

2.2.4 - Gas Calibration Log

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

GAS CALIBRATION LOG

Client:	Paxford Composites	Date:	14/02/2012	Horiba ID:	N/A
Site:	Huntingdon	Job Number:	PX04FEB12	FID ID:	AS0234
Stack ID:	Spray Booth One	Mobile Lab ID:	BD09 WUR	Sonimix ID:	N/A
Reference Oxygen %	N/A	Nitrogen Cylinder ID:	N/A	Initial N ₂ pressure psi	500

PRE CALIBRATION

	VOCs	CO	NOx	O ₂	CO ₂
Gas Cylinder ID:	162576				
Initial Reg. Pressure psi	2000				
Cylinder Concentration:	51.6 ppm C ₃ H ₈				
Span Value:	51.6 ppm C ₃ H ₈				
Analyser Range:0 -	100 ppm C ₃ H ₈				
Check Zero	Time	08:30			
	Reading	-0.016 ppm C ₃ H ₈			
	Initial Gain	4.71			
Adjust Zero	Time	08:31			
	Reading	0.0007 ppm C ₃ H ₈			
	Final Gain	4.79			
Check Span	Time	08:33			
	Reading	54.92 ppm C ₃ H ₈			
	Initial Gain	4.61			
	Response Time/s	15			
Adjust Span	Time	08:35			
	Reading	51.6 ppm C ₃ H ₈			
	Final Gain	4.350			
Check Zero	Time	08:38			
	Reading	0.02 ppm C ₃ H ₈			
Two x Zero Repeatability		PASS			

POST CALIBRATION

	VOCs	CO	NOx	O ₂	CO ₂
Span Value:	51.6 ppm C ₃ H ₈				
Check Zero	Time	09:36			
	Reading	0.05 ppm C ₃ H ₈			
Check Span	Time	09:38			
	Reading	51.74 ppm C ₃ H ₈			
	Reg Pressure	2000			
Check Zero	Time	09:40			
	Reading	0.03 ppm C ₃ H ₈			
	Reg Pressure	500			
Zero Drift (%)		0.05			
Span Drift (%)		0.23			
		Accept			

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

Name:	Matthew Ellison	MCERTS ID:	MM-05-682	Personnel Present:	Matthew Ellison & Kevin Blakley
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GAS CALIBRATION LOG

Client:	Paxford Composites	Date:	14/02/2012	Horiba ID:	N/A
Site:	Huntingdon	Job Number:	PX04FEB12	FID ID:	AS0234
Stack ID:	Spray Booth Two	Mobile Lab ID:	BD09 WUR	Sonimix ID:	N/A
Reference Oxygen %	N/A	Nitrogen Cylinder ID:	N/A	Initial N ₂ pressure psi	500

PRE CALIBRATION

	VOCs	CO	NOx	O ₂	CO ₂
Gas Cylinder ID:	162576				
Initial Reg. Pressure psi	2000				
Cylinder Concentration:	51.6 ppm C ₃ H ₈				
Span Value:	51.6 ppm C ₃ H ₈				
Analyser Range:0 -	100 ppm C ₃ H ₈				
Check Zero	Time	10:56			
	Reading	0.087 ppm C ₃ H ₈			
	Initial Gain	4.79			
Adjust Zero	Time	10:57			
	Reading	0.004 ppm C ₃ H ₈			
	Final Gain	4.73			
Check Span	Time	10:59			
	Reading	51.26 ppm C ₃ H ₈			
	Initial Gain	4.35			
	Response Time/s	15			
Adjust Span	Time	11:01			
	Reading	51.610 ppm C ₃ H ₈			
	Final Gain	4.42			
Check Zero	Time	11:03			
	Reading	0.0004 ppm C ₃ H ₈			
Two x Zero Repeatability		PASS			

POST CALIBRATION

	VOCs	CO	NOx	O ₂	CO ₂
Span Value:	51.6 ppm C ₃ H ₈				
Check Zero	Time	13:24			
	Reading	0.00 ppm C ₃ H ₈			
Check Span	Time	13:26			
	Reading	50.81 ppm C ₃ H ₈			
	Reg Pressure	2000			
Check Zero	Time	13:27			
	Reading	0.00 ppm C ₃ H ₈			
	Reg Pressure	500			
Zero Drift (%)		0.0			
Span Drift (%)		1.6			
		Accept			

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

Name:	Matthew Ellison	MCERTS ID:	MM-05-682	Personnel Present:	Matthew Ellison & Kevin Blakley
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NATIONAL PHYSICAL LABORATORY
Continuation Sheet

GAS CALIBRATION LOG

Client:	Paxford Composites	Date:	14/02/2012	Horiba ID:	N/A
Site:	Huntingdon	Job Number:	PX04FEB12	FID ID:	AS0234
Stack ID:	Spray Booth Two	Mobile Lab ID:	BD09 WUR	Sonimix ID:	N/A
Reference Oxygen %	N/A	Nitrogen Cylinder ID:	N/A	Initial N ₂ pressure psi	500

PRE CALIBRATION

	VOCs	CO	NOx	O ₂	CO ₂
Gas Cylinder ID:	162576				
Initial Reg. Pressure psi	2000				
Cylinder Concentration:	51.6 ppm C ₃ H ₈				
Span Value:	51.6 ppm C ₃ H ₈				
Analyser Range:0 -	100 ppm C ₃ H ₈				
Check Zero	Time	14:07			
	Reading	0.036 ppm C ₃ H ₈			
	Initial Gain	4.73			
Adjust Zero	Time	14:08			
	Reading	0.00 ppm C ₃ H ₈			
	Final Gain	4.80			
Check Span	Time	14:09			
	Reading	45.450 ppm C ₃ H ₈			
	Initial Gain	4.42			
	Response Time/s	15			
Adjust Span	Time	14:10			
	Reading	51.50 ppm C ₃ H ₈			
	Final Gain	5.28			
Check Zero	Time	14:12			
	Reading	0.0003 ppm C ₃ H ₈			
Two x Zero Repeatability	PASS				

POST CALIBRATION

	VOCs	CO	NOx	O ₂	CO ₂
Span Value:	51.6 ppm C ₃ H ₈				
Check Zero	Time	15:16			
	Reading	0.03 ppm C ₃ H ₈			
Check Span	Time	15:19			
	Reading	51.20 ppm C ₃ H ₈			
	Reg Pressure	2000			
Check Zero	Time	15:21			
	Reading	0.02 ppm C ₃ H ₈			
	Reg Pressure	500			
Zero Drift (%)	0.03				
Span Drift (%)	0.58				
	Accept				

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

Name:	Matthew Ellison	MCERTS ID:	MM-05-682	Personnel Present:	Matthew Ellison & Kevin Blakley
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2.2.5 - Particulate Summary Sheets

SB1 Particulates Results Summary

Field	Units	Blank	TEST 1
Date	dd/mm/yyyy	14/02/2012	14/02/2012
Test No.		Blank	PM1
Filter No.		11TF197	11TF191
Stack Description		SB1	SB1
Start Time	hh:mm	-	09:00
End Time	hh:mm	-	09:30
Total Time	min	-	30
Stack Temp.	C	-	22
Gas Meter Temp	C	-	22
Gas Meter Pressure	kPa	-	102.5
Filter	mg	<0.2	1.7
Washings	mg	<0.2	1.2
TOTAL Mass Collected	mg	<0.2	2.9
Test H ₂ O	% Vol	-	0.4
Stack Pressure	kPa	-	102.5
Nozzle Diameter	mm	-	5.8
Duct Area	m ²	-	0.47
Isokinicity	%	-	100
Stack Velocity	Stack T & P, uncorrected, ms ⁻¹	-	10.11
Gas Vol. Sampled	Dry Gas Basis, Ambient T and P	-	0.49
Gas Vol. Sampled	Wet Gas Basis, Standard T and P	-	0.45
Particulate Concentration	Wet Gas Basis, Standard T and P, mg Nm ⁻³	<0.2	6.4
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, %	-	13
Mass Emission	Wet Gas Basis, Standard T and P, g s ⁻¹	-	0.1

SB2 Particulates Results Summary

Field	Units	Blank	TEST 1
Date	dd/mm/yyyy	14/02/2012	14/02/2012
Test No.		Blank	PM1
Filter No.		11TF196	11TF192
Stack Description		SB2	SB2
Start Time	hh:mm	-	11:30
End Time	hh:mm	-	12:00
Total Time	min	-	30
Stack Temp.	C	-	20
Gas Meter Temp	C	-	24
Gas Meter Pressure	kPa	-	102.5
Filter	mg	<0.2	2.5
Washings	mg	<0.2	1.1
TOTAL Mass Collected	mg	<0.2	3.6
Test H ₂ O	% Vol	-	0.3
Stack Pressure	kPa	-	102.5
Nozzle Diameter	mm	-	5.8
Duct Area	m ²	-	0.64
Isokinicity	%	-	97
Stack Velocity	Stack T & P, uncorrected, ms ⁻¹	-	17.33
Gas Vol. Sampled	Dry Gas Basis, Ambient T and P	-	0.82
Gas Vol. Sampled	Wet Gas Basis, Standard T and P	-	0.75
Particulate Concentration	Wet Gas Basis, Standard T and P, mg Nm ⁻³	<0.2	4.8
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, %	-	10
Mass Emission	Wet Gas Basis, Standard T and P, g s ⁻¹	-	0.1

SB3 Particulates Results Summary

Field	Units	Blank	TEST 1
Date	dd/mm/yyyy	14/02/2012	14/02/2012
Test No.		Blank	PM1
Filter No.		11TF195	11TF193
Stack Description		SB3	SB3
Start Time	hh:mm	-	14:15
End Time	hh:mm	-	14:45
Total Time	min	-	30
Stack Temp.	C	-	21
Gas Meter Temp	C	-	24
Gas Meter Pressure	kPa	-	102.5
Filter	mg	<0.2	-0.1
Washings	mg	<0.2	0.4
TOTAL Mass Collected	mg	<0.2	0.3
Test H ₂ O	% Vol	-	0.6
Stack Pressure	kPa	-	102.5
Nozzle Diameter	mm	-	5.8
Duct Area	m ²	-	0.59
Isokinicity	%	-	105
Stack Velocity	Stack T & P, uncorrected, ms ⁻¹	-	6.39
Gas Vol. Sampled	Dry Gas Basis, Ambient T and P	-	0.33
Gas Vol. Sampled	Wet Gas Basis, Standard T and P	-	0.30
Particulate Concentration	Wet Gas Basis, Standard T and P, mg Nm ⁻³	<0.2	1.0
Expanded Uncertainty	+/-mg Nm ⁻³ , 95% Conf. k=2	-	1.5
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	-	0.01

2.2.6 - Moisture Calculations

National Physical Laboratory
Absorber Test Form

Test No	PM1
Date	14-2-12
pbar (mbar)	1025
pbar (mmHg):	769
nozzle diameter (mm)	5.80
Temp of Meter (in)/(out) deg. C	22
ΔH_{avo} (mmH ₂ O)	26.4
Filter No (if app)	11TF191

Site	Paxford Composites
Stack	SB1
Site Team:	KCB & MRE
Data Entered By:	Kevin Blakley

End Volume Reading	471.60	m ³
Start Volume reading	471.12	m ³
Volume Sampled	0.49	m ³

end time	09:30	hr:min
start time	09:00	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)	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
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Gas Volume of water at 0°C (l)	1.93
Gas Meter volume at 0°C (l)	455.88

Moisture content of Gases (%)	0.4
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NOTES:

at 0°C

Volume (l) of water in gas phase is $V_{wc} = 1.2444 \times \text{wt of water collected (g)}$

Volume of gas sampled by meter (l) dry $V_{mc} = 359.2 \times \text{gas meter reading (m}^3) \times (\text{Pbar} + \Delta H/13.6) / (\text{meter temp} + 273)$

moisture content (fraction) = $V_{wc}/(V_{wc}+V_{mc})$

an approximation is: 1 m³ of gas weighs approx 1.2 kg

moisture content approx =

$\text{wt of water collected (g)} \times 100$

$\text{wt of water collected (g)} + (\text{m}^3 \text{ of gas on meter} \times 1200)$

National Physical Laboratory
Absorber Test Form

Test No	ISOCYANATE S 1
Date	14-2-12
pbar (mbar)	1025
pbar (mmHg):	769
nozzle diameter (mm)	5.80
Temp of Meter (in)/(out) deg. C	26
ΔH_{ave} (mmH ₂ O)	23.4
Filter No (if app)	-

Site	Paxford Composites
Stack	SB1
Site Team:	KCB & MRE
Data Entered By:	Kevin Blakley

End Volume Reading	472.10	m ³
Start Volume reading	471.61	m ³
Volume Sampled	0.49	m ³

end time	10:15	hr:min
start time	09:45	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)	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
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Gas Volume of water at 0°C (l)	2.60
Gas Meter volume at 0°C (l)	451.08

Moisture content of Gases (%)	0.6
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NOTES:

at 0°C
Volume (l) of water in gas phase is $V_{wc} = 1.2444 \times \text{wt of water collected (g)}$
Volume of gas sampled by meter (l) dry $V_{mc} = 359.2 \times \text{gas meter reading (m}^3) \times (\text{Pbar} + \Delta H/13.6) / (\text{meter temp} + 273)$

moisture content (fraction) = $V_{wc}/(V_{wc}+V_{mc})$

an approximation is: 1 m³ of gas weighs approx 1.2 kg

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

National Physical Laboratory
Absorber Test Form

Test No	PM1
Date	14-2-12
pbar (mbar)	1025
pbar (mmHg):	769
nozzle diameter (mm)	5.80
Temp of Meter (in)/(out) deg. C	24
ΔH_{avo} (mmH ₂ O)	79.4
Filter No (if app)	11TF192

Site	Paxford Composites
Stack	SB2
Site Team:	KCB & MRE
Data Entered By:	Kevin Blakley

End Volume Reading	472.92	m ³
Start Volume reading	472.10	m ³
Volume Sampled	0.82	m ³

end time	12:00	hr:min
start time	11:30	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:	HCL	HCL	H2O	H2O				MRE
Weight of jars plus absorber plus washings (g)								
Weight of Jars plus absorber after sampling (g)	759.7	811.4	652.3	851.4				MRE
Weight of Jars plus absorber (g)	814.6	825.4	593.3	839.8				MRE
Weight of Jars (g)	609.9	604.3	593.6	593.0				MRE
Weight Gain (g)	-54.9	-14.0	59.0	11.6				

Total Weight Gain (1+2+3+4) (g)	1.7
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Gas Volume of water at 0°C (l)	2.12
Gas Meter volume at 0°C (l)	764.34

Moisture content of Gases (%)	0.3
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NOTES:

at 0°C

Volume (l) of water in gas phase is $V_{wc} = 1.2444 \times \text{wt of water collected (g)}$

Volume of gas sampled by meter (l) dry $V_{mc} = 359.2 \times \text{gas meter reading (m}^3\text{)} \times (\text{Pbar} + \Delta H/13.6) / (\text{meter temp} + 273)$

moisture content (fraction) = $V_{wc}/(V_{wc}+V_{mc})$

an approximation is: 1 m³ of gas weighs approx 1.2 kg

moisture content approx =

wt of water collected (g) x 100

wt of water collected (g) + (m³ of gas on meter x 1200)

National Physical Laboratory
Absorber Test Form

Test No	ISOCYANATE S 1
Date	14-2-12
pbar (mbar)	1025
pbar (mmHg):	769
nozzle diameter (mm)	5.80
Temp of Meter (in)/(out) deg. C	27
ΔH_{ave} (mmH ₂ O)	73.3
Filter No (if app)	-

Site	Paxford Composites
Stack	SB2
Site Team:	KCB & MRE
Data Entered By:	Kevin Blakley

End Volume Reading	473.80	m ³
Start Volume reading	472.93	m ³
Volume Sampled	0.87	m ³

end time	12:50	hr:min
start time	12:20	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:	HCL	HCL	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
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Gas Volume of water at 0°C (l)	3.86
Gas Meter volume at 0°C (l)	808.15

Moisture content of Gases (%)	0.5
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NOTES:

at 0°C

Volume (l) of water in gas phase is $V_{wc} = 1.2444 \times \text{wt of water collected (g)}$

Volume of gas sampled by meter (l) dry $V_{mc} = 359.2 \times \text{gas meter reading (m}^3\text{)} \times (\text{Pbar} + \Delta H/13.6) / (\text{meter temp} + 273)$

moisture content (fraction) = $V_{wc}/(V_{wc}+V_{mc})$

an approximation is: 1 m³ of gas weighs approx 1.2 kg

moisture content approx =

wt of water collected (g) x 100

wt of water collected (g) + (m³ of gas on meter x 1200)

National Physical Laboratory
Absorber Test Form

Test No	PM1
Date	14-2-12
pbar (mbar)	1025
pbar (mmHg):	769
nozzle diameter (mm)	5.80
Temp of Meter (in)/(out) deg. C	24
ΔH_{ave} (mmH ₂ O)	10.1
Filter No (if app)	11TF193

Site	Paxford Composites
Stack	SB3
Site Team:	KCB & MRE
Data Entered By:	Kevin Blakley

End Volume Reading	474.17	m ³
Start Volume reading	473.84	m ³
Volume Sampled	0.33	m ³

end time	14:45	hr:min
start time	14:15	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:	HCL	HCL	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
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Gas Volume of water at 0°C (l)	1.87
Gas Meter volume at 0°C (l)	303.18

Moisture content of Gases (%)	0.6
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NOTES:

at 0°C
Volume (l) of water in gas phase is $V_{wc} = 1.2444 \times \text{wt of water collected (g)}$
Volume of gas sampled by meter (l) dry $V_{mc} = 359.2 \times \text{gas meter reading (m}^3) \times (P_{bar} + \Delta H/13.6) / (\text{meter temp} + 273)$

moisture content (fraction) = $V_{wc}/(V_{wc}+V_{mc})$

an approximation is: 1 m³ of gas weighs approx 1.2 kg

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

National Physical Laboratory
Absorber Test Form

Test No	ISOCYANATE S 1
Date	14-2-12
pbar (mbar)	1025
pbar (mmHg):	769
nozzle diameter (mm)	5.80
Temp of Meter (in)/(out) deg. C	27
ΔH_{ave} (mmH ₂ O)	38.0
Filter No (if app)	-

Site	Paxford Composites
Stack	SB3
Site Team:	KCB & MRE
Data Entered By:	Kevin Blakley

End Volume Reading	474.82	m ³
Start Volume reading	474.17	m ³
Volume Sampled	0.65	m ³

end time	15:30	hr:min
start time	15:00	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:	HCL	HCL	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
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Gas Volume of water at 0°C (l)	3.36
Gas Meter volume at 0°C (l)	598.04

Moisture content of Gases (%)	0.6
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NOTES:

at 0°C

Volume (l) of water in gas phase is $V_{wc} = 1.2444 \times \text{wt of water collected (g)}$

Volume of gas sampled by meter (l) dry $V_{mc} = 359.2 \times \text{gas meter reading (m}^3\text{)} \times (P_{bar} + \Delta H/13.6) / (\text{meter temp} + 273)$

moisture content (fraction) = $V_{wc}/(V_{wc}+V_{mc})$

an approximation is: 1 m³ of gas weighs approx 1.2 kg

moisture content approx =

wt of water collected (g) x 100

wt of water collected (g) + (m³ of gas on meter x 1200)

2.2.7 - Sample Sheets

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

Test no	PM1		Site:	Paxford Composites	Stack Description:	SB1
Date	14-2-12	dd/mm/yy	Filter No:	11TF191	Absorber No(s):	T01, A-D
nozzle diameter	5.8	mm	Blank I.D.:	11TF197		
Stack Pres (with +/- above barometric if unknown enter zero)	0	mmH ₂ O	SITE TEAM:	KCB & MRE		
			COMMENTS:	Particulates Test 1		
end volume reading	471.602	m ³			Control Box I.D. No:	AS0003
start volume reading	471.116	m ³	end time	09:30	hh:mm	Stack Thermocouple I.D. No.
volume sampled	0.49	m ³	start time	09:00	hh:mm	Probe I.D. No.
Conditions	Value	Units	total time	00:30	hh:mm	Barometer I.D. No.
			stop time	00:00	hh:mm	Pitot I.D. No.
Stack pressure	768.63	mmHg	Diagram of Sample Location:			
Gas Meter Calibration Factor Y	0.9808					
Ref oxygen Value	21	%				
Moisture content	0.4	%				
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	47.10	mmH ₂ O				
area of stack	0.47	m ²	LEAK CHECK			
Pbar	1024.5	mbar	Pre Vac (in Hg):	15	Post Vac (in Hg):	4.0
Pbar	768.6	mmHg	Leak rate (m ³ /l) or (%):			
pitot tube coeff	0.83		Leak rate (m ³ /l) or (%):			
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	Δp mm H ₂ O	Δh mm H ₂ O	Stack Temp T _s °C	Probe Temp T _p °C	Oven Temp °C	Impinger Temp °C	Resin/L ine °C	Meter in T _m (in) °C	Meter out T _m (out) °C	Vacuum In Hg
1:	9:00	471.1160	A3	5	15.00	41.3	18	N/A	N/A	18	N/A	19	18	4.0
2:	9:05	471.2290	A3	5	15.50	42.6	20	N/A	N/A	20	N/A	24	18	4.0
3:	9:10	471.3280	A2	5	9.00	24.8	23	N/A	N/A	22	N/A	27	18	2.0
4:	9:15	471.4140	A2	5	8.00	22.0	23	N/A	N/A	25	N/A	27	19	2.0
5:	9:20	471.4920	A1	5	5.00	13.8	23	N/A	N/A	26	N/A	28	19	1.0
6:	9:25	471.5490	A1	5	5.00	13.8	24	N/A	N/A	25	N/A	28	20	1.0
7:	9:30	471.6020	STOP											
8:														
9:														
10:														

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

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 ₂ O	Δ h mm H ₂ O	Stack Temp T _s °C	Probe Temp T _p °C	Oven Temp °C	Impinger Temp °C	Resin/L ine °C	Meter in T _m (in) °C	Meter out T _m (out) °C	Vacuum in Hg
11:													
12:													
13:													
14:													
15:													
Summary values			30		26.35	21.8	#DIV/0!	#DIV/0!	22.7	n/a		22.1	2.3

Duct / Stack Flow Characteristics:		Units	
Test No	SB1 PM1		
Stack Velocity at stack gas T & P and a wet gas basis		10.11	ms ⁻¹
Stack flow @ STP, O ₂ (ref) and on a dry gas basis		4.43	m ³ s ⁻¹
Stack flow @ stack gas T & P and on a wet gas basis		4.75	m ³ s ⁻¹
Stack flow @ stack gas T & P and on a dry gas basis		4.73	m ³ s ⁻¹
Stack flow @ STP and on a wet gas basis		4.45	m ³ s ⁻¹
Stack flow @ STP, O ₂ (ref) and on a wet gas basis		4.91	m ³ s ⁻¹
Gas vol. samp. @ STP and on a dry gas basis		0.45	m ³
Gas vol. samp. @ STP, O ₂ (ref), and on a dry gas basis		0.45	m ³
Gas vol. samp. @ STP and on a wet gas basis		0.45	m ³
Gas vol. samp. @ STP, O ₂ (ref) and on a wet gas basis		0.45	m ³
Percentage Isokinicity		100	%

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

Test no	ISOCYANATES 1		Site:	Paxford Composites	Stack Description:	SB1
Date	14-2-12	dd/mm/yy	Filter No:	-	Absorber No(s):	T01, A-D
nozzle diameter	5.8	mm	Blank I.D.:	-		
Stack Pres (with +/- above barometric if unknown enter zero)	0	mmH ₂ O	SITE TEAM:	KCB & MRE		
COMMENTS:		Isocyanates Test 1				
end volume reading	472.097	m ³	end time	10:15	hh:mm	Control Box I.D. No:
start volume reading	471.610	m ³	start time	09:45	hh:mm	Stack Thermocouple I.D. No.
volume sampled	0.49	m ³	total time	00:30	hh:mm	Probe I.D. No.
Conditions	Value	Units	stop time	00:00	hh:mm	Barometer I.D. No.
Stack pressure	768.63	mmHg	Diagram of Sample Location:			
Gas Meter Calibration Factor Y	0.9808					
Ref oxygen Value	21	%				
Moisture content	0.6	%				
CO	0	ppm				
CO ₂	0	%				
N ₂	79.10	%				
O ₂	20.9	%				
dry molecular wt	28.84					
stack molecular wt	28.77					
Orifice ΔH@ Factor	47.10	mmH ₂ O				
area of stack	0.47	m ²	LEAK CHECK			
Pbar	1024.5	mbar	Pre Vac (in Hg):	15	Post Vac (in Hg):	3.0
Pbar	768.6	mmHg	Leak rate (m ³ /l) or (%):			<2%
pilot tube coeff	0.83		Leak rate (m ³ /l) or (%):			<2%
Reference Temp	273	K				
Reference Pressure	760	mmHg				

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

	Start Time at this Position or Setting hh: mm	volume reading at start m ³	Probe position	Time at each position / min	Δp mm H ₂ O	Δh mm H ₂ O	Stack Temp T _s °C	Probe Temp T _p °C	Oven Temp °C	Impinger Temp °C	Resin/L ine °C	Meter in T _m (in) °C	Meter out T _m (out) °C	Vacuum in Hg
1:	9:45	471.610	A3	5	15.00	41.3	24	N/A	N/A	15	N/A	23	22	3.0
2:	9:50	471.729	A3	5	15.00	41.3	24	N/A	N/A	15	N/A	28	22	3.0
3:	9:55	471.827	A2	5	7.00	19.3	23	N/A	N/A	18	N/A	30	23	1.0
4:	10:00	471.935	A2	5	6.00	16.5	24	N/A	N/A	22	N/A	31	23	1.0
5:	10:05	471.985	A1	5	4.00	11.0	24	N/A	N/A	21	N/A	29	24	1.0
6:	10:10	472.028	A1	5	4.00	11.0	24	N/A	N/A	22	N/A	30	24	1.0
7:	10:15	472.097	STOP											
8:														
9:														
10:														

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

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 ₂ O	Δ h mm H ₂ O	Stack Temp T _s °C	Probe Temp T _p °C	Oven Temp °C	Impinger Temp °C	Resin/L ine °C	Meter in T _m (in) °C	Meter out T _m (out) °C	Vacuum in Hg
11:													
12:													
13:													
14:													
15:													
Summary values					23.38	23.8	#DIV/0!	#DIV/0!	18.8	n/a		25.8	1.7

Duct / Stack Flow Characteristics:	SB1	Units
Test No	ISOCYANATES 1	
Stack Velocity at stack gas T & P and a wet gas basis		ms ⁻¹
Stack flow @ STP, O ₂ (ref) and on a dry gas basis		m ³ s ⁻¹
Stack flow @ stack gas T & P and on a wet gas basis		m ³ s ⁻¹
Stack flow @ stack gas T & P and on a dry gas basis		m ³ s ⁻¹
Stack flow @ STP and on a wet gas basis		m ³ s ⁻¹
Stack flow @ STP, O ₂ (ref) and on a wet gas basis		m ³ s ⁻¹
Gas vol. samp. @ STP and on a dry gas basis		m ³
Gas vol. samp. @ STP, O ₂ (ref), and on a dry gas basis		m ³
Gas vol. samp. @ STP and on a wet gas basis		m ³
Gas vol. samp. @ STP, O ₂ (ref) and on a wet gas basis		m ³
Percentage Isokinicity		%

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

Test no	PM1	Site:	Paxford Composites	Stack Description:	SB2
Date	14-2-12	Filter No:	11TF192	Absorber No(s):	T01, A-D
nozzle diameter	5.8	Blank I.D.:	11TF196		
Stack Pres (with +/- above barometric if unknown enter zero)	0	SITE TEAM:		KCB & MRE	
		COMMENTS:		Particulates Test 1	
end volume reading	472.918			Control Box I.D. No:	AS0003
start volume reading	472.102	end time	12:00 hh:mm	Stack Thermocouple I.D. No.	AS0264A
volume sampled	0.82	start time	11:30 hh:mm	Probe I.D. No.	AS0264
Conditions	Value	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	Diagram of Sample Location:			
Gas Meter Calibration Factor Y	0.9808				
Ref oxygen Value	21				
Moisture content	0.3				
CO	0				
CO ₂	0				
N ₂	79.10				
O ₂	20.9				
dry molecular wt	28.84				
stack molecular wt	28.81				
Orifice ΔH@ Factor	47.10				
area of stack	0.64	LEAK CHECK			
Pbar	1024.5	Pre Vac (in Hg):	15	Post Vac (in Hg):	10
Pbar	768.6	Leak rate (m ³ /l) or (%):			
pilot tube coeff	0.83	Leak rate (m ³ /l) or (%):			
Reference Temp	273	Leak rate (m ³ /l) or (%):			
Reference Pressure	760	Leak rate (m ³ /l) or (%):			

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

	Start Time at this Position or Setting hh: mm	Volume reading at start m ³	Probe position	Time at each position / min	Δp mm H ₂ O	Δh mm H ₂ O	Stack Temp T _s °C	Probe Temp T _p °C	Oven Temp °C	Impinger Temp °C	Resin/Line °C	Meter in T _m (in) °C	Meter out T _m (out) °C	Vacuum in Hg
1:	11:30	472.1020	A1	5	36.00	98.0	19	N/A	N/A	17	N/A	21	21	9.0
2:	11:35	472.2540	A2	5	10.00	27.5	19	N/A	N/A	19	N/A	23	21	2.5
3:	11:40	472.3440	A3	5	11.00	30.0	21	N/A	N/A	21	N/A	26	21	2.0
4:	11:45	472.4450	B1	5	34.00	96.0	21	N/A	N/A	21	N/A	30	21	9.0
5:	11:50	472.5930	B2	5	42.00	115.0	20	N/A	N/A	23	N/A	30	22	10.0
6:	11:55	472.7450	B3	5	40.00	110.0	22	N/A	N/A	23	N/A	29	23	10.0
7:	12:00	472.9180	END											
8:														
9:														
10:														

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

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 ₂ O	Δ h mm H ₂ O	Stack Temp T _s °C	Probe Temp T _p °C	Oven Temp °C	Impinger Temp °C	Resin/Line °C	Meter in T _m (in) °C	Meter out T _m (out) °C	Vacuum in Hg
11:													
12:													
13:													
14:													
15:													
Summary values					79.42	20.3	#DIV/0!	#DIV/0!	20.7	n/a		24.0	7.1

Duct / Stack Flow Characteristics:		Units	
Test No	SB2 PM1		
Stack Velocity at stack gas T & P and a wet gas basis		17.33	m s ⁻¹
Stack flow @ STP, O ₂ (ref) and on a dry gas basis		0.00	m ³ s ⁻¹
Stack flow @ stack gas T & P and on a wet gas basis		11.09	m ³ s ⁻¹
Stack flow @ stack gas T & P and on a dry gas basis		11.06	m ³ s ⁻¹
Stack flow @ STP and on a wet gas basis		10.44	m ³ s ⁻¹
Stack flow @ STP, O ₂ (ref) and on a wet gas basis		0.00	m ³ s ⁻¹
Gas vol. samp. @ STP and on a dry gas basis		0.75	m ³
Gas vol. samp. @ STP, O ₂ (ref), and on a dry gas basis		0.00	m ³
Gas vol. samp. @ STP and on a wet gas basis		0.75	m ³
Gas vol. samp. @ STP, O ₂ (ref) and on a wet gas basis		0.00	m ³
Percentage Isokinicity		97	%

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

Test no	ISOCYANATES 1		Site:	Paxford Composites	Stack Description:	SB2
Date	14-2-12	dd/mm/yy	Filter No:	-	Absorber No(s):	T01, A-D
nozzle diameter	5.8	mm	Blank I.D.:	-		
Stack Pres (with +/- above barometric if unknown enter zero)	0	mmH ₂ O	SITE TEAM:	KCB & MRE		
			COMMENTS:	Isocyanates Test 1		
end volume reading	473.800	m ³	end time		12:50	hh:mm
start volume reading	472.928	m ³	start time		12:20	hh:mm
volume sampled	0.87	m ³	total time		00:30	hh:mm
Conditions	Value	Units	stop time		00:00	hh:mm
Stack pressure	768.63	mmHg	Diagram of Sample Location:			
Gas Meter Calibration Factor Y	0.9808					
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	47.10	mmH ₂ O				
area of stack	0.64	m ²	LEAK CHECK			
Pbar	1024.5	mbar	Pre Vac (in Hg):		15	Post Vac (in Hg):
Pbar	768.6	mmHg	Leak rate (m ³ /l) or (%):		<2%	Leak rate (m ³ /l) or (%):
pitot tube coeff	0.83		Leak rate (m ³ /l) or (%):		<2%	Leak rate (m ³ /l) or (%):
Reference Temp	273	K				
Reference Pressure	760	mmHg				

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

	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 ₂ O	Δ h mm H ₂ O	Stack Temp T _s °C	Probe Temp T _p °C	Oven Temp °C	Impinger Temp °C	Resin/L ine °C	Meter in T _m (in) °C	Meter out T _m (out) °C	Vacuum in Hg
1:	12:20	472.9280	A1	5	20.00	55.0	20	N/A	N/A	17	N/A	24	24	5.0
2:	12:25	473.0750	A2	5	12.00	33.0	21	N/A	N/A	18	N/A	26	24	3.0
3:	12:30	473.2010	A3	5	25.00	67.5	21	N/A	N/A	19	N/A	29	24	4.0
4:	12:35	473.3410	B1	5	30.00	82.0	21	N/A	N/A	19	N/A	33	24	6.0
5:	12:40	473.4810	B2	5	34.00	92.0	21	N/A	N/A	21	N/A	33	24	8.0
6:	12:45	473.6300	B3	5	40.00	110.0	21	N/A	N/A	23	N/A	34	25	9.0
7:	12:50	473.8000	END											
8:														
9:														
10:														

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

Start Time at this Position or Setting hh: mm	Volume reading at start m ³	Probe position	Time at each position / min	ΔP mm H ₂ O	Δh mm H ₂ O	Stack Temp T _s °C	Probe Temp T _p °C	Oven Temp °C	Impinger Temp °C	Resin/L ine °C	Meter in T _m (in) °C	Meter out T _m (out) °C	Vacuum in Hg
11:													
12:													
13:													
14:													
15:													
Summary values			30		73.25	20.8	#DIV/0!	#DIV/0!	19.5	n/a		27.0	5.8

Duct / Stack Flow Characteristics:		SB2	Units
Test No		ISOCYANATES 1	
Stack Velocity at stack gas T & P and a wet gas basis			17.04 ms ⁻¹
Stack flow @ STP, O ₂ (ref) and on a dry gas basis			N/A m ³ s ⁻¹
Stack flow @ stack gas T & P and on a wet gas basis			10.91 m ³ s ⁻¹
Stack flow @ stack gas T & P and on a dry gas basis			10.85 m ³ s ⁻¹
Stack flow @ STP and on a wet gas basis			10.25 m ³ s ⁻¹
Stack flow @ STP, O ₂ (ref) and on a wet gas basis			N/A m ³ s ⁻¹
Gas vol. samp. @ STP and on a dry gas basis			0.79 m ³
Gas vol. samp. @ STP, O ₂ (ref), and on a dry gas basis			N/A m ³
Gas vol. samp. @ STP and on a wet gas basis			0.80 m ³
Gas vol. samp. @ STP, O ₂ (ref) and on a wet gas basis			N/A m ³
Percentage Isokinicity			105 %

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

Test no	PM1	Site:	Paxford Composites	Stack Description:	SB3
Date	14-2-12	Filter No:	11TF193	Absorber No(s):	T01, A-D
nozzle diameter	5.8	Blank I.D.:	11TF195		
Stack Pres (with +/- above barometric if unknown enter zero)	0	SITE TEAM:		KCB & MRE	
		COMMENTS:		Particulates Test 1	
end volume reading	474.167			Control Box I.D. No:	AS0003
start volume reading	473.841	end time	14:45 hh:mm	Stack Thermocouple I.D. No.	AS0264A
volume sampled	0.33	start time	14:15 hh:mm	Probe I.D. No.	AS0264
Conditions	Value	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	Diagram of Sample Location:			
Gas Meter Calibration Factor Y	0.9808				
Ref oxygen Value	21				
Moisture content	0.6				
CO	0				
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				
area of stack	0.59	LEAK CHECK			
Pbar	1024.5	Pre Vac (in Hg):	15	Post Vac (in Hg):	1.0
Pbar	768.6	Leak rate (m ³ /l) or (%):	<2%	Leak rate (m ³ /l) or (%):	<2%
pitot tube coeft	0.83				
Reference Temp	273				
Reference Pressure	760				

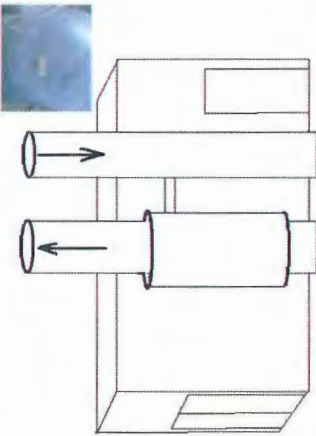
NATIONAL PHYSICAL LABORATORY
Continuation Sheet

	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 ₂ O	Δ h mm H ₂ O	Stack Temp Ts °C	Probe Temp Tp °C	Oven Temp °C	Impinger Temp °C	Resin/L ine °C	Meter in Tm(in) °C	Meter out Tm(out) °C	Vacuum in Hg
1:	14:15	473.8410	A3	5	3.50	9.6	21	N/A	N/A	16	N/A	23	23	1.0
2:	14:20	473.8970	A3	5	4.00	11.0	21	N/A	N/A	15	N/A	24	23	1.0
3:	14:25	473.9550	A2	5	4.00	11.0	21	N/A	N/A	16	N/A	25	22	1.0
4:	14:30	474.0110	A2	5	3.00	8.3	21	N/A	N/A	18	N/A	27	23	1.0
5:	14:35	474.0670	A1	5	3.00	8.3	21	N/A	N/A	19	N/A	27	23	1.0
6:	14:40	474.1190	A1	5	4.50	12.4	21	N/A	N/A	20	N/A	27	23	1.0
7:	14:45	474.1670	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 ₂ O	Δ h mm H ₂ O	Stack Temp T _s °C	Probe Temp T _p °C	Oven Temp °C	Impinger Temp °C	Resin/L ine °C	Meter in T _m (in) °C	Meter out T _m (out) °C	Vacuum in Hg
Summary values		474.17		30		10.08	21.0	#DIV/0!	#DIV/0!	17.3	n/a	24.2		1.0
11:														
12:														
13:														
14:														
15:														

Duct / Stack Flow Characteristics:		SB3	Units
Test No		PM1	
Stack Velocity at stack gas T & P and a wet gas basis			m s ⁻¹
Stack flow @ STP, O ₂ (ref) and on a dry gas basis			m ³ s ⁻¹
Stack flow @ stack gas T & P and on a wet gas basis			m ³ s ⁻¹
Stack flow @ stack gas T & P and on a dry gas basis			m ³ s ⁻¹
Stack flow @ STP and on a wet gas basis			m ³ s ⁻¹
Stack flow @ STP, O ₂ (ref) and on a wet gas basis			m ³ s ⁻¹
Gas vol. samp. @ STP and on a dry gas basis			m ³
Gas vol. samp. @ STP, O ₂ (ref), and on a dry gas basis			m ³
Gas vol. samp. @ STP and on a wet gas basis			m ³
Gas vol. samp. @ STP, O ₂ (ref) and on a wet gas basis			m ³
Percentage Isokinicity			%
			105

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

Test no	ISOCYANATES 1		Site:	Paxford Composites	Stack Description:	SB3
Date	14-2-12	dd/mm/yy	Filter No:	-	Absorber No(s):	T01, A-D
nozzle diameter	5.8	mm	Blank I.D.:	-		
Stack Pres (with +/- above barometric if unknown enter zero)	0	mmH ₂ O	SITE TEAM:		KCB & MRE	
			COMMENTS:		Isocyanates Test 1	
end volume reading	474.819	m ³			Control Box I.D. No:	AS0003
start volume reading	474.171	m ³	end time	15:30 hh:mm	Stack Thermocouple I.D. No.	AS0264A
volume sampled	0.65	m ³	start time	15:00 hh:mm	Probe I.D. No.	AS0264
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
Diagram of Sample Location:						
						
Stack pressure	768.63	mmHg				
Gas Meter Calibration Factor Y	0.9808					
Ref oxygen Value	21	%				
Moisture content	0.6	%				
CO	0	ppm				
CO ₂	0	%				
N ₂	79.10	%				
O ₂	20.9	%				
dry molecular wt	28.84					
stack molecular wt	28.78					
Orifice ΔH@ Factor	47.10	mmH ₂ O				
area of stack	0.59	m ²				
Pbar	1024.5	mbar	Pre Vac (in Hg):	15	Post Vac (in Hg):	4.0
Pbar	768.6	mmHg				
pilot tube coeft	0.83					
Reference Temp	273	K				
Reference Pressure	760	mmHg				
			Leak rate (m ³ /l) or (%):		Leak rate (m ³ /l) or (%):	
			<2%		<2%	

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

	Start Time at this Position or Setting hh: mm	volume reading at start m ³	Probe position	Time at each position / min	Δp mm H ₂ O	Δh mm H ₂ O	Stack Temp Ts °C	Probe Temp Tp °C	Oven Temp °C	Impinger Temp °C	Resin/L ine °C	Meter in Tm(in) °C	Meter out Tm(out) °C	Vacuum in Hg
1:	15:00	474.1710	A1	5	11.00	30.0	20	N/A	N/A	14	N/A	24	23	2.0
2:	15:05	474.2730	A2	5	14.00	39.0	20	N/A	N/A	16	N/A	28	24	3.0
3:	15:10	474.3920	A3	5	13.50	38.0	20	N/A	N/A	18	N/A	31	24	4.0
4:	15:15	474.5110	B1	5	14.50	40.0	21	N/A	N/A	20	N/A	32	24	4.0
5:	15:20	474.6310	B2	5	14.00	40.0	22	N/A	N/A	22	N/A	33	25	4.0
6:	15:25	474.7510	B3	5	15.00	41.0	23	N/A	N/A	23	N/A	34	25	4.0
7:	15:30	474.8190	END											
8:														
9:														
10:														

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

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 ₂ O	Δ h mm H ₂ O	Stack Temp T _s °C	Probe Temp T _p °C	Oven Temp °C	Impinger Temp °C	Resin/Line °C	Meter in T _m (in) °C	Meter out T _m (out) °C	Vacuum in Hg
Summary values		474.82		30		38.00	21.0	#DIV/0!	#DIV/0!	18.8	n/a		27.3	3.5
11:														
12:														
13:														
14:														
15:														

Duct / Stack Flow Characteristics:	SB3	Units
Test No	ISOCYANATES 1	
Stack Velocity at stack gas T & P and a wet gas basis		12.36 m s ⁻¹
Stack flow @ STP, O ₂ (ref) and on a dry gas basis		N/A m ³ s ⁻¹
Stack flow @ stack gas T & P and on a wet gas basis		7.29 m ³ s ⁻¹
Stack flow @ stack gas T & P and on a dry gas basis		7.25 m ³ s ⁻¹
Stack flow @ STP and on a wet gas basis		6.85 m ³ s ⁻¹
Stack flow @ STP, O ₂ (ref) and on a wet gas basis		N/A m ³ s ⁻¹
Gas vol. samp. @ STP and on a dry gas basis		0.59 m ³
Gas vol. samp. @ STP, O ₂ (ref), and on a dry gas basis		N/A m ³
Gas vol. samp. @ STP and on a wet gas basis		0.59 m ³
Gas vol. samp. @ STP, O ₂ (ref) and on a wet gas basis		N/A m ³
Percentage Isokinicity		107 %

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

Measurement Equation

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

Limit value (ELV)	50 mg.m ⁻³	Reference oxygen	20.9 % by volume
Measured concentration	6.4 mg.m ⁻³ (at reference conditions)		

Measured Quantities	Symbol	Value	Standard uncertainty	Units	Uncertainty as percentage	Uncertainty at lv	Requirement of std
Sampled Volume	V _m	0.49	uV _m	m ³	0.21	0.21	<=2%
Sampled gas Temperature	T _m	295	uT _m	2 K	0.68	0.68	<=1%
Sampled gas Pressure	p _m	102.45	up _m	1 kPa	0.98	0.98	<=1%
Sampled gas Humidity	H _m	0	uH _m	1 % by volume	1.00	1.00	<=1%
Mass particulate	m	2.9	um	0.23 mg	7.98	1.03	<5% of limit value
Note - Sampled gas humidity, temperature and pressure are values at the gas meter							
Leak	L	2		%	2.00	2.00	<=2%
Uncollected Mass	UCM	0		mg	0	0	<=10%
(Instack filter - no rinse)							

Intermediate calculations

Factor for std conds	fs	0.94	u (in units of fs)
uncertainty components	symbol	sensitivity coeff	
	p _m	0.009	0.009
	H _m	0.009	0.009
	T _m	0.003	0.006
	ufs		0.015
Corrected volume	V	0.45	uV
			0.007 m ³
			V = V _m f _s
			1.57

$$f_s = \frac{(100 - H_m) 273}{100 T_m} \frac{\rho_m}{101.3}$$

Parameter	Value	Units	Sensitivity coeff	Uncertainty contribution	Uncertainty as %
Corrected Volume (standard)	V	0.45 m ³	14.12	0.10 mg.m ⁻³	1.57 %
Mass	m	2.88 mg	2.23	0.51 mg.m ⁻³	7.98 %
Leak	L	0.07 mg.m ⁻³	1.00	0.07 mg.m ⁻³	1.15 %
Uncollected mass	UCM	0.00 mg	2.23	0.00 mg.m ⁻³	0.00 %
Combined measurement uncertainty				0.53 mg.m ⁻³	
Expanded uncertainty as percentage of measured value		16.47 %	measured of value	expressed with a level of confidence of 95% (Using a coverage factor k=2)	
Expanded uncertainty in units of measurement		1.06 mg.m ⁻³			
Expanded uncertainty as percentage of limit value		2.11 %	ELV		

Uncertainty calculation for EN 13284 Determination of low range mass concentration of dust, Manual Gravimetric Method
Spray Booth Two Run One

Measurement Equation

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

Limit value (ELV)	50 mg.m ⁻³	Reference oxygen	20.9 % by volume
Measured concentration	4.80 mg.m ⁻³ (at reference conditions)		

Measured Quantities	Symbol	Value	Standard uncertainty	Units	Uncertainty as percentage	Uncertainty at lv	Requirement of std
Sampled Volume	V _m	0.82	0.001	m ³	0.12	0.12	<=2%
Sampled gas Temperature	T _m	297	2	K	0.67	0.67	<=1%
Sampled gas Pressure	p _m	102.45	1	kPa	0.98	0.98	<=1%
Sampled gas Humidity	H _m	0	1	% by volume	1.00	1.00	<=1%
Mass particulate	m	3.606666667	0.23	mg	6.40	0.61	<5% of limit value
Note - Sampled gas humidity, temperature and pressure are values at the gas meter							
Leak	L	2		%	2.00	2.00	<=2%
Uncollected Mass (Instack filter - no rinse)	UCM	0		mg	0	0	<=10%

Intermediate calculations

Factor for std conds	fs	0.93
uncertainty components	symbol	sensitivity coeff
	p _m	0.009
	H _m	0.009
	T _m	0.003
	ufs	0.014
	V	0.76
Corrected volume	V	0.76
	uV	0.012 m ³
	V = V _m f _s	1.55
		1.56

$$f_s = \frac{(100 - H_m) 273}{100 T_m} \frac{\rho_m}{101.3}$$

Parameter	Value	Units	Sensitivity coeff	Uncertainty contribution	Uncertainty as %
Corrected Volume (standard	V	0.76 m ³	6.32	0.07 mg.m ⁻³	1.56 %
Mass	m	3.61 mg	1.33	0.31 mg.m ⁻³	6.40 %
Leak	L	0.06 mg.m ⁻³	1.00	0.06 mg.m ⁻³	1.15 %
Uncollected mass	UCM	0.00 mg	1.33	0.00 mg.m ⁻³	0.00 %
Combined measurement uncertainty				0.32 mg.m ⁻³	

Expanded uncertainty as percentage of measured value

13.41 % measured of value

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

Expanded uncertainty in units of measurement

0.64 mg.m⁻³

Expanded uncertainty as percentage of limit value

1.29 % ELV

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

Spray Booth Three Run One

Measurement Equation

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

Limit value (ELV)	50 mg.m ⁻³	Reference oxygen	20.95 % by volume
Measured concentration	1.04 mg.m ⁻³ (at reference conditions)		

Measured Quantities	Symbol	Value	Standard uncertainty	Units	Uncertainty as percentage	Uncertainty at lv	Requirement of std
Sampled Volume	V _m	0.33	0.001	m ³	0.31		<=2%
Sampled gas Temperature	T _m	297	2	K	0.67		<=1%
Sampled gas Pressure	p _m	102.45	1	kPa	0.98		<=1%
Sampled gas Humidity	H _m	0	1	% by volume	1.00		<=1%
Mass particulate	m	0.31	0.23	mg	73.95	1.53	<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		
uncertainty components	symbol	sensitivity coeff	u (in units of fs)	
	p _m	0.009	0.009	
	H _m	0.009	0.009	
	T _m	0.003	0.006	
	ufs		0.014	
Corrected volume	V	0.30	uV	0.005 m ³
				V = V _m f _s
				1.55
				1.59

$$f_s = \frac{(100 - H_m) 273}{100 T_m 101.3}$$

Parameter	Value	Units	Sensitivity coeff	Uncertainty contribution	Uncertainty as %
Corrected Volume (standard	V	0.30 m ³	3.42	0.02 mg.m ⁻³	1.59 %
Mass	m	0.31 mg	3.34	0.77 mg.m ⁻³	73.95 %
Leak	L	0.01 mg.m ⁻³	1.00	0.01 mg.m ⁻³	1.15 %
Uncollected mass	UCM	0.00 mg	3.34	0.00 mg.m ⁻³	0.00 %
Combined measurement uncertainty					0.77 mg.m ⁻³
Expanded uncertainty as percentage of measured value		147.95	% measured of value	expressed with a level of confidence of 95% (Using a coverage factor k=2)	
Expanded uncertainty in units of measurement		1.53	mg.m ⁻³		
Expanded uncertainty as percentage of limit value		3.07	% ELV		

Uncertainty calculation for Gaseous Measurement TOC to EN 12619:1999

Limit value	50 mg/m ³ (corrected) TOC	82.83 mg/m ³ TOC
Measured concentration	221.5 mg/m ³	1605 mg/m ³
Measured concentration	221.5 mg/m ³ (Corrected)	

Correction for reference conditions	02, %	Moisture, %	Pressure, kPa	Temperature, K
ref	20.50	0.00	101.30	273.00
measured	20.50	0.00	101.30	273.00
Uncert	0.00	1.00	0.00	0.00
Factors	0.00	0.00	1.00	1.00
Uncertainty in factor	0.00	0.00	0.00	0.00
Correction factor	1.00	0.01	0.01	0.01

Performance characteristics	Value	specification
Response time	15 seconds	60.000
Lower sampling interval	60 seconds	
Measurement period	31 minutes	
Number of readings in measurement	31	
Repeatability at zero	0.133 mg/m ³	0.133 mg/m ³
Repeatability at span level	0.15 mg/m ³	0.2 mg/m ³
Deviation from linearity (at fit)	0.4 mg/m ³	< 0.4 mg/m ³
Zero drift	0.08 mg/m ³	0.7 mg/m ³ (long term)
Span drift	0.19 mg/m ³	< 2 % / 3 kPa
Volume or pressure flow dependence	0.02 % of full scale/2 kPa	< 3 % / 2 kPa
atmospheric pressure dependence	0.8 % of full scale/2 kPa	0.8 mg/m ³ / 10k (at span)
ambient temperature dependence	0.01 mg/m ³	0.8 mg/m ³
O ₂ (% vol)	20	sum of all effects of these
NO ₂ (mg/m ³)	260	interferents when taking all
NO ₂ (mg/m ³)	860	positive or all negative
CO ₂ (mg/m ³)	160	effects shall be less than 1
CO ₂ (% vol)	490	mg/m ³
CO ₂ (% vol)	16	< 2 % range
HCl (mg/m ³)	40	within 15 % of test gas value (5 mg/m ³)
H ₂ O (% vol)	20	< 0.1 % vol / 10 vol
dependence on voltage	0.1 % of value	< 2 % of value
Control gas reading difference	10	
losses in the line (leak)	1	
Uncertainty of calibration gas	1.29	

Effect of drift	0.59 mg/m ³	0.04 % full scale
-----------------	------------------------	-------------------

ranges	min	max	value at callb
flow pressure	98.00	105	100 kPa
temp	100.76	100.82	100.89 kPa
temp	287	288.5	287.5 K
O ₂ range	0	16	20 % vol
SO ₂ range	0	300	0 mg/m ³
NO range	0	600	0 mg/m ³
NO ₂ range	0	50	0 mg/m ³
CO range	0	500	0 mg/m ³
CO ₂ range	0	20	0 % vol
HCl range	0	5	0 mg/m ³
H ₂ O range	0	20	0 % vol
Voltage	93	121	110 V

Performance characteristic	Uncertainty	Value of uncertainty quantity
Standard deviation of repeatability at zero	U ₀	for mean
Standard deviation of repeatability at span level	U _{sp}	for mean
Leak of fit	U _{le}	use rep at zero
Drift	U _{dr}	0.23
Volume or pressure flow dependence	U _{vol}	0.34
atmospheric pressure dependence	U _{atm}	0.31
ambient temperature dependence	U _{amb}	0.39
O ₂	U _{o2}	0.00
NO ₂ (mg/m ³)	U _{no2}	0.11
NO ₂ (mg/m ³)	U _{no2}	0.08
CO ₂ (mg/m ³)	U _{co2}	0.13
CO ₂ (% vol)	U _{co2}	0.13
HCl (mg/m ³)	U _{hcl}	0.01
H ₂ O (% vol)	U _{h2o}	0.12
Dependence on voltage	U _{vol}	1.39
losses in the line (leak)	U _{leak}	1.28
Uncertainty of calibration gas	U _{cal}	1.84
control gas	U _{control}	92.86
Uncertainty in factor	U _f	2.98

Use largest of sum of all positive or all negative influences	
Criteria	sum < 1 mg/m ³
Value to use for interference uncertainty	4.4298
U _{int}	0.76

Measurement uncertainty			
Combined uncertainty	k = 2	92.70	mg/m ³
Expanded uncertainty		185.41	mg/m ³
Uncertainty corrected to std cond		185.47	mg/m ³
Expanded uncertainty	expressed with a level of confidence of 95%	370.94	% ELV
Expanded uncertainty	expressed with a level of confidence of 95%	185.47	mg/m ³
Expanded uncertainty	expressed with a level of confidence of 95%	85.74	% value

Uncertainty calculation for Gaseous Measurement TOC to EN 12619:1999

Limit value	50 mg/m ³ (corrected) TOC	82.8 mg·m ⁻³ TOC
Measured concentration	53.6 mg/m ³	Full Scale
Measured concentration	53.6 mg/m ³ (Corrected)	100.3 mg·m ⁻³

Correction for reference conditions			
	ref	measured	Uncert
Factors	0.00	0.00	1.00
Uncertainty in factor	0.00	0.00	0.00
Correction factor	1.00	0.01	0.01

Performance characteristics	Value	specification
Response time	15 seconds	80,000
Logger sampling interval	60 seconds	
Measurement period	31 minutes	
Number of readings in measurement	31	
Repeatability at zero	0.133	0.133 mg/m ³
Repeatability at span level	0.15	0.2 mg/m ³
Deviation from linearity (lack of fit)	0.4	± 0.4 mg/m ³
Zero drift	0.05	0.4 mg/m ³ (long term)
Span drift	0.48	± 0.7 mg/m ³ (long term)
Volume or pressure flow dependence	0.02	± 2 % / 2 kPa
atmospheric pressure dependence	0.8	± 3 % / 2 kPa
ambient temperature dependence	0.01	0.8 mg/m ³ / 10K (at span)
O ₂ (% vol)	0.2	0.8 mg/m ³
SO ₂ (mg/m ³)	260	sum of all effects of these
NO ₂ (mg/m ³)	860	interferents when taking all
CO ₂ (mg/m ³)	150	positive or all negative
CO (mg/m ³)	430	effects shall be less than 1
CO ₂ (% vol)	0.2	mg/m ³
HCl (mg/m ³)	40	
H ₂ O (% vol)	20	
dependence on voltage	0.1	
Control gas reading difference	10	
losses in the line (leak)	1	
Uncertainty of calibration gas	1.29	

Performance characteristics	Value	specification
Response time	15 seconds	80,000
Logger sampling interval	60 seconds	
Measurement period	31 minutes	
Number of readings in measurement	31	
Repeatability at zero	0.133	0.133 mg/m ³
Repeatability at span level	0.15	0.2 mg/m ³
Deviation from linearity (lack of fit)	0.4	± 0.4 mg/m ³
Zero drift	0.05	0.4 mg/m ³ (long term)
Span drift	0.48	± 0.7 mg/m ³ (long term)
Volume or pressure flow dependence	0.02	± 2 % / 2 kPa
atmospheric pressure dependence	0.8	± 3 % / 2 kPa
ambient temperature dependence	0.01	0.8 mg/m ³ / 10K (at span)
O ₂ (% vol)	0.2	0.8 mg/m ³
SO ₂ (mg/m ³)	260	sum of all effects of these
NO ₂ (mg/m ³)	860	interferents when taking all
CO ₂ (mg/m ³)	150	positive or all negative
CO (mg/m ³)	430	effects shall be less than 1
CO ₂ (% vol)	0.2	mg/m ³
HCl (mg/m ³)	40	
H ₂ O (% vol)	20	
dependence on voltage	0.1	
Control gas reading difference	10	
losses in the line (leak)	1	
Uncertainty of calibration gas	1.29	

Performance characteristic	Uncertainty	Value of uncertainty quantity
Standard deviation of repeatability at zero	U ₀	for mean
Standard deviation of repeatability at span level	U ₁	for mean
Lack of fit	U ₂	use rep at zero
Drift	U ₃	0.23
Volume or pressure flow dependence	U ₄	0.21
atmospheric pressure dependence	U ₅	0.03
ambient temperature dependence	U ₆	0.04
O ₂	U ₇	0.00
SO ₂ (mg/m ³)	U ₈	0.11
NO ₂ (mg/m ³)	U ₉	0.13
CO ₂ (mg/m ³)	U ₁₀	0.08
CO (mg/m ³)	U ₁₁	0.04
CO ₂ (% vol)	U ₁₂	0.13
HCl (mg/m ³)	U ₁₃	0.01
H ₂ O (% vol)	U ₁₄	0.12
Dependence on voltage	U ₁₅	0.14
losses in the line (leak)	U ₁₆	0.31
Uncertainty of calibration gas	U ₁₇	0.40
control gas	U ₁₈	9.27
Uncertainty in factor	U ₁₉	0.57

Performance characteristic	Uncertainty	Value of uncertainty quantity
Standard deviation of repeatability at zero	U ₀	for mean
Standard deviation of repeatability at span level	U ₁	for mean
Lack of fit	U ₂	use rep at zero
Drift	U ₃	0.23
Volume or pressure flow dependence	U ₄	0.21
atmospheric pressure dependence	U ₅	0.03
ambient temperature dependence	U ₆	0.04
O ₂	U ₇	0.00
SO ₂ (mg/m ³)	U ₈	0.11
NO ₂ (mg/m ³)	U ₉	0.13
CO ₂ (mg/m ³)	U ₁₀	0.08
CO (mg/m ³)	U ₁₁	0.04
CO ₂ (% vol)	U ₁₂	0.13
HCl (mg/m ³)	U ₁₃	0.01
H ₂ O (% vol)	U ₁₄	0.12
Dependence on voltage	U ₁₅	0.14
losses in the line (leak)	U ₁₆	0.31
Uncertainty of calibration gas	U ₁₇	0.40
control gas	U ₁₈	9.27
Uncertainty in factor	U ₁₉	0.57

Measurement uncertainty			
Combined uncertainty	k = 2	9.32	mg/m ³
Expanded uncertainty		18.63	mg/m ³
Uncertainty corrected to aid cond			
Expanded uncertainty	expressed with a level of confidence of 95%	18.67	mg/m ³
Expanded uncertainty	expressed with a level of confidence of 95%	37.34	% ELV
Expanded uncertainty	expressed with a level of confidence of 95%	18.67	mg/m ³
Expanded uncertainty	expressed with a level of confidence of 95%	34.68	% value

Measurement uncertainty			
Combined uncertainty	k = 2	9.32	mg/m ³
Expanded uncertainty		18.63	mg/m ³
Uncertainty corrected to aid cond			
Expanded uncertainty	expressed with a level of confidence of 95%	18.67	mg/m ³
Expanded uncertainty	expressed with a level of confidence of 95%	37.34	% ELV
Expanded uncertainty	expressed with a level of confidence of 95%	18.67	mg/m ³
Expanded uncertainty	expressed with a level of confidence of 95%	34.68	% value

2.2.9 - Analytical Results



Test Certificate

Date 29/02/2012

Client National Physical Laboratory
Module F7-A10
Hampton Road
Teddington
Middx
TW11 OLW

Order No. 991050
Certificate No. WK12-1026
Issue No. 1

Contact Matthew Ellison
Description 7 filters for HDI

Date Received 21/02/2012
Technique HPLC

Parameter	Analysis Method	Accreditation	Method LOD	Uncertainty
HDI (pp)	M119	UKAS	0.07ug	12.00%

Sample No.	684360	SB1 A	Method
HDI (pp)	<0.07 ug	M119(U)	
Sample No.	684361	SB1 B	Method
HDI (pp)	<0.07 ug	M119(U)	
Sample No.	684362	SB2 A	Method
HDI (pp)	0.16 ug	M119(U)	
Sample No.	684363	SB2 B	Method
HDI (pp)	<0.07 ug	M119(U)	
Sample No.	684364	SB3 A	Method
HDI (pp)	2.56 ug	M119(U)	
Sample No.	684365	SB3 B	Method
HDI (pp)	<0.07 ug	M119(U)	
Sample No.	684366	Blank	Method
HDI (pp)	<0.07 ug	M119(U)	

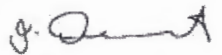


Test Certificate

Date 29/02/2012

Client	National Physical Laboratory	Certificate No.	WK12-1026
		Issue No.	1

Tested By Lora McKerracher Date 27/02/2012

Approved By  Date 29/02/2012
Joanne Dewhurst
Laboratory Manager

For and on authority of RPS Laboratories Ltd.

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

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

Results stated as ml are referring to the sample volume.

Analysis carried out on samples 'as received'

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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.

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

Where the Constant = 0.6071 Metric

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

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

Where K_m = Orifice meter coefficient

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

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:

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

Particulate Concentration C_s in stack Gases

At 273K and 101.325kPa and dry gas

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

Oxygen Concentration Correction C_{oxy} to Particulate concentration

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

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

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

Mass Emission Rate M_R

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

IsoKinicity

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

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
V_s	= Velocity of stack gas m/s
C_M	= measured concentration of particulate matter (mg/m ³)
T_m	= average temperature at dry gas meter (°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 ₂ O)
DH	= mean orifice pressure drop (mm H ₂ O)
D_s	= diameter of stack (m)
D_n	= Nozzle diameter (mm)
T_s	= stack temperature (°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)