.6
28.06.2016	12:30:36	0.4	0.6	0.6
28.06.2016	12:30:51	0.4	0.6	0.6
28.06.2016	12:31:06	0.4	0.6	0.6
28.06.2016	12:31:21	0.4	0.6	0.6
28.06.2016	12:31:36	0.4	0.6	0.6
28.06.2016	12:31:51	0.4	0.6	0.6
28.06.2016	12:32:06	0.4	0.6	0.6
28.06.2016	12:32:21	0.4	0.6	0.6

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
28.06.2016	12:32:36	0.4	0.6	0.6
28.06.2016	12:32:51	0.4	0.6	0.6
28.06.2016	12:33:06	0.4	0.6	0.6
28.06.2016	12:33:21	0.4	0.6	0.6
28.06.2016	12:33:36	0.3	0.5	0.5
28.06.2016	12:33:51	0.3	0.5	0.5
28.06.2016	12:34:06	0.3	0.5	0.5
28.06.2016	12:34:21	0.3	0.5	0.5
28.06.2016	12:34:36	0.3	0.5	0.5
28.06.2016	12:34:51	0.3	0.5	0.5
28.06.2016	12:35:06	0.3	0.5	0.5
28.06.2016	12:35:21	0.4	0.6	0.6
28.06.2016	12:35:36	0.3	0.5	0.5
28.06.2016	12:35:51	0.3	0.5	0.5
28.06.2016	12:36:06	0.3	0.5	0.5
28.06.2016	12:36:21	0.3	0.5	0.5
28.06.2016	12:36:36	0.3	0.5	0.5
28.06.2016	12:36:51	0.4	0.6	0.6
28.06.2016	12:37:06	0.4	0.6	0.6
28.06.2016	12:37:21	0.4	0.6	0.6
28.06.2016	12:37:36	0.4	0.6	0.6
28.06.2016	12:37:51	0.3	0.5	0.5
28.06.2016	12:38:06	0.4	0.6	0.6
28.06.2016	12:38:21	0.4	0.6	0.6
28.06.2016	12:38:36	0.4	0.6	0.6
28.06.2016	12:38:51	0.4	0.6	0.6
28.06.2016	12:39:06	0.4	0.6	0.6
28.06.2016	12:39:21	0.4	0.6	0.6
28.06.2016	12:39:36	0.4	0.6	0.6
28.06.2016	12:39:51	0.4	0.6	0.6
28.06.2016	12:40:06	0.4	0.6	0.6
28.06.2016	12:40:21	0.4	0.6	0.6
28.06.2016	12:40:36	0.4	0.6	0.6
28.06.2016	12:40:51	0.4	0.6	0.6
28.06.2016	12:41:06	0.4	0.6	0.6
28.06.2016	12:41:21	0.4	0.6	0.6
28.06.2016	12:41:36	0.4	0.6	0.6
28.06.2016	12:41:51	0.4	0.6	0.6
28.06.2016	12:42:06	0.4	0.6	0.6
28.06.2016	12:42:21	0.4	0.6	0.6
28.06.2016	12:42:36	0.4	0.6	0.6
28.06.2016	12:42:51	0.4	0.6	0.6
28.06.2016	12:43:06	0.4	0.6	0.6
28.06.2016	12:43:21	0.4	0.6	0.6
28.06.2016	12:43:36	0.4	0.7	0.7
28.06.2016	12:43:51	0.4	0.7	0.7
28.06.2016	12:44:06	0.4	0.6	0.6
28.06.2016	12:44:21	0.4	0.7	0.7

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
28.06.2016	12:44:36	0.5	0.8	0.8
28.06.2016	12:44:51	0.5	0.8	0.8
28.06.2016	12:45:06	0.5	0.8	0.8
28.06.2016	12:45:21	0.6	0.9	0.9
28.06.2016	12:45:36	0.6	0.9	0.9
28.06.2016	12:45:51	0.6	1.0	1.0
28.06.2016	12:46:06	0.7	1.1	1.1
28.06.2016	12:46:21	0.7	1.2	1.2
28.06.2016	12:46:36	0.8	1.2	1.2
28.06.2016	12:46:51	0.8	1.3	1.3
28.06.2016	12:47:06	0.8	1.4	1.4
28.06.2016	12:47:21	1.0	1.5	1.5
28.06.2016	12:47:36	1.0	1.7	1.7
28.06.2016	12:47:51	1.1	1.8	1.8
28.06.2016	12:48:06	1.2	1.9	1.9
28.06.2016	12:48:21	1.2	1.9	1.9
28.06.2016	12:48:36	1.2	2.0	2.0
28.06.2016	12:48:51	1.2	2.0	2.0
28.06.2016	12:49:06	1.3	2.0	2.0
28.06.2016	12:49:21	1.3	2.0	2.0
28.06.2016	12:49:36	1.3	2.0	2.0
28.06.2016	12:49:51	1.3	2.1	2.1
28.06.2016	12:50:06	1.3	2.0	2.0
28.06.2016	12:50:21	1.2	2.0	2.0
28.06.2016	12:50:36	1.2	2.0	2.0
28.06.2016	12:50:51	1.2	2.0	2.0
28.06.2016	12:51:06	1.2	2.0	2.0
28.06.2016	12:51:21	1.2	2.0	2.0
28.06.2016	12:51:36	1.3	2.0	2.0
28.06.2016	12:51:51	1.2	2.0	2.0
28.06.2016	12:52:06	1.2	1.9	1.9
28.06.2016	12:52:21	1.2	1.9	1.9
28.06.2016	12:52:36	1.2	1.9	1.9
28.06.2016	12:52:51	1.2	1.9	1.9
28.06.2016	12:53:06	1.2	1.8	1.8
28.06.2016	12:53:21	1.1	1.8	1.8
28.06.2016	12:53:36	1.1	1.8	1.8
28.06.2016	12:53:51	1.1	1.8	1.8
28.06.2016	12:54:06	1.1	1.8	1.8
28.06.2016	12:54:21	1.1	1.8	1.8
28.06.2016	12:54:36	1.1	1.8	1.8
28.06.2016	12:54:51	1.1	1.8	1.8
28.06.2016	12:55:06	1.1	1.8	1.8
28.06.2016	12:55:21	1.1	1.8	1.8
28.06.2016	12:55:36	1.1	1.7	1.7
28.06.2016	12:55:51	1.1	1.7	1.7
28.06.2016	12:56:06	1.0	1.7	1.7
28.06.2016	12:56:21	1.0	1.6	1.6

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
28.06.2016	12:56:36	1.0	1.6	1.6
28.06.2016	12:56:51	1.0	1.6	1.6
28.06.2016	12:57:06	1.0	1.6	1.6
28.06.2016	12:57:21	0.9	1.5	1.5
28.06.2016	12:57:36	0.9	1.4	1.4
28.06.2016	12:57:51	0.9	1.4	1.4
28.06.2016	12:58:06	0.9	1.4	1.4
28.06.2016	12:58:21	0.8	1.3	1.3
28.06.2016	12:58:36	0.8	1.3	1.3
28.06.2016	12:58:51	0.8	1.3	1.3
28.06.2016	12:59:06	1.1	1.7	1.7
28.06.2016	12:59:21	1.1	1.7	1.7
Mean		0.7	1.1	1.1
Max		1.3	2.1	2.1
Min		0.3	0.5	0.5

2.5.8 Uncertainty Calculations

Particulates

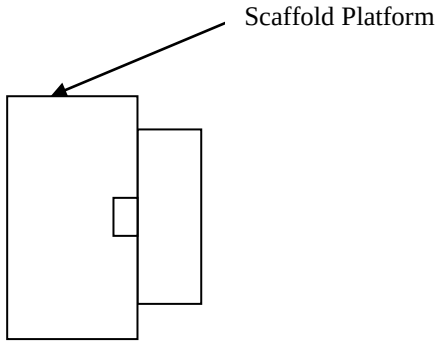
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Pressure	4.81		
Gas Volume	3.11		As % of result
Gas Temperature	0.69		11.23
Humidity	0.50		
Washing Weighing	0.02	5.79	As % of ELV
Filter Weighing	0.01		0.22
Leak	0.00		
O_2 Concentration	0.00		As mg/m^3
			0.11

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	0.10		
Span gas	0.08		
Temperature effect (zero)	0.05		0.27
Barometric Pressure	0.04		
Temperature effect (span)	0.02		
Repeatability	0.01	0.14	
Span drift	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		41.40
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		0.44

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)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
√ΔP	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Temperature (ºC)	25	25	25	25	25	25	25	25	25	25	25	25
Traverse Point	**A5**			**A6**			**A7**			**A8**		
Pressure (mm H_2O)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
√ΔP	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Temperature (ºC)	25	25	25	25	25	25	25	25	25	25	25	25

Static Pressure (mmH_2O)	1.0	**Barometric Pressure (mm Hg)**	754.0	**Duct Dimensions (m)**	0.25 x 0.85

Velocity (m/s) average	7.0	**Actual Flow of stack gas (m^3/hr)**	5391.6
Stack Geometry	Rectangular	**Flow (wet) at STP (m^3/hr)**	4900.8
Dimensions (m)	0.25 x 0.85	**Flow (dry) at STP (m^3/hr)**	4821.1
Area (m^2)	0.213		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	4.0	4.0	4.0	1.0	Yes
√ΔP (mm H_2O)^{½}	2.00	2.00	2.00	1.0	Yes
Temperature (ºC)	25.0	25.0	25.0	1.0	Yes
Angle of flow	<15º				Yes
Local Negative Flow	No				Yes

2.6.3 Gas Measurements

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

2.6.4 Manual Method Calculations

Test Dates	28.06.16		
Company	Leack Construction (BAE Systems)		
Contact	T Hughes		
Stack	Shot Blast		
	Blank	Test 1	Units
Sample Ref	epa.16.511.05	epa.16.511.06	-
Start Time	10:14	10:29	hr:mm
Stop Time	10:19	11:01	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	11.6	ml
B_{wo}	0.02	0.016	-
P_b	-	754.0	mm Hg
St	-	1	mm H_2O
T_s	-	25.00	ºC
$\sqrt{\Delta P}$	-	2.00	$(mm\ H_2O)^{½}$
Yd	-	1.021	-
Test Time	5	32	min
T_m	-	17.56	ºC
C_p	-	0.829	-
As	-	0.213	m^2
D_n	-	9.71	mm
ΔH ave	-	80.42	mm H_20
V_{mstd}	0.8737	0.8737	m^3
V_{wstd}	0.0144	0.0144	m^3
$Q_{std,wet}$	-	4733.9	Nm^3/h
Q_{act}	-	5208.0	Nm^3/h
Isokinetic Rate	-	100.9	%
Vs	-	6.81	m/s
Washings			
Sample Ref	epa.16.511.05W	epa.16.511.06W	-
Weight	0.87	0.77	mg
Filter			
Sample Ref	epa.16.511.05F	epa.16.511.06F	-
Weight	<0.1	<0.1	mg
Particulate Concentration (Dry, No O_2 Correction)	1.1	1.0	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	1.1	1.0	mg/Nm^3
Particulate Release Rate	-	4.64	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	0.87
Run 1	<0.1	0.77

2.6.5 Sampling Measurements

Date	28.06.16		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	10:29		1	915.9	915.7	-0.2		**Leak Check (Pre)**	0.11	10			
End Time	11:01		2	805.7	805.7	0.0		**Leak Check (Post)**	0.07	7			
Duration (mm.ss)	32.00		3	668.2	669.7	1.5							
Stack	Paint Shop Shot Blast		4	709.4	719.7	10.3		**Pitot ID**	pitot 06			Velocity Head	
Run	1		5	241.7	241.7	0.0		**DGM ID**	dgm 09			Min	4
												Max	4
												Max:Min	1.00
								Nozzle ID	n6				
			Sample Ref	epa.16.511.06				**Nozzle Diameter (mm)**	9.71				
K Factor	20.11		**Filter Number**	epa.16.511.06F									
Stack Diameter (m)	0.25		**Probe Washing No**	epa.16.511.06W									
							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		8240.38	In	Out	Probe	Filter	**Impinger**
a1	0 4	4	25	4		2.00	80.42	8348	16	16	160	160	
a2	4 8	4	25	4		2.00	80.42	8463	16	16	160	160	
a3	8 12	4	25	4		2.00	80.42	8577	16	16	160	160	
a4	12 16	4	25	4		2.00	80.42	8692	16	16	160	160	
a5	16 20	4	25	4		2.00	80.42	8817	19	17	160	160	
a6	20 24	4	25	4		2.00	80.42	8922	20	19	160	160	
a7	24 28	4	25	4		2.00	80.42	9068	20	19	160	160	
a8	28 32	4	25	4		2.00	80.42	9151.3	20	19	160	160	
Total / Average		4.00	25.00	4.00		2.00	80.42	910.92	17.88	17.25	160.00	160.00	

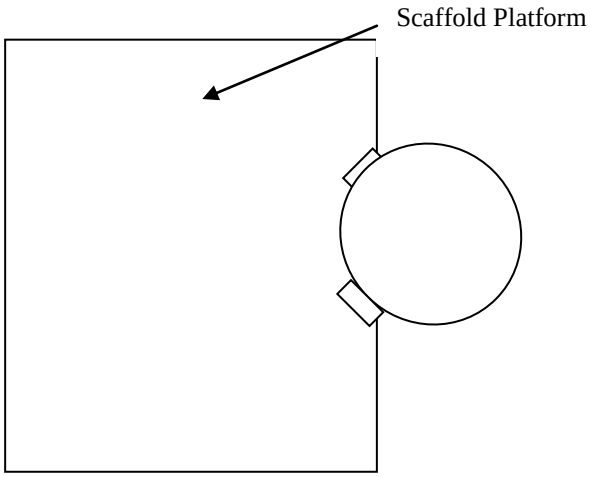
2.6.6 Uncertainty Calculations

Particulates

Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Pressure	4.66	5.66	As % of result 10.99
Gas Volume	3.10		
Gas Temperature	0.70		
Humidity	0.50		As % of ELV 0.22
Washing Weighing	0.04		
Leak	0.00		
Filter Weighing	0.00		As mg/m^3 0.11
O_2 Concentration	0.00		

Ge2.7 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)	20.0	20.0	20.0
√ΔP	4.47	4.47	4.47
Temperature (ºC)	27	27	27

Static Pressure (mmH_2O)	38	**Barometric Pressure (mm Hg)**	756.8	**Duct Dimensions (m)**	0.35

Velocity (m/s) average	15.7	**Actual Flow of stack gas (m^3/hr)**	5447.8
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	4936.6
Dimensions (m)	0.35	**Flow (dry) at STP (m^3/hr)**	4833.8
Area (m^2)	0.096		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	20.0	20.0	20.0	1.0	Yes
√ΔP (mm H_2O)^{½}	4.47	4.47	4.47	1.0	Yes
Temperature (ºC)	27.0	27.0	27.0	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	28.06.16		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	Paint Shop Dryer		
	Blank	Test 1	Units
Sample Ref	epa.16.511.11	epa.16.511.12	-
Start Time	14:50	15:05	hr:mm
Stop Time	14:55	15:35	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	11.9	ml
B_{wo}	0.02	0.021	-
P_b	-	754.0	mm Hg
St	-	38	mm H_2O
T_s	-	25.67	ºC
√ΔP	-	4.47	$(mm\ H_2O)^{½}$
Yd	-	1.021	-
Test Time	-	30	min
T_m	-	21.83	ºC
C_p	-	0.832	-
As	-	0.096	m^2
D_n	-	5.93	mm
ΔH ave	-	56.54	mm H_20
V_{mstd}	0.6965	0.6965	m^3
V_{wstd}	0.0148	0.0148	m^3
$Q_{std,wet}$	-	4817.4	Nm^3/h
Q_{act}	-	5292.6	Nm^3/h
Isokinetic Rate	-	102.9	%
Vs	-	15.28	m/s
Washings			
Sample Ref	epa.16.511.11W	epa.16.511.12W	-
Weight	0.6	0.87	mg
Filter			
Sample Ref	epa.16.511.11F	epa.16.511.12F	-
Weight	<0.04	<0.04	mg
Particulate Concentration (Dry, No O_2 Correction)	0.9	1.3	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	0.9	1.3	mg/Nm^3
Particulate Release Rate	-	6.16	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	0.6
Run 1	<0.04	0.87

2.7.5 Sampling Measurements

Date	28.06.16		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	15:05		1	928.5	930.8	2.3		**Leak Check (Pre)**	0.11	10			
End Time	15:35		2	809.6	811.1	1.5		**Leak Check (Post)**	0.08	7			
Duration (mm.ss)	30.00		3	671.8	673.0	1.2							
Stack	Paint Shop General / Dryer		4	729.3	736.2	6.9		**Pitot ID**	pitot 14			Velocity Head	
Run	1		5	241.7	241.7	0.0		**DGM ID**	dgm 09			Min	20
												Max	20
												Max:Min	1.00
								Nozzle ID	n35				
			Sample Ref	epa.16.511.12				**Nozzle Diameter (mm)**	5.93				
K Factor	2.83		**Filter Number**	epa.16.511.12F									
Stack Diameter (m)	0.35		**Probe Washing No**	epa.16.511.12W									
							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		820.21	In	Out	Probe	**Filter**	**Impinger**
a1	0 5	4	25	20		4.47	56.54	952	21	21	50		
a1	5 10	4	25	20		4.47	56.54	1059	21	21	50		
a1	10 15	4	26	20		4.47	56.54	1212	22	21	50		
a1	15 20	4	26	20		4.47	56.54	1324	23	22	50		
a1	20 25	4	26	20		4.47	56.54	1440	23	22	50		
a1	25 30	4	26	20		4.47	56.54	1558.76	23	22	50		
Total / Average		4.00	25.67	20.00		4.47	56.54	738.55	22.17	21.50	50.00		

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	0.02	0.00	-0.02

Span Gas

				Pre Test		Post Test	
Gas	Analyser Range	Gas Cylinder ID	Gas Conc.	Analyser	System	System	Span Drift
VOC (ppm)	10	EPA/CGAS/101	7.93	7.94	7.89	7.85	-0.04

2.7.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
28.06.2016	15:05:06	69.1	111.1	111.1
28.06.2016	15:05:21	66.1	106.2	106.2
28.06.2016	15:05:36	59.9	96.3	96.3
28.06.2016	15:05:51	53.8	86.5	86.5
28.06.2016	15:06:06	28.9	46.4	46.4
28.06.2016	15:06:21	12.8	20.6	20.6
28.06.2016	15:06:36	9.3	14.9	14.9
28.06.2016	15:06:51	9.1	14.7	14.7
28.06.2016	15:07:06	10.2	16.4	16.4
28.06.2016	15:07:21	8.4	13.5	13.5
28.06.2016	15:07:36	7.3	11.7	11.7
28.06.2016	15:07:51	8.6	13.8	13.8
28.06.2016	15:08:06	6.8	10.9	10.9
28.06.2016	15:08:21	5.7	9.1	9.1
28.06.2016	15:08:36	6.1	9.8	9.8
28.06.2016	15:08:51	6.6	10.6	10.6
28.06.2016	15:09:06	6.1	9.7	9.7
28.06.2016	15:09:21	5.9	9.5	9.5
28.06.2016	15:09:36	6.2	9.9	9.9
28.06.2016	15:09:51	6.8	10.9	10.9
28.06.2016	15:10:06	7.8	12.6	12.6
28.06.2016	15:10:21	6.8	11.0	11.0
28.06.2016	15:10:36	5.8	9.4	9.4
28.06.2016	15:10:51	8.9	14.4	14.4
28.06.2016	15:11:06	8.7	13.9	13.9
28.06.2016	15:11:21	8.2	13.2	13.2
28.06.2016	15:11:36	6.6	10.6	10.6
28.06.2016	15:11:51	5.6	9.0	9.0
28.06.2016	15:12:06	5.4	8.6	8.6
28.06.2016	15:12:21	5.4	8.6	8.6

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
28.06.2016	15:12:36	5.1	8.2	8.2
28.06.2016	15:12:51	4.2	6.8	6.8
28.06.2016	15:13:06	4.6	7.4	7.4
28.06.2016	15:13:21	4.3	6.9	6.9
28.06.2016	15:13:36	4.5	7.2	7.2
28.06.2016	15:13:51	4.3	7.0	7.0
28.06.2016	15:14:06	4.2	6.7	6.7
28.06.2016	15:14:21	3.7	6.0	6.0
28.06.2016	15:14:36	3.7	6.0	6.0
28.06.2016	15:14:51	20.4	32.8	32.8
28.06.2016	15:15:06	60.4	97.1	97.1
28.06.2016	15:15:21	46.2	74.3	74.3
28.06.2016	15:15:36	33.1	53.2	53.2
28.06.2016	15:15:51	9.1	14.6	14.6
28.06.2016	15:16:06	6.2	10.0	10.0
28.06.2016	15:16:21	5.4	8.6	8.6
28.06.2016	15:16:36	5.0	8.1	8.1
28.06.2016	15:16:51	4.4	7.0	7.0
28.06.2016	15:17:06	4.2	6.7	6.7
28.06.2016	15:17:21	4.2	6.7	6.7
28.06.2016	15:17:36	3.9	6.3	6.3
28.06.2016	15:17:51	3.7	5.9	5.9
28.06.2016	15:18:06	3.5	5.6	5.6
28.06.2016	15:18:21	3.4	5.4	5.4
28.06.2016	15:18:36	3.3	5.3	5.3
28.06.2016	15:18:51	3.3	5.3	5.3
28.06.2016	15:19:06	3.5	5.7	5.7
28.06.2016	15:19:21	3.7	6.0	6.0
28.06.2016	15:19:36	3.6	5.9	5.9
28.06.2016	15:19:51	3.6	5.7	5.7
28.06.2016	15:20:06	3.5	5.6	5.6
28.06.2016	15:20:21	3.4	5.4	5.4
28.06.2016	15:20:36	3.3	5.3	5.3
28.06.2016	15:20:51	3.2	5.1	5.1
28.06.2016	15:21:06	3.1	4.9	4.9
28.06.2016	15:21:21	3.1	5.0	5.0
28.06.2016	15:21:36	3.2	5.1	5.1
28.06.2016	15:21:51	3.2	5.1	5.1
28.06.2016	15:22:06	3.1	4.9	4.9
28.06.2016	15:22:21	3.0	4.8	4.8
28.06.2016	15:22:36	3.1	5.0	5.0
28.06.2016	15:22:51	3.0	4.7	4.7
28.06.2016	15:23:06	2.8	4.5	4.5
28.06.2016	15:23:21	3.0	4.8	4.8
28.06.2016	15:23:36	2.8	4.4	4.4
28.06.2016	15:23:51	2.8	4.5	4.5
28.06.2016	15:24:06	2.8	4.5	4.5
28.06.2016	15:24:21	2.7	4.4	4.4

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
28.06.2016	15:24:36	2.6	4.2	4.2
28.06.2016	15:24:51	2.6	4.1	4.1
28.06.2016	15:25:06	2.7	4.4	4.4
28.06.2016	15:25:21	2.7	4.3	4.3
28.06.2016	15:25:36	2.7	4.4	4.4
28.06.2016	15:25:51	2.7	4.4	4.4
28.06.2016	15:26:06	2.6	4.2	4.2
28.06.2016	15:26:21	2.6	4.2	4.2
28.06.2016	15:26:36	2.6	4.2	4.2
28.06.2016	15:26:51	2.5	4.1	4.1
28.06.2016	15:27:06	2.5	4.1	4.1
28.06.2016	15:27:21	2.6	4.2	4.2
28.06.2016	15:27:36	2.5	4.0	4.0
28.06.2016	15:27:51	2.3	3.6	3.6
28.06.2016	15:28:06	2.4	3.9	3.9
28.06.2016	15:28:21	2.3	3.8	3.8
28.06.2016	15:28:36	42.8	68.8	68.8
28.06.2016	15:28:51	46.4	74.6	74.6
28.06.2016	15:29:06	35.3	56.7	56.7
28.06.2016	15:29:21	14.7	23.6	23.6
28.06.2016	15:29:36	5.8	9.4	9.4
28.06.2016	15:29:51	4.3	6.8	6.8
28.06.2016	15:30:06	3.6	5.8	5.8
28.06.2016	15:30:21	3.2	5.1	5.1
28.06.2016	15:30:36	2.9	4.7	4.7
28.06.2016	15:30:51	2.7	4.3	4.3
28.06.2016	15:31:06	2.5	4.1	4.1
28.06.2016	15:31:21	2.4	3.9	3.9
28.06.2016	15:31:36	2.3	3.7	3.7
28.06.2016	15:31:51	2.4	3.8	3.8
28.06.2016	15:32:06	2.4	3.8	3.8
28.06.2016	15:32:21	2.4	3.9	3.9
28.06.2016	15:32:36	2.3	3.7	3.7
28.06.2016	15:32:51	2.2	3.5	3.5
28.06.2016	15:33:06	2.2	3.6	3.6
28.06.2016	15:33:21	2.1	3.4	3.4
28.06.2016	15:33:36	2.1	3.4	3.4
28.06.2016	15:33:51	2.1	3.4	3.4
28.06.2016	15:34:06	2.1	3.3	3.3
28.06.2016	15:34:21	2.0	3.3	3.3
28.06.2016	15:34:36	2.0	3.3	3.3
28.06.2016	15:34:51	2.0	3.1	3.1
28.06.2016	15:35:06	1.9	3.1	3.1
28.06.2016	15:35:21	2.0	3.2	3.2
28.06.2016	15:35:36	2.0	3.2	3.2
28.06.2016	15:35:51	1.9	3.0	3.0
Mean		8.4	13.4	13.4
Max		69.1	111.1	111.1

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
Min		1.9	3.0	3.0

2.7.8 Uncertainty Calculations

Particulates

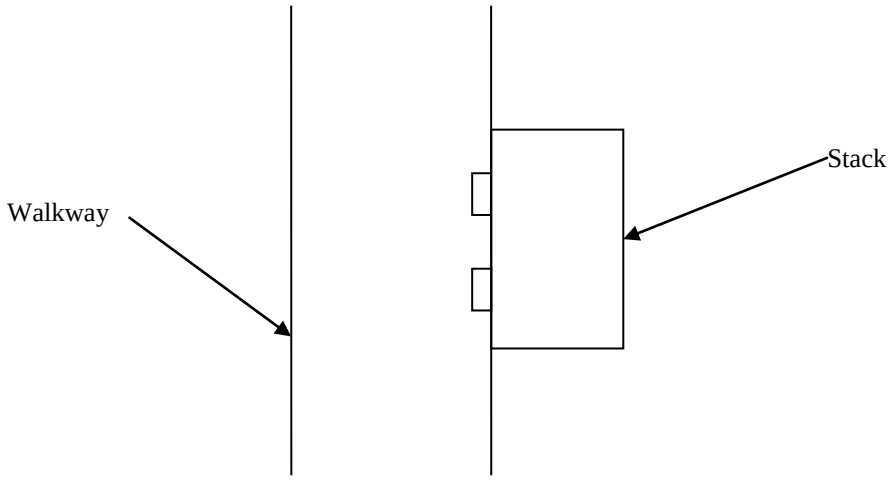
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Pressure	6.63		
Gas Volume	2.51		As % of result
Gas Temperature	0.69		13.86
Humidity	0.50		
Washing Weighing	0.04	7.14	As % of ELV 0.36
Leak	0.00		
Filter Weighing	0.00		As mg/m^3
O_2 Concentration	0.00		0.18

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		0.27
Barometric Pressure	0.04		
Temperature effect (span)	0.02		
Span drift	0.01	0.14	
Repeatability	0.01		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.01		
Cross sensitivity CO (1.2 % vol)	0.00		
Cross sensitivity NO (127 mgm^{-3})	0.00		As % of Result
Cross sensitivity H_2O (sat 325K)	0.00		3.29
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		0.44

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)	5.0	5.0	5.0	5.0	5.0	5.0
$\sqrt{\Delta P}$	2.24	2.24	2.24	2.24	2.24	2.24
Temperature (ºC)	25	25	25	25	25	25
Traverse Point	**B1**			**B2**		
Pressure (mm H_2O)	5.0	5.0	5.0	5.0	5.0	5.0
$\sqrt{\Delta P}$	2.24	2.24	2.24	2.24	2.24	2.24
Temperature (ºC)	25	25	25	25	25	25

Static Pressure (mmH_2O)	7.0	**Barometric Pressure (mm Hg)**	752.5	**Duct Dimensions (m)**	0.40 x 0.65

Velocity (m/s) average	7.9	**Actual Flow of stack gas (m^3/hr)**	6699.4
Stack Geometry	Rectangular	**Flow (wet) at STP (m^3/hr)**	6080.9
Dimensions (m)	0.40 x 0.59	**Flow (dry) at STP (m^3/hr)**	6040.4
Area (m^2)	0.236		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	5.0	5.0	5.0	1.0	Yes
$\sqrt{\Delta P}$ (mm $H_2O)^{½}$	2.24	2.24	2.24	1.0	Yes
Temperature (ºC)	25.0	25.0	25.0	1.0	Yes
Angle of flow	<15º				Yes
Local Negative Flow	No				Yes

2.8.3 Gas Measurements

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

2.8.4 Manual Method Calculations

Test Dates	29.06.16		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	DDH Paint Extract		
	Blank	Test 1	Units
Sample Ref	epa.16.511.13	epa.16.511.14	-
Start Time	11:16	14:31	hr:mm
Stop Time	11:21	15:05	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	4.3	ml
B_{wo}	0.01	0.007	-
P_b	-	752.5	mm Hg
St	-	7	mm H_2O
T_s	-	24.00	ºC
$\sqrt{\Delta P}$	-	2.45	$(mm\ H_2O)^{½}$
Yd	-	1.021	-
Test Time	-	32	min
T_m	-	22.88	ºC
C_p	-	0.829	-
As	-	0.236	m^2
D_n	-	8.43	mm
ΔH ave	-	68.57	mm H_20
V_{mstd}	0.7977	0.7977	m^3
V_{wstd}	0.0054	0.0054	m^3
$Q_{std,wet}$	-	6433.6	Nm^3/h
Q_{act}	-	7064.1	Nm^3/h
Isokinetic Rate	-	99.0	%
Vs	-	8.31	m/s
Washings			
Sample Ref	epa.16.511.13W	epa.16.511.14W	-
Weight	1.03	<0.5	mg
Filter			
Sample Ref	epa.16.511.13F	epa.16.511.14F	-
Weight	<0.04	3.63	mg
Particulate Concentration (Dry, No O_2 Correction)	1.3	5.2	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	1.3	5.1	mg/Nm^3
Particulate Release Rate	-	33.09	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	1.03
Run 1	3.63	<0.5

2.8.5 Sampling Measurements

Date	29.06.16		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	14:31		1	928.7	929.2	0.5		**Leak Check (Pre)**	0.07	10			
End Time	15:05		2	810.4	808.8	-1.6		**Leak Check (Post)**	0.07	7			
Duration (mm.ss)	32.00		3	672.0	670.2	-1.8							
Stack	DDH Spray Paints		4	735.2	742.4	7.2		**Pitot ID**	pitot 06			Velocity Head	
Run	1		5	241.5	241.5	0.0		**DGM ID**	dgm 09			Min	6
												Max	6
												Max:Min	1.00
								Nozzle ID	n32				
			Sample Ref	epa.16.511.14				**Nozzle Diameter (mm)**	8.43				
K Factor	11.43		**Filter Number**	epa.16.511.14F									
Stack Diameter (m)	0.40		**Probe Washing No**	epa.16.511.14W									
							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		1659.32	In	Out	Probe	**Filter**	**Impinger**
a1	0 4	5	24	6		2.45	68.57	1769	22	22	50		
a1	4 8	5	24	6		2.45	68.57	1875	22	22	50		
a2	8 12	5	24	6		2.45	68.57	1976	23	22	50		
a2	12 16	5	24	6		2.45	68.57	2083	23	22	50		
b1	16 20	5	24	6		2.45	68.57	2195	24	23	50		
b1	20 24	5	24	6		2.45	68.57	2299	24	23	50		
b2	24 28	5	24	6		2.45	68.57	2407	24	23	50		
b2	28 32	5	24	6		2.45	68.57	2508.82	24	23	50		
Total / Average		5.00	24.00	6.00		2.45	68.57	849.50	23.25	22.50	50.00		

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	0.02	0.04	0.02

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	801.79	805.10	802.65	-2.45

2.8.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
29.06.2016	14:31:14	34.4	55.3	55.3
29.06.2016	14:31:29	34.9	56.1	56.1
29.06.2016	14:31:44	34.6	55.7	55.7
29.06.2016	14:31:59	34.4	55.3	55.3
29.06.2016	14:32:14	27.6	44.4	44.4
29.06.2016	14:32:29	101.3	162.8	162.8
29.06.2016	14:32:44	131.9	212.0	212.0
29.06.2016	14:32:59	182.2	292.8	292.8
29.06.2016	14:33:14	189.7	304.9	304.9
29.06.2016	14:33:29	137.2	220.5	220.5
29.06.2016	14:33:44	88.6	142.4	142.4
29.06.2016	14:33:59	59.1	95.0	95.0
29.06.2016	14:34:14	46.4	74.6	74.6
29.06.2016	14:34:29	40.3	64.8	64.8
29.06.2016	14:34:44	27.8	44.7	44.7
29.06.2016	14:34:59	24.9	40.0	40.0
29.06.2016	14:35:14	22.5	36.2	36.2
29.06.2016	14:35:29	19.3	31.0	31.0
29.06.2016	14:35:44	19.3	31.0	31.0
29.06.2016	14:35:59	72.3	116.2	116.2
29.06.2016	14:36:14	158.5	254.7	254.7
29.06.2016	14:36:29	57.6	92.6	92.6
29.06.2016	14:36:44	100.9	162.2	162.2
29.06.2016	14:36:59	568.0	912.9	912.9
29.06.2016	14:37:14	229.1	368.2	368.2
29.06.2016	14:37:29	124.3	199.8	199.8
29.06.2016	14:37:44	79.4	127.6	127.6
29.06.2016	14:37:59	61.3	98.5	98.5
29.06.2016	14:38:14	51.8	83.3	83.3
29.06.2016	14:38:29	38.8	62.4	62.4

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
29.06.2016	14:38:44	34.7	55.8	55.8
29.06.2016	14:38:59	29.1	46.8	46.8
29.06.2016	14:39:14	53.5	86.0	86.0
29.06.2016	14:39:29	101.2	162.6	162.6
29.06.2016	14:39:44	104.2	167.5	167.5
29.06.2016	14:39:59	120.2	193.2	193.2
29.06.2016	14:40:14	122.1	196.2	196.2
29.06.2016	14:40:29	204.2	328.2	328.2
29.06.2016	14:40:44	363.4	584.0	584.0
29.06.2016	14:40:59	290.1	466.2	466.2
29.06.2016	14:41:14	339.4	545.5	545.5
29.06.2016	14:41:29	411.2	660.9	660.9
29.06.2016	14:41:44	511.2	821.6	821.6
29.06.2016	14:41:59	1529.0	2457.3	2457.3
29.06.2016	14:42:14	1626.0	2613.2	2613.2
29.06.2016	14:42:29	1634.0	2626.1	2626.1
29.06.2016	14:42:44	1636.0	2629.3	2629.3
29.06.2016	14:42:59	1690.0	2716.1	2716.1
29.06.2016	14:43:14	1656.0	2661.4	2661.4
29.06.2016	14:43:29	1783.0	2865.5	2865.5
29.06.2016	14:43:44	1634.0	2626.1	2626.1
29.06.2016	14:43:59	1658.0	2664.6	2664.6
29.06.2016	14:44:14	1604.0	2577.9	2577.9
29.06.2016	14:44:29	1385.0	2225.9	2225.9
29.06.2016	14:44:44	1556.0	2500.7	2500.7
29.06.2016	14:44:59	1734.0	2786.8	2786.8
29.06.2016	14:45:14	1673.0	2688.8	2688.8
29.06.2016	14:45:29	1719.0	2762.7	2762.7
29.06.2016	14:45:44	1534.0	2465.4	2465.4
29.06.2016	14:45:59	1521.0	2444.5	2444.5
29.06.2016	14:46:14	1580.0	2539.3	2539.3
29.06.2016	14:46:29	1372.0	2205.0	2205.0
29.06.2016	14:46:44	1074.0	1726.1	1726.1
29.06.2016	14:46:59	1595.0	2563.4	2563.4
29.06.2016	14:47:14	1617.0	2598.8	2598.8
29.06.2016	14:47:29	1429.0	2296.6	2296.6
29.06.2016	14:47:44	659.3	1059.6	1059.6
29.06.2016	14:47:59	390.7	627.9	627.9
29.06.2016	14:48:14	935.3	1503.2	1503.2
29.06.2016	14:48:29	1597.0	2566.6	2566.6
29.06.2016	14:48:44	1673.0	2688.8	2688.8
29.06.2016	14:48:59	1802.0	2896.1	2896.1
29.06.2016	14:49:14	1829.0	2939.5	2939.5
29.06.2016	14:49:29	1753.0	2817.3	2817.3
29.06.2016	14:49:44	1768.0	2841.4	2841.4
29.06.2016	14:49:59	1766.0	2838.2	2838.2
29.06.2016	14:50:14	1687.0	2711.3	2711.3
29.06.2016	14:50:29	1448.0	2327.1	2327.1

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
29.06.2016	14:50:44	1673.0	2688.8	2688.8
29.06.2016	14:50:59	1832.0	2944.3	2944.3
29.06.2016	14:51:14	1790.0	2876.8	2876.8
29.06.2016	14:51:29	1863.0	2994.1	2994.1
29.06.2016	14:51:44	1802.0	2896.1	2896.1
29.06.2016	14:51:59	1812.0	2912.1	2912.1
29.06.2016	14:52:14	1851.0	2974.8	2974.8
29.06.2016	14:52:29	1915.0	3077.7	3077.7
29.06.2016	14:52:44	1873.0	3010.2	3010.2
29.06.2016	14:52:59	1812.0	2912.1	2912.1
29.06.2016	14:53:14	1871.0	3007.0	3007.0
29.06.2016	14:53:29	1788.0	2873.6	2873.6
29.06.2016	14:53:44	1692.0	2719.3	2719.3
29.06.2016	14:53:59	1819.0	2923.4	2923.4
29.06.2016	14:54:14	1836.0	2950.7	2950.7
29.06.2016	14:54:29	1856.0	2982.9	2982.9
29.06.2016	14:54:44	1841.0	2958.8	2958.8
29.06.2016	14:54:59	1934.0	3108.2	3108.2
29.06.2016	14:55:14	1861.0	2990.9	2990.9
29.06.2016	14:55:29	1643.0	2640.5	2640.5
29.06.2016	14:55:44	1800.0	2892.9	2892.9
29.06.2016	14:55:59	1971.0	3167.7	3167.7
29.06.2016	14:56:14	1917.0	3080.9	3080.9
29.06.2016	14:56:29	1824.0	2931.4	2931.4
29.06.2016	14:56:44	1915.0	3077.7	3077.7
29.06.2016	14:56:59	1487.0	2389.8	2389.8
29.06.2016	14:57:14	576.3	926.2	926.2
29.06.2016	14:57:29	1216.0	1954.3	1954.3
29.06.2016	14:57:44	1661.0	2669.5	2669.5
29.06.2016	14:57:59	1126.0	1809.6	1809.6
29.06.2016	14:58:14	930.4	1495.3	1495.3
29.06.2016	14:58:29	1758.0	2825.4	2825.4
29.06.2016	14:58:44	1827.0	2936.3	2936.3
29.06.2016	14:58:59	1768.0	2841.4	2841.4
29.06.2016	14:59:14	1048.0	1684.3	1684.3
29.06.2016	14:59:29	1148.0	1845.0	1845.0
29.06.2016	14:59:44	1963.0	3154.8	3154.8
29.06.2016	14:59:59	1824.0	2931.4	2931.4
29.06.2016	15:00:14	1878.0	3018.2	3018.2
29.06.2016	15:00:29	1407.0	2261.3	2261.3
29.06.2016	15:00:44	1714.0	2754.6	2754.6
29.06.2016	15:00:59	1797.0	2888.0	2888.0
29.06.2016	15:01:14	1170.0	1880.4	1880.4
29.06.2016	15:01:29	1101.0	1769.5	1769.5
29.06.2016	15:01:44	1824.0	2931.4	2931.4
29.06.2016	15:01:59	1912.0	3072.9	3072.9
29.06.2016	15:02:14	1978.0	3178.9	3178.9
29.06.2016	15:02:29	1912.0	3072.9	3072.9

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
29.06.2016	15:02:44	1871.0	3007.0	3007.0
29.06.2016	15:02:59	1956.0	3143.6	3143.6
29.06.2016	15:03:14	1893.0	3042.3	3042.3
29.06.2016	15:03:29	1705.0	2740.2	2740.2
29.06.2016	15:03:44	923.1	1483.6	1483.6
29.06.2016	15:03:59	874.2	1405.0	1405.0
29.06.2016	15:04:14	678.9	1091.1	1091.1
29.06.2016	15:04:29	393.2	631.9	631.9
29.06.2016	15:04:44	249.1	400.3	400.3
29.06.2016	15:04:59	359.0	577.0	577.0
29.06.2016	15:05:14	268.6	431.7	431.7
29.06.2016	15:05:29	236.9	380.7	380.7
29.06.2016	15:05:44	234.4	376.7	376.7
29.06.2016	15:05:59	200.2	321.8	321.8
Mean		1083.5	1741.3	1741.3
Max		1978.0	3178.9	3178.9
Min		19.3	31.0	31.0

2.8.8 Uncertainty Calculations

Particulates

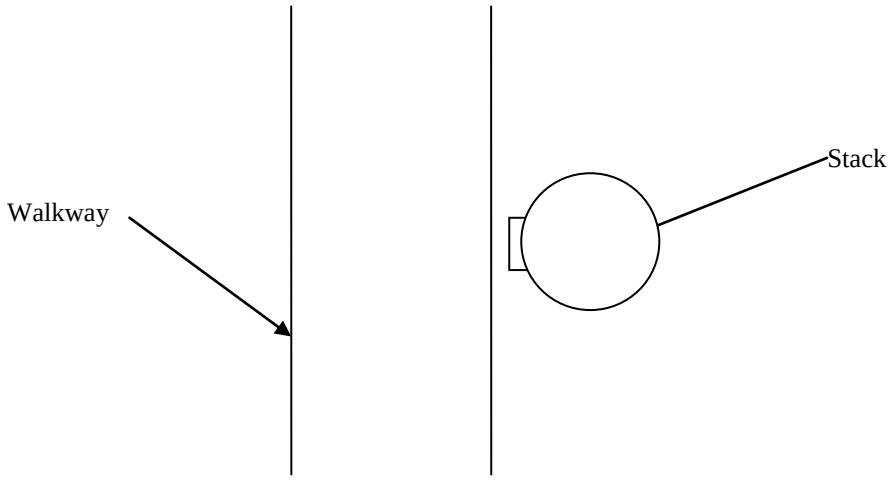
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Pressure	5.47		
Gas Volume	2.89		As % of result
Gas Temperature	0.68		12.12
Humidity	0.50		
Filter Weighing	0.16	6.25	As % of ELV
Washing Weighing	0.02		1.25
Leak	0.01		
O_2 Concentration	0.00		As mg/m^3
			0.63

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		23.97
Span gas	3.52		
Temperature effect (span)	2.32		
Span drift	0.71	12.20	
Repeatability	0.69		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.01		
Cross sensitivity CO (1.2 % vol)	0.00		
Cross sensitivity NO (127 mgm^{-3})	0.00		As % of Result
Cross sensitivity H_2O (sat 325K)	0.00		2.18
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		38.04

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)	32.0	32.0	32.0
$\sqrt{\Delta P}$	5.66	5.66	5.66
Temperature (ºC)	25	25	25

Static Pressure (mmH_2O)	-100.0	**Barometric Pressure (mm Hg)**	751.7	**Duct Dimensions (m)**	0.29

Velocity (m/s) average	20.1	**Actual Flow of stack gas (m^3/hr)**	4787.6
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	4295.9
Dimensions (m)	0.29	**Flow (dry) at STP (m^3/hr)**	4258.7
Area (m^2)	0.066		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	32.0	32.0	32.0	1.0	Yes
$\sqrt{\Delta P}$ (mm H_2O)^{½}	5.66	5.66	5.66	1.0	Yes
Temperature (ºC)	25.0	25.0	25.0	1.0	Yes
Angle of flow	<15º				Yes
Local Negative Flow	No				Yes

2.9.3 Gas Measurements

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

2.9.4 Manual Method Calculations

Test Dates	30.06.16		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	DDH Tile Adhesive		
	Blank	Test 1	Units
Sample Ref	epa.16.511.19	epa.16.511.20	-
Start Time	13:28	14:04	hr:mm
Stop Time	13:33	14:34	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	7	ml
B_{wo}	0.01	0.009	-
P_b	-	751.7	mm Hg
St	-	-100	mm H_2O
T_s	-	25.00	ºC
$\sqrt{\Delta P}$	-	5.66	$(mm\ H_2O)^{½}$
Yd	-	1.036	-
Test Time	-	30	min
T_m	-	25.08	ºC
C_p	-	0.824	-
As	-	0.066	m^2
D_n	-	6.46	mm
ΔH ave	-	123.30	mm H_20
V_{mstd}	0.9986	0.9986	m^3
V_{wstd}	0.0087	0.0087	m^3
$Q_{std,wet}$	-	4104.2	Nm^3/h
Q_{act}	-	4574.0	Nm^3/h
Isokinetic Rate	-	98.9	%
Vs	-	19.24	m/s
Washings			
Sample Ref	epa.16.511.19W	epa.16.511.20W	-
Weight	0.6	<0.5	mg
Filter			
Sample Ref	epa.16.511.19F	epa.16.511.20F	-
Weight	<0.1	<0.1	mg
Particulate Concentration (Dry, No O_2 Correction)	0.7	<0.6	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	0.7	<0.59	mg/Nm^3
Particulate Release Rate	-	<2	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	0.6
Run 1	<0.1	<0.5

2.9.5 Sampling Measurements

Date	30.06.16		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	14:04		1	928.2	928.6	0.4		**Leak Check (Pre)**	0.12	10			
End Time	14:34		2	809.9	809.9	0.0		**Leak Check (Post)**	0.11	7			
Duration (mm.ss)	30.00		3	672.2	673.0	0.8							
Stack	Tile Adhesive		4	770.4	776.2	5.8		**Pitot ID**	pitot 06			Velocity Head	
Run	1		5	241.7	241.7	0.0		**DGM ID**	dgm 09			Min	32
												Max	32
												Max:Min	1.00
								Nozzle ID	N14				
			Sample Ref	epa.16.511.20				**Nozzle Diameter (mm)**	6.46				
K Factor	3.85		**Filter Number**	epa.16.511.20F									
Stack Diameter (m)	0.29		**Probe Washing No**	epa.16.511.20W									
							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		4581.21	In	Out	Probe	**Filter**	**Impinger**
a1	0 5	6	25	32		5.66	123.30	4755	25	25	160		
a1	5 10	6	25	32		5.66	123.30	4920	25	25	160		
a1	10 15	6	25	32		5.66	123.30	5091	25	25	160		
a1	15 20	6	25	32		5.66	123.30	5264	25	25	160		
a1	20 25	6	25	32		5.66	123.30	5447	25	25	160		
a1	25 30	6	25	32		5.66	123.30	5632.54	26	25	160		
Total / Average		6.00	25.00	32.00		5.66	123.30	1051.33	25.17	25.00	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)	1000	Ambient Air	0.00	0.00	0.00	0.02	0.04	0.02

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	801.79	805.10	802.65	-2.45

2.9.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
29.06.2016	14:31:14	34.4	55.3	55.3
29.06.2016	14:31:29	34.9	56.1	56.1
29.06.2016	14:31:44	34.6	55.7	55.7
29.06.2016	14:31:59	34.4	55.3	55.3
29.06.2016	14:32:14	27.6	44.4	44.4
29.06.2016	14:32:29	101.3	162.8	162.8
29.06.2016	14:32:44	131.9	212.0	212.0
29.06.2016	14:32:59	182.2	292.8	292.8
29.06.2016	14:33:14	189.7	304.9	304.9
29.06.2016	14:33:29	137.2	220.5	220.5
29.06.2016	14:33:44	88.6	142.4	142.4
29.06.2016	14:33:59	59.1	95.0	95.0
29.06.2016	14:34:14	46.4	74.6	74.6
29.06.2016	14:34:29	40.3	64.8	64.8
29.06.2016	14:34:44	27.8	44.7	44.7
29.06.2016	14:34:59	24.9	40.0	40.0
29.06.2016	14:35:14	22.5	36.2	36.2
29.06.2016	14:35:29	19.3	31.0	31.0
29.06.2016	14:35:44	19.3	31.0	31.0
29.06.2016	14:35:59	72.3	116.2	116.2
29.06.2016	14:36:14	158.5	254.7	254.7
29.06.2016	14:36:29	57.6	92.6	92.6
29.06.2016	14:36:44	100.9	162.2	162.2
29.06.2016	14:36:59	568.0	912.9	912.9
29.06.2016	14:37:14	229.1	368.2	368.2
29.06.2016	14:37:29	124.3	199.8	199.8
29.06.2016	14:37:44	79.4	127.6	127.6
29.06.2016	14:37:59	61.3	98.5	98.5
29.06.2016	14:38:14	51.8	83.3	83.3
29.06.2016	14:38:29	38.8	62.4	62.4

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
29.06.2016	14:38:44	34.7	55.8	55.8
29.06.2016	14:38:59	29.1	46.8	46.8
29.06.2016	14:39:14	53.5	86.0	86.0
29.06.2016	14:39:29	101.2	162.6	162.6
29.06.2016	14:39:44	104.2	167.5	167.5
29.06.2016	14:39:59	120.2	193.2	193.2
29.06.2016	14:40:14	122.1	196.2	196.2
29.06.2016	14:40:29	204.2	328.2	328.2
29.06.2016	14:40:44	363.4	584.0	584.0
29.06.2016	14:40:59	290.1	466.2	466.2
29.06.2016	14:41:14	339.4	545.5	545.5
29.06.2016	14:41:29	411.2	660.9	660.9
29.06.2016	14:41:44	511.2	821.6	821.6
29.06.2016	14:41:59	1529.0	2457.3	2457.3
29.06.2016	14:42:14	1626.0	2613.2	2613.2
29.06.2016	14:42:29	1634.0	2626.1	2626.1
29.06.2016	14:42:44	1636.0	2629.3	2629.3
29.06.2016	14:42:59	1690.0	2716.1	2716.1
29.06.2016	14:43:14	1656.0	2661.4	2661.4
29.06.2016	14:43:29	1783.0	2865.5	2865.5
29.06.2016	14:43:44	1634.0	2626.1	2626.1
29.06.2016	14:43:59	1658.0	2664.6	2664.6
29.06.2016	14:44:14	1604.0	2577.9	2577.9
29.06.2016	14:44:29	1385.0	2225.9	2225.9
29.06.2016	14:44:44	1556.0	2500.7	2500.7
29.06.2016	14:44:59	1734.0	2786.8	2786.8
29.06.2016	14:45:14	1673.0	2688.8	2688.8
29.06.2016	14:45:29	1719.0	2762.7	2762.7
29.06.2016	14:45:44	1534.0	2465.4	2465.4
29.06.2016	14:45:59	1521.0	2444.5	2444.5
29.06.2016	14:46:14	1580.0	2539.3	2539.3
29.06.2016	14:46:29	1372.0	2205.0	2205.0
29.06.2016	14:46:44	1074.0	1726.1	1726.1
29.06.2016	14:46:59	1595.0	2563.4	2563.4
29.06.2016	14:47:14	1617.0	2598.8	2598.8
29.06.2016	14:47:29	1429.0	2296.6	2296.6
29.06.2016	14:47:44	659.3	1059.6	1059.6
29.06.2016	14:47:59	390.7	627.9	627.9
29.06.2016	14:48:14	935.3	1503.2	1503.2
29.06.2016	14:48:29	1597.0	2566.6	2566.6
29.06.2016	14:48:44	1673.0	2688.8	2688.8
29.06.2016	14:48:59	1802.0	2896.1	2896.1
29.06.2016	14:49:14	1829.0	2939.5	2939.5
29.06.2016	14:49:29	1753.0	2817.3	2817.3
29.06.2016	14:49:44	1768.0	2841.4	2841.4
29.06.2016	14:49:59	1766.0	2838.2	2838.2
29.06.2016	14:50:14	1687.0	2711.3	2711.3
29.06.2016	14:50:29	1448.0	2327.1	2327.1

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
29.06.2016	14:50:44	1673.0	2688.8	2688.8
29.06.2016	14:50:59	1832.0	2944.3	2944.3
29.06.2016	14:51:14	1790.0	2876.8	2876.8
29.06.2016	14:51:29	1863.0	2994.1	2994.1
29.06.2016	14:51:44	1802.0	2896.1	2896.1
29.06.2016	14:51:59	1812.0	2912.1	2912.1
29.06.2016	14:52:14	1851.0	2974.8	2974.8
29.06.2016	14:52:29	1915.0	3077.7	3077.7
29.06.2016	14:52:44	1873.0	3010.2	3010.2
29.06.2016	14:52:59	1812.0	2912.1	2912.1
29.06.2016	14:53:14	1871.0	3007.0	3007.0
29.06.2016	14:53:29	1788.0	2873.6	2873.6
29.06.2016	14:53:44	1692.0	2719.3	2719.3
29.06.2016	14:53:59	1819.0	2923.4	2923.4
29.06.2016	14:54:14	1836.0	2950.7	2950.7
29.06.2016	14:54:29	1856.0	2982.9	2982.9
29.06.2016	14:54:44	1841.0	2958.8	2958.8
29.06.2016	14:54:59	1934.0	3108.2	3108.2
29.06.2016	14:55:14	1861.0	2990.9	2990.9
29.06.2016	14:55:29	1643.0	2640.5	2640.5
29.06.2016	14:55:44	1800.0	2892.9	2892.9
29.06.2016	14:55:59	1971.0	3167.7	3167.7
29.06.2016	14:56:14	1917.0	3080.9	3080.9
29.06.2016	14:56:29	1824.0	2931.4	2931.4
29.06.2016	14:56:44	1915.0	3077.7	3077.7
29.06.2016	14:56:59	1487.0	2389.8	2389.8
29.06.2016	14:57:14	576.3	926.2	926.2
29.06.2016	14:57:29	1216.0	1954.3	1954.3
29.06.2016	14:57:44	1661.0	2669.5	2669.5
29.06.2016	14:57:59	1126.0	1809.6	1809.6
29.06.2016	14:58:14	930.4	1495.3	1495.3
29.06.2016	14:58:29	1758.0	2825.4	2825.4
29.06.2016	14:58:44	1827.0	2936.3	2936.3
29.06.2016	14:58:59	1768.0	2841.4	2841.4
29.06.2016	14:59:14	1048.0	1684.3	1684.3
29.06.2016	14:59:29	1148.0	1845.0	1845.0
29.06.2016	14:59:44	1963.0	3154.8	3154.8
29.06.2016	14:59:59	1824.0	2931.4	2931.4
29.06.2016	15:00:14	1878.0	3018.2	3018.2
29.06.2016	15:00:29	1407.0	2261.3	2261.3
29.06.2016	15:00:44	1714.0	2754.6	2754.6
29.06.2016	15:00:59	1797.0	2888.0	2888.0
29.06.2016	15:01:14	1170.0	1880.4	1880.4
29.06.2016	15:01:29	1101.0	1769.5	1769.5
29.06.2016	15:01:44	1824.0	2931.4	2931.4
29.06.2016	15:01:59	1912.0	3072.9	3072.9
29.06.2016	15:02:14	1978.0	3178.9	3178.9
29.06.2016	15:02:29	1912.0	3072.9	3072.9

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
29.06.2016	15:02:44	1871.0	3007.0	3007.0
29.06.2016	15:02:59	1956.0	3143.6	3143.6
29.06.2016	15:03:14	1893.0	3042.3	3042.3
29.06.2016	15:03:29	1705.0	2740.2	2740.2
29.06.2016	15:03:44	923.1	1483.6	1483.6
29.06.2016	15:03:59	874.2	1405.0	1405.0
29.06.2016	15:04:14	678.9	1091.1	1091.1
29.06.2016	15:04:29	393.2	631.9	631.9
29.06.2016	15:04:44	249.1	400.3	400.3
29.06.2016	15:04:59	359.0	577.0	577.0
29.06.2016	15:05:14	268.6	431.7	431.7
29.06.2016	15:05:29	236.9	380.7	380.7
29.06.2016	15:05:44	234.4	376.7	376.7
29.06.2016	15:05:59	200.2	321.8	321.8
Mean		1083.5	1741.3	1741.3
Max		1978.0	3178.9	3178.9
Min		19.3	31.0	31.0

2.9.8 Uncertainty Calculations

Particulates

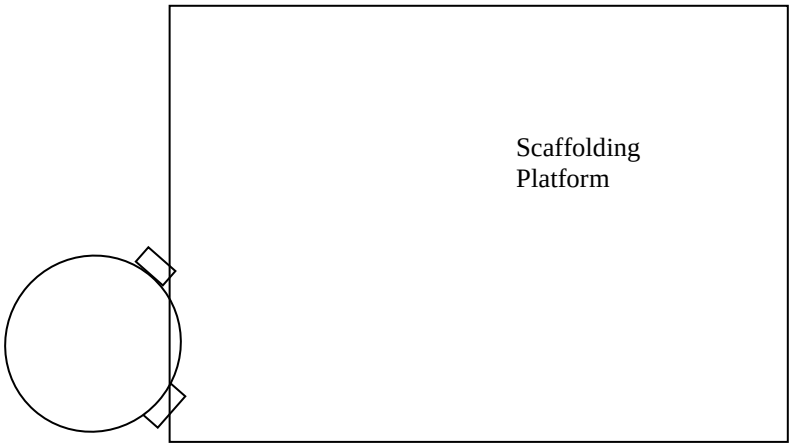
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Gas Volume	3.57	12.02	As % of result 9.25
Pressure	3.04		
Gas Temperature	0.68		
Humidity	0.50		
Washing Weighing	0.02		As % of ELV 0.11
Leak	0.00		
Filter Weighing	0.00		As mg/m^3 0.06
O_2 Concentration	0.00		

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	9.62	12.20	23.67
Temperature effect (zero)	4.63		
Barometric Pressure	4.01		
Span gas	3.52		
Temperature effect (span)	2.32		
Span drift	0.71		
Repeatability	0.69		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.01		
Cross sensitivity CO (1.2 % vol)	0.00		
Cross sensitivity NO (127 mgm^{-3})	0.00		As % of Result 2.18
Cross sensitivity H_2O (sat 325K)	0.00		
Cross sensitivity SO_2 (2767 mgm^{-3})	0.00		As mg/m^3 at ref conditions 38.04
Cross sensitivity CO_2 (15.2 % vol)	0.00		

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)	8.0	8.0	8.0	8.0	8.0	8.0
$\sqrt{\Delta P}$	2.83	2.83	2.83	2.83	2.83	2.83
Temperature (ºC)	28	28	28	28	28	28
Traverse Point	**B1**			**B2**		
Pressure (mm H_2O)	8.0	8.0	8.0	7.5	7.5	7.5
$\sqrt{\Delta P}$	2.83	2.83	2.83	2.74	2.74	2.74
Temperature (ºC)	28	28	28	28	28	28

Static Pressure (mmH_2O)	21	**Barometric Pressure (mm Hg)**	759.2	**Duct Dimensions (m)**	0.45

Velocity (m/s) average	9.9	**Actual Flow of stack gas (m^3/hr)**	5160.3
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	4685.2
Dimensions (m)	0.45	**Flow (dry) at STP (m^3/hr)**	4572.2
Area (m^2)	0.159		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	7.9	8.0	7.5	1.1	Yes
$\sqrt{\Delta P}$ (mm $H_2O)^{½}$	2.81	2.83	2.74	1.0	Yes
Temperature (ºC)	28.0	28.0	28.0	1.0	Yes
Angle of flow	<15º				Yes
Local Negative Flow	No				Yes

2.10.3 Gas Measurements

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

2.10.4 Manual Method Calculations

Test Dates	02.08.16		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	NAS Annex		
	Blank	Test 1	Units
Sample Ref	epa.16.511.21	epa.16.511.22	-
Start Time	10:25	10:39	hr:mm
Stop Time	10:30	11:13	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	18.6	ml
B_{wo}	0.02	0.024	-
P_b	-	759.2	mm Hg
St	-	21	mm H_2O
T_s	-	28.00	ºC
$\sqrt{\Delta P}$	-	2.83	$(mm\ H_2O)^{½}$
Yd	-	1.021	-
Test Time	5	32	min
T_m	-	20.06	ºC
C_p	-	0.830	-
As	-	0.145	m^2
D_n	-	8.46	mm
ΔH ave	-	92.16	mm H_20
V_{mstd}	0.9367	0.9367	m^3
V_{wstd}	0.0231	0.0231	m^3
$Q_{std,wet}$	-	4584.8	Nm^3/h
Q_{act}	-	5049.8	Nm^3/h
Isokinetic Rate	-	101.4	%
Vs	-	9.66	m/s
Washings			
Sample Ref	epa.16.511.21W	epa.16.511.22W	-
Weight	<0.5	<0.5	mg
Filter			
Sample Ref	epa.16.511.21F	epa.16.511.22F	-
Weight	<0.1	<0.1	mg
Particulate Concentration (Dry, No O_2 Correction)	<0.64	<0.64	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	<0.62	<0.62	mg/Nm^3
Particulate Release Rate	-	<3	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	<0.5

2.10.5 Sampling Measurements

Date	02.08.16		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	10:39		1	860.9	862.7	1.8		**Leak Check (Pre)**	0.09	10			
End Time	11:13		2	916.0	919.3	3.3		**Leak Check (Post)**	0.07	6			
Duration (mm.ss)	32.00		3	678.1	680.2	2.1							
Stack	NAS		4	756.0	767.4	11.4		**Pitot ID**	pitot 14			Velocity Head	
Run	1		5	241.7	241.7	0.0		**DGM ID**	dgm 09			Min	8
												Max	8
												Max:Min	1.00
								Nozzle ID	n32				
			Sample Ref	epa.16.511.22				**Nozzle Diameter (mm)**	8.46				
K Factor	11.52		**Filter Number**	epa.16.511.22F									
Stack Diameter (m)	0.43		**Probe Washing No**	epa.16.511.22W									
							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**		6314.62	In	Out	Probe	**Filter**	**Impinger**
a1	0 4	4	28	8		2.83	92.16	6450	18	18	160	160	
a1	4 8	4	28	8		2.83	92.16	6570	19	18	160	160	
a2	8 12	4	28	8		2.83	92.16	6700	20	19	160	160	
a2	12 16	4	28	8		2.83	92.16	6810	21	20	160	160	
b1	16 20	4	28	8		2.83	92.16	6942	21	20	160	160	
b1	20 24	4	28	8		2.83	92.16	7048	21	20	160	160	
b2	24 28	4	28	8		2.83	92.16	7168	22	21	160	160	
b2	28 32	4	28	8		2.83	92.16	7291.76	22	21	160	160	
Total / Average		4.00	28.00	8.00		2.83	92.16	977.14	20.50	19.63	160.00	160.00	

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	0.02	0.02

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	800.73	796.58	804.64	8.06

2.10.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
02.08.2016	10:39:12	307.0	493.4	493.4
02.08.2016	10:39:27	328.7	528.3	528.3
02.08.2016	10:39:42	346.3	556.6	556.6
02.08.2016	10:39:57	378.3	608.0	608.0
02.08.2016	10:40:12	398.0	639.6	639.6
02.08.2016	10:40:27	372.2	598.2	598.2
02.08.2016	10:40:42	390.2	627.1	627.1
02.08.2016	10:40:57	388.0	623.6	623.6
02.08.2016	10:41:12	354.3	569.4	569.4
02.08.2016	10:41:27	307.4	494.0	494.0
02.08.2016	10:41:42	343.1	551.4	551.4
02.08.2016	10:41:57	360.4	579.2	579.2
02.08.2016	10:42:12	327.7	526.7	526.7
02.08.2016	10:42:27	314.0	504.6	504.6
02.08.2016	10:42:42	274.0	440.4	440.4
02.08.2016	10:42:57	332.1	533.7	533.7
02.08.2016	10:43:12	306.7	492.9	492.9
02.08.2016	10:43:27	313.8	504.3	504.3
02.08.2016	10:43:42	328.9	528.6	528.6
02.08.2016	10:43:57	332.4	534.2	534.2
02.08.2016	10:44:12	321.1	516.1	516.1
02.08.2016	10:44:27	339.4	545.5	545.5
02.08.2016	10:44:42	374.1	601.2	601.2
02.08.2016	10:44:57	373.1	599.6	599.6
02.08.2016	10:45:12	381.0	612.3	612.3
02.08.2016	10:45:27	435.2	699.4	699.4
02.08.2016	10:45:42	391.7	629.5	629.5
02.08.2016	10:45:57	331.4	532.6	532.6
02.08.2016	10:46:12	247.4	397.6	397.6
02.08.2016	10:46:27	261.1	419.6	419.6

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
02.08.2016	10:46:42	308.9	496.4	496.4
02.08.2016	10:46:57	315.3	506.7	506.7
02.08.2016	10:47:12	347.7	558.8	558.8
02.08.2016	10:47:27	363.9	584.8	584.8
02.08.2016	10:47:42	358.7	576.5	576.5
02.08.2016	10:47:57	314.8	505.9	505.9
02.08.2016	10:48:12	226.4	363.9	363.9
02.08.2016	10:48:27	223.9	359.8	359.8
02.08.2016	10:48:42	248.1	398.7	398.7
02.08.2016	10:48:57	220.8	354.9	354.9
02.08.2016	10:49:12	254.5	409.0	409.0
02.08.2016	10:49:27	247.9	398.4	398.4
02.08.2016	10:49:42	293.3	471.4	471.4
02.08.2016	10:49:57	288.4	463.5	463.5
02.08.2016	10:50:12	291.3	468.2	468.2
02.08.2016	10:50:27	370.9	596.1	596.1
02.08.2016	10:50:42	264.2	424.6	424.6
02.08.2016	10:50:57	349.5	561.7	561.7
02.08.2016	10:51:12	477.2	766.9	766.9
02.08.2016	10:51:27	454.5	730.4	730.4
02.08.2016	10:51:42	458.1	736.2	736.2
02.08.2016	10:51:57	455.9	732.7	732.7
02.08.2016	10:52:12	450.1	723.4	723.4
02.08.2016	10:52:27	474.2	762.1	762.1
02.08.2016	10:52:42	502.3	807.3	807.3
02.08.2016	10:52:57	481.6	774.0	774.0
02.08.2016	10:53:12	265.7	427.0	427.0
02.08.2016	10:53:27	354.1	569.1	569.1
02.08.2016	10:53:42	400.0	642.9	642.9
02.08.2016	10:53:57	395.1	635.0	635.0
02.08.2016	10:54:12	437.4	703.0	703.0
02.08.2016	10:54:27	460.8	740.6	740.6
02.08.2016	10:54:42	462.0	742.5	742.5
02.08.2016	10:54:57	397.3	638.5	638.5
02.08.2016	10:55:12	350.2	562.8	562.8
02.08.2016	10:55:27	331.6	532.9	532.9
02.08.2016	10:55:42	337.5	542.4	542.4
02.08.2016	10:55:57	380.2	611.0	611.0
02.08.2016	10:56:12	334.6	537.8	537.8
02.08.2016	10:56:27	327.0	525.5	525.5
02.08.2016	10:56:42	278.6	447.8	447.8
02.08.2016	10:56:57	271.8	436.8	436.8
02.08.2016	10:57:12	264.0	424.3	424.3
02.08.2016	10:57:27	236.4	379.9	379.9
02.08.2016	10:57:42	270.6	434.9	434.9
02.08.2016	10:57:57	296.5	476.5	476.5
02.08.2016	10:58:12	344.1	553.0	553.0
02.08.2016	10:58:27	374.8	602.4	602.4

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
02.08.2016	10:58:42	276.7	444.7	444.7
02.08.2016	10:58:57	217.8	350.0	350.0
02.08.2016	10:59:12	240.3	386.2	386.2
02.08.2016	10:59:27	262.5	421.9	421.9
02.08.2016	10:59:42	296.9	477.2	477.2
02.08.2016	10:59:57	328.0	527.1	527.1
02.08.2016	11:00:12	373.9	600.9	600.9
02.08.2016	11:00:27	411.5	661.3	661.3
02.08.2016	11:00:42	435.9	700.6	700.6
02.08.2016	11:00:57	438.3	704.4	704.4
02.08.2016	11:01:12	375.6	603.6	603.6
02.08.2016	11:01:27	378.8	608.8	608.8
02.08.2016	11:01:42	354.3	569.4	569.4
02.08.2016	11:01:57	358.0	575.4	575.4
02.08.2016	11:02:12	336.3	540.5	540.5
02.08.2016	11:02:27	231.7	372.4	372.4
02.08.2016	11:02:42	276.9	445.0	445.0
02.08.2016	11:02:57	389.0	625.2	625.2
02.08.2016	11:03:12	374.8	602.4	602.4
02.08.2016	11:03:27	373.4	600.1	600.1
02.08.2016	11:03:42	276.9	445.0	445.0
02.08.2016	11:03:57	239.8	385.4	385.4
02.08.2016	11:04:12	246.2	395.7	395.7
02.08.2016	11:04:27	258.6	415.6	415.6
02.08.2016	11:04:42	264.2	424.6	424.6
02.08.2016	11:04:57	246.6	396.3	396.3
02.08.2016	11:05:12	265.2	426.2	426.2
02.08.2016	11:05:27	317.5	510.3	510.3
02.08.2016	11:05:42	308.7	496.1	496.1
02.08.2016	11:05:57	227.1	365.0	365.0
02.08.2016	11:06:12	193.2	310.5	310.5
02.08.2016	11:06:27	172.2	276.8	276.8
02.08.2016	11:06:42	166.3	267.3	267.3
02.08.2016	11:06:57	155.1	249.3	249.3
02.08.2016	11:07:12	153.8	247.2	247.2
02.08.2016	11:07:27	250.3	402.3	402.3
02.08.2016	11:07:42	244.2	392.5	392.5
02.08.2016	11:07:57	209.0	335.9	335.9
02.08.2016	11:08:12	135.3	217.4	217.4
02.08.2016	11:08:27	156.0	250.7	250.7
02.08.2016	11:08:42	233.0	374.5	374.5
02.08.2016	11:08:57	311.8	501.1	501.1
02.08.2016	11:09:12	356.3	572.6	572.6
02.08.2016	11:09:27	321.9	517.3	517.3
02.08.2016	11:09:42	303.5	487.8	487.8
02.08.2016	11:09:57	254.2	408.5	408.5
02.08.2016	11:10:12	290.1	466.2	466.2
02.08.2016	11:10:27	343.1	551.4	551.4

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
02.08.2016	11:10:42	310.1	498.4	498.4
02.08.2016	11:10:57	297.2	477.6	477.6
02.08.2016	11:11:12	284.5	457.2	457.2
02.08.2016	11:11:27	266.7	428.6	428.6
02.08.2016	11:11:42	283.8	456.1	456.1
02.08.2016	11:11:57	253.0	406.6	406.6
02.08.2016	11:12:12	247.2	397.3	397.3
02.08.2016	11:12:27	247.2	397.3	397.3
02.08.2016	11:12:42	243.3	391.0	391.0
02.08.2016	11:12:57	241.2	387.6	387.6
02.08.2016	11:13:12	257.1	413.2	413.2
02.08.2016	11:13:27	215.2	345.9	345.9
Mean		316.3	508.3	508.3
Max		502.3	807.3	807.3
Min		135.3	217.4	217.4

2.10.8 Uncertainty Calculations

Particulates

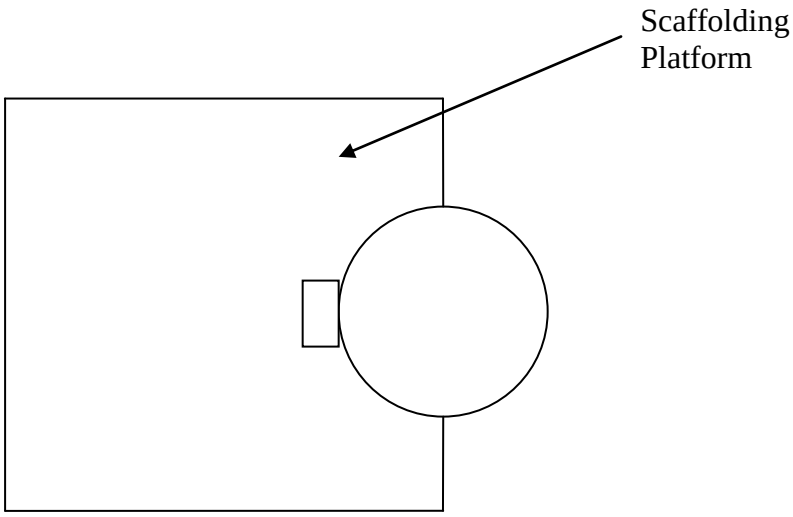
Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Pressure	4.07	5.32	As % of Result 10.33
Gas Volume	3.32		
Gas Temperature	0.69		
Humidity	0.50		As % of ELV 0.13
Washing Weighing	0.02		
Leak	0.00		As mg/m^3 0.07
Filter Weighing	0.00		
O_2 Concentration	0.00		

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	9.62	12.40	24.06
Temperature effect (zero)	4.63		
Barometric Pressure	4.01		
Span gas	3.52		
Span drift	2.33		
Temperature effect (span)	2.32		
Repeatability	0.69		**Expanded Uncertainty (95% Confidence limit) %**
Zero drift	0.01		
Cross sensitivity CO (1.2 % vol)	0.00		
Cross sensitivity NO (127 mgm^{-3})	0.00		As % of Result 7.61
Cross sensitivity H_2O (sat 325K)	0.00		
Cross sensitivity SO_2 (2767 mgm^{-3})	0.00		As mg/m^3 at ref conditions 38.67
Cross sensitivity CO_2 (15.2 % vol)	0.00		

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)	16.0	16.0	16.0
$\sqrt{\Delta P}$	4.00	4.00	4.00
Temperature (ºC)	22	22	22

Static Pressure (mmH_2O)	2.0	**Barometric Pressure (mm Hg)**	751.7	**Duct Dimensions (m)**	0.245

Velocity (m/s) average	14.0	**Actual Flow of stack gas (m^3/hr)**	2375.3
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	2174.7
Dimensions (m)	0.245	**Flow (dry) at STP (m^3/hr)**	2140.9
Area (m^2)	0.047		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	16.0	16.0	16.0	1.0	Yes
$\sqrt{\Delta P}$ (mm H_2O)^{½}	4.00	4.00	4.00	1.0	Yes
Temperature (ºC)	22.0	22.0	22.0	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	30.06.18		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	Tile Cutting Facility		
	Blank	Test 1	Units
Sample Ref	epa.16.511.15	epa.16.511.16	-
Start Time	9:26	10:25	hr:mm
Stop Time	9:31	10:55	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	11.2	ml
B_{wo}	0.02	0.016	-
P_b	-	751.7	mm Hg
St	-	2	mm H_2O
T_s	-	22.67	ºC
$\sqrt{\Delta P}$	-	4.00	$(mm\ H_2O)^{½}$
Yd	-	1.021	-
Test Time	-	30	min
T_m	-	18.33	ºC
C_p	-	0.828	-
As	-	0.047	m^2
D_n	-	7.09	mm
ΔH ave	-	92.16	mm H_20
V_{mstd}	0.8832	0.8832	m^3
V_{wstd}	0.0139	0.0139	m^3
$Q_{std,wet}$	-	2102.8	Nm^3/h
Q_{act}	-	2302.0	Nm^3/h
Isokinetic Rate	-	101.9	%
Vs	-	13.56	m/s
Washings			
Sample Ref	epa.16.511.15W	epa.16.511.16W	-
Weight	<0.5	<0.5	mg
Filter			
Sample Ref	epa.16.511.15F	epa.16.511.16F	-
Weight	<0.1	<0.1	mg
Particulate Concentration (Dry, No O_2 Correction)	<0.68	<0.68	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	<0.67	<0.67	mg/Nm^3
Particulate Release Rate	-	<1	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	<0.5

2.11.5 Sampling Measurements

Date	30.06.16		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	10:25		1	928.7	928.9	0.2		**Leak Check (Pre)**	0.07	10			
End Time	10:55		2	807.3	809.6	2.3		**Leak Check (Post)**	0.06	10			
Duration (mm.ss)	30.00		3	670.1	672.1	2.0							
Stack	Tile C|utting		4	742.5	749.2	6.7		**Pitot ID**	Pitot 06			Velocity Head	
Run	1		5	241.7	241.7	0.0		**DGM ID**	DGM 09			Min	16
												Max	16
												Max:Min	1.00
								Nozzle ID	N36				
			Sample Ref	epa.16.511.16				**Nozzle Diameter (mm)**	7.09				
K Factor	5.76		**Filter Number**	epa.16.511.16F									
Stack Diameter (m)	0.25		**Probe Washing No**	epa.16.511.16W									
							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**		2541.62	In	Out	Probe	Filter	**Impinger**
a1	0 5	4	22	16		4.00	92.16	2697	18	18	160	160	
a1	5 10	4	22	16		4.00	92.16	2847	18	18	160	160	
a1	10 15	4	23	16		4.00	92.16	3002	19	18	160	160	
a1	15 20	4	23	16		4.00	92.16	3143	19	18	160	160	
a1	20 25	4	23	16		4.00	92.16	3299	19	18	160	160	
a1	25 30	4	23	16		4.00	92.16	3466.62	19	18	160	160	
Total / Average		4.00	22.67	16.00		4.00	92.16	925.00	18.67	18.00	160.00	160.00	

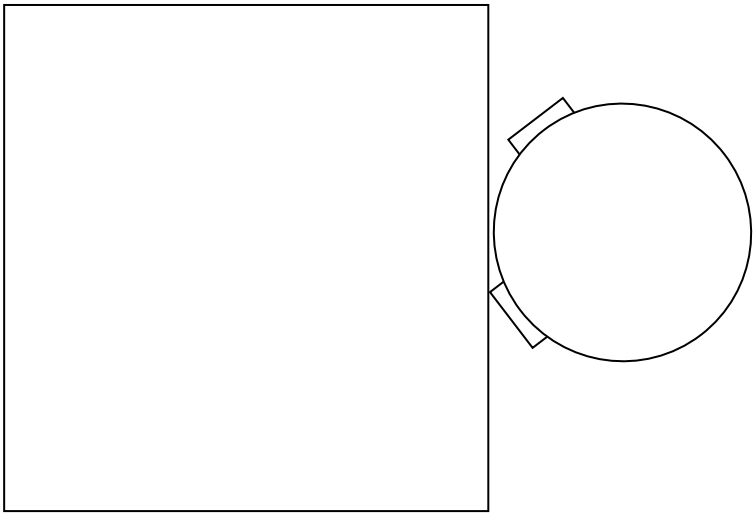
2.11.6 Uncertainty Calculations

Particulates

Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Pressure	4.07	5.21	As % of result 10.12
Gas Volume	3.15		
Gas Temperature	0.69		
Humidity	0.50		As % of ELV 0.14
Washing Weighing	0.02		
Leak	0.00		
Filter Weighing	0.00		As mg/m^3 0.07
O_2 Concentration	0.00		

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)	16.0	16.0	16.0	21.0	21.0	21.0
$\sqrt{\Delta P}$	4.00	4.00	4.00	4.58	4.58	4.58
Temperature (ºC)	24	24	24	24	24	24
Traverse Point	**B1**			**B2**		
Pressure (mm H_2O)	18.0	18.0	18.0	22.0	22.0	22.0
$\sqrt{\Delta P}$	4.24	4.24	4.24	4.69	4.69	4.69
Temperature (ºC)	24	24	24	24	24	24

Static Pressure (mmH_2O)	-42.0	**Barometric Pressure (mm Hg)**	751.7	**Duct Dimensions (m)**	0.56

Velocity (m/s) average	15.4	**Actual Flow of stack gas (m^3/hr)**	13660.7
Stack Geometry	Circular	**Flow (wet) at STP (m^3/hr)**	12369.5
Dimensions (m)	0.56	**Flow (dry) at STP (m^3/hr)**	12253.8
Area (m^2)	0.246		

	Average	**Max**	**Min**	**Ratio Max/Min**	**Compliance**
Pressure (mm H_2O)	19.3	22.0	16.0	1.4	Yes
$\sqrt{\Delta P}$ (mm $H_2O)^{½}$	4.38	4.69	4.00	1.2	Yes
Temperature (ºC)	24.0	24.0	24.0	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	30.06.16		
Company	Leck Construction (BAE Systems)		
Contact	T Hughes		
Stack	Paint Mixing Facility		
	Blank	Test 1	Units
Sample Ref	epa.16.511.17	epa.16.511.18	-
Start Time	11:33	11:51	hr:mm
Stop Time	11:38	12:25	hr:mm
% O_2	20.90	20.90	%
% CO_2	0.03	0.03	%
%N_2	-	79.07	%
V_{lc}	-	6.5	ml
B_{wo}	0.01	0.009	-
P_b	-	751.7	mm Hg
St	-	-42	mm H_2O
T_s	-	24.00	ºC
$\sqrt{\Delta P}$	-	4.38	$(mm\ H_2O)^{½}$
Yd	-	1.021	-
Test Time	-	32	min
T_m	-	20.63	ºC
C_p	-	0.832	-
As	-	0.246	m^2
D_n	-	6.46	mm
ΔH ave	-	76.31	mm H_20
V_{mstd}	0.8573	0.8573	m^3
V_{wstd}	0.0081	0.0081	m^3
$Q_{std,wet}$	-	12028.3	Nm^3/h
Q_{act}	-	13284.0	Nm^3/h
Isokinetic Rate	-	101.4	%
Vs	-	14.98	m/s
Washings			
Sample Ref	epa.16.511.17W	epa.16.511.18W	-
Weight	0.5	<0.5	mg
Filter			
Sample Ref	epa.16.511.17F	epa.16.511.18F	-
Weight	<0.04	<0.04	mg
Particulate Concentration (Dry, No O_2 Correction)	0.6	<0.63	mg/Nm^3
Particulate Concentration (at Ref Water and Oxygen)	0.6	<0.62	mg/Nm^3
Particulate Release Rate	-	<8	g/hr
Reference Temp	273		K
Reference Pressure	101.3		kPa
Reference Moisture	No correction for moisture		-
Reference Oxygen	No correction for Oxygen		%

Particulates

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

2.12.5 Sampling Measurements

Date	30.06.16		Impinger	Initial Wt (g)	Final Wt (g)	Wt Gained (g)			**l/min**	**Vac (in Hg)**			
Start Time	11:51		1	928.1	928.2	0.1		**Leak Check (Pre)**	0.07	10			
End Time	12:25		2	809.5	809.9	0.4		**Leak Check (Post)**	0.05	7			
Duration (mm.ss)	32.00		3	671.5	672.2	0.7							
Stack	Mix Room		4	749.2	754.5	5.3		**Pitot ID**	Pitot 12			Velocity Head	
Run	1		5	241.7	241.7	0.0		**DGM ID**	DGM 09			Min	17
												Max	21
												Max:Min	1.24
								Nozzle ID	N14				
			Sample Ref	epa.16.511.18				**Nozzle Diameter (mm)**	6.46				
K Factor	3.96		**Filter Number**	epa.16.511.18F									
Stack Diameter (m)	0.56		**Probe Washing No**	epa.16.511.18W									
							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**		3480.28	In	Out	Probe	**Filter**	**Impinger**
a1	0 4	4	24	17		4.12	67.39	3587	20	19	50		
a1	4 8	4	24	17		4.12	67.39	3697	20	19	50		
a2	8 12	4	24	21		4.58	83.25	3809	20	19	50		
a2	12 16	4	24	21		4.58	83.25	3927	20	19	50		
b1	16 20	4	24	18		4.24	71.35	4040	22	20	50		
b1	20 24	4	24	18		4.24	71.35	4150	23	21	50		
b2	24 28	4	24	21		4.58	83.25	4270	23	21	50		
b2	28 32	4	24	21		4.58	83.25	4386.52	23	21	50		
Total / Average		4.00	24.00	19.25		4.38	76.31	906.24	21.38	19.88	50.00		

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	0.03	0.00	-0.03

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	80.17	80.11	80.09	-0.02

2.12.7 Instrumental Gas Analyser Results

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
30.06.2016	11:51:00	30.9	49.7	49.7
30.06.2016	11:51:15	32.1	51.6	51.6
30.06.2016	11:51:30	34.2	55.0	55.0
30.06.2016	11:51:45	34.6	55.6	55.6
30.06.2016	11:52:00	35.1	56.4	56.4
30.06.2016	11:52:15	33.2	53.4	53.4
30.06.2016	11:52:30	32.9	52.9	52.9
30.06.2016	11:52:45	33.9	54.5	54.5
30.06.2016	11:53:00	34.4	55.3	55.3
30.06.2016	11:53:15	36.6	58.8	58.8
30.06.2016	11:53:30	40.0	64.3	64.3
30.06.2016	11:53:45	42.1	67.7	67.7
30.06.2016	11:54:00	37.5	60.3	60.3
30.06.2016	11:54:15	37.6	60.4	60.4
30.06.2016	11:54:30	36.3	58.3	58.3
30.06.2016	11:54:45	36.6	58.8	58.8
30.06.2016	11:55:00	33.7	54.2	54.2
30.06.2016	11:55:15	33.7	54.2	54.2
30.06.2016	11:55:30	36.8	59.1	59.1
30.06.2016	11:55:45	35.8	57.5	57.5
30.06.2016	11:56:00	35.7	57.4	57.4
30.06.2016	11:56:15	35.1	56.4	56.4
30.06.2016	11:56:30	34.2	55.0	55.0
30.06.2016	11:56:45	33.7	54.2	54.2
30.06.2016	11:57:00	32.9	52.9	52.9
30.06.2016	11:57:15	31.7	50.9	50.9
30.06.2016	11:57:30	32.9	52.9	52.9
30.06.2016	11:57:45	32.4	52.1	52.1
30.06.2016	11:58:00	32.2	51.8	51.8
30.06.2016	11:58:15	33.1	53.2	53.2

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
30.06.2016	11:58:30	33.4	53.7	53.7
30.06.2016	11:58:45	32.5	52.2	52.2
30.06.2016	11:59:00	32.4	52.1	52.1
30.06.2016	11:59:15	32.7	52.6	52.6
30.06.2016	11:59:30	31.5	50.6	50.6
30.06.2016	11:59:45	32.1	51.6	51.6
30.06.2016	12:00:00	29.7	47.7	47.7
30.06.2016	12:00:15	32.0	51.4	51.4
30.06.2016	12:00:30	33.3	53.5	53.5
30.06.2016	12:00:45	34.1	54.8	54.8
30.06.2016	12:01:00	35.7	57.4	57.4
30.06.2016	12:01:15	38.0	61.1	61.1
30.06.2016	12:01:30	38.1	61.2	61.2
30.06.2016	12:01:45	39.0	62.7	62.7
30.06.2016	12:02:00	38.2	61.4	61.4
30.06.2016	12:02:15	37.7	60.6	60.6
30.06.2016	12:02:30	38.3	61.6	61.6
30.06.2016	12:02:45	36.7	59.0	59.0
30.06.2016	12:03:00	36.7	59.0	59.0
30.06.2016	12:03:15	38.7	62.2	62.2
30.06.2016	12:03:30	37.6	60.4	60.4
30.06.2016	12:03:45	34.7	55.8	55.8
30.06.2016	12:04:00	31.8	51.1	51.1
30.06.2016	12:04:15	36.5	58.7	58.7
30.06.2016	12:04:30	36.8	59.1	59.1
30.06.2016	12:04:45	40.0	64.3	64.3
30.06.2016	12:05:00	40.4	64.9	64.9
30.06.2016	12:05:15	39.7	63.8	63.8
30.06.2016	12:05:30	40.2	64.6	64.6
30.06.2016	12:05:45	38.7	62.2	62.2
30.06.2016	12:06:00	37.1	59.6	59.6
30.06.2016	12:06:15	38.6	62.0	62.0
30.06.2016	12:06:30	36.5	58.7	58.7
30.06.2016	12:06:45	36.1	58.0	58.0
30.06.2016	12:07:00	36.9	59.3	59.3
30.06.2016	12:07:15	37.3	59.9	59.9
30.06.2016	12:07:30	36.3	58.3	58.3
30.06.2016	12:07:45	35.3	56.7	56.7
30.06.2016	12:08:00	34.2	55.0	55.0
30.06.2016	12:08:15	34.8	55.9	55.9
30.06.2016	12:08:30	33.7	54.2	54.2
30.06.2016	12:08:45	32.5	52.2	52.2
30.06.2016	12:09:00	32.9	52.9	52.9
30.06.2016	12:09:15	32.8	52.7	52.7
30.06.2016	12:09:30	32.3	51.9	51.9
30.06.2016	12:09:45	31.6	50.8	50.8
30.06.2016	12:10:00	30.6	49.2	49.2
30.06.2016	12:10:15	31.0	49.8	49.8

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
30.06.2016	12:10:30	33.0	53.0	53.0
30.06.2016	12:10:45	32.3	51.9	51.9
30.06.2016	12:11:00	33.6	54.0	54.0
30.06.2016	12:11:15	33.4	53.7	53.7
30.06.2016	12:11:30	33.5	53.8	53.8
30.06.2016	12:11:45	35.1	56.4	56.4
30.06.2016	12:12:00	35.1	56.4	56.4
30.06.2016	12:12:15	33.0	53.0	53.0
30.06.2016	12:12:30	34.2	55.0	55.0
30.06.2016	12:12:45	33.3	53.5	53.5
30.06.2016	12:13:00	34.8	55.9	55.9
30.06.2016	12:13:15	33.1	53.2	53.2
30.06.2016	12:13:30	34.1	54.8	54.8
30.06.2016	12:13:45	34.1	54.8	54.8
30.06.2016	12:14:00	34.0	54.6	54.6
30.06.2016	12:14:15	32.8	52.7	52.7
30.06.2016	12:14:30	31.7	50.9	50.9
30.06.2016	12:14:45	34.1	54.8	54.8
30.06.2016	12:15:00	31.3	50.3	50.3
30.06.2016	12:15:15	32.1	51.6	51.6
30.06.2016	12:15:30	32.9	52.9	52.9
30.06.2016	12:15:45	31.1	50.0	50.0
30.06.2016	12:16:00	33.7	54.2	54.2
30.06.2016	12:16:15	32.7	52.6	52.6
30.06.2016	12:16:30	32.4	52.1	52.1
30.06.2016	12:16:45	34.6	55.6	55.6
30.06.2016	12:17:00	33.2	53.4	53.4
30.06.2016	12:17:15	35.9	57.7	57.7
30.06.2016	12:17:30	36.4	58.5	58.5
30.06.2016	12:17:45	34.7	55.8	55.8
30.06.2016	12:18:00	33.1	53.2	53.2
30.06.2016	12:18:15	31.6	50.8	50.8
30.06.2016	12:18:30	30.8	49.5	49.5
30.06.2016	12:18:45	32.6	52.4	52.4
30.06.2016	12:19:00	32.1	51.6	51.6
30.06.2016	12:19:15	33.9	54.5	54.5
30.06.2016	12:19:30	33.5	53.8	53.8
30.06.2016	12:19:45	33.7	54.2	54.2
30.06.2016	12:20:00	32.2	51.8	51.8
30.06.2016	12:20:15	31.7	50.9	50.9
30.06.2016	12:20:30	32.6	52.4	52.4
30.06.2016	12:20:45	35.3	56.7	56.7
30.06.2016	12:21:00	34.7	55.8	55.8
30.06.2016	12:21:15	33.6	54.0	54.0
30.06.2016	12:21:30	33.4	53.7	53.7
30.06.2016	12:21:45	33.8	54.3	54.3
30.06.2016	12:22:00	34.6	55.6	55.6
30.06.2016	12:22:15	33.1	53.2	53.2

Date	Time	VOC ppm	VOC as C mg/m^3	Ref VOC as C mg/m^3
30.06.2016	12:22:30	31.2	50.1	50.1
30.06.2016	12:22:45	30.7	49.3	49.3
30.06.2016	12:23:00	31.7	50.9	50.9
30.06.2016	12:23:15	31.4	50.5	50.5
30.06.2016	12:23:30	32.9	52.9	52.9
30.06.2016	12:23:45	34.5	55.4	55.4
30.06.2016	12:24:00	32.7	52.6	52.6
30.06.2016	12:24:15	32.3	51.9	51.9
30.06.2016	12:24:30	25.8	41.5	41.5
30.06.2016	12:24:45	23.6	37.9	37.9
30.06.2016	12:25:00	21.8	35.1	35.1
30.06.2016	12:25:15	21.6	34.7	34.7
30.06.2016	12:25:30	21.3	34.3	34.3
30.06.2016	12:25:45	21.0	33.8	33.8
Mean		33.8	54.4	Mean
Max		42.1	67.7	Max
Min		21.0	33.8	Min

2.12.8 Uncertainty Calculations

Particulates

Source of uncertainty	Estimate of Component (1 SD) (± %)	Combined Uncertainty (± %)	Expanded Uncertainty (95% Confidence limit) (± %)
Pressure	4.92	5.86	As % of result 11.38
Gas Volume	3.08		
Gas Temperature	0.69		
Humidity	0.50		
Washing Weighing	0.02		As % of ELV 0.14
Leak	0.00		
Filter Weighing	0.00		As mg/m^3 0.07
O_2 Concentration	0.00		

Total VOC's

Source of uncertainty	Estimate of Component (1 SD) ppm	Combined Uncertainty ppm	Expanded Uncertainty (95% Confidence limit) ppm
Linearity	0.96	1.22	2.36
Temperature effect (zero)	0.46		
Barometric Pressure	0.40		
Span gas	0.35		
Temperature effect (span)	0.23		
Repeatability	0.07		
Zero drift	0.01		**Expanded Uncertainty (95% Confidence limit) %**
Span drift	0.01		
Cross sensitivity CO (1.2 % vol)	0.00		
Cross sensitivity NO (127 mgm^{-3})	0.00		As % of Result 6.99
Cross sensitivity H_2O (sat 325K)	0.00		
Cross sensitivity SO_2 (2767 mgm^{-3})	0.00		As mg/m^3 at ref conditions 3.80
Cross sensitivity CO_2 (15.2 % vol)	0.00		

2.13 Certificates of Analysis

RPS

UKAS TESTING 0605

Test Certificate

Date 14/07/2016

Client	EPA Union Street Hetton Le Hole Sunderland Tyne & Wear DH5 9HU	**Order No.**	EPA.16.026
		Certificate No.	**WK16-4093**
		Issue No.	1
Contact	Tracy Dodds	**Date Received**	05/07/2016
Description	20 filters & 20 washes for TPM	**Technique**	Gravimetric Stack

Sample No.	**889358**	**EPA.16.511.01F**	**Method**
Total particulate matter		<0.10 mg	D9(U)
Sample No.	**889359**	**EPA.16.511.02F**	**Method**
Total particulate matter		<0.10 mg	D9(U)
Sample No.	**889360**	**EPA.16.511.03F**	**Method**
Total particulate matter		<0.10 mg	D9(U)
Sample No.	**889361**	**EPA.16.511.04F**	**Method**
Total particulate matter		13.47 mg	D9(U)
Sample No.	**889362**	**EPA.16.511.01W**	**Method**
Total particulate matter		1.07 mg	D9(U)
Sample No.	**889363**	**EPA.16.511.02W**	**Method**
Total particulate matter		1.06 mg	D9(U)
Sample No.	**889364**	**EPA.16.511.03W**	**Method**
Total particulate matter		0.83 mg	D9(U)
Sample No.	**889365**	**EPA.16.511.04W**	**Method**
Total particulate matter		47.63 mg	D9(U)

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UKAS TESTING 0605

Date 14/07/2016

Test Certificate

Client	EPA		**Certificate No.**	**WK16-4093**
			Issue No.	1
Sample No.	**889366**	**EPA.16.511.05F**		**Method**
Total particulate matter		<0.10 mg		D9(U)
Sample No.	**889367**	**EPA.16.511.06F**		**Method**
Total particulate matter		<0.10 mg		D9(U)
Sample No.	**889368**	**EPA.16.511.07F**		**Method**
Total particulate matter		<0.04 mg		D9(U)
Sample No.	**889369**	**EPA.16.511.08F**		**Method**
Total particulate matter		0.34 mg		D9(U)
Sample No.	**889370**	**EPA.16.511.05W**		**Method**
Total particulate matter		0.87 mg		D9(U)
Sample No.	**889371**	**EPA.16.511.06W**		**Method**
Total particulate matter		0.77 mg		D9(U)
Sample No.	**889372**	**EPA.16.511.07W**		**Method**
Total particulate matter		1.57 mg		D9(U)
Sample No.	**889373**	**EPA.16.511.08W**		**Method**
Total particulate matter		0.50 mg		D9(U)
Sample No.	**889374**	**EPA.16.511.09F**		**Method**
Total particulate matter		<0.10 mg		D9(U)
Sample No.	**889375**	**EPA.16.511.10F**		**Method**
Total particulate matter		<0.10 mg		D9(U)
Sample No.	**889376**	**EPA.16.511.11F**		**Method**
Total particulate matter		<0.04 mg		D9(U)

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Date 14/07/2016

Test Certificate

Client	EPA		**Certificate No.**	**WK16-4093**
			Issue No.	1
Sample No.	**889377**	**EPA.16.511.12F**		**Method**
Total particulate matter		<0.04 mg		D9(U)
Sample No.	**889378**	**EPA.16.511.09W**		**Method**
Total particulate matter		0.73 mg		D9(U)
Sample No.	**889379**	**EPA.16.511.10W**		**Method**
Total particulate matter		0.53 mg		D9(U)
Sample No.	**889380**	**EPA.16.511.11W**		**Method**
Total particulate matter		0.60 mg		D9(U)
Sample No.	**889381**	**EPA.16.511.12W**		**Method**
Total particulate matter		0.87 mg		D9(U)
Sample No.	**889382**	**EPA.16.511.13F**		**Method**
Total particulate matter		<0.04 mg		D9(U)
Sample No.	**889383**	**EPA.16.511.14F**		**Method**
Total particulate matter		3.63 mg		D9(U)
Sample No.	**889384**	**EPA.16.511.15F**		**Method**
Total particulate matter		<0.10 mg		D9(U)
Sample No.	**889385**	**EPA.16.511.16F**		**Method**
Total particulate matter		<0.10 mg		D9(U)
Sample No.	**889386**	**EPA.16.511.13W**		**Method**
Total particulate matter		1.03 mg		D9(U)
Sample No.	**889387**	**EPA.16.511.14W**		**Method**
Total particulate matter		<0.50 mg		D9(U)

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Date 14/07/2016

Test Certificate

Client	EPA		**Certificate No.**	**WK16-4093**
			Issue No.	1
Sample No.	**889388**	**EPA.16.511.15W**		**Method**
Total particulate matter		<0.50 mg		D9(U)
Sample No.	**889389**	**EPA.16.511.16W**		**Method**
Total particulate matter		<0.50 mg		D9(U)
Sample No.	**889390**	**EPA.16.511.17F**		**Method**
Total particulate matter		<0.04 mg		D9(U)
Sample No.	**889391**	**EPA.16.511.18F**		**Method**
Total particulate matter		<0.04 mg		D9(U)
Sample No.	**889392**	**EPA.16.511.19F**		**Method**
Total particulate matter		<0.10 mg		D9(U)
Sample No.	**889393**	**EPA.16.511.20F**		**Method**
Total particulate matter		<0.10 mg		D9(U)
Sample No.	**889394**	**EPA.16.511.17W**		**Method**
Total particulate matter		0.50 mg		D9(U)
Sample No.	**889395**	**EPA.16.511.18W**		**Method**
Total particulate matter		<0.50 mg		D9(U)
Sample No.	**889396**	**EPA.16.511.19W**		**Method**
Total particulate matter		0.60 mg		D9(U)
Sample No.	**889397**	**EPA.16.511.20W**		**Method**
Total particulate matter		<0.50 mg		D9(U)

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Date 14/07/2016

Test Certificate

Client EPA

Certificate No. WK16-4093

Issue No. 1

Tested By Simon Doodson Date 14/07/2016

Approved By Date 14/07/2016

Joanne Dewhurst
Operational 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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RPS

UKAS TESTING 0605

Test Certificate

Date 26/08/2016

Client	EPA Union Street Hetton Le Hole Sunderland Tyne & Wear DH5 9HU	**Order No.**	EPA.16.036
		Certificate No.	WK16-4960
		Issue No.	1
Contact	Tracy Dodds	**Date Received**	12/08/2016
Description	2 filters & 2 washes for TPM	**Technique**	Gravimetric Stack

Sample No.	**895526**	**EPA.16.511.21F**	**Method**
Total particulate matter	<0.1 mg		D9(U)
Sample No.	**895527**	**EPA.16.511.22F**	**Method**
Total particulate matter	<0.1 mg		D9(U)
Sample No.	**895528**	**EPA.16.511.21W**	**Method**
Total particulate matter	<0.5 mg		D9(U)
Sample No.	**895529**	**EPA.16.511.22W**	**Method**
Total particulate matter	<0.5 mg		D9(U)

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Date 26/08/2016

Test Certificate

Client	EPA	Certificate No.	WK16-4960
		Issue No.	1

Tested By	Kirstie Davenport	Date	25/08/2016
Approved By		Date	26/08/2016

Joanne Dewhurst
Operational 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	7.93 ppm	+/-0.16 ppm	2.1 %	FID
SYNTHETIC AIR	Balance				

All concentrations are molar

EPA/CGAS/101

Cylinder Number: 216684
Production Order Number: 2616300
Issuing Laboratory: UKAS Accredited Calibration Laboratory 0408 & Reference Material Producer 4183

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

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 IC GAS 197

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

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UKAS: 1816/3753 HSQ/388860/AR/UK/0911/NM

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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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