

2.3.3 - Particulate Field Data Sheet

Test no	SB2 PM Test 1		Site:	Paxford	Stack Description:	SB2
Date	11-5-11		Filter No:	11TF103	Absorber No(s):	T01,A-D
nozzle diameter	mm		Blank I.D.:	11TF104		
Stack Pres (with +/- above barometric if unknown enter zero)	-7		SITE TEAM:		KCB & MRE	
			COMMENTS:			
			Particulates Test 1 of 1			
end volume reading	511.997	m ³	end time	14:04	hh:mm	Control Box I.D. No:
start volume reading	510.899	m ³	start time	13:34	hh:mm	Stack Thermocouple I.D. No.
volume sampled	1.098000	m ³	total time	00:30	hh:mm	Probe and Pitot I.D. No.
Conditions	Value	Units	stop time	00:00	hh:mm	Barometer I.D. No.
Stack pressure	770.31	mmHg	Diagram of Sample Location: See Traverse			
Gas Meter Calibration Factor Y	1.0623					
Ref oxygen Value	21	%				
Moisture content	0.3	%				
CO	0	ppm				
CO ₂	0	%				
N ₂	79.10	%				
O ₂	20.9	%				
dry molecular wt	28.84					
stack molecular wt	28.80					
Orifice ΔH@ Factor	44.80	mmH ₂ O				
area of stack	0.64	m ²				
Pbar	1027.4	mbar	Pre Vac (in Hg):		15	Post Vac (in Hg):
Pbar	770.8	mmHg	Leak rate (m ³ /l) or (%):		<2%	Leak rate (m ³ /l) or (%):
pilot tube coeft	0.830	K	Leak rate (m ³ /l) or (%):		<2%	<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 / setting 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
1:	13:34	510.8990	A1	5	11.60	218.0	18	N/A	N/A	14	N/A	18	18	6.0
2:	13:39	511.0710	A2	5	9.80	187.0	18	N/A	N/A	16	N/A	19	19	4.0
3:	13:44	511.2820	A3	5	7.00	135.0	17	N/A	N/A	19	N/A	19	19	3.0
4:	13:49	511.4640	B1	5	3.00	57.0	17	N/A	N/A	12	N/A	20	20	1.0
5:	13:54	511.5770	B2	5	9.00	170.0	17	N/A	N/A	14	N/A	21	21	6.0
6:	13:59	511.7970	B3	5	8.50	160.0	18	N/A	N/A	17	N/A	22	22	7.0
7:	14:04	511.9970	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 / setting 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
44:													
45:													
46:													
47:													
48:													
Summary values			30		154.50	17.5	#DIV/0!	#DIV/0!	15.3	n/a		19.8	4.5

Duct / Stack Flow Characteristics:		SB2		Units
Test No		SB2 PM Test 1		
Stack Velocity at stack gas T & P and a wet gas basis			9.32	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			5.93	m ³ s ⁻¹
Stack flow @ stack gas T & P and on a dry gas basis			5.91	m ³ s ⁻¹
Stack flow @ STP and on a wet gas basis			5.65	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			1.12	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			1.12	m ³
Gas vol. samp. @ STP, O ₂ (ref) and on a wet gas basis			N/A	m ³
Percentage Isokineticity			99	%

2.3.4 - Moisture Calculation

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

National Physical Laboratory
Absorber Test Form

Test No	SB2 PM Test 1
Date	11-5-11
pbar (mbar)	1027
pbar (mmHg):	771
nozzle diameter (mm)	9.52
Temp of Meter (In)/(out) deg. C	20
ΔH_{ave} (mmH ₂ O)	154.5
Filter No (if app)	11TF103

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

End Volume Reading	512.00	m ³
Start Volume reading	510.90	m ³
Volume Sampled	1.10	m ³

end time	14:04	hr:min
start time	13:34	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:	Moisture	Moisture	Moisture	Moisture				MRE
Weight of jars plus absorber plus washings (g)								
Weight of Jars plus absorber after sampling (g)	696.430	839.980	683.260	965.370				MRE
Weight of Jars plus absorber (g)	727.310	848.070	657.430	949.990				MRE
Weight of Jars (g)								
Weight Gain (g)	-30.88	-8.09	25.83	15.38	0	0	0	

Total Weight Gain (1+2+3+4) (g)	2.24
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Gas Volume of water at 0°C (l)	2.79
Gas Meter volume at 0°C (l)	1053.49

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) = $V_{wc}/(V_{wc}+V_{mc})$

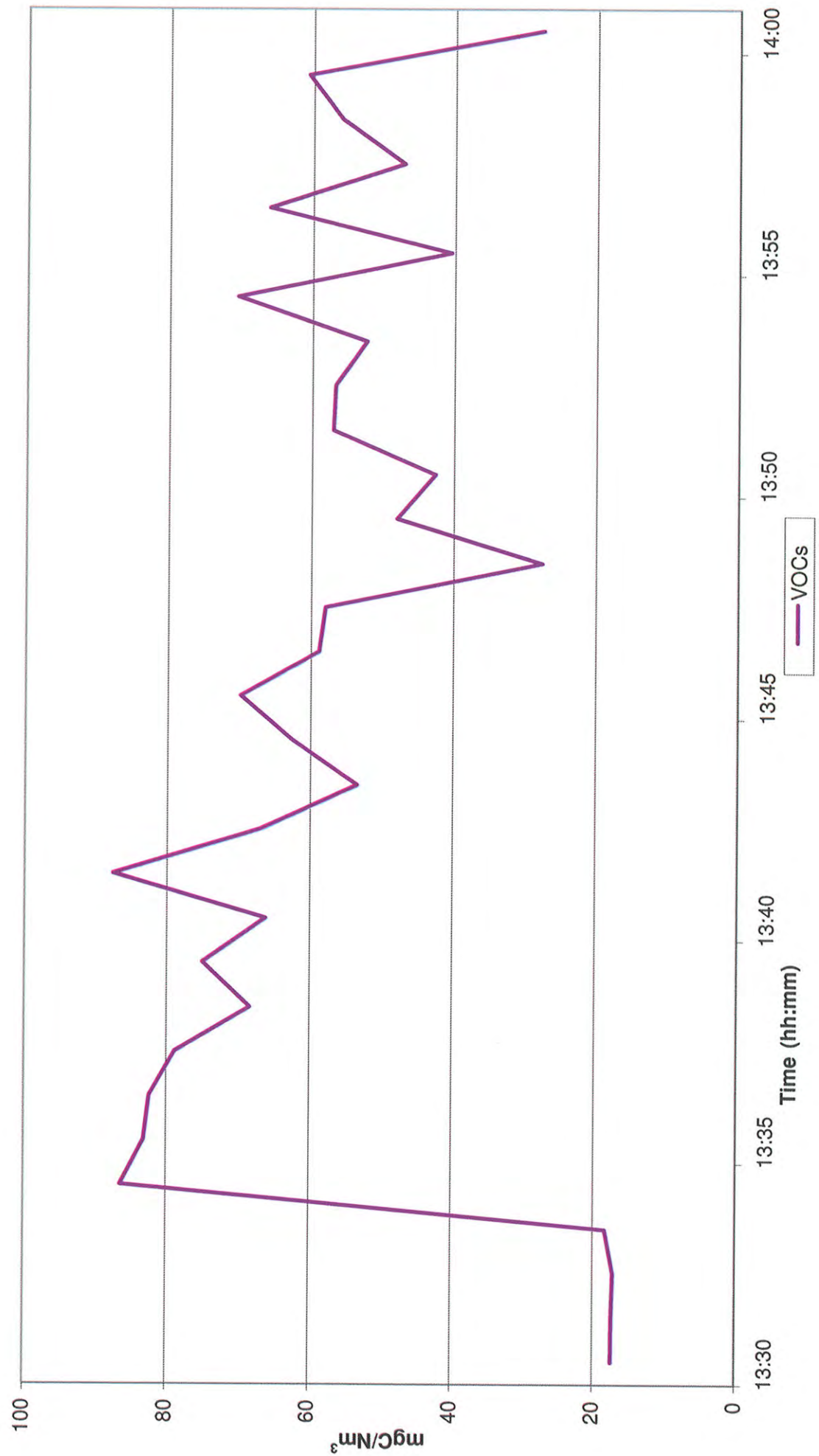
an approximation is: 1 m³ of gas weighs approx 1.2 kg

moisture content approx =

wt of water collected (g) x 100

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

2.3.5 - Paxford Composites Minute Averaged VOC Emissions Data, Spray Booth Two - 11th May 2011
(273.15K, 101.325kPa, on a Wet Gas basis) using the NPL Conventional Analysis Package



2.3.6 - Gas Calibration Record

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Calibration Log

Instrument SN:		Type		Job No:	Page No:
		NOx			
Mobile Lab: NPL				Client Site:	3 of 3
				Other Equipment:	

Gas Cyl. No.			Gas Cyl Conc. ppm			Date.		Instrument Range:	
Cal Type	Time (Start and Finish)	Initial Reading	Initial Gain/Setting (if app.)	Final Reading	Final Gain/Setting (if app.)	System(S) / Direct(D)	Total Regulator Pressure (bar/Psi delete as app.)	Comment	Signature
Check Zero								Zero Drift: ____%	
Zero Adj								Span Drift: ____%	
Check Span								Response Time : ____sec	
Span Adj								Span Value: ____ppm	
Check Zero								2 X Repeatability @ Zero =	
Check Zero									
Check Span									
Zero Adj									
Span Adj									
Check Zero									

Instrument SN: AS0452		Type		Paxford Composites Spray Booth Two	
		VOC			
NPL					

Gas Cyl. No. 163226			Gas Cyl Conc. 10.9ppm Propane Delete as app.			Date. 11/05/2011		Instrument Range: 0 - 100 ppm	
Cal Type	Time (Start and Finish)	Initial Reading	Initial Gain/Setting (if app.)	Final Reading	Final Gain/Setting (if app.)	System(S) / Direct(D)	Total Regulator Pressure (bar/Psi delete as app.)	Comment	Signature
Check Zero	12:50	0.01	4.83			D	2000	Zero Drift: <2%	MRE
Zero Adj	12:51			0	4.82	D		Span Drift: <2%	MRE
Check Span	12:52	1.061	2.33			D	1500	Response Time : 15 sec	MRE
Span Adj	12:53			1.09	2.42	D		Span Value: 10.9 ppm	MRE
Check Zero	12:55	0.015	4.82			D	2000		MRE
Check Zero	14:31	0.11	-			D	2000		MRE
Check Span	14:33	1.088	-			D	1500		MRE
Zero Adj									
Span Adj									
Check Zero	14:34	0.08	-			D	2000		MRE

IF REGULATOR PRESSURE IS LESS THAN 500 PSI (35 bar) CONTACT SUPPLIER IMMEDIATELY

MCERTS LEVEL2 with TE4
MCERTS ID: MM-05-682

Name: M.Ellison

NPL Ltd: 15 OCT 2009
Author: KCB

Revision 3
QPAS B 538

Reference: PAXFORD_HUNTINGDON_03MAY11_PPC
Permit: B01/02
Checked By: 

Version 1

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2.3.7 - Uncertainty Calculations

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

v15

Measurement Equation

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

Limit value (ELV)	50	mg.m ⁻³	Reference oxygen	21	% by volume
Measured concentration	4.15	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		0.5	uV _m	0.001	0.20	<=2%
Sampled gas Temperature	T _m		299	uT _m	2	0.67	<=1%
Sampled gas Pressure	p _m		101.3	up _m	1	0.99	<=1%
Sampled gas Humidity	H _m		0	uH _m	1	1.00	<=1%
Mass particulate	m		4.7	um	0.11	2.36	<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	UCM		0			0	<=10%
(Instack filter - no rinse)							

Intermediate calculations

Factor for std conds	fs		0.91	
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	0.46	uV	0.007 m ³
				1.56
				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	0.46 m ³	9.09	0.07 mg.m ⁻³	1.57 %
Mass	m	4.66 mg	0.89	0.10 mg.m ⁻³	2.36 %
Leak	L	0.05 mg.m ⁻³	1.00	0.05 mg.m ⁻³	1.15 %
Uncollected mass	UCM	0.00 mg	0.89	0.00 mg.m ⁻³	0.00 %
Combined measurement uncertainty				0.13 mg.m ⁻³	

Expanded uncertainty as percentage of measured value	6.22	% measured of value	expressed with a level of confidence of 95% (Using a coverage factor k=2)
Expanded uncertainty in units of measurement	0.26	mg.m ⁻³	
Expanded uncertainty as percentage of limit value	0.52	% ELV	

Note: Enter values into green boxes

Developed for the STA by R Robinson, NPL

Uncertainty calculation for Gaseous Measurement TOC to EN 12619:1999
V3.3 Nov-09

Limit value	50 mg/m ³ (corrected) TOC	Cal gas conc	17.43 mg/m ³ TOC
Measured concentration	55.48 mg/m ³	Full Scale	180.5 mg/m ³
Measured concentration	55.48 mg/m ³ (Corrected)		

Correction for reference conditions				
	ref	measured	Uncert	
Factors	21.00	20.95	0.00	101.30
Uncertainty in factor	0.00	0.00	1.00	0.00
Correction Factor	0.00	0.00	0.01	0.00

Performance characteristics	Value	Specification
Response time	15	seconds
Logger sampling interval	60	seconds
Measurement period	30	minutes
Number of readings in measurement	30	
Repeatability at zero	0.193	mg/m ³
Repeatability at span level	0.15	mg/m ³
Deviation from linearity (lack of fit)	0.4	mg/m ³
Zero drift	0.096	mg/m ³
Span drift	0.003	mg/m ³
Volume or pressure flow dependence	0.02	% of full scale/3 kPa
atmospheric pressure dependence	0.8	% of full scale/2 kPa
ambient temperature dependence	0.01	mg/m ³
O ₂ (% vol)	0.2	mg/m ³
SO ₂ (mg/m ³)	260	mg/m ³
NO (mg/m ³)	860	mg/m ³
NO ₂ (mg/m ³)	150	mg/m ³
CO (mg/m ³)	430	mg/m ³
CO ₂ (% vol)	18	mg/m ³
HCl (mg/m ³)	40	mg/m ³
H ₂ O (% vol)	20	mg/m ³
dependence on voltage	0.1	% full scale/10V
Control gas reading difference	10	% of value
losses in the line (leak)	1	% of value
Uncertainty of calibration gas	1.29	% of value

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 all zero
Drift	U ₃	0.23
Volume or pressure flow dependence	U ₄	0.06
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 (mg/m ³)	U ₉	0.13
NO 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	0.32
losses in the line (leak)	U ₁₆	0.41
Uncertainty of calibration gas	U ₁₇	9.27
control gas	U ₁₈	0.59
Uncertainty in factor	U ₁₉	

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%	1.18 mg/m ³
Expanded uncertainty	expressed with a level of confidence of 95%	2.36 % ELV
Expanded uncertainty	expressed with a level of confidence of 95%	1.18 mg/m ³
Expanded uncertainty	expressed with a level of confidence of 95%	2.13 % value

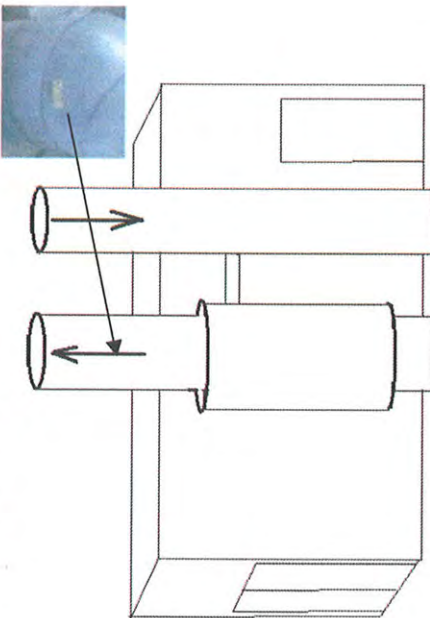
Effect of drift	0.11 mg/m ³
	0.07 % full scale

	low	pressure	temp	O ₂ range	SO ₂ range	NO range	NO ₂ range	CO range	CO ₂ range	HCl range	H ₂ O range
ranges	min	max	value at calib								
	85.00	105	100.92	100.88 kPa	0	300	0	500	0	5	93
	100.76	100.92	287.5 K	287.5 K	0	600	0	500	0	20	121
	287	288.5		20 % vol	0 mg/m ³	0 mg/m ³	0 mg/m ³	0 mg/m ³	0 % vol	0 mg/m ³	110 V

Use largest of sum of all positive or all negative influences	
Criteria	sum < 1 mg/m ³
Value to use for interference uncertainty	1.109520968
U _{int}	0.76

APPENDIX FOUR - SPRAY BOOTH THREE

2.4.1 Spray Booth Three Stack Diagram & Traverse Information

Test no	TRAVERSE		Site:	Paxford Composites	Stack Description:	SB3
Date	11-5-11		Time of Survey:	15:05		
Swirl Test Conducted	OK		SITE TEAM:	KCB/MRE		
Stack Pres (with +/- above barometric if unknown enter zero)	-7	mmH ₂ O	COMMENTS:	TRAVERSE		
Pitot Type and Tube ID	S-Type AS0440					Diagram of Sample Location: 
Conditions	Value	Units				
Stack pressure	770.29	mmHg				
Ref oxygen Value	21	%				
Moisture Content	0.3	%				
CO	0	ppm				
CO ₂	0	%				
N ₂	79.05	%				
O ₂	20.95	%				
dry molecular wt	28.84					
stack molecular wt	28.81					
area of stack	0.59	m ²				
Pbar	1027.4	mbar				
Pbar	771	mmHg				
Flow Criteria Measurements			Fulfilled?			
pitot tube coef	0.83		Is the gas flow angle <15° to the duct axis?		Yes ✓	
Reference Temp	273	K	Is there any local negative flow?		No ✓	
Reference Pressure	760	mmHg	Is the flow rate high enough to be measured?		Yes ✓	
PITOT LEAK CHECK (Yes/No)	YES		Ratio of flows less than 3:1 (or 9:1 for pressure readings?)		Yes ✓	

SAMPLING LINE: A							
Traverse Point	Distance into duct (m)	Δp mm H ₂ O	Δp Pa	Stack Temp T _s °C	Velocity @ stack gas T&P on wet gas basis m/s	Angle of Swirl °	$\sqrt{\Delta p}$
1	A1	5.50	53.92	21	7.84	<15	2.35
2	A2	5.50	53.92	21	7.84	<15	2.35
3	A3	5.75	56.37	21	8.01	<15	2.40
4	A4	7.00	68.62	21	8.84	<15	2.65
5	A5	7.75	75.97	22	9.32	<15	2.78
6	A6	8.00	78.42	22	9.47	<15	2.83
7	A7	5.50	53.92	22	7.85	<15	2.35
8	A8	5.75	56.37	22	8.03	<15	2.40
9	A9	5.00	49.02	22	7.48	<15	2.24
10	A10	4.75	46.56	21	7.28	<15	2.18
Average values		6.1	59.31	21.5	8.22	<15	2.46
Duct / Stack Flow Characteristics:							
Test No: SB3							
TRAVERSE							
Average Units							
Stack Velocity at stack gas T & P and a wet gas basis		8.22			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		4.85			m ³ s ⁻¹		
Stack flow @ stack gas T & P and on a dry gas basis		4.84			m ³ s ⁻¹		
Stack flow @ STP and on a wet gas basis		4.56			m ³ s ⁻¹		
Stack flow @ STP, O ₂ (ref) and on a wet gas basis		N/A			m ³ s ⁻¹		

2.4.2

SB3 Particulates Results Summary

Field	Units	Blank	TEST 1
Date	dd/mm/yyyy	11/05/2011	11/05/2011
Test No.		Blank	SB3 PM Test 1
Filter No.		11TF106	11TF105
Stack Description		SB3	SB3
Start Time	hh:mm	-	15:33
End Time	hh:mm	-	16:03
Total Time	min	-	30
Stack Temp.	C	-	22
Gas Meter Temp	C	-	20
Gas Meter Pressure	kPa	-	102.7
Filter	mg	0.0	3.4
Washings	mg	0.0	0.3
TOTAL Mass Collected	mg	0.0	3.6
Test H2O	% Vol	-	0.3
Stack Temp	°C	-	22.3
Stack Pressure	kPa	-	102.7
Nozzle Diameter	mm	-	9.52
Duct Area	m ²	-	0.64
Isokinicity	%	-	103
Stack Velocity	Stack T & P, uncorrected, ms ⁻¹	-	7.60
Gas Vol. Sampled	Dry Gas Basis, Ambient T and P	-	0.92
Gas Vol. Sampled	Wet Gas Basis, Standard T and P	-	0.94
Particulate Concentration	Wet Gas Basis, Standard T and P, mg Nm ⁻³	<0.2	3.9
Expanded Uncertainty	+/-mg Nm ⁻³ , 95% Conf. k=2	-	0.3
Emission Limit Value (ELV)	Wet Gas Basis, Standard T and P, mg Nm ⁻³	50	50
Percentage of Emission Limit Value (ELV) for Test	Dry Gas Basis, Standard T and P, %	0	8
Mass Emission	Wet Gas Basis, Standard T and P, g s ⁻¹	-	0.02

2.4.3 - Particulate Field Data Sheet

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

Test no	SB3 PM Test 1		Site:	Paxford	Stack Description:	SB3
Date	11-5-11		Filter No:	11TF105	Absorber No(s):	T01,A-D
nozzle diameter	9.52	mm	Blank I.D.:	11TF106		
Stack Pres (with +/- above barometric if unknown enter zero)	-7	mmH ₂ O	SITE TEAM:		KCB & MRE	
			COMMENTS:		Particulates Test 1 of 1	
end volume reading	512.930	m ³	end time	16:03	hh:mm	Control Box I.D. No: AS0240
start volume reading	512.008	m ³	start time	15:33	hh:mm	Stack Thermocouple I.D. No. 1.5M APEX
volume sampled	0.922000	m ³	total time	00:30	hh:mm	Probe and Pitot I.D. No. AS0440
Conditions	Value	Units	stop time	00:00	hh:mm	Barometer I.D. No. AS0252
Stack pressure	770.31	mmHg	Diagram of Sample Location: See Traverse			
Gas Meter Calibration Factor Y	1.0623					
Ref oxygen Value	21	%				
Moisture content	0.3	%				
CO	0	ppm				
CO ₂	0	%				
N ₂	79.10	%				
O ₂	20.9	%				
dry molecular wt	28.84					
stack molecular wt	28.80					
Orifice ΔH@ Factor	44.80	mmH ₂ O				
area of stack	0.59	m ²				
Pbar	1027.4	mbar	Pre Vac (in Hg):		15	Post Vac (in Hg): 2
Pbar	770.8	mmHg	Leak rate (m ³ /l) or (%):		<2%	Leak rate (m ³ /l) or (%): <2%
pilot tube coeft	0.830					
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 / setting 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:	15:33	512.0080	A1	5	5.50	110.0	22	N/A	N/A	16	N/A	17	17	1.0
2:	15:38	512.1680	A2	5	5.75	115.0	22	N/A	N/A	17	N/A	18	18	1.0
3:	15:43	512.3270	A3	5	5.75	115.0	22	N/A	N/A	19	N/A	19	19	1.0
4:	15:48	512.4900	B1	5	4.50	90.0	22	N/A	N/A	21	N/A	20	20	1.0
5:	15:53	512.6360	B2	5	4.50	90.0	23	N/A	N/A	23	N/A	21	21	1.0
6:	15:58	512.7810	B3	5	5.00	100.0	23	N/A	N/A	25	N/A	22	22	1.0
7:	16:03	512.9300	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 / setting 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
44:														
45:														
46:														
47:														
48:														
Summary values		512.9300		30		103.33	22.3	#DIV/0!	#DIV/0!	20.2	n/a		19.5	1.0

Duct / Stack Flow Characteristics:	SB3	Units
Test No	SB3 PM Test 1	
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	7.60	m ³ s ⁻¹
Stack flow @ stack gas T & P and on a wet gas basis	N/A	m ³ s ⁻¹
Stack flow @ stack gas T & P and on a dry gas basis	4.48	m ³ s ⁻¹
Stack flow @ STP and on a wet gas basis	4.47	m ³ s ⁻¹
Stack flow @ STP and on a dry gas basis	4.20	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	0.94	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	0.94	m ³
Gas vol. samp. @ STP, O ₂ (ref) and on a wet gas basis	N/A	m ³
Percentage Isokineticity	103	%

Reference: PAXFORD_HUNTINGDON_03MAY11_PPC

Permit: B01/02

Checked By: 

2.4.4 - Moisture Calculation

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

National Physical Laboratory
Absorber Test Form

Test No	SB3 PM Test 1
Date	11-5-11
pbar (mbar)	1027
pbar (mmHg):	771
nozzle diameter (mm)	9.52
Temp of Meter (In)/(out) deg. C	20
ΔH_{ave} (mmH ₂ O)	103.3
Filter No (if app)	11TF105

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

End Volume Reading	512.93	m ³
Start Volume reading	512.01	m ³
Volume Sampled	0.92	m ³

end time	16:03	hr:min
start time	15:33	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:	Moisture	Moisture	Moisture	Moisture				MRE
Weight of jars plus absorber plus washings (g)								
Weight of Jars plus absorber after sampling (g)	794.780	771.120	579.160	958.220				MRE
Weight of Jars plus absorber (g)	804.070	773.060	579.220	944.580				MRE
Weight of Jars (g)								
Weight Gain (g)	-9.29	-1.94	-0.06	13.64	0	0	0	

Total Weight Gain (1+2+3+4) (g)	2.35
---------------------------------	------

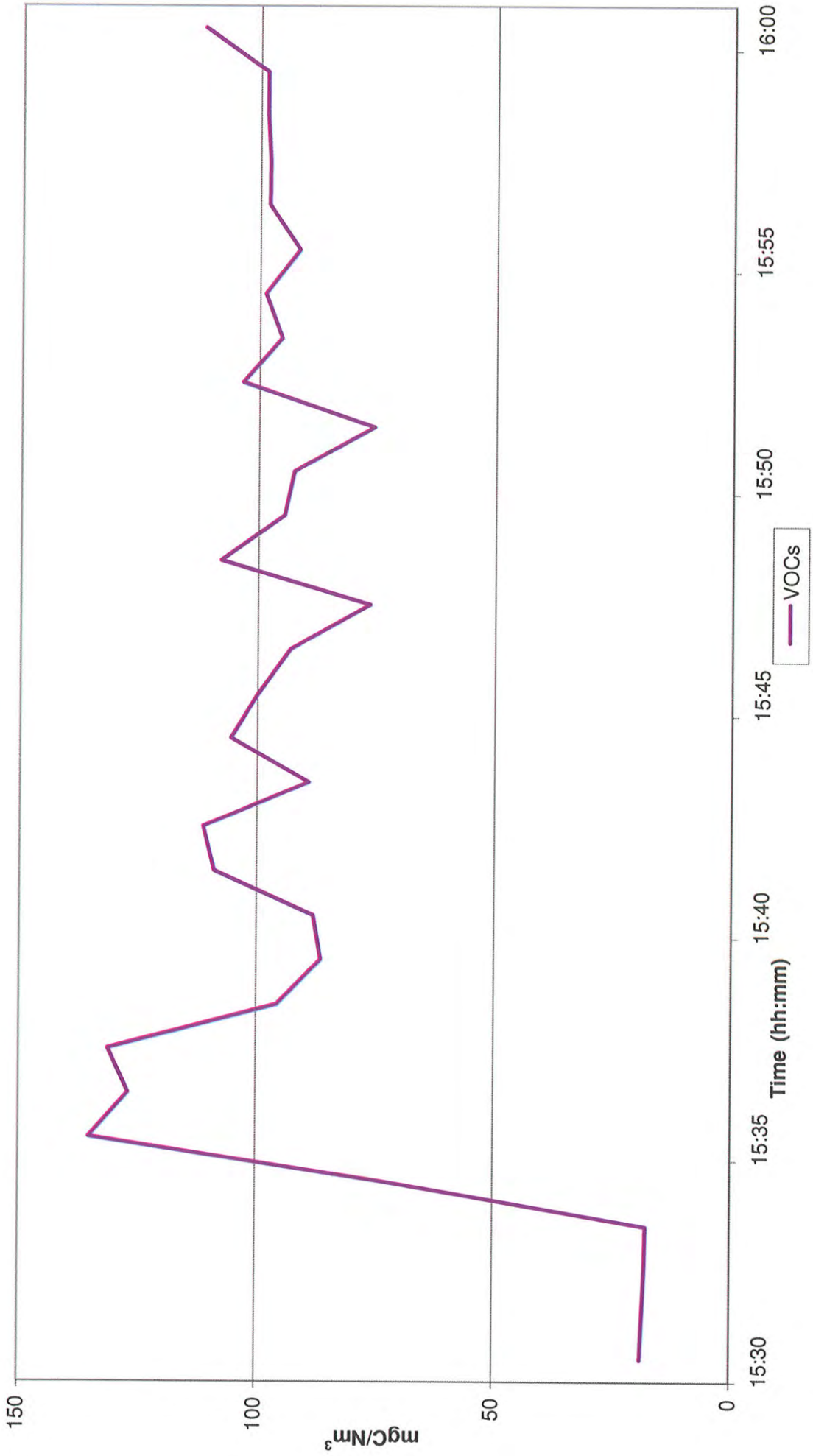
Gas Volume of water at 0°C (l)	2.93
Gas Meter volume at 0°C (l)	881.37

Moisture content of Gases (%)	0.3
-------------------------------	-----

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 $V_{mc} = 359.2 \times \text{gas meter reading (m}^3) \times (\text{Pbar} + \text{delta H}/13.6) / (\text{meter temp} + 273)$
 moisture content (fraction) = $V_{wc}/(V_{wc}+V_{mc})$
 an approximation is: 1 m³ of gas weighs approx 1.2 kg
 moisture content approx = $\frac{\text{wt of water collected (g)} \times 100}{\text{wt of water collected (g)} + (\text{m}^3 \text{ of gas on meter} \times 1200)}$

2.4.5 - Paxford Composites Minute Averaged VOC Emissions Data, Spray Booth Three - 11th May 2011
(273.15K, 101.325kPa, on a Wet Gas basis) using the NPL Conventional Analysis Package



2.4.6 - Gas Calibration Record

NATIONAL PHYSICAL LABORATORY
Continuation Sheet

Calibration Log

Instrument SN:		Type		Job No:	Page No: 3 of 3
		NOx			
Mobile Lab: NPL				Client Site:	
				Other Equipment:	

Gas Cyl. No.		Gas Cyl Conc.		ppm		Date	Instrument Range:	
Cal Type	Time (Start and Finish)	Initial Reading	Initial Gain/Setting (if app.)	Final Reading	Final Gain/Setting (if app.)	System(S) / Direct(D)	Total Regulator Pressure (bar/Psi delete as app.)	Comment
Check Zero								Zero Drift: ____%
Zero Adj								Span Drift: ____%
Check Span								Response Time : ____sec
Span Adj								Span Value: ____ppm
Check Zero								2 X Repeatability @ Zero =

Instrument SN: AS0452		Type		Paxford Composites Spray Booth Three
		VOC		
NPL				

Gas Cyl. No. 163226		Gas Cyl Conc. 10.9ppm Propane		Delete as app.		Date. 11/05/2011	Instrument Range: 0 - 100 ppm	
Cal Type	Time (Start and Finish)	Initial Reading	Initial Gain/Setting (if app.)	Final Reading	Final Gain/Setting (if app.)	System(S) / Direct(D)	Total Regulator Pressure (bar/Psi delete as app.)	Comment
Check Zero	15:18	0.2	4.82			D	2000	Zero Drift: <2%
Zero Adj	15:19			0	4.8	D		Span Drift: <2%
Check Span	15:20	1.16	2.42			D	1500	Response Time : 15 sec
Span Adj	15:21			1.09	2.38	D		Span Value: 10.9 ppm
Check Zero	15:23	0.02	4.8			D	2000	
Check Zero	16:16	0.13	-			D	2000	
Check Span	16:18	1.103	-			D	1500	
Zero Adj								
Span Adj								
Check Zero	16:20	0.09	-			D	2000	

IF REGULATOR PRESSURE IS LESS THAN 500 PSI (35 bar) CONTACT SUPPLIER IMMEDIATELY

MCERTS LEVEL2 with TE4
MCERTS ID: MM-05-682

Name: M.Ellison

NPL Ltd: 15 OCT 2009
Author: KCB

Revision 3
QPAS B 538

Reference: PAXFORD_HUNTINGDON_03MAY11_PPC
Permit: B01/02
Checked By:

2.4.7 - Uncertainty Calculations

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

v15

Measurement Equation

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

Limit value (ELV)	50 mg.m ⁻³	Reference oxygen	21 % by volume
Measured concentration	3.88 mg.m ⁻³ (at reference conditions)		

Measured Quantities	Symbol	Value	Standard uncertainty	Units	Uncertainty as percentage	Uncertainty at iv	Requirement of std
Sampled Volume	V _m	0.5	0.001	m ³	0.20		<=2%
Sampled gas Temperature	T _m	299	2	K	0.67		<=1%
Sampled gas Pressure	p _m	101.3	1	kPa	0.99		<=1%
Sampled gas Humidity	H _m	0	1	% by volume	1.00		<=1%
Mass particulate	m	3.6	0.11	mg	3.02	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	UCM	0		mg	0		<=10%
(Instack filter - no rinse)							
Intermediate calculations							
Factor for std conds	f _s	0.91					
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	0.46		uV	0.007 m ³	V = V _m f _s	1.56
							1.57

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

Parameter	Value	Units	Sensitivity coeff	Uncertainty contribution	Uncertainty as %
Corrected Volume (standard)	V	0.46 m ³	8.51	0.06 mg.m ⁻³	1.57 %
Mass	m	3.65 mg	1.06	0.12 mg.m ⁻³	3.02 %
Leak	L	0.04 mg.m ⁻³	1.00	0.04 mg.m ⁻³	1.15 %
Uncollected mass	UCM	0.00 mg	1.06	0.00 mg.m ⁻³	0.00 %
Combined measurement uncertainty				0.14 mg.m ⁻³	
Expanded uncertainty as percentage of measured value		7.26	% measured of value		expressed with a level of confidence of 95% (Using a coverage factor k=2)
Expanded uncertainty in units of measurement		0.28	mg.m ⁻³		
Expanded uncertainty as percentage of limit value		0.56	% ELV		

Note: Enter values into green boxes

Developed for the STA by R Robinson, NPL

Reference: PAXFORD_HUNTINGDON_03MAY11_PPC

Permit: B01/02

Checked By: 

Version 1

Uncertainty calculation for Gaseous Measurement TOC to EN 12619:1999
V3.3
Nov-09

Limit value	50 mg/m ³ (corrected) TOC	17.43 mg/m ³ *TOC
Measured concentration	88.33 mg/m ³	Full Scale
Measured concentration	88.33 mg/m ³ (Corrected)	180.5 mg/m ³

Correction for reference conditions				
	O ₂ %	Moisture, %	Pressure, kPa	Temperature, K
	ref	21.00	0.00	101.30
	measured	20.95	0.00	101.30
	Uncert1	0.00	1.00	0.00
		0.00	1.00	1.00
Factors				
Uncertainty in factor	0.00	0.01	0.00	0.00
Correction Factor	0.00	0.01	0.00	0.00

Effect of drift	0.28 mg/m ³
	0.18 % full scale

Performance characteristics	Value	specification
Response time	30 seconds	60.000
Logger sampling interval	60 seconds	
Measurement period	30 minutes	
Number of readings in measurement	30	
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	0.2	0.4 mg/m ³ (long term)
Span drift	0.02	0.7 mg/m ³ (long term)
Volume or pressure flow dependence	0.02	-2 % / 3 kPa
atmospheric pressure dependence	0.8	-3 % / 2 kPa
ambient temperature dependence	0.01	0.5 mg/m ³ / 10K (at span)
O ₂ (% vol)	20	0.6 mg/m ³
SO ₂ (mg/m ³)	260	
NO (mg/m ³)	890	
NO ₂ (mg/m ³)	150	
CO (mg/m ³)	450	
CO ₂ (% vol)	18	
HCl (mg/m ³)	40	
H ₂ O (% vol)	20	
dependence on voltage	0.2	
Control gas reading difference	0.1	
losses in the line (leak)	10	
Uncertainty of calibration gas	1	
	1.29	

Performance characteristics	Uncertainty	Value of uncertainty quantity
Standard deviation of repeatability at zero	U ₀	0.02
Standard deviation of repeatability at span level	U _s	use rep at zero
Lack of fit	U _{lc}	0.23
Drift	U _{dr}	0.16
volume or pressure flow dependence	U _{vol}	0.03
atmospheric pressure dependence	U _{pres}	0.04
ambient temperature dependence	U _{temp}	0.00
O ₂	U _{SO2}	0.11
SO ₂ (mg/m ³)	U _{NO}	0.13
NO (mg/m ³)	U _{NO2}	0.08
NO ₂ (mg/m ³)	U _{CO}	0.04
CO (mg/m ³)	U _{CO2}	0.13
CO ₂ (% vol)	U _{HCl}	0.01
HCl (mg/m ³)	U _{H2O}	0.12
H ₂ O (% vol)	U _{losses}	0.14
Dependence on voltage	U _{uncal}	0.51
losses in the line (leak)	U _{control}	0.66
Uncertainty of calibration gas	U _{uncal}	0.97
control gas	U _{control}	0.95
Uncertainty in factor	U _{total}	

Use largest of sum of all positive or all negative influences
Criteria
sum < 1 mg/m ³
1.777853923
Value to use for interference uncertainty
U _{int}
0.78

Measurement uncertainty		
Combined uncertainty	9.34	mg/m ³
Expanded uncertainty	18.68	mg/m ³
Uncertainty corrected to aid cond		
Expanded uncertainty	expressed with a level of confidence of 95%	3.78 % ELV
Expanded uncertainty	expressed with a level of confidence of 95%	1.89 mg/m ³
Expanded uncertainty	expressed with a level of confidence of 95%	2.13 % value