NATIONAL PHYSICAL LABORATORY
Teddington Middlesex UK TW11 0LW Telephone +44 20 8977 3222

Test Report

UKAS TESTING
0002

PPC COMPLIANCE TESTING FOR PAXFORD COMPOSITES LIMITED
19TH - 20TH FEBRUARY 2013

Permit Number:	**B01/02**
Operator Name:	**Paxford Composites Ltd**
Installation Name:	**Paxford Composites**
Dates of Monitoring Visit:	**19th - 20th February 2013**
Contract Reference:	**B0102/PAXFORD/PAXFORD/FEB2013/SBs/PPC/Visit 1**
Client Contact:	**Neil Search**
Client Organisation:	**Paxford Composites Ltd**
Address:	**2 - 4 Redwongs Way** **Huntingdon** **PE29 7HB**
Monitoring Organisation:	**National Physical Laboratory (NPL)**
Address:	**Hampton Road** **Teddington** **Middlesex** **TW11 0LW**
Date of Report:	**13th March 2013**
Report Author	**Simon Render**

Report Approver:	Kevin Blakley	NPL Authorised Signatory
MCERTS Registration:	MM-03-317	Name: Mr R Robinson (for NPLML)
Level & TEs Held:	Level 2, TE1, TE2, TE3 & TE4	Signature:
Signature:		

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1.1 Monitoring Objectives

NPL were awarded a contract by Paxford Composites Limited to carry out emissions compliance testing at their factory in Huntingdon. The scope of work includes carrying out monitoring on three spray paint booths.

Each spray paint booth was monitored for Particulates, Isocyanates and VOCs. Each test lasted for half an hour and was conducted during normal operation of the spray booths.

Results have been reported at standard conditions (273K and 101.3 kPa) on a wet gas basis. Testing was carried out on the 19th and 20th February 2013.

1.2.1 Particulate Monitoring Results

Client: Paxford Composites Ltd
Site: Paxford Composites

Emission Point		Spray Booth One		Spray Booth Two		Spray Booth Three	
Test Designation		Run One	Blank	Run One	Blank	Run One	Blank
Emission Limit Value	mg/m^3, Reference Conditions	50	-	50	-	50	-
Periodic Monitoring Result	Reference Conditions	<0.2	<0.2	9.4	<0.2	1.2	<0.5
Uncertainty (95% Confidence Level)	Reference Conditions	0.2	-	0.6	-	1.1	-
	Units	mg/m^3					
Reference Conditions		273K, 101.3 kPa on a wet gas basis					
Date	dd/mm/yyyy	20/02/2013		19/02/2013		19/02/2013	
Sample Period	From hh:mm	10:36	-	14:00	-	15:45	-
	To hh:mm	11:06	-	14:30	-	16:15	-
Monitoring Method		BS EN 13284-1					
Accreditation		UKAS & MCERTS					
Process Status		Spray paint batch run					

1.2.2 Isocyanates (HDI) Monitoring Results

Client: Paxford Composites Ltd
Site: Paxford Composites

Emission Point		Spray Booth One		Spray Booth Two		Spray Booth Three	
Test Designation		Run One	Blank	Run One	Blank	Run One	Blank
Emission Limit Value	mg/m^3, Reference Conditions	0.1	-	0.1	-	0.1	-
Periodic Monitoring Result	Reference Conditions	<0.0004	<0.0002	0.003	<0.0001	<0.0004	<0.0002
Uncertainty (95% Confidence Level)	Reference Conditions	0.0001	-	0.001	-	0.0001	-
	Units	mg/m^3					
Reference Conditions		273K, 101.3 kPa on a wet gas basis					
Date	dd/mm/yyyy	20/02/2013		19/02/2012		19/02/2013	
Sample Period	From hh:mm	11:12	-	14:50	-	16:23	-
	To hh:mm	11:42	-	15:20	-	16:53	-
Monitoring Method		US EPA CTM 36					
Accreditation		None					
Process Status		Spray paint batch run					

1.2.3 VOCs Monitoring Results

Client: Paxford Composites Ltd
Site: Paxford Composites

Emission Point		Spray Booth One	Spray Booth Two	Spray Booth Three
Test Designation		Run One	Run One	Run One
Emission Limit Value	mgC/m^3, Reference Conditions	50	50	50
Periodic Monitoring Result	Reference Conditions	5.2	8.4	40.8
Uncertainty (95% Confidence Level)	Reference Conditions	1.0	1.2	5.8
	Units	mgC/m^3		
Reference Conditions		273K, 101.3 kPa on a wet gas basis		
Date	dd/mm/yyyy	20/02/2013	19/03/2013	19/03/2013
Sample Period	From hh:mm	11:00	14:45	16:15
	To hh:mm	11:30	15:15	16:45
Monitoring Method		BS EN 12619:2013		
Accreditation		UKAS & MCERTS		
Process Status		Spray paint batch run		

1.3 Operating Information

Paxford Composites is located in Huntingdon and specialises in design and manufacturing of a wide range of components. The site also has spray painting facilities and can use a variety of different paints such as Epoxy, Polyurethane and Polyester.

The site has three spray paint booths each approximately the size of a garage, this allows large items to be transported inside. Air is pumped in from outside and can be heated if necessary to aid in the curing of the products. The paint filled air is then passed through a filter before being emitted to the atmosphere via a vent stack. Each batch run lasts approximately 20 to 30 minutes, depending upon how many layers of paint are required, and the size of the components.

Continuous or Batch Process?	Batch Process
What part of the batch process was sampled? (If applicable)	The whole batch process was sampled
What fuel was used during monitoring? (If applicable)	None
What feedstock was used during monitoring? (If applicable)	None
What was the load during monitoring?	N/A
What abatement systems are present? Were they in operation?	A filter is installed in the vent system to reduce particulate emissions. This was in operation during the time of the monitoring
Periodic monitoring results and corresponding CEM values	There are no CEMS installed on the spray booths

1.4 Monitoring Deviations

Were all substances in the monitoring objectives monitored? If not why?	All substances set out in the objectives were monitored
Were all substances monitored in accordance to the relevant method? If not why?	Due to the duct area size of each spray booth, two sampling lines are required to monitor particulates to BS EN 13284:1. Whilst ports were provided, only one port on each spray booth could be accessed due to external obstructions and general accessibility
Were there any other issues relevant to the monitoring results?	No

1.5 Conclusions

NPL carried out the emissions monitoring for particulates, isocyanates and VOCs on all three paint spray booths on the 19th and 20th February 2012. No homogeneity tests have been carried out.

1.6 References

1. STA – Risk Assessment Guide: Industrial-emission monitoring – Version 12 - June 2012.

2. Environmental Agency - Manual Stack emission monitoring performance standard for Organisations – Version 7.2 - November 2011.

3. Environmental Agency – M1 Technical Guidance Note – Sampling requirements for stack emission monitoring – Version 6 –January 2010.

4. Environmental Agency – M2 Technical Guidance Note – Monitoring of stack emissions to air – Version 9 – January 2013.

5. Guidance on Assessing Measurement Uncertainty in Stack Emissions Monitoring, by Pullen J and Robinson R, Source Testing Association, Quality Guidance Note QGN1.

APPENDIX 1

2.1.1 Emissions Testing Personnel Details

Name	Role	MCERTS Number	Certification Level & Expiry Dates					
			Level 1	Level 2	TE1	TE2	TE3	TE4
Simon Render	Team Leader	MM08 938	March-15	March-15	May-14	September-14	September-14	December-14
Matthew Ellison	Team Leader	MM05 682	September-13	September-13	September-13	September-13	December-13	September-13

2.1.2 Emissions Testing Procedures

Determinand	VOCs	Particulates	Isocyanates	H_2O	Stack Flow	Temperature
SRM Standard	BS EN 12619	BS EN 13284-1	US EPA CTM 36	BS EN 14790	BS EN 13284-1	BS EN 13284-1
Instrument	FID	APEX Method 5	APEX Method 5	APEX Method 5	Pitot	Type K Thermocouple
Instrument Serial No.	AS0234	AS0240	AS0240	AS0240	AS0466	N/A
Principle	FID	Gravimetric	HPLC	Gravimetric	Flow	Temperature
Operational Range	0 - 100 ppm	N/A	N/A	N/A	N/A	N/A
Certified Range	0 - 15 mg/m^3	N/A	N/A	N/A	N/A	N/A
Uncertainty	25%	15%	12%	20%	N/A	N/A
NPL Procedure	QPAS B 538	QPAS B 536	In House	QPAS B 536	QPAS B 536	QPAS B 536
UKAS Accreditation	YES	YES	NO	YES	YES	YES

Particulate and Isocyanate sampling was conducted using an APEX Method 5 and sampling train. A sample was extracted through a filter and then down a heated probe and sample line. The stack gas was then passed through a series of impingers to remove the moisture before passing through a dry gas meter (DGM) and out to atmosphere. The particulate filter had been weighed in a laboratory before and after testing in order to determine any weight gain. The isocyanate filter had been pre treated and sent to an analytical laboratory for analysis. The uncertainty quoted for the Isocyanate result is based upon the lab uncertainty.

VOC analysis was conducted using a SICK Bernath FID (Flame Ionisation Detector). A sample of stack gas was drawn through a heated filter and heated line before passing into the analyser.

The FID analyser zero and span settings were checked before and after each test run using zero grade nitrogen (ex BOC), a suitable gas mixture (BOC beta gas standard), traceable to national reference standards and a gas dilution system. The certified accuracies of the gas standards are listed below: -

SB1

Component	Sample Location	Cylinder ID	Certified Amount	Instrument Range	Certified Uncertainty
Propane	SB1	138227	53 ppm	0 - 100 ppm	1%

SB2

Component	Sample Location	Cylinder ID	Certified Amount	Instrument Range	Certified Uncertainty
Propane	SB2	138227	53 ppm	0 - 100 ppm	1%

SB3

Component	Sample Location	Cylinder ID	Certified Amount	Instrument Range	Certified Uncertainty
Propane	SB3	138227	53 ppm	0 - 1000 ppm	1%

These measurement uncertainties are expressed at a 95% level of confidence.

A leak test was conducted before testing to confirm hydraulic integrity of the gaseous sampling system. This was conducted by sending nitrogen down the entire sample line and ensuring a zero reading was obtained.

The electrical volt/millivolt outputs from the FID analyser was collected by a squirrel data logger and downloaded to digital media at the end of the day. Under the program used during the tests, the software records and stores individual readings every 2 seconds. From this data, the logger can perform a series of calculations to output 1 minute averaged measurement on a mass/volume basis. After each 1 minute average has been established the data buffer is reset and the process repeats.

2.1.3 Equipment Checklist Reference

See Work file PX05FEB13/CHECKLIST

2.1.4 Data Capture Location Reference

All data collected is transferred onto digital media at the end of the day, and then stored on the NPL internal servers upon arrival back at base. The location reference for this is below:

P:\Stack Emissions Team\Paxford Composites\PX05FEB13\7. Monitoring Record Sheets

APPENDIX 2

2.2.1 - Stack Diagram & Traverse Information

Test no	SB1 Velocity	
Date	20-2-13	
Swirl Test Conducted	OK	
Stack Pres (with +/- above barometric if unknown enter zero)	0	mmH_20
Pitot Type and Tube ID	AS0466	

Conditions	Value	Units
Stack pressure	768.63	mmHg
Ref oxygen Value	21	%
Moisture Content	1	%
CO	0	ppm
CO_2	0	%
N_2	79.05	%
O_2	20.95	%
dry molecular wt	28.84	
stack molecular wt	28.73	
area of stack	0.47	m^2
Pbar	1024.5	mbar
Pbar	769	mmHg
pitot tube coeft	0.83	
Reference Temp	273	K
Reference Pressure	760	mmHg
PITOT LEAK CHECK (Yes/No)	YES	

Site: Paxford Composites **Stack Description:** SB1

Time of Survey: 10:05

SITE TEAM: SDR & MRE

COMMENTS: Temperature & Velocity Traverse

Diagram of Sample Location:

Flow Criteria Measurements		Fulfilled?
Is the gas flow angle <15° to the duct axis?	Yes	✔
Is there any local negative flow?	No	✔
Is the flow rate high enough to be measured?	Yes	✔
Ratio of flows less than 3:1 (or 9:1 for pressure readings)?	Yes	✔

SAMPLING LINE: A							
Traverse Point	Distance into duct (m)	Δ p mm H_2O	Δ p Pa	Stack Temp Ts °C	Velocity @ stack gas T&P on wet gas basis m/s	Angle of Swirl °	√Δp
1	A10	18.20	178.42	13	14.09	<15	4.27
2	A9	16.40	160.77	13	13.38	<15	4.05
3	A8	16.00	156.85	13	13.21	<15	4.00
4	A7	11.20	109.79	13	11.05	<15	3.35
5	A6	5.60	54.90	13	7.82	<15	2.37
6	A5	4.80	47.05	13	7.24	<15	2.19
7	A4	3.80	37.25	12	6.43	<15	1.95
8	A3	3.60	35.29	12	6.26	<15	1.90
9	A2	2.40	23.53	12	5.11	<15	1.55
10	A1	2.20	21.57	12	4.89	<15	1.48
	Average values	**8.4**	**20.6**	**12.6**	**8.9**	**<15**	**2.7**

Duct / Stack Flow Characteristics:	**SB1**	
Test No:	**SB1 Velocity**	
	Average	**Units**
Stack Velocity at stack gas T & P and a wet gas basis	8.95	ms^{-1}
Stack flow @ STP, O_2 (ref) and on a dry gas basis	N/A	m^3s^{-1}
Stack flow @ stack gas T & P and on a wet gas basis	4.20	m^3s^{-1}
Stack flow @ stack gas T & P and on a dry gas basis	4.16	m^3s^{-1}
Stack flow @ STP and on a wet gas basis	4.06	m^3s^{-1}
Stack flow @ STP, O_2 (ref) and on a wet gas basis	N/A	m^3s^{-1}

Test no	SB2 Velocity	
Date	19-2-13	
Swirl Test Conducted	OK	
Stack Pres (with +/- above barometric if unknown enter zero)	0	mmH_20
Pitot Type and Tube ID	AS0466	

Conditions	Value	Units
Stack pressure	768.63	mmHg
Ref oxygen Value	21	%
Moisture Content	1	%
CO	0	ppm
CO_2	0	%
N_2	79.05	%
O_2	20.95	%
dry molecular wt	28.84	
stack molecular wt	28.73	
area of stack	0.64	m^2
Pbar	1024.5	mbar
Pbar	769	mmHg
pitot tube coeft	0.83	
Reference Temp	273	K
Reference Pressure	760	mmHg
PITOT LEAK CHECK (Yes/No)	YES	

Site: Paxford Composites **Stack Description:** SB2

Time of Survey: 12:55

SITE TEAM: SDR & MRE

COMMENTS: Temperature & Velocity Traverse

Diagram of Sample Location:

Flow Criteria Measurements		Fulfilled?
Is the gas flow angle <15° to the duct axis?	Yes	✔
Is there any local negative flow?	No	✔
Is the flow rate high enough to be measured?	Yes	✔
Ratio of flows less than 3:1 (or 9:1 for pressure readings)?	Yes	✔

SAMPLING LINE: A							
Traverse Point	Distance into duct (m)	Δ p mm H_2O	Δ p Pa	Stack Temp Ts °C	Velocity @ stack gas T&P on wet gas basis m/s	Angle of Swirl °	√Δp
1	A10	28.00	274.49	21	17.72	<15	5.29
2	A9	26.00	254.88	21	17.08	<15	5.10
3	A8	26.00	254.88	21	17.08	<15	5.10
4	A7	22.60	221.55	21	15.92	<15	4.75
5	A6	18.80	184.30	21	14.52	<15	4.34
6	A5	16.60	162.73	22	13.67	<15	4.07
7	A4	14.00	137.24	22	12.55	<15	3.74
8	A3	8.40	82.35	22	9.72	<15	2.90
9	A2	6.60	64.70	22	8.62	<15	2.57
10	A1	6.00	58.82	22	8.22	<15	2.45
	Average values	**17.3**	**42.4**	**21.5**	**13.5**	**<15**	**4.0**

Duct / Stack Flow Characteristics:	**SB2**	
Test No:	**SB2 Velocity**	
	Average	**Units**
Stack Velocity at stack gas T & P and a wet gas basis	13.51	ms^{-1}
Stack flow @ STP, O_2 (ref) and on a dry gas basis	N/A	m^3s^{-1}
Stack flow @ stack gas T & P and on a wet gas basis	8.65	m^3s^{-1}
Stack flow @ stack gas T & P and on a dry gas basis	8.56	m^3s^{-1}
Stack flow @ STP and on a wet gas basis	8.11	m^3s^{-1}
Stack flow @ STP, O_2 (ref) and on a wet gas basis	N/A	m^3s^{-1}

Test no	SB3 Velocity	
Date	19-2-13	
Swirl Test Conducted	OK	
Stack Pres (with +/- above barometric if unknown enter zero)	20	mmH_20
Pitot Type and Tube ID	AS0466	

Conditions	Value	Units
Stack pressure	770.10	mmHg
Ref oxygen Value	21	%
Moisture Content	1	%
CO	0	ppm
CO_2	0	%
N_2	79.05	%
O_2	20.95	%
dry molecular wt	28.84	
stack molecular wt	28.73	
area of stack	0.59	m^2
Pbar	1024.5	mbar
Pbar	769	mmHg
pitot tube coeft	0.83	
Reference Temp	273	K
Reference Pressure	760	mmHg
PITOT LEAK CHECK (Yes/No)	YES	

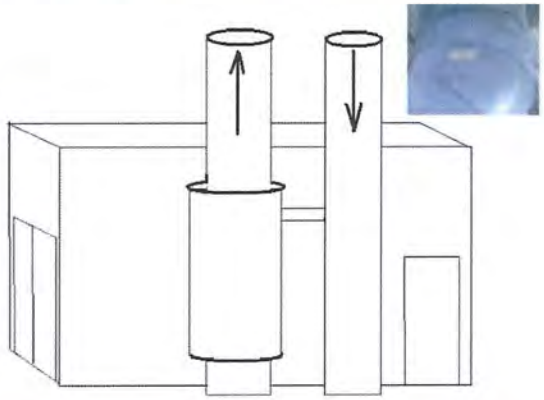
Site: Paxford Composites **Stack Description:** SB3

Time of Survey: 15:15

SITE TEAM: SDR & MRE

COMMENTS: Temperature & Velocity Traverse

Diagram of Sample Location:



Flow Criteria Measurements		Fulfilled?
Is the gas flow angle <15° to the duct axis?	Yes	✔
Is there any local negative flow?	No	✔
Is the flow rate high enough to be measured?	Yes	✔
Ratio of flows less than 3:1 (or 9:1 for pressure readings)?	Yes	✔

SAMPLING LINE: A							
Traverse Point	Distance into duct (m)	Δ p mm H_2O	Δ p Pa	Stack Temp Ts °C	Velocity @ stack gas T&P on wet gas basis m/s	Angle of Swirl °	√Δp
1	A10	22.00	215.67	22	15.72	<15	4.69
2	A9	22.00	215.67	22	15.72	<15	4.69
3	A8	21.40	209.79	22	15.50	<15	4.63
4	A7	20.60	201.94	22	15.21	<15	4.54
5	A6	18.80	184.30	22	14.53	<15	4.34
6	A5	16.00	156.85	22	13.41	<15	4.00
7	A4	15.60	152.93	22	13.24	<15	3.95
8	A3	10.20	99.99	22	10.70	<15	3.19
9	A2	8.00	78.42	22	9.48	<15	2.83
10	A1	8.20	80.39	22	9.60	<15	2.86
	Average values	**16.3**	**39.9**	**22.0**	**13.3**	**<15**	**4.0**

Duct / Stack Flow Characteristics:	**SB3**	
Test No:	**SB3 Velocity**	
	Average	**Units**
Stack Velocity at stack gas T & P and a wet gas basis	13.31	ms^{-1}
Stack flow @ STP, O_2 (ref) and on a dry gas basis	N/A	m^3s^{-1}
Stack flow @ stack gas T & P and on a wet gas basis	7.85	m^3s^{-1}
Stack flow @ stack gas T & P and on a dry gas basis	7.78	m^3s^{-1}
Stack flow @ STP and on a wet gas basis	7.36	m^3s^{-1}
Stack flow @ STP, O_2 (ref) and on a wet gas basis	N/A	m^3s^{-1}

2.2.2 - One Minute Averaged Gaseous Emissions Data

Paxford Composites - Spray Booth One
273K, 101.3 kPa, on a Wet Gas Basis
20th February 2013

Time	VOCs (Cmg/m^3)
11:00	7.8
11:01	8.1
11:02	5.5
11:03	4.7
11:04	4.0
11:05	3.7
11:06	4.8
11:07	4.6
11:08	4.6
11:09	4.6
11:10	4.8
11:11	4.6
11:12	3.8
11:13	4.3
11:14	5.4
11:15	6.4
11:16	6.9
11:17	6.7
11:18	6.9
11:19	7.0
11:20	6.2
11:21	5.7
11:22	5.3
11:23	4.9
11:24	5.0
11:25	4.2
11:26	3.5
11:27	3.1
11:28	3.5
11:29	5.1
11:30	6.2
Maximum	**8.1**
Minimum	**3.1**
Average	**5.2**

Paxford Composites - Spray Booth Two
273K, 101.3 kPa, on a Wet Gas Basis
19th February 2013

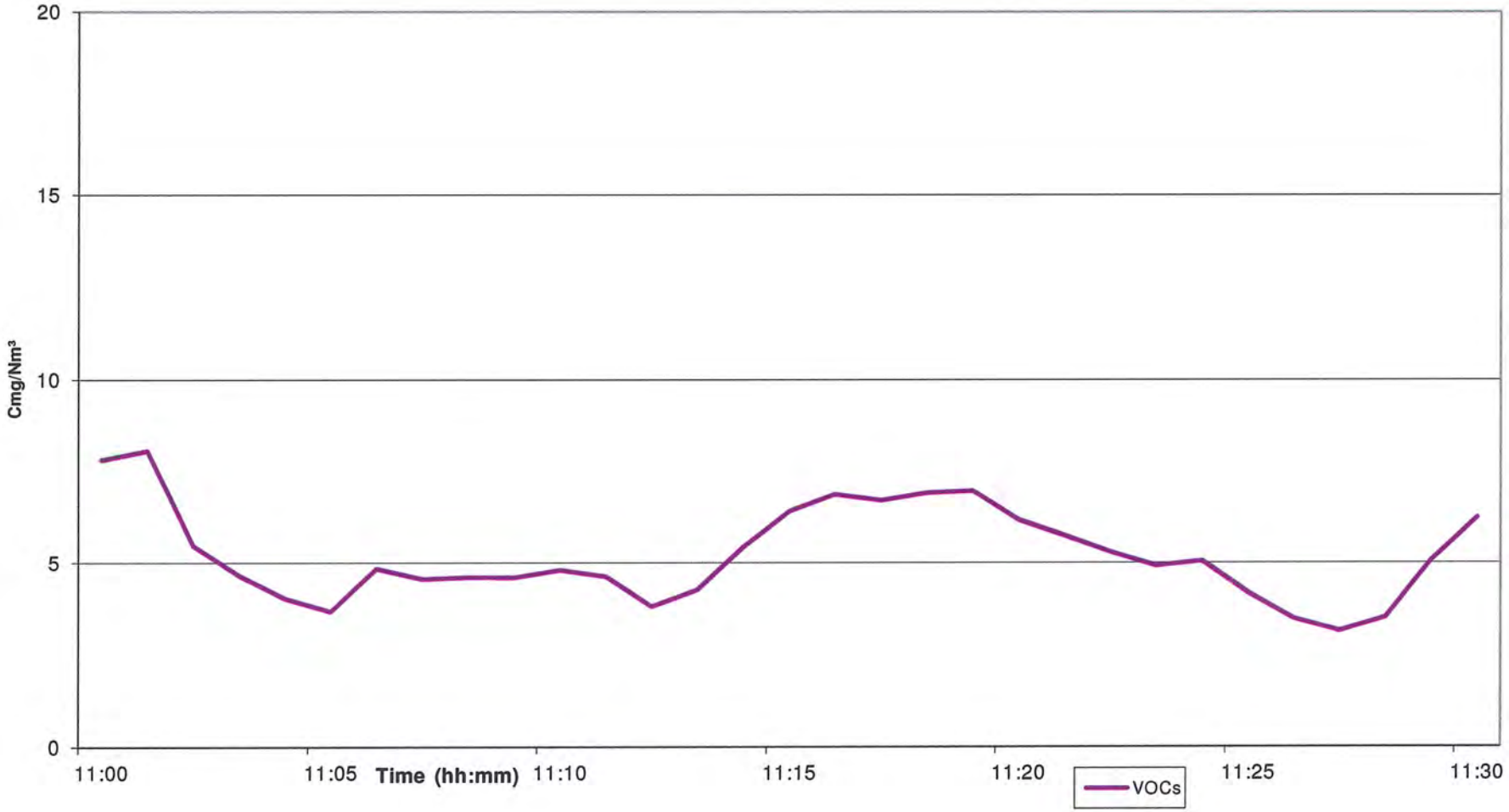
Time	VOCs (Cmg/m^3)
14:45	7.4
14:46	9.0
14:47	9.7
14:48	9.0
14:49	11.3
14:50	18.3
14:51	15.8
14:52	13.3
14:53	18.0
14:54	21.4
14:55	18.1
14:56	13.1
14:57	10.0
14:58	8.1
14:59	7.1
15:00	6.2
15:01	6.8
15:02	5.6
15:03	5.0
15:04	4.5
15:05	4.3
15:06	4.1
15:07	3.8
15:08	3.7
15:09	3.5
15:10	3.3
15:11	3.3
15:12	3.1
15:13	6.6
15:14	3.8
15:15	3.1
Maximum	**21.4**
Minimum	**3.1**
Average	**8.4**

Paxford Composites - Spray Booth Three 273K, 101.3 kPa on a Wet Gas Basis 19th February 2013

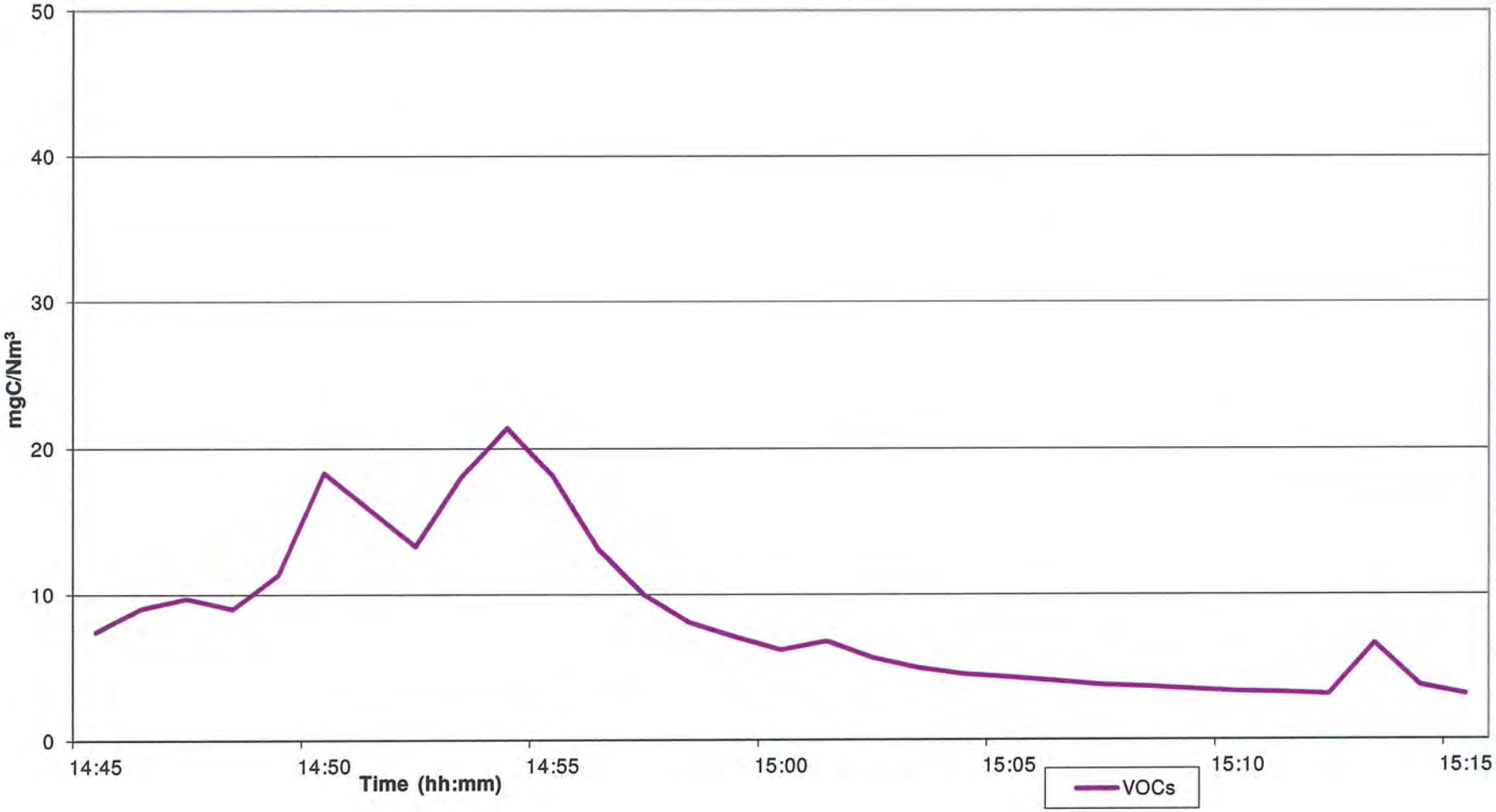
Time	VOCs (Cmg/m^3)
16:15	39.2
16:16	37.1
16:17	35.4
16:18	34.6
16:19	35.1
16:20	34.1
16:21	34.3
16:22	34.3
16:23	33.7
16:24	31.6
16:25	29.9
16:26	28.3
16:27	26.7
16:28	25.5
16:29	26.5
16:30	96.5
16:31	102
16:32	75.9
16:33	60.2
16:34	49.4
16:35	42.3
16:36	37.0
16:37	33.2
16:38	30.5
16:39	28.6
16:40	27.1
16:41	26.1
16:42	25.3
16:43	24.6
16:44	28.0
16:45	92.9
Maximum	**102**
Minimum	**24.6**
Average	**40.8**

2.2.3 - Gaseous Emissions Graphical Data

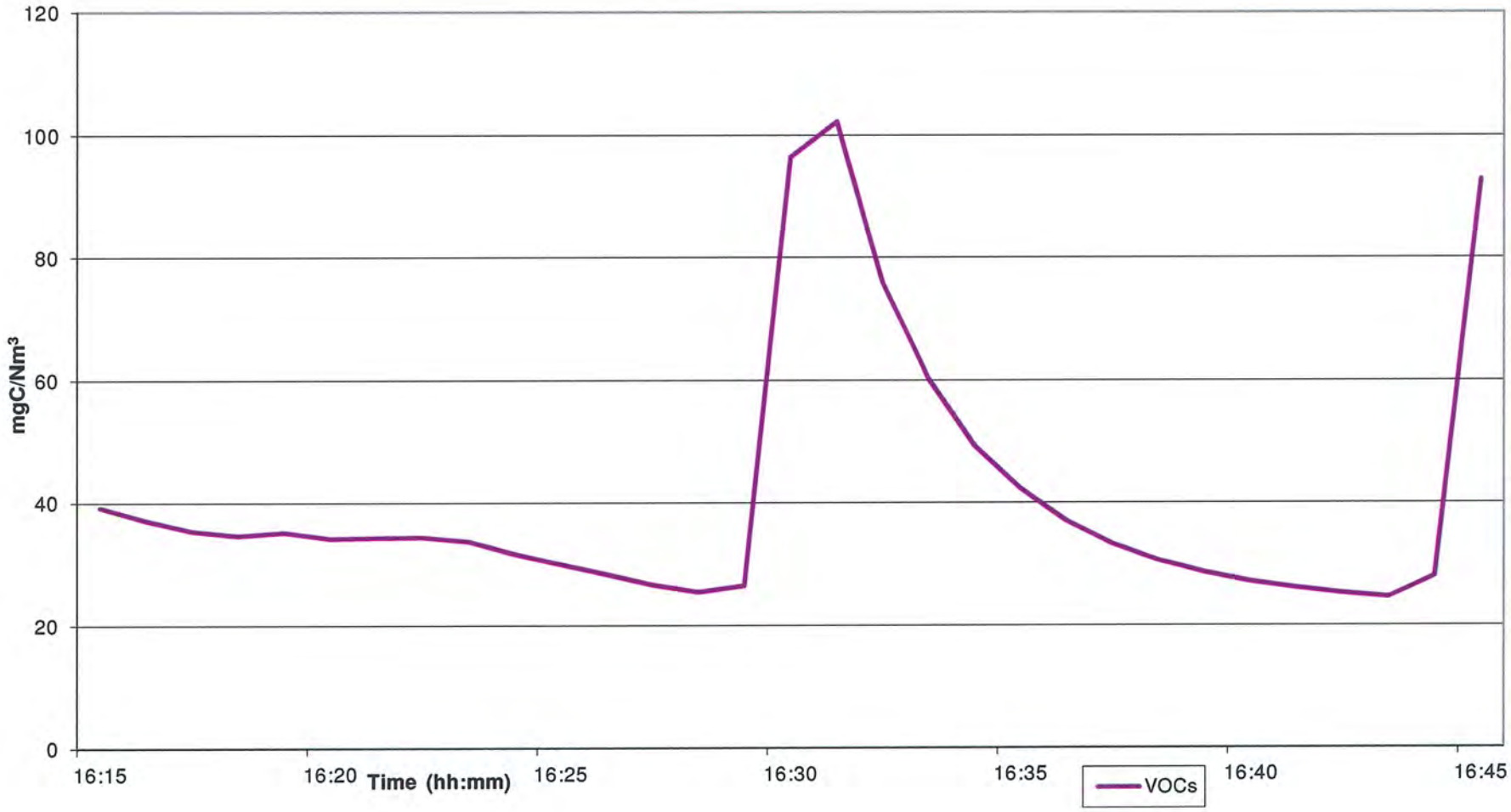
Spray Booth One Minute Averaged VOCs Emissions Data - 20th February 2013
(273.15K, 101.325kPa, on a Wet Gas basis) using the NPL Conventional Analysis Package



Spray Booth Two Minute Averaged VOCs Emissions Data - 19th February 2013
(273.15K, 101.325kPa, on a Wet Gas basis) using the NPL Conventional Analysis Package



**Spray Booth Three Minute Averaged VOCs Emissions Data - 19th February 2013
(273.15K, 101.325kPa on a Wet Gas basis) using the NPL Conventional Analysis Package**



2.2.4 - Gas Calibration Log

GAS CALIBRATION MEASUREMENTS

Client:	Paxford Composites	Date:	20/02/2013	Horiba ID:	-
Site:	Paxford Composites	Job Number:	PX05FEB13	FID ID:	AS0234
Stack ID:	SB1	Mobile Lab ID:	BD09 WUR	Sonimix ID:	-
Reference oxygen %	N/A	Nitrogen cylinder ID:	Zero Grade	Initial N_2 pressure bar	-

GAS CALIBRATION LOG - DIRECT CALIBRATION

		SO_2	CO	NOx	O_2	CO_2	VOCs
Gas Cylinder ID:							138227
Initial Reg. Pressure bar							85
Cylinder Concentration:							53.0 ppm C_3H_8
Span Value:							53.0 ppm C_3H_8
Analyser Range:0 -							100 ppm C_3H_8
Check Zero	Time						09:24
	Reading						0.27 ppm C_3H_8
Adjust Zero	Time						09:25
	Reading						0 ppm C_3H_8
Check Span	Time						09:26
	Reading						54.9 ppm C_3H_8
Adjust Span	Time						09:27
	Reading						53.0 ppm C_3H_8
Check Zero	Time						09:29
	Reading						0.0 ppm C_3H_8

GAS CALIBRATION LOG - SYSTEM CAL (Including heated line and chiller unit)

		SO_2	CO	NOx	O_2	CO_2	VOCs
Span Value:							53.0 ppm C3H8
Check Zero	Time						09:31
	Reading						0.1 ppm
	Pass/fail						PASS
Check Span	Time						09:32
	Reading						52.9 ppm
	Response Time/s						20
	Pass/fail						PASS
Check Zero	Time						09:34
	Reading						0.1 ppm

GAS CALIBRATION LOG - POST CAL (Including heated line and chiller unit)

		SO_2	CO	NOx	O_2	CO_2	VOCs
Span Value:							53.0 ppm C_3H_8
Check Zero	Time						11:45
	Reading						0.01 ppm C_3H_8
Check Span	Time						11:46
	Reading						52.4 ppm C_3H_8
	Reg Pressure						85
Zero Repeatability as % of Range							0.1%
Acceptance							Accept
Zero Drift (%)							0.1
Span Drift (%)							1.0
							Accept
Comments:							

CALIBRATION TO BE CARRIED OUT BY OR UNDER THE SUPERVISION OF MCERTS QUALIFIED PERSONNEL WITH LEVEL TWO AND TE4

Name:	Simon Render
MCERTS ID:	MM08-938

Personnel Present:	SDR/MRE

GAS CALIBRATION MEASUREMENTS

Client:	Paxford Composites	Date:	19/02/2013	Horiba ID:	-
Site:	Paxford Composites	Job Number:	PX05FEB13	FID ID:	AS0234
Stack ID:	SB2	Mobile Lab ID:	BD09 WUR	Sonimix ID:	-
Reference oxygen %	N/A	Nitrogen cylinder ID:	Zero Grade	Initial N_2 pressure bar	-

GAS CALIBRATION LOG - DIRECT CALIBRATION

		SO_2	CO	NOx	O_2	CO_2	VOCs
Gas Cylinder ID:							138227
Initial Reg. Pressure bar							85
Cylinder Concentration:							53.0 ppm C_3H_8
Span Value:							53.0 ppm C_3H_8
Analyser Range:0 -							100 ppm C_3H_8
Check Zero	Time						14:15
	Reading						-0.19 ppm C_3H_8
Adjust Zero	Time						14:16
	Reading						0 ppm C_3H_8
Check Span	Time						14:17
	Reading						49.9 ppm C_3H_8
Adjust Span	Time						14:18
	Reading						53.0 ppm C_3H_8
Check Zero	Time						14:19
	Reading						0.0 ppm C_3H_8

GAS CALIBRATION LOG - SYSTEM CAL (Including heated line and chiller unit)

		SO_2	CO	NOx	O_2	CO_2	VOCs
Span Value:							53.0 ppm C3H8
Check Zero	Time						14:22
	Reading						0.0 ppm
	Pass/fail						PASS
Check Span	Time						14:24
	Reading						52.7 ppm
	Response Time/s						20
	Pass/fail						PASS
Check Zero	Time						14:26
	Reading						0.1 ppm

GAS CALIBRATION LOG - POST CAL (Including heated line and chiller unit)

		SO_2	CO	NOx	O_2	CO_2	VOCs
Span Value:							53.0 ppm C_3H_8
Check Zero	Time						15:22
	Reading						-0.01 ppm C_3H_8
Check Span	Time						15:24
	Reading						53.6 ppm C_3H_8
	Reg Pressure						85
Zero Repeatability as % of Range							0.0%
Acceptance							Accept
Zero Drift (%)							0.0
Span Drift (%)							1.7
							Accept
Comments:							

CALIBRATION TO BE CARRIED OUT BY OR UNDER THE SUPERVISION OF MCERTS QUALIFIED PERSONNEL WITH LEVEL TWO AND TE4

Name:	Simon Render
MCERTS ID:	MM08-938

Personnel Present:	SDR/MRE

GAS CALIBRATION MEASUREMENTS

Client:	Paxford Composites	Date:	19/02/2013	Horiba ID:	-
Site:	Paxford Composites	Job Number:	PX05FEB13	FID ID:	AS0234
Stack ID:	SB3	Mobile Lab ID:	BD09 WUR	Sonimix ID:	-
Reference oxygen %	N/A	Nitrogen cylinder ID:	Zero Grade	Initial N_2 pressure bar	-

GAS CALIBRATION LOG - DIRECT CALIBRATION

		SO_2	CO	NOx	O_2	CO_2	VOCs
Gas Cylinder ID:							138227
Initial Reg. Pressure bar							85
Cylinder Concentration:							53.0 ppm C_3H_8
Span Value:							53.0 ppm C_3H_8
Analyser Range:0 -							1000 ppm C_3H_8
Check Zero	Time						15:33
	Reading						-0.08 ppm C_3H_8
Adjust Zero	Time						15:34
	Reading						0 ppm C_3H_8
Check Span	Time						15:35
	Reading						52.9 ppm C_3H_8
Adjust Span	Time						15:36
	Reading						53.0 ppm C_3H_8
Check Zero	Time						15:38
	Reading						0.1 ppm C_3H_8

GAS CALIBRATION LOG - SYSTEM CAL (Including heated line and chiller unit)

		SO_2	CO	NOx	O_2	CO_2	VOCs
Span Value:							53.0 ppm C3H8
Check Zero	Time						15:40
	Reading						0.0 ppm
	Pass/fail						PASS
Check Span	Time						15:41
	Reading						52.9 ppm
	Response Time/s						20
	Pass/fail						PASS
Check Zero	Time						15:42
	Reading						0.0 ppm

GAS CALIBRATION LOG - POST CAL (Including heated line and chiller unit)

		SO_2	CO	NOx	O_2	CO_2	VOCs
Span Value:							53.0 ppm C_3H_8
Check Zero	Time						17:00
	Reading						-0.1 ppm C_3H_8
Check Span	Time						17:02
	Reading						52.8 ppm C_3H_8
	Reg Pressure						85
Zero Repeatability as % of Range							0.0%
Acceptance							Accept
Zero Drift (%)							0.0
Span Drift (%)							0.2
							Accept
Comments:							

CALIBRATION TO BE CARRIED OUT BY OR UNDER THE SUPERVISION OF MCERTS QUALIFIED PERSONNEL WITH LEVEL TWO AND TE4

Name:	Simon Render
MCERTS ID:	MM08-938

Personnel Present:	SDR/MRE

2.2.5 - Particulate Summary Sheets

SB1 Particulates Results Summary

Field	Units	Blank	TEST 1
Date	dd/mm/yyyy	*20/02/2013*	20/02/2013
Test No.		*Blank*	PM1
Filter No.		*12TF220*	12TF223
Stack Description		*SB1*	SB1
Start Time	hh:mm	-	10:36
End Time	hh:mm	-	11:06
Total Time	min	-	30
Stack Temp.	C	-	14
Gas Meter Temp	C	-	16
Gas Meter Pressure	kPa	-	102.5
Filter	mg	*<0.2*	<0.2
Washings	mg	<0.2	<0.2
TOTAL Mass Collected	mg	*<0.2*	<0.2
Test H_20	% Vol	-	0.5
Stack Pressure	kPa	-	102.5
Nozzle Diameter	mm	-	5.02
Duct Area	m^2	-	0.47
Isokinicity	%	-	99
Stack Velocity	Stack T & P, uncorrected, ms^{-1}	-	11.60
Gas Vol. Sampled	Dry Gas Basis, Ambient T and P	-	0.40
Gas Vol. Sampled	Wet Gas Basis, Standard T and P	-	0.39
Particulate Concentration	**Wet Gas Basis, Standard T and P, mg Nm^{-3}**	*<0.2*	**<0.2**
Expanded Uncertainty	+/-mg Nm^{-3}, 95% Conf. k=2	-	0.2
Emission Limit Value (ELV)	Wet Gas Basis, Standard T and P, mg Nm^{-3}	*50*	50
Percentage of Emission Limit Value (ELV) for Test	Wet Gas Basis, Standard T and P, %	-	0
Mass Emission	Wet Gas Basis, Standard T and P, g s^{-1}	-	0.002

SB2 Particulates Results Summary

Field	Units	Blank	TEST 1
Date	dd/mm/yyyy	*19/02/2013*	19/02/2013
Test No.		*Blank*	PM1
Filter No.		*12TF216*	12TF217
Stack Description		*SB2*	SB2
Start Time	hh:mm	-	14:00
End Time	hh:mm	-	14:30
Total Time	min	-	30
Stack Temp.	C	-	21
Gas Meter Temp	C	-	20
Gas Meter Pressure	kPa	-	102.5
Filter	mg	*<0.2*	5.0
Washings	mg	<0.2	3.7
TOTAL Mass Collected	mg	*<0.2*	8.8
Test H_20	% Vol	-	0.9
Stack Pressure	kPa	-	102.5
Nozzle Diameter	mm	-	6.02
Duct Area	m^2	-	0.64
Isokinicity	%	-	100
Stack Velocity	Stack T & P, uncorrected, ms^{-1}	-	19.37
Gas Vol. Sampled	Dry Gas Basis, Ambient T and P	-	0.99
Gas Vol. Sampled	Wet Gas Basis, Standard T and P	-	0.93
Particulate Concentration	Wet Gas Basis, Standard T and P, mg Nm^{-3}	*<0.2*	9.4
Expanded Uncertainty	+/-mg Nm^{-3}, 95% Conf. k=2	-	0.6
Emission Limit Value (ELV)	Wet Gas Basis, Standard T and P, mg Nm^{-3}	*50*	50
Percentage of Emission Limit Value (ELV) for Test	Wet Gas Basis, Standard T and P, %	-	19
Mass Emission	Wet Gas Basis, Standard T and P, g s^{-1}	-	0.2

SB3 Particulates Results Summary

Field	Units	Blank	TEST 1
Date	dd/mm/yyyy	*19/02/2013*	19/02/2013
Test No.		*Blank*	PM1
Filter No.		*12TF218*	12TF219
Stack Description		*SB3*	SB3
Start Time	hh:mm	-	15:45
End Time	hh:mm	-	16:15
Total Time	min	-	30
Stack Temp.	C	-	25
Gas Meter Temp	C	-	22
Gas Meter Pressure	kPa	-	101.8
Filter	mg	*<0.2*	*0.5*
Washings	mg	0.3	0.1
TOTAL Mass Collected	mg	*<0.5*	0.5
Test H_20	% Vol	-	0.5
Stack Pressure	kPa	-	101.8
Nozzle Diameter	mm	-	5.02
Duct Area	m^2	-	0.59
Isokinicity	%	-	104
Stack Velocity	Stack T & P, uncorrected, ms^{-1}	-	12.35
Gas Vol. Sampled	Dry Gas Basis, Ambient T and P	-	0.44
Gas Vol. Sampled	Wet Gas Basis, Standard T and P	-	0.42
Particulate Concentration	**Wet Gas Basis, Standard T and P, mg Nm^{-3}**	*<0.5*	**1.2**
Expanded Uncertainty	+/-mg Nm^{-3}, 95% Conf. k=2	-	1.1
Emission Limit Value (ELV)	Wet Gas Basis, Standard T and P, mg Nm^{-3}	*50*	50
Percentage of Emission Limit Value (ELV) for Test	Wet Gas Basis, Standard T and P, %	-	2
Mass Emission	Wet Gas Basis, Standard T and P, g s^{-1}	-	0.02

2.2.6 - Sample Sheets

Test no	PM1		Site:	Paxford Composites	Stack Description:	SB1
Date	20-2-13	dd/mm/yy	Filter No:	12TF223	Absorber No(s):	T01, A-D
nozzle diameter	5.0	mm	Blank I.D.:	12TF220		
Stack Pres (with +/- above barometric if unknown enter zero)	0	mmH_20	SITE TEAM:	SDR & MRE		
			COMMENTS:	Particulates Test 1		
end volume reading	26.575	m^3			Control Box I.D. No:	AS0003
start volume reading	26.175	m^3	end time	11:06 hh:mm	Stack Thermocouple I.D. No.	AS0257A
volume sampled	0.40	m^3	start time	10:36 hh:mm	Probe I.D. No.	AS0257
Conditions	Value	Units	total time	00:30 hh:mm	Barometer I.D. No.	AS0300
			stop time	00:00 hh:mm	Pitot I.D. No.	AS0015
Stack pressure	768.63	mmHg	Diagram of Sample Location:			
Gas Meter Calibration Factor Y	1.0214					
Ref oxygen Value	21	%				
Moisture content	0.5	%				
CO	0	ppm				
CO_2	0	%				
N_2	79.05	%				
O_2	20.95	%				
dry molecular wt	28.84					
stack molecular wt	28.78					
Orifice ΔH@ Factor	41.70	mmH_20				
area of stack	0.47	m^2	LEAK CHECK			
Pbar	1024.5	mbar	Pre Vac (in Hg):	15	Post Vac (in Hg):	0.5
Pbar	768.6	mmHg				
pitot tube coeft	0.83		Leak rate (m^3/l) or (%):	<2%	Leak rate (m^3/l) or (%):	<2%
Reference Temp	273	K				
Reference Pressure	760	mmHg				

	Start Time at this Position or Setting hh: mm	volume reading at start m^3	Probe position	Time at each position / min	Δ p mm H_2O	Δ h mm H_2O	Stack Temp Ts °C	Probe Temp Tp °C	Oven Temp °C	Impinger Temp °C	Resin/Line °C	Meter in Tm(in) °C	Meter out Tm(out) °C	Vacuum in Hg
1:	10:36	26.1750	A3	5	17.80	24.9	11	158	N/A	17	N/A	15	15	0.5
2:	10:41	26.2610	A3	5	17.80	24.9	10	159	N/A	16	N/A	15	15	0.5
3:	10:46	26.3440	A2	5	14.60	20.4	10	160	N/A	18	N/A	16	16	0.5
4:	10:51	26.4140	A2	5	14.20	19.9	18	160	N/A	19	N/A	17	17	0.5
5:	10:56	26.4830	A1	5	6.20	8.7	17	160	N/A	19	N/A	17	17	0.5
6:	11:01	26.5290	A1	5	6.40	9.0	18	159	N/A	20	N/A	17	17	0.5
7:	11:06	26.5750	STOP											
8:														
9:														
10:														

	Start Time at this Position or Setting hh: mm	volume reading at start m^3	Probe position	Time at each position / min	Δ p mm H_2O	Δ h mm H_2O	Stack Temp Ts °C	Probe Temp Tp °C	Oven Temp °C	Impinger Temp °C	Resin/Line °C	Meter in Tm(in) °C	Meter out Tm(out) °C	Vacuum in Hg
11:														
12:														
13:														
14:														
15:														
	Summary values	**26.58**		**30**		**17.97**	**14.0**	**159.3**	**#DIV/0!**	**18.2**	**n/a**		**16.2**	**0.5**

Duct / Stack Flow Characteristics: **Test No**	**SB1** **PM1**		**Units**
Stack Velocity at stack gas T & P and a wet gas basis		11.60	ms^{-1}
Stack flow @ STP, O_2 (ref) and on a dry gas basis		5.22	m^3s^{-1}
Stack flow @ stack gas T & P and on a wet gas basis		5.45	m^3s^{-1}
Stack flow @ stack gas T & P and on a dry gas basis		5.42	m^3s^{-1}
Stack flow @ STP and on a wet gas basis		5.24	m^3s^{-1}
Stack flow @ STP, O_2 (ref) and on a wet gas basis		5.72	m^3s^{-1}
Gas vol. samp. @ STP and on a dry gas basis		0.39	m^3
Gas vol. samp. @ STP, O_2(ref), and on a dry gas basis		0.39	m^3
Gas vol. samp. @ STP and on a wet gas basis		0.39	m^3
Gas vol. samp. @ STP, O_2 (ref) and on a wet gas basis		0.39	m^3
Percentage Isokinicity		99	%

Test no	ISOCYANATES 1		Site:	Paxford Composites	Stack Description:	SB1
Date	20-2-13	dd/mm/yy	Filter No:	-	Absorber No(s):	T01, A-D
nozzle diameter	5.02	mm	Blank I.D.:	-		
Stack Pres (with +/- above barometric if unknown enter zero)	0	mmH_20	SITE TEAM:	SDR & MRE		
			COMMENTS:	Isocyanates Test 1		
end volume reading	26.994	m^3			Control Box I.D. No:	AS0003
start volume reading	26.582	m^3	end time	11:42 hh:mm	Stack Thermocouple I.D. No.	AS0257A
volume sampled	0.41	m^3	start time	11:12 hh:mm	Probe I.D. No.	AS0257
Conditions	Value	Units	total time	00:30 hh:mm	Barometer I.D. No.	AS0300
			stop time	00:00 hh:mm	Pitot I.D. No.	AS0015
Stack pressure	768.63	mmHg	Diagram of Sample Location:			
Gas Meter Calibration Factor Y	0.9808					
Ref oxygen Value	21	%				
Moisture content	0.7	%				
CO	0	ppm				
CO_2	0	%				
N_2	79.05	%				
O_2	20.95	%				
dry molecular wt	28.84					
stack molecular wt	28.77					
Orifice ΔH@ Factor	47.10	mmH_20				
area of stack	0.47	m^2	LEAK CHECK			
Pbar	1024.5	mbar	Pre Vac (in Hg):	15	Post Vac (in Hg):	1
Pbar	768.6	mmHg				
pitot tube coeft	0.83		Leak rate (m^3/l) or (%):	<2%	Leak rate (m^3/l) or (%):	<2%
Reference Temp	273	K				
Reference Pressure	760	mmHg				

	Start Time at this Position or Setting hh: mm	volume reading at start m^3	Probe position	Time at each position / min	Δ p mm H_2O	Δ h mm H_2O	Stack Temp Ts °C	Probe Temp Tp °C	Oven Temp °C	Impinger Temp °C	Resin/Line °C	Meter in Tm(in) °C	Meter out Tm(out) °C	Vacuum in Hg
1:	11:12	26.582	A3	5	18.20	25.5	17	160	N/A	15	N/A	18	18	0.5
2:	11:17	26.664	A3	5	17.60	24.6	15	160	N/A	17	N/A	19	19	0.5
3:	11:22	26.742	A2	5	15.00	21.0	12	161	N/A	20	N/A	19	19	0.5
4:	11:27	26.811	A2	5	14.80	20.7	10	161	N/A	21	N/A	20	20	0.5
5:	11:32	26.881	A1	5	6.60	9.2	10	160	N/A	22	N/A	21	21	0.5
6:	11:37	26.937	A1	5	6.40	9.0	10	160	N/A	22	N/A	21	21	0.5
7:	11:42	26.994	STOP											
8:														
9:														
10:														

	Start Time at this Position or Setting hh: mm	volume reading at start m^3	Probe position	Time at each position / min	Δ p mm H_2O	Δ h mm H_2O	Stack Temp Ts °C	Probe Temp Tp °C	Oven Temp °C	Impinger Temp °C	Resin/Line °C	Meter in Tm(in) °C	Meter out Tm(out) °C	Vacuum in Hg
11:														
12:														
13:														
14:														
15:														
	Summary values	**26.99**		**30**		**18.34**	**12.3**	**160.3**	**#DIV/0!**	**19.5**	**n/a**		**19.7**	**0.5**

Duct / Stack Flow Characteristics: Test No	SB1 ISOCYANATES 1		Units
Stack Velocity at stack gas T & P and a wet gas basis		11.69	ms^{-1}
Stack flow @ STP, O_2 (ref) and on a dry gas basis		5.28	m^3s^{-1}
Stack flow @ stack gas T & P and on a wet gas basis		5.50	m^3s^{-1}
Stack flow @ stack gas T & P and on a dry gas basis		5.46	m^3s^{-1}
Stack flow @ STP and on a wet gas basis		5.32	m^3s^{-1}
Stack flow @ STP, O_2 (ref) and on a wet gas basis		5.79	m^3s^{-1}
Gas vol. samp. @ STP and on a dry gas basis		0.38	m^3
Gas vol. samp. @ STP, O_2(ref), and on a dry gas basis		0.38	m^3
Gas vol. samp. @ STP and on a wet gas basis		0.38	m^3
Gas vol. samp. @ STP, O_2 (ref) and on a wet gas basis		0.38	m^3
Percentage Isokinicity		95	%

Test no	PM1		Site:	Paxford Composites	Stack Description:	SB2
Date	19-2-13	dd/mm/yy	Filter No:	12TF217	Absorber No(s):	T01, A-D
nozzle diameter	6.02	mm	Blank I.D.:	12TF216		
Stack Pres (with +/- above barometric if unknown enter zero)	0	mmH_20	SITE TEAM:	SDR & MRE		
			COMMENTS:	Particulates Test 1		
end volume reading	24.667	m^3			Control Box I.D. No:	AS0240
start volume reading	23.678	m^3	end time	14:30 hh:mm	Stack Thermocouple I.D. No.	AS0257A
volume sampled	0.99	m^3	start time	14:00 hh:mm	Probe I.D. No.	AS0257
Conditions	Value	Units	total time	00:30 hh:mm	Barometer I.D. No.	AS0300
			stop time	00:00 hh:mm	Pitot I.D. No.	AS0466
Stack pressure	768.63	mmHg	Diagram of Sample Location:			
Gas Meter Calibration Factor Y	0.9808					
Ref oxygen Value	21	%				
Moisture content	0.9	%				
CO	0	ppm				
CO_2	0	%				
N_2	79.05	%				
O_2	20.95	%				
dry molecular wt	28.84					
stack molecular wt	28.74					
Orifice ΔH@ Factor	47.10	mmH_20				
area of stack	0.64	m^2	LEAK CHECK			
Pbar	1024.5	mbar	Pre Vac (in Hg):	15	Post Vac (in Hg):	1
Pbar	768.6	mmHg				
pitot tube coeft	0.83		Leak rate (m^3/l) or (%):	<2%	Leak rate (m^3/l) or (%):	<2%
Reference Temp	273	K				
Reference Pressure	760	mmHg				

	Start Time at this Position or Setting hh: mm	volume reading at start m^3	Probe position	Time at each position / min	Δ p mm H_2O	Δ h mm H_2O	Stack Temp Ts °C	Probe Temp Tp °C	Oven Temp °C	Impinger Temp °C	Resin/Line °C	Meter in Tm(in) °C	Meter out Tm(out) °C	Vacuum in Hg
1:	14:00	23.6780	A1	5	52.00	145.6	18	160	N/A	14	N/A	14	14	0.5
2:	14:05	23.9000	A1	5	48.00	134.4	20	160	N/A	15	N/A	17	17	0.5
3:	14:10	24.1080	A2	5	38.00	106.4	20	160	N/A	16	N/A	20	20	0.5
4:	14:15	24.2890	A2	5	28.00	78.4	21	160	N/A	16	N/A	22	22	0.5
5:	14:20	24.4350	A3	5	24.00	67.2	22	160	N/A	17	N/A	23	23	0.5
6:	14:25	24.5690	A3	5	18.00	50.4	22	160	N/A	18	N/A	24	24	0.5
7:	14:30	24.6670	END											
8:														
9:														
10:														

	Start Time at this Position or Setting hh: mm	volume reading at start m^3	Probe position	Time at each position / min	Δ p mm H_2O	Δ h mm H_2O	Stack Temp Ts °C	Probe Temp Tp °C	Oven Temp °C	Impinger Temp °C	Resin/Line °C	Meter in Tm(in) °C	Meter out Tm(out) °C	Vacuum in Hg
11:														
12:														
13:														
14:														
15:														
	Summary values	**24.67**		**30**		**97.07**	**20.5**	**160.0**	**#DIV/0!**	**16.0**	**n/a**		**20.0**	**0.5**

Duct / Stack Flow Characteristics: **Test No**	**SB2** **PM1**		**Units**
Stack Velocity at stack gas T & P and a wet gas basis		19.37	ms^{-1}
Stack flow @ STP, O_2 (ref) and on a dry gas basis		11.56	m^3s^{-1}
Stack flow @ stack gas T & P and on a wet gas basis		12.40	m^3s^{-1}
Stack flow @ stack gas T & P and on a dry gas basis		12.29	m^3s^{-1}
Stack flow @ STP and on a wet gas basis		11.66	m^3s^{-1}
Stack flow @ STP, O_2 (ref) and on a wet gas basis		12.84	m^3s^{-1}
Gas vol. samp. @ STP and on a dry gas basis		0.92	m^3
Gas vol. samp. @ STP, O_2(ref), and on a dry gas basis		0.92	m^3
Gas vol. samp. @ STP and on a wet gas basis		0.93	m^3
Gas vol. samp. @ STP, O_2 (ref) and on a wet gas basis		0.93	m^3
Percentage Isokinicity		100	%

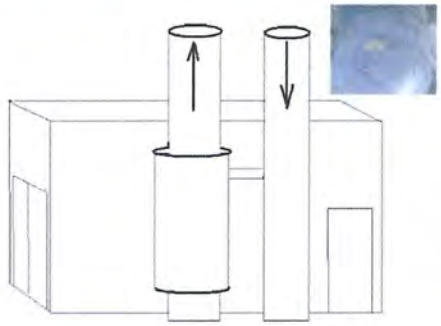
Test no	ISOCYANATES 1		Site:	Paxford Composites	Stack Description:	SB2
Date	19-2-12	dd/mm/yy	Filter No:	-	Absorber No(s):	T01, A-D
nozzle diameter	5.02	mm	Blank I.D.:	-		
Stack Pres (with +/- above barometric if unknown enter zero)	0	mmH_20	SITE TEAM:	SDR & MRE		
			COMMENTS:	Isocyanates Test 1		
end volume reading	25.239	m^3			Control Box I.D. No:	AS0003
start volume reading	24.692	m^3	end time	15:20 hh:mm	Stack Thermocouple I.D. No.	AS0257A
volume sampled	0.55	m^3	start time	14:50 hh:mm	Probe I.D. No.	AS0257
Conditions	Value	Units	total time	00:30 hh:mm	Barometer I.D. No.	AS0300
			stop time	00:00 hh:mm	Pitot I.D. No.	AS0466
Stack pressure	758.50	mmHg	Diagram of Sample Location:			
Gas Meter Calibration Factor Y	0.9808					
Ref oxygen Value	21	%				
Moisture content	0.8	%				
CO	0	ppm				
CO_2	0	%				
N_2	79.05	%				
O_2	20.95	%				
dry molecular wt	28.84					
stack molecular wt	28.76					
Orifice ΔH@ Factor	47.10	mmH_20				
area of stack	0.64	m^2	LEAK CHECK			
Pbar	1011	mbar	Pre Vac (in Hg):	15	Post Vac (in Hg):	0.5
Pbar	758.5	mmHg				
pitot tube coeft	0.83		Leak rate (m^3/l) or (%):	<2%	Leak rate (m^3/l) or (%):	<2%
Reference Temp	273	K				
Reference Pressure	760	mmHg				

	Start Time at this Position or Setting hh: mm	volume reading at start m^3	Probe position	Time at each position / min	Δ p mm H_2O	Δ h mm H_2O	Stack Temp Ts °C	Probe Temp Tp °C	Oven Temp °C	Impinger Temp °C	Resin/Line °C	Meter in Tm(in) °C	Meter out Tm(out) °C	Vacuum in Hg
1:	14:50	24.6920	A1	5	26.00	36.4	19	160	N/A	17	N/A	19	19	0.5
2:	14:55	24.7870	A2	5	24.00	33.6	20	160	N/A	14	N/A	23	23	0.5
3:	15:00	24.8920	A3	5	10.00	14.0	25	160	N/A	16	N/A	24	24	0.5
4:	15:05	24.9480	A1	5	32.00	44.8	24	161	N/A	17	N/A	24	24	0.5
5:	15:10	25.0580	A2	5	26.00	36.4	25	160	N/A	17	N/A	24	24	0.5
6:	15:15	25.1620	A3	5	11.00	15.4	25	161	N/A	17	N/A	24	24	0.5
7:	15:20	25.2390	END											
8:														
9:														
10:														

	Start Time at this Position or Setting hh: mm	volume reading at start m^3	Probe position	Time at each position / min	Δ p mm H_2O	Δ h mm H_2O	Stack Temp Ts °C	Probe Temp Tp °C	Oven Temp °C	Impinger Temp °C	Resin/Line °C	Meter in Tm(in) °C	Meter out Tm(out) °C	Vacuum in Hg
11:														
12:														
13:														
14:														
15:														
	Summary values	**25.24**		**30**		**30.10**	**23.0**	**160.3**	**#DIV/0!**	**16.3**	**n/a**		**23.0**	**0.5**

Duct / Stack Flow Characteristics: **Test No**	**SB2** **ISOCYANATES 1**		**Units**
Stack Velocity at stack gas T & P and a wet gas basis		15.35	ms^{-1}
Stack flow @ STP, O_2 (ref) and on a dry gas basis		8.97	m^3s^{-1}
Stack flow @ stack gas T & P and on a wet gas basis		9.82	m^3s^{-1}
Stack flow @ stack gas T & P and on a dry gas basis		9.75	m^3s^{-1}
Stack flow @ STP and on a wet gas basis		9.04	m^3s^{-1}
Stack flow @ STP, O_2 (ref) and on a wet gas basis		9.99	m^3s^{-1}
Gas vol. samp. @ STP and on a dry gas basis		0.50	m^3
Gas vol. samp. @ STP, O_2(ref), and on a dry gas basis		0.50	m^3
Gas vol. samp. @ STP and on a wet gas basis		0.50	m^3
Gas vol. samp. @ STP, O_2 (ref) and on a wet gas basis		0.50	m^3
Percentage Isokinicity		99	%

Test no	PM1		Site:	Paxford Composites	Stack Description:	SB3
Date	19-2-13	dd/mm/yy	Filter No:	12TF219	Absorber No(s):	T01, A-D
nozzle diameter	5.02	mm	Blank I.D.:	12TF218		
Stack Pres (with +/- above barometric if unknown enter zero)	0	mmH_20	SITE TEAM:	SDR & MRE		
			COMMENTS:	Particulates Test 1		
end volume reading	25.695	m^3			Control Box I.D. No:	AS0003
start volume reading	25.254	m^3	end time	16:15 hh:mm	Stack Thermocouple I.D. No.	AS0257A
volume sampled	0.44	m^3	start time	15:45 hh:mm	Probe I.D. No.	AS0257
Conditions	Value	Units	total time	00:30 hh:mm	Barometer I.D. No.	AS0300
			stop time	00:00 hh:mm	Pitot I.D. No.	AS0466
Stack pressure	763.75	mmHg	Diagram of Sample Location:			
Gas Meter Calibration Factor Y	1.0214					
Ref oxygen Value	21	%				
Moisture content	0.5	%				
CO	0	ppm				
CO_2	0	%				
N_2	79.05	%				
O_2	20.95	%				
dry molecular wt	28.84					
stack molecular wt	28.79					
Orifice ΔH@ Factor	41.70	mmH_20				
area of stack	0.59	m^2	LEAK CHECK			
Pbar	1018	mbar	Pre Vac (in Hg):	15	Post Vac (in Hg):	0.5
Pbar	763.8	mmHg				
pitot tube coeft	0.83		Leak rate (m^3/l) or (%):	<2%	Leak rate (m^3/l) or (%):	<2%
Reference Temp	273	K				
Reference Pressure	760	mmHg				

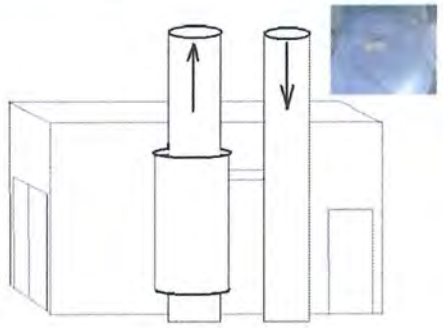


	Start Time at this Position or Setting hh: mm	volume reading at start m^3	Probe position	Time at each position / min	Δ p mm H_2O	Δ h mm H_2O	Stack Temp Ts °C	Probe Temp Tp °C	Oven Temp °C	Impinger Temp °C	Resin/Line °C	Meter in Tm(in) °C	Meter out Tm(out) °C	Vacuum in Hg
1:	15:45	25.2540	A3	5	22.00	30.8	26	158	N/A	13	N/A	22	22	0.5
2:	15:50	25.3610	A3	5	20.00	28.0	24	159	N/A	13	N/A	22	22	0.5
3:	15:55	25.4670	A2	5	16.00	22.4	23	159	N/A	14	N/A	22	22	0.5
4:	16:00	25.5460	A2	5	15.00	21.0	22	160	N/A	15	N/A	22	22	0.5
5:	16:05	25.6110	A1	5	6.00	8.4	30	160	N/A	15	N/A	22	22	0.5
6:	16:10	25.6540	A1	5	6.00	8.4	24	159	N/A	15	N/A	21	21	0.5
7:	16:15	25.6950	STOP											
8:														
9:														
10:														

	Start Time at this Position or Setting hh: mm	volume reading at start m^3	Probe position	Time at each position / min	Δ p mm H_2O	Δ h mm H_2O	Stack Temp Ts °C	Probe Temp Tp °C	Oven Temp °C	Impinger Temp °C	Resin/Line °C	Meter in Tm(in) °C	Meter out Tm(out) °C	Vacuum in Hg
11:														
12:														
13:														
14:														
15:														
	Summary values	**25.70**		**30**		**19.83**	**24.8**	**159.2**	**#DIV/0!**	**14.2**	**n/a**		**21.8**	**0.5**

Duct / Stack Flow Characteristics: **Test No**	**SB3** **PM1**		**Units**
Stack Velocity at stack gas T & P and a wet gas basis		12.35	ms^{-1}
Stack flow @ STP, O_2 (ref) and on a dry gas basis		6.68	m^3s^{-1}
Stack flow @ stack gas T & P and on a wet gas basis		7.29	m^3s^{-1}
Stack flow @ stack gas T & P and on a dry gas basis		7.25	m^3s^{-1}
Stack flow @ STP and on a wet gas basis		6.71	m^3s^{-1}
Stack flow @ STP, O_2 (ref) and on a wet gas basis		7.43	m^3s^{-1}
Gas vol. samp. @ STP and on a dry gas basis		0.42	m^3
Gas vol. samp. @ STP, O_2(ref), and on a dry gas basis		0.42	m^3
Gas vol. samp. @ STP and on a wet gas basis		0.42	m^3
Gas vol. samp. @ STP, O_2 (ref) and on a wet gas basis		0.42	m^3
Percentage Isokinicity		104	%

Test no	ISOCYANATES 1		Site:	Paxford Composites	Stack Description:	SB3
Date	19-2-13	dd/mm/yy	Filter No:	-	Absorber No(s):	T01, A-D
nozzle diameter	5.02	mm	Blank I.D.:	-		
Stack Pres (with +/- above barometric if unknown enter zero)	0	mmH_20	SITE TEAM:	SDR & MRE		
			COMMENTS:	Isocyanates Test 1		
end volume reading	26.104	m^3			Control Box I.D. No:	AS0003
start volume reading	25.700	m^3	end time	16:53 hh:mm	Stack Thermocouple I.D. No.	AS0257A
volume sampled	0.40	m^3	start time	16:23 hh:mm	Probe I.D. No.	AS0257
Conditions	Value	Units	total time	00:30 hh:mm	Barometer I.D. No.	AS0300
			stop time	00:00 hh:mm	Pitot I.D. No.	AS0466
Stack pressure	768.63	mmHg	Diagram of Sample Location:			
Gas Meter Calibration Factor Y	1.0214					
Ref oxygen Value	21	%				
Moisture content	0.9	%				
CO	0	ppm				
CO_2	0	%				
N_2	79.05	%				
O_2	20.95	%				
dry molecular wt	28.84					
stack molecular wt	28.74					
Orifice ΔH@ Factor	47.10	mmH_20				
area of stack	0.59	m^2	LEAK CHECK			
Pbar	1024.5	mbar	Pre Vac (in Hg):	15	Post Vac (in Hg):	1
Pbar	768.6	mmHg				
pitot tube coeft	0.83		Leak rate (m^3/l) or (%):	<2%	Leak rate (m^3/l) or (%):	<2%
Reference Temp	273	K				
Reference Pressure	760	mmHg				



	Start Time at this Position or Setting hh: mm	volume reading at start m^3	Probe position	Time at each position / min	Δ p mm H_2O	Δ h mm H_2O	Stack Temp Ts °C	Probe Temp Tp °C	Oven Temp °C	Impinger Temp °C	Resin/Line °C	Meter in Tm(in) °C	Meter out Tm(out) °C	Vacuum in Hg
1:	16:23	25.7000	A1	5	21.00	29.4	23	159	59	13	N/A	20	20	0.5
2:	16:28	25.7820	A2	5	20.00	28.0	29	161	N/A	13	N/A	21	21	0.5
3:	16:33	25.8630	A3	5	15.00	21.0	24	161	N/A	13	N/A	21	21	0.5
4:	16:38	25.9440	B1	5	15.00	21.0	29	160	N/A	15	N/A	21	21	0.5
5:	16:43	26.0160	B2	5	6.00	8.4	24	159	N/A	16	N/A	21	21	0.5
6:	16:48	26.0600	B3	5	6.20	8.7	29	160	N/A	16	N/A	20	20	0.5
7:	16:53	26.1040	END											
8:														
9:														
10:														

	Start Time at this Position or Setting hh: mm	volume reading at start m^3	Probe position	Time at each position / min	Δ p mm H_2O	Δ h mm H_2O	Stack Temp Ts °C	Probe Temp Tp °C	Oven Temp °C	Impinger Temp °C	Resin/Line °C	Meter in Tm(in) °C	Meter out Tm(out) °C	Vacuum in Hg
11:														
12:														
13:														
14:														
15:														
	Summary values	26.10		30		19.41	26.3	160.0	59.0	14.3	n/a		20.7	0.5

Duct / Stack Flow Characteristics: Test No	SB3 ISOCYANATES 1		Units
Stack Velocity at stack gas T & P and a wet gas basis		12.24	ms^{-1}
Stack flow @ STP, O_2 (ref) and on a dry gas basis		6.60	m^3s^{-1}
Stack flow @ stack gas T & P and on a wet gas basis		7.22	m^3s^{-1}
Stack flow @ stack gas T & P and on a dry gas basis		7.16	m^3s^{-1}
Stack flow @ STP and on a wet gas basis		6.66	m^3s^{-1}
Stack flow @ STP, O_2 (ref) and on a wet gas basis		7.39	m^3s^{-1}
Gas vol. samp. @ STP and on a dry gas basis		0.39	m^3
Gas vol. samp. @ STP, O_2(ref), and on a dry gas basis		0.39	m^3
Gas vol. samp. @ STP and on a wet gas basis		0.39	m^3
Gas vol. samp. @ STP, O_2 (ref) and on a wet gas basis		0.39	m^3
Percentage Isokinicity		97	%

2.2.7 - Moisture Calculations

National Physical Laboratory
Absorber Test Form

Test No	PM1
Date	20-2-13
pbar (mbar)	1025
pbar (mmHg):	769
nozzle diameter (mm)	5.02
Temp of Meter (in)/(out) deg. C	16
ΔH_{ave} (mmH_20)	18.0
Filter No (if app)	12TF223

Site	Paxford Composites
Stack	SB1
Site Team:	SDR & MRE
Data Entered By:	Simon Render

End Volume Reading	26.58	m^3
Start Volume reading	26.18	m^3
Volume Sampled	0.40	m^3

end time	11:06	hr:min
start time	10:36	hr:min
total time	00:30	hr:min

IMPINGER	1	2	3	4	5	6	7	Initials of Analyst
Absorber Solution (Type):	DI Water	DI Water	Empty	Silica Gel				MRE
Sample No:	T1/A	T1/B	T1/C	T1/D				MRE
Analysis Required:	H2O	H2O	H2O	H2O				MRE
Weight of jars plus absorber plus washings (g)								
Weight of Jars plus absorber after sampling (g)	814.6	825.4	593.3	839.8				MRE
Weight of Jars plus absorber (g)	829.6	815.5	593.6	832.9				MRE
Weight of Jars (g)	609.9	604.3	593.6	593.0				MRE
Weight Gain (g)	-15.0	9.9	-0.3	6.9				

Total Weight Gain (1+2+3+4) (g)	1.55

Gas Volume of water at 0°C (l)	1.93
Gas Meter volume at 0°C (l)	382.58

Moisture content of Gases (%)	0.5

NOTES:

at 0°C
Volume (l) of water in gas phase is Vwc= 1.2444 x wt of water collected (g)
Volume of gas sampled by meter (l) dry Vmc= 359.2 x gas meter reading(m^3) x (Pbar + delta H/13.6) / (meter temp +273)

moisture content (fraction) = Vwc/(Vwc+Vmc)

an approximation is: 1 m^3 of gas weighs approx 1.2 kg

$$\text{moisture content aprrox} = \frac{\text{wt of water collected (g)} \times 100}{\text{wt of water collected (g)} + (m^3 \text{ of gas on meter} \times 1200)}$$

National Physical Laboratory

Absorber Test Form

Test No	ISOCYANATE S 1
Date	20-2-13
pbar (mbar)	1025
pbar (mmHg):	769
nozzle diameter (mm)	5.02
Temp of Meter (in)/(out) deg. C	20
ΔH_{ave} (mmH_20)	18.3
Filter No (if app)	-

Site	Paxford Composites
Stack	SB1
Site Team:	SDR & MRE
Data Entered By:	Simon Render

End Volume Reading	26.99	m^3
Start Volume reading	26.58	m^3
Volume Sampled	0.41	m^3

end time	11:42	hr:min
start time	11:12	hr:min
total time	00:30	hr:min

IMPINGER	1	2	3	4	5	6	7	Initials of Analyst
Absorber Solution (Type):	DI Water	DI Water	Empty	Silica Gel				MRE
Sample No:	T1/A	T1/B	T1/C	T1/D				MRE
Analysis Required:	H2O	H2O	H2O	H2O				MRE
Weight of jars plus absorber plus washings (g)								
Weight of Jars plus absorber after sampling (g)	840.3	792.4	479.4	834.6				MRE
Weight of Jars plus absorber (g)	843.5	793.1	479.4	828.6				MRE
Weight of Jars (g)	645.3	585.6	479.4	585.5				MRE
Weight Gain (g)	-3.2	-0.6	0.0	6.0				

Total Weight Gain (1+2+3+4) (g)	2.09

Gas Volume of water at 0°C (l)	2.60
Gas Meter volume at 0°C (l)	389.36

Moisture content of Gases (%)	0.7

NOTES:

at 0°C
Volume (l) of water in gas phase is Vwc= 1.2444 x wt of water collected (g)
Volume of gas sampled by meter (l) dry Vmc= 359.2 x gas meter reading(m^3) x (Pbar + delta H/13.6) / (meter temp +273)

moisture content (fraction) = Vwc/(Vwc+Vmc)

an approximation is: 1 m^3 of gas weighs approx 1.2 kg

$$\text{moisture content aprrox} = \frac{\text{wt of water collected (g)} \times 100}{\text{wt of water collected (g)} + (m^3 \text{ of gas on meter} \times 1200)}$$

National Physical Laboratory
Absorber Test Form

Test No	PM1
Date	19-2-13
pbar (mbar)	1025
pbar (mmHg):	769
nozzle diameter (mm)	6.02
Temp of Meter (in)/(out) deg. C	20
ΔH_{ave} (mmH_20)	97.1
Filter No (if app)	12TF217

Site	Paxford Composites
Stack	SB2
Site Team:	SDR & MRE
Data Entered By:	Simon Render

End Volume Reading	24.67	m^3
Start Volume reading	23.68	m^3
Volume Sampled	0.99	m^3

end time	14:30	hr:min
start time	14:00	hr:min
total time	00:30	hr:min

IMPINGER	1	2	3	4	5	6	7	Initials of Analyst
Absorber Solution (Type):	DI Water	DI Water	Empty	Silica Gel				MRE
Sample No:	T1/A	T1/B	T1/C	T1/D				MRE
Analysis Required:	H2O	H2O	H2O	H2O				MRE
Weight of jars plus absorber plus washings (g)								
Weight of Jars plus absorber after sampling (g)	759.7	811.4	598.8	851.4				MRE
Weight of Jars plus absorber (g)	762.3	812.1	593.6	846.6				MRE
Weight of Jars (g)	609.9	604.3	593.6	593.0				MRE
Weight Gain (g)	-2.6	-0.7	5.2	4.8				

Total Weight Gain (1+2+3+4) (g)	6.7

Gas Volume of water at 0°C (l)	8.34
Gas Meter volume at 0°C (l)	940.61

Moisture content of Gases (%)	0.9

NOTES:

at 0°C
Volume (l) of water in gas phase is Vwc= 1.2444 x wt of water collected (g)
Volume of gas sampled by meter (l) dry Vmc= 359.2 x gas meter reading(m^3) x (Pbar + delta H/13.6) / (meter temp +273)

moisture content (fraction) = Vwc/(Vwc+Vmc)

an approximation is: 1 m^3 of gas weighs approx 1.2 kg

$$\text{moisture content aprrox} = \frac{\text{wt of water collected (g)} \times 100}{\text{wt of water collected (g)} + (m^3 \text{ of gas on meter} \times 1200)}$$

National Physical Laboratory

Absorber Test Form

Test No	ISOCYANATE S 1
Date	19-2-12
pbar (mbar)	1011
pbar (mmHg):	758
nozzle diameter (mm)	5.02
Temp of Meter (in)/(out) deg. C	23
ΔH_{ave} (mmH_20)	30.1
Filter No (if app)	-

Site	Paxford Composites
Stack	SB2
Site Team:	SDR & MRE
Data Entered By:	Simon Render

End Volume Reading	25.24	m^3
Start Volume reading	24.69	m^3
Volume Sampled	0.55	m^3

end time	15:20	hr:min
start time	14:50	hr:min
total time	00:30	hr:min

IMPINGER	1	2	3	4	5	6	7	Initials of Analyst
Absorber Solution (Type):	DI Water	DI Water	Empty	Silica Gel				MRE
Sample No:	T1/A	T1/B	T1/C	T1/D				MRE
Analysis Required:	H2O	H2O	H2O	H2O				MRE
Weight of jars plus absorber plus washings (g)								
Weight of Jars plus absorber after sampling (g)	833.8	790.6	479.4	846.0				MRE
Weight of Jars plus absorber (g)	840.3	792.4	479.4	834.6				MRE
Weight of Jars (g)	645.3	585.6	479.4	585.5				MRE
Weight Gain (g)	-6.5	-1.8	0	11.4				

Total Weight Gain (1+2+3+4) (g)	3.1

Gas Volume of water at 0°C (l)	3.86
Gas Meter volume at 0°C (l)	504.97

Moisture content of Gases (%)	0.8

NOTES:

at 0°C
Volume (l) of water in gas phase is Vwc= 1.2444 x wt of water collected (g)
Volume of gas sampled by meter (l) dry Vmc= 359.2 x gas meter reading(m^3) x (Pbar + delta H/13.6) / (meter temp +273)

moisture content (fraction) = Vwc/(Vwc+Vmc)

an approximation is: 1 m^3 of gas weighs approx 1.2 kg

$$\text{moisture content aprrox} = \frac{\text{wt of water collected (g)} \times 100}{\text{wt of water collected (g)} + (m^3 \text{ of gas on meter} \times 1200)}$$

National Physical Laboratory
Absorber Test Form

Test No	PM1
Date	19-2-13
pbar (mbar)	1018
pbar (mmHg):	764
nozzle diameter (mm)	5.02
Temp of Meter (in)/(out) deg. C	22
ΔH_{ave} (mmH_20)	19.8
Filter No (if app)	12TF219

Site	Paxford Composites
Stack	SB3
Site Team:	SDR & MRE
Data Entered By:	Simon Render

End Volume Reading	25.70	m^3
Start Volume reading	25.25	m^3
Volume Sampled	0.44	m^3

end time	16:15	hr:min
start time	15:45	hr:min
total time	00:30	hr:min

IMPINGER	1	2	3	4	5	6	7	Initials of Analyst
Absorber Solution (Type):	DI Water	DI Water	Empty	Silica Gel				MRE
Sample No:	T1/A	T1/B	T1/C	T1/D				MRE
Analysis Required:	H2O	H2O	H2O	H2O				MRE
Weight of jars plus absorber plus washings (g)								
Weight of Jars plus absorber after sampling (g)	757.3	810.9	598.8	855.8				MRE
Weight of Jars plus absorber (g)	759.7	811.4	598.8	851.4				MRE
Weight of Jars (g)	609.9	604.3	593.6	593.0				MRE
Weight Gain (g)	-2.4	-0.5	0	4.4				

Total Weight Gain (1+2+3+4) (g)	1.5

Gas Volume of water at 0°C (l)	1.87
Gas Meter volume at 0°C (l)	411.14

Moisture content of Gases (%)	0.5

NOTES:

at 0°C
Volume (l) of water in gas phase is Vwc= 1.2444 x wt of water collected (g)
Volume of gas sampled by meter (l) dry Vmc= 359.2 x gas meter reading(m^3) x (Pbar + delta H/13.6) / (meter temp +273)

moisture content (fraction) = Vwc/(Vwc+Vmc)

an approximation is: 1 m^3 of gas weighs approx 1.2 kg

$$\text{moisture content aprrox} = \frac{\text{wt of water collected (g)} \times 100}{\text{wt of water collected (g)} + (m^3 \text{ of gas on meter} \times 1200)}$$

National Physical Laboratory

Absorber Test Form

Test No	ISOCYANATE S 1
Date	19-2-13
pbar (mbar)	1025
pbar (mmHg):	769
nozzle diameter (mm)	5.02
Temp of Meter (in)/(out) deg. C	21
ΔH_{ave} (mmH_20)	19.4
Filter No (if app)	-

Site	Paxford Composites
Stack	SB3
Site Team:	SDR & MRE
Data Entered By:	Simon Render

End Volume Reading	26.10	m^3
Start Volume reading	25.70	m^3
Volume Sampled	0.40	m^3

end time	16:53	hr:min
start time	16:23	hr:min
total time	00:30	hr:min

IMPINGER	1	2	3	4	5	6	7	Initials of Analyst
Absorber Solution (Type):	DI Water	DI Water	Empty	Silica Gel				MRE
Sample No:	T1/A	T1/B	T1/C	T1/D				MRE
Analysis Required:	H2O	H2O	H2O	H2O				MRE
Weight of jars plus absorber plus washings (g)								
Weight of Jars plus absorber after sampling (g)	829.8	790.2	479.4	853.1				MRE
Weight of Jars plus absorber (g)	833.8	790.6	479.4	846.0				MRE
Weight of Jars (g)	645.3	585.6	479.4	585.5				MRE
Weight Gain (g)	-4.0	-0.4	0.0	7.1				

Total Weight Gain (1+2+3+4) (g)	2.7

Gas Volume of water at 0°C (l)	3.36
Gas Meter volume at 0°C (l)	380.54

Moisture content of Gases (%)	0.9

NOTES:

at 0°C
Volume (l) of water in gas phase is Vwc= 1.2444 x wt of water collected (g)
Volume of gas sampled by meter (l) dry Vmc= 359.2 x gas meter reading(m^3) x (Pbar + delta H/13.6) / (meter temp +273)

moisture content (fraction) = Vwc/(Vwc+Vmc)

an approximation is: 1 m^3 of gas weighs approx 1.2 kg

$$\text{moisture content aprrox} = \frac{\text{wt of water collected (g)} \times 100}{\text{wt of water collected (g)} + (m^3 \text{ of gas on meter} \times 1200)}$$

2.2.8 - Uncertainty Calculations

Uncertainty calculation for EN 13284 Determination of low range mass concentration of dust, Manual Gravimetric Method

Spray Booth One Test One

Limit value (ELV)	50	$mg.m^{-3}$	**Reference oxygen**	20.9	**% by volume**
Measured concentration	0.2	$mg.m^{-3}$ **(at reference conditions)**			

Measurement Equation

$$c = \frac{m}{V} f_c$$

Measured Quantities	Symbol	Value	Standard uncertainty		Units	Uncertainty as percentage	Uncertainty at lv	Requirement of std
Sampled Volume	V_m	0.40	uV_m	0.001	m^3	0.25		<=2%
Sampled gas Temperature	T_m	289	uTm	2	k	0.69		<=1%
Sampled gas Pressure	ρ_m	102.45	$u\rho_m$	1	kPa	0.98		<=1%
Sampled gas Humidity	H_m	0	uH_m	1	% by volume	1.00		<=1%
Mass particulate	m	0.4	um	0.23	mg	57.30	0.23	<5% of limit value
Note - Sampled gas humidity, temperature and pressure are values at the gas meter								
Leak	L	2			%	2.00		<=2%
Uncollected Mass (Instack filter - no rinse)	UCM	0			mg	0		<=10%

Intermediate calculations						
Factor for std conds	fs	0.95				
uncertainty components	symbol	sensitivity coeff	u (in units of fs)			
	ρ_m	0.009	0.009			
	H_m	0.010	0.010	$f_s = \frac{(100 - H_m)}{100} \frac{273}{T_m} \frac{\rho_m}{101.3}$		
	T_m	0.003	0.007			
	ufs		0.015			1.56
Corrected volume	V	0.38	uV 0.006	m^3	$V = V_m f_s$	1.58

Parameter		Value	Units	Sensitivity coeff	Uncertainty contribution	Uncertainty as %
Corrected Volume (standarc	V	0.38	m^3	0.52	0.00 $mg.m^{-3}$	1.58 %
Mass	m	0.40	mg	0.50	0.11 $mg.m^{-3}$	57.30 %
Leak	L	0.00	$mg.m^{-3}$	1.00	0.00 $mg.m^{-3}$	1.15 %
Uncollected mass	UCM	0.00	mg	0.50	0.00 $mg.m^{-3}$	0.00 %
Combined measurement uncertainty					**0.11** $mg.m^{-3}$	

Expanded uncertainty as percentage of measured value	**114.68**	**% measured of value**	**expressed with a level of confidence of 95% (Using a coverage factor k=2)**
Expanded uncertainty in units of measurement	**0.23**	$mg.m^{-3}$	
Expanded uncertainty as percentage of limit value	**0.46**	**% ELV**	

Uncertainty calculation for EN 13284 Determination of low range mass concentration of dust, Manual Gravimetric Method

Spray Booth Two Run One

Limit value (ELV)	50	$mg.m^{-3}$	**Reference oxygen**	20.9	**% by volume**
Measured concentration	9.41	$mg.m^{-3}$ **(at reference conditions)**			

Measurement Equation

$$c = \frac{m}{V} f_c$$

Measured Quantities	Symbol	Value	Standard uncertainty		Units	Uncertainty as percentage	Uncertainty at lv	Requirement of std
Sampled Volume	V_m	0.99	uV_m	0.001	m^3	0.10		<=2%
Sampled gas Temperature	T_m	293	uTm	2	k	0.68		<=1%
Sampled gas Pressure	ρ_m	102.45	$u\rho_m$	1	kPa	0.98		<=1%
Sampled gas Humidity	H_m	0	uH_m	1	% by volume	1.00		<=1%
Mass particulate	m	8.756666667	um	0.24	mg	2.71	0.51	<5% of limit value
Note - Sampled gas humidity, temperature and pressure are values at the gas meter								
Leak	L	2			%	2.00		<=2%
Uncollected Mass (Instack filter - no rinse)	UCM	0			mg	0		<=10%

Intermediate calculations						
Factor for std conds	fs	0.94				
uncertainty components	symbol	**sensitivity coeff**	**u (in units of fs)**			
	ρ_m	0.009	0.009			
	H_m	0.009	0.009	$f_s = \frac{(100 - H_m)}{100} \frac{273}{T_m} \frac{\rho_m}{101.3}$		
	T_m	0.003	0.006			
	ufs		0.015			1.56
Corrected volume	V	0.93	uV	0.015	m^3	$V = V_m f_s$ 1.56

Parameter		Value	Units	Sensitivity coeff	Uncertainty contribution	Uncertainty as %
Corrected Volume (standarc	V	0.93	m^3	10.10	0.15 $mg.m^{-3}$	1.56 %
Mass	m	8.76	mg	1.07	0.26 $mg.m^{-3}$	2.71 %
Leak	L	0.11	$mg.m^{-3}$	1.00	0.11 $mg.m^{-3}$	1.15 %
Uncollected mass	UCM	0.00	mg	1.07	0.00 $mg.m^{-3}$	0.00 %
Combined measurement uncertainty					**0.32** $mg.m^{-3}$	

Expanded uncertainty as percentage of measured value	6.75	**% measured of value**
Expanded uncertainty in units of measurement	0.64	$mg.m^{-3}$
Expanded uncertainty as percentage of limit value	1.27	**% ELV**

expressed with a level of confidence of 95%
(Using a coverage factor k=2)

Uncertainty calculation for EN 13284 Determination of low range mass concentration of dust, Manual Gravimetric Method

Spray Booth Three Run One

Limit value (ELV)	50	**mg.m^{-3}**	**Reference oxygen**	20.9	**% by volume**
Measured concentration	1.25	**mg.m^{-3} (at reference conditions)**			

Measurement Equation

$$c = \frac{m}{V} f_c$$

Measured Quantities	Symbol	Value	Standard uncertainty		Units	Uncertainty as percentage	Uncertainty at lv	Requirement of std
Sampled Volume	V_m	0.44	uV_m	0.001	m^3	0.23		<=2%
Sampled gas Temperature	T_m	295	uTm	2	k	0.68		<=1%
Sampled gas Pressure	ρ_m	101.8	$u\rho_m$	1	kPa	0.98		<=1%
Sampled gas Humidity	H_m	0	uH_m	1	% by volume	1.00		<=1%
Mass particulate	m	0.53	um	0.23	mg	43.53	1.09	<5% of limit value
Note - Sampled gas humidity, temperature and pressure are values at the gas meter								
Leak	L	2			%	2.00		<=2%
Uncollected Mass (Instack filter - no rinse)	UCM	0			mg	0		<=10%

Intermediate calculations						
Factor for std conds	fs	0.93			$f_s = \frac{(100 - H_m)}{100} \frac{273}{T_m} \frac{\rho_m}{101.3}$	
uncertainty components	symbol	sensitivity coeff	u (in units of fs)			
	ρ_m	0.009	0.009			
	H_m	0.009	0.009			
	T_m	0.003	0.006			
	ufs		0.014			1.56
Corrected volume	V	0.41	uV	0.006 m^3	$V = V_m f_s$	1.58

Parameter		Value	Units	Sensitivity coeff	Uncertainty contribution	Uncertainty as %
Corrected Volume (standarc	V	0.41	m^3	3.04	0.02 mg.m^{-3}	1.58 %
Mass	m	0.53	mg	2.37	0.54 mg.m^{-3}	43.53 %
Leak	L	0.01	mg.m^{-3}	1.00	0.01 mg.m^{-3}	1.15 %
Uncollected mass	UCM	0.00	mg	2.37	0.00 mg.m^{-3}	0.00 %
Combined measurement uncertainty					**0.54** mg.m^{-3}	

Expanded uncertainty as percentage of measured value	**87.15**	**% measured of value**	**expressed with a level of confidence of 95% (Using a coverage factor k=2)**
Expanded uncertainty in units of measurement	**1.09**	**mg.m^{-3}**	
Expanded uncertainty as percentage of limit value	**2.18**	**% ELV**	

Uncertainty calculation for Gaseous Measurement TOC to EN 12619:1999

Spray Booth One

Limit value	50	mg/m³ (corrected) TOC	**Cal gas conc**	85.1	mg.m⁻³ TOC
Measured concentration	5.2	mg/m3	**Full Scale**	161	mg/m³
Measured concentration	5.2	mg/m³ (Corrected)			

Correction for reference conditions					
		O2, %	**Moisture, %**	**Pressure, KPa**	**Temperature, K**
	ref	20.90	0.00	101.30	**273.00**
	measured	20.90	0.00	101.30	**273.00**
	Uncert	0.00	1.00	0.00	**1.00**
Factors		1.00	1.00	1.00	1.00
Uncertainty in factor		0.00	0.01	0.00	0.00
Correction Factor		**1.00**	uf	**0.01**	

Performance characteristics		**Value**			**specification**
Response time		20	seconds		60.000
Logger sampling interval		60	seconds		
Measurement period		31	minutes		
Number of readings in measurement		31			
Repeatability at zero		0.133	mg/m3		0.133 mg/m3
Repeatability at span level		0.15	mg/m3		0.2 mg/m3
Deviation from linearity(lack of fit)		0.4	mg/m3		< 0.4 mg/m3
Zero drift		0.2	mg/m3		0.4 mg/m3 (long term)
Span drift		1.54	mg/m3		0.7 mg/m3 (long term)
volume or pressure flow dependence		0.02	% of full scale/3 kPa		<2 % / 3 kPa
atmospheric pressure dependence		0.8	% of full scale/2 kPa		<3% / 2 kPa
ambient temperature dependence		0.01	mg/m3		0.5 mg/m3 /10k (at span)
O_2 (% vol)	20	0.2	mg/m³		0.8 mg/m3
SO2 (mg/m3)	260	0.2	mg/m³		sum of all effects of these interferents when taking all positive or all negative effects shall be less than 1 mg/m3
NO (mg/m3)	860	0.2	mg/m³		
NO2 (mg/m3)	150	0.2	mg/m³		
CO (mg/m3)	430	0.2	mg/m³		
CO2 (% vol)	18	0.2	mg/m³		
HCl (mg/m³)	40	0.2	mg/m³		
H2O (% vol)	20	0.2	mg/m³		
dependence on voltage		0.1	% full scale/10V		<2% range
Control gas reading difference		10	% of value		within 15% of test gas value (5 mg/m3)
losses in the line (leak)		1	% of value		< 0.1%vol /10 volt
Uncertainty of calibration gas		2.00	% of value		< 2% of value

Effect of drift
0.29 mg/m3
0.18 % full scale

	ranges min	max	value at calib	
flow	95.00	105	100	kPa
pressure	100.76	100.92	100.88	kPa
temp	287	288.5	287.5	K
O2 range	6	16	20	% vol
SO2 range	0	300	0	mg/m3
NO range	0	600	0	mg/m3
NO2 range	0	50	0	mg/m3
CO range	0	500	0	mg/m3
CO2 range	0	20	0	% vol
HCl range	0	5	0	mg/m3
H2O range	0	20	0	% vol
Voltage	93	121	110	V

Performance characteristic			**Uncertainty**	**Value of uncertainty quantity**		**mg/m3**
Standard deviation of repeatability at zero			u_{r0}	for mean		0.02
Standard deviation of repeatability at span level			u_{rs}	for mean		use rep at zero
Lack of fit			u_{fit}			0.23
Drift			u_{Odr}			0.17
volume or pressure flow dependence			u_{spres}			0.03
atmopsheric pressure dependence			u_{spres}			0.04
ambient temperature dependence			u_{temp}			0.00
O2			u_{inter}			0.11
SO2 (mg/m3)			u_{inter}			0.13
NO (mg/m3)			u_{inter}			0.08
NO2 (mg/m3)			u_{inter}			0.04
CO (mg/m3)			u_{inter}			0.13
CO2 (% vol)			u_{inter}			0.13
HCl (mg/m³)			u_{inter}			0.01
H2O (% vol)			u_{inter}			0.12
Dependence on voltage			u_{vol}			0.14
losses in the line (leak)			u_{leak}			0.03
Uncertainty of calibration gas			u_{calib}			0.06
control gas			$u_{control}$			0.30
Uncertainty in factor			uf			0.06

Use largest of sum of all positive or all negative influences

0.17	all +ves
0.00	all -ves
0.17	largest

Criteria
sum < 1 mg/m3
0.104459613

Value to use for interference uncertainty
u_{int} 0.17

Measurement uncertainty				
Combined uncertainty			0.48	mg/m³
Expanded uncertainty	k =	2	0.96	mg/m³
Uncertainty corrected to std conds			**0.96**	**mg/m³**
Expanded uncertainty	**expressed with a level of confidence of 95%**		**1.93**	**% ELV**
Expanded uncertainty	**expressed with a level of confidence of 95%**		**0.96**	**mg.m⁻³**
Expanded uncertainty	**expressed with a level of confidence of 95%**		**18.44**	**% value**

Uncertainty calculation for Gaseous Measurement TOC to EN 13526:2001

Spray Booth Two

Limit value	50	mg/m^3 (corrected) TOC	**Cal gas conc**	82.8	mg.m^{-3} TOC
Measured concentration	8.4	mg/m3	**Full Scale**	161	mg/m^3
Measured concentration	8.4	mg/m^3 (Corrected)			

Correction for reference conditions					
		O2, %	**Moisture, %**	**Pressure, KPa**	**Temperature, K**
	ref	20.95	0.00	101.30	**273.00**
	measured	20.95	0.00	101.30	**273.00**
	Uncert	0.00	1.00	0.00	**1.00**
Factors		1.00	1.00	1.00	1.00
Uncertainty in factor		0.00	0.01	0.00	0.00
Correction Factor		**1.00**	uf	**0.01**	

Performance characteristics		**Value**			**specification**
Response time		20	seconds		60.000
Logger sampling interval		60	seconds		
Measurement period		31	minutes		
Number of readings in measurement		31			
Repeatability at zero		0.133	mg/m3		0.133 mg/m3
Repeatability at span level		0.15	mg/m3		0.2 mg/m3
Deviation from linearity(lack of fit)		0.4	mg/m3		< 0.4 mg/m3
Zero drift		0.03	mg/m3		0.4 mg/m3 (long term)
Span drift		2.54	mg/m3		0.7 mg/m3 (long term)
volume or pressure flow dependence		0.02	% of full scale/3 kPa		<2 % / 3 kPa
atmospheric pressure dependence		0.8	% of full scale/2 kPa		<3% / 2 kPa
ambient temperature dependence		0.01	mg/m3		0.5 mg/m3 /10k (at span)
O_2 (% vol)	20	0.2	mg/m^3		0.8 mg/m3
SO2 (mg/m3)	260	0.2	mg/m^3		
NO (mg/m3)	860	0.2	mg/m^3		sum of all effects of these
NO2 (mg/m3)	150	0.2	mg/m^3		interferents when taking all
CO (mg/m3)	430	0.2	mg/m^3		positive or all negative
CO2 (% vol)	18	0.2	mg/m^3		effects shall be less than 1
HCl (mg/m^3)	40	0.2	mg/m^3		mg/m3
H2O (% vol)	20	0.2	mg/m^3		
dependence on voltage		0.1	% full scale/10V		<2% range
Control gas reading difference		10	% of value		within 15% of test gas value (5 mg/m3)
losses in the line (leak)		1	% of value		< 0.1%vol /10 volt
Uncertainty of calibration gas		2.00	% of value		< 2% of value

Effect of drift	
0.29	mg/m3
0.18	% full scale

	ranges min	max	value at calib	
flow	95.00	105	100	kPa
pressure	100.76	100.92	100.88	kPa
temp	287	288.5	287.5	K
O2 range	6	18	20	% vol
SO2 range	0	300	0	mg/m3
NO range	0	600	0	mg/m3
NO2 range	0	50	0	mg/m3
CO range	0	500	0	mg/m3
CO2 range	0	20	0	% vol
HCl range	0	5	0	mg/m3
H2O range	0	20	0	% vol
Voltage	93	121	110	V

Performance characteristic		**Uncertainty**	**Value of uncertainty quantity**		**mg/m3**
Standard deviation of repeatability at zero		u_{rp}	for mean		0.02
Standard deviation of repeatability at span level		u_{rs}	for mean		use rep at zero
Lack of fit		u_{fit}			0.23
Drift		u_{Ddr}			0.17
volume or pressure flow dependence		u_{spres}			0.03
atmopsheric pressure dependence		u_{spres}			0.04
ambient temperature dependence		u_{temp}			0.00
O2		u_{intef}			0.11
SO2 (mg/m3)		u_{intef}			0.13
NO (mg/m3)		u_{intef}			0.08
NO2 (mg/m3)		u_{intef}			0.04
CO (mg/m3)		u_{intef}			0.13
CO2 (% vol)		u_{intef}			0.13
HCl (mg/m^3)		u_{intef}			0.01
H2O (% vol)		u_{intef}			0.12
Dependence on voltage		u_{volt}			0.14
losses in the line (leak)		u_{leak}			0.05
Uncertainty of calibration gas		u_{calib}			0.10
control gas		u_{consol}			0.49
Uncertainty in factor		uf			0.09

Use largest of sum of all positive or all negative influences

0.17	all +ves	Criteria
0.00	all -ves	sum < 1 mg/m3
0.17	largest	0.168079742

Value to use for interference uncertainty
u_{int} 0.17

Measurement uncertainty				
Combined uncertainty			0.62	mg/m^3
Expanded uncertainty	k =	2	1.23	mg/m^3
Uncertainty corrected to std conds			**1.24**	**mg/m^3**
Expanded uncertainty	**expressed with a level of confidence of 95%**		**2.49**	**% ELV**
Expanded uncertainty	**expressed with a level of confidence of 95%**		**1.24**	**mg.m^{-3}**
Expanded uncertainty	**expressed with a level of confidence of 95%**		**14.81**	**% value**

Uncertainty calculation for Gaseous Measurement TOC to EN 12619:1999

Spray Booth Three

Limit value	50	mg/m^3 (corrected) TOC	**Cal gas conc**	82.8	mg.m^{-3} TOC
Measured concentration	40.8	mg/m3	**Full Scale**	1605	mg/m^3
Measured concentration	40.8	mg/m^3 (Corrected)			

Correction for reference conditions					
		O2, %	**Moisture, %**	**Pressure, KPa**	**Temperature, K**
	ref	20.95	0.00	101.30	**273.00**
	measured	20.95	0.00	101.30	**273.00**
	Uncert	0.00	1.00	0.00	**1.00**
Factors		1.00	1.00	1.00	1.00
Uncertainty in factor		0.00	0.01	0.00	0.00
Correction Factor		**1.00**	uf	**0.01**	

Performance characteristics		**Value**			**specification**
Response time		20	seconds		60.000
Logger sampling interval		60	seconds		
Measurement period		31	minutes		
Number of readings in measurement		31			
Repeatability at zero		0.133	mg/m3		0.133 mg/m3
Repeatability at span level		0.15	mg/m3		0.2 mg/m3
Deviation from linearity(lack of fit)		0.4	mg/m3		< 0.4 mg/m3
Zero drift		0.17	mg/m3		0.4 mg/m3 (long term)
Span drift		0.33	mg/m3		0.7 mg/m3 (long term)
volume or pressure flow dependence		0.02	% of full scale/3 kPa		<2 % / 3 kPa
atmospheric pressure dependence		0.8	% of full scale/2 kPa		<3% / 2 kPa
ambient temperature dependence		0.01	mg/m3		0.5 mg/m3 /10k (at span)
O_2 (% vol)	20	0.2	mg/m^3		0.8 mg/m3
SO2 (mg/m3)	260	0.2	mg/m^3		
NO (mg/m3)	860	0.2	mg/m^3		sum of all effects of these
NO2 (mg/m3)	150	0.2	mg/m^3		interferents when taking all
CO (mg/m3)	430	0.2	mg/m^3		positive or all negative
CO2 (% vol)	18	0.2	mg/m^3		effects shall be less than 1
HCl (mg/m^3)	40	0.2	mg/m^3		mg/m3
H2O (% vol)	20	0.2	mg/m^3		
dependence on voltage		0.1	% full scale/10V		<2% range
Control gas reading difference		10	% of value		within 15% of test gas value (5 mg/m3)
losses in the line (leak)		1	% of value		< 0.1%vol /10 volt
Uncertainty of calibration gas		2.00	% of value		< 2% of value

Effect of drift
0.33 mg/m3
0.02 % full scale

	ranges min	max	value at calib	
flow	95.00	105	100	kPa
pressure	100.76	100.92	100.88	kPa
temp	287	288.5	287.5	K
O2 range	6	16	20	% vol
SO2 range	0	300	0	mg/m3
NO range	0	600	0	mg/m3
NO2 range	0	50	0	mg/m3
CO range	0	500	0	mg/m3
CO2 range	0	20	0	% vol
HCl range	0	5	0	mg/m3
H2O range	0	20	0	% vol
Voltage	93	121	110	V

Performance characteristic			**Uncertainty**	**Value of uncertainty quantity**		**mg/m3**
Standard deviation of repeatability at zero			u_{rep}	for mean		0.02
Standard deviation of repeatability at span level			u_{rs}	for mean		use rep at zero
Lack of fit			u_{fit}			0.23
Drift			u_{Odr}			0.19
volume or pressure flow dependence			u_{spres}			0.31
atmopsheric pressure dependence			u_{apres}			0.39
ambient temperature dependence			u_{temp}			0.00
O2			u_{interf}			0.11
SO2 (mg/m3)			u_{interf}			0.13
NO (mg/m3)			u_{interf}			0.08
NO2 (mg/m3)			u_{interf}			0.04
CO (mg/m3)			u_{interf}			0.13
CO2 (% vol)			u_{interf}			0.13
HCl (mg/m^3)			u_{interf}			0.01
H2O (% vol)			u_{interf}			0.12
Dependence on voltage			u_{volt}			1.38
losses in the line (leak)			u_{leak}			0.24
Uncertainty of calibration gas			u_{calib}			0.47
control gas			$u_{control}$			2.36
Uncertainty in factor			uf			0.43

Use largest of sum of all positive or all negative influences

0.17	all +ves
0.00	all -ves
0.17	largest

Criteria
sum < 1 mg/m3
0.816815565

Value to use for interference uncertainty
u_{int} 0.17

Measurement uncertainty				
Combined uncertainty			2.85	mg/m^3
Expanded uncertainty	k =	2	5.70	mg/m^3
Uncertainty corrected to std conds			**5.77**	**mg/m^3**
Expanded uncertainty	**expressed with a level of confidence of 95%**		**11.53**	**% ELV**
Expanded uncertainty	**expressed with a level of confidence of 95%**		**5.77**	**mg.m^{-3}**
Expanded uncertainty	**expressed with a level of confidence of 95%**		**14.12**	**% value**

2.2.9 - Analytical Results

2.2.9 Analytical Laboratory Details

	Isocyanates
Analytical Laboratory	RPS Laboratories
UKAS Lab Number	0605
Analytical Method	HPLC
Accreditation	UKAS
Date of Analysis	25/02/2013

2.2.10 - Calculations Used in Reporting Results

Nozzle Selection

For isokinetic sampling, the pressure difference of the orifice meter must equal the pressure difference of the Pitot tube pressure multiplied by the K-factor. Where:

$$K = \text{Constant} \times C_p^2 \times D_n^4 \times DH_@ \times \left(\frac{M_d}{M_s}\right)\left(\frac{1-B_{wm}}{1-B_{ws}}\right)^2\left(\frac{T_m+273}{T_s+273}\right)\left(\frac{P_s}{P_m}\right)$$

$$DH = K \times Dp$$

Where:-

Constant: is a constant dependent on the units used to measure the nozzle (8.038×10^{-5} for mm)

D_n the nozzle diameter mm

$DH_@$ a constant dependent on the sampler control box orifice and gas meter

B_{ws} the percent water vapour in the emission as a fraction i.e.12% = 0.12

B_{wm} the percentage water vapour in the air around the meter box often assumed to be zero

C_p Pitot tube coefficient dependent on the Pitot tube type

T_m the meter temperature in °C

T_s the stack temperature in °C

P_s the stack pressure

P_m the meter pressure

M_d dry gas molecular weight

M_s apparent stack gas molecular weight

DH pressure drop across the orifice (mm water)

DP differential Pitot pressure (mm water)

From this the correct nozzle size can be determined.

$$D_n = \sqrt{\left(\frac{\text{Constant}.Q_m.P_m}{(T_m+273)C_p}\right)\left(\frac{1-B_{wm}}{1-B_{ws}}\right)\sqrt{\frac{(T_s+273)M_s}{(P_s.(\Delta P)_{avg})}}}$$

Where the Constant = 0.6071 Metric

Qm = Orifice flow rate normally 21.2 actual $lmin^{-1}$

$$= K_m\sqrt{\frac{(T_m+273)\Delta H}{P_m M_m}}$$

Where Km =Orifice meter coefficient

$$Km = Qm\sqrt{\frac{P_m M_m}{\Delta H(T_m+273)}} = Const\sqrt{\frac{1}{\Delta H_@}}$$

Where Const = 183.7 metric

Moisture Determination Calculations

These calculations are based at 273K and 101.325kPa

To calculate moisture the following equation is used:

$$B_{ws} = \frac{0.001245 \times W_1 \times 100}{(0.001245 \times W_1) + 0.359V_m \left(\frac{P_b + \frac{\Delta H_{avg}}{13.6}}{(T_m + 273)} \right)}$$

Particulate Concentration C_s in stack Gases
At 273K and 101.325kPa and dry gas

$$C_s = \frac{W_t}{V_m} \times \frac{T_m + 273}{273} \times \frac{760}{\left(P_b + \frac{\Delta H_{avg}}{13.6} \right)} \times 1000 \quad mg/Nm^3$$

Oxygen Concentration Correction C_{oxy} to Particulate concentration

$$C_{oxy} = C \times \frac{(20.9 - \%O_2 ref)}{(20.9 - \%O_2 Meas)} \quad mg/Nm^3$$

Dry Molecular Weight of gases

$M_D = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N)$

Stack Molecular Weight of gases

$$M_s = 0.18(B_{ws}) + \frac{M_d}{100}(100 - B_{ws})$$

Stack Gas Velocity

$$(V_s)_{avg} = 34.96 \times C_p \times \sqrt{(\Delta P)_{avg}} \sqrt{\frac{T_s + 273}{P_s M_s}} \quad m/s$$

Mass Emission Rate M_R

$$M_R = \frac{C_m \times (V_s)_{avg} \times A \times 3600}{10^6} \quad kg/hr$$

IsoKinicity

$$I = \frac{2.12 \times 10^{8} \times Vm \times Y \times \left(P_b + \left(\frac{\Delta H_{avg}}{13.6} \right) \right) \left(\frac{273 + T_s}{273 + T_m} \right)}{\Theta P_s \pi D_n^2 (Vs)avg \left(100 - B_{ws}\right)} \%$$

W_I = the weight change of the impingers during sampling in g
V_m = volume of dry gas sample in litres at temperature of the meter box
B_{ws} = the percent water vapour in the emission
Q = length of time sampling in minutes
Y = Gas Meter Calibration correction factor
Vs = Velocity of stack gas m/s
C_M = measured concentration of particulate matter (mg/m^3)
T_m = average temperature at dry gas meter ($^{\circ}C$)
P_b = atmospheric pressure (mmHg)
$\%O_{2ref}$ = % oxygen at standard temperature & pressure
$\%O_{2Meas}$ = % oxygen measured on site
C_P = Pitot tube coefficient
DP = mean differential Pitot pressure drop (mm H_2O)
DH = mean orifice pressure drop (mm H_2O)
D_s = diameter of stack (m)
D_n = Nozzle diameter (mm)
T_s = stack temperature ($^{\circ}C$)
M_d = molecular weight of dry stack gas
B_W = moisture fraction
P_s = stack pressure (mmHg)
A = duct c.s.a. (m^2)
M_s = molecular weight of wet stack gas
M_d = molecular weight of dry stack gas
W_t = total weight of particulate matter (g)