

BS EN 14181 Report

Permit Number: **RP3133LD**
Operator: **RWE Generation UK plc.**
Installation: **Aberthaw Power Station**
Installation Type: **Coal-Fired Power Station**
Emission Point: **Unit 8**
Monitoring Dates: **3rd – 5th March 2015**



1709



Contract Reference: FTBS 29312
Operator: RWE Generation UK plc.
Address: Aberthaw Power Plant
The Leys
Aberthaw, Nr Barry
South Glamorgan
CF62 4ZW
Client Contact: Richard Kadim
Monitoring Organisation: RPS Consultants
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Report Date: 17th September 2015
Report Author: Glyn Harrison
Report Approved By: Richard Harvey
Position: Principal Consultant
MCERTS Qualifications: Level 2, Technical Endorsements 1, 2, 3 & 4
MCERTS Registration No.: MM 02 020
Signature:

A handwritten signature in black ink, appearing to read 'Richard Harvey', enclosed in a rectangular box.

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Section 1 – Executive Summary

1B.1 Result Summary – QAL2

EN 14181 Test Type		QAL2				
Stack designation		Unit 8				
Measurand	Correlation coefficient of parallel data (R^2)	Derived Calibration function (y_i)		Calibrated Range ²	Extrapolated Calibrated Range ³	Variability Test
		$y_i = a + bx_i$				
Oxides of Nitrogen (GM32)	0.8661	5.83 ¹	0.853 ¹	0 – 1058 mg/m ³	0 – 2060 mg/m ³	Pass
Sulphur Dioxide (GM32 – Low Range)	0.9907	-1.739 ¹	1.026 ¹	0 – 519 mg/m ³	0 – 2563 mg/m ³	Pass
Sulphur Dioxide (GM32 – High Range)	0.9907	-1.972 ¹	1.025 ¹	0 – 519 mg/m ³	0 – 2563 mg/m ³	Pass
Oxides of Nitrogen (Procal 2)	0.9108	20.354 ¹	0.998 ¹	0 – 1085 mg/m ³	0 – 1651 mg/m ³	Pass
Sulphur Dioxide (Procal 2 – Low Range)	0.9930	-20.572 ¹	1.034 ¹	0 – 495 mg/m ³	0 – 571 mg/m ³	Pass
Sulphur Dioxide (Procal 2 – High Range)	0.9927	-21.757 ¹	1.043 ¹	0 – 494 mg/m ³	0 – 571 mg/m ³	Pass

Notes:

- 1 – Calibration function derived using Method A.
- 2 – Calibrated range derived using parallel test data extended 10%.
- 3 – Calibrated range extrapolated using reference materials.

Note: The calibration functions, once applied, only remain valid as long as the QAL 3 data remains within control limits, and there are no manual adjustments made to the CEMS other than those allowed to bring the settings back within the QAL 3 control limits.

1B.2 Result Summary - AST

EN 14181 Test Type		AST						
Stack designation		Unit 8						
Measurand	Correlation coefficient of raw data (R^2)	Established Calibration function (y_i)		Established Calibrated Range ³	AST Calibrated Range ³	Extrapolated Calibrated range ⁴	Variability Test	Test of Calibration Function
		$y_i = a$	$+ bx_i$					
Oxides of Nitrogen (Procal 1)	0.9607	10.7	0.996	0 – 1320 mg/m	0 – 1211 mg/m ³	-	Pass	Pass
Sulphur Dioxide (Procal 1 – Low Range)	0.9529	-1.9	0.98	0 – 677.8 mg/m	0 – 500 mg/m ³	-	Pass	Pass
Sulphur Dioxide (Procal 1 – High Range)	0.9542	-1.8	0.984	0 – 2781 mg/m	0 – 531 mg/m ³	-	Pass	Pass
Total Particulate Matter (Erwin SICK)	0.4621	-0.303 ¹	1.208 ¹	0 – 24.6 mg/m ³	0 – 33.4 mg/m ³	0 – 64.8 mg/m	Pass	Pass

Notes:

- 1 – Calibration function derived using Method A.
- 2 – Calibrated range derived using parallel test data extended 10%.
- 3 – Calibrated range extrapolated using reference materials.

Note: The calibration functions, once applied, only remain valid as long as the QAL 3 data remains within control limits, and there are no manual adjustments made to the CEMS other than those allowed to bring the settings back within the QAL 3 control limits.

1C Deviations

SRM deviations	None
Reason for deviation	None
EN 14181 deviations	None
Reason for deviation	N/A
Impact on results	N/A
Further actions required	None

Section 2 - Information about the Regulated Installation

2.1 Regulatory Information

Name of operator	RWE Generation UK plc.
Name of Installation	Aberthaw Power Station
Address of installation	The Leys Aberthaw, Nr Barry South Glamorgan CF62 4ZW
Sector	LCPD
Permit Number	RP3133LD
Date of last QAL 2/AST	February 2014, QAL2

Regulated Determinands

Determinand	Emission Point	48-Hour Mean	Calendar Monthly	Uncertainty Requirement
Oxides of Nitrogen	Unit 8	1210 mg/m ³ (NO _x as NO ₂)	1100 mg/m ³ (NO _x as NO ₂)	20% at the ELV
Sulphur Dioxide	Unit 8	440 mg/m ³	400 mg/m ³	20% at the ELV
Total particulate Matter	Unit 8	55 mg/m ³	25 mg/m ³	30% at the ELV

Note: ELVs at reference conditions 273K, 101.3kPa, 6% oxygen, dry gas

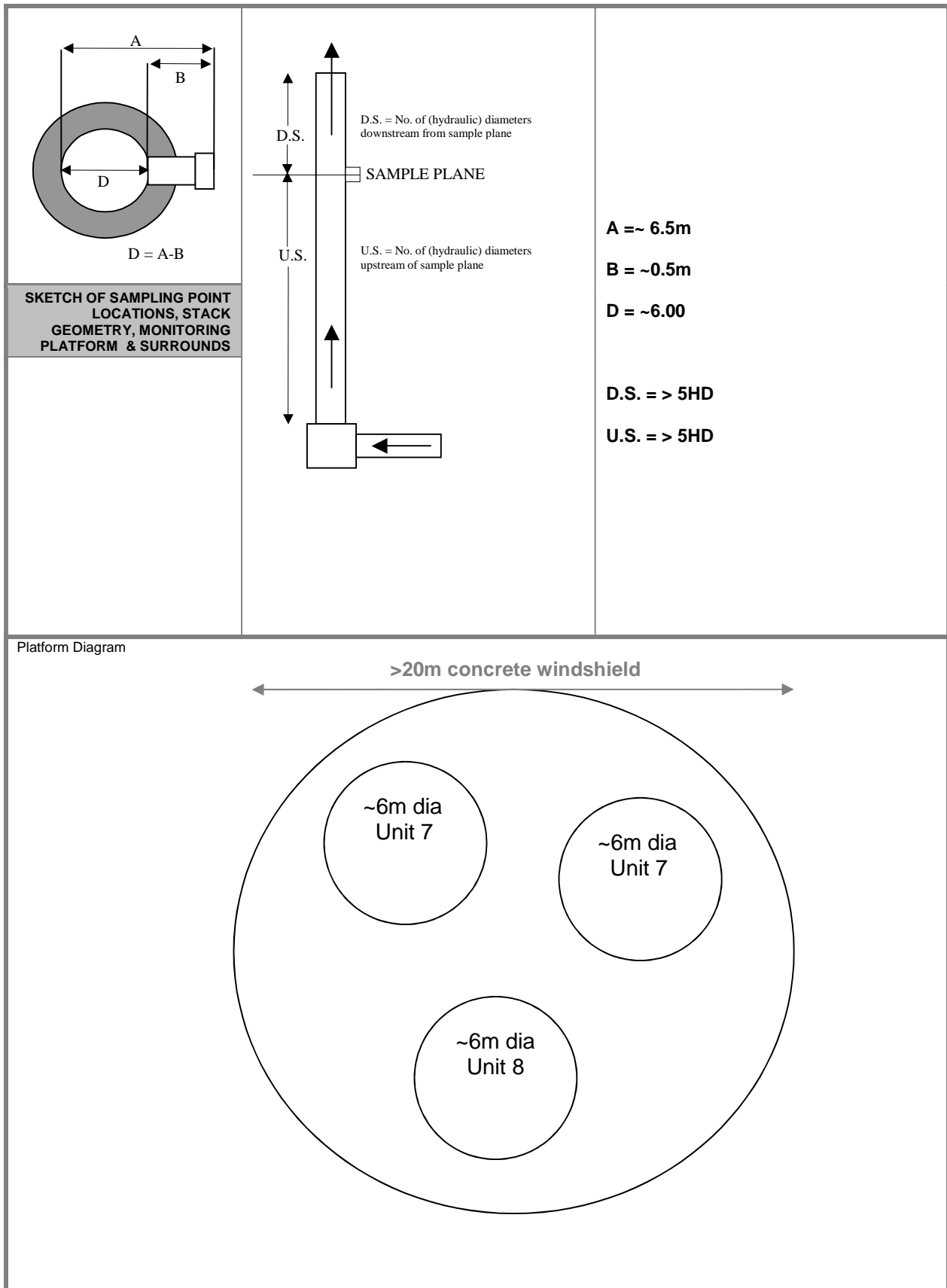
2.2 Operational Information and site monitoring provisions

2.2.1 Process type and emissions variations

Process Type	Continuous - Coal-Fired Power Station
Process Variations	Once operational at maximum load variation is minimal
Expected emissions variations	
1 Oxides of nitrogen	1050 - 1250 mg/m ³ as NO ₂ – constant
2 Sulphur Dioxide	10 - 40 mg/m ³ – constant
3 Oxygen	6 – 6.5% – constant
Possible low level emissions	Sulphur Dioxide
Provision to deal with low level emissions	Use values from linearity checks to derive calibrated range
Other factors affecting monitoring results	None
Fuel type	Coal
Abatement	Flue Gas Desulphurisation & Combustion control

2.3 Monitoring Provisions at the installation

2.3.1 Stack & sampling ports



Photograph of Stack Photo of Monitoring Platform



Access was limited to ports due to the stack layout inside the windshield. The port shown is one of four.

2.3.2 Monitoring platform and site provisions

Requirement	Compliant	Notes
<ul style="list-style-type: none"> A safe and clean working environment with sufficient space and weather protections. 	CEMs cabinet – Monitoring probe -	Both cabinet and probe are located inside the windshield and are thus in a spacious, clean and weatherproof environment.
<ul style="list-style-type: none"> Easy and safe access to the CEM. 	CEMS cabinet – Monitoring probe -	Stairways to the relevant levels.
<ul style="list-style-type: none"> Adequate supplies of reference materials, tools and spare parts. 	Yes	
<ul style="list-style-type: none"> Facilities to introduce the reference materials for gaseous-monitoring systems, both at the inlet of the sampling line (where present), and at the inlet of the CEM. 	N/A	There is no facility to introduce reference materials to the sample line or CEM. The CEMs are cross-duct IR (NO, NO ₂ , SO ₂) and cross-duct forward scatter (particulate).
<ul style="list-style-type: none"> Compliance with TGN M1 	No	Unable to access sample port B
<ul style="list-style-type: none"> Compliance with EN 15259 – <p>flow stability criteria (if applicable),</p> <p>Stack gas homogeneity.</p>	<p>Yes</p> <p>Yes</p>	<p>Stack gas homogeneity carried out previously by Atkins.</p>

Temperature and Velocity Profile

Company Name: RWE Date: 03/03/15
Site Name: Aberthaw Run: 1
Sampling Point Ref: Unit 8 Barometric Press. Mbar: 1009
Project Reference: FTBS 29312
Stack Diameter (m): 6.00
Stack Static press.mm H₂O: -30 Stack Area (m²): 28.274

Traverse Point No.	Port A			Port C			Port D		
	Δp , mm H ₂ O	Root Δp	Stack Temp °C	Δp , mm H ₂ O	Root Δp	Stack Temp °C	Δp , mm H ₂ O	Root Δp	Stack Temp °C
1	28	5.292	67						
2	30	5.477	68						
3	32	5.657	68						
4									
5									
6									
7									
8				26	5.099	67	26	5.099	67
9				30	5.477	68	30	5.477	68
10				32	5.657	68	32	5.657	68
Minimum	28.0	5.292	67	26.0	5.099	67	26.0	5.099	67
Maximum	32.0	5.657	68	32.0	5.657	68	32.0	5.657	68
Mean	30.0	5.475	67.7	29.3	5.411	67.7	29.3	5.411	67.7
Sum	90	16.426	203	88	16.233	203	88	16.233	203
Total Sum							266	48.892	609

Max. pitot press. = 32.0
Min. pitot press. = 26.0
Ratio Max:Min = 1.2 :1

Notes : Port B inaccessible due to wall
Traverse points are those reachable
with usable length probe in windshell

2.4.1 Continuous Emissions Monitoring Systems at the installation

	Procal 1 & 2	SICK	SICK
Determinand	NO _x & SO ₂	NO _x & SO ₂	Particulate
Type	In Situ IR	In-situ Probe – UV-DOAS	Cross Duct Forward Scatter
Make	Procal	SICK Maihak GmbH	Erwin Sick
Model	Pulsi 200 series	GM32 – In-situ	OMD41
MCERTS Certificate	MC990006/07	MC100163/01	MC040042/01
Certification ranges	NO = 0 – 1000 ppm SO ₂ low = 0 – 250 ppm SO ₂ high = 0 – 1000 ppm	Measuring path length 1.25m: NO 0 to 70 mg/m ³ & 0 to 700 mg/m ³ SO ₂ 0 to 75mg/m ³ & 0 to 1000mg/m ³ Measuring path length 1.00m NO 0 to 87.5 mg/m ³ & 0 to 875 mg/m ³ SO ₂ 0 to 93.8 mg/m ³ and 0 to 1250 mg/m ³	0 – 0.3 extinction
Operational ranges	As Above	SO ₂ Low: 0 – 250 ppm SO ₂ High: 0 – 1000ppm NO: 0 – 1000ppm NO ₂ : 0 - 100ppm	0 – 50 mg/m ³
Principle	Dual wavelength infra-red	UV DOAS	Opacity
Raw data units	ppm	ppm	Extinction
Reference condition of raw data	wet gas, no oxygen correction	wet gas, no oxygen correction	wet gas, no oxygen, temp or pressure correction
Signal output	4-20 mA	4 – 20mA	Fibre optics
Provision for logging of 14181 data	Data logged by DCS		
Location of sample	Measurement taken at monitoring platform. SRM sample obtained from monitoring platform.		
Moisture – Measurement or calculated	Measured Measured	Measured	Measured

Section 3 – Information about the Monitoring campaign

Table 3.1 - Monitoring Organisation Staff Details

Project Manager	Position	MCERTS Level	Technical Endorsements	Expiry Dates	MCERTS Registration Number
Glyn Harrison	Operations Manager (Stack Emissions)	2	1	10/19	MM 03 228
			2	06/17	
			3	12/16	

Site Team	Position	MCERTS Level	Technical Endorsements	Expiry Dates	MCERTS Registration Number
Ian Baggley	Consultant	2	1	06/18	MM 05 642
			2	03/20	
			3	12/17	
			4	03/17	
Chris Davies	Consultant	2	1	12/19	MM 03 252
			2	12/15	
			3	12/17	
			4	06/16	

Report Author	Position	MCERTS Level	Technical Endorsements	Expiry Dates	MCERTS Registration Number
Glyn Harrison	Operations Manager (Stack Emissions)	2	1	10/19	MM 03 228
			2	06/17	
			3	12/16	

Report Reviewer	Position	MCERTS Level	Technical Endorsements	Expiry Dates	MCERTS Registration Number
Richard Harvey	Principal Consultant	2	1	11/17	MM 02 020
			2	03/20	
			3	03/16	
			4	12/15	

3.2 - Monitoring Organisation Method Details

Emission Parameter	Standard Method	Monitoring Procedure No.	Monitoring Accreditation Status	Analysis Technique	Expected Uncertainty (%)	Analysis Procedure No.	Analytical Laboratory	Analysis Accreditation Status
Oxides of Nitrogen (as NO ₂)	BS EN 14792:2005	RPSCE/1/21f	MCERTS	Chemiluminescence	6	N/A	N/A	N/A
Oxygen	BS EN 14789:2005	RPSCE/1/21g	MCERTS	Zirconia Cell	5	N/A	N/A	N/A
Sulphur Dioxide	TGN M22	RPSCE/1/24	MCERTS	FTIR	10	N/A	N/A	N/A
Total particulate Matter	BS EN 13284:2002	RPSCE/1/7c	MCERTS	Gravimetric	10 - 30	D9	RPS	UKAS

Equipment details

Emission Parameter	Analysis Technique	Analyser	Analyser Certification Status	Certified Ranges	Operational Ranges	Operating Principle
Oxygen	Zirconia Cell	Horiba PG 250	MCERTs certificate No MC050056/02	0 – 25%	0-25%	Extractive, multicomponent dry gas analyser. Sample extracted through sample probe and 5metre heated sample line (with integral heated filter) – line temperature 180°C. Sample line connected directly to a gas conditioner (peltier cooler) set at 3°C. Cold dry sample then passes to analyser. Sample is drawn through system by integral pump built into analyser.
Oxides of Nitrogen	Chemiluminescence	Horiba PG 250	MCERTs certificate No MC050056/02	NOx 0 – 130 mg/m ³	0 – 1000 ppm	
Sulphur Dioxide	FTIR	Gasmet DX4000	MCERTs certificate No MC30014/05	0 – 75mg/m ³	0 – 500 ppm	Extractive wet gas analyser. Sample obtained non-isokinetically. Sample extracted through sample probe and filtered before passing through 5metre heated sample line (with integral heated filter) – line temperature 180°C. Sample line connected directly to a heated sample pump which in turn was connected to the FTIR. Hot, wet sample then passes to analyser.
Stack Gas Moisture	FTIR	Gasmet DX4000	MCERTs certificate No MC30014/05	0-40%	0-40%	
Total Particulate Matter	Multipoint isokinetic sampling with in stack filtration	N/A	N/A	0 – 50mg/m ³	-	Extractive manual test. Sample obtained isokinetically through sharp edged nozzle. Sample gas passed through a pre weighed, pre blown filter. Filter holder mounted in-stack.

Section 4A1: Data & calculations – QAL2 – Unit 8, SICK GM32

Section 4A1 – Data and calculations – QAL2 SICK GM32

4A1.1 Table 4.1.1 – Raw monitoring Data – Oxides of Nitrogen

Test No	Test Date	Test Start Time	Test End Time	CEMS Raw Value (Wet)	CEMS Oxygen	CEMS Moisture	SRM Raw Value (Dry)	SRM Oxygen (Dry)	SRM Moisture	SRM at CEMs Raw conditions (wet)
		hr:min		NO (ppm)	(%)	(%)	NOx (ppm)	(%)	(%)	NOx (ppm)
1	03-Mar-15	12:00	13:00	392.51	6.11	2.22	385.84	6.37	2.38	376.6
2	03-Mar-15	14:02	15:02	391.70	6.14	2.10	379.00	6.47	2.30	370.3
3	03-Mar-15	16:04	17:04	380.51	6.11	2.01	359.08	6.50	2.18	351.2
4	03-Mar-15	18:06	19:06	368.71	6.08	2.06	345.18	6.58	2.20	337.6
5	03-Mar-15	20:08	21:08	327.85	6.15	2.00	307.58	6.64	1.96	301.6
6	03-Mar-15	22:10	23:10	295.07	6.02	2.11	275.87	6.61	2.09	270.1
7	04-Mar-15	0:00	1:00	299.32	5.99	2.14	275.44	6.64	2.23	269.3
8	04-Mar-15	2:02	3:02	315.59	6.07	2.03	287.33	6.78	2.11	281.3
9	04-Mar-15	4:04	5:04	363.32	7.02	2.06	322.43	7.68	2.16	315.5
10	04-Mar-15	6:06	7:06	379.12	6.47	2.00	335.97	7.21	2.10	328.9
11	04-Mar-15	8:08	9:08	401.84	6.17	2.09	341.98	6.93	2.22	334.4
12	04-Mar-15	11:10	12:10	517.70	6.32	2.38	456.62	6.82	2.44	445.5
13	04-Mar-15	13:12	14:12	476.8	6.21	2.38	424.60	6.82	2.38	414.5
14	04-Mar-15	15:14	16:14	360.0	6.10	2.34	323.50	6.74	2.37	315.8
15	04-Mar-15	17:16	18:16	352.3	5.93	2.32	311.30	6.80	2.33	304.0
16	04-Mar-15	19:18	20:18	366.3	6.05	2.26	319.00	6.88	2.25	311.8
17	04-Mar-15	21:20	22:20	401.8	6.24	2.22	345.60	6.97	2.18	338.1
18	05-Mar-15	00:00	01:00	397.4	6.04	2.30	335.70	6.86	2.29	328.0
19	05-Mar-15	02:02	03:02	398.2	6.17	2.21	332.80	6.97	2.19	325.5
20	05-Mar-15	04:04	05:04	377.0	6.56	2.22	316.00	7.34	2.21	309.0
21	05-Mar-15	06:06	07:06	363.5	6.30	1.96	303.20	7.11	1.92	297.4
22	05-Mar-15	08:08	09:08	325.4	6.00	1.78	266.00	6.92	1.73	261.4
23	05-Mar-15	10:30	11:30	405.8	6.21	1.60	349.70	6.57	1.83	343.3
24	05-Mar-15	12:32	13:32	386.5	5.96	1.96	333.10	6.53	1.95	326.6

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

4A1.2 Table 4.2.1 - Standardised monitoring Data – Oxides of Nitrogen

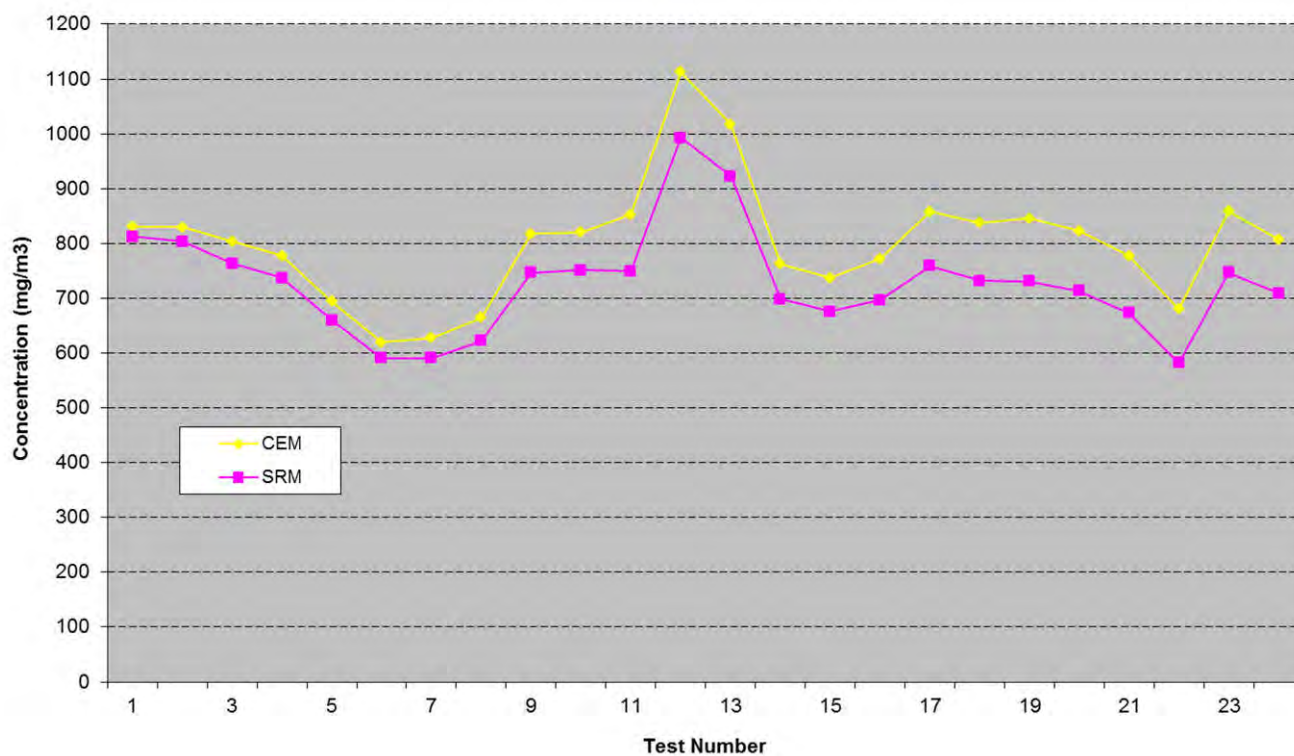
Test No	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
	hr:min		NO as NO ₂ (mg/m ³)	NOx as NO ₂ (mg/m ³)	(mg/m ³)
1	12:00	13:00	830.5	812.3	20
2	14:02	15:02	829.5	803.8	20
3	16:04	17:04	803.4	763.2	19
4	18:06	19:06	777.3	737.4	19
5	20:08	21:08	694.0	659.8	18
6	22:10	23:10	619.9	590.8	18
7	0:00	1:00	627.7	591.2	18
8	2:02	3:02	664.6	622.7	18
9	4:04	5:04	817.8	746.3	20
10	6:06	7:06	820.3	751.0	19
11	8:08	9:08	852.6	749.2	20
12	11:10	12:10	1112.9	992.5	23
13	13:12	14:12	1017.4	922.8	22
14	15:14	16:14	762.2	698.9	19
15	17:16	18:16	737.2	675.4	19
16	19:18	20:18	772.2	696.3	19
17	21:20	22:20	857.6	759.0	20
18	0:00	1:00	837.7	731.7	19
19	2:02	3:02	845.9	730.8	19
20	4:04	5:04	822.8	713.1	19
21	6:06	7:06	777.0	673.0	19
22	8:08	9:08	680.4	582.2	18
23	10:30	11:30	859.1	746.7	20
24	12:32	13:32	807.3	709.1	19

Note:

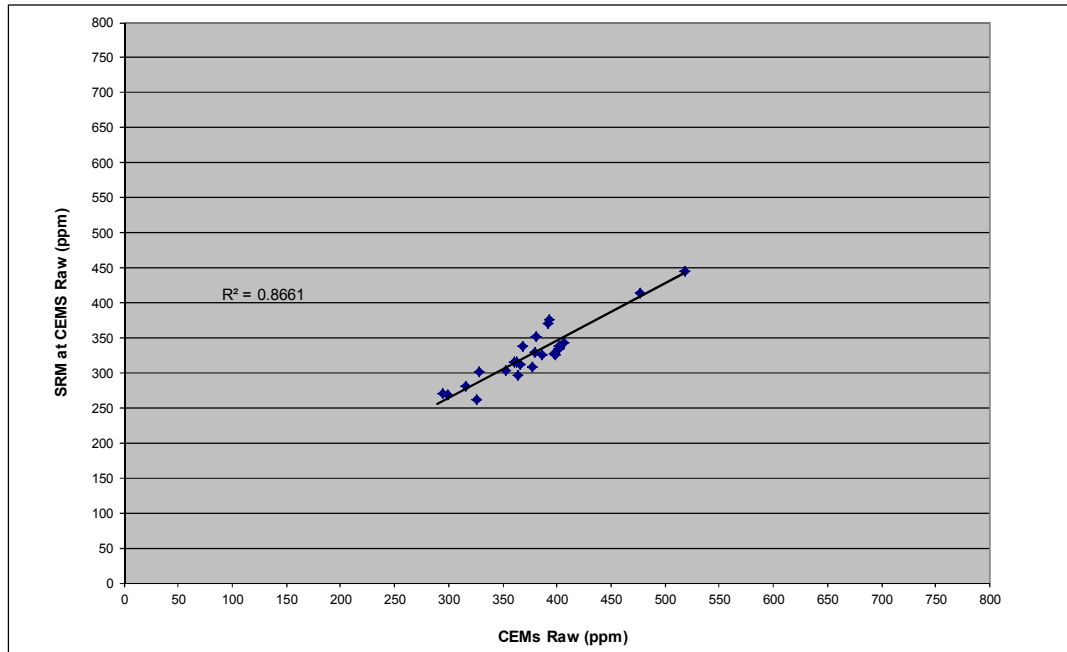
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

4A1.3 – Plot 1.1 - Time Series of Standardised CEM versus Standardised SRM data – Oxides of Nitrogen, (Expressed at reference conditions 273K, 101.3kPa, dry gas, 6% oxygen)



4A1.4 – Elimination of Outliers – Oxides of Nitrogen,



Test No	Test Date	Test Start Time	Test End Time	CEMS Raw Value	SRM Value at CEMS Raw conditions	Difference Di	Difference Di - Di	Is Result an Outlier - Di - Di > 2SD
		hr:min		NO (ppm)	NOx (ppm)			
1	03-Mar-15	12:00	13:00	392.5	376.6	-15.87	33.57	No
2	03-Mar-15	14:02	15:02	391.7	370.3	-21.42	28.02	No
3	03-Mar-15	16:04	17:04	380.5	351.2	-29.27	20.18	No
4	03-Mar-15	18:06	19:06	368.7	337.6	-31.12	18.33	No
5	03-Mar-15	20:08	21:08	327.9	301.6	-26.29	23.16	No
6	03-Mar-15	22:10	23:10	295.1	270.1	-24.97	24.47	No
7	04-Mar-15	00:00	01:00	299.3	269.3	-30.03	19.41	No
8	04-Mar-15	02:02	03:02	315.6	281.3	-34.32	15.12	No
9	04-Mar-15	04:04	05:04	363.3	315.5	-47.83	1.61	No
10	04-Mar-15	06:06	07:06	379.1	328.9	-50.22	-0.78	No
11	04-Mar-15	08:08	09:08	401.8	334.4	-67.45	-18.01	No
12	04-Mar-15	11:10	12:10	517.7	445.5	-72.19	-22.75	No
13	04-Mar-15	13:12	14:12	476.8	414.5	-62.35	-12.90	No
14	04-Mar-15	15:14	16:14	360.0	315.8	-44.21	5.23	No
15	04-Mar-15	17:16	18:16	352.3	304.0	-48.26	1.18	No
16	04-Mar-15	19:18	20:18	366.3	311.8	-54.48	-5.04	No
17	04-Mar-15	21:20	22:20	401.8	338.1	-63.71	-14.27	No
18	05-Mar-15	00:00	01:00	397.4	328.0	-69.42	-19.98	No
19	05-Mar-15	02:02	03:02	398.2	325.5	-72.72	-23.27	No
20	05-Mar-15	04:04	05:04	377.0	309.0	-68.01	-18.57	No
21	05-Mar-15	06:06	07:06	363.5	297.4	-66.10	-16.65	No
22	05-Mar-15	08:08	09:08	325.4	261.4	-64.02	-14.58	No
23	05-Mar-15	10:30	11:30	405.8	343.3	-62.53	-13.08	No
24	05-Mar-15	12:32	13:32	386.5	326.6	-59.85	-10.41	No
				Average Di		-49.44		
				Standard Deviation		18.32		
				Standard Deviation x2		36.64		

4A1.5.1 Determination of Method A or Method B - Oxides of Nitrogen

Test No	Test Date	Test Start Time	Test End Time	SRM measured value (y)	SRM Moisture	SRM O2	SRM Standardised
		hr:min		(ppm)	(%)	(%)	(mg/m3)
1	03-Mar-15	12:00	13:00	376.6	2.38	6.4	812.3
2	03-Mar-15	14:02	15:02	370.3	2.30	6.5	803.8
3	03-Mar-15	16:04	17:04	351.2	2.18	6.5	763.2
4	03-Mar-15	18:06	19:06	337.6	2.20	6.6	737.4
5	03-Mar-15	20:08	21:08	301.6	1.96	6.6	659.8
6	03-Mar-15	22:10	23:10	270.1	2.09	6.6	590.8
7	04-Mar-15	0:00	1:00	269.3	2.23	6.6	591.2
8	04-Mar-15	2:02	3:02	281.3	2.11	6.8	622.7
9	04-Mar-15	4:04	5:04	315.5	2.16	7.7	746.3
10	04-Mar-15	6:06	7:06	328.9	2.10	7.2	751.0
11	04-Mar-15	8:08	9:08	334.4	2.22	6.9	749.2
12	04-Mar-15	11:10	12:10	445.5	2.44	6.8	992.5
13	04-Mar-15	13:12	14:12	414.5	2.38	6.8	922.8
14	04-Mar-15	15:14	16:14	315.8	2.37	6.7	698.9
15	04-Mar-15	17:16	18:16	304.0	2.33	6.8	675.4
16	04-Mar-15	19:18	20:18	311.8	2.25	6.9	696.3
17	04-Mar-15	21:20	22:20	338.1	2.18	7.0	759.0
18	05-Mar-15	0:00	1:00	328.0	2.29	6.9	731.7
19	05-Mar-15	2:02	3:02	325.5	2.19	7.0	730.8
20	05-Mar-15	4:04	5:04	309.0	2.21	7.3	713.1
21	05-Mar-15	6:06	7:06	297.4	1.92	7.1	673.0
22	05-Mar-15	8:08	9:08	261.4	1.73	6.9	582.2
23	05-Mar-15	10:30	11:30	343.3	1.83	6.6	746.7
24	05-Mar-15	12:32	13:32	326.6	1.95	6.5	709.1
Sum				7857.76			
Emission Limit Value (ELV) =				1210	mg/Nm ³		
15% of the ELV =				181.5	mg/Nm ³		
Therefore Ymax - Ymin > 15% of the ELV				Method A			
						Y _{max}	992.51
						Y _{min}	582.19
						Y _{max} - Ymin	410.32

4A1.6.1 Table 4.3.1 - Data used to derive calibration function - Oxides of Nitrogen,

Test No	Test Date	Test Start Time	Test End Time	SRM measured value (y)	CEMS measured signal (x)	Yi	Xi	Xi * Yi	Xi ²	b
		hr:min		NOx (ppm)	NO (ppm)	1	2	3	4	
1	16-Feb-15	Reference Gas		0	0.05	-314.3105579	-361.7279913	113694.9268	130847.1397	
2	03-Mar-15	12:00	13:00	376.6	392.5	62.33	30.73	1915.70	944.61	
3	03-Mar-15	14:02	15:02	370.3	391.7	55.97	29.92	1674.67	895.26	
4	03-Mar-15	16:04	17:04	351.2	380.5	36.94	18.73	691.97	350.98	
5	03-Mar-15	18:06	19:06	337.6	368.7	23.28	6.93	161.27	47.99	
6	03-Mar-15	20:08	21:08	301.6	327.9	-12.75	-33.93	432.40	1150.98	
7	03-Mar-15	22:10	23:10	270.1	295.1	-44.21	-66.71	2949.08	4449.88	
8	04-Mar-15	0:00	1:00	269.3	299.3	-45.02	-62.46	2812.18	3901.15	
9	04-Mar-15	2:02	3:02	281.3	315.6	-33.04	-46.19	1526.00	2133.34	
10	04-Mar-15	4:04	5:04	315.5	363.3	1.17	1.54	1.80	2.37	
11	04-Mar-15	6:06	7:06	328.9	379.1	14.59	17.35	253.15	300.90	
12	04-Mar-15	8:08	9:08	334.4	401.8	20.08	40.06	804.41	1605.16	
13	04-Mar-15	11:10	12:10	445.5	517.7	131.19	155.92	20455.41	24310.72	
14	04-Mar-15	13:12	14:12	414.5	476.8	100.18	115.06	11526.84	13238.82	
15	04-Mar-15	15:14	16:14	315.8	360.0	1.53	-1.73	-2.65	2.99	
16	04-Mar-15	17:16	18:16	304.0	352.3	-10.27	-9.48	97.33	89.82	
17	04-Mar-15	19:18	20:18	311.8	366.3	-2.49	4.53	-11.26	20.48	
18	04-Mar-15	21:20	22:20	338.1	401.8	23.77	40.01	951.18	1601.08	
19	05-Mar-15	0:00	1:00	328.0	397.4	13.70	35.66	488.51	1271.30	
20	05-Mar-15	2:02	3:02	325.5	398.2	11.19	36.44	407.91	1328.02	
21	05-Mar-15	4:04	5:04	309.0	377.0	-5.29	15.26	-80.64	232.72	
22	05-Mar-15	6:06	7:06	297.4	363.5	-16.94	1.69	-28.60	2.85	
23	05-Mar-15	8:08	9:08	261.4	325.4	-52.91	-36.35	1923.48	1321.57	
24	05-Mar-15	10:30	11:30	343.3	405.8	29.01	44.06	1278.15	1941.69	
25	05-Mar-15	12:32	13:32	326.6	386.5	12.29	24.68	303.27	608.95	
Sum				7857.76	9044.45	0.00	0.00	164226.50	192600.78	0.85

4A1.7.1 Determination of Calibration Function - Oxides of Nitrogen

Method A

If $Y_{max} - Y_{min} > 15\%$ of the ELV, the following formulae are used:

$$b = \frac{\sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^N (x_i - \bar{x})^2} \quad \text{where} \quad \bar{x} = \frac{1}{N} \sum_{i=1}^N x_i \quad \bar{y} = \frac{1}{N} \sum_{i=1}^N y_i$$

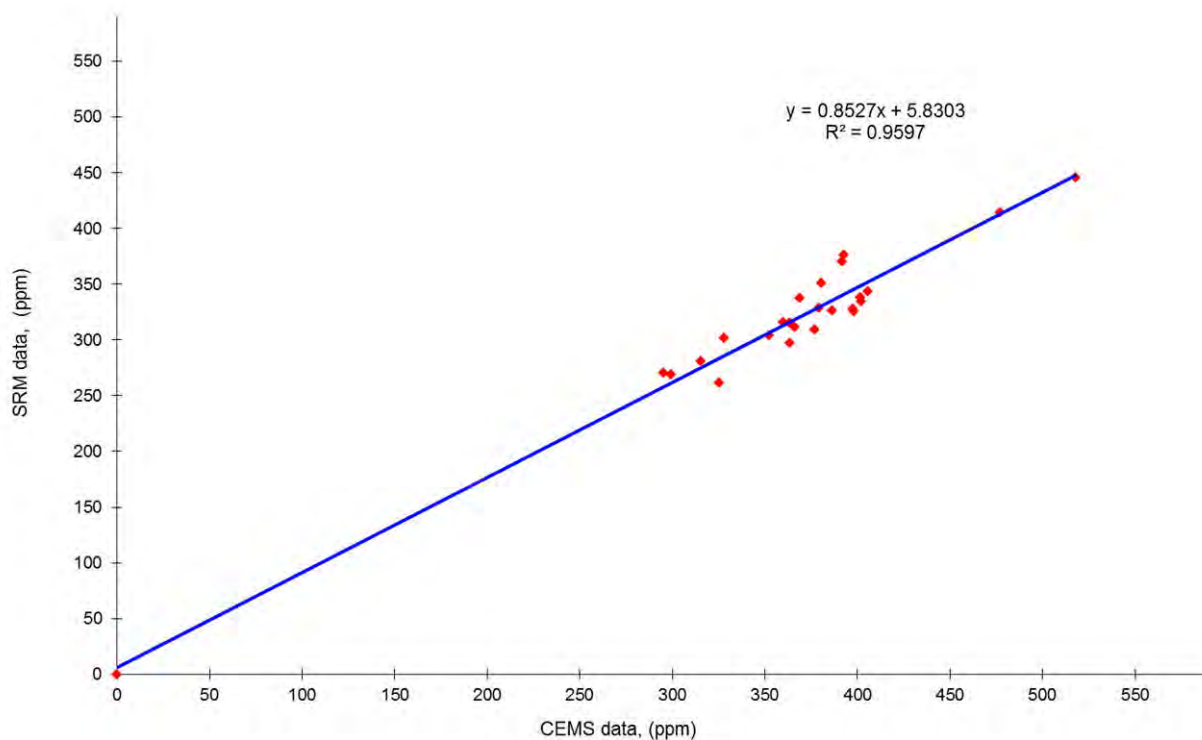
$$a = y - bx \quad a = 314.32 - 361.78 * 0.852$$

The calibration is function $y_i = a + b x_i$ or $y_i = 5.83 + 0.853 * x_i$

4A1.8.1 Table 4.4.1 - Calculation of calibrated CEMS values - Oxides of Nitrogen

Test No	Test Date	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Moisture	CEMS Oxygen	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		NO (ppm)	NO (ppm)	(%)	(%)	NO as NO2 (mg/m3)	NOx as NO2 (mg/m3)
1	16-Feb-15	Reference Gas		0.1	5.9	N/A	N/A	12.1	0.0
2	03-Mar-15	12:00	13:00	392.5	340.5	2.2	6.1	720.5	812.3
3	03-Mar-15	14:02	15:02	391.7	339.8	2.1	6.1	719.6	803.8
4	03-Mar-15	16:04	17:04	380.5	330.3	2.0	6.1	697.3	763.2
5	03-Mar-15	18:06	19:06	368.7	320.2	2.1	6.1	675.1	737.4
6	03-Mar-15	20:08	21:08	327.9	285.4	2.0	6.2	604.1	659.8
7	03-Mar-15	22:10	23:10	295.1	257.4	2.1	6.0	540.8	590.8
8	04-Mar-15	00:00	01:00	299.3	261.1	2.1	6.0	547.4	591.2
9	04-Mar-15	02:02	03:02	315.6	274.9	2.0	6.1	579.0	622.7
10	04-Mar-15	04:04	05:04	363.3	315.6	2.1	7.0	710.4	746.3
11	04-Mar-15	06:06	07:06	379.1	329.1	2.0	6.5	712.1	751.0
12	04-Mar-15	08:08	09:08	401.8	348.5	2.1	6.2	739.4	749.2
13	04-Mar-15	11:10	12:10	517.7	447.3	2.4	6.3	961.5	992.5
14	04-Mar-15	13:12	14:12	476.8	412.4	2.4	6.2	880.0	922.8
15	04-Mar-15	15:14	16:14	360.0	312.8	2.3	6.1	662.3	698.9
16	04-Mar-15	17:16	18:16	352.3	306.2	2.3	5.9	640.8	675.4
17	04-Mar-15	19:18	20:18	366.3	318.2	2.3	6.1	670.7	696.3
18	04-Mar-15	21:20	22:20	401.8	348.4	2.2	6.2	743.7	759.0
19	05-Mar-15	00:00	01:00	397.4	344.7	2.3	6.0	726.5	731.7
20	05-Mar-15	02:02	03:02	398.2	345.4	2.2	6.2	733.7	730.8
21	05-Mar-15	04:04	05:04	377.0	327.3	2.2	6.6	714.3	713.1
22	05-Mar-15	06:06	07:06	363.5	315.8	2.0	6.3	675.0	673.0
23	05-Mar-15	08:08	09:08	325.4	283.3	1.8	6.0	592.4	582.2
24	05-Mar-15	10:30	11:30	405.8	351.9	1.6	6.2	744.9	746.7
25	05-Mar-15	12:32	13:32	386.5	335.4	2.0	6.0	700.5	709.1
Sum								16704.0	
Emission Limit Value (ELV) =				1210	mg/Nm ³				
Reference Oxygen						6 %			

4A1.9.1 Plot 2.1 CEM versus SRM Parallel Test Data at CEM measurement conditions –NOx ppm, wet gas.



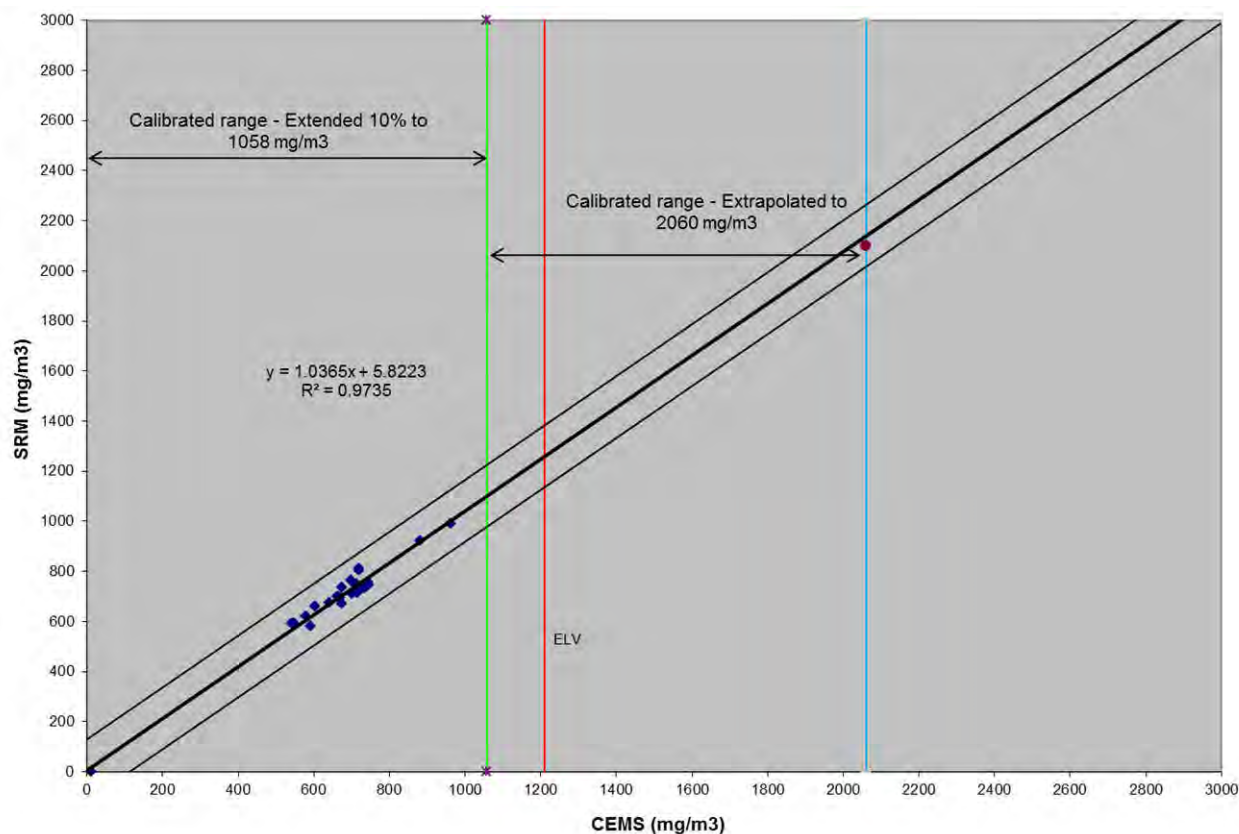
4A1.10.1 Table 4.5.1 – Data used for the Variability Test – Oxides of Nitrogen

Test No	Test Date	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
		hr:min		mg/m3	mg/m3			
1		Reference Gas		12.1	0.0	-12.06	-42.27	1786.42
2	03-Mar-15	12:00	13:00	720.5	812.3	91.85	61.65	3800.22
3	03-Mar-15	14:02	15:02	719.6	803.8	84.20	53.99	2915.02
4	03-Mar-15	16:04	17:04	697.3	763.2	65.88	35.68	1272.94
5	03-Mar-15	18:06	19:06	675.1	737.4	62.28	32.07	1028.47
6	03-Mar-15	20:08	21:08	604.1	659.8	55.73	25.52	651.31
7	03-Mar-15	22:10	23:10	540.8	590.8	50.04	19.84	393.48
8	04-Mar-15	00:00	01:00	547.4	591.2	43.72	13.51	182.60
9	04-Mar-15	02:02	03:02	579.0	622.7	43.73	13.52	182.90
10	04-Mar-15	04:04	05:04	710.4	746.3	35.84	5.64	31.78
11	04-Mar-15	06:06	07:06	712.1	751.0	38.90	8.70	75.67
12	04-Mar-15	08:08	09:08	739.4	749.2	9.81	-20.40	416.10
13	04-Mar-15	11:10	12:10	961.5	992.5	31.01	0.80	0.65
14	04-Mar-15	13:12	14:12	880.0	922.8	42.83	12.63	159.45
15	04-Mar-15	15:14	16:14	662.3	698.9	36.65	6.44	41.49
16	04-Mar-15	17:16	18:16	640.8	675.4	34.60	4.40	19.33
17	04-Mar-15	19:18	20:18	670.7	696.3	25.58	-4.63	21.43
18	04-Mar-15	21:20	22:20	743.7	759.0	15.26	-14.95	223.47
19	05-Mar-15	00:00	01:00	726.5	731.7	5.12	-25.09	629.50
20	05-Mar-15	02:02	03:02	733.7	730.8	-2.86	-33.07	1093.35
21	05-Mar-15	04:04	05:04	714.3	713.1	-1.17	-31.38	984.52
22	05-Mar-15	06:06	07:06	675.0	673.0	-1.97	-32.18	1035.51
23	05-Mar-15	08:08	09:08	592.4	582.2	-10.17	-40.38	1630.16
24	05-Mar-15	10:30	11:30	744.9	746.7	1.82	-28.39	805.93
25	05-Mar-15	12:32	13:32	700.5	709.1	8.54	-21.67	469.44
25	Tests		Mean			30.21		
Sum								19851.15

4A1.11.1 - Variability Test Calculation – Oxides of Nitrogen

SD=	Root(1-Number).Integral(D1-D) ²	28.76	mg/m3(s,d),6%O ₂
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O ₀ is therefore calculated as:-			
O ₀ =	0.2*1210 mg/m3 (s,d,6%O ₂)/1.96	123.47	mg/m3(s,d),6%O ₂
For 25 tests, k _v =	0.9861		
Therefore variability=	28.76 <= 123.47 * 0.9861		
	or 28.76 <= 121.75		
Which is TRUE therefore the CEMS passes the test			

4A1.12.1 Plot 3.1 –Standardised CEM data versus standardised SRM - Oxides of Nitrogen (as NO₂) – Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen



4A1.1.2 Table 4.1.2 – Raw monitoring Data – Sulphur Dioxide, Low Range

Test No	Test Date	Test Start Time	Test End Time	CEMS Raw Value (Wet)	CEMS Oxygen	CEMS Moisture	SRM Raw Value (Wet)	SRM Oxygen (Dry)	SRM Moisture	SRM at CEMS Raw conditions (wet)
		hr:min		SO2 (ppm)	(%)	(%)	SO2 (ppm)	(%)	(%)	SO2 (ppm)
1	03-Mar-15	12:00	13:00	115.64	6.11	2.22	116.61	6.37	2.38	116.6
2	03-Mar-15	14:02	15:02	109.40	6.14	2.10	109.29	6.47	2.30	109.3
3	03-Mar-15	16:04	17:04	132.15	6.11	2.01	132.89	6.50	2.18	132.9
4	03-Mar-15	18:06	19:06	147.30	6.08	2.06	155.07	6.58	2.20	155.1
5	03-Mar-15	20:08	21:08	148.83	6.15	2.00	159.26	6.64	1.96	159.3
6	03-Mar-15	22:10	23:10	144.07	6.02	2.11	154.02	6.61	2.09	154.0
7	04-Mar-15	0:00	1:00	142.77	5.99	2.14	146.57	6.64	2.23	146.6
8	04-Mar-15	2:02	3:02	142.35	6.07	2.03	141.51	6.78	2.11	141.5
9	04-Mar-15	4:04	5:04	148.58	7.02	2.06	151.77	7.68	2.16	151.8
10	04-Mar-15	6:06	7:06	150.46	6.47	2.00	155.21	7.21	2.10	155.2
11	04-Mar-15	8:08	9:08	131.78	6.17	2.09	129.17	6.93	2.22	129.2
12	04-Mar-15	11:10	12:10	94.61	6.32	2.38	94.26	6.82	2.44	94.3
13	04-Mar-15	13:12	14:12	89.2	6.21	2.38	88.58	6.82	2.38	88.6
14	04-Mar-15	15:14	16:14	74.6	6.10	2.34	74.65	6.74	2.37	74.6
15	04-Mar-15	17:16	18:16	70.8	5.93	2.32	69.29	6.80	2.33	69.3
16	04-Mar-15	19:18	20:18	89.9	6.05	2.26	89.55	6.88	2.25	89.6
17	04-Mar-15	21:20	22:20	105.6	6.24	2.22	103.51	6.97	2.18	103.5
18	05-Mar-15	00:00	01:00	121.0	6.04	2.30	117.02	6.86	2.29	117.0
19	05-Mar-15	02:02	03:02	126.8	6.17	2.21	122.66	6.97	2.19	122.7
20	05-Mar-15	04:04	05:04	128.4	6.56	2.22	124.31	7.34	2.21	124.3
21	05-Mar-15	06:06	07:06	80.3	6.30	1.96	80.41	7.11	1.92	80.4
22	05-Mar-15	08:08	09:08	37.2	6.00	1.78	38.53	6.92	1.73	38.5
23	05-Mar-15	10:30	11:30	35.8	6.21	1.60	36.82	6.57	1.83	36.8
24	05-Mar-15	12:32	13:32	29.1	5.96	1.96	31.14	6.53	1.95	31.1

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

4A1.2.2 Table 4.2.2 -Standardised monitoring Data – Sulphur Dioxide, Low Range

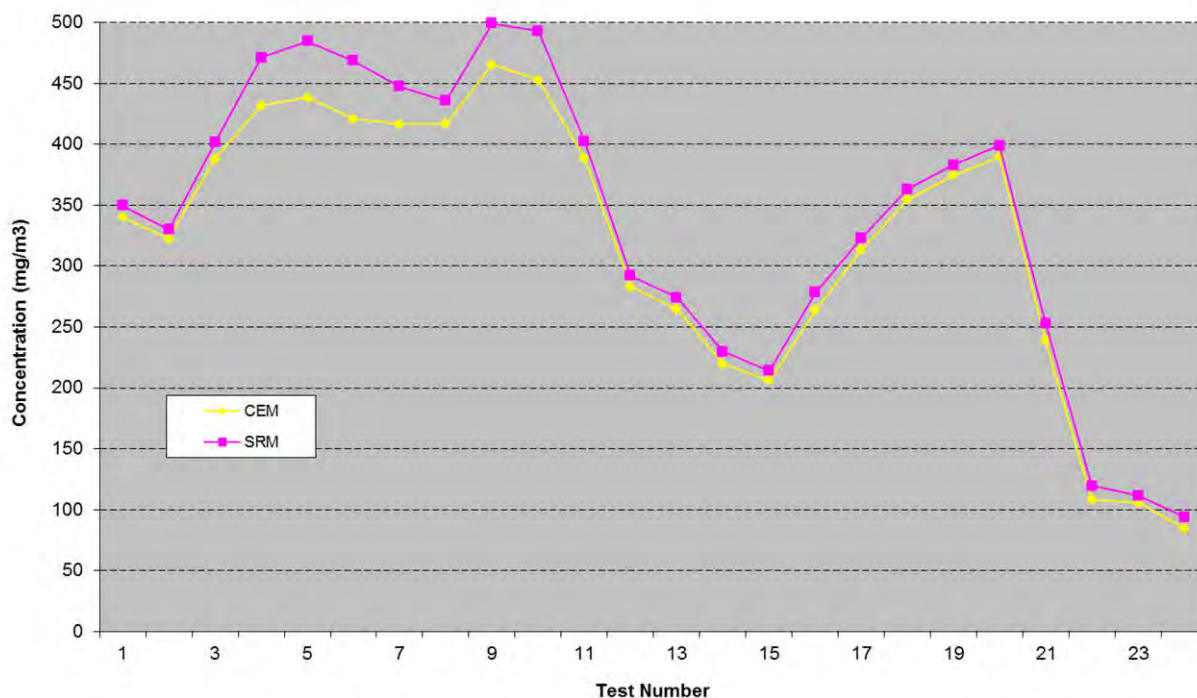
Test No	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
	hr:min		SO ₂ (mg/m3)	SO ₂ (mg/m3)	(mg/m3)
1	12:00	13:00	340.4	349.9	6.0
2	14:02	15:02	322.3	330.1	5.6
3	16:04	17:04	388.2	401.7	6.8
4	18:06	19:06	432.1	471.2	8.0
5	20:08	21:08	438.3	484.8	8.2
6	22:10	23:10	421.1	468.7	7.6
7	0:00	1:00	416.5	447.7	7.5
8	2:02	3:02	417.1	435.9	7.3
9	4:04	5:04	465.3	499.5	7.8
10	6:06	7:06	453.0	493.1	8.0
11	8:08	9:08	389.0	402.6	6.7
12	11:10	12:10	283.0	292.2	4.8
13	13:12	14:12	264.9	274.4	4.6
14	15:14	16:14	219.7	229.8	3.9
15	17:16	18:16	206.1	214.2	3.6
16	19:18	20:18	263.6	278.2	4.6
17	21:20	22:20	313.6	323.3	5.4
18	0:00	1:00	354.9	363.2	6.0
19	2:02	3:02	374.6	383.2	6.3
20	4:04	5:04	389.8	399.1	6.4
21	6:06	7:06	238.9	253.2	4.1
22	8:08	9:08	108.3	119.4	2.0
23	10:30	11:30	105.5	111.4	1.9
24	12:32	13:32	84.6	94.1	1.6

Note:

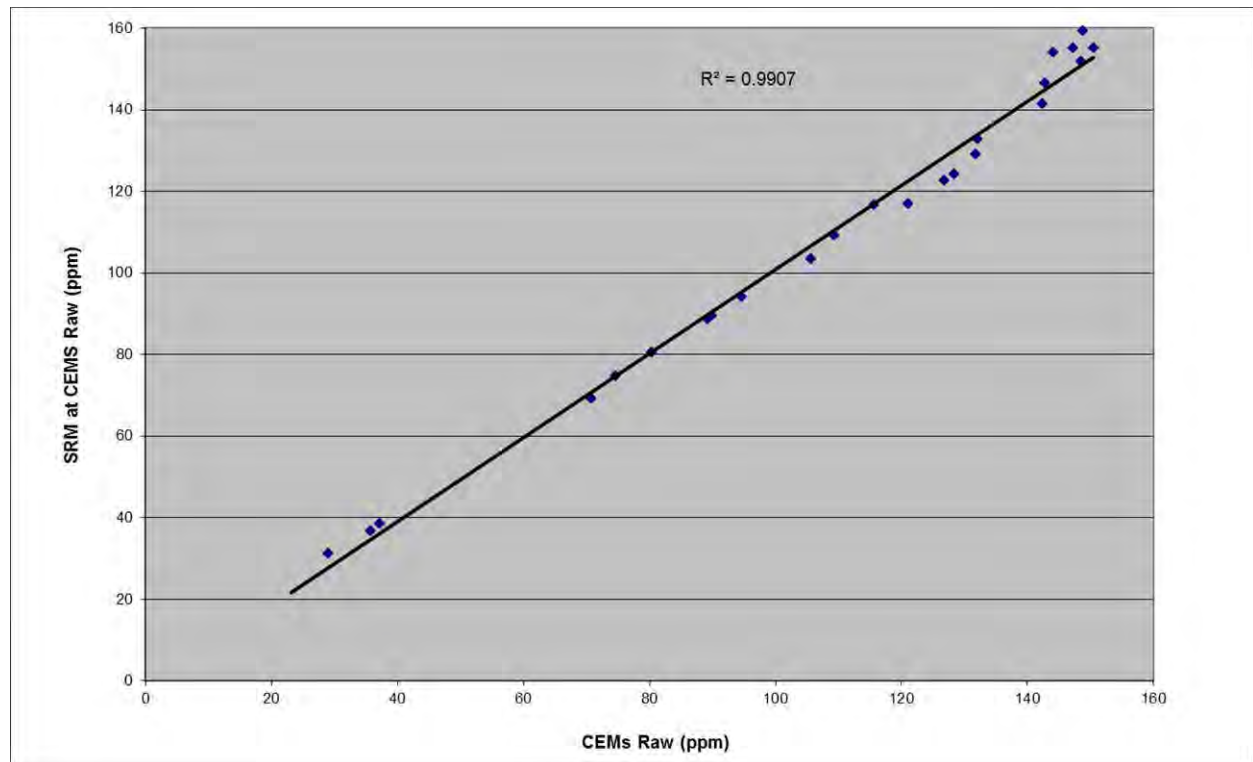
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

4A1.3.2 – Plot 1.2 - Time Series of Standardised CEM versus Standardised SRM data – Sulphur Dioxide, Low Range (Expressed at reference conditions 273K, 101.3kPa, dry gas, 6% oxygen)



4A1.4.2 – Elimination of Outliers – Sulphur Dioxide, Low Range.



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R^2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.

Additionally, any data points are not likely to be outliers unless they are more than three standard deviations from the regression line'

As the R^2 value for this determinand was 0.9907, an outlier test has not been undertaken.

4A1.5.2 Determination of Method A or Method B - Sulphur Dioxide, Low Range.

Test No	Test Date	Test Start Time	Test End Time	SRM measured value (y)	SRM Moisture	SRM O2	SRM Standardised
		hr:min		(ppm)	(%)	(%)	(mg/m3)
1	03-Mar-15	12:00	13:00	116.6	2.38	6.4	349.9
2	03-Mar-15	14:02	15:02	109.3	2.30	6.5	330.1
3	03-Mar-15	16:04	17:04	132.9	2.18	6.5	401.7
4	03-Mar-15	18:06	19:06	155.1	2.20	6.6	471.2
5	03-Mar-15	20:08	21:08	159.3	1.96	6.6	484.8
6	03-Mar-15	22:10	23:10	154.0	2.09	6.6	468.7
7	04-Mar-15	0:00	1:00	146.6	2.23	6.6	447.7
8	04-Mar-15	2:02	3:02	141.5	2.11	6.8	435.9
9	04-Mar-15	4:04	5:04	151.8	2.16	7.7	499.5
10	04-Mar-15	6:06	7:06	155.2	2.10	7.2	493.1
11	04-Mar-15	8:08	9:08	129.2	2.22	6.9	402.6
12	04-Mar-15	11:10	12:10	94.3	2.44	6.8	292.2
13	04-Mar-15	13:12	14:12	88.6	2.38	6.8	274.4
14	04-Mar-15	15:14	16:14	74.6	2.37	6.7	229.8
15	04-Mar-15	17:16	18:16	69.3	2.33	6.8	214.2
16	04-Mar-15	19:18	20:18	89.6	2.25	6.9	278.2
17	04-Mar-15	21:20	22:20	103.5	2.18	7.0	323.3
18	05-Mar-15	0:00	1:00	117.0	2.29	6.9	363.2
19	05-Mar-15	2:02	3:02	122.7	2.19	7.0	383.2
20	05-Mar-15	4:04	5:04	124.3	2.21	7.3	399.1
21	05-Mar-15	6:06	7:06	80.4	1.92	7.1	253.2
22	05-Mar-15	8:08	9:08	38.5	1.73	6.9	119.4
23	05-Mar-15	10:30	11:30	36.8	1.83	6.6	111.4
24	05-Mar-15	12:32	13:32	31.1	1.95	6.5	94.1
Sum				2622.10			
Emission Limit Value (ELV) =				440	mg/Nm ³		
15% of the ELV =				66	mg/Nm ³		
Therefore Ymax - Ymin > 15% of the ELV				Method A			
						Y _{max}	499.48
						Y _{min}	94.06
						Y _{max} - Ymin	405.42

4A1.6.2 Table 4.3.2 - Data used to derive calibration function - Sulphur Dioxide, Low Range.

Test No	Test Date	Test Start Time	Test End Time	SRM measured value (y)	CEMS measured signal (x)	Yi	Xi	Xi * Yi	Xi ²	b
		hr:min		SO2 (ppm)	SO2 (ppm)	1	2	3	4	
1	16-Feb-15	Reference Gas		0	0.33	-104.8838637	-103.5507564	10860.80342	10722.75914	
2	03-Mar-15	12:00	13:00	116.6	115.6	11.72	11.76	137.81	138.18	
3	03-Mar-15	14:02	15:02	109.3	109.4	4.40	5.52	24.30	30.44	
4	03-Mar-15	16:04	17:04	132.9	132.2	28.01	28.27	791.84	799.28	
5	03-Mar-15	18:06	19:06	155.1	147.3	50.19	43.42	2179.11	1885.34	
6	03-Mar-15	20:08	21:08	159.3	148.8	54.38	44.95	2444.50	2020.76	
7	03-Mar-15	22:10	23:10	154.0	144.1	49.13	40.19	1974.64	1615.13	
8	04-Mar-15	0:00	1:00	146.6	142.8	41.68	38.89	1621.11	1512.45	
9	04-Mar-15	2:02	3:02	141.5	142.4	36.63	38.47	1409.18	1480.16	
10	04-Mar-15	4:04	5:04	151.8	148.6	46.88	44.70	2095.75	1998.09	
11	04-Mar-15	6:06	7:06	155.2	150.5	50.33	46.58	2344.39	2169.92	
12	04-Mar-15	8:08	9:08	129.2	131.8	24.29	27.90	677.69	778.63	
13	04-Mar-15	11:10	12:10	94.3	94.6	-10.62	-9.27	98.51	85.99	
14	04-Mar-15	13:12	14:12	88.6	89.2	-16.30	-14.64	238.66	214.36	
15	04-Mar-15	15:14	16:14	74.6	74.6	-30.24	-29.29	885.65	857.97	
16	04-Mar-15	17:16	18:16	69.3	70.8	-35.59	-33.08	1177.26	1094.15	
17	04-Mar-15	19:18	20:18	89.6	89.9	-15.33	-14.02	214.86	196.44	
18	04-Mar-15	21:20	22:20	103.5	105.6	-1.38	1.71	-2.36	2.93	
19	05-Mar-15	0:00	1:00	117.0	121.0	12.14	17.14	208.02	293.81	
20	05-Mar-15	2:02	3:02	122.7	126.8	17.78	22.87	406.63	523.19	
21	05-Mar-15	4:04	5:04	124.3	128.4	19.42	24.52	476.15	601.06	
22	05-Mar-15	6:06	7:06	80.4	80.3	-24.48	-23.56	576.57	554.89	
23	05-Mar-15	8:08	9:08	38.5	37.2	-66.36	-66.66	4423.13	4443.15	
24	05-Mar-15	10:30	11:30	36.8	35.8	-68.06	-68.05	4631.80	4631.39	
25	05-Mar-15	12:32	13:32	31.1	29.1	-73.74	-74.78	5514.65	5592.16	
Sum				2622.10	2597.02	0.00	0.00	45410.64	44242.61	1.03

4A1.7.2 Determination of Calibration Function - Sulphur Dioxide, Low Range.

Method A

If $Y_{max} - Y_{min} > 15\%$ of the ELV, the following formulae are used:

$$b = \frac{\sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^N (x_i - \bar{x})^2} \quad \text{where} \quad \bar{x} = \frac{1}{N} \sum_{i=1}^N x_i \quad \bar{y} = \frac{1}{N} \sum_{i=1}^N y_i$$

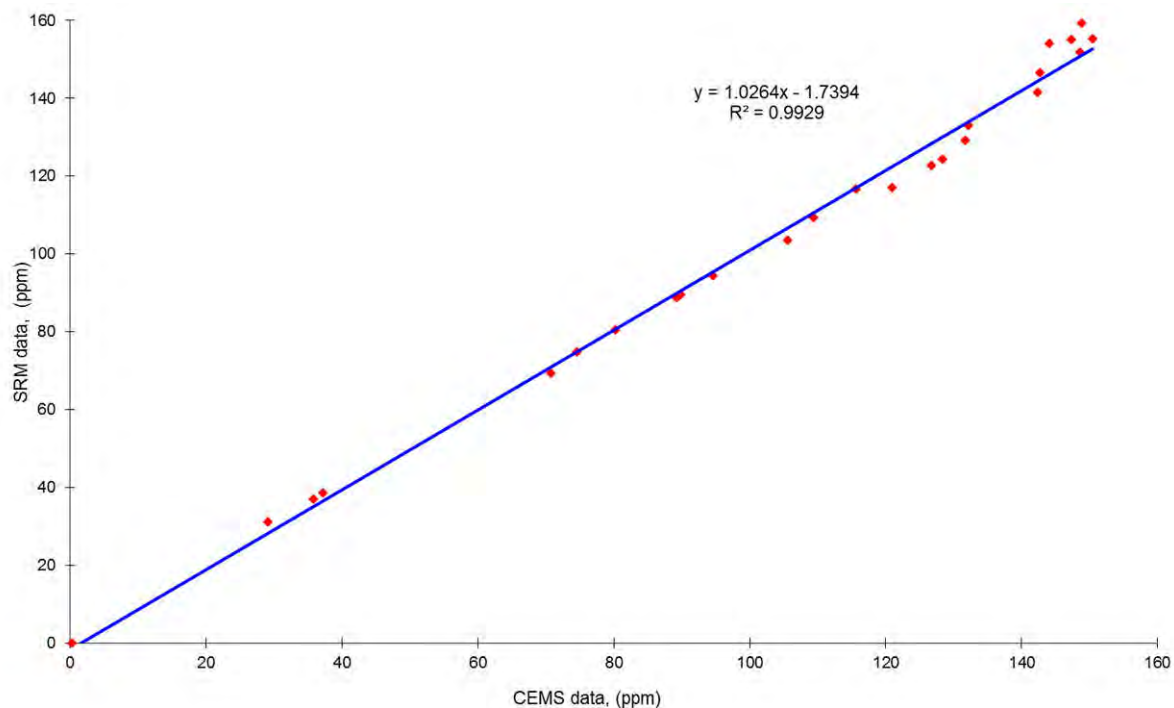
$$a = y - bx \quad a = 104.89 - 103.89 * 1.026$$

The calibration is function $y_i = a + b x_i$ or $y_i = -1.739 + 1.026 * x_i$

4A1.8.2 Table A.4.4.2 - Calculation of calibrated CEMS values - Sulphur Dioxide, Low Range

Test No	Test Date	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Moisture	CEMS wet Oxygen	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		SO2 (ppm)	SO2 (ppm)	(%)	(%)	SO2 (mg/m3)	SO2 (mg/m3)
1	16-Feb-15	Reference Gas		0.3	-1.4	N/A	N/A	-4.0	0.0
2	03-Mar-15	12:00	13:00	115.6	116.9	2.2	6.1	344.3	349.9
3	03-Mar-15	14:02	15:02	109.4	110.5	2.1	6.1	325.7	330.1
4	03-Mar-15	16:04	17:04	132.2	133.9	2.0	6.1	393.3	401.7
5	03-Mar-15	18:06	19:06	147.3	149.5	2.1	6.1	438.4	471.2
6	03-Mar-15	20:08	21:08	148.8	151.0	2.0	6.2	444.8	484.8
7	03-Mar-15	22:10	23:10	144.1	146.1	2.1	6.0	427.1	468.7
8	04-Mar-15	00:00	01:00	142.8	144.8	2.1	6.0	422.5	447.7
9	04-Mar-15	02:02	03:02	142.4	144.4	2.0	6.1	423.0	435.9
10	04-Mar-15	04:04	05:04	148.6	150.8	2.1	7.0	472.1	499.5
11	04-Mar-15	06:06	07:06	150.5	152.7	2.0	6.5	459.7	493.1
12	04-Mar-15	08:08	09:08	131.8	133.5	2.1	6.2	394.2	402.6
13	04-Mar-15	11:10	12:10	94.6	95.4	2.4	6.3	285.2	292.2
14	04-Mar-15	13:12	14:12	89.2	89.9	2.4	6.2	266.8	274.4
15	04-Mar-15	15:14	16:14	74.6	74.8	2.3	6.1	220.4	229.8
16	04-Mar-15	17:16	18:16	70.8	70.9	2.3	5.9	206.5	214.2
17	04-Mar-15	19:18	20:18	89.9	90.5	2.3	6.1	265.4	278.2
18	04-Mar-15	21:20	22:20	105.6	106.6	2.2	6.2	316.7	323.3
19	05-Mar-15	00:00	01:00	121.0	122.5	2.3	6.0	359.2	363.2
20	05-Mar-15	02:02	03:02	126.8	128.4	2.2	6.2	379.4	383.2
21	05-Mar-15	04:04	05:04	128.4	130.0	2.2	6.6	394.8	399.1
22	05-Mar-15	06:06	07:06	80.3	80.7	2.0	6.3	240.0	253.2
23	05-Mar-15	08:08	09:08	37.2	36.5	1.8	6.0	106.1	119.4
24	05-Mar-15	10:30	11:30	35.8	35.0	1.6	6.2	103.2	111.4
25	05-Mar-15	12:32	13:32	29.1	28.1	2.0	6.0	81.8	94.1
Sum								7766.4	
Emission Limit Value (ELV) =				440	mg/Nm ³				
				Reference Oxygen			6 %		

4A1.9.2 Plot 2.2 CEM versus SRM Parallel Test Data at CEM measurement conditions –Sulphur dioxide.



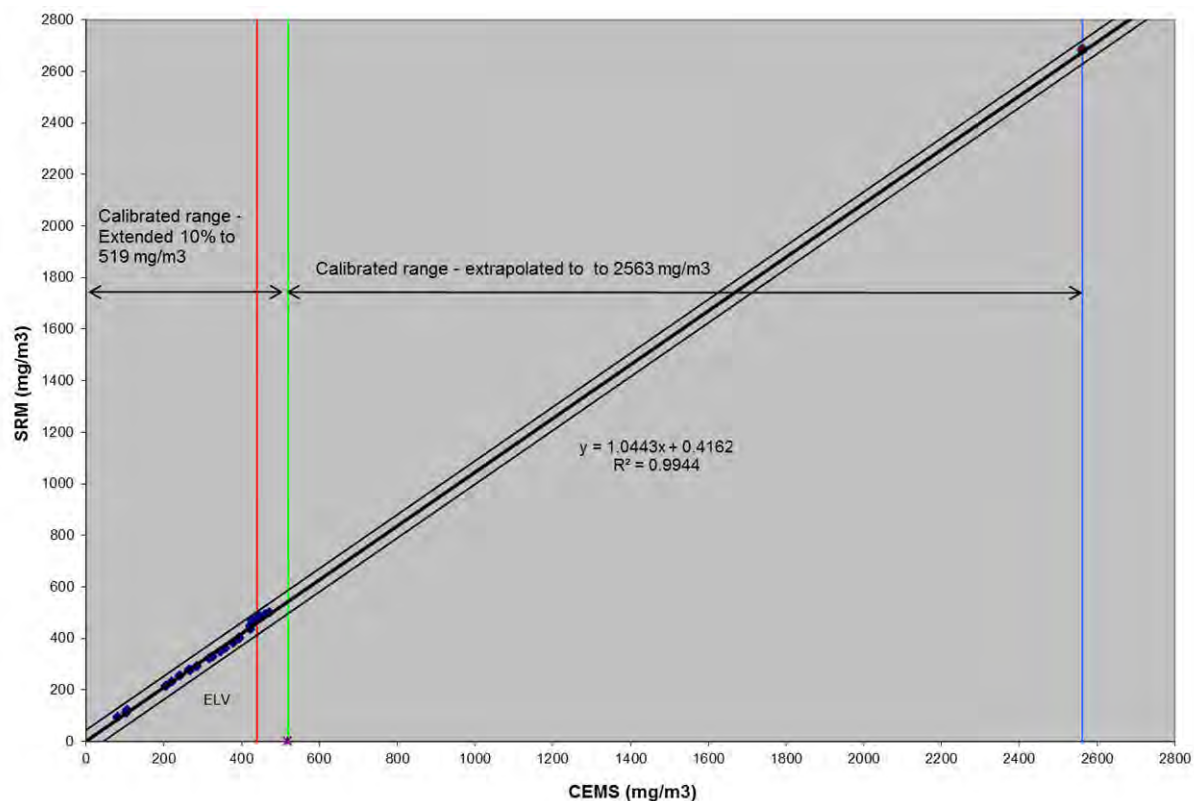
4A1.10.2 Table 4.5.2 – Data used for the Variability Test – Sulphur Dioxide, Low Range.

Test No	Test Date	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
		hr:min		mg/m3	mg/m3			
1	16-Feb-15	Reference Gas		-4.0	0.0	4.00	-10.17	103.52
2	03-Mar-15	12:00	13:00	344.3	349.9	5.63	-8.54	72.97
3	03-Mar-15	14:02	15:02	325.7	330.1	4.38	-9.80	95.98
4	03-Mar-15	16:04	17:04	393.3	401.7	8.42	-5.76	33.14
5	03-Mar-15	18:06	19:06	438.4	471.2	32.88	18.70	349.70
6	03-Mar-15	20:08	21:08	444.8	484.8	40.04	25.87	669.05
7	03-Mar-15	22:10	23:10	427.1	468.7	41.63	27.45	753.60
8	04-Mar-15	00:00	01:00	422.5	447.7	25.19	11.01	121.26
9	04-Mar-15	02:02	03:02	423.0	435.9	12.87	-1.30	1.70
10	04-Mar-15	04:04	05:04	472.1	499.5	27.35	13.17	173.49
11	04-Mar-15	06:06	07:06	459.7	493.1	33.40	19.22	369.43
12	04-Mar-15	08:08	09:08	394.2	402.6	8.48	-5.70	32.47
13	04-Mar-15	11:10	12:10	285.2	292.2	6.93	-7.24	52.47
14	04-Mar-15	13:12	14:12	266.8	274.4	7.64	-6.53	42.70
15	04-Mar-15	15:14	16:14	220.4	229.8	9.45	-4.72	22.31
16	04-Mar-15	17:16	18:16	206.5	214.2	7.65	-6.52	42.56
17	04-Mar-15	19:18	20:18	265.4	278.2	12.80	-1.38	1.90
18	04-Mar-15	21:20	22:20	316.7	323.3	6.60	-7.58	57.47
19	05-Mar-15	00:00	01:00	359.2	363.2	4.01	-10.17	103.38
20	05-Mar-15	02:02	03:02	379.4	383.2	3.80	-10.38	107.77
21	05-Mar-15	04:04	05:04	394.8	399.1	4.25	-9.92	98.47
22	05-Mar-15	06:06	07:06	240.0	253.2	13.15	-1.03	1.05
23	05-Mar-15	08:08	09:08	106.1	119.4	13.30	-0.87	0.76
24	05-Mar-15	10:30	11:30	103.2	111.4	8.25	-5.93	35.11
25	05-Mar-15	12:32	13:32	81.8	94.1	12.31	-1.87	3.49
25	Tests		Mean			14.18		
Sum								3345.74

4A1.11.2 - Variability Test Calculation – Sulphur Dioxide, Low Range.

SD=	Root(1-Number).Integral(D1-D) ²	11.81	mg/m3(s,d),6%O ₂
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O ₀ is therefore calculated as:-			
O ₀ =	0.2*440 mg/m3 (s,d,6%O ₂)/1.96	44.90	mg/m3(s,d),6%O ₂
For 25 tests, k _v =	0.9861		
Therefore variability=	11.81 <= 44.9 * 0.9861		
	or 11.81 <=	44.27	
Which is TRUE therefore the CEMS passes the test			

4A1.12.2 Plot 3.2 –Standardised CEM data versus standardised SRM - Sulphur dioxide, Low Range – Reference conditions 273K, 101.3kPa dry gas



4A1.1.3 Table 4.1.3– Raw monitoring Data – Sulphur Dioxide, High Range

Test No	Test Date	Test Start Time	Test End Time	CEMS Raw Value (Wet)	CEMS Oxygen	CEMS Moisture	SRM Raw Value (Wet)	SRM Oxygen (Dry)	SRM Moisture	SRM at CEMS Raw conditions (wet)
		hr:min		SO2 (ppm)	(%)	(%)	SO2 (ppm)	(%)	(%)	SO2 (ppm)
1	03-Mar-15	12:00	13:00	115.99	6.11	2.22	116.61	6.37	2.38	116.6
2	03-Mar-15	14:02	15:02	109.77	6.14	2.10	109.29	6.47	2.30	109.3
3	03-Mar-15	16:04	17:04	132.55	6.11	2.01	132.89	6.50	2.18	132.9
4	03-Mar-15	18:06	19:06	147.68	6.08	2.06	155.07	6.58	2.20	155.1
5	03-Mar-15	20:08	21:08	149.21	6.15	2.00	159.26	6.64	1.96	159.3
6	03-Mar-15	22:10	23:10	144.45	6.02	2.11	154.02	6.61	2.09	154.0
7	04-Mar-15	0:00	1:00	143.15	5.99	2.14	146.57	6.64	2.23	146.6
8	04-Mar-15	2:02	3:02	142.74	6.07	2.03	141.51	6.78	2.11	141.5
9	04-Mar-15	4:04	5:04	148.94	7.02	2.06	151.77	7.68	2.16	151.8
10	04-Mar-15	6:06	7:06	150.83	6.47	2.00	155.21	7.21	2.10	155.2
11	04-Mar-15	8:08	9:08	132.17	6.17	2.09	129.17	6.93	2.22	129.2
12	04-Mar-15	11:10	12:10	94.98	6.32	2.38	94.26	6.82	2.44	94.3
13	04-Mar-15	13:12	14:12	89.6	6.21	2.38	88.58	6.82	2.38	88.6
14	04-Mar-15	15:14	16:14	75.0	6.10	2.34	74.65	6.74	2.37	74.6
15	04-Mar-15	17:16	18:16	71.2	5.93	2.32	69.29	6.80	2.33	69.3
16	04-Mar-15	19:18	20:18	90.2	6.05	2.26	89.55	6.88	2.25	89.6
17	04-Mar-15	21:20	22:20	106.0	6.24	2.22	103.51	6.97	2.18	103.5
18	05-Mar-15	00:00	01:00	121.4	6.04	2.30	117.02	6.86	2.29	117.0
19	05-Mar-15	02:02	03:02	127.1	6.17	2.21	122.66	6.97	2.19	122.7
20	05-Mar-15	04:04	05:04	128.7	6.56	2.22	124.31	7.34	2.21	124.3
21	05-Mar-15	06:06	07:06	80.6	6.30	1.96	80.41	7.11	1.92	80.4
22	05-Mar-15	08:08	09:08	37.5	6.00	1.78	38.53	6.92	1.73	38.5
23	05-Mar-15	10:30	11:30	36.2	6.21	1.60	36.82	6.57	1.83	36.8
24	05-Mar-15	12:32	13:32	29.4	5.96	1.96	31.14	6.53	1.95	31.1

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

4A1.2.3 Table 4.2.3 -Standardised monitoring Data – Sulphur Dioxide, High Range

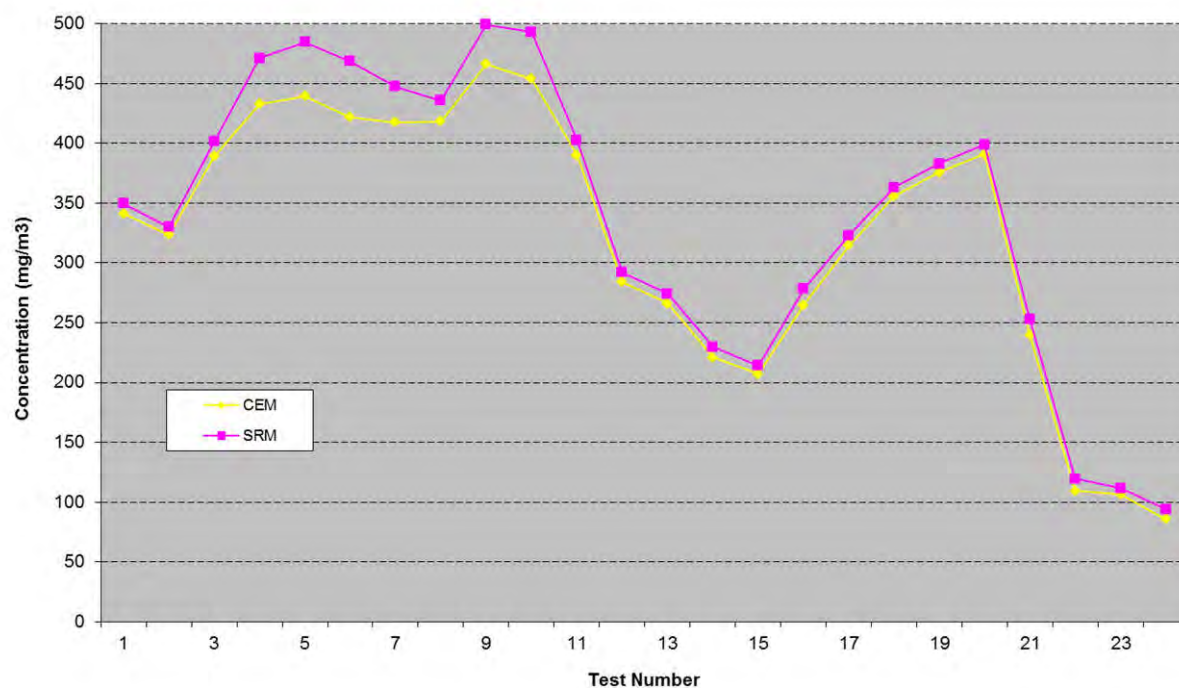
Test No	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
	hr:min		SO ₂ (mg/m3)	SO ₂ (mg/m3)	(mg/m3)
1	12:00	13:00	341.4	349.9	6.0
2	14:02	15:02	323.4	330.1	5.6
3	16:04	17:04	389.4	401.7	6.8
4	18:06	19:06	433.2	471.2	8.0
5	20:08	21:08	439.4	484.8	8.2
6	22:10	23:10	422.2	468.7	7.6
7	0:00	1:00	417.7	447.7	7.5
8	2:02	3:02	418.2	435.9	7.3
9	4:04	5:04	466.4	499.5	7.8
10	6:06	7:06	454.1	493.1	8.0
11	8:08	9:08	390.1	402.6	6.7
12	11:10	12:10	284.1	292.2	4.8
13	13:12	14:12	266.1	274.4	4.6
14	15:14	16:14	220.8	229.8	3.9
15	17:16	18:16	207.2	214.2	3.6
16	19:18	20:18	264.7	278.2	4.6
17	21:20	22:20	314.7	323.3	5.4
18	0:00	1:00	355.9	363.2	6.0
19	2:02	3:02	375.5	383.2	6.3
20	4:04	5:04	390.9	399.1	6.4
21	6:06	7:06	239.8	253.2	4.1
22	8:08	9:08	109.2	119.4	2.0
23	10:30	11:30	106.5	111.4	1.9
24	12:32	13:32	85.4	94.1	1.6

Note:

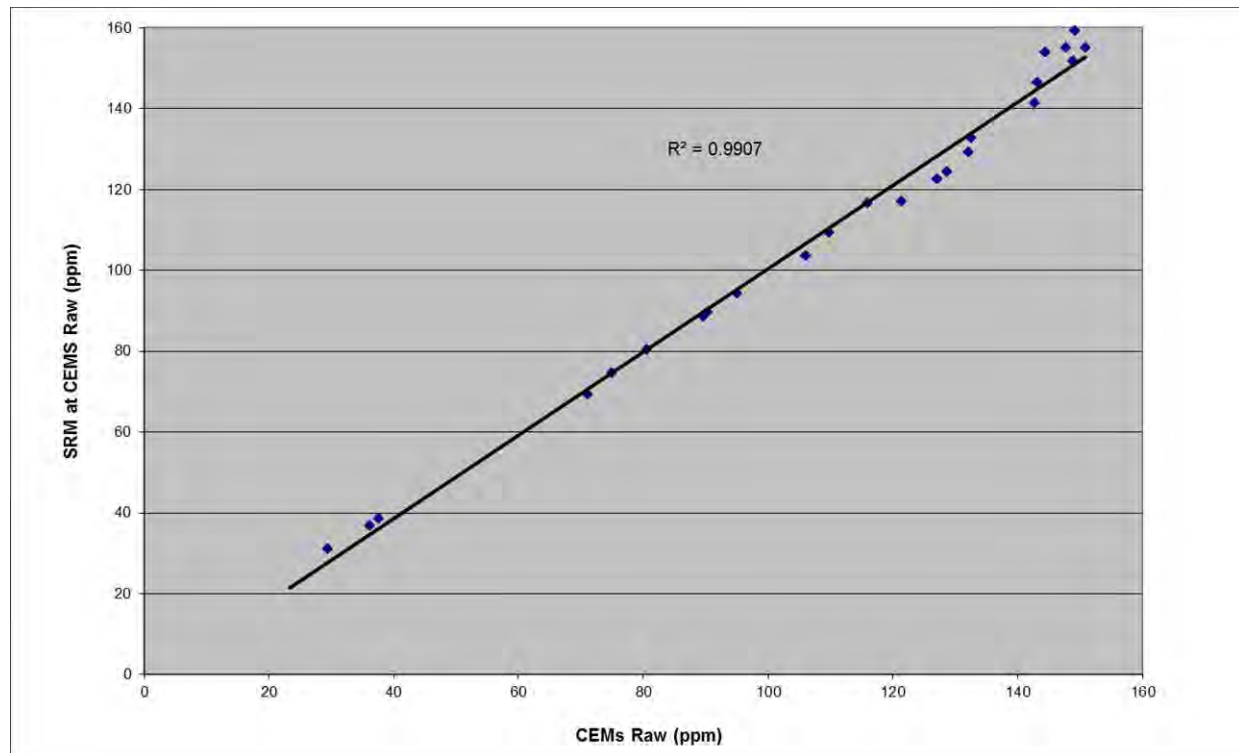
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

4A1.3.3 – Plot 1.3 - Time Series of Standardised CEM versus Standardised SRM data – Sulphur Dioxide, High Range (Expressed at reference conditions 273K, 101.3kPa, dry gas, 6% oxygen)



4A1.4.3 – Elimination of Outliers – Sulphur Dioxide, High Range.



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R^2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.

Additionally, any data points are not likely to be outliers unless they are more than three standard deviations from the regression line'

As the R^2 value for this determinand was 0.9907, an outlier test has not been undertaken.

4A1.5.3 Determination of Method A or Method B - Sulphur Dioxide, High Range.

Test No	Test Date	Test Start Time	Test End Time	SRM measured value (y)	SRM Moisture	SRM O2	SRM Standardised
		hr:min		(ppm)	(%)	(%)	(mg/m3)
1	03-Mar-15	12:00	13:00	116.6	2.38	6.4	349.9
2	03-Mar-15	14:02	15:02	109.3	2.30	6.5	330.1
3	03-Mar-15	16:04	17:04	132.9	2.18	6.5	401.7
4	03-Mar-15	18:06	19:06	155.1	2.20	6.6	471.2
5	03-Mar-15	20:08	21:08	159.3	1.96	6.6	484.8
6	03-Mar-15	22:10	23:10	154.0	2.09	6.6	468.7
7	04-Mar-15	0:00	1:00	146.6	2.23	6.6	447.7
8	04-Mar-15	2:02	3:02	141.5	2.11	6.8	435.9
9	04-Mar-15	4:04	5:04	151.8	2.16	7.7	499.5
10	04-Mar-15	6:06	7:06	155.2	2.10	7.2	493.1
11	04-Mar-15	8:08	9:08	129.2	2.22	6.9	402.6
12	04-Mar-15	11:10	12:10	94.3	2.44	6.8	292.2
13	04-Mar-15	13:12	14:12	88.6	2.38	6.8	274.4
14	04-Mar-15	15:14	16:14	74.6	2.37	6.7	229.8
15	04-Mar-15	17:16	18:16	69.3	2.33	6.8	214.2
16	04-Mar-15	19:18	20:18	89.6	2.25	6.9	278.2
17	04-Mar-15	21:20	22:20	103.5	2.18	7.0	323.3
18	05-Mar-15	0:00	1:00	117.0	2.29	6.9	363.2
19	05-Mar-15	2:02	3:02	122.7	2.19	7.0	383.2
20	05-Mar-15	4:04	5:04	124.3	2.21	7.3	399.1
21	05-Mar-15	6:06	7:06	80.4	1.92	7.1	253.2
22	05-Mar-15	8:08	9:08	38.5	1.73	6.9	119.4
23	05-Mar-15	10:30	11:30	36.8	1.83	6.6	111.4
24	05-Mar-15	12:32	13:32	31.1	1.95	6.5	94.1
Sum				2622.10			
Emission Limit Value (ELV) =			440	mg/Nm ³		Y _{max}	499.48
15% of the ELV =			66	mg/Nm ³		Y _{min}	94.06
Therefore Ymax - Ymin > 15% of the ELV			Method A			Y _{max} - Ymin	405.42

4A1.6.3 Table 4.3.3 - Data used to derive calibration function - Sulphur Dioxide, High Range.

Test No	Test Date	Test Start Time	Test End Time	SRM measured value (y)	CEMS measured signal (x)	y_i	x_i	$x_i * y_i$	x_i^2	b
		hr:min		SO2 (ppm)	SO2 (ppm)	1	2	3	4	
1	16-Feb-15	Reference Gas		0	0.33	-104.8838637	-103.8989224	10897.32042	10794.98608	
2	03-Mar-15	12:00	13:00	116.6	116.0	11.72	11.76	137.86	138.29	
3	03-Mar-15	14:02	15:02	109.3	109.8	4.40	5.54	24.41	30.71	
4	03-Mar-15	16:04	17:04	132.9	132.6	28.01	28.32	793.24	802.11	
5	03-Mar-15	18:06	19:06	155.1	147.7	50.19	43.45	2180.78	1888.23	
6	03-Mar-15	20:08	21:08	159.3	149.2	54.38	44.98	2446.07	2023.37	
7	03-Mar-15	22:10	23:10	154.0	144.5	49.13	40.23	1976.45	1618.10	
8	04-Mar-15	0:00	1:00	146.6	143.2	41.68	38.92	1622.52	1515.08	
9	04-Mar-15	2:02	3:02	141.5	142.7	36.63	38.51	1410.54	1483.04	
10	04-Mar-15	4:04	5:04	151.8	148.9	46.88	44.71	2096.29	1999.13	
11	04-Mar-15	6:06	7:06	155.2	150.8	50.33	46.60	2345.37	2171.73	
12	04-Mar-15	8:08	9:08	129.2	132.2	24.29	27.94	678.53	780.54	
13	04-Mar-15	11:10	12:10	94.3	95.0	-10.62	-9.25	98.31	85.63	
14	04-Mar-15	13:12	14:12	88.6	89.6	-16.30	-14.60	237.91	213.02	
15	04-Mar-15	15:14	16:14	74.6	75.0	-30.24	-29.26	884.82	856.37	
16	04-Mar-15	17:16	18:16	69.3	71.2	-35.59	-33.05	1176.44	1092.63	
17	04-Mar-15	19:18	20:18	89.6	90.2	-15.33	-13.98	214.31	195.43	
18	04-Mar-15	21:20	22:20	103.5	106.0	-1.38	1.76	-2.42	3.09	
19	05-Mar-15	0:00	1:00	117.0	121.4	12.14	17.15	208.10	294.03	
20	05-Mar-15	2:02	3:02	122.7	127.1	17.78	22.84	406.03	521.67	
21	05-Mar-15	4:04	5:04	124.3	128.7	19.42	24.52	476.14	601.03	
22	05-Mar-15	6:06	7:06	80.4	80.6	-24.48	-23.60	577.67	556.99	
23	05-Mar-15	8:08	9:08	38.5	37.5	-66.36	-66.70	4425.80	4448.51	
24	05-Mar-15	10:30	11:30	36.8	36.2	-68.06	-68.06	4632.03	4631.84	
25	05-Mar-15	12:32	13:32	31.1	29.4	-73.74	-74.83	5518.20	5599.37	
Sum				2622.10	2605.72	0.00	0.00	45462.71	44344.90	1.03

4A1.7.3 Determination of Calibration Function - Sulphur Dioxide, High Range.

Method A

If $Y_{max} - Y_{min} > 15\%$ of the ELV, the following formulae are used:

$$b = \frac{\sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^N (x_i - \bar{x})^2} \quad \text{where} \quad \bar{x} = \frac{1}{N} \sum_{i=1}^N x_i \quad \bar{y} = \frac{1}{N} \sum_{i=1}^N y_i$$

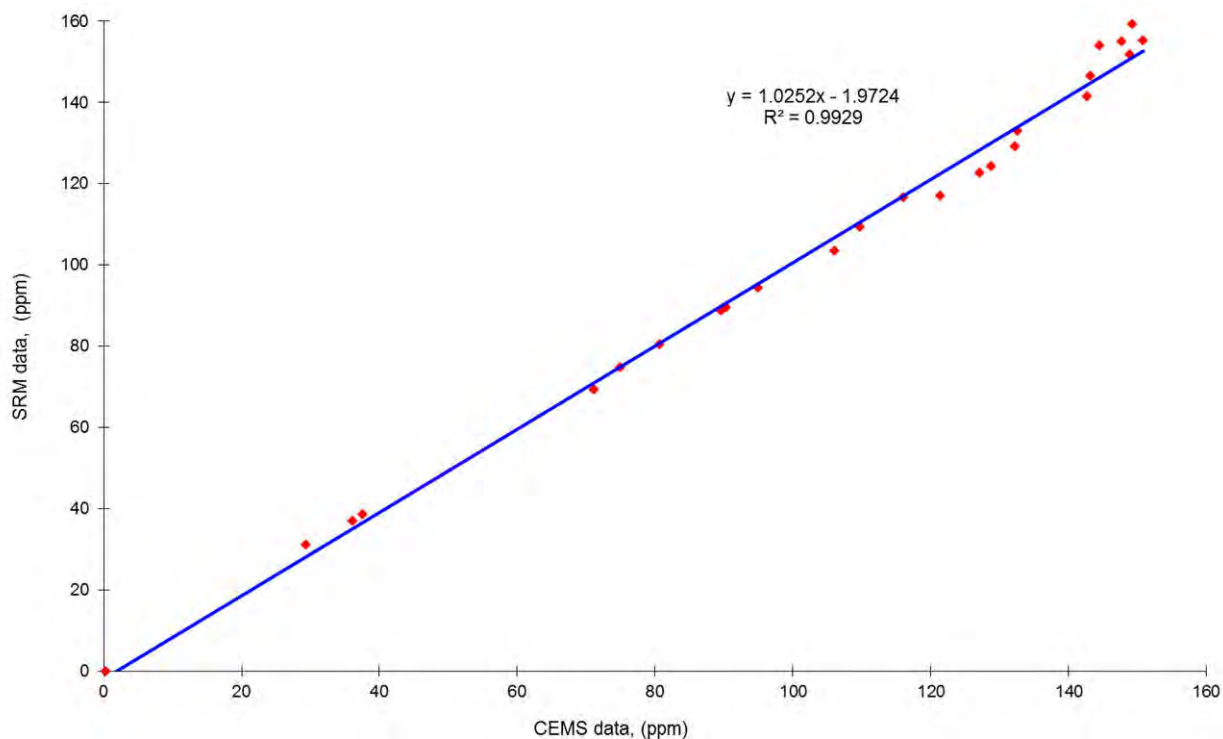
$$a = y - bx \quad a = 104.89 - 104.23 * 1.025$$

The calibration is function $y_i = a + b x_i$ or $y_i = -1.972 + 1.025 * x_i$

4A1.8.3 Table A.4.4.3 - Calculation of calibrated CEMS values - Sulphur Dioxide, High Range.

Test No	Test Date	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Moisture	CEMS wet Oxygen	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		SO2 (ppm)	SO2 (ppm)	(%)	(%)	SO2 (mg/m3)	SO2 (mg/m3)
1	16-Feb-15	Reference Gas		0.3	-1.6	N/A	N/A	-4.7	0.0
2	03-Mar-15	12:00	13:00	116.0	116.9	2.2	6.1	344.2	349.9
3	03-Mar-15	14:02	15:02	109.8	110.6	2.1	6.1	325.8	330.1
4	03-Mar-15	16:04	17:04	132.6	133.9	2.0	6.1	393.4	401.7
5	03-Mar-15	18:06	19:06	147.7	149.4	2.1	6.1	438.3	471.2
6	03-Mar-15	20:08	21:08	149.2	151.0	2.0	6.2	444.7	484.8
7	03-Mar-15	22:10	23:10	144.5	146.1	2.1	6.0	427.1	468.7
8	04-Mar-15	00:00	01:00	143.2	144.8	2.1	6.0	422.4	447.7
9	04-Mar-15	02:02	03:02	142.7	144.4	2.0	6.1	423.0	435.9
10	04-Mar-15	04:04	05:04	148.9	150.7	2.1	7.0	472.0	499.5
11	04-Mar-15	06:06	07:06	150.8	152.7	2.0	6.5	459.6	493.1
12	04-Mar-15	08:08	09:08	132.2	133.5	2.1	6.2	394.2	402.6
13	04-Mar-15	11:10	12:10	95.0	95.4	2.4	6.3	285.3	292.2
14	04-Mar-15	13:12	14:12	89.6	89.9	2.4	6.2	266.9	274.4
15	04-Mar-15	15:14	16:14	75.0	74.9	2.3	6.1	220.6	229.8
16	04-Mar-15	17:16	18:16	71.2	71.0	2.3	5.9	206.7	214.2
17	04-Mar-15	19:18	20:18	90.2	90.6	2.3	6.1	265.6	278.2
18	04-Mar-15	21:20	22:20	106.0	106.7	2.2	6.2	316.8	323.3
19	05-Mar-15	00:00	01:00	121.4	122.5	2.3	6.0	359.1	363.2
20	05-Mar-15	02:02	03:02	127.1	128.3	2.2	6.2	379.2	383.2
21	05-Mar-15	04:04	05:04	128.7	130.0	2.2	6.6	394.7	399.1
22	05-Mar-15	06:06	07:06	80.6	80.7	2.0	6.3	240.0	253.2
23	05-Mar-15	08:08	09:08	37.5	36.5	1.8	6.0	106.2	119.4
24	05-Mar-15	10:30	11:30	36.2	35.1	1.6	6.2	103.4	111.4
25	05-Mar-15	12:32	13:32	29.4	28.2	2.0	6.0	81.9	94.1
Sum								7766.4	
Emission Limit Value (ELV) =				440	mg/Nm ³				
				Reference Oxygen			6 %		

4A1.9.3 Plot 2.3 CEM versus SRM Parallel Test Data at CEM measurement conditions –Sulphur dioxide, dry gas.



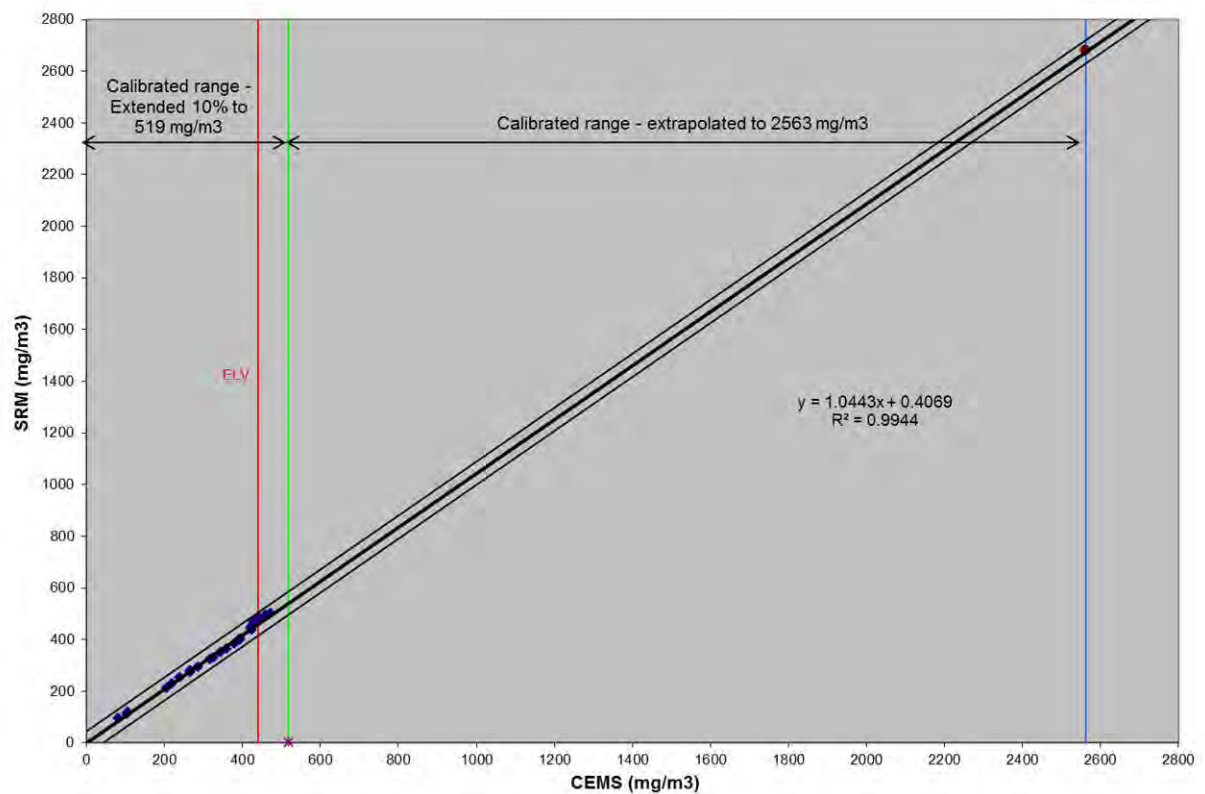
4A1.10.3 Table 4.5.3 – Data used for the Variability Test – Sulphur Dioxide, High Range.

Test No	Test Date	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
		hr:min		mg/m3	mg/m3			
1	03-Mar-15	Reference Gas		-4.7	0.0	4.67	-9.51	90.39
2	03-Mar-15	12:00	13:00	344.2	349.9	5.66	-8.51	72.48
3	03-Mar-15	14:02	15:02	325.8	330.1	4.32	-9.85	97.05
4	03-Mar-15	16:04	17:04	393.4	401.7	8.37	-5.81	33.73
5	03-Mar-15	18:06	19:06	438.3	471.2	32.93	18.75	351.65
6	03-Mar-15	20:08	21:08	444.7	484.8	40.11	25.94	672.72
7	03-Mar-15	22:10	23:10	427.1	468.7	41.66	27.48	755.23
8	04-Mar-15	00:00	01:00	422.4	447.7	25.22	11.05	122.02
9	04-Mar-15	02:02	03:02	423.0	435.9	12.90	-1.28	1.64
10	04-Mar-15	04:04	05:04	472.0	499.5	27.48	13.30	176.93
11	04-Mar-15	06:06	07:06	459.6	493.1	33.50	19.33	373.58
12	04-Mar-15	08:08	09:08	394.2	402.6	8.47	-5.70	32.53
13	04-Mar-15	11:10	12:10	285.3	292.2	6.84	-7.34	53.82
14	04-Mar-15	13:12	14:12	266.9	274.4	7.45	-6.73	45.23
15	04-Mar-15	15:14	16:14	220.6	229.8	9.27	-4.91	24.09
16	04-Mar-15	17:16	18:16	206.7	214.2	7.47	-6.71	44.99
17	04-Mar-15	19:18	20:18	265.6	278.2	12.64	-1.54	2.36
18	04-Mar-15	21:20	22:20	316.8	323.3	6.46	-7.71	59.50
19	05-Mar-15	00:00	01:00	359.1	363.2	4.05	-10.13	102.55
20	05-Mar-15	02:02	03:02	379.2	383.2	3.98	-10.20	104.03
21	05-Mar-15	04:04	05:04	394.7	399.1	4.34	-9.83	96.68
22	05-Mar-15	06:06	07:06	240.0	253.2	13.20	-0.97	0.95
23	05-Mar-15	08:08	09:08	106.2	119.4	13.19	-0.99	0.97
24	05-Mar-15	10:30	11:30	103.4	111.4	8.02	-6.15	37.88
25	05-Mar-15	12:32	13:32	81.9	94.1	12.19	-1.98	3.93
25	Tests		Mean			14.18		
Sum								3356.92

4A1.11.3 - Variability Test Calculation – Sulphur Dioxide, High Range.

SD=	Root(1-Number).Integral(D1-D) ²	11.83	mg/m3(s,d),6%O ₂
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O ₀ is therefore calculated as:-			
O ₀ =	0.2*440 mg/m3 (s,d,6%O ₂)/1.96	44.90	mg/m3(s,d),6%O ₂
For 25 tests, k _v =	0.9861		
Therefore variability=	11.83 <= 44.9 * 0.9861		
	or 11.83 <=	44.27	
Which is TRUE therefore the CEMS passes the test			

4A1.12.3 Plot 3.3 –Standardised CEM data versus standardised SRM - Sulphur dioxide, High Range – Reference conditions 273K, 101.3kPa., 6% oxygen, dry gas.



Section 4A2: Data & calculations – QAL2 – Unit 8, Procal 2

Section 4A2 – Data and calculations – QAL2 Procal 2

4A2.1 Table 4.1.1 – Raw monitoring Data – Oxides of Nitrogen

Test No	Test Date	Test Start Time	Test End Time	CEMS Raw Value (Wet)	CEMS Oxygen	CEMS Moisture	SRM Raw value (Dry)	SRM Oxygen (Dry)	SRM Moisture	SRM at CEMS Raw conditions
		hr:min		NO (ppm)	(%)	(%)	NOx (ppm)	(%)	(%)	NOx (ppm)
1	03-Mar-15	12:00	13:00	334.50	6.11	3.21	385.8	6.37	2.38	376.6
2	03-Mar-15	14:02	15:02	328.80	6.14	3.34	379.0	6.47	2.30	370.3
3	03-Mar-15	16:04	17:04	312.48	6.11	3.31	359.1	6.50	2.18	351.2
4	03-Mar-15	18:06	19:06	302.85	6.08	3.28	345.2	6.58	2.20	337.6
5	03-Mar-15	20:08	21:08	267.51	6.15	3.25	307.6	6.64	1.96	301.6
6	03-Mar-15	22:10	23:10	230.99	6.02	3.23	275.9	6.61	2.09	270.1
7	04-Mar-15	0:00	1:00	236.59	5.99	3.25	275.4	6.64	2.23	269.3
8	04-Mar-15	2:02	3:02	251.49	6.07	3.24	287.3	6.78	2.11	281.3
9	04-Mar-15	4:04	5:04	292.33	7.02	3.34	322.4	7.68	2.16	315.5
10	04-Mar-15	6:06	7:06	304.52	6.47	3.36	336.0	7.21	2.10	328.9
11	04-Mar-15	8:08	9:08	320.77	6.17	3.48	342.0	6.93	2.22	334.4
12	04-Mar-15	11:10	12:10	433.17	6.32	3.67	456.6	6.82	2.44	445.5
13	04-Mar-15	13:12	14:12	420.8	6.21	3.62	424.6	6.82	2.38	414.5
14	04-Mar-15	15:14	16:14	296.2	6.10	3.47	323.5	6.74	2.37	315.8
15	04-Mar-15	17:16	18:16	279.9	5.93	3.49	311.3	6.80	2.33	304.0
16	04-Mar-15	19:18	20:18	289.0	6.05	3.52	319.0	6.88	2.25	311.8
17	04-Mar-15	21:20	22:20	321.4	6.24	3.59	345.6	6.97	2.18	338.1
18	05-Mar-15	00:00	01:00	306.7	6.04	3.69	335.7	6.86	2.29	328.0
19	05-Mar-15	02:02	03:02	313.3	6.17	3.42	332.8	6.97	2.19	325.5
20	05-Mar-15	04:04	05:04	305.6	6.56	3.43	316.0	7.34	2.21	309.0
21	05-Mar-15	06:06	07:06	297.4	6.30	3.24	303.2	7.11	1.92	297.4
22	05-Mar-15	08:08	09:08	259.2	6.00	3.08	266.0	6.92	1.73	261.4
23	05-Mar-15	10:30	11:30	339.7	6.21	3.14	349.7	6.57	1.83	343.3
24	05-Mar-15	12:32	13:32	316.1	5.96	3.24	333.1	6.53	1.95	326.6

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

4A2.2 Table 4.2.1 - Standardised monitoring Data – Oxides of Nitrogen

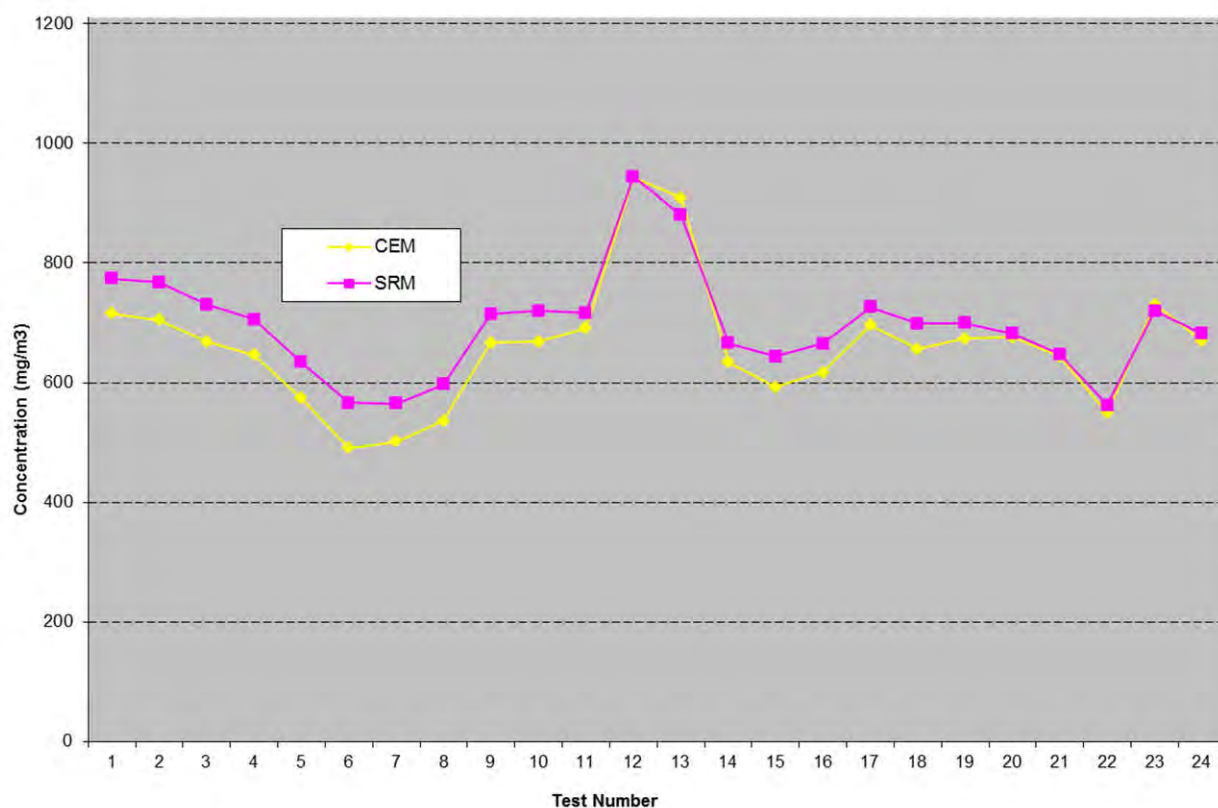
Test No	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty NOx as NO2
	hr:min		NOx as NO2(mg/m3)	NOx as NO2(mg/m3)	(mg/m3)
1	12:00	13:00	715.0	774.1	20
2	14:02	15:02	705.2	767.3	20
3	16:04	17:04	668.6	730.3	19
4	18:06	19:06	646.5	705.3	19
5	20:08	21:08	573.6	634.2	18
6	22:10	23:10	490.8	566.4	18
7	0:00	1:00	501.8	565.0	18
8	2:02	3:02	536.3	596.7	18
9	4:04	5:04	666.7	714.4	20
10	6:06	7:06	668.2	719.8	19
11	8:08	9:08	690.4	716.3	20
12	11:10	12:10	943.7	944.8	23
13	13:12	14:12	909.3	879.4	22
14	15:14	16:14	634.4	666.2	19
15	17:16	18:16	592.9	644.3	19
16	19:18	20:18	617.1	665.3	19
17	21:20	22:20	695.8	726.3	20
18	0:00	1:00	655.8	698.5	19
19	2:02	3:02	673.9	699.1	19
20	4:04	5:04	675.2	682.0	19
21	6:06	7:06	644.1	647.4	19
22	8:08	9:08	549.3	562.2	18
23	10:30	11:30	730.5	719.7	20
24	12:32	13:32	669.1	681.7	19

Note:

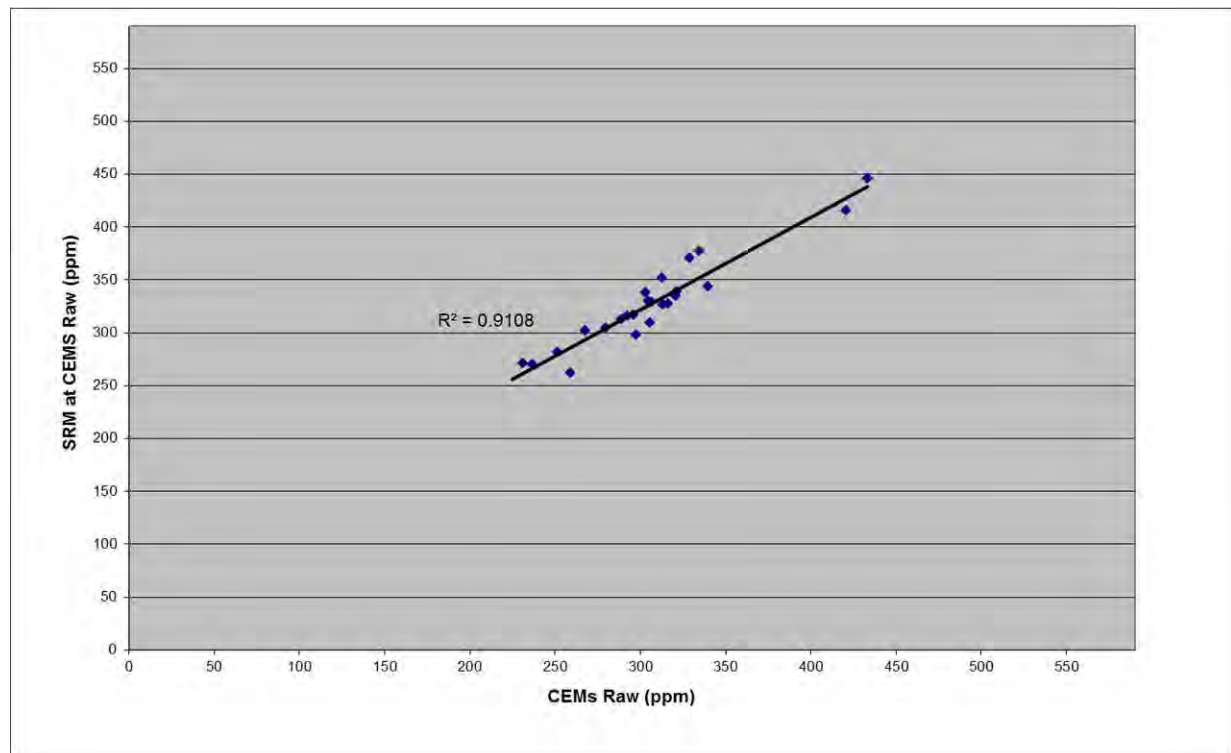
Emission concentrations expressed at reference conditions 27

6 % Oxygen, dry gas

4A2.3 – Plot 1.1 - Time Series of Standardised CEM versus Standardised SRM data – Oxides of Nitrogen, (Expressed at reference conditions 273K, 101.3kPa, dry gas, 6% oxygen)



4A2.4 – Elimination of Outliers – Oxides of Nitrogen,



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R^2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.

Additionally, any data points are not likely to be outliers unless they are more than three standard deviations from the regression line'

As the R^2 value for this determinand was 0.9108, an outlier test has not been undertaken.

4A2.5.1 Determination of Method A or Method B - Oxides of Nitrogen

Test No	Test Date	Test Start Time	Test End Time	SRM measured value (y)	SRM Moisture	SRM O2	SRM Standardised
		hr:min		(ppm)	(%)	(%)	(mg/m3)
1	03-Mar-15	12:00	13:00	376.6	2.38	6.4	774.1
2	03-Mar-15	14:02	15:02	370.3	2.30	6.5	785.3
3	03-Mar-15	16:04	17:04	351.2	2.18	6.5	746.5
4	03-Mar-15	18:06	19:06	337.6	2.20	6.6	721.1
5	03-Mar-15	20:08	21:08	301.6	1.96	6.6	646.9
6	03-Mar-15	22:10	23:10	270.1	2.09	6.6	578.5
7	04-Mar-15	0:00	1:00	269.3	2.23	6.6	577.9
8	04-Mar-15	2:02	3:02	281.3	2.11	6.8	609.6
9	04-Mar-15	4:04	5:04	315.5	2.16	7.7	730.2
10	04-Mar-15	6:06	7:06	328.9	2.10	7.2	735.2
11	04-Mar-15	8:08	9:08	334.4	2.22	6.9	732.5
12	04-Mar-15	11:10	12:10	445.5	2.44	6.8	968.3
13	04-Mar-15	13:12	14:12	414.5	2.38	6.8	900.9
14	04-Mar-15	15:14	16:14	315.8	2.37	6.7	682.4
15	04-Mar-15	17:16	18:16	304.0	2.33	6.8	659.6
16	04-Mar-15	19:18	20:18	311.8	2.25	6.9	680.7
17	04-Mar-15	21:20	22:20	338.1	2.18	7.0	742.5
18	05-Mar-15	0:00	1:00	328.0	2.29	6.9	714.9
19	05-Mar-15	2:02	3:02	325.5	2.19	7.0	714.8
20	05-Mar-15	4:04	5:04	309.0	2.21	7.3	697.4
21	05-Mar-15	6:06	7:06	297.4	1.92	7.1	660.1
22	05-Mar-15	8:08	9:08	261.4	1.73	6.9	572.1
23	05-Mar-15	10:30	11:30	343.3	1.83	6.6	733.1
24	05-Mar-15	12:32	13:32	326.6	1.95	6.5	695.2
Sum				7857.76			
Emission Limit Value (ELV) =				1210	mg/Nm ³		Y _{max} 968.34
15% of the ELV =				181.5	mg/Nm ³		Y _{min} 572.13
Therefore Ymax - Ymin > 15% of the ELV				Method A		Y _{max} - Y _{min}	396.21

4A2.6.1 Table 4.3.1 - Data used to derive calibration function - Oxides of Nitrogen,

Test No	Test Date	Test Start Time	Test End Time	SRM measured value (y)	CEMS measured signal (x)	Yi	Xi	Xi * Yi	Xi ²	b
		hr:min		NOx (ppm)	NO (ppm)					
1	17-Feb-15	Reference Gas		0	-0.33	-314.3105579	-294.7696	92649.19744	86889.11708	
2	03-Mar-15	12:00	13:00	376.6	334.5	62.33	40.06	2496.99	1604.84	
3	03-Mar-15	14:02	15:02	370.3	328.8	55.97	34.36	1923.15	1180.64	
4	03-Mar-15	16:04	17:04	351.2	312.5	36.94	18.04	666.34	325.46	
5	03-Mar-15	18:06	19:06	337.6	302.9	23.28	8.41	195.78	70.73	
6	03-Mar-15	20:08	21:08	301.6	267.5	-12.75	-26.93	343.23	725.20	
7	03-Mar-15	22:10	23:10	270.1	231.0	-44.21	-63.45	2805.06	4025.85	
8	04-Mar-15	0:00	1:00	269.3	236.6	-45.02	-57.85	2604.63	3346.58	
9	04-Mar-15	2:02	3:02	281.3	251.5	-33.04	-42.95	1419.00	1844.67	
10	04-Mar-15	4:04	5:04	315.5	292.3	1.17	-2.11	-2.47	4.45	
11	04-Mar-15	6:06	7:06	328.9	304.5	14.59	10.08	147.11	101.61	
12	04-Mar-15	8:08	9:08	334.4	320.8	20.08	26.33	528.66	693.29	
13	04-Mar-15	11:10	12:10	445.5	433.2	131.19	138.73	18200.40	19246.12	
14	04-Mar-15	13:12	14:12	414.5	420.8	100.18	126.32	12654.91	15956.84	
15	04-Mar-15	15:14	16:14	315.8	296.2	1.53	1.75	2.68	3.06	
16	04-Mar-15	17:16	18:16	304.0	279.9	-10.27	-14.50	148.92	210.24	
17	04-Mar-15	19:18	20:18	311.8	289.0	-2.49	-5.47	13.61	29.92	
18	04-Mar-15	21:20	22:20	338.1	321.4	23.77	26.97	641.13	727.40	
19	05-Mar-15	0:00	1:00	328.0	306.7	13.70	12.30	168.53	151.30	
20	05-Mar-15	2:02	3:02	325.5	313.3	11.19	18.89	211.45	356.85	
21	05-Mar-15	4:04	5:04	309.0	305.6	-5.29	11.15	-58.94	124.33	
22	05-Mar-15	6:06	7:06	297.4	297.4	-16.94	2.92	-49.47	8.53	
23	05-Mar-15	8:08	9:08	261.4	259.2	-52.91	-35.20	1862.43	1239.01	
24	05-Mar-15	10:30	11:30	343.3	339.7	29.01	45.25	1312.54	2047.60	
25	05-Mar-15	12:32	13:32	326.6	316.1	12.29	21.66	266.20	469.17	
Sum				7857.76	7360.99	0.00	0.00	141151.05	141382.81	1.00

4A2.7.1 Determination of Calibration Function - Oxides of Nitrogen

Method A					
If Ymax-Ymin >15% of the ELV, the following formulae are used:					
$b = \frac{\sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^N (x_i - \bar{x})^2}$	where	$\bar{x} = 1/N \sum_{i=1}^N x_i$	$\bar{y} = 1/N \sum_{i=1}^N y_i$	x=	294.44
				y=	314.31
				b=	0.998
$a = y - bx$		$a = 314.32 - 294.44 * 0.998$		a=	20.354
The calibration is function $y_i = a + b x_i$ or			$y_i =$	$20.354 + 0.998 * x_i$	

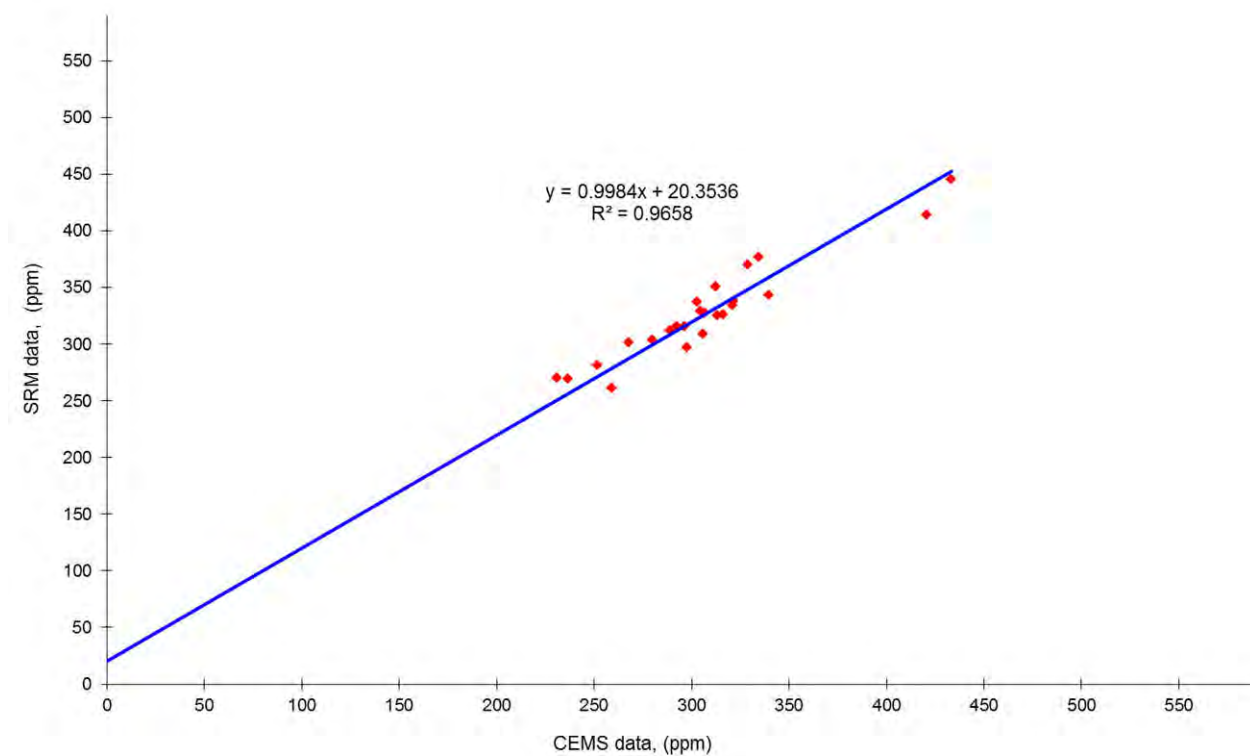
4A2.8.1 Table 4.4.1 - Calculation of calibrated CEMS values - Oxides of Nitrogen

Test No	Test Date	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Moisture	CEMS Dry Oxygen	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		NO (ppm)	NO (ppm)	(%)	(%)	NOx as NO2(mg/m3)	NOx as NO2(mg/m3)
1	17-Feb-15	Reference Gas		-0.3	20.0	N/A	N/A	41.1	0.0
2	03-Mar-15	12:00	13:00	334.5	354.3	3.2	6.1	757.3	774.1
3	03-Mar-15	14:02	15:02	328.8	348.6	3.3	6.1	747.7	767.3
4	03-Mar-15	16:04	17:04	312.5	332.3	3.3	6.1	711.1	730.3
5	03-Mar-15	18:06	19:06	302.9	322.7	3.3	6.1	688.9	705.3
6	03-Mar-15	20:08	21:08	267.5	287.4	3.3	6.2	616.3	634.2
7	03-Mar-15	22:10	23:10	231.0	251.0	3.2	6.0	533.3	566.4
8	04-Mar-15	00:00	01:00	236.6	256.6	3.3	6.0	544.2	565.0
9	04-Mar-15	02:02	03:02	251.5	271.4	3.2	6.1	578.8	596.7
10	04-Mar-15	04:04	05:04	292.3	312.2	3.3	7.0	712.0	714.4
11	04-Mar-15	06:06	07:06	304.5	324.4	3.4	6.5	711.7	719.8
12	04-Mar-15	08:08	09:08	320.8	340.6	3.5	6.2	733.0	716.3
13	04-Mar-15	11:10	12:10	433.2	452.8	3.7	6.3	986.5	944.8
14	04-Mar-15	13:12	14:12	420.8	440.4	3.6	6.2	951.8	879.4
15	04-Mar-15	15:14	16:14	296.2	316.1	3.5	6.1	676.9	666.2
16	04-Mar-15	17:16	18:16	279.9	299.8	3.5	5.9	635.0	644.3
17	04-Mar-15	19:18	20:18	289.0	308.8	3.5	6.1	659.6	665.3
18	04-Mar-15	21:20	22:20	321.4	341.2	3.6	6.2	738.7	726.3
19	05-Mar-15	00:00	01:00	306.7	326.6	3.7	6.0	698.2	698.5
20	05-Mar-15	02:02	03:02	313.3	333.2	3.4	6.2	716.6	699.1
21	05-Mar-15	04:04	05:04	305.6	325.4	3.4	6.6	719.1	682.0
22	05-Mar-15	06:06	07:06	297.4	317.2	3.2	6.3	687.1	647.4
23	05-Mar-15	08:08	09:08	259.2	279.2	3.1	6.0	591.5	562.2
24	05-Mar-15	10:30	11:30	339.7	359.5	3.1	6.2	773.1	719.7
25	05-Mar-15	12:32	13:32	316.1	335.9	3.2	6.0	711.1	681.7
Sum								16920.6	
Emission Limit Value (ELV) =				1210	mg/Nm ³				

Reference Oxygen

6 %

4A2.9.1 Plot 2.1 CEM versus SRM Parallel Test Data at CEM measurement conditions –NOx ppm, wet gas.



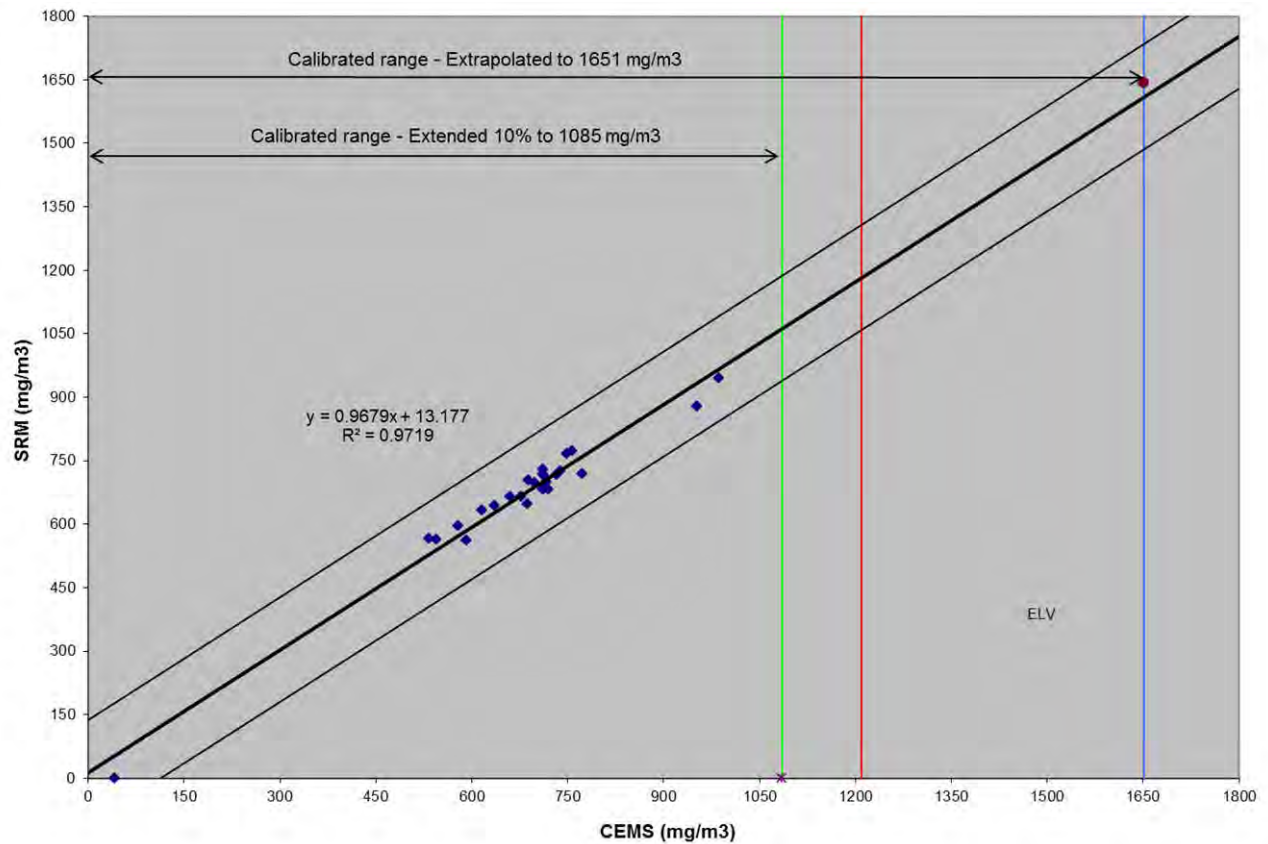
4A2.10.1 Table 4.5.1 – Data used for the Variability Test – Oxides of Nitrogen

Test No	Test Date	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
		hr:min		mg/m3	mg/m3			
1	17-Feb-15	Reference Gas		41.1	0.0	-41.12	-32.56	1060.16
2	03-Mar-15	12:00	13:00	757.3	774.1	16.77	25.33	641.59
3	03-Mar-15	14:02	15:02	747.7	767.3	19.58	28.14	792.08
4	03-Mar-15	16:04	17:04	711.1	730.3	19.20	27.76	770.62
5	03-Mar-15	18:06	19:06	688.9	705.3	16.42	24.98	624.11
6	03-Mar-15	20:08	21:08	616.3	634.2	17.97	26.53	703.81
7	03-Mar-15	22:10	23:10	533.3	566.4	33.10	41.66	1735.61
8	04-Mar-15	00:00	01:00	544.2	565.0	20.85	29.41	865.07
9	04-Mar-15	02:02	03:02	578.8	596.7	17.95	26.51	702.69
10	04-Mar-15	04:04	05:04	712.0	714.4	2.39	10.96	120.03
11	04-Mar-15	06:06	07:06	711.7	719.8	8.03	16.59	275.27
12	04-Mar-15	08:08	09:08	733.0	716.3	-16.77	-8.21	67.41
13	04-Mar-15	11:10	12:10	986.5	944.8	-41.74	-33.18	1100.94
14	04-Mar-15	13:12	14:12	951.8	879.4	-72.42	-63.86	4078.12
15	04-Mar-15	15:14	16:14	676.9	666.2	-10.69	-2.13	4.55
16	04-Mar-15	17:16	18:16	635.0	644.3	9.24	17.80	316.70
17	04-Mar-15	19:18	20:18	659.6	665.3	5.74	14.30	204.61
18	04-Mar-15	21:20	22:20	738.7	726.3	-12.43	-3.87	14.97
19	05-Mar-15	00:00	01:00	698.2	698.5	0.28	8.84	78.12
20	05-Mar-15	02:02	03:02	716.6	699.1	-17.48	-8.92	79.59
21	05-Mar-15	04:04	05:04	719.1	682.0	-37.11	-28.55	815.20
22	05-Mar-15	06:06	07:06	687.1	647.4	-39.72	-31.16	971.03
23	05-Mar-15	08:08	09:08	591.5	562.2	-29.28	-20.72	429.28
24	05-Mar-15	10:30	11:30	773.1	719.7	-53.38	-44.82	2008.49
25	05-Mar-15	12:32	13:32	711.1	681.7	-29.39	-20.83	433.79
25	Tests		Mean			-8.56		
Sum								18893.84

4A2.11.1 - Variability Test Calculation – Oxides of Nitrogen

SD=	Root(1-Number).Integral(D1-D) ²	28.06	mg/m3(s,d),6%O ₂
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O ₀ is therefore calculated as:-			
O ₀ =	0.2*1210 mg/m3 (s,d,6%O ₂)/1.96	123.47	mg/m3(s,d),6%O ₂
For 25 tests, k _v =	0.9861		
Therefore variability=	28.06 <= 123.47 * 0.9861		
	or 28.06 <=	121.75	
Which is TRUE therefore the CEMS passes the test			

4A2.12.1 Plot 3.1 –Standardised CEM data versus standardised SRM - Oxides of Nitrogen (as NO₂) – Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen



4A2.1.2 Table 4.1.2 – Raw monitoring Data – Sulphur Dioxide, Low Range

Test No	Test Date	Test Start Time	Test End Time	CEMS Raw Value (Wet)	CEMS Oxygen (wet)	CEMS Moisture	SRM Raw value (Wet)	SRM Oxygen (Dry)	SRM Moisture	SRM at CEMS Raw conditions
		hr:min		SO ₂ (ppm)	(%)	(%)	SO ₂ (ppm)	(%)	(%)	SO ₂ (ppm)
1	03-Mar-15	12:00	13:00	134.34	6.11	3.21	116.61	6.37	2.38	116.6
2	03-Mar-15	14:02	15:02	128.07	6.14	3.34	109.29	6.47	2.30	109.3
3	03-Mar-15	16:04	17:04	151.00	6.11	3.31	132.89	6.50	2.18	132.9
4	03-Mar-15	18:06	19:06	166.52	6.08	3.28	155.07	6.58	2.20	155.1
5	03-Mar-15	20:08	21:08	164.29	6.15	3.25	159.26	6.64	1.96	159.3
6	03-Mar-15	22:10	23:10	163.46	6.02	3.23	154.02	6.61	2.09	154.0
7	04-Mar-15	0:00	1:00	162.02	5.99	3.25	146.57	6.64	2.23	146.6
8	04-Mar-15	2:02	3:02	153.21	6.07	3.24	141.51	6.78	2.11	141.5
9	04-Mar-15	4:04	5:04	161.69	7.02	3.34	151.77	7.68	2.16	151.8
10	04-Mar-15	6:06	7:06	164.53	6.47	3.36	155.21	7.21	2.10	155.2
11	04-Mar-15	8:08	9:08	150.44	6.17	3.48	129.17	6.93	2.22	129.2
12	04-Mar-15	11:10	12:10	113.78	6.32	3.67	94.26	6.82	2.44	94.3
13	04-Mar-15	13:12	14:12	109.0	6.21	3.62	88.58	6.82	2.38	88.6
14	04-Mar-15	15:14	16:14	96.6	6.10	3.47	74.65	6.74	2.37	74.6
15	04-Mar-15	17:16	18:16	90.2	5.93	3.49	69.29	6.80	2.33	69.3
16	04-Mar-15	19:18	20:18	110.2	6.05	3.52	89.55	6.88	2.25	89.6
17	04-Mar-15	21:20	22:20	124.0	6.24	3.59	103.51	6.97	2.18	103.5
18	05-Mar-15	00:00	01:00	136.7	6.04	3.69	117.02	6.86	2.29	117.0
19	05-Mar-15	02:02	03:02	135.3	6.17	3.42	122.66	6.97	2.19	122.7
20	05-Mar-15	04:04	05:04	136.1	6.56	3.43	124.31	7.34	2.21	124.3
21	05-Mar-15	06:06	07:06	104.0	6.30	3.24	80.41	7.11	1.92	80.4
22	05-Mar-15	08:08	09:08	63.3	6.00	3.08	38.53	6.92	1.73	38.5
23	05-Mar-15	10:30	11:30	59.4	6.21	3.14	36.82	6.57	1.83	36.8
24	05-Mar-15	12:32	13:32	55.5	5.96	3.24	31.14	6.53	1.95	31.1

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa, dry gas

4A2.2.2 Table 4.2.2 -Standardised monitoring Data – Sulphur Dioxide, Low Range

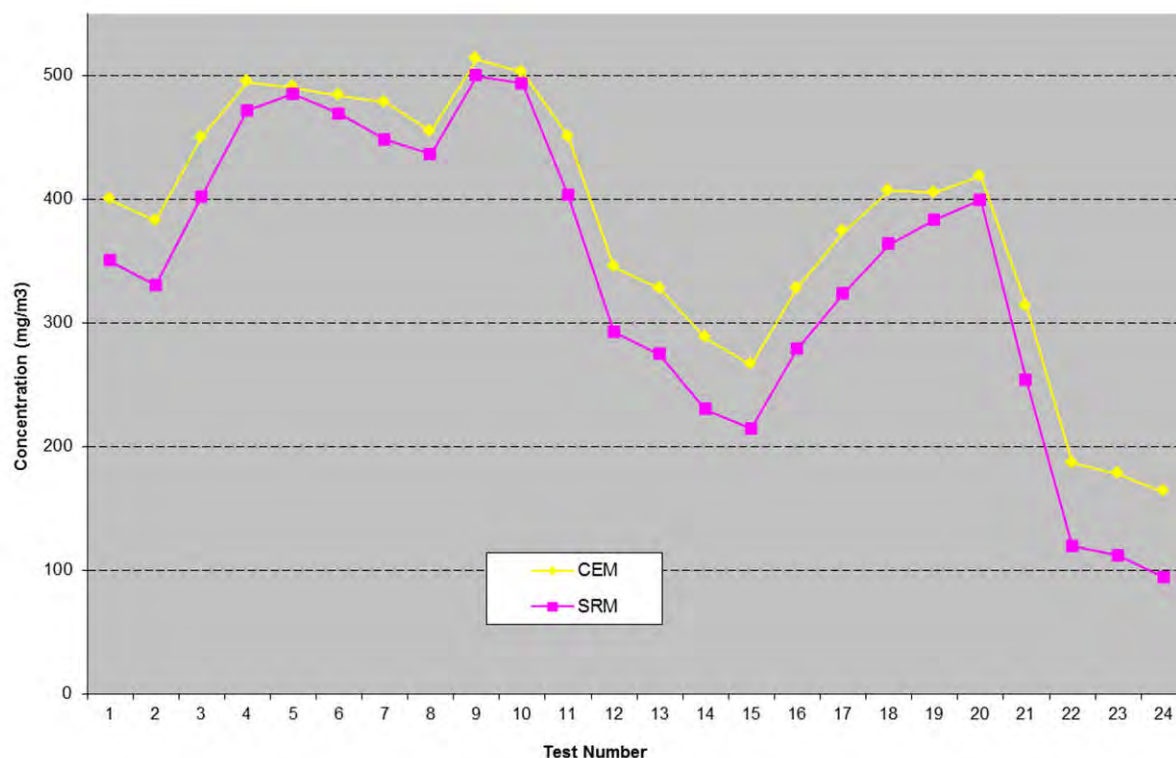
Test No	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty SO ₂
	hr:min		SO ₂ (mg/m ³)	SO ₂ (mg/m ³)	(mg/m ³)
1	12:00	13:00	399.5	349.9	6.0
2	14:02	15:02	382.1	330.1	5.6
3	16:04	17:04	449.5	401.7	6.8
4	18:06	19:06	494.6	471.2	8.0
5	20:08	21:08	490.1	484.8	8.2
6	22:10	23:10	483.3	468.7	7.6
7	0:00	1:00	478.1	447.7	7.5
8	2:02	3:02	454.5	435.9	7.3
9	4:04	5:04	513.1	499.5	7.8
10	6:06	7:06	502.3	493.1	8.0
11	8:08	9:08	450.5	402.6	6.7
12	11:10	12:10	344.9	292.2	4.8
13	13:12	14:12	327.7	274.4	4.6
14	15:14	16:14	287.8	229.8	3.9
15	17:16	18:16	265.7	214.2	3.6
16	19:18	20:18	327.5	278.2	4.6
17	21:20	22:20	373.4	323.3	5.4
18	0:00	1:00	406.6	363.2	6.0
19	2:02	3:02	404.9	383.2	6.3
20	4:04	5:04	418.4	399.1	6.4
21	6:06	7:06	313.4	253.2	4.1
22	8:08	9:08	186.6	119.4	2.0
23	10:30	11:30	177.7	111.4	1.9
24	12:32	13:32	163.4	94.1	1.6

Note:

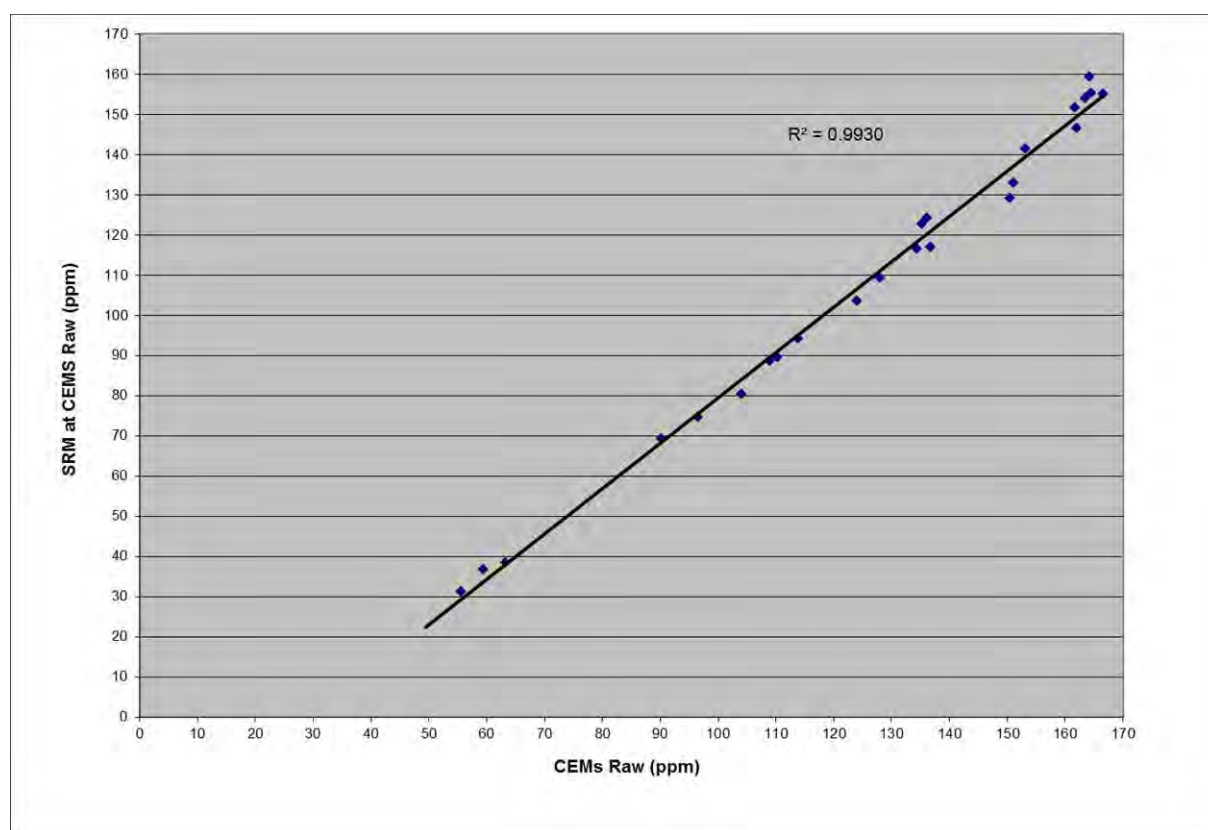
Emission concentrations expressed at reference conditions 27

6 % Oxygen, dry gas

4A2.3.2 – Plot 1.2 - Time Series of Standardised CEM versus Standardised SRM data – Sulphur Dioxide, Low Range (Expressed at reference conditions 273K, 101.3kPa, dry gas, 6% oxygen)



4A2.4.2 – Elimination of Outliers – Sulphur Dioxide, Low Range.



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R^2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.

Additionally, any data points are not likely to be outliers unless they are more than three standard deviations from the regression line'

As the R^2 value for this determinand was 0.9930, an outlier test has not been undertaken.

4A2.5.2 Determination of Method A or Method B - Sulphur Dioxide, Low Range.

Test No	Test Date	Test Start Time	Test End Time	SRM measured value (y)	SRM Moisture	SRM O2	SRM Standardised
		hr:min		(ppm)	(%)	(%)	(mg/m3)
1	03-Mar-15	12:00	13:00	116.6	2.38	6.4	349.9
2	03-Mar-15	14:02	15:02	109.3	2.30	6.5	330.1
3	03-Mar-15	16:04	17:04	132.9	2.18	6.5	401.7
4	03-Mar-15	18:06	19:06	155.1	2.20	6.6	471.2
5	03-Mar-15	20:08	21:08	159.3	1.96	6.6	484.8
6	03-Mar-15	22:10	23:10	154.0	2.09	6.6	468.7
7	04-Mar-15	0:00	1:00	146.6	2.23	6.6	447.7
8	04-Mar-15	2:02	3:02	141.5	2.11	6.8	435.9
9	04-Mar-15	4:04	5:04	151.8	2.16	7.7	499.5
10	04-Mar-15	6:06	7:06	155.2	2.10	7.2	493.1
11	04-Mar-15	8:08	9:08	129.2	2.22	6.9	402.6
12	04-Mar-15	11:10	12:10	94.3	2.44	6.8	292.2
13	04-Mar-15	13:12	14:12	88.6	2.38	6.8	274.4
14	04-Mar-15	15:14	16:14	74.6	2.37	6.7	229.8
15	04-Mar-15	17:16	18:16	69.3	2.33	6.8	214.2
16	04-Mar-15	19:18	20:18	89.6	2.25	6.9	278.2
17	04-Mar-15	21:20	22:20	103.5	2.18	7.0	323.3
18	05-Mar-15	0:00	1:00	117.0	2.29	6.9	363.2
19	05-Mar-15	2:02	3:02	122.7	2.19	7.0	383.2
20	05-Mar-15	4:04	5:04	124.3	2.21	7.3	399.1
21	05-Mar-15	6:06	7:06	80.4	1.92	7.1	253.2
22	05-Mar-15	8:08	9:08	38.5	1.73	6.9	119.4
23	05-Mar-15	10:30	11:30	36.8	1.83	6.6	111.4
24	05-Mar-15	12:32	13:32	31.1	1.95	6.5	94.1
Sum				2622.10			
Emission Limit Value (ELV) =			440	mg/Nm ³		Y _{max}	499.48
15% of the ELV =			66	mg/Nm ³		Y _{min}	94.06
Therefore Ymax - Ymin > 15% of the ELV			Method A			Y _{max} - Ymin	405.42

4A2.6.2 Table 4.3.2 - Data used to derive calibration function - Sulphur Dioxide, Low Range.

Test Date	Test Start Time	Test End Time	SRM measured value (y)	CEMS measured signal (x)	Yi	Xi	Xi * Yi	Xi ²	b
	hr:min		SO2 (ppm)	SO2 (ppm)	1	2	3	4	
17-Feb-15	Reference Gas		0	-0.5	-104.8838637	-121.8232	12777.28791	14840.89206	
03-Mar-15	12:00	13:00	116.6	134.3	11.72	13.02	152.60	169.44	
03-Mar-15	14:02	15:02	109.3	128.1	4.40	6.75	29.71	45.52	
03-Mar-15	16:04	17:04	132.9	151.0	28.01	29.68	831.20	880.71	
03-Mar-15	18:06	19:06	155.1	166.5	50.19	45.20	2268.25	2042.75	
03-Mar-15	20:08	21:08	159.3	164.3	54.38	42.97	2336.50	1846.15	
03-Mar-15	22:10	23:10	154.0	163.5	49.13	42.14	2070.36	1775.51	
04-Mar-15	0:00	1:00	146.6	162.0	41.68	40.70	1696.42	1656.23	
04-Mar-15	2:02	3:02	141.5	153.2	36.63	31.89	1167.94	1016.77	
04-Mar-15	4:04	5:04	151.8	161.7	46.88	40.37	1892.59	1629.48	
04-Mar-15	6:06	7:06	155.2	164.5	50.33	43.21	2174.51	1866.83	
04-Mar-15	8:08	9:08	129.2	150.4	24.29	29.12	707.15	847.79	
04-Mar-15	11:10	12:10	94.3	113.8	-10.62	-7.54	80.14	56.90	
04-Mar-15	13:12	14:12	88.6	109.0	-16.30	-12.32	200.88	151.86	
04-Mar-15	15:14	16:14	74.6	96.6	-30.24	-24.75	748.44	612.72	
04-Mar-15	17:16	18:16	69.3	90.2	-35.59	-31.16	1109.11	971.15	
04-Mar-15	19:18	20:18	89.6	110.2	-15.33	-11.09	170.06	123.06	
04-Mar-15	21:20	22:20	103.5	124.0	-1.38	2.65	-3.65	7.01	
05-Mar-15	0:00	1:00	117.0	136.7	12.14	15.38	186.61	236.45	
05-Mar-15	2:02	3:02	122.7	135.3	17.78	13.98	248.47	195.35	
05-Mar-15	4:04	5:04	124.3	136.1	19.42	14.78	286.99	218.35	
05-Mar-15	6:06	7:06	80.4	104.0	-24.48	-17.32	424.01	300.09	
05-Mar-15	8:08	9:08	38.5	63.3	-66.36	-58.02	3850.23	3366.69	
05-Mar-15	10:30	11:30	36.8	59.4	-68.06	-61.92	4214.52	3834.48	
05-Mar-15	12:32	13:32	31.1	55.5	-73.74	-65.82	4854.08	4332.69	
Sum			2622.10	3033.08	0.00	0.00	44474.39	43024.86	1.03

4A2.7.2 Determination of Calibration Function - Sulphur Dioxide, Low Range.

Method A				
If Ymax-Ymin >15% of the ELV, the following formulae are used:				
$b = \frac{\sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^N (x_i - \bar{x})^2}$	where	$\bar{x} = 1/N \sum_{i=1}^N x_i$	$\bar{y} = 1/N \sum_{i=1}^N y_i$	
			x =	121.32
			y =	104.88
			b =	1.034
$a = y - bx$		$a = 104.89 - 121.33 * 1.033$	a =	-20.527
The calibration is function $y_i = a + b x_i$ or			$y_i =$	-20.527 + 1.034 * x_i

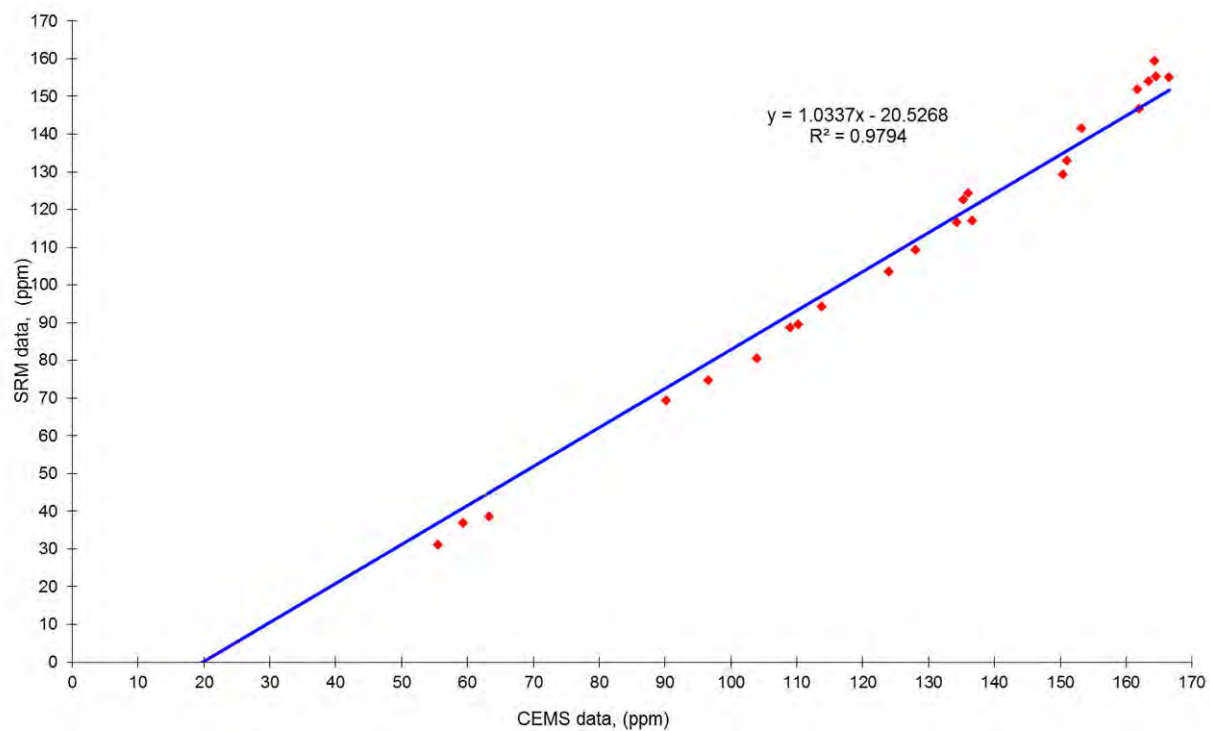
4A2.8.2 Table A.4.4.2 - Calculation of calibrated CEMS values - Sulphur Dioxide, Low Range

Test No	Test Date	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Moisture	CEMS Oxygen	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		SO2 (ppm)	SO2 (ppm)	(%)	(%)	SO2(mg/m3)	SO2(mg/m3)
1	17-Feb-15	Reference Gas		-0.5	-21.0	N/A	N/A	-60.1	0.0
2	03-Mar-15	12:00	13:00	134.3	118.3	3.2	6.1	340.6	349.9
3	03-Mar-15	14:02	15:02	128.1	111.9	3.3	6.1	322.6	330.1
4	03-Mar-15	16:04	17:04	151.0	135.6	3.3	6.1	390.2	401.7
5	03-Mar-15	18:06	19:06	166.5	151.6	3.3	6.1	435.5	471.2
6	03-Mar-15	20:08	21:08	164.3	149.3	3.3	6.2	430.9	484.8
7	03-Mar-15	22:10	23:10	163.5	148.4	3.2	6.0	424.7	468.7
8	04-Mar-15	00:00	01:00	162.0	147.0	3.3	6.0	419.6	447.7
9	04-Mar-15	02:02	03:02	153.2	137.8	3.2	6.1	395.7	435.9
10	04-Mar-15	04:04	05:04	161.7	146.6	3.3	7.0	449.7	499.5
11	04-Mar-15	06:06	07:06	164.5	149.5	3.4	6.5	441.2	493.1
12	04-Mar-15	08:08	09:08	150.4	135.0	3.5	6.2	390.1	402.6
13	04-Mar-15	11:10	12:10	113.8	97.1	3.7	6.3	283.5	292.2
14	04-Mar-15	13:12	14:12	109.0	92.1	3.6	6.2	267.0	274.4
15	04-Mar-15	15:14	16:14	96.6	79.3	3.5	6.1	228.1	229.8
16	04-Mar-15	17:16	18:16	90.2	72.7	3.5	5.9	206.7	214.2
17	04-Mar-15	19:18	20:18	110.2	93.4	3.5	6.1	267.8	278.2
18	04-Mar-15	21:20	22:20	124.0	107.6	3.6	6.2	312.5	323.3
19	05-Mar-15	00:00	01:00	136.7	120.8	3.7	6.0	346.0	363.2
20	05-Mar-15	02:02	03:02	135.3	119.3	3.4	6.2	344.9	383.2
21	05-Mar-15	04:04	05:04	136.1	120.2	3.4	6.6	356.7	399.1
22	05-Mar-15	06:06	07:06	104.0	87.0	3.2	6.3	253.6	253.2
23	05-Mar-15	08:08	09:08	63.3	44.9	3.1	6.0	128.3	119.4
24	05-Mar-15	10:30	11:30	59.4	40.9	3.1	6.2	118.5	111.4
25	05-Mar-15	12:32	13:32	55.5	36.8	3.2	6.0	105.0	94.1
Sum								7599.2	
Emission Limit Value (ELV) =				440	mg/Nm ³				

Reference Oxygen

6 %

4A2.9.2 Plot 2.2 CEM versus SRM Parallel Test Data at CEM measurement conditions –Sulphur dioxide.



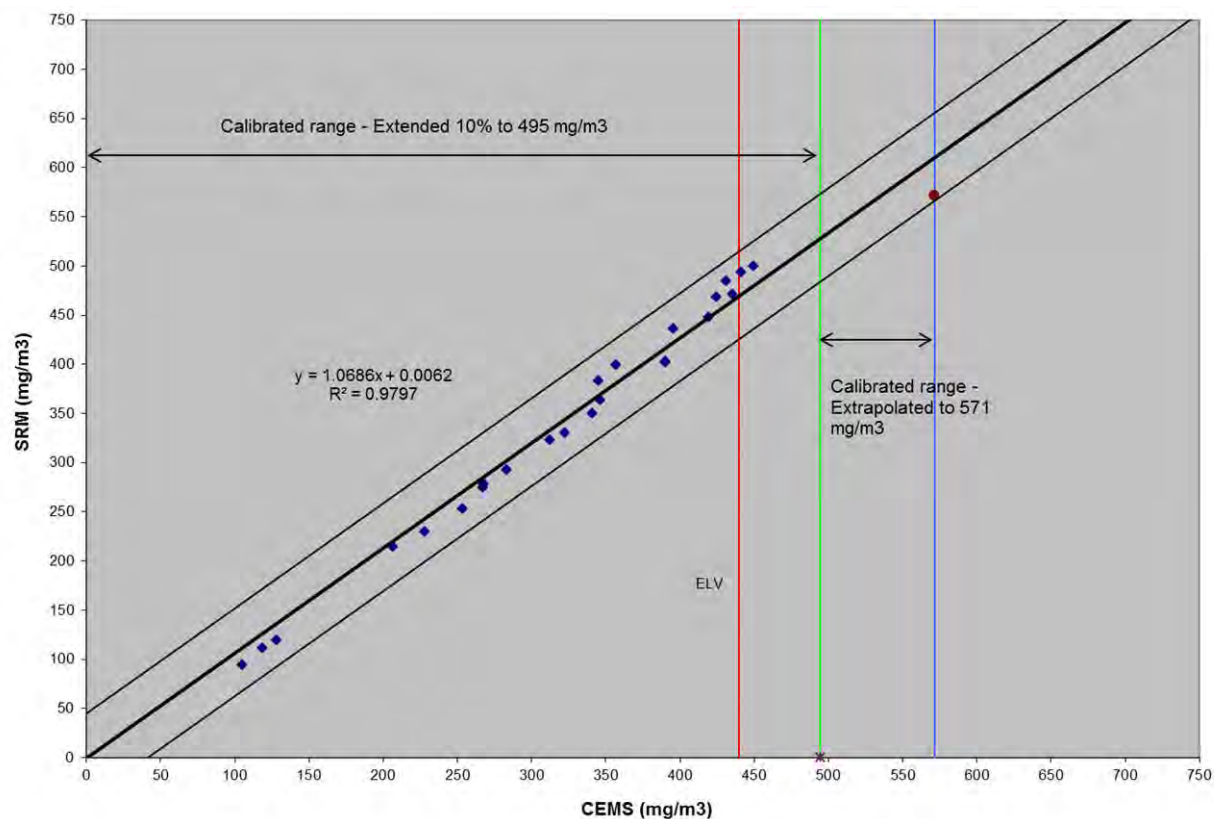
4A2.10.2 Table 4.5.2 – Data used for the Variability Test – Sulphur Dioxide, Low Range.

Test No	Test Date	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
		hr:min		mg/m3	mg/m3			
1	17-Feb-15	Reference Gas	00:00	-60.1	0.0	60.12	39.26	1541.41
2	03-Mar-15	12:00	13:00	340.6	349.9	9.29	-11.58	134.07
3	03-Mar-15	14:02	15:02	322.6	330.1	7.45	-13.41	179.93
4	03-Mar-15	16:04	17:04	390.2	401.7	11.54	-9.32	86.88
5	03-Mar-15	18:06	19:06	435.5	471.2	35.74	14.88	221.37
6	03-Mar-15	20:08	21:08	430.9	484.8	53.91	33.05	1092.08
7	03-Mar-15	22:10	23:10	424.7	468.7	44.06	23.19	537.90
8	04-Mar-15	00:00	01:00	419.6	447.7	28.08	7.21	52.04
9	04-Mar-15	02:02	03:02	395.7	435.9	40.20	19.33	373.75
10	04-Mar-15	04:04	05:04	449.7	499.5	49.81	28.94	837.73
11	04-Mar-15	06:06	07:06	441.2	493.1	51.89	31.03	962.72
12	04-Mar-15	08:08	09:08	390.1	402.6	12.52	-8.35	69.65
13	04-Mar-15	11:10	12:10	283.5	292.2	8.69	-12.17	148.16
14	04-Mar-15	13:12	14:12	267.0	274.4	7.36	-13.51	182.40
15	04-Mar-15	15:14	16:14	228.1	229.8	1.74	-19.13	365.86
16	04-Mar-15	17:16	18:16	206.7	214.2	7.50	-13.37	178.65
17	04-Mar-15	19:18	20:18	267.8	278.2	10.43	-10.43	108.83
18	04-Mar-15	21:20	22:20	312.5	323.3	10.77	-10.09	101.89
19	05-Mar-15	00:00	01:00	346.0	363.2	17.15	-3.71	13.78
20	05-Mar-15	02:02	03:02	344.9	383.2	38.27	17.41	303.02
21	05-Mar-15	04:04	05:04	356.7	399.1	42.38	21.51	462.79
22	05-Mar-15	06:06	07:06	253.6	253.2	-0.43	-21.29	453.31
23	05-Mar-15	08:08	09:08	128.3	119.4	-8.92	-29.78	886.90
24	05-Mar-15	10:30	11:30	118.5	111.4	-7.03	-27.89	777.83
25	05-Mar-15	12:32	13:32	105.0	94.1	-10.92	-31.79	1010.39
25	Tests		Mean			20.86		
Sum								11083.33

4A2.11.2 - Variability Test Calculation – Sulphur Dioxide, Low Range.

SD=	Root(1-Number).Integral(D1-D) ²	21.49	mg/m3(s,d),6%O ₂
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O ₀ is therefore calculated as:-			
O ₀ =	0.2*440 mg/m3 (s,d,6%O ₂)/1.96	44.90	mg/m3(s,d),6%O ₂
For 25 tests, k _v =	0.9861		
Therefore variability=	21.49 <= 44.9 * 0.9861		
	or 21.49 <= 44.27		
Which is TRUE therefore the CEMS passes the test			

4A2.12.2 Plot 3.2 –Standardised CEM data versus standardised SRM - Sulphur dioxide, Low Range – Reference conditions 273K, 101.3kPa dry gas



4A2.1.3 Table 4.1.3– Raw monitoring Data – Sulphur Dioxide, High Range

Test No	Test Date	Test Start Time	Test End Time	CEMS Raw Value (Wet)	CEMS Oxygen	CEMS Moisture	SRM Raw value (Wet)	SRM Oxygen (Dry)	SRM Moisture	SRM at CEMS Raw conditions
		hr:min		SO2 (ppm)	(%)	(%)	SO2 (ppm)	(%)	(%)	SO2 (ppm)
1	03-Mar-15	12:00	13:00	134.47	6.11	3.21	116.61	6.37	2.38	116.6
2	03-Mar-15	14:02	15:02	127.70	6.14	2.83	109.29	6.47	2.30	109.3
3	03-Mar-15	16:04	17:04	150.92	6.11	3.31	132.89	6.50	2.18	132.9
4	03-Mar-15	18:06	19:06	165.71	6.08	3.28	155.07	6.58	2.20	155.1
5	03-Mar-15	20:08	21:08	163.70	6.15	3.25	159.26	6.64	1.96	159.3
6	03-Mar-15	22:10	23:10	162.48	6.02	3.23	154.02	6.61	2.09	154.0
7	04-Mar-15	0:00	1:00	160.57	5.99	3.25	146.57	6.64	2.23	146.6
8	04-Mar-15	2:02	3:02	154.09	6.07	3.24	141.51	6.78	2.11	141.5
9	04-Mar-15	4:04	5:04	161.16	7.02	3.34	151.77	7.68	2.16	151.8
10	04-Mar-15	6:06	7:06	163.75	6.47	3.36	155.21	7.21	2.10	155.2
11	04-Mar-15	8:08	9:08	150.23	6.17	3.48	129.17	6.93	2.22	129.2
12	04-Mar-15	11:10	12:10	114.55	6.32	3.67	94.26	6.82	2.44	94.3
13	04-Mar-15	13:12	14:12	109.3	6.21	3.62	88.58	6.82	2.38	88.6
14	04-Mar-15	15:14	16:14	97.1	6.10	3.47	74.65	6.74	2.37	74.6
15	04-Mar-15	17:16	18:16	91.0	5.93	3.49	69.29	6.80	2.33	69.3
16	04-Mar-15	19:18	20:18	111.1	6.05	3.52	89.55	6.88	2.25	89.6
17	04-Mar-15	21:20	22:20	124.2	6.24	3.59	103.51	6.97	2.18	103.5
18	05-Mar-15	00:00	01:00	136.8	6.04	3.69	117.02	6.86	2.29	117.0
19	05-Mar-15	02:02	03:02	135.1	6.17	3.42	122.66	6.97	2.19	122.7
20	05-Mar-15	04:04	05:04	136.1	6.56	3.43	124.31	7.34	2.21	124.3
21	05-Mar-15	06:06	07:06	104.5	6.30	3.24	80.41	7.11	1.92	80.4
22	05-Mar-15	08:08	09:08	64.4	6.00	3.08	38.53	6.92	1.73	38.5
23	05-Mar-15	10:30	11:30	60.3	6.21	3.14	36.82	6.57	1.83	36.8
24	05-Mar-15	12:32	13:32	56.4	5.96	3.24	31.14	6.53	1.95	31.1

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

4A2.2.3 Table 4.2.3 -Standardised monitoring Data – Sulphur Dioxide, High Range

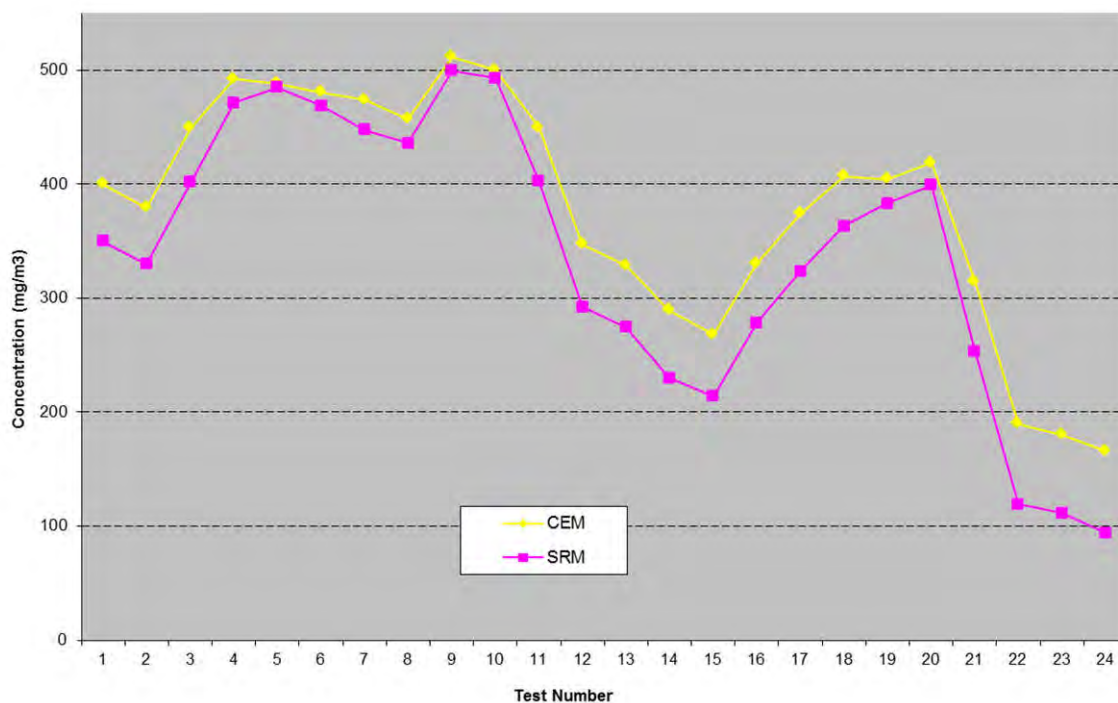
Test No	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty SO2
	hr:min		SO2(mg/m3)	SO2(mg/m3)	(mg/m3)
1	12:00	13:00	399.9	349.9	6.0
2	14:02	15:02	379.0	330.1	5.6
3	16:04	17:04	449.3	401.7	6.8
4	18:06	19:06	492.2	471.2	8.0
5	20:08	21:08	488.3	484.8	8.2
6	22:10	23:10	480.4	468.7	7.6
7	0:00	1:00	473.9	447.7	7.5
8	2:02	3:02	457.1	435.9	7.3
9	4:04	5:04	511.4	499.5	7.8
10	6:06	7:06	499.9	493.1	8.0
11	8:08	9:08	449.8	402.6	6.7
12	11:10	12:10	347.2	292.2	4.8
13	13:12	14:12	328.6	274.4	4.6
14	15:14	16:14	289.3	229.8	3.9
15	17:16	18:16	268.0	214.2	3.6
16	19:18	20:18	330.2	278.2	4.6
17	21:20	22:20	374.0	323.3	5.4
18	0:00	1:00	406.9	363.2	6.0
19	2:02	3:02	404.3	383.2	6.3
20	4:04	5:04	418.4	399.1	6.4
21	6:06	7:06	314.9	253.2	4.1
22	8:08	9:08	189.9	119.4	2.0
23	10:30	11:30	180.4	111.4	1.9
24	12:32	13:32	166.1	94.1	1.6

Note:

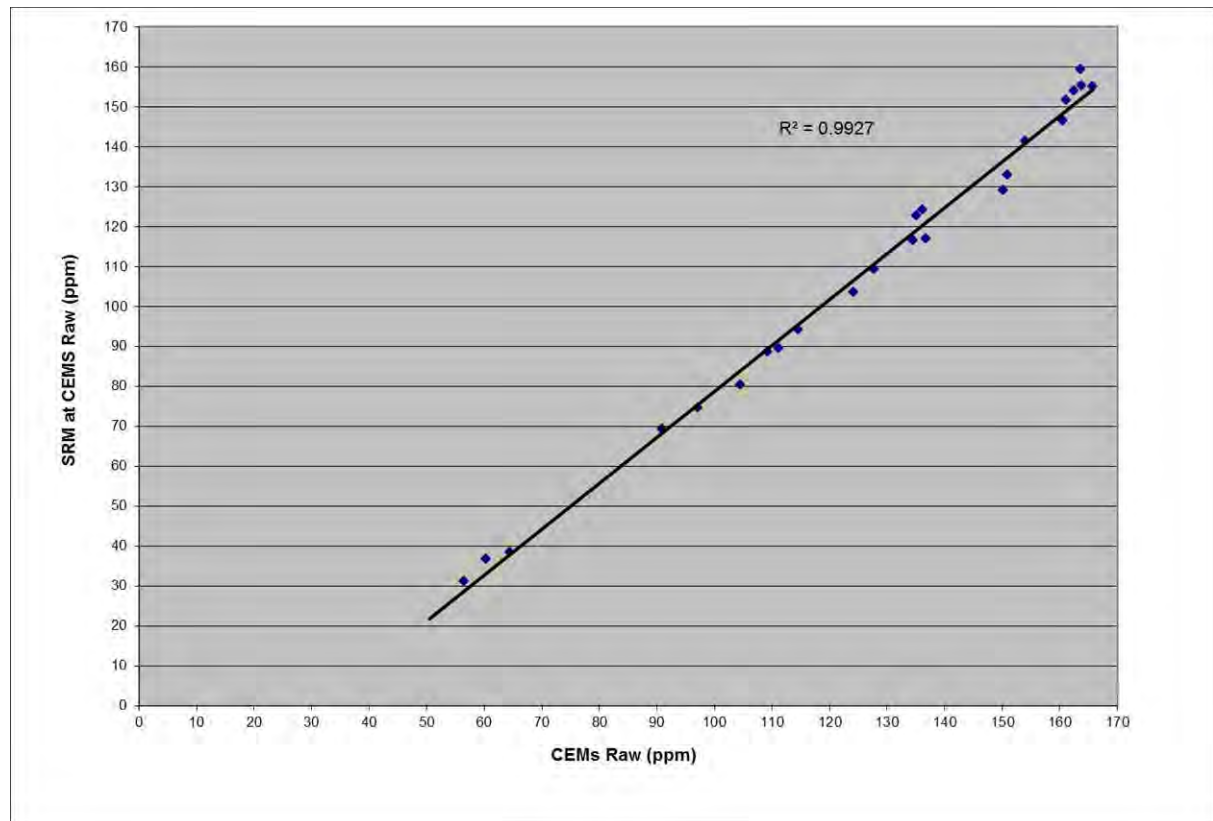
Emission concentrations expressed at reference conditions 27

6 % Oxygen, dry gas

4A2.3.3 – Plot 1.3 - Time Series of Standardised CEM versus Standardised SRM data – Sulphur Dioxide, High Range (Expressed at reference conditions 273K, 101.3kPa, dry gas, 6% oxygen)



4A2.4.3 – Elimination of Outliers – Sulphur Dioxide, High Range.



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R^2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.

Additionally, any data points are not likely to be outliers unless they are more than three standard deviations from the regression line'

As the R^2 value for this determinand was 0.9927, an outlier test has not been undertaken.

4A2.5.3 Determination of Method A or Method B - Sulphur Dioxide, High Range.

Test No	Test Date	Test Start Time	Test End Time	SRM measured value (y)	SRM Moisture	SRM O2	SRM Standardised
		hr:min		(ppm)	(%)	(%)	(mg/m3)
1	03-Mar-15	12:00	13:00	116.6	2.38	6.4	349.9
2	03-Mar-15	14:02	15:02	109.3	2.30	6.5	330.1
3	03-Mar-15	16:04	17:04	132.9	2.18	6.5	401.7
4	03-Mar-15	18:06	19:06	155.1	2.20	6.6	471.2
5	03-Mar-15	20:08	21:08	159.3	1.96	6.6	484.8
6	03-Mar-15	22:10	23:10	154.0	2.09	6.6	468.7
7	04-Mar-15	0:00	1:00	146.6	2.23	6.6	447.7
8	04-Mar-15	2:02	3:02	141.5	2.11	6.8	435.9
9	04-Mar-15	4:04	5:04	151.8	2.16	7.7	499.5
10	04-Mar-15	6:06	7:06	155.2	2.10	7.2	493.1
11	04-Mar-15	8:08	9:08	129.2	2.22	6.9	402.6
12	04-Mar-15	11:10	12:10	94.3	2.44	6.8	292.2
13	04-Mar-15	13:12	14:12	88.6	2.38	6.8	274.4
14	04-Mar-15	15:14	16:14	74.6	2.37	6.7	229.8
15	04-Mar-15	17:16	18:16	69.3	2.33	6.8	214.2
16	04-Mar-15	19:18	20:18	89.6	2.25	6.9	278.2
17	04-Mar-15	21:20	22:20	103.5	2.18	7.0	323.3
18	05-Mar-15	0:00	1:00	117.0	2.29	6.9	363.2
19	05-Mar-15	2:02	3:02	122.7	2.19	7.0	383.2
20	05-Mar-15	4:04	5:04	124.3	2.21	7.3	399.1
21	05-Mar-15	6:06	7:06	80.4	1.92	7.1	253.2
22	05-Mar-15	8:08	9:08	38.5	1.73	6.9	119.4
23	05-Mar-15	10:30	11:30	36.8	1.83	6.6	111.4
24	05-Mar-15	12:32	13:32	31.1	1.95	6.5	94.1
Sum				2622.10			
Emission Limit Value (ELV) =			440	mg/Nm ³		Y _{max}	499.48
15% of the ELV =			66	mg/Nm ³		Y _{min}	94.06
Therefore Ymax - Ymin > 15% of the ELV			Method A			Y _{max} - Ymin	405.42

4A2.6.3 Table 4.3.3 - Data used to derive calibration function - Sulphur Dioxide, High Range.

Test Date	Test Start Time	Test End Time	SRM measured value (y)	CEMS measured signal (x)	Yi	Xi	Xi * Yi	Xi ²	b
	hr:min		SO2 (ppm)	SO2 (ppm)	1	2	3	4	
17-Feb-15	Reference Gas		0	-0.5	-104.8838637	-121.9014414	12785.49417	14859.96143	
03-Mar-15	12:00	13:00	116.6	134.5	11.72	13.06	153.16	170.67	
03-Mar-15	14:02	15:02	109.3	127.7	4.40	6.30	27.74	39.67	
03-Mar-15	16:04	17:04	132.9	150.9	28.01	29.52	826.73	871.27	
03-Mar-15	18:06	19:06	155.1	165.7	50.19	44.31	2223.60	1963.11	
03-Mar-15	20:08	21:08	159.3	163.7	54.38	42.29	2299.96	1788.86	
03-Mar-15	22:10	23:10	154.0	162.5	49.13	41.08	2018.29	1687.33	
04-Mar-15	0:00	1:00	146.6	160.6	41.68	39.17	1632.67	1534.09	
04-Mar-15	2:02	3:02	141.5	154.1	36.63	32.69	1197.31	1068.54	
04-Mar-15	4:04	5:04	151.8	161.2	46.88	39.76	1864.04	1580.70	
04-Mar-15	6:06	7:06	155.2	163.7	50.33	42.35	2131.18	1793.18	
04-Mar-15	8:08	9:08	129.2	150.2	24.29	28.83	700.23	831.29	
04-Mar-15	11:10	12:10	94.3	114.6	-10.62	-6.85	72.75	46.90	
04-Mar-15	13:12	14:12	88.6	109.3	-16.30	-12.10	197.26	146.44	
04-Mar-15	15:14	16:14	74.6	97.1	-30.24	-24.32	735.36	591.49	
04-Mar-15	17:16	18:16	69.3	91.0	-35.59	-30.44	1083.34	926.53	
04-Mar-15	19:18	20:18	89.6	111.1	-15.33	-10.29	157.73	105.87	
04-Mar-15	21:20	22:20	103.5	124.2	-1.38	2.77	-3.82	7.66	
05-Mar-15	0:00	1:00	117.0	136.8	12.14	15.40	186.84	237.02	
05-Mar-15	2:02	3:02	122.7	135.1	17.78	13.70	243.52	187.65	
05-Mar-15	4:04	5:04	124.3	136.1	19.42	14.70	285.47	216.05	
05-Mar-15	6:06	7:06	80.4	104.5	-24.48	-16.90	413.69	285.66	
05-Mar-15	8:08	9:08	38.5	64.4	-66.36	-56.99	3782.00	3248.43	
05-Mar-15	10:30	11:30	36.8	60.3	-68.06	-61.11	4159.40	3734.84	
05-Mar-15	12:32	13:32	31.1	56.4	-73.74	-65.00	4793.48	4225.19	
Sum			2622.10	3035.04	0.00	0.00	43967.42	42148.39	1.04

4A2.7.3 Determination of Calibration Function - Sulphur Dioxide, High Range.

Method A				
If Ymax-Ymin >15% of the ELV, the following formulae are used:				
$b = \frac{\sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^N (x_i - \bar{x})^2}$	where	$\bar{x} = 1/N \sum_{i=1}^N x_i$	$\bar{y} = 1/N \sum_{i=1}^N y_i$	
			x=	121.40
			y=	104.88
			b=	1.043
$a = y - bx$		$a = 104.89 - 121.41 * 1.043$	a=	-21.757
The calibration is function $y_i = a + b x_i$ or			$y_i =$	-21.757 + 1.043 * x_i

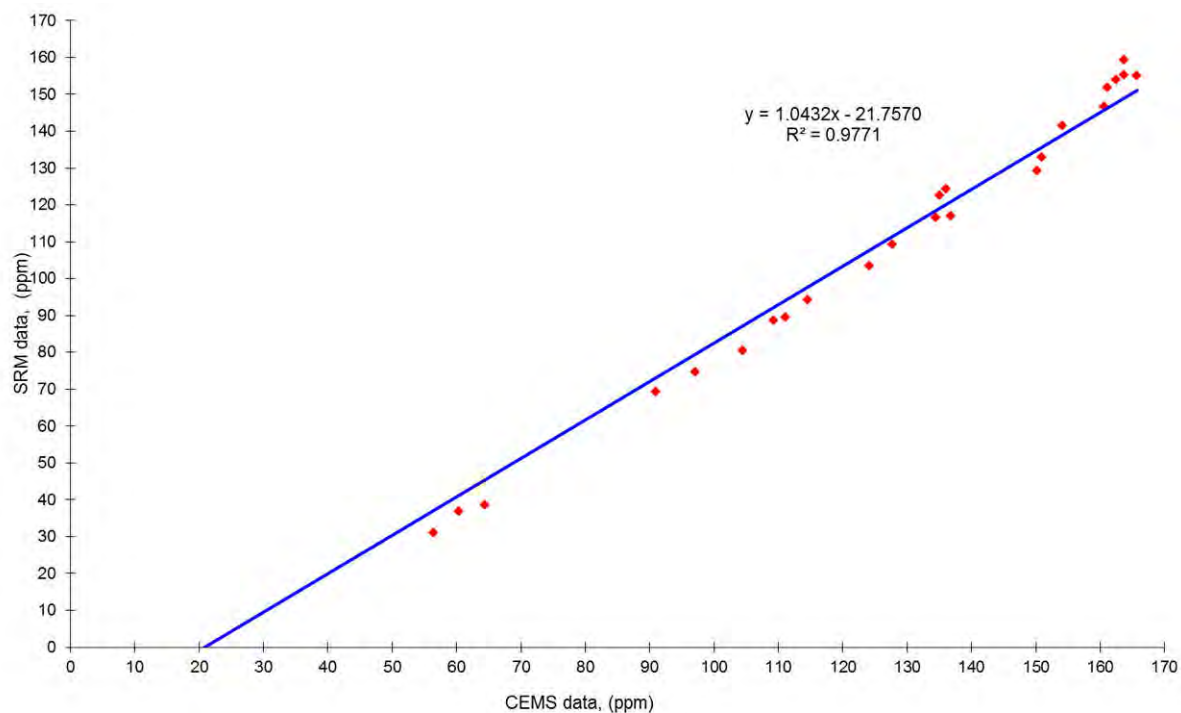
4A2.8.3 Table A.4.4.3 - Calculation of calibrated CEMS values - Sulphur Dioxide, High Range.

Test No	Test Date	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Moisture	CEMS Oxygen	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		SO2 (ppm)	SO2 (ppm)	(%)	(%)	SO2(mg/m3)	SO2(mg/m3)
1	17-Feb-15	Reference Gas		-0.5	-22.3	N/A	N/A	-63.7	0.0
2	03-Mar-15	12:00	13:00	134.5	118.5	3.2	6.1	341.1	349.9
3	03-Mar-15	14:02	15:02	127.7	111.5	2.8	6.1	321.5	330.1
4	03-Mar-15	16:04	17:04	150.9	135.7	3.3	6.1	390.5	401.7
5	03-Mar-15	18:06	19:06	165.7	151.1	3.3	6.1	434.1	471.2
6	03-Mar-15	20:08	21:08	163.7	149.0	3.3	6.2	430.1	484.8
7	03-Mar-15	22:10	23:10	162.5	147.7	3.2	6.0	422.7	468.7
8	04-Mar-15	00:00	01:00	160.6	145.7	3.3	6.0	416.1	447.7
9	04-Mar-15	02:02	03:02	154.1	139.0	3.2	6.1	399.0	435.9
10	04-Mar-15	04:04	05:04	161.2	146.4	3.3	7.0	448.9	499.5
11	04-Mar-15	06:06	07:06	163.7	149.1	3.4	6.5	439.7	493.1
12	04-Mar-15	08:08	09:08	150.2	135.0	3.5	6.2	390.1	402.6
13	04-Mar-15	11:10	12:10	114.6	97.7	3.7	6.3	285.4	292.2
14	04-Mar-15	13:12	14:12	109.3	92.3	3.6	6.2	267.4	274.4
15	04-Mar-15	15:14	16:14	97.1	79.5	3.5	6.1	228.7	229.8
16	04-Mar-15	17:16	18:16	91.0	73.1	3.5	5.9	208.0	214.2
17	04-Mar-15	19:18	20:18	111.1	94.2	3.5	6.1	269.9	278.2
18	04-Mar-15	21:20	22:20	124.2	107.8	3.6	6.2	313.0	323.3
19	05-Mar-15	00:00	01:00	136.8	120.9	3.7	6.0	346.5	363.2
20	05-Mar-15	02:02	03:02	135.1	119.2	3.4	6.2	344.4	383.2
21	05-Mar-15	04:04	05:04	136.1	120.2	3.4	6.6	356.9	399.1
22	05-Mar-15	06:06	07:06	104.5	87.3	3.2	6.3	254.4	253.2
23	05-Mar-15	08:08	09:08	64.4	45.4	3.1	6.0	129.8	119.4
24	05-Mar-15	10:30	11:30	60.3	41.1	3.1	6.2	119.2	111.4
25	05-Mar-15	12:32	13:32	56.4	37.1	3.2	6.0	105.7	94.1
Sum								7599.2	
Emission Limit Value (ELV) =				440	mg/Nm ³				

Reference Oxygen

6 %

4A2.9.3 Plot 2.3 CEM versus SRM Parallel Test Data at CEM measurement conditions –Sulphur dioxide, wet gas.



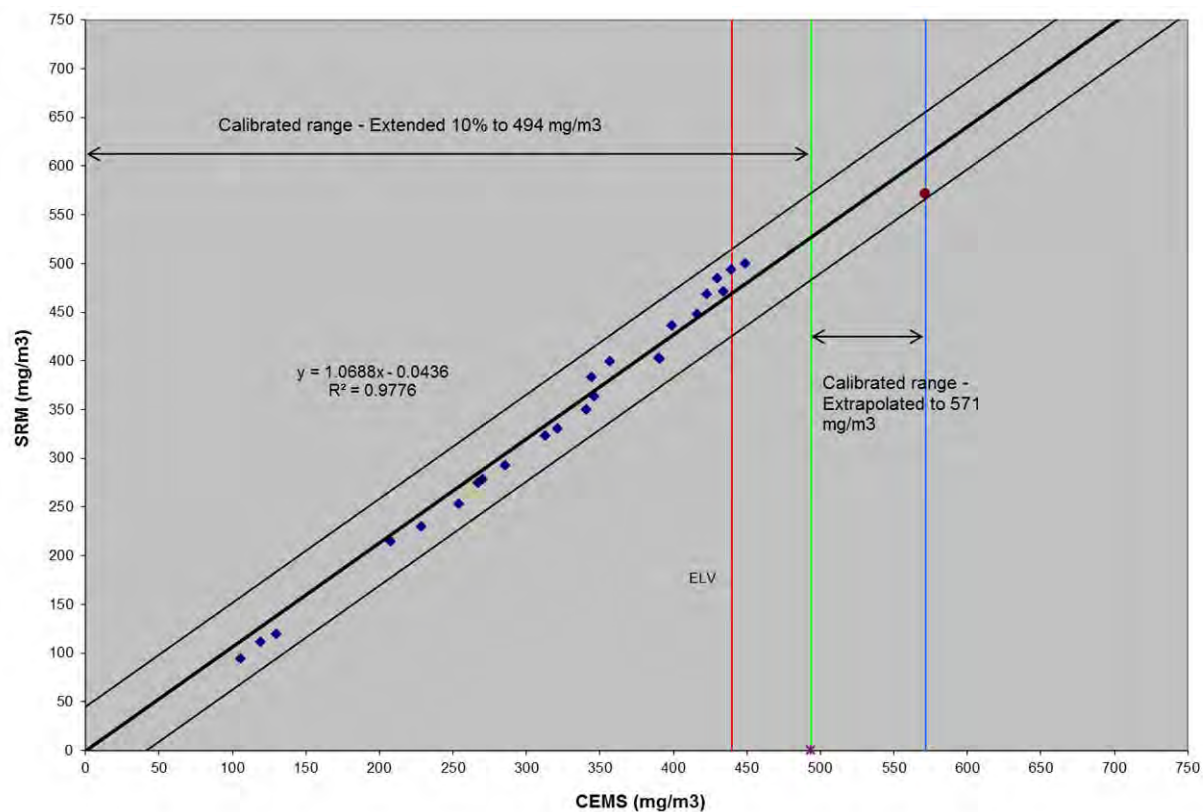
4A2.10.3 Table 4.5.3 – Data used for the Variability Test – Sulphur Dioxide, High Range.

Test No	Test Date	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
		hr:min		mg/m3	mg/m3			
1	17-Feb-15	Reference Gas	00:00	-63.7	0.0	63.65	42.79	1830.85
2	03-Mar-15	12:00	13:00	341.1	349.9	8.79	-12.08	145.84
3	03-Mar-15	14:02	15:02	321.5	330.1	8.61	-12.25	150.07
4	03-Mar-15	16:04	17:04	390.5	401.7	11.21	-9.65	93.15
5	03-Mar-15	18:06	19:06	434.1	471.2	37.18	16.31	266.18
6	03-Mar-15	20:08	21:08	430.1	484.8	54.76	33.89	1148.85
7	03-Mar-15	22:10	23:10	422.7	468.7	46.08	25.21	635.70
8	04-Mar-15	00:00	01:00	416.1	447.7	31.53	10.67	113.81
9	04-Mar-15	02:02	03:02	399.0	435.9	36.93	16.06	258.07
10	04-Mar-15	04:04	05:04	448.9	499.5	50.58	29.72	883.18
11	04-Mar-15	06:06	07:06	439.7	493.1	53.33	32.47	1054.26
12	04-Mar-15	08:08	09:08	390.1	402.6	12.58	-8.28	68.63
13	04-Mar-15	11:10	12:10	285.4	292.2	6.78	-14.08	198.29
14	04-Mar-15	13:12	14:12	267.4	274.4	7.03	-13.84	191.51
15	04-Mar-15	15:14	16:14	228.7	229.8	1.11	-19.75	390.16
16	04-Mar-15	17:16	18:16	208.0	214.2	6.19	-14.68	215.39
17	04-Mar-15	19:18	20:18	269.9	278.2	8.33	-12.54	157.16
18	04-Mar-15	21:20	22:20	313.0	323.3	10.33	-10.53	110.94
19	05-Mar-15	00:00	01:00	346.5	363.2	16.68	-4.19	17.52
20	05-Mar-15	02:02	03:02	344.4	383.2	38.73	17.86	319.09
21	05-Mar-15	04:04	05:04	356.9	399.1	42.20	21.34	455.35
22	05-Mar-15	06:06	07:06	254.4	253.2	-1.23	-22.10	488.25
23	05-Mar-15	08:08	09:08	129.8	119.4	-10.41	-31.28	978.24
24	05-Mar-15	10:30	11:30	119.2	111.4	-7.77	-28.64	820.22
25	05-Mar-15	12:32	13:32	105.7	94.1	-11.59	-32.45	1053.28
25	Tests		Mean			20.86		
Sum								12043.99

4A2.11.3 - Variability Test Calculation – Sulphur Dioxide, High Range.

SD=	Root(1-Number).Integral(D1-D) ²	22.40	mg/m3(s,d),6%O ₂
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O ₀ is therefore calculated as:-			
O ₀ =	0.2*440 mg/m3 (s,d,6%O ₂)/1.96	44.90	mg/m3(s,d),6%O ₂
For 25 tests, k _v =	0.9861		
Therefore variability=	22.40 <= 44.9 * 0.9861		
	or 22.40 <=	44.27	
Which is TRUE therefore the CEMS passes the test			

4A2.12.3 Plot 3.3 –Standardised CEM data versus standardised SRM - Sulphur dioxide, High Range – Reference conditions 273K, 101.3kPa., 6% oxygen, dry gas.



Section 4B1: Data & calculations – AST – Unit 8, Procal 1

Section 4B1 – Data and calculations – AST Procal 1

4B1 4.1.1 Table 4.1.1 – Raw monitoring Data – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (wet)	CEMS Oxygen	CEMS Moisture	SRM Raw value (Dry)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMS Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	03-Mar-15	12:00	13:00	392.51	6.11	2.22	385.84	6.37	2.38	376.64
2	03-Mar-15	14:02	15:02	391.69	6.14	2.10	379.00	6.47	2.30	370.28
3	03-Mar-15	16:04	17:04	380.51	6.11	2.01	359.08	6.50	2.18	351.25
4	03-Mar-15	18:06	19:06	368.71	6.08	2.06	345.18	6.58	2.20	337.59
5	03-Mar-15	20:08	21:08	327.85	6.15	2.00	307.58	6.64	1.96	301.57
6	03-Mar-15	22:10	23:10	295.07	6.02	2.11	275.87	6.61	2.09	270.10
7	04-Mar-15	0:00	1:00	298.93	5.99	2.14	275.44	6.64	2.23	269.29
8	04-Mar-15	2:02	3:02	315.10	6.07	2.03	287.33	6.78	2.11	281.27
9	04-Mar-15	4:04	5:04	353.51	7.02	2.06	322.43	7.68	2.16	315.48
10	04-Mar-15	6:06	7:06	368.61	6.47	2.00	335.97	7.21	2.10	328.90
11	04-Mar-15	8:08	9:08	387.09	6.17	2.09	341.98	6.93	2.22	334.39
12	04-Mar-15	11:10	12:10	498.40	6.32	2.38	456.62	6.82	2.44	445.50

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

4B1 4.2.1 Table 4.2.1 – Standardised monitoring Data – Oxides of Nitrogen

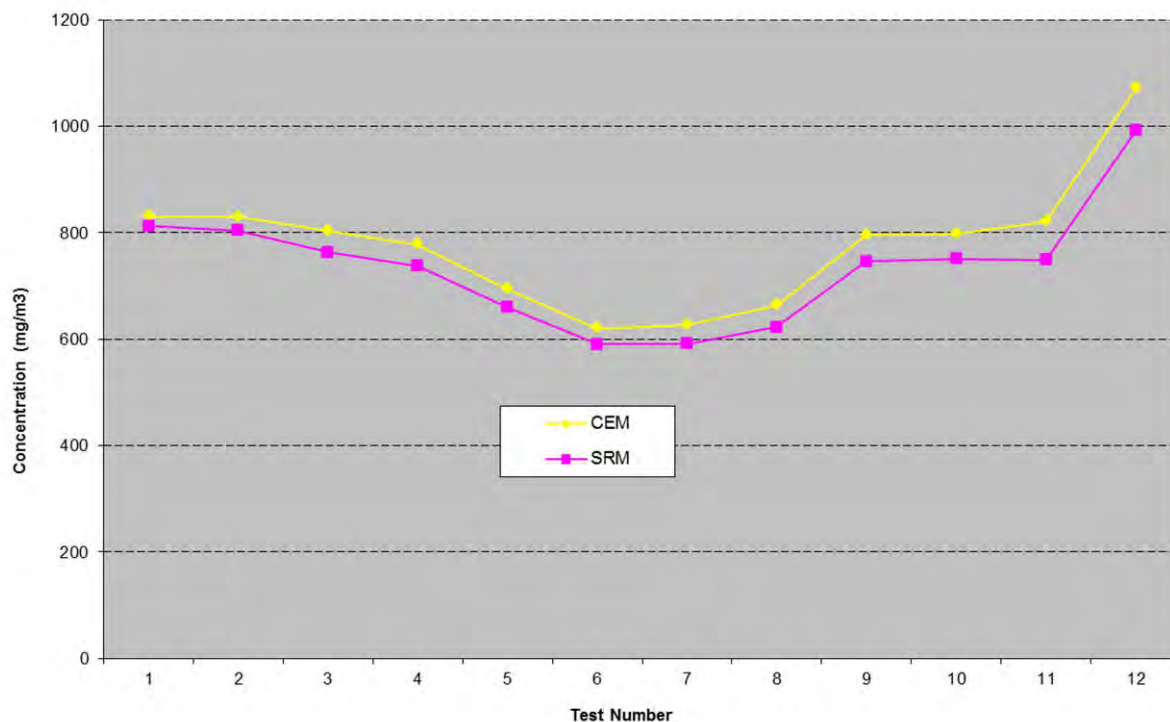
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(mg/m3)	(mg/m3)	(mg/m3)
1	03-Mar-15	12:00	13:00	830.5	812.3	27.0
2	03-Mar-15	14:02	15:02	829.4	803.8	27.0
3	03-Mar-15	16:04	17:04	803.4	763.2	25.0
4	03-Mar-15	18:06	19:06	777.3	737.4	23.8
5	03-Mar-15	20:08	21:08	694.0	659.8	21.9
6	03-Mar-15	22:10	23:10	619.9	590.8	19.6
7	04-Mar-15	0:00	1:00	626.9	591.2	20.0
8	04-Mar-15	2:02	3:02	663.6	622.7	20.7
9	04-Mar-15	4:04	5:04	795.7	746.3	24.6
10	04-Mar-15	6:06	7:06	797.6	751.0	24.8
11	04-Mar-15	8:08	9:08	821.3	749.2	24.8
12	04-Mar-15	11:10	12:10	1071.4	992.5	32.7

Note:

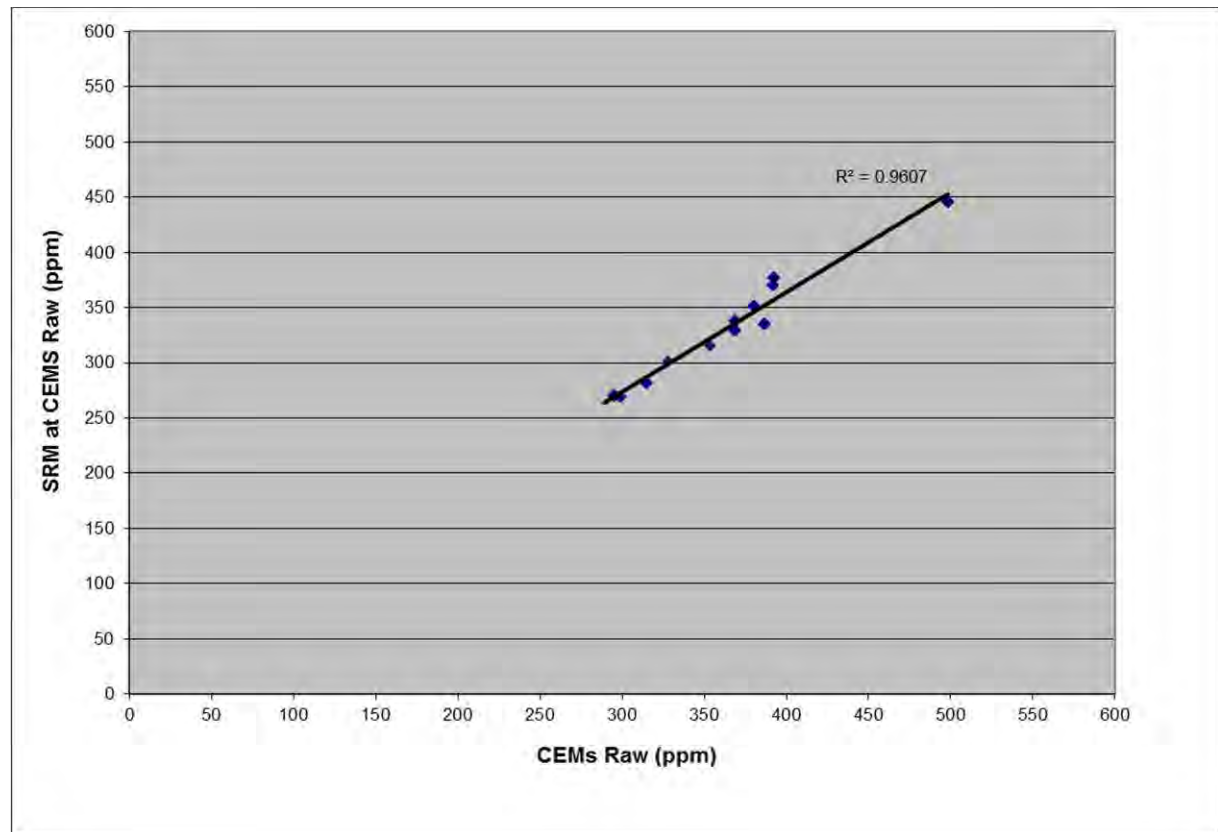
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

4B1 4.3.1 Plot 1.1 –Time Series of Standardised CEM versus Standardised SRM data – Oxides of Nitrogen. Reference conditions: 273K, 101.3kPa, dry gas, 6% oxygen.



4B1 4.4.1 –Elimination of Outliers – Oxides of Nitrogen.



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R^2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.

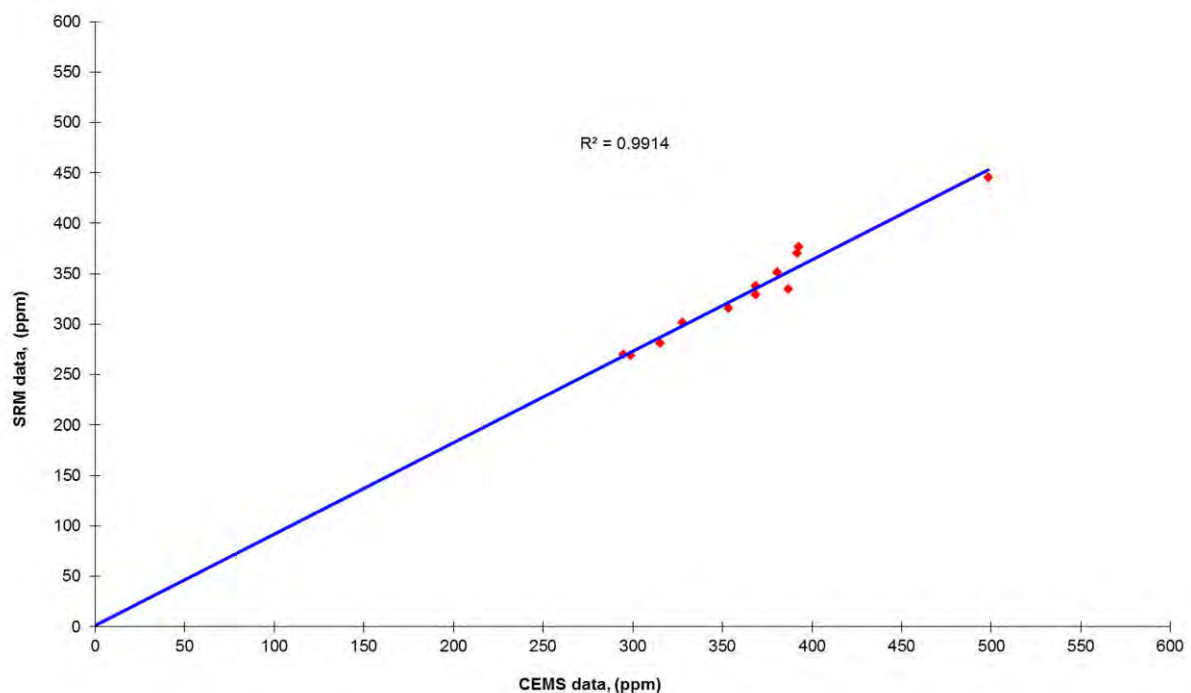
Additionally, any data points are not likely to be outliers unless they are more than three standard deviations from the regression line'

As the R^2 value for this determinand was 0.9607, an outlier test has not been undertaken.

4B1 4.5.1 Table 4.3.1 - Data used to Calculate Calibrated Values – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS wet Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised	
		hr:min		(ppm)	(ppm)	%	%	(mg/Nm ³)	(mg/Nm ³)	(mg/m3)	
1	03-Mar-15	Reference		-0.7	10.0	0.00		-0.7	10.0	0.0	
2	03-Mar-15	12:00	13:00	392.5	401.6	6.11	2.22	830.5	849.8	812.3	
3	03-Mar-15	14:02	15:02	391.7	400.8	6.14	2.10	829.4	848.8	803.8	
4	03-Mar-15	16:04	17:04	380.5	389.7	6.11	2.01	803.4	822.7	763.2	
5	03-Mar-15	18:06	19:06	368.7	377.9	6.08	2.06	777.3	796.7	737.4	
6	03-Mar-15	20:08	21:08	327.9	337.2	6.15	2.00	694.0	713.9	659.8	
7	03-Mar-15	22:10	23:10	295.1	304.6	6.02	2.11	619.9	639.9	590.8	
8	04-Mar-15	00:00	01:00	298.9	308.4	5.99	2.14	626.9	646.8	591.2	
9	04-Mar-15	02:02	03:02	315.1	324.5	6.07	2.03	663.6	683.5	622.7	
10	04-Mar-15	04:04	05:04	353.5	362.8	7.02	2.06	795.7	816.6	746.3	
11	04-Mar-15	06:06	07:06	368.6	377.8	6.47	2.00	797.6	817.5	751.0	
12	04-Mar-15	08:08	09:08	387.1	396.2	6.17	2.09	821.3	840.7	749.2	
13	04-Mar-15	11:10	12:10	498.4	507.1	6.47	2.38	1071.4	1101.5	992.5	
Sum								9330.23			
Emission Limit Value (ELV) =				1210	mg/Nm ³						
Reference Oxygen					6						%
Established Calibration Function y _i =				10.7 + 0.996x _i							

Plot of CEM versus SRM Parallel Test Data at CEM measurement conditions – wet gas



4B1 4.6.1 Table 4.4.1 – Data used for the Variability Test – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
		hr:min		mg/m3	mg/m3			
1	03-Mar-15	Reference		10.0	0.0	-10.0	49.06	2407.14
2	03-Mar-15	12:00	13:00	849.8	812.3	-37.48	21.62	467.30
3	03-Mar-15	14:02	15:02	848.8	803.8	-44.98	14.12	199.36
4	03-Mar-15	16:04	17:04	822.7	763.2	-59.53	-0.44	0.19
5	03-Mar-15	18:06	19:06	796.7	737.4	-59.39	-0.30	0.09
6	03-Mar-15	20:08	21:08	713.9	659.8	-54.04	5.05	25.54
7	03-Mar-15	22:10	23:10	639.9	590.8	-49.03	10.07	101.41
8	04-Mar-15	00:00	01:00	646.8	591.2	-55.64	3.46	11.97
9	04-Mar-15	02:02	03:02	683.5	622.7	-60.75	-1.65	2.74
10	04-Mar-15	04:04	05:04	816.6	746.3	-70.33	-11.24	126.25
11	04-Mar-15	06:06	07:06	817.5	751.0	-66.53	-7.44	55.30
12	04-Mar-15	08:08	09:08	840.7	749.2	-91.54	-32.44	1052.37
13	04-Mar-15	11:10	12:10	1101.5	992.5	-108.98	-49.88	2488.39
Mean						-59.10		
Sum								6938.05

4B1 4.7.1 - Variability Test and Test of Calibration Function Calculations – Oxides of Nitrogen

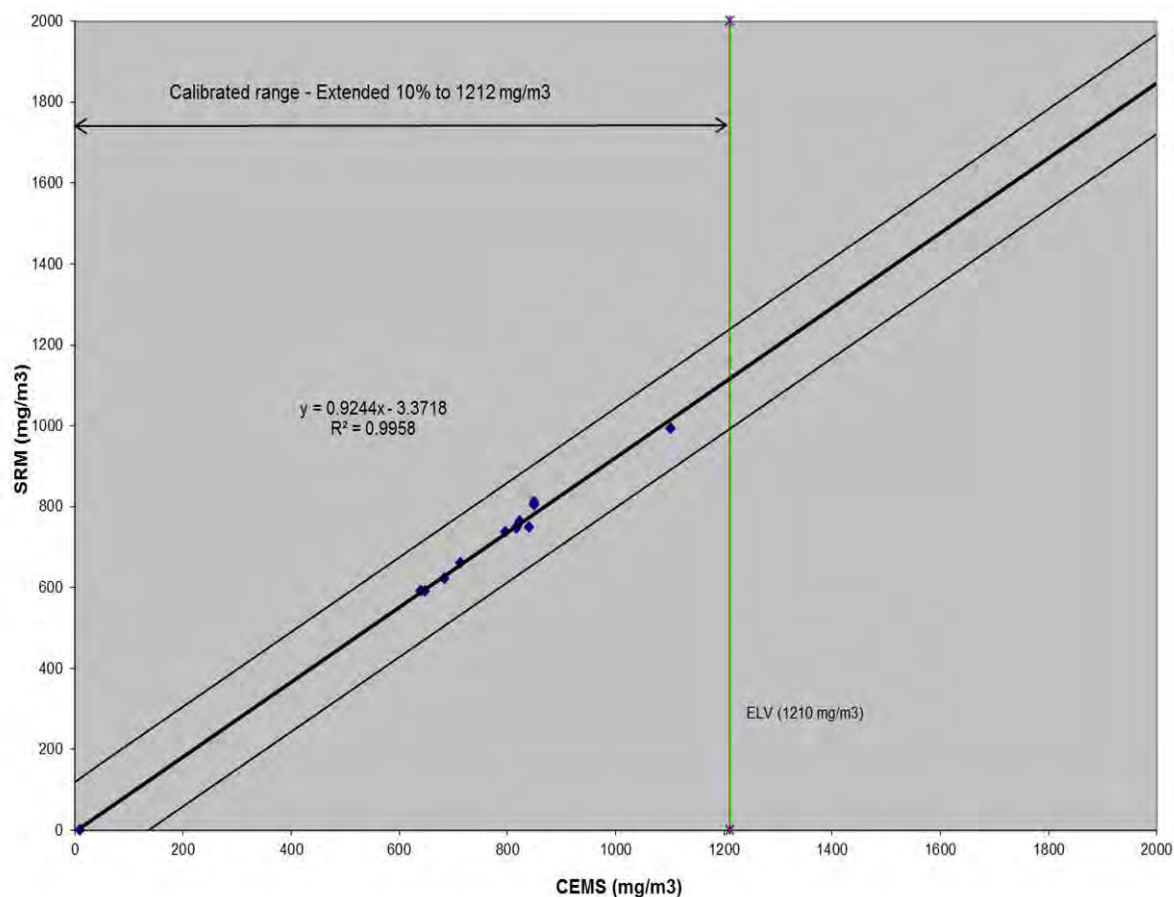
Variability Test

SD= $\sqrt{\frac{1}{N-1} \sum (D1-D)^2}$ 24.05 mg/m3(s,d),6%O2
 The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O_0 is therefore calculated as:-
 $O_0 = 0.2 * 1210 \text{ mg/m3 (s,d,6\%O2) / 1.96}$ 123.47 mg/m3(s,d),6%O2
 For 13 tests, kv = 0.9721
 Therefore variability= $24.05 \leq 123.47 * 0.9721 * 1.5$
 or $24.05 \leq 180.04$
 Which is TRUE therefore the CEMS passes the test

Test of Calibration Function

The calibration of the AMS is accepted if: $D1 \leq t_{0.95}(N-1) * (s,d/\sqrt{N}) + O_0$
 $D1 = 59.10$
 For 13 tests, $t_{0.95}(N-1) : 1.782$
 Therefore test of calibration = $59.1 \leq 1.782 * (24.05/\sqrt{13}) + 123.47$
 or $59.10 \leq 135.35$
 Which is TRUE therefore the calibration function is VALID

4B1 4.8.1 Plot 2.1 –Standardised CEM data versus standardised SRM - Oxides of Nitrogen (as NO₂) – Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen.



4B1 4.1.2 Table 4.1.2 – Raw monitoring Data – Sulphur Dioxide Low Range

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (wet)	CEMS Oxygen	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMs Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	03-Mar-15	12:00	13:00	116.35	6.11	2.22	116.61	6.37	2.38	116.61
2	03-Mar-15	14:02	15:02	108.73	6.14	2.10	109.29	6.47	2.30	109.29
3	03-Mar-15	16:04	17:04	132.60	6.11	2.01	132.89	6.50	2.18	132.89
4	03-Mar-15	18:06	19:06	147.12	6.08	2.06	155.07	6.58	2.20	155.07
5	03-Mar-15	20:08	21:08	148.00	6.15	2.00	159.26	6.64	1.96	159.26
6	03-Mar-15	22:10	23:10	144.31	6.02	2.11	154.02	6.61	2.09	154.02
7	04-Mar-15	0:00	1:00	143.56	5.99	2.14	146.57	6.64	2.23	146.57
8	04-Mar-15	2:02	3:02	143.05	6.07	2.03	141.51	6.78	2.11	141.51
9	04-Mar-15	4:04	5:04	149.91	7.02	2.06	151.77	7.68	2.16	151.77
10	04-Mar-15	6:06	7:06	151.24	6.47	2.00	155.21	7.21	2.10	155.21
11	04-Mar-15	8:08	9:08	134.45	6.17	2.09	129.17	6.93	2.22	129.17
12	04-Mar-15	11:10	12:10	90.70	6.32	2.38	94.26	6.82	2.44	94.26

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

4B1 4.2.2 Table 4.2.2 – Standardised monitoring Data – Sulphur Dioxide - Low Range

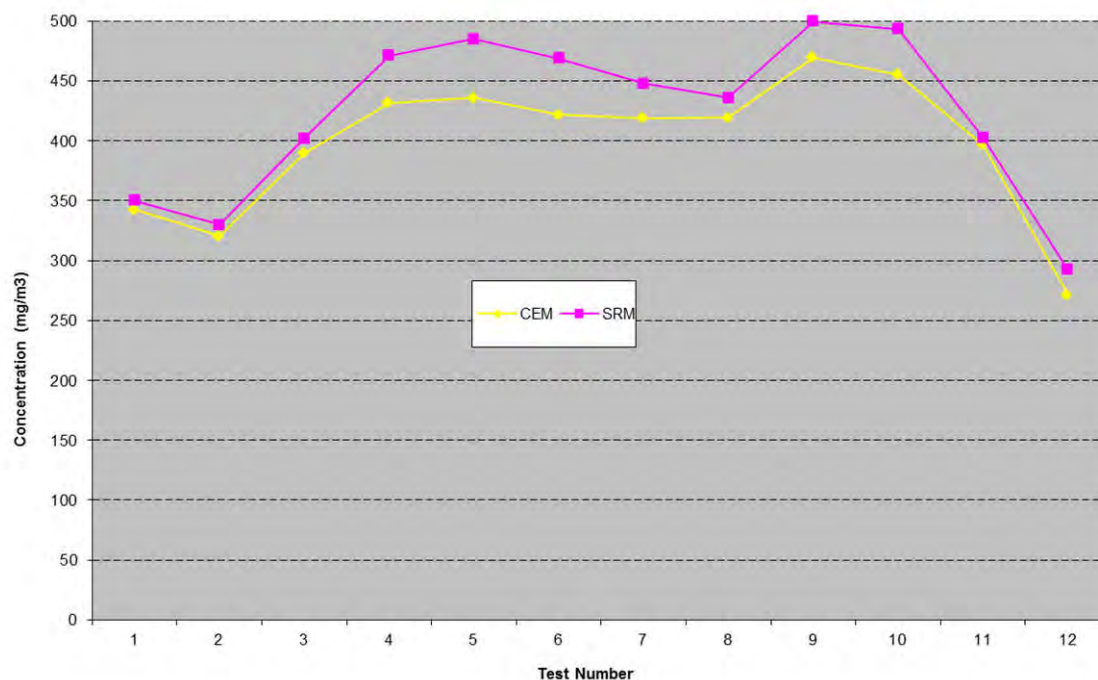
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(mg/m3)	(mg/m3)	(mg/m3)
1	03-Mar-15	12:00	13:00	342.5	349.9	23.0
2	03-Mar-15	14:02	15:02	320.4	330.1	22.0
3	03-Mar-15	16:04	17:04	389.5	401.7	21.0
4	03-Mar-15	18:06	19:06	431.5	471.2	19.0
5	03-Mar-15	20:08	21:08	435.9	484.8	19.0
6	03-Mar-15	22:10	23:10	421.8	468.7	15.0
7	04-Mar-15	0:00	1:00	418.9	447.7	22.0
8	04-Mar-15	2:02	3:02	419.2	435.9	3.8
9	04-Mar-15	4:04	5:04	469.5	499.5	3.4
10	04-Mar-15	6:06	7:06	455.3	493.1	2.9
11	04-Mar-15	8:08	9:08	396.9	402.6	2.4
12	04-Mar-15	11:10	12:10	271.3	292.2	2.1

Note:

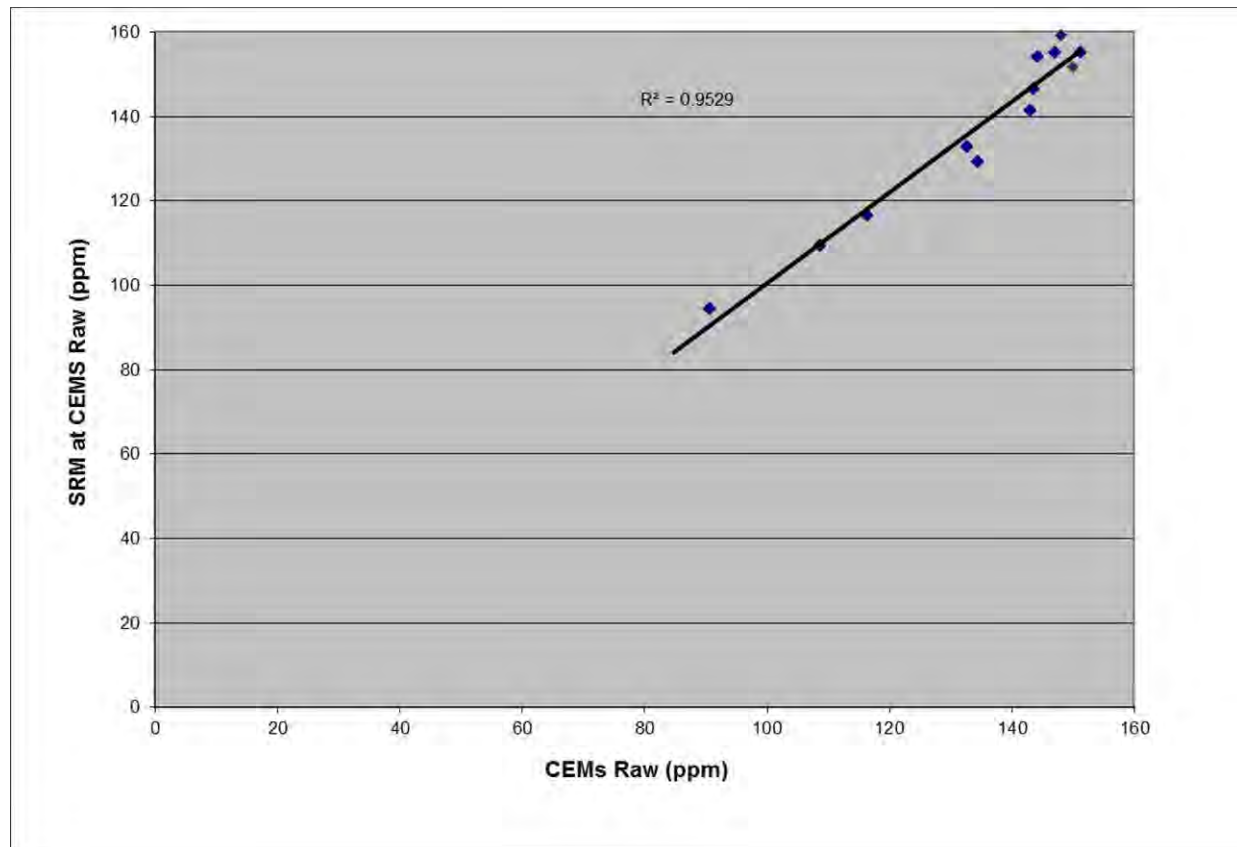
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

4B1 4.3.2 Plot 1.2 –Time Series of Standardised CEM versus Standardised SRM data – Sulphur Dioxide - Low Range. Reference conditions: 273K, 101.3kPa, dry gas, 6% oxygen.



4B1 4.4.2 – Elimination of Outliers – Sulphur Dioxide - Low Range.



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.

Additionally, any data points are not likely to be outliers unless they are more than three standard deviations from the regression line'

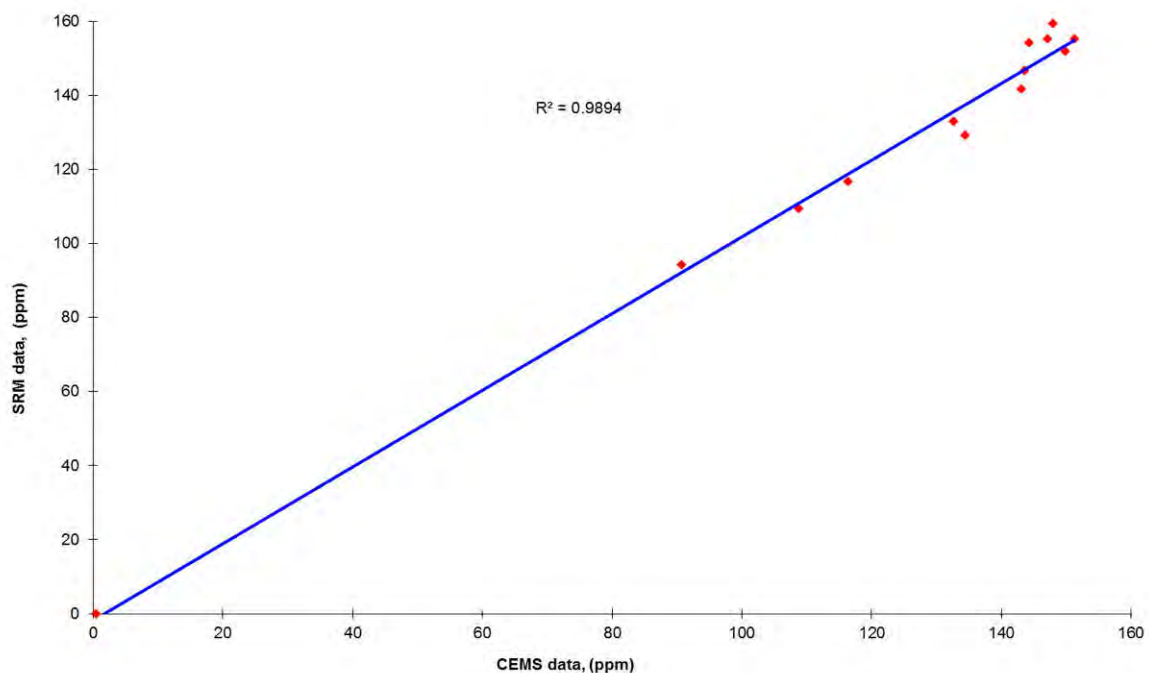
As the R2 value for this determinand was 0.9529, an outlier test has not been undertaken.

4B1 4.5.2 Table 4.3.2 - Data used to Calculate Calibrated Values – Sulphur Dioxide - Low Range.

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS wet Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		(ppm)	(ppm)	%	%	(mg/Nm ³)	(mg/Nm ³)	(mg/m3)
1	18-Feb-15	Reference		0.5	-1.4	N/A	N/A	0.5	-4.0	0.0
2	03-Mar-15	12:00	13:00	116.3	112.1	6.11	2.22	342.5	330.1	349.9
3	03-Mar-15	14:02	15:02	108.7	104.7	6.14	2.10	320.4	308.4	330.1
4	03-Mar-15	16:04	17:04	132.6	128.0	6.11	2.01	389.5	376.1	401.7
5	03-Mar-15	18:06	19:06	147.1	142.3	6.08	2.06	431.5	417.3	471.2
6	03-Mar-15	20:08	21:08	148.0	143.1	6.15	2.00	435.9	421.6	484.8
7	03-Mar-15	22:10	23:10	144.3	139.5	6.02	2.11	421.8	407.8	468.7
8	04-Mar-15	00:00	01:00	143.6	138.8	5.99	2.14	418.9	404.9	447.7
9	04-Mar-15	02:02	03:02	143.1	138.3	6.07	2.03	419.2	405.2	435.9
10	04-Mar-15	04:04	05:04	149.9	145.0	7.02	2.06	469.5	454.1	499.5
11	04-Mar-15	06:06	07:06	151.2	146.3	6.47	2.00	455.3	440.5	493.1
12	04-Mar-15	08:08	09:08	134.5	129.9	6.17	2.09	396.9	383.4	402.6
13	04-Mar-15	11:10	12:10	90.7	87.0	6.47	2.38	271.3	262.9	292.2
Sum								4773.01		

Reference Oxygen	6	%
Established Calibration Function y=	-1.9 + 0.98xi	

Plot of CEM versus SRM Data at CEM measurement conditions– Sulphur Dioxide - Low Range. wet gas



4B2 4.6.2 Table 4.4.2 – Data used for the Variability Test – Sulphur Dioxide - Low Range

Test No	Date	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
		hr:min		mg/m3	mg/m3			
1	18-Feb-15	Reference		-4.0	0.0	4.0	-32.07	1028.41
2	03-Mar-15	12:00	13:00	330.1	349.9	19.84	-16.25	264.22
3	03-Mar-15	14:02	15:02	308.4	330.1	21.72	-14.37	206.57
4	03-Mar-15	16:04	17:04	376.1	401.7	25.63	-10.47	109.66
5	03-Mar-15	18:06	19:06	417.3	471.2	53.91	17.81	317.15
6	03-Mar-15	20:08	21:08	421.6	484.8	63.25	27.15	737.33
7	03-Mar-15	22:10	23:10	407.8	468.7	60.94	24.84	617.14
8	04-Mar-15	00:00	01:00	404.9	447.7	42.72	6.62	43.84
9	04-Mar-15	02:02	03:02	405.2	435.9	30.70	-5.40	29.18
10	04-Mar-15	04:04	05:04	454.1	499.5	45.35	9.25	85.65
11	04-Mar-15	06:06	07:06	440.5	493.1	52.60	16.50	272.32
12	04-Mar-15	08:08	09:08	383.4	402.6	19.28	-16.82	282.87
13	04-Mar-15	11:10	12:10	262.9	292.2	29.30	-6.79	46.16
Mean						36.10		
Sum								4040.51

4B2 4.7.2 - Variability Test and Test of Calibration Function Calculations – Sulphur Dioxide - Low Range.

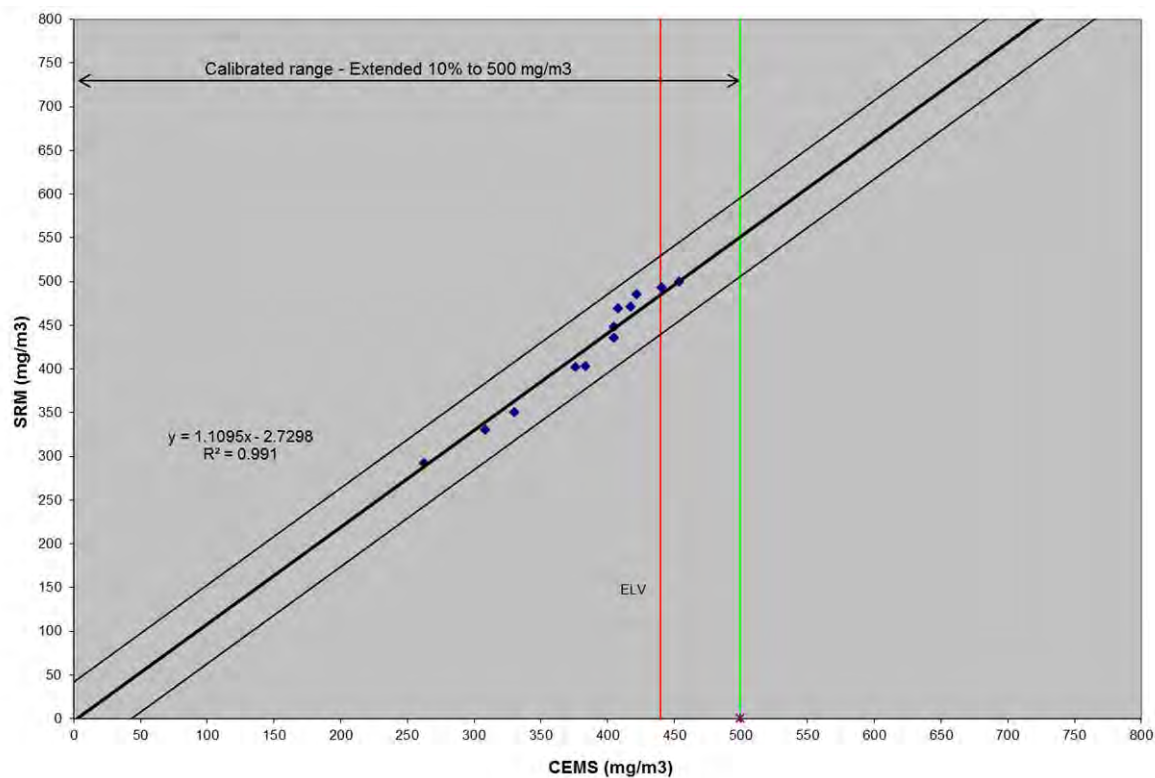
Variability Test

SD= $\text{Root}(1-\text{Number}).\text{Integral}(\text{D1}-\text{D})^2$ 18.35 mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O_0 is therefore calculated as:-
 $O_0 = 0.2 * 440 \text{ mg/m3 (s,d,6\%O2)}/1.96$ 44.90 mg/m3(s,d),6%O2
For 13 tests, kv = 0.9721
Therefore variability= $18.35 \leq 44.9 * 0.9721 * 1.5$
or 18.35 \leq 65.47
Which is TRUE therefore the CEMS passes the test

Test of Calibration Function

The calibration of the AMS is accepted if: $\text{D1} \leq t_{0.95}(N-1) * (\text{s,d}/\text{root } N) + O_0$
D1= 36.10
For 13 tests, $t_{0.95}(N-1)$: 1.782
Therefore test of calibration = $36.1 \leq 1.782 * (18.35/\text{root } 13) + 44.9$
or 36.10 \leq 53.97
Which is TRUE therefore the calibration function is VALID

4B2 4.8.2 Plot 2.2 – Standardised CEM data versus standardised SRM - Sulphur Dioxide - Low Range – Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen.



4B1 4.1.3 Table 4.1.3 – Raw monitoring Data – Sulphur Dioxide High Range

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (wet)	CEMS Oxygen (wet)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMS Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	03-Mar-15	12:00	13:00	125.75	6.11	2.22	116.61	6.37	2.38	116.61
2	03-Mar-15	14:02	15:02	117.77	6.14	2.10	109.29	6.47	2.30	109.29
3	03-Mar-15	16:04	17:04	141.12	6.11	2.01	132.89	6.50	2.18	132.89
4	03-Mar-15	18:06	19:06	155.79	6.08	2.06	155.07	6.58	2.20	155.07
5	03-Mar-15	20:08	21:08	156.41	6.15	2.00	159.26	6.64	1.96	159.26
6	03-Mar-15	22:10	23:10	153.17	6.02	2.11	154.02	6.61	2.09	154.02
7	04-Mar-15	0:00	1:00	152.51	5.99	2.14	146.57	6.64	2.23	146.57
8	04-Mar-15	2:02	3:02	151.59	6.07	2.03	141.51	6.78	2.11	141.51
9	04-Mar-15	4:04	5:04	158.52	7.02	2.06	151.77	7.68	2.16	151.77
10	04-Mar-15	6:06	7:06	159.65	6.47	2.00	155.21	7.21	2.10	155.21
11	04-Mar-15	8:08	9:08	143.30	6.17	2.09	129.17	6.93	2.22	129.17
12	04-Mar-15	11:10	12:10	100.84	6.32	2.38	94.26	6.82	2.44	94.26

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

4B1 4.2.3 Table 4.2.3 – Standardised monitoring Data – Sulphur Dioxide - High Range

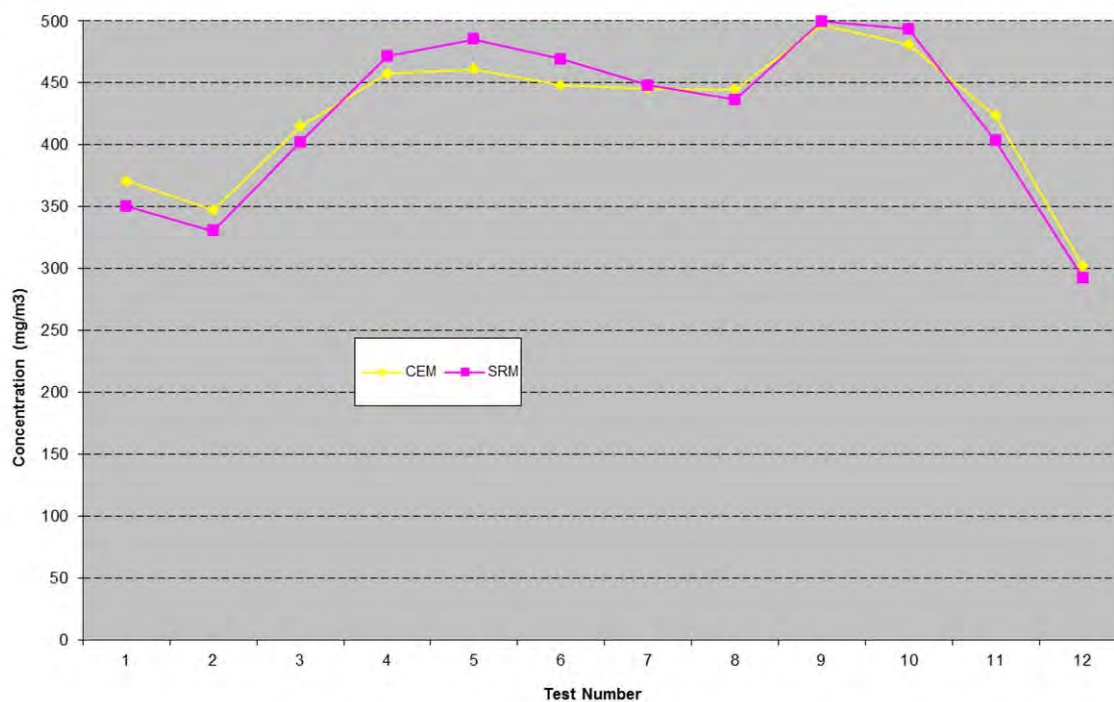
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(mg/m3)	(mg/m3)	(mg/m3)
1	03-Mar-15	12:00	13:00	370.2	349.9	18.0
2	03-Mar-15	14:02	15:02	347.0	330.1	17.2
3	03-Mar-15	16:04	17:04	414.5	401.7	20.7
4	03-Mar-15	18:06	19:06	457.0	471.2	24.3
5	03-Mar-15	20:08	21:08	460.6	484.8	25.0
6	03-Mar-15	22:10	23:10	447.7	468.7	24.2
7	04-Mar-15	0:00	1:00	445.0	447.7	23.1
8	04-Mar-15	2:02	3:02	444.2	435.9	22.5
9	04-Mar-15	4:04	5:04	496.4	499.5	25.7
10	04-Mar-15	6:06	7:06	480.6	493.1	25.4
11	04-Mar-15	8:08	9:08	423.0	402.6	20.8
12	04-Mar-15	11:10	12:10	301.6	292.2	15.1

Note:

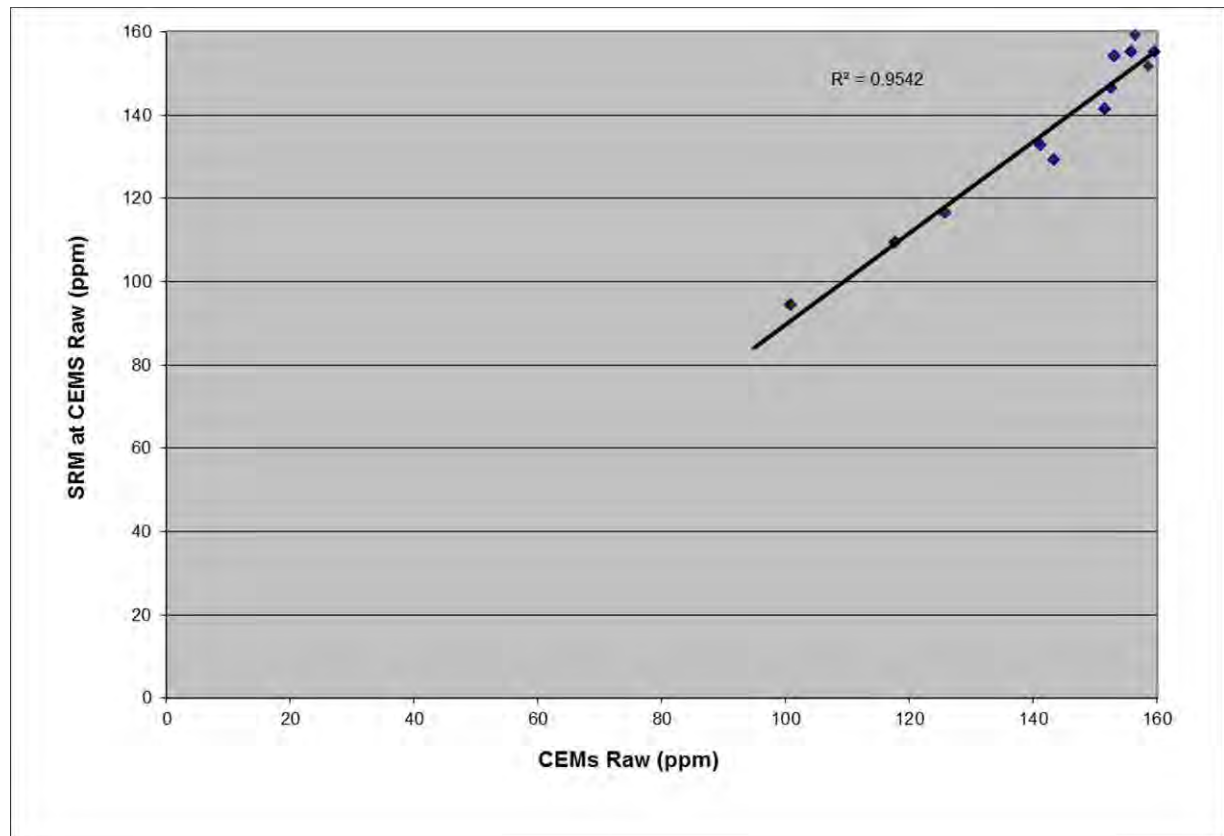
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

4B1 4.3.3 Plot 1.3 –Time Series of Standardised CEM versus Standardised SRM data – Sulphur Dioxide - High Range. Reference conditions: 273K, 101.3kPa, dry gas, 6% oxygen.



4B1 4.4.3 – Elimination of Outliers – Sulphur Dioxide - High Range.



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R^2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.

Additionally, any data points are not likely to be outliers unless they are more than three standard deviations from the regression line'

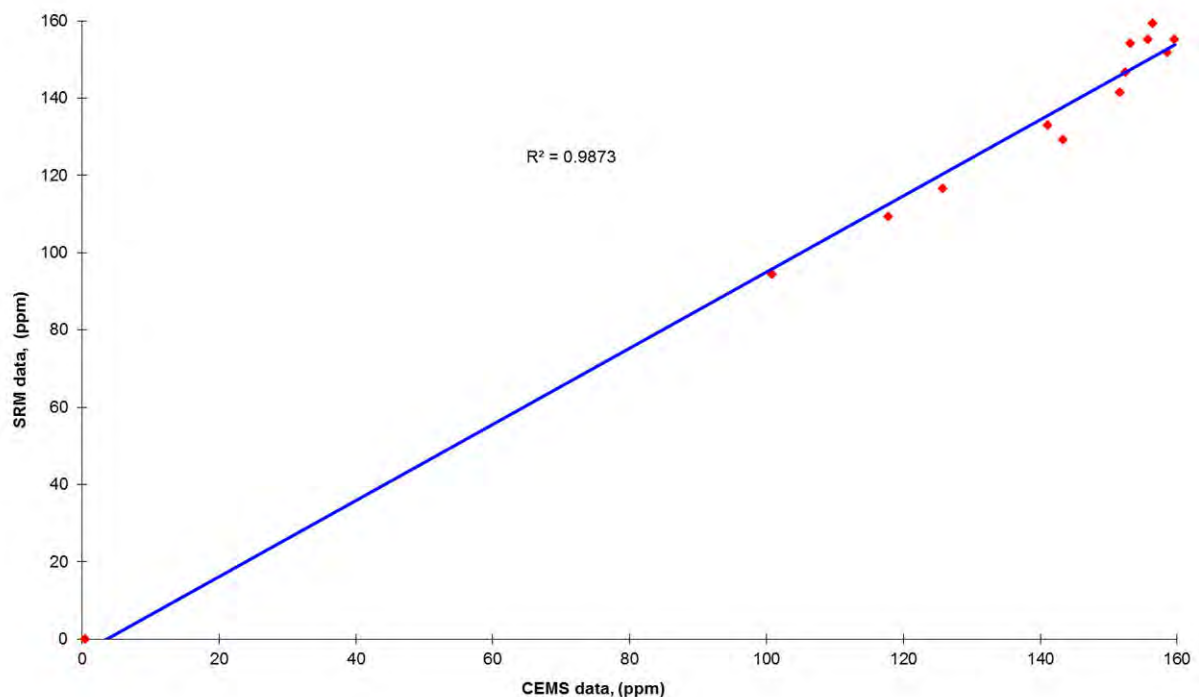
As the R^2 value for this determinand was 0.9542, an outlier test has not been undertaken.

4B1 4.5.3 Table 4.3.3 - Data used to Calculate Calibrated Values – Sulphur Dioxide - High Range.

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS wet Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		(ppm)	(ppm)	%	%	(mg/Nm ³)	(mg/Nm ³)	(mg/m3)
1	18-Feb-15	Reference		0.5	-1.3	N/A	N/A	0.5	-3.7	0.0
2	03-Mar-15	12:00	13:00	125.7	121.9	6.11	2.22	370.2	359.0	349.9
3	03-Mar-15	14:02	15:02	117.8	114.1	6.14	2.10	347.0	336.1	330.1
4	03-Mar-15	16:04	17:04	141.1	137.1	6.11	2.01	414.5	402.6	401.7
5	03-Mar-15	18:06	19:06	155.8	151.5	6.08	2.06	457.0	444.4	471.2
6	03-Mar-15	20:08	21:08	156.4	152.1	6.15	2.00	460.6	448.0	484.8
7	03-Mar-15	22:10	23:10	153.2	148.9	6.02	2.11	447.7	435.3	468.7
8	04-Mar-15	00:00	01:00	152.5	148.3	5.99	2.14	445.0	432.6	447.7
9	04-Mar-15	02:02	03:02	151.6	147.4	6.07	2.03	444.2	431.8	435.9
10	04-Mar-15	04:04	05:04	158.5	154.2	7.02	2.06	496.4	482.8	499.5
11	04-Mar-15	06:06	07:06	159.6	155.3	6.47	2.00	480.6	467.5	493.1
12	04-Mar-15	08:08	09:08	143.3	139.2	6.17	2.09	423.0	410.9	402.6
13	04-Mar-15	11:10	12:10	100.8	97.4	6.47	2.38	301.6	294.4	292.2
Sum								5088.25		

Reference Oxygen	6	%
Established Calibration Function y _i =	-1.8 + 0.984x _i	

Plot of CEM versus SRM Data at CEM measurement conditions– Sulphur Dioxide - High Range. wet gas



4B2 4.6.3 Table 4.4.3 – Data used for the Variability Test – Sulphur Dioxide - High Range.

Test No	Date	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
		hr:min		mg/m3	mg/m3			
1	18-Feb-15	Reference		-3.7	0.0	3.7	-6.71	45.02
2	03-Mar-15	12:00	13:00	359.0	349.9	-9.04	-19.49	379.92
3	03-Mar-15	14:02	15:02	336.1	330.1	-6.06	-16.50	272.31
4	03-Mar-15	16:04	17:04	402.6	401.7	-0.87	-11.32	128.10
5	03-Mar-15	18:06	19:06	444.4	471.2	26.86	16.42	269.53
6	03-Mar-15	20:08	21:08	448.0	484.8	36.85	26.40	696.96
7	03-Mar-15	22:10	23:10	435.3	468.7	33.49	23.04	531.07
8	04-Mar-15	00:00	01:00	432.6	447.7	15.08	4.63	21.43
9	04-Mar-15	02:02	03:02	431.8	435.9	4.11	-6.34	40.13
10	04-Mar-15	04:04	05:04	482.8	499.5	16.64	6.19	38.36
11	04-Mar-15	06:06	07:06	467.5	493.1	25.58	15.13	228.99
12	04-Mar-15	08:08	09:08	410.9	402.6	-8.31	-18.76	351.85
13	04-Mar-15	11:10	12:10	294.4	292.2	-2.26	-12.70	161.38
Mean						10.45		
Sum								3165.04

4B2 4.7.3 - Variability Test and Test of Calibration Function Calculations – Sulphur Dioxide - High Range.

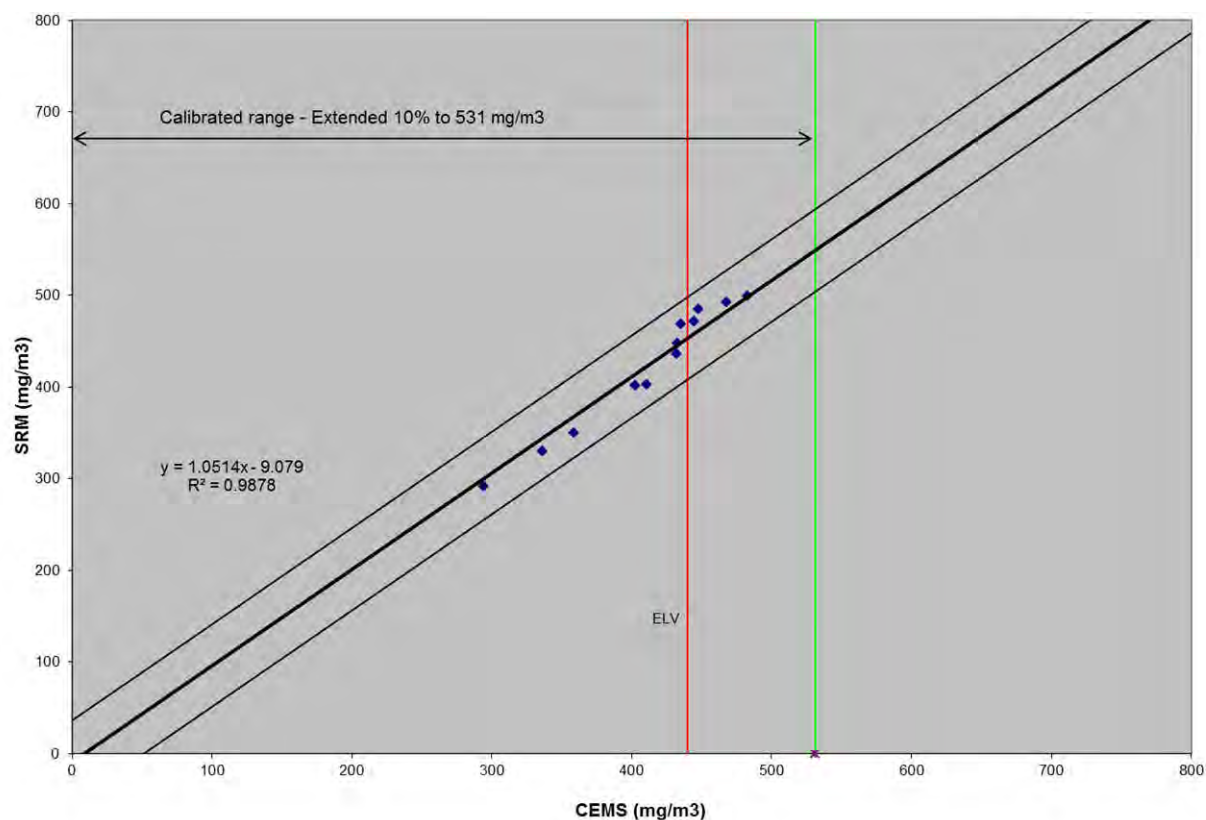
Variability Test

SD= $\text{Root}(1-\text{Number}).\text{Integral}(\text{D1}-\text{D})^2$ 16.24 mg/m3(s,d),6%O2
 The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O_0 is therefore calculated as:-
 $O_0 = 0.2 * 440 \text{ mg/m3 (s,d,6\%O2)} / 1.96$ 44.90 mg/m3(s,d),6%O2
 For 13 tests, kv = 0.9721
 Therefore variability= $16.24 \leq 44.9 * 0.9721 * 1.5$
 or $16.24 \leq 65.47$
 Which is TRUE therefore the CEMS passes the test

Test of Calibration Function

The calibration of the AMS is accepted if: $\text{D1} \leq t_{0.95}(N-1) * (\text{s,d}/\text{root } N) + O_0$
 $\text{D1} = 10.45$
 For 13 tests, $t_{0.95}(N-1) : 1.782$
 Therefore test of calibration = $10.45 \leq 1.782 * (16.24/\text{root } 13) + 44.9$
 or $10.45 \leq 52.92$
 Which is TRUE therefore the calibration function is VALID

B1 4.8.3 Plot 2.3 – Standardised CEM data versus standardised SRM - Sulphur Dioxide - High Range – Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen.



Section 4B2: Data & calculations – AST – Unit 8, SICK OMD 41

4B2 4.1 Table 4.1 – Raw monitoring Data – Total Particulate Matter

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (Extinction)	CEMS Oxygen (Wet)	CEMS Moisture (Wet)	CEM Stack Temp	CEM Stack Press	SRM Raw value (dry)	SRM Moisture (Wet FT)	SRM Oxygen (Dry)	SRM Stack Temp	SRM Stack Press	SRM at CEMs Raw conditions
		hr:min		%	(%)	(%)	C	kpa	(mg/m3)	(%)	(%)	C	kpa	(mg/m3)
1	03-Mar-15	11:50	12:40	5.7	6.1	2.2	69.4	100.1	14.7	2.4	6.4	68.9	100.2	11.3
2	03-Mar-15	13:15	14:05	5.7	6.1	2.1	68.4	100.1	16.1	2.2	6.4	67.4	100.2	12.5
3	03-Mar-15	14:30	15:20	5.9	6.2	2.1	68.2	100.1	6.7	2.3	6.5	66.7	100.2	5.2
4	04-Mar-15	11:05	11:55	10.7	6.3	2.3	68.9	100.2	21.7	2.4	6.8	68.0	100.3	16.8
5	04-Mar-15	12:10	13:00	7.7	6.3	2.6	70.1	100.2	20.2	2.6	6.9	68.6	100.3	15.6
6	04-Mar-15	13:10	14:00	6.0	6.2	2.4	69.7	100.2	16.3	2.4	6.8	68.9	100.3	12.6
7	04-Mar-15	14:18	15:09	6.5	6.0	2.3	70.0	100.2	17.7	2.3	6.7	68.9	100.3	13.7

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

4B2 4.2 Table 4.2 – Standardised monitoring Data – Total Particulate Matter

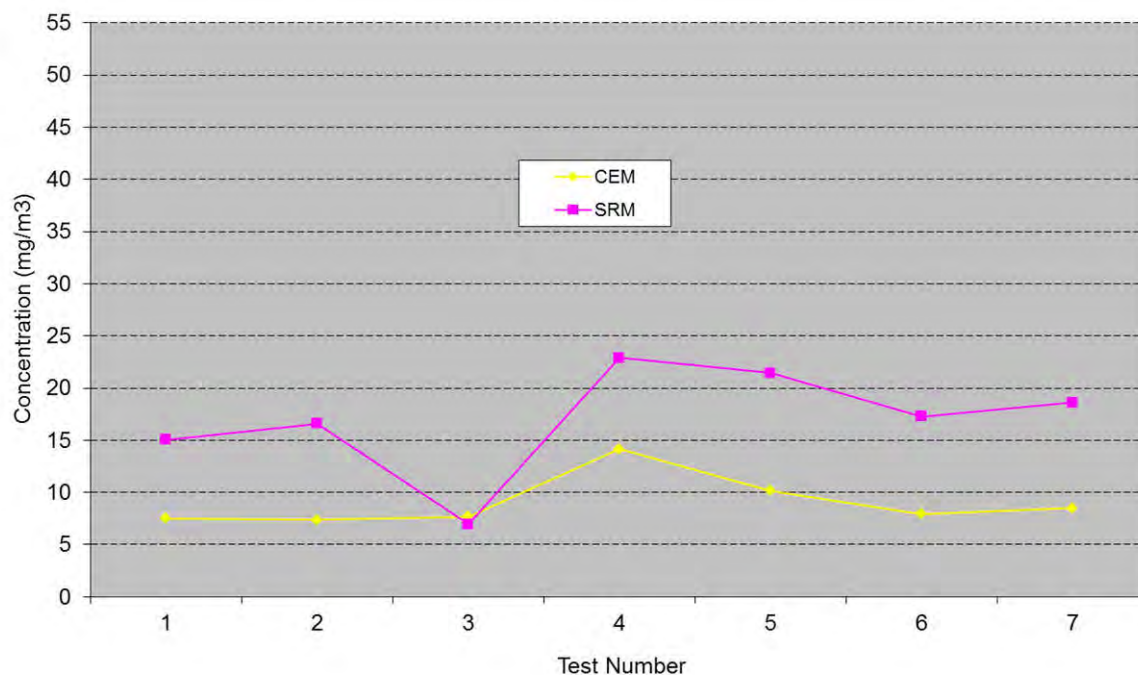
Test No	Date	Test Start Time	Test End Time	CEMS Standardised Value	SRM Standardised Value	SRM Uncertainty
		hr:min		(mg/m3)	mg/m3	(mg/m3)
1	03-Mar-15	11:50	12:40	7.5	15.1	0.56
2	03-Mar-15	13:15	14:05	7.4	16.6	0.60
3	03-Mar-15	14:30	15:20	7.7	6.9	0.38
4	04-Mar-15	11:05	11:55	14.1	22.9	0.76
5	04-Mar-15	12:10	13:00	10.2	21.4	0.71
6	04-Mar-15	13:10	14:00	7.9	17.3	0.59
7	04-Mar-15	14:18	15:09	8.5	18.6	0.64

Note:

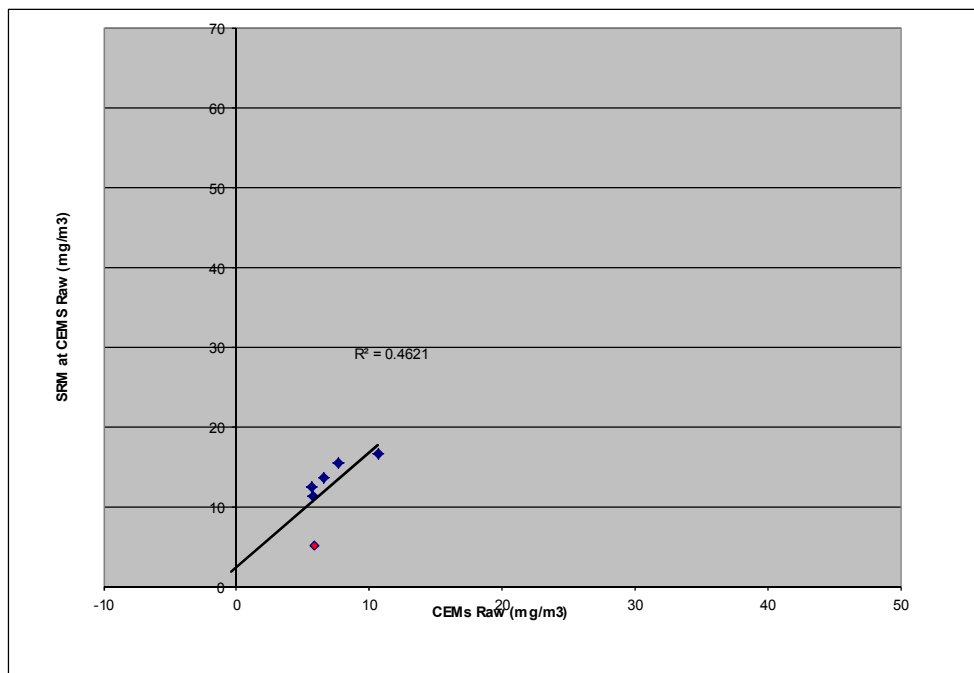
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

4B2 4.3 Plot 1 –Time Series of Standardised CEM versus Standardised SRM data – Total Particulate Matter. Reference conditions: 273K, 101.3kPa, dry gas, 6% oxygen.



4B2 4.4 – Elimination of Outliers – Total Particulate Matter.



Test No	Test Start Time	Test End Time	CEMS Raw Value (Extinction)	SRM Value at CEMS Raw conditions	Difference Di	Difference Di - \bar{D}_i	Is Result an Outlier - $D_i - \bar{D}_i > 2SD$
	hr:min		%	(mg/m3)			
1	11:50	12:40	5.7	11.3	5.58	0.10	No
2	13:15	14:05	5.7	12.5	6.83	1.35	No
3	14:30	15:20	5.9	5.2	-0.67	-6.15	Yes
4	11:05	11:55	10.7	16.8	6.11	0.63	No
5	12:10	13:00	7.7	15.6	7.91	2.43	No
7	14:18	15:09	6.5	13.7	7.12	1.63	No
				Average \bar{D}_i	5.48		
				Standard Deviation	3.12		
				Standard Deviation x2	6.24		

4B2 4.5 Table 4.3 - Data used to Calculate Calibrated Values – Total Particulate Matter.

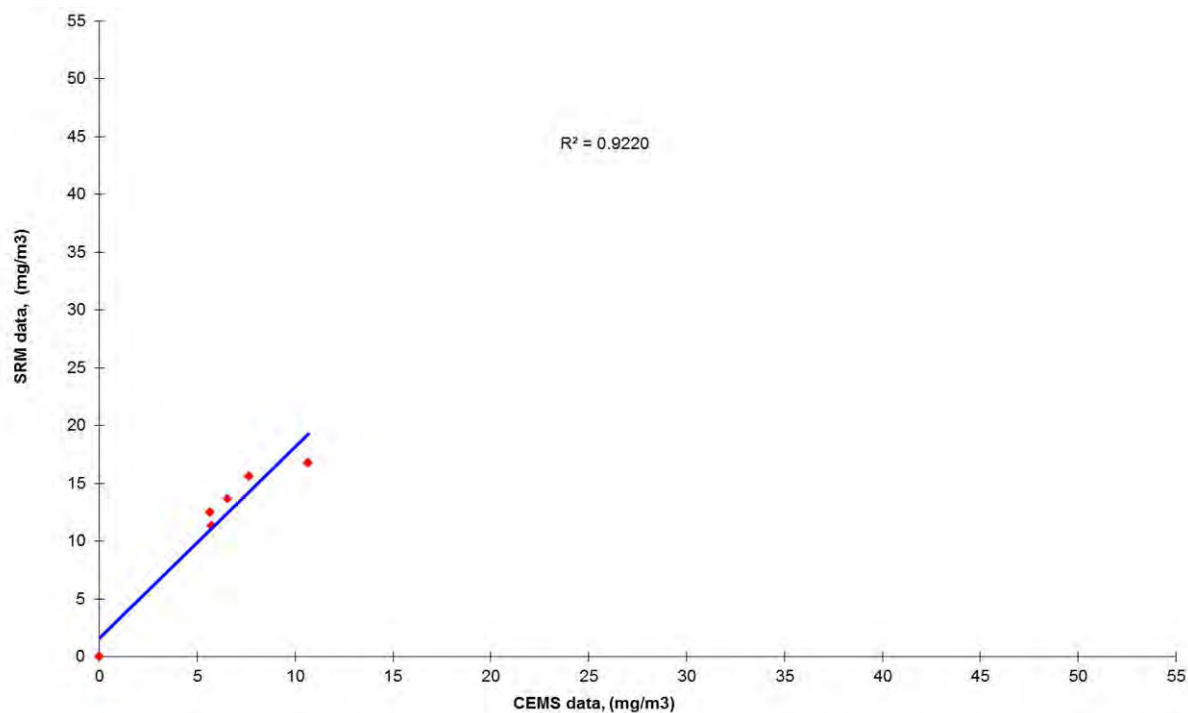
Test No	Test Start Time	Test End Time	CEMS Raw Value (Extinction)	CEMS Calibrated signal	CEMS Moisture	CEMS Temp	CEMS Pressure	CEMS Dry Oxygen	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
	hr:min		%	(mg/m3)	(%)	(°C)	(kPa)	(%)	(mg/Nm ³)	(mg/Nm ³)	(mg/m3)
1	Reference		0.0	-0.3	0.0	N/A	N/A	0.0	0.0	-0.3	0.0
2	11:50	12:40	5.7	6.6	2.2	69.4	100.1	6.1	7.5	8.7	15.1
3	13:15	14:05	5.7	6.5	2.1	68.4	100.1	6.1	7.4	8.5	16.6
5	11:05	11:55	10.7	12.6	2.3	68.9	100.2	6.3	14.1	16.7	22.9
6	12:10	13:00	7.7	8.9	2.6	70.1	100.2	6.3	10.2	11.9	21.4
7	14:18	15:09	6.5	7.6	2.3	70.0	100.2	6.0	8.5	9.9	18.6
Sum									47.69		

Reference Oxygen

6 %

Established Calibration Function $y_i = -0.303 + 1.208x_i$

Plot of CEM versus SRM Data at CEM measurement conditions– Total Particulate Matter, at stack temperature, pressure and moisture conditions.



4B2 4.6 Table 4.4 – Data used for the Variability Test – Total Particulate Matter.

Test No	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
	hr:min		mg/m3	mg/m3			
1	Reference		-0.3	0.0	0.30	-6.25	39.02
2	11:50	12:40	8.7	15.1	6.39	-0.16	0.03
3	13:15	14:05	8.5	16.6	8.07	1.52	2.31
5	11:05	11:55	16.7	22.9	6.24	-0.31	0.10
6	12:10	13:00	11.9	21.4	9.54	2.99	8.97
7	14:18	15:09	9.9	18.6	8.75	2.20	4.84
6 Tests		Mean			6.55		
Sum							55.26

4B2 4.7 - Variability Test and Test of Calibration Function Calculations – Total Particulate Matter.

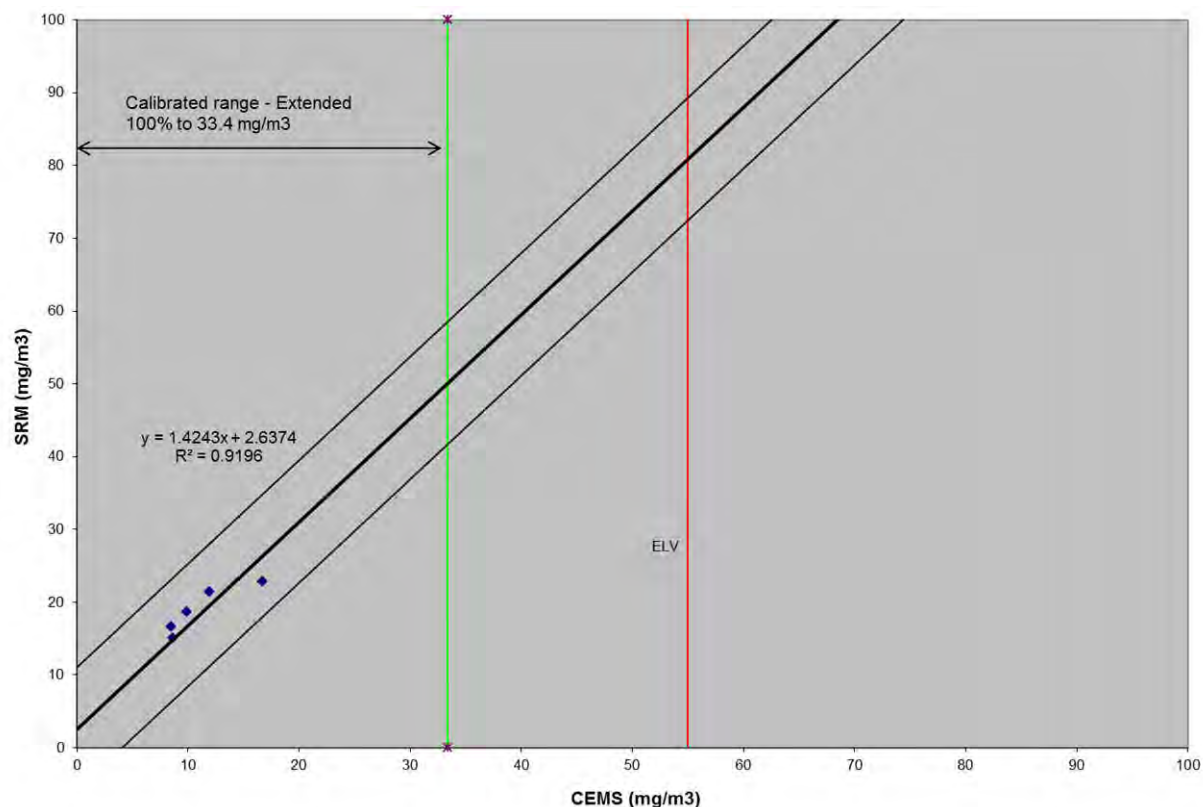
Variability Test

SD=	$\text{Root}(1-\text{Number}).\text{Integral}(D1-D)^2$	3.32	mg/m3(s,d),6%O ₂
The uncertainty laid down by the authorities is 30% ELV as a 95% confidence interval. O ₀ is therefore calculated as:-			
O ₀ =	$0.3 \times 55 \text{ mg/m}^3 (\text{s,d},6\% \text{O}_2)/1.96$	8.42	mg/m3(s,d),6%O ₂
For 6 tests, k _v =	0.9329		
Therefore variability=	$3.32 \leq 8.42 \times 0.9329 \times 1.5$		
or	$3.32 \leq 11.78$		
Which is TRUE therefore the CEMS passes the test			

Test of Calibration Function

The calibration of the AMS is accepted if:		$D1 \leq t_{0.95}(N-1) \times (s,d/\text{root } N) + O_0$
	D1=	6.55
For 6 tests, t _{0.95} (N-1) =	2.015	
Therefore test of calibration =	$6.55 \leq 2.015 \times (3.32/\text{root } 6) + 8.42$	
or	$6.55 \leq 11.15$	
Which is TRUE therefore the calibration function is VALID		

4B2 4.8 Plot 2 – Standardised CEM data versus standardised SRM - Total Particulate Matter – Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen.



Section 5 – Results of Functional tests

Table 5.1 - Audit of functional tests

Operator	RWE Generation UK plc.	
Site	Aberthaw Power Plant	
Stack	Unit 8	
Process Sector	LCPD	
Analyser A - Make Model MCERTs Certificate Number	Procal 1 - Pulsi 2000, In Situ IR MC990006/07	
Analyser B - Make Model MCERTs Certificate Number	Procal 2 - Pulsi 2000, In Situ IR MC990006/07	
Analyser C - Make Model MCERTs Certificate Number	Erwin SICK OMD41, Cross Duct Forward Scatter MC040042/01	
Analyser D - Make Model MCERTs Certificate Number	SICK Maihak GmbH GM32 – In-situ MC100163/01	
Parameters Tested	Daily ELV	Certified range
NO & NO₂	1210 mg/m ³ (NO _x as NO ₂)	PROCAL: NO = 0 – 1000 ppm GM 32: Measuring path length 1.25m: NO 0 to 70 mg/m ³ & 0 to 700 mg/m ³ GM 32: Measuring path length 1.00m NO 0 to 87.5 mg/m ³ & 0 to 875 mg/m ³
Total Particulate Matter	55 mg/m ³	Erwin SICK: TPM = 0 – 200 mg/m ³
SO₂	440 mg/m ³	PROCAL = SO ₂ low = 0 – 250 ppm SO ₂ high = 0 – 1000 ppm GM 32: Measuring path length 1.25m: SO ₂ 0 to 75mg/m ³ & 0 to 1000mg/m ³ GM 32: Measuring path length 1.00m SO ₂ 0 to 93.8 mg/m ³ and 0 to 1250 mg/m ³

Analysers A & B	
Organisation carrying out tests -	Kittiwake Procal Ltd
Status of organisation – CEMS manufacturer/operator/service contractor	CEMS OEM
Test engineer	M Findley
Date of tests	16 th February 2015
Analyser C & D	
Organisation carrying out tests -	SICK
Status of organisation – CEMS manufacturer/operator/service contractor	CEMS OEM
Test engineer	Rhodri Jones
Date of tests	16 th & 17 th February 2015

Functional Test compliance with EN 14181

Requirement	Compliance Y/N	Notes
<p>1 – Alignment and cleanliness All checks specified in MID 14181 carried out ?</p> <p>– Sampling System</p> <p>A visual inspection of the sampling system shall be performed, noting the condition of the following components, when fitted:</p> <ul style="list-style-type: none"> - sampling probe; - gas conditioning systems; - pumps; - all connections; - sample lines; - power lines; - filters. <p>The sampling system shall be in good condition and free of any visible faults, which may decrease the quality of the testing.</p>	<p>Yes</p>	<p>Procal – Yes SICK (OMD) – Yes – Optics cleaned SICK (GM32) – Yes</p>
<p>2 - Leak Test</p> <p>Leak testing shall be performed according to the AMS manuals. The test shall cover the entire sampling system.</p>	<p>Yes</p>	
<p>Results of leak check compliant with requirements of relevant standards</p>	<p>N/A</p>	<p>Procal – N/A although differential pressure noted as OK SICK (OMD & GM32) – N/A</p>
<p>3 - Zero and Span Check Analyser</p> <p>Reference zero and span materials shall be used to verify the corresponding readings of the AMS.</p>	<p>N/A</p>	
<p>Results compliant with requirements of relevant standards</p> <p>Parameter:</p>	<p>Yes</p>	<p>Procal – Yes SICK – Yes – although based on the use of filters SICK (GM32) – Yes, although gas concentration not stated</p>
<p>NO</p> <p>SO₂</p> <p>TPM</p>	<p>Yes</p> <p>Yes</p> <p>Yes</p>	<p>SICK – Filters used with corresponding extinction values</p>

Requirement	Compliance Y/N	Notes
4 - Zero and Span Check Full System Reference zero and span materials shall be used to verify the corresponding readings of the AMS.	N/A	Procal, & SICK GM 32 analysers are in situ type and therefore there is as such, no 'full system'.
5 – NOx converter efficiency check	N/A	
6 - Linearity The linearity of the analysers shall be checked using five different reference materials, including zero concentration.	Yes	Procal – Yes SICK (OMD) – Yes – although based on the use of filters SICK (GM32) Use reference/gas cells of different lengths to conduct linearities.
The reference material with zero concentration, as well as the reference materials with four different concentrations, shall have a verifiable quantity and quality.	Yes	Procal – Yes SICK – Yes – although based on the use of filters SICK (GM32) - Yes
The reference material concentrations shall be selected such that the measured values are approximately 20%, 40%, 60% and 80% of two times the emission limit.	See note	Procal – Yes SICK – Used 8 points using filters SICK (GM32) - NOx - No
The dry test reference material shall be applied to the inlet of the AMS. Reference materials can be introduced directly into the analyser as long as the integrity of the sample system has been proved	N/A	N/A

Requirement	Compliance Y/N	Notes
<p>6 – Linearity (continued)</p> <p>After each change in concentration, the first instrument readings shall be taken after a time period equal to at least three times the response time of the AMS. At each reference material concentration, at least three readings shall be made. The time period between the start of each of the three readings shall be separated by at least four times the response time.</p> <p>A risk based approach may be adopted in order to reduce the time for the linearity tests</p>	<p>No</p> <p>N/A</p>	<p>Procal – No times stated in report</p> <p>SICK (OMD & GM32) – No times stated in report</p>
Linearity Test Pass		<p>Procal – Yes</p> <p>SICK (OMD & GM32) – Yes</p>
Parameter		
NO, SO ₂ & TPM	Yes	
6 – Interferences (only required in the event of a failure of the QAL 2/AST)	N/A	
7 – Zero and Span Drift (Audit)	Yes	
8- Response time	Yes	<p>Procal – Yes</p> <p>SICK (OMD & GM32) – Yes</p>
<p>The response of the AMS shall be checked. This can be performed, if appropriate, by feeding the reference material at the end of the sampling probe. The response time shall not exceed the measured value as identified during QAL 1.</p>		

Requirement	Compliance Y/N	Notes
9a – Service Report - PROCAL		
• Document reference	Yes	
• Instrument manufacturer	Yes	Procal
• Instrument Type	Yes	In-situ
• Instrument model	Yes	PULSI 200
• Instrument Serial No's	Yes	
• Operating principal	Yes	
• Operating range	Yes	
• Certification details	Yes	
• Compliance with MCERTS	Yes	
• Location	Yes	
• Date and time of work	Yes	
• Equipment used - Type serial no's etc	Yes	Gas divider and regulator nos
• Gases used – certificate numbers, expiry dates, type	No	Copy of gas certificates emailed to customer
• NOx converter efficiency check	N/A	
• Calibration and linearity data	Yes	
• Logged data for period of calibration/linearity	No	
• Name & signature of test engineer	Yes	

Requirement	Compliance Y/N	Notes
9c – Service Report – SICK OMD		
• Document reference	Yes	
• Instrument manufacturer	Yes	
• Instrument Type	Yes	
• Instrument model	Yes	
• Instrument Serial No's	Yes	
• Operating principal	Yes	
• Operating range	Yes	
• Certification details	Yes	
• Compliance with MCERTS	Yes	
• Location	Yes	
• Date and time of work	Yes	Date Only
• Equipment used - Type serial no's etc	Yes	On Linearity Sheet
• Gases used – certificate numbers, expiry dates, type	Yes	Including expiry dates
• NOx converter efficiency check	N/A	
• Calibration and linearity data	Yes	
• Logged data for period of calibration/linearity	Yes	Data supplied separately by client
• Name & signature of test engineer	Yes	

Requirement	Compliance Y/N	Notes
9c – Service Report – SICK GM32		
• Document reference	Yes	
• Instrument manufacturer	Yes	
• Instrument Type	Yes	
• Instrument model	Yes	
• Instrument Serial No's	Yes	
• Operating principal	Yes	
• Operating range	Yes	
• Certification details	Yes	
• Compliance with MCERTS	Yes	
• Location	Yes	
• Date and time of work	Yes	
• Equipment used - Type serial no's etc	No	
• Gases used – certificate numbers, expiry dates, type	Yes	
• NOx converter efficiency check	N/A	
• Calibration and linearity data	Yes	
• Logged data for period of calibration/linearity	No	
• Name & signature of test engineer	Yes	



Functionality Test Results

DECLARATION OF CONFORMITY

We,

Kittiwake Procal Ltd
5 Maxwell Road
Woodston
Peterborough
Cambridgeshire
PE2 7HU
United Kingdom

Tel: (+44) (0) 1733 232495

Fax: (+44) (0) 1733 235255

e-mail: post@procal.com

Web site: www.procal.com

declare that the product: **Type PULSI 200 Analyser** installed at

Customer	RWE Aberthaw
Control Unit Serial Number	8800624
P200 Serial Number	8500726
Site Identification	Unit 8 Secondary

to which this declaration relates is in conformance with the MCERTs Performance Standard for Continuous Emission Monitoring Systems: Version 2. Revision 1 (April 2003).

MCERTS Product Conformance Certificates:

Licence	Certificate Number	Variation	Dated
ACU	SIRA MC 990006/	8	02/10/09
ACWn	SIRA MC 050060/	6	02/10/09

MCERTs Certification Body:


Sira Certification Service	
12 Acorn Industrial Park	Tel: (+44) (0) 1322 520500
Crayford Road	
Crayford	Fax: (+44) (0) 1322 520501
Dartford	
Kent	
DA1 4AL	e-mail: info@siraenvironmental.com
United Kingdom	Web site: www.siracertification.com

Quality System:

ISO 9001:2008	Certificate Nr: 062043	Dated: 11/06/09
EN 15267-2	Dated: 2009	
EN 15267-3	Dated: 2007	

Technical Standards Used:

All tests carried out to Kittiwake Procal's working procedures and those within Annex A of EN14181, Version 2.3 June 2010, relating to functionality testing by CEMs' manufacturers.

Signed:.....  Date: 17/02/2015.....

Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, United Kingdom
Tel: +44 (0) 1733 232495 E-mail: procal@parker.com Web: www.procal.com
F:\Drawings & Forms\Forms & procedures\Forms\Current\7-7880-01 Functionality Test Results inc App1
Change Note: 7008144 Date: 24/09/10

Page 1 of 6



1.0 Alignment and Cleanliness.

1.1 Internal Check of Analyser

Analyser under test	Status	Notes
Optical path clear	Yes	OK
Optics clean	Yes	OK
Internal wiring ok	Yes	
Air supply on	Yes	
Purge flow >300 ltrs/hr	Yes	
Pressure differential <80mBar	Yes	48 mbar

2.0 Zero and Span Checks.

2.1 Zero Check

Component: Units:	H2O %	CO2 mAU	CO ppm	NO ppm	SO2-H ppm	SO2-L ppm	Ta	Ts	Ps
Process conc	3.1	168	101	406	112	47	25.1	129.3	1027.8
Zero conc	0	-1	1	2	1	0	25.9	129.2	1075.3
% error	<2	<2	<2	<2	<2	<2			
Pass/Fail	Pass	Pass	Pass	Pass	Pass	Pass			
T90 recovery									

2.2 Span Check

Component: Units:	H2O %	CO2 mAU	CO ppm	NO ppm	SO2-H ppm	SO2-L ppm	Ta	Ts	Ps
Full range	10		500	1000	1000	250			
Zero Conc	-0.1	-4	2	2	2	1	25.6	127.7	1074
Test Gas Conc			306	800	995	250			
Cert number			5682016	5501912	5503377	5503373			
Response Conc			312	802	988	252			
% Error			<2	<2	<2	<2			
Pass/Fail			Pass	Pass	Pass	Pass			
T90 time				70	70	70			

2.3 Filter Level Checks

All on zero air	F6	F2	F7	F5G	F3	F1G	F4	F8	
Factory	3254	4455	3769	2280	3242	1962	556	3716	
Last visit									
This visit	1803	2373	2029	1235	1781	1224	352	2377	



1.0 Alignment and Cleanliness.

1.1 Internal Check of Analyser

Analyser under test	Status	Notes
Optical path clear	Yes	OK
Optics clean	Yes	OK
Internal wiring ok	Yes	
Air supply on	Yes	
Purge flow >300 ltrs/hr	Yes	
Pressure differential <80mBar	Yes	48 mbar

2.0 Zero and Span Checks.

2.1 Zero Check

Component: Units:	H2O %	CO2 mAU	CO ppm	NO ppm	SO2-H ppm	SO2-L ppm	Ta	Ts	Ps
Process conc	3.1	168	101	406	112	47	25.1	129.3	1027.8
Zero conc	0	-1	1	2	1	0	25.9	129.2	1075.3
% error	<2	<2	<2	<2	<2	<2			
Pass/Fail	Pass	Pass	Pass	Pass	Pass	Pass			
T90 recovery									

2.2 Span Check

Component: Units:	H2O %	CO2 mAU	CO ppm	NO ppm	SO2-H ppm	SO2-L ppm	Ta	Ts	Ps
Full range	10		500	1000	1000	250			
Zero Conc	-0.1	-4	2	2	2	1	25.6	127.7	1074
Test Gas Conc			306	800	995	250			
Cert number			5682016	5501912	5503377	5503373			
Response Conc			312	802	988	252			
% Error			<2	<2	<2	<2			
Pass/Fail			Pass	Pass	Pass	Pass			
T90 time				70	70	70			

2.3 Filter Level Checks

All on zero air	F6	F2	F7	F5G	F3	F1G	F4	F8	
Factory	3254	4455	3769	2280	3242	1962	556	3716	
Last visit									
This visit	1803	2373	2029	1235	1781	1224	352	2377	



2.4 Interference Checks

Component: Units:	H2O %	CO2 mAU	CO ppm	NO ppm	SO2-H ppm	SO2-L ppm
ZERO	0	3	0	-3	3	3
CO2 15%						
H2O 3%	3.6	3	2	9	-1	0
H2O + CO2						

3.0 Data Acquisition.

Displayed \ Component						
Zero	Analyser					
	DCS					
	4-20mA					
Span	Analyser					
	DCS					
	4-20mA					

4.0 Linear coefficient record.

Coefficient \ Component		H2O	CO2	CO	NO	SO2-H	SO2-L
Last test	Linear	1.860e-2		4.872e+0	7.384e+0	4.781e+0	2.490e+0
	Squared	4.760e-5		6.496e-2	3.844e-2	1.689e-3	3.105e-3
	Cubed						
This test	Linear	1.860e-2		4.300e+0	7.238e+0	4.416e+0	2.761e+0
	Squared	4.760e-5		5.733e-2	3.768e-2	1.560e-3	3.433e-3
	Cubed						

5.0 Test Information

5.1 Procal Engineer: Panteleimon Kompeas-Charidis

5.2 Test House:

5.3 Test House Engineer:



Appendix 1. Pro-forma for assessing and reporting the results of the functional tests

Requirement	Notes	
1. Alignment and Cleanliness		
A visual inspection, with reference to the CEMs manuals, shall be carried out on the following when applicable:		
• Internal check of the CEM	√	All functions ok
• Cleanliness of the optical components	√	
• Flushing air supply	√	Ok
• Obstructions in the optical path	√	None
• After re-assembly at the measurement location at least the following shall be checked	√	No re-assembly required
• Alignment of the measuring system	√	No alignment required
• Contamination control (internal check of optical surfaces)	√	Filter levels ok
2. Sampling Systems		
A visual inspection of the sampling system shall be performed, noting the condition of the following components, when fitted:		
• Sampling probe	n/a	
• Gas conditioning systems	n/a	
• Pumps	n/a	
• All connections	√	Ok
• Sample lines	n/a	
• Power supplies	√	Ok
• Filters	√	Ok
• NOx converters - if the sampling system contains a NOx converter, then the test laboratory shall record when the last efficiency-test was performed, and the result of this test.	n/a	
• The sampling system shall be in good condition and free of any visible faults, which may decrease the quality of data	√	Ok
3. Leak testing		
• Leak testing shall be performed according to the CEMs manuals. The tests shall cover the entire sampling system.	n/a	
4. Zero and Span check		
• Reference zero and span materials shall be used to verify the corresponding readings of the CEM.	√	Ok
• In case of non-extractive CEM, zero and span checks shall be performed using a reference-path free of flue gas before and after readjustment and after re-assembly of the CEM at the measurement location.	√	Ok
5. Linearity		
• During the calibration/linearity tests the applied concentrations should be logged onto the DCS to prove the complete system i.e. concentration applied to the instrument is represented by the instrument output and identical to the value logged on the DCS.	√	Data collected on ACU MK4 & customer DCS during testing



Requirement		Notes
DCS logged values should be included in the instrument service report.	√	Data collected on ACU MK4 & customer DCS during testing
<ul style="list-style-type: none"> The linearity of the CEM's response shall be checked using five different reference materials, including a zero concentration. 	√	See linearity Cert
<ul style="list-style-type: none"> The reference material with zero concentration, as well as the reference materials with four different concentrations, shall have a verifiable quantity and quality. 	√	See gas certs
<ul style="list-style-type: none"> In case of gaseous reference materials, these four reference materials can be obtained from different gas cylinders or can be prepared by means of a calibrated dilution system from one single gas concentration. 	√	Gas points derived from blending full gas range using a Procal P9000, a water generator/gas blender
<ul style="list-style-type: none"> The reference material concentrations shall be selected such that the measured values are at approximately 20 %, 40 %, 60 % and 80 % of the range of two times the emission limit. It is necessary to know the values of the ratios of their concentrations precisely enough so that an incorrect failure of the linearity test does not occur. The dry test reference material shall be applied to the inlet of the CEM. 	√	See linearity cert
The individual CEMs are tested using the following concentrations applied in a randomised sequence:		
<ul style="list-style-type: none"> Reference material with zero concentration; 	√	See linearity cert
Reference material concentration approximately 20 % of 2 times the emission limit;	√	See linearity cert
<ul style="list-style-type: none"> Reference material concentration approximately 40 % of 2 times the emission limit; 	√	See linearity cert
<ul style="list-style-type: none"> Reference material concentration approximately 60 % of 2 times the emission limit; 	√	See linearity cert
<ul style="list-style-type: none"> Reference material concentration approximately 80 % of 2 times the emission limit; 	√	See linearity cert
<ul style="list-style-type: none"> Reference material with zero concentration; 	√	See linearity cert
<p>After each change in concentration, the first instrument reading shall ordinarily be taken after a time period equal to at least three times the response time of the CEM. At each reference material concentration, at least three readings shall be made, six readings shall be taken at zero. The time period between the start of each of the three readings shall be separated by at least four times the response time.</p> <p>The test-laboratory may apply a risk-based approach to linearity testing in order to reduce the time for the tests. For example, the readings may be taken after less than 3x the response time; however, if the CEM fails the linearity test, then the test laboratory shall repeat the linearity test and wait at least 3x the response time as stated above. Alternatively, the number of repetitions of the test may be reduced if the CEM passes the required performance criteria by a factor of at least 2 (i.e. half the allowable residual). Increasing the waiting time to 5x the response time, for example, may be a means of meeting this requirement. Where no other method is possible, the linearity can also be performed with the aid of reference materials such as grating filters or gas filters.</p>		



Requirement	Notes
The linearity shall be calculated and tested using the procedure as given in EN 14181 annex B. If the CEM does not pass this test; then the problem shall be identified and rectified.	
6. Interferences	
<ul style="list-style-type: none"> A test shall be undertaken if the process gases to be monitored contain components that are known interferences, as identified during QAL1 and there is a failure of the QAL2 or AST which could be due to interferences. 	<div>√</div> Interference checks made with Water vapour, CO2 and each gas species. See also Calcert
7. Zero and Span drift (Audit)	
<ul style="list-style-type: none"> The test laboratory shall assess whether the operator has a QAL3 procedure in place, and whether the operator has applied this procedure. The evidence would comprise (i) a documented procedure, (ii) zero and span data, (iii) control charts. 	<div>√</div>
Response Time	
<ul style="list-style-type: none"> The response time of the CEM shall be checked. This can be performed, if appropriate, by feeding of the reference material at the end of the sampling probe. The response time shall not exceed the performance requirement applied during the QAL1 tests. 	<div>√</div> Response time recorded on test sheet.
9. Service Report	
As a minimum requirement the service report should include the following:	
<ul style="list-style-type: none"> Document reference for work instruction for the type of work being undertaken 	<div>√</div> Procal Method Statement
<ul style="list-style-type: none"> Instrument manufacturer 	<div>√</div> Procal
<ul style="list-style-type: none"> Instrument type 	<div>√</div> Pulsi 2000
<ul style="list-style-type: none"> Instrument model 	<div>√</div> P2000
<ul style="list-style-type: none"> Instrument Serial No 	<div>√</div> 8500726
<ul style="list-style-type: none"> Operating principle 	<div>√</div> GFCIR & NIR
<ul style="list-style-type: none"> Operating range 	<div>√</div> Recorded on this report
<ul style="list-style-type: none"> Certification details 	<div>√</div> Mcerted
<ul style="list-style-type: none"> Compliance with MCERTS (including certificate no.) 	<div>√</div> SIRA MC 990006/08
<ul style="list-style-type: none"> Location 	<div>√</div> RWE Aberthaw
<ul style="list-style-type: none"> Date and time work was undertaken 	<div>√</div> 17/02/2015
<ul style="list-style-type: none"> Equipment used - type, serial no's, calibration dates 	<div>√</div> Procal Water Generator/Gas divider Pcal #6
<ul style="list-style-type: none"> Gases used - certificate numbers, expiry dates, binary / mix 	<div>√</div> Copy of Gas certs can be provided
<ul style="list-style-type: none"> NOx converter efficiency test, if applicable 	<div>n/a</div>
<ul style="list-style-type: none"> Calibration and linearity data as required by EN14181 	<div>√</div> See Linearity & Calcert Data
<ul style="list-style-type: none"> Logged data for period of calibration and linearity. Note there may be gaps in the data, in such cases, the test laboratory shall state why there are gaps in the data 	<div>√</div> See Linearity & Calcert Data

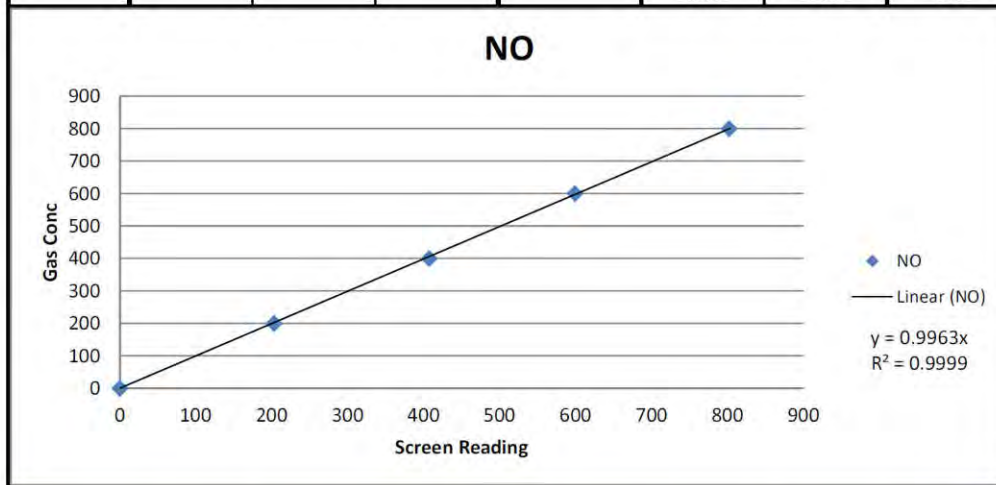


LINEARISATION RESULTS

Site	Aberthaw	
Date	18/02/2015	
Instrument	Unit 8 Primary	
Instrument Ref	8800539	8500916M
Engineer	Michael Findley	

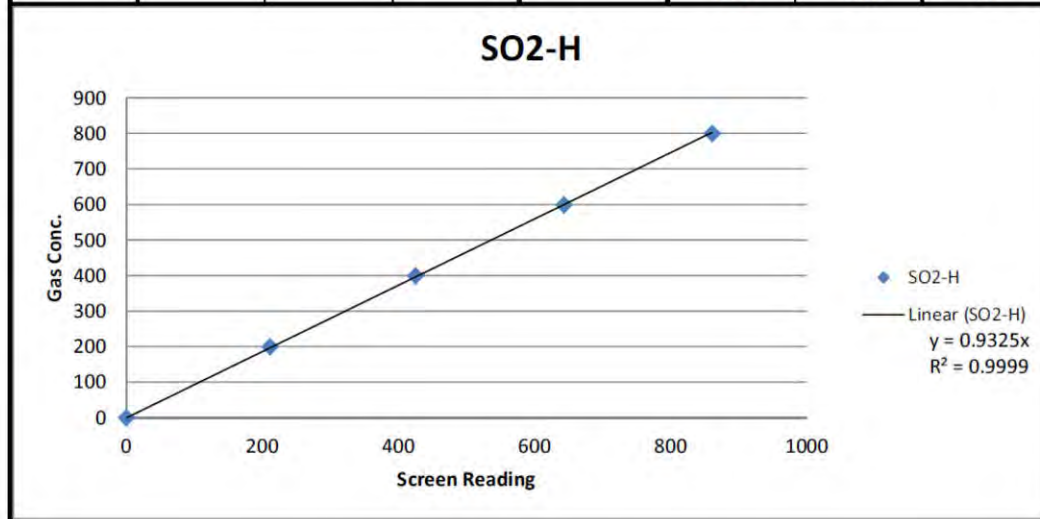
The above analyser has undergone a linearisation check and calibration, if required, in accordance with the company's quality system. The following results were obtained.

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
NO	PPM	1000	800	40005501912	802	802	0.2
					803	803	0.3
					802	802	0.2
NO	PPM	1000	600	40005501912	599	599	-0.1
					604	604	0.4
					605	605	0.5
NO	PPM	1000	400	40005501912	407	407	0.7
					407	407	0.7
					404	404	0.4
NO	PPM	1000	200	40005501912	203	203	0.3
					203	203	0.3
					202	202	0.2



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Tel: +44 (0) 17336 232495 Email: procalsales@parker.com Website: www.procal.com

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
SO2-H	PPM	1000	800	40005503378	861	861	6.1
					861	861	6.1
					860	860	6.0
SO2-H	PPM	1000	600	40005503378	643	643	4.3
					643	643	4.3
					643	643	4.3
SO2-H	PPM	1000	400	40005503378	425	425	2.5
					426	426	2.6
					428	428	2.8
SO2-H	PPM	1000	200	40005503378	211	211	1.1
					211	211	1.1
					210	210	1.0



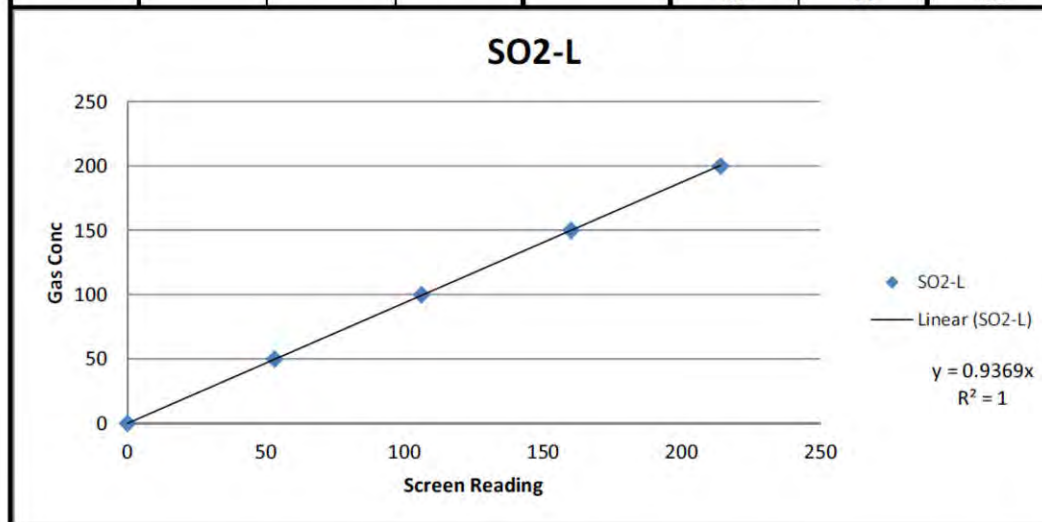
Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK TEL:+44(0)1733 23495 FAX:+44(0)1733 235255
E-mail: asampson@procal.com Website: www.procal.com

7-7862-04 Linearisation Certificate

Change note: 7009251

Date: 30/07/12

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
SO2-L	PPM	250	200	40005503378	214	214	5.6
					212	212	4.8
					213	213	5.2
SO2-L	PPM	250	150	40005503378	160	160	4.0
					160	160	4.0
					159	159	3.6
SO2-L	PPM	250	100	40005503378	106	106	2.4
					108	108	3.2
					107	107	2.8
SO2-L	PPM	250	50	40005503378	53	53	1.2
					55	55	2.0
					53	53	1.2



Zero	H2O	CO2	CO	NO	SO2 - H	SO2 - L
#1	0	0	1	3	0	0
#2	0	0	-4	4	0	0
#3	0	0	1	-1	-1	-1
#4	0	-1	-3	0	1	1
#5	0	0	-1	-3	1	1
#6	-0.1	-2	-6	0	2	2

Signature:

Procal Customer Support Engineer

Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK TEL:+44(0)1733 23495 FAX:+44(0)1733 235255
E-mail: asampson@procal.com Website: www.procal.com

7-7862-04 Linearisation Certificate

Change note: 7009251

Date: 30/07/12



Visit Ref:0000548



Service Engineers Report

Client Aberthaw Power Station RWE INNOGY PLC THE LEYS (NEAR BARRY) SOUTH GLAMORGAN Contact James Beveridge Tel No. 01446 750271	Job Category Chargeable UK Activity Functionality inc. Linearisation Date of Visit 16/02/2015 Analyser/System No. U8 Secondary U9 Secondary U7 Secondary
---	---

Qty	Description	Part No.

Travel Time	9 Hours	Mileage driven	498
Site Time	3 Days	Expenses incurred	£358.94
Engineer	Pandeli Kompeas-Charidis	For Client	

Notes for Call

8800624: Linearisation completed on all Secondary Units 7, 8 & 9

Unit7 Secondary 8500705: Dry gases no coefficient changes made, NO reads quite OK, SO2-H reads slightly high, SO2-L reads rather low and CO reads a bit high but within spec

Unit8 Secondary 8500726: Dry gases, all coefficients had to be changed; NO, SO2 & CO gases now all within spec, SO2-L & SO2-H readings now in close match which was achieved also by reverting back to older X-product coefficients

Unit9 Secondary 8500707: Dry gases no coefficient changes made, NO reads rather low, SO2-H reads rather high, SO2-L and CO read quite OK

Please refer to certs for more details

Kittiwake Procal Limited - 5 Maxwell Road, Woodston, Peterborough, PE2 7HU
Telephone: +44 01733 232495 Fax: +44 01733 235255 Web: www.procal.com

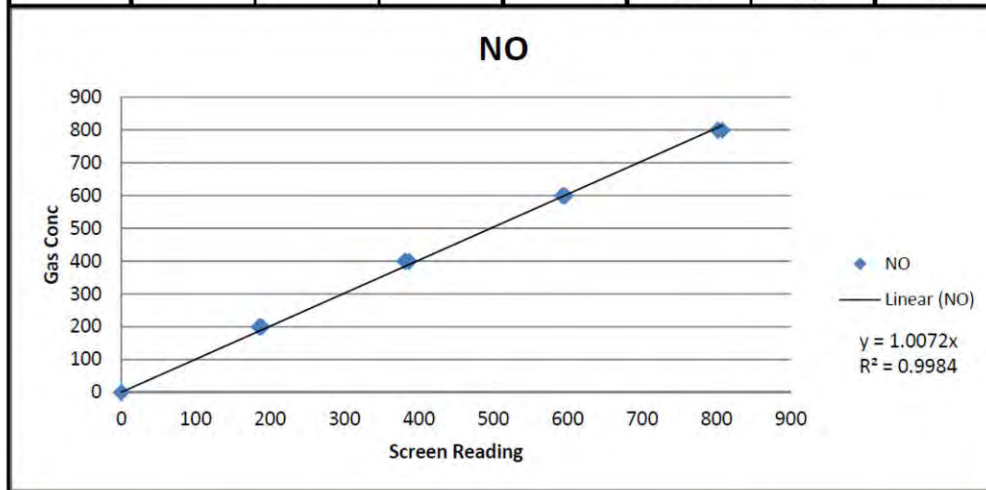


LINEARISATION RESULTS

Site	RWE Aberthaw	
Date	17/02/2015	
Instrument	Unit 8 Secondary	
Instrument Ref	8800624	8500726
Engineer	PKC	

The above analyser has undergone a linearisation check and calibration, if required, in accordance with the company's quality system. The following results were obtained.

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
NO	ppm	1000	800	40005501912	802	802	0.2
					808	808	0.8
					802	802	0.2
NO	ppm	1000	200	40005501912	185	185	-1.5
					187	187	-1.3
					189	189	-1.1
NO	ppm	1000	600	40005501912	593	593	-0.7
					595	595	-0.5
					597	597	-0.3
NO	ppm	1000	400	40005501912	382	382	-1.8
					381	381	-1.9
					387	387	-1.3



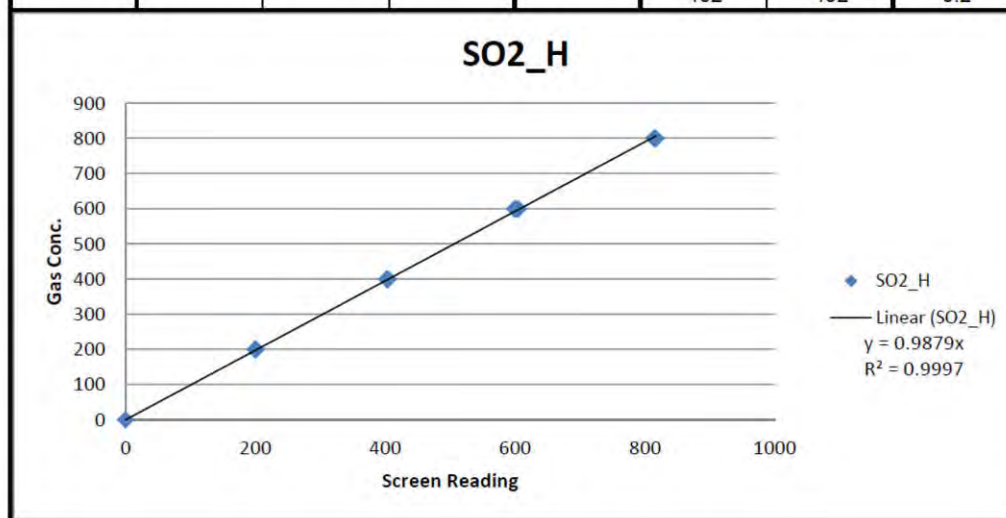
Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK
Tel: +44 (0) 17336 232495 Email: procalsales@parker.com Website: www.procal.com

7-7862-04 Linearisation Certificate

Change note: 7009251

Date: 30/07/12

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
SO2_H	ppm	1000	800	40005503377	814	814	1.4
					815	815	1.5
					817	817	1.7
SO2_H	ppm	1000	200	40005503377	201	201	0.1
					200	200	0.0
					199	199	-0.1
SO2_H	ppm	1000	600	40005503377	605	605	0.5
					601	601	0.1
					599	599	-0.1
SO2_H	ppm	1000	400	40005503377	404	404	0.4
					404	404	0.4
					402	402	0.2



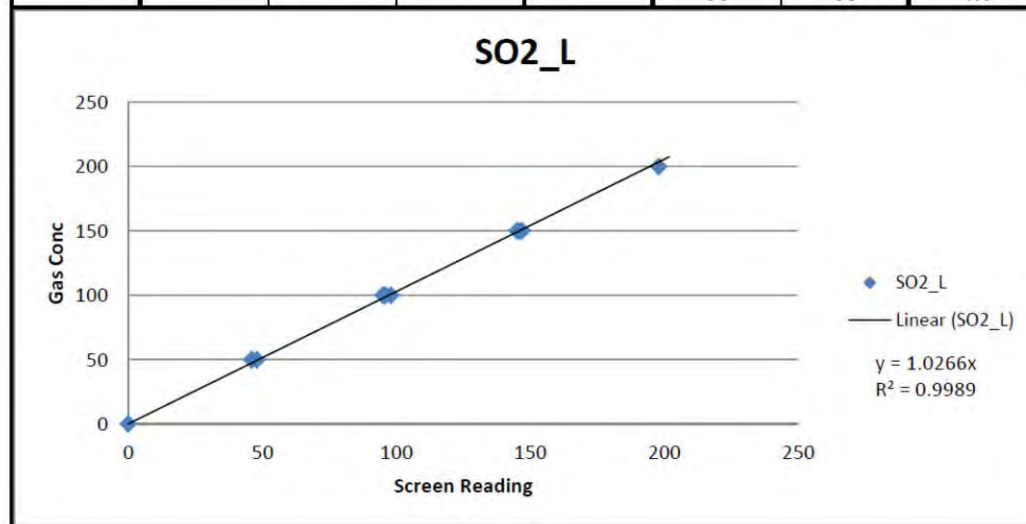
Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK TEL:+44(0)1733 23495 FAX:+44(0)1733 235255
E-mail: asampson@procal.com Website: www.procal.com

7-7862-04 Linearisation Certificate

Change note: 7009251

Date: 30/07/12

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
SO2_L	ppm	250	200	40005503373	198	198	-0.8
					202	202	0.8
					200	200	0.0
SO2_L	ppm	250	50	40005503373	46	46	-1.6
					48	48	-0.8
					46	46	-1.6
SO2_L	ppm	250	150	40005503373	147	147	-1.2
					146	146	-1.6
					145	145	-2.0
SO2_L	ppm	250	100	40005503373	95	95	-2.0
					98	98	-0.8
					96	96	-1.6



Zero	H2O	CO2	CO	NO	SO2 - H	SO2 - L
#1	0	1	1	6	-1	-1
#2	0	3	-2	-3	4	3
#3	-0.1	-4	2	2	2	1
#4	0	-1	5	3	-1	-1
#5	0	0	3	-6	-3	-3
#6	0	-1	2	-4	-2	-1

Signature: 

PKC

Procal Customer Support Engineer

Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK TEL:+44(0)1733 23495 FAX:+44(0)1733 235255

E-mail: asampson@procal.com Website: www.procal.com

7-7862-04 Linearisation Certificate

Change note: 7009251

Date: 30/07/12



CALIBRATION CERTIFICATE

Site	Aberthaw	
Date	18/02/2015	
Instrument	Unit 8 Primary	
Instrument Ref	8800539	8500916M
Engineer	M.Findley	

Results:

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
CO	PPM	500	333	Site Gas	317	336	0.6
NO	PPM	1000	667	Site Gas	667	670	0.3
SO2-H	PPM	1000	800	5501912	861	861	6.1
SO2-L	PPM	250	200	5503378	214	214	5.6

Cross sensitivity tests:

Test/ Gas conc	Response			% Error FSD		
	CO	NO	SO2-H	CO	NO	SO2-H
CO2 15%	-8	16	1	-1.6	1.6	0.1
H2O 2.5%	-2	-17	9	-0.4	-1.7	0.9
CO2 15% & H2O 2.5%	-4	14	12	-0.8	1.4	1.2

Test/ Gas conc	Response			% Error FSD		
	SO2-L			SO2-L		
CO2 15%	1			0.4		
H2O 2.5%	0			0.0		
CO2 15% & H2O 2.5%	3			1.2		

Signature: *M. Findley*

M.Findley
Procal Customer Support Engineer

Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK
Tel: +44 (0) 17336 232495 Email: procal@parker.com Website: www.procal.com



Functionality Test Results

DECLARATION OF CONFORMITY

We,

Kittiwake Procal Ltd
5 Maxwell Road
Woodston
Peterborough
Cambridgeshire
PE2 7HU
United Kingdom

Tel: (+44) (0) 1733 232495

Fax: (+44) (0) 1733 235255

e-mail: post@procal.com

Web site: www.procal.com

Declare that the product: **Type PULSI 200 Analyser** installed at

Customer	Aberthaw
Control Unit Serial Number	8800539
P200 Serial Number	8500916M
Site Identification	Unit 8 Primary

To which this declaration relates is in conformance with the MCERTs Performance Standard for Continuous Emission Monitoring Systems: Version 2. Revision 1 (April 2003).

MCERTS Product Conformance Certificates:

Licence	Certificate Number	Variation	Dated
ACU	SIRA MC 990006/	8	02/10/09
ACWn	SIRA MC 050060/	6	02/10/09

MCERTs Certification Body:

Sira Certification Service	
12 Acorn Industrial Park	Tel: (+44) (0) 1322 520500
Crayford Road	
Crayford	Fax: (+44) (0) 1322 520501
Dartford	
Kent	
DA1 4AL	e-mail: info@siraenvironmental.com
United Kingdom	Web site: www.siracertification.com

Quality System:

ISO 9001:2008	Certificate Nr: 062043	Dated: 11/06/09
EN 15267-2	Dated: 2009	
EN 15267-3	Dated: 2007	

Technical Standards Used:

All tests carried out to Kittiwake Procal's working procedures and those within Annex A of EN14181, Version 2.3 June 2010, relating to functionality testing by CEMs' manufacturers.

Signed:.....

18/2/2015

Date:.....

Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, United Kingdom

Tel: +44 (0) 1733 232495 E-mail: procal@parker.com Web: www.procal.com

F:/Drawings & Forms/Forms & procedures/Forms/Current/7-7880-01 Functionality Test Results inc App1
Change Note: 7008144 Date: 24/09/10

Page 1 of 6



1.0 Alignment and Cleanliness.

1.1 Internal Check of Analyser

Analyser under test	Status	Notes
Optical path clear	✓	
Optics clean	✓	Process Mirror replaced
Internal wiring ok	✓	
Air supply on	✓	
Purge flow >300 ltrs/hr	✓	Ok
Pressure differential <80mBar	✓	21

2.0 Zero and Span Checks.

2.1 Zero Check

Component: Units:	H2O %	CO2 mau	CO PPM	NO PPM	SO2-H PPM	SO2-L PPM	Ta	Ts	Ps
Process conc	2	181	1130	373	78	69	25.3	129	1019
Zero conc	0	0	1	-1	-1	-1	25.3	129	1040
% error	<2	<2	<2	<2	<2	<2			
Pass/Fail	Pass	Pass	Pass	Pass	Pass	Pass			
T90 recovery									

2.2 Span Check

Component: Units:	H2O %	CO2 mau	CO PPM	NO PPM	SO2-H PPM	SO2-L PPM	Ta	Ts	Ps
Full range	10		500	1000	1000	250			
Zero Conc	0	0	1	-1	-1	-1	25.3	129	1040
Test Gas Conc			333	667	800	200			
Cert number			Site Gas	Site Gas	040005 501912	040005 503378			
Response Conc			336	670	861	214	25.1	129	1038
% Error			<2	<2	>2	>2			
Pass/Fail			Pass	Pass	Fail	Fail			
T90 time Seconds				75	70	60			

2.3 Filter Level Checks

All on zero air	F6	F2	F7	F5G	F3	F1G	F4	F8
Factory	2822	4446	4654	2684	3487	2294	536	3053
Last visit	2079	2868	3153	1851	2534	1829	408	2215
This visit	2342	3188	3529	2072	2847	2067	468	2545



2.4 Interference Checks

Component:	H2O	CO2	CO	NO	SO2-H	SO2-L
Units:	%	mau	PPM	PPM	PPM	PPM
ZERO	0	0	-4	4	0	0
CO2 15%	-0.2	181.7	-8	16	1	1
H2O 2.5 %	1.9	1	-2	-17	9	0
H2O 2.5% & CO2 15%	1.9	181	-4	14	12	3

3.0 Data Acquisition.

Displayed \ Component	H2O %	CO PPM	NO PPM	SO2-H PPM	SO2-L PPM
Zero	Analyser	0	1	-1	-1
	DCS				
	4-20mA				
Span	Analyser	1.9	336	670	861
	DCS				
	4-20mA				

4.0 Linear coefficient record.

Coefficient \ Component		H2O	CO2	CO	NO	SO2-H	SO2-L
Last test	Linear	2.200e-2	1	1.007e+1	1.318e+1	5.921e+0	6.004e+0
	Squared	5.980e-5	0	9.970e-2	3.767e-2	-1.811e-3	-3.100e-3
	Cubed						
This test	Linear	2.200e-2	1	9.817e0	1.390e1	6.020e0	6.054e0
	Squared	5.980e-5	0	9.721e-2	3.741e-2	-7.302e-4	-7.348e-4
	Cubed						

5.0 Test Information

5.1 Procal Engineer: Michael Findley

5.2 Test House:

5.3 Test House Engineer:



Appendix 1. Pro-forma for assessing and reporting the results of the functional tests

Requirement	Notes	
1. Alignment and Cleanliness		
A visual inspection, with reference to the CEMs manuals, shall be carried out on the following when applicable:		
• Internal check of the CEM	√	All Functions ok
• Cleanliness of the optical components	√	Process Mirror replaced
• Flushing air supply	√	Ok
• Obstructions in the optical path	√	None
• After re-assembly at the measurement location at least the following shall be checked	√	No re-assembly required
• Alignment of the measuring system	√	
• Contamination control (internal check of optical surfaces)	√	Ok
2. Sampling Systems		
A visual inspection of the sampling system shall be performed, noting the condition of the following components, when fitted:		
• Sampling probe	n/a	
• Gas conditioning systems	n/a	
• Pumps	n/a	
• All connections	√	Ok
• Sample lines	n/a	
• Power supplies	√	Ok
• Filters	√	Ok
• NOx converters - if the sampling system contains a NOx converter, then the test laboratory shall record when the last efficiency-test was performed, and the result of this test.	n/a	
• The sampling system shall be in good condition and free of any visible faults, which may decrease the quality of data	√	Ok
3. Leak testing		
• Leak testing shall be performed according to the CEMs manuals. The tests shall cover the entire sampling system.	n/a	
4. Zero and Span check		
• Reference zero and span materials shall be used to verify the corresponding readings of the CEM.	√	Ok
• In case of non-extractive CEM, zero and span checks shall be performed using a reference-path free of flue gas before and after readjustment and after re-assembly of the CEM at the measurement location.	√	Ok
5. Linearity		
• During the calibration/linearity tests the applied concentrations should be logged onto the DCS to prove the complete system i.e. concentration applied to the instrument is represented by the instrument output and identical to the value logged on the DCS.	√	Data collected on ACU and customer DCS during testing



Requirement		Notes
DCS logged values should be included in the instrument service report.	√	Data collected on ACU and customer DCS during testing
<ul style="list-style-type: none"> The linearity of the CEM's response shall be checked using five different reference materials, including a zero concentration. 	√	See linearity Cert
<ul style="list-style-type: none"> The reference material with zero concentration, as well as the reference materials with four different concentrations, shall have a verifiable quantity and quality. 	√	Recorded on Test Sheet
<ul style="list-style-type: none"> In case of gaseous reference materials, these four reference materials can be obtained from different gas cylinders or can be prepared by means of a calibrated dilution system from one single gas concentration. 	√	Gas points derived from blending full gas range using a Procal P900, a water generator/gas blender
<ul style="list-style-type: none"> The reference material concentrations shall be selected such that the measured values are at approximately 20 %, 40 %, 60 % and 80 % of the range of two times the emission limit. It is necessary to know the values of the ratios of their concentrations precisely enough so that an incorrect failure of the linearity test does not occur. The dry test reference material shall be applied to the inlet of the CEM. 	√	See linearity Cert
The individual CEMs are tested using the following concentrations applied in a randomized sequence:		
<ul style="list-style-type: none"> Reference material with zero concentration; 	√	See linearity Cert
Reference material concentration approximately 20 % of 2 times the emission limit;	√	See linearity Cert
<ul style="list-style-type: none"> Reference material concentration approximately 40 % of 2 times the emission limit; 	√	See linearity Cert
<ul style="list-style-type: none"> Reference material concentration approximately 60 % of 2 times the emission limit; 	√	See linearity Cert
<ul style="list-style-type: none"> Reference material concentration approximately 80 % of 2 times the emission limit; 	√	See linearity Cert
<ul style="list-style-type: none"> Reference material with zero concentration; 	√	See linearity Cert
<p>After each change in concentration, the first instrument reading shall ordinarily be taken after a time period equal to at least three times the response time of the CEM. At each reference material concentration, at least three readings shall be made, six readings shall be taken at zero. The time period between the start of each of the three readings shall be separated by at least four times the response time.</p> <p>The test-laboratory may apply a risk-based approach to linearity testing in order to reduce the time for the tests. For example, the readings may be taken after less than 3x the response time; however, if the CEM fails the linearity test, then the test laboratory shall repeat the linearity test and wait at least 3x the response time as stated above. Alternatively, the number of repetitions of the test may be reduced if the CEM passes the required performance criteria by a factor of at least 2 (i.e. half the allowable residual). Increasing the waiting time to 5x the response time, for example, may be a means of meeting this requirement. Where no other method is possible, the linearity can also be performed with the aid of reference materials such as grating filters or gas filters.</p>		



Requirement	Notes
The linearity shall be calculated and tested using the procedure as given in EN 14181 annex B. If the CEM does not pass this test; then the problem shall be identified and rectified.	
6. Interferences	
<ul style="list-style-type: none"> A test shall be undertaken if the process gases to be monitored contain components that are known interferences, as identified during QAL1 and there is a failure of the QAL2 or AST which could be due to interferences. 	<ul style="list-style-type: none"> √ Interference checks made with water vapour, CO2 and each gas species. See Calcert
7. Zero and Span drift (Audit)	
<ul style="list-style-type: none"> The test laboratory shall assess whether the operator has a QAL3 procedure in place, and whether the operator has applied this procedure. The evidence would comprise (i) a documented procedure, (ii) zero and span data, (iii) control charts. 	<ul style="list-style-type: none"> √ Customer has procedure in place and documented evidence
Response Time	
<ul style="list-style-type: none"> The response time of the CEM shall be checked. This can be performed, if appropriate, by feeding of the reference material at the end of the sampling probe. The response time shall not exceed the performance requirement applied during the QAL1 tests. 	<ul style="list-style-type: none"> √ Response time recorded on test sheet and this report
9. Service Report	
As a minimum requirement the service report should include the following:	
<ul style="list-style-type: none"> Document reference for work instruction for the type of work being undertaken 	<ul style="list-style-type: none"> √ Parker Procal Method Statement
<ul style="list-style-type: none"> Instrument manufacturer 	<ul style="list-style-type: none"> √ Parker Procal (UK)
<ul style="list-style-type: none"> Instrument type 	<ul style="list-style-type: none"> √ Pulsi 2000
<ul style="list-style-type: none"> Instrument model 	<ul style="list-style-type: none"> √ P2000
<ul style="list-style-type: none"> Instrument Serial No 	<ul style="list-style-type: none"> √ 8500916M
<ul style="list-style-type: none"> Operating principle 	<ul style="list-style-type: none"> √ GFCIR/NIR
<ul style="list-style-type: none"> Operating range 	<ul style="list-style-type: none"> √ Recorded on this report
<ul style="list-style-type: none"> Certification details 	<ul style="list-style-type: none"> √ mcerted
<ul style="list-style-type: none"> Compliance with MCERTS (including certificate no.) 	<ul style="list-style-type: none"> √ SIRA MC 990006/08
<ul style="list-style-type: none"> Location 	<ul style="list-style-type: none"> √ Aberthaw Power Station, Wales
<ul style="list-style-type: none"> Date and time work was undertaken 	<ul style="list-style-type: none"> √ 18/02/2015
<ul style="list-style-type: none"> Equipment used - type, serial no's, calibration dates 	<ul style="list-style-type: none"> √ Procal Water Generator/Gas divider Pcal #2
<ul style="list-style-type: none"> Gases used - certificate numbers, expiry dates, binary / mix 	<ul style="list-style-type: none"> √ Copy of Gas certs can be provided
<ul style="list-style-type: none"> NOx converter efficiency test, if applicable 	<ul style="list-style-type: none"> n/a
<ul style="list-style-type: none"> Calibration and linearity data as required by EN14181 	<ul style="list-style-type: none"> √ See Linearity & Calcert data
<ul style="list-style-type: none"> Logged data for period of calibration and linearity. Note there may be gaps in the data, in such cases, the test laboratory shall state why there are gaps in the data 	<ul style="list-style-type: none"> √ See Linearity & Calcert data



Visit Ref:0000601

Service Engineers Report

Client Aberthaw Power Station RWE INNOGY PLC THE LEYS (NEAR BARRY) SOUTH GLAMORGAN Contact James Beveridge Tel No. 01446 750271	Job Category Contract Activity Functionality inc. Linearisation Date of Visit 16/03/2015 Analyser/System No. U8 Secondary U7 Primary U8 Primary U9 Primary
---	--

Qty	Description	Part No.

Travel Time	10hrs	Mileage driven	510
Site Time	4 Days	Expenses incurred	£455.55
Engineer	Michael Findley	For Client	

Notes for Call

Unit 7 Primary 8500443M

Dry gas test carried out on functionality test, NO, CO, within spec. SO2-H & SO2-L out of spec but no adjustment made.
Linearization tests completed on NO, SO2-H & SO2-L channels. SO2-H & SO2-L greater than 2% but reading on the high scale for SO2-H and the low scale for SO2-L. No adjustments made to SO2-H or SO2-L channel. NO channel within spec.

Unit 8 Primary 8500916M

Dry gas test carried out on functionality test, NO, CO, within spec. SO2-H & SO2-L out of spec but no adjustment made.
Linearization tests completed on NO, SO2-H & SO2-L channels. SO2-H & SO2-L greater than 2% but reading on the high scale for SO2-H & SO2-L channel. No adjustments made to SO2-H or SO2-L channel. NO channel within spec.

Unit 9 Primary 8500442M

Dry gas test carried out on functionality test, CO & SO2-L, within spec. NO & SO2-L slightly out of spec but no adjustment made.
Linearization tests completed on NO, SO2-H & SO2-L channels. SO2-L within spec and SO2-H & NO channels greater than 2% no adjustments made to SO2-H or NO channel.

Kittiwake Procal Limited - 5 Maxwell Road, Woodston, Peterborough, PE2 7HU
Telephone: +44 01733 232495 Fax: +44 01733 235255 Web: www.procal.com

SICK (UK)LTD Waldkirch House, 39 Hedley Rd St Albans, Herts, AL1 5BN	<h1 style="color: blue; margin: 0;">SICK</h1>	Tel : 0044 (0)1727 831121 Fax : 0044 (0)1727 855332 E – Mail : info@sick.co.uk	
<h2 style="margin: 0;">Maintenance Report OMD41</h2>			
<input checked="" type="checkbox"/> Maintenance <input type="checkbox"/> Repair			
Customer:	RWE nPower	Customer no:	FGD U8 Spare
Country:	UK	Location:	Aberthaw, Barry
Receiver:	M221	Serial no.:	09148014
Reflector:	R22	Serial no.:	09148014
Eval.Unit:	A3	Serial no.:	98078000
Plant operating status: Instrument in workshop			

done Remarks:

Check weekly/monthly/ quarterly log files: Log files ok?	<input checked="" type="checkbox"/>	NA
Training recommended:	<input checked="" type="checkbox"/>	Training provided

Dust reading before check

Opacity or Extinction		Extinction
Dust in mg / m ³	mg/m ³	0.0 mg/m3
Contamination	mA	0.0%
Dust reading, measured values	mA	4.0
Control cycle, Zero point values	mA	4.00
Control cycle, Span value	mA	16.80

1. Visual Inspection

1.1 Check if measured values are plausible in the control room	<input checked="" type="checkbox"/>	Yes
1.2 Check if control cycle is (zero/span) valid (control room or recorder or evaluation unit)	<input checked="" type="checkbox"/>	QAL3 charts consistent
1.3 Check if there is any error message	<input checked="" type="checkbox"/>	No errors or warnings
1.4 Check for mechanical or electrical connection damage	<input checked="" type="checkbox"/>	No mechanical damage
1.5 Check mechanical mounting	<input checked="" type="checkbox"/>	All sound

2. Purge Air Unit

2.1 Check the hoses and ring nozzles	<input checked="" type="checkbox"/>	All sound
2.2 Clean the pre-filter	<input checked="" type="checkbox"/>	NA
2.3 Replace the filter insert, part no. 5306091 for OMD41 SN > 97xxxxxx, or part no.6700149 for OMD41 SN <96xxxxxx	<input checked="" type="checkbox"/>	Purge air maintained internal
2.4 Check function of filter monitor purge switch.	<input checked="" type="checkbox"/>	Not fitted

3. Fail Safe Shutter (FSS Optional)

3.1 <input type="checkbox"/> Check function of fail-safe shutter	<input checked="" type="checkbox"/>	Not fitted on stack
--	-------------------------------------	---------------------

4. Optical unit

4.1 Clean housing	<input checked="" type="checkbox"/>	Housing cleaned
4.2 Check and, if necessary readjust optical axis	<input checked="" type="checkbox"/>	Not required
4.3 Clean optical boundary surfaces for sender/receiver and reflector, 2 x part no. 4003353	<input checked="" type="checkbox"/>	Both optical surfaces cleaned
4.4 Check and replace desiccant cartridge, part no. 2008475	<input checked="" type="checkbox"/>	Blue - OK

31.03.15

Maintenance check list OMD 41

1 / 2

4.5.	Check the transmitter diode	<input checked="" type="checkbox"/>	Course = 127 Good
4.6	Check the stepper motor	<input checked="" type="checkbox"/>	All motors functioning correct
4.7	Check zero point, re-calibrate at smoke-free measurement point if it deviates	<input checked="" type="checkbox"/>	Not required
4.8	Check function of control cycle	<input checked="" type="checkbox"/>	Good
4.9	Linearity check	<input checked="" type="checkbox"/>	See below

Linearity Measurement	Set value	Actual Value	Deviation in %	< 2% OK?
Zero	4.00 mA	4.00 mA	0.0	OK
Span 2 (aprox. 30%)	10.24 mA	10.24 mA	0.0	OK
Span 1 (aprox. 70%)	16.8 mA	16.8 mA	0.0	OK
Span 3 (100%)	20.00 mA	20.00 mA	0.0	OK

5. Connection unit

Check the analogue and digital input and output signals	<input checked="" type="checkbox"/>	Analogue outputs +/- 0.1 mA
---	-------------------------------------	-----------------------------

6. Final check

6.1	Check function of complete measurement system	<input checked="" type="checkbox"/>	System functioning Well
6.2	Check the availability of the system	<input checked="" type="checkbox"/>	100%
6.3	Write device data into the report file	<input checked="" type="checkbox"/>	Device data saved
6.4	Complete Service Report and Measurement Log-file	<input checked="" type="checkbox"/>	Report complete

7. Report in writing to the plant manager as follows:

Quality of maintenance work by plant personnel: Good
Cleanliness of measuring station and devices: OK
Maintenance work done(in addition to Annex 1): NA
Problems found, solution applied: No problems
Recommendation for repair, changes: NA
Availability of the unit: 100 %
Proposal how to reach higher availability and better emission data quality: NA
Training provided to plant personnel, proposal for settlement: Training already provided
Training requirements detected: NA
Others:

Dust reading after check

Opacity or Extinction	Extinction
Dust in mg / m ³	mg/m ³ 0.0 mg/m3
Contamination	mA 0.000%
Dust reading, measured values	mA 0.0 mg/m3
Control cycle, Zero point values	mA 4.00
Control cycle, Span value	mA 16.80

Remarks :

System functioning perfectly	
Date : 25.02.2015	Plant person: _____ Technician: Rhodri Jones


SICK (UK) LTD
Waldkirch House,
39 Hedley Rd
St Albans,
Herts,
AL1 5BN

SICK

Tel : 0044 (0)1727 831121
Fax : 0044 (0)1727 855332
E – Mail : info@sick.co.uk

U8 - OMD 41 Particulate Monitor

BS EN 14181 – Functional Test &
Maintenance Report

Customer	RWE nPower
Site	Aberthaw
Contact	James Beveridge
Service Ref No.	SVON017322
Survey Dates	13.02.2015
Device Type	OMD41
Receiver S/N	9807 8002
Reflector S/N	9807 8002
Evaluation Unit S/N	9807 8000
Device Location	Unit 8
MCERTS Cert No	MC 040042/01
Certification Details	See Certificate
Measurement Principle	Opacity
SICK Engineer	Rhodri Jones
Signature	

Dust reading before check			
Opacity or Extinction		Extinction	
Dust in mg / m ³	mg/m ³	0.0	
Contamination	mA	0.000%	
Dust reading, measured values	mA	4.0	
Control cycle, Zero point values	mA	4.0	
Control cycle, Span value	mA	16.8	

1. Alignment & Cleanliness			
1.1 Visual Inspection of the analyser	<input checked="" type="checkbox"/>	Analyser dusty but OK	
1.2 Internal check of the analyser	<input checked="" type="checkbox"/>	Internal optics cleaned	
1.3 Cleanliness of optical components	<input checked="" type="checkbox"/>	Cleaned using optic cloth	
1.4 Flushing of air supply	<input checked="" type="checkbox"/>	Purge air OK	
1.5 Obstructions in the optical path	<input checked="" type="checkbox"/>	Cross duct - no obstructions	

2. Sampling System			
2.1 System in good condition and free from faults	<input checked="" type="checkbox"/>	No faults or warnings	
2.2 Visual Inspection of sampling probe	<input checked="" type="checkbox"/>	N/A	
2.3 Check of the Gas Conditioning System	<input checked="" type="checkbox"/>	N/A	
2.4 Check of the sample pump	<input checked="" type="checkbox"/>	N/A	
2.5 Check of all hoses, gas lines and connections	<input checked="" type="checkbox"/>	NA	
2.6 Check of power supplies	<input checked="" type="checkbox"/>	Power supplies OK	
2.7 Check of all filters	<input checked="" type="checkbox"/>	Purge air filter OK	
2.8 Check of heated lines are operating correctly	<input checked="" type="checkbox"/>	N/A	
2.9 Efficiency of NOx converter > 95% (if applicable)	<input checked="" type="checkbox"/>	N/A	
2.10 Has the response time been checked by applying gas to probe	<input checked="" type="checkbox"/>	N/A	

3. Serviceability			
3.1 Safe & Clean working environment for servicing	<input checked="" type="checkbox"/>	Workshop available	
3.2 Adequate supply of reference gases	<input checked="" type="checkbox"/>	NA	
3.3 Adequate supply of spare parts	<input checked="" type="checkbox"/>	Whole spare analysers available	
3.4 Ability to apply gas at probe	<input checked="" type="checkbox"/>	NA	
3.5 Output signals checked	<input checked="" type="checkbox"/>	Analogue outputs spot on	

4. Zero Span & Leak Checks		
4.1 Leak check of whole system carried out	<input checked="" type="checkbox"/>	N/A
4.2 Are the QAL3 checks (control cycle) being done	<input checked="" type="checkbox"/>	Yes - 3 x Daily
4.3 Are the QAL3 checks being logged and plotted on control charts	<input checked="" type="checkbox"/>	Yes - OK
4.4 Are the QAL3 charts exhibiting signs of drift	<input checked="" type="checkbox"/>	No - OK

5. Linearity		
5.1 Checks at 0, 20%, 40%, 60% & 80% of 2 X Daily ELV's	<input checked="" type="checkbox"/>	N/A – % of Analyser Range
5.2 Different concentrations applied in a random sequence	<input checked="" type="checkbox"/>	Refer to linearity report
5.3 Has the response time for each component been recorded (T90)	<input checked="" type="checkbox"/>	Refer to linearity report
5.4 Have the first readings been taken at 3 x T90	<input checked="" type="checkbox"/>	Refer to linearity report
5.5 Have three readings been taken at least 4 x T90 apart	<input checked="" type="checkbox"/>	Refer to linearity report
5.6 Does the filter set have a valid calibration	<input checked="" type="checkbox"/>	Refer to linearity report

6. Visual Inspection		
6.1 Check if measured values are plausible in the control room	<input checked="" type="checkbox"/>	Yes
6.2 Check if control cycle (zero/span) is valid	<input checked="" type="checkbox"/>	Recorded & stored
6.3 Check if there is any error message	<input checked="" type="checkbox"/>	No errors
6.4 Check for mechanical or electrical connection damage	<input checked="" type="checkbox"/>	No damage
6.5 Check mechanical mounting	<input checked="" type="checkbox"/>	Sound

7. Purge Air Unit		
7.1 Check the hoses and ring nozzles	<input checked="" type="checkbox"/>	All OK
7.2 Clean the pre-filter	<input checked="" type="checkbox"/>	Replaced
7.3 Replace the filter insert	<input checked="" type="checkbox"/>	Replaced
7.4 Check function of filter monitor purge switch.	<input checked="" type="checkbox"/>	OK

8. Fail Safe Shutter (FSS Option)		
8.1 Check function of fail-safe shutter	<input checked="" type="checkbox"/>	Not fitted on stack

9. Optical unit		
9.1	Clean housing	<input checked="" type="checkbox"/> Housing cleaned
9.2	Check and, if necessary readjust optical axis	<input checked="" type="checkbox"/> Not required
9.3	Clean optical boundary surfaces for sender & receiver	<input checked="" type="checkbox"/> Optical surfaces cleaned
9.4	Check and replace desiccant cartridge, part no. 2008475	<input checked="" type="checkbox"/> Not required
9.5	Check the transmitter diode	<input checked="" type="checkbox"/> OK
9.6	Check the stepper motor	<input checked="" type="checkbox"/> Stepper motor functioning well
9.7	Check zero point. Re-calibrate zero point if required	<input checked="" type="checkbox"/> Reading Zero in workshop
9.8	Check function of control cycle	<input checked="" type="checkbox"/> Good
9.9	Carry out internal linearity check, record results below	<input checked="" type="checkbox"/> See below

Linearity Measurement	Set value	Actual Value	Deviation in %	< 2% OK?
Zero	4.00 mA	4.00 mA	0.0	OK
Span 2 (approx. 30%)	14.06 mA	14.06 mA	0.0	OK
Span 1 (approx. 70%)	16.80 mA	16.80 mA	0.0	OK
Span 3 (100%)	20.00 mA	20.00 mA	0.0	OK

10. Connection unit		
10.1	Check the analogue and digital input and output signals	<input checked="" type="checkbox"/> Reading 4.0 @ 3.99mA

11. Final check		
11.1	Check function of complete measurement system	<input checked="" type="checkbox"/> System functioning well
11.2	Check the availability of the system	<input checked="" type="checkbox"/> 100%
11.3	Write device data into the report file	<input checked="" type="checkbox"/> Device data saved
11.4	Complete Service Report and Measurement Log-file	<input checked="" type="checkbox"/> Report complete


12. Additional details:	
Quality of maintenance work by plant personnel: Good	
Cleanliness of measuring station and devices: OK	
Maintenance work done (in addition to Annex 1): NA	
Problems found, solution applied: No problems	
Recommendation for repair, changes: NA	
Availability of the unit: 100 %	
Proposal how to reach higher availability and better emission data quality: NA	
Training provided to plant personnel, proposal for settlement: Training recently provided	
Training requirements detected: NA	
Others:NA	

Dust reading after check			
Opacity or Extinction		Extinction	
Dust in mg / m ³	mg/m ³	0.0	
Contamination	mA	0.00%	
Dust reading, measured values	mA	0.0mg/m3	
Control cycle, Zero point values	mA	4.0	
Control cycle, Span value	mA	16.8	

Remarks
Analyser functioning correctly
Approved by customer Name:
Position:



Unit 8 GM32 - Linearity Report

Customer	RWE Npower
Site	Aberthaw Power Station
Permit Ref	A1234
Contact	James Beveridge
Service Ref No.	SVON017322
Survey Date	16.02.2015
Device Type	GM32
Device Location	Unit 8
Serial Number	1149 8001
MCERTS Cert No	MC100163/01
Certification Details	See Certificate (attached)
Measurement Principle	UV DOAS
Gas Box Serial Number	0816 8035
SICK Engineer	Rhodri Jones
Signature	

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GM32 SO₂ Linearity

Customer	RWE Npower
Site	Aberthaw Power Station
Product	GM32
Analysers Serial Number	1149 8001
MCERTS Certificate Number	MC100163/01
Location	Unit 8
Active Path Length (mm)	500

Site Permit Ref	A1234
SVON No	SVON017322
Order Number	AXC1235784133
QAL2/AST/Routine	QAL2
Date	16.02.2015
Engineer	Rhodri Jones

Gas Box Serial Number	0816 8035
Calibration Date	01.12.2014
Calibration Gas Cylinder Ref:	VC3713C
Test Gas Conc. (ppm)	3752
Test Gas Conc. (mg.m ⁻³)	10693
Gas Expiry Date	15.01.2018
Tolerance	2%

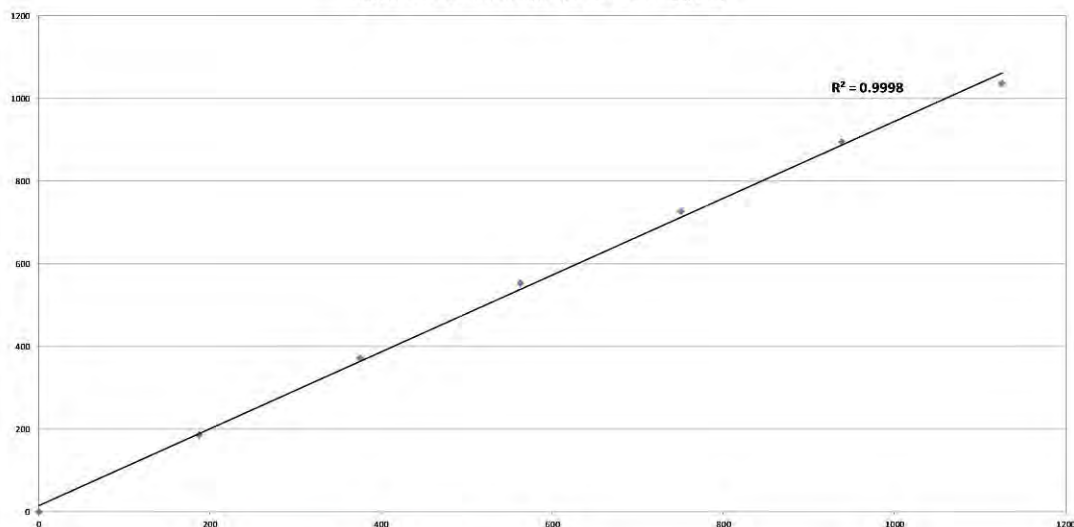
Response Time (T ₉₀) Seconds	30
Permit Daily ELV for SO ₂ (mg.m ⁻³)	440
Permit Daily ELV x 2 (mg.m ⁻³) (e ₂)	880
Analysers Range	1200
Ambient Pressure (hPa)	1022
Results Visible on DCS?	Yes, when not in maintenance mode
Corrections Applied?	None - As measured (ppm)

Component 1		Linearity Results								
SO ₂		% 2 x ELV	Test Cell Length (mm)	Expected (ppm)	Reading 1 (ppm)	Reading 2 (ppm)	Reading 3 (ppm)	Average Reading (ppm)	DCS (ppm)	Time
Set Pt Time (4xT ₉₀) sec	120	244%	100	750.40	720.00	728.00	735.00	727.00		13:47 - 13:55
Log Time (3xT ₉₀) sec	90	183%	75	562.80	560.00	552.00	546.00	552.67		13:36 - 13:44
Gasbox Temperature (°C)	90	305%	125	938.00	895.00	892.00	901.00	896.00		13:26 - 13:35
Reference Temperature (K)	273	81%	25	187.60	187.00	185.00	185.00	185.67		13:57 - 14:05
ppm to mg.m ⁻³ for SO ₂	2.86	122%	50	375.20	381.00	374.00	359.00	371.33		14:07 - 14:15
		368%	150	1125.60	1030.00	1038.00	1043.00	1037.00		13:13 - 13:23

Zero Results			
ZERO	Analysers Reading (ppm)	DCS (ppm)	Time
Zero Reading 1	0.00		10:58
Zero Reading 2	0.00		11:02
Zero Reading 3	1.00		14:56
Zero Reading 4	0.00		15:00
Zero Reading 5	1.00		15:15
Zero Reading 6	0.00		15:28
AVERAGE	0.33		

Test Cell Length (mm)	Actual Value (ppm)	% Range	% 2 x ELV	Average CEM Reading (ppm)	d _{C,rel}	d _{C,rel} <5% (EN 14181)
NA	0.00	0.0%	0%	0.33	-1.14%	PASS
25mm	187.60	15.6%	21%	185.67	-0.03%	PASS
50mm	375.20	31.3%	43%	371.33	1.11%	PASS
75mm	562.80	46.9%	84%	552.67	1.76%	PASS
100mm	750.40	62.5%	85%	727.00	1.62%	PASS
125mm	938.00	78.2%	107%	896.00	0.87%	PASS
150mm	1125.60	93.8%	128%	1037.00	-3.06%	PASS

Applied Concentration (ppm) v CEM Reading (ppm)



Engineer	Rhodri Jones
Signature	
Comments	

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GM32 NO Linearity

Customer	RWE Npower
Site	Aberthaw Power Station
Product	GM32
Analysers Serial Number	1149 8001
MICERTS Certificate Number	MC10016301
Location	Unit 8
Active Path Length (mm)	500

Site Permit Ref	A1234
SVON No	SVON017322
Order Number	AXC123784133
QAL2/AST/Routine	QAL2
Date	16.02.2015
Engineer	Rhodri Jones

Gas Box Serial Number	0816 8035
Calibration Date	01.12.2014
Calibration Gas Cylinder Ref:	VCSMG3285
Test Gas Conc. (ppm)	6817
Test Gas Conc. (mg.m ⁻³)	9135
Gas Expiry Date	30.01.2018
Tolerance	2%

Response Time (T ₉₀) Seconds	30
Permit Daily ELV for NO (mg.m ⁻³)	1210
Permit Daily ELV x 2 (mg.m ⁻³) (C _{ELV})	2420
Analysers Range	1200
Ambient Pressure (hPa)	1022
Results Visible on DCS?	Yes, when not in maintenance mode
Corrections Applied?	None - As measured (ppm)

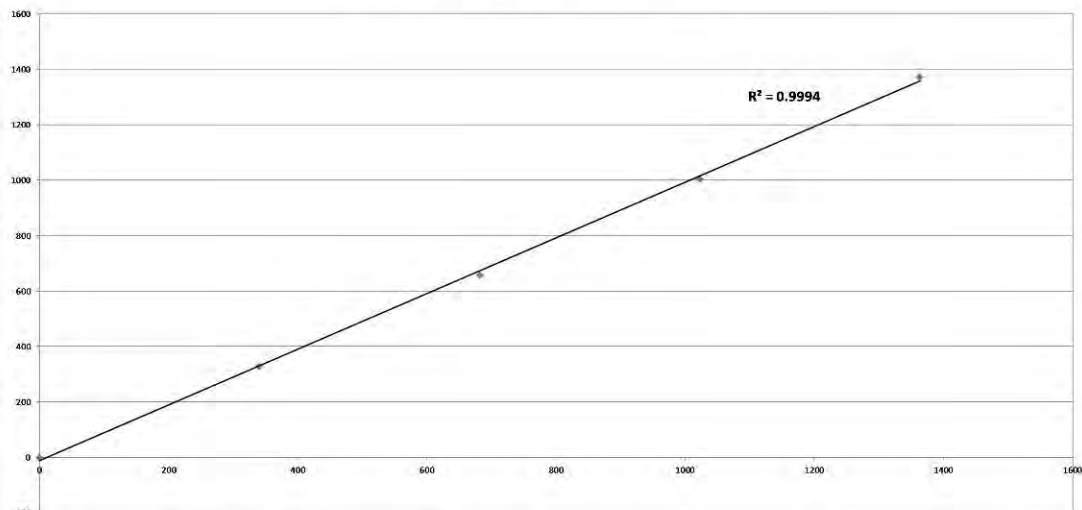
Component 1	NO
Set Pt Time (4xT ₉₀) sec	120
Log Time (3xT ₉₀) sec	90
Gas box Temperature (°C)	50
Reference Temperature (K)	273
ppm to mg.m ⁻³ for NO	1.34

Linearity Results								
% 2 x ELV	Test Cell Length (mm)	Expected (ppm)	Reading 1 (ppm)	Reading 2 (ppm)	Reading 3 (ppm)	Average Reading (ppm)	DCS	Time
75%	100	1363.40	1374.00	1372.00	1372.00	1372.67		
57%	75	1022.55	1003.00	1002.00	1005.00	1003.33		
19%	25	340.85	330.00	326.00	328.00	328.00		
38%	50	681.70	659.00	655.00	658.00	657.33		

Zero Results			
ZERO	Analysers Reading (ppm)	DCS (ppm)	Time
Zero Reading 1	0.16		
Zero Reading 2	0.01		
Zero Reading 3	0.00		
Zero Reading 4	0.05		
Zero Reading 5	0.06		
Zero Reading 6	0.00		
AVERAGE	0.05		

Test Cell Length (mm)	Actual Value (ppm)	% Range	% 2 x ELV	Average CEM Reading (ppm)	d _{c,rel}	d _{c,rel} <5% (EN 14181)
NA	0.00	0.0%	0%	0.05	0.31%	PASS
25mm	340.85	28.4%	14%	328.00	-0.21%	PASS
50mm	681.70	56.8%	28%	657.33	-0.68%	PASS
75mm	1022.55	85.2%	42%	1003.33	-0.45%	PASS
100mm	1363.40	113.6%	56%	1372.67	0.73%	PASS

Applied Concentration (ppm) v CEM Reading (ppm)



Engineer	Rhodri Jones
Signature	
Comments	

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GM32 NO₂ Linearity

Customer	RWE Npower
Site	Aberthaw Power Station
Product	GM32
Analyser Serial Number	1149 8001
MCERTS Certificate Number	MC100163/01
Location	Unit 8
Active Path Length (mm)	500

Site Permit Ref	A1234
SVON No	SVON017322
Order Number	AXC1235784133
QAL2/AST/Routine	AST
Date	16.02.2015
Engineer	Rhodri Jones

Gas Box Serial Number	0816 8035
Calibration Date	01.12.2014
Calibration Gas Cylinder Ref:	EPRX11644352
Test Gas Conc. (ppm)	986
Test Gas Conc. (mg.m ⁻³)	2021
Gas Expiry Date	25/05/2016
Tolerance	2%

Response Time (T ₉₀) Seconds	30
Permit Daily ELV for NO ₂ (mg.m ⁻³)	121.0
Permit Daily ELV x 2 (mg.m ⁻³) (c _a)	242
Analyser Range	100
Ambient Pressure (hPa)	1022
Results Visible on DCS?	Yes, when not in maintenance mode
Corrections Applied?	None - As measured (ppm)

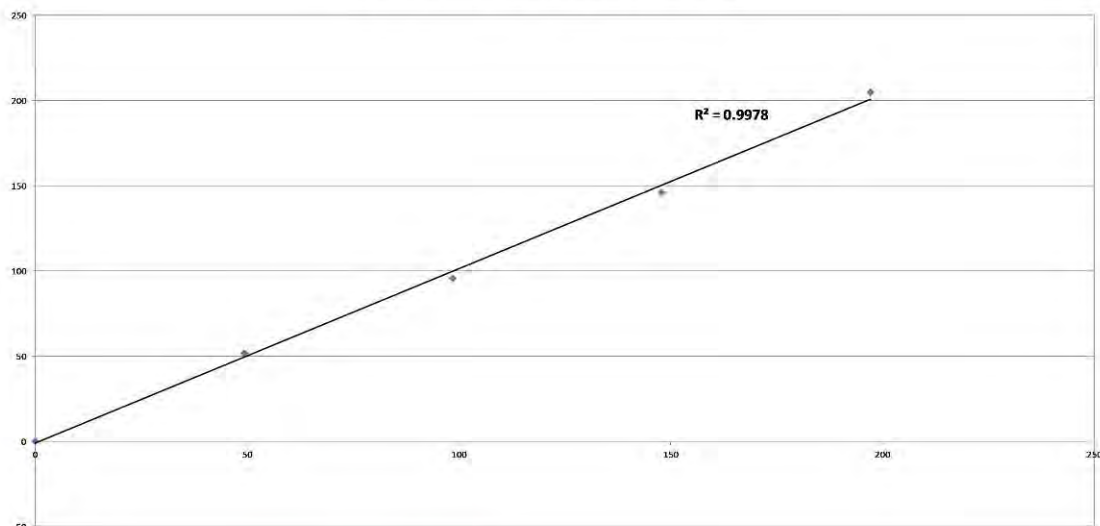
Component 1	NO ₂
Set Pt Time (4xT ₉₀) sec	120
Log Time (3xT ₉₀) sec	90
Gasbox Temperature (°C)	80
Reference Temperature (K)	273
ppm to mg.m ⁻³ for NO ₂	2.05

Linearity Results								
% 2 x ELV	Test Cell Length (mm)	Expected (ppm)	Reading 1 (ppm)	Reading 2 (ppm)	Reading 3 (ppm)	Average Reading (ppm)	DCS	Time
NA	100	197.20	199.80	206.60	209.10	205.17		15:02 - 15:06
NA	75	147.90	149.40	142.20	147.60	146.40		15:08 - 15:12
NA	25	49.30	54.60	48.70	51.90	51.73		15:21 - 15:26
NA	50	98.60	98.50	93.90	95.60	96.00		15:15 - 15:19

Zero Results			
ZERO	Analyser Reading (ppm)	DCS (ppm)	Time
Zero Reading 1	0.16		
Zero Reading 2	0.01		
Zero Reading 3	0.00		
Zero Reading 4	0.05		
Zero Reading 5	0.06		
Zero Reading 6	0.00		
AVERAGE	0.05		

Test Cell Length (mm)	Actual Value (ppm)	% Range	% 2 x ELV	Average CEM Reading (ppm)	d _{c,rel}	d _{c,rel} <5% (EN 14181)
NA	0.00	0.0%	NA	0.05	0.30%	PASS
25mm	49.30	49.3%	NA	51.73	-0.85%	PASS
50mm	98.60	98.6%	NA	96.00	-1.66%	PASS
75mm	147.90	147.9%	NA	146.40	-1.64%	PASS
100mm	197.20	197.2%	NA	205.17	1.84%	PASS

Applied Concentration (ppm) v CEM Reading (ppm)



Engineer Signature	Rhodri Jones
Comments	

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Unit 8 - GM32

BS EN 14181 – Functional Test & Maintenance Report

Customer	RWN nPower
Site	Aberthaw
Contact	James Beverage
Service Ref No.	SVON017322
Survey Dates	16 th February 2015
Device Type	GM32 Probe version
Serial Number	1149 8001
Device Location	Unit 8
MCERTS Cert No	MC100163/01
Certification Details	See Certificate
Measurement Principle	UV Spectroscopy
SICK Engineer	Rhodri Jones
Signature	

Actual installation data			Remarks
Location	Outside <input type="checkbox"/>	Under cover <input type="checkbox"/>	Inside <input checked="" type="checkbox"/>
Ambient temperature	8	°C	
Gas temperature	124	°C	
Length of the probe / Flange – Flange (CD)	1500	mm	
Active measurement distance	500	mm	
Zero path	N/A	mm	

Plant operating status:	Online
-------------------------	--------

Measurement values before check					
	Unit	Range	Reading	Zero point	Span point
SO ₂ Hi	ppm	0-1200	74	-0.0	839.8
NO	ppm	0-1000	386	0.1	700.2
NO ₂	ppm	0-100	9.8	0.3	69.9
SO ₂ Lo	ppm	0-250	73.8	-0.2	174.8
Temp.	°C	0-200	81	- X -	- X -
Press.	hPa	900-1200	1021	- X -	- X -

Lamp data		
Max. lamp intensity	18500	
Exposure:	280	ms
Lamp pulse:	100	mA

1. Alignment & Cleanliness		
1.1 Visual Inspection of the analyser	<input checked="" type="checkbox"/>	Analyser free from damage
1.2 Internal check of the analyser	<input checked="" type="checkbox"/>	All optics cleaned
1.3 Cleanliness of optical components	<input checked="" type="checkbox"/>	Checked & cleaned
1.4 Flushing of air supply	<input checked="" type="checkbox"/>	Air supply purged
1.5 Obstructions in the optical path	<input checked="" type="checkbox"/>	No obstructions
1.6 Check optical alignment of the Analyser	<input checked="" type="checkbox"/>	Checked & adjusted alignment.

2. Sampling System		
2.1	System in good condition and free from faults	<input checked="" type="checkbox"/> Yes
2.2	Visual Inspection of sampling probe	<input checked="" type="checkbox"/> Probe removed from stack - OK
2.3	Check of the Gas Conditioning System	<input checked="" type="checkbox"/> N/A
2.4	Check of the sample pump	<input checked="" type="checkbox"/> N/A
2.5	Check of all hoses, gas lines and connections	<input checked="" type="checkbox"/> Checked analyser & air hoses.
2.6	Check of power supplies	<input checked="" type="checkbox"/> Checked. OK
2.7	Check of all filters	<input checked="" type="checkbox"/> Replaced purge air filter
2.8	Check of heated lines are operating correctly	<input checked="" type="checkbox"/> N/A
2.9	Efficiency of NOx converter > 95% (if applicable)	<input checked="" type="checkbox"/> N/A
2.10	Has the response time been checked by applying gas to probe	<input checked="" type="checkbox"/> N/A

3. Serviceability		
3.1	Safe & Clean working environment for servicing	<input checked="" type="checkbox"/> Working environment is ok
3.2	Adequate supply of reference gases	<input checked="" type="checkbox"/> N/A
3.3	Adequate supply of spare parts	<input checked="" type="checkbox"/> Spare analyser available
3.4	Ability to apply gas at probe	<input checked="" type="checkbox"/> N/A
3.5	Output signals checked	<input checked="" type="checkbox"/> Analogue outputs checked

4. Zero Span & Leak Checks		
4.1	Leak check of whole system carried out	<input checked="" type="checkbox"/> N/A
4.2	Have span checks been carried out at suitable levels	<input checked="" type="checkbox"/> 70% of range
4.3	Have zero checks been carried out at suitable levels	<input checked="" type="checkbox"/> At Zero

5. Linearity		
5.1	Checks at 0, 20%, 40%, 60% & 80% of 2 X Daily ELV's	<input checked="" type="checkbox"/> Refer to linearity report
5.2	Different concentrations applied in a random sequence	<input checked="" type="checkbox"/> Refer to linearity report
5.3	Has the response time for each component been recorded (T90)	<input checked="" type="checkbox"/> Refer to linearity report
5.4	Have the first readings been taken at 3 x T90	<input checked="" type="checkbox"/> Refer to linearity report
5.5	Have three readings been taken at least 4 x T90 apart	<input checked="" type="checkbox"/> Refer to linearity report
5.6	Are the gases used traceable to ISO 17025 standards	<input checked="" type="checkbox"/> Refer to linearity report

6. Visual inspection		
6.1	Check measured values are plausible in control room	<input checked="" type="checkbox"/> Checked. All ok
6.2	Check if control cycle is (zero/span) valid	<input checked="" type="checkbox"/> Checked. Valid zero and span
6.3	Check if messages are active	<input checked="" type="checkbox"/> Checked
	Failure:	No
	Maintenance Req:	No
	Uncertain:	No
6.4	Check for mechanical damages	<input checked="" type="checkbox"/> No mechanical damage detected
6.5	Check attachments and connections	<input checked="" type="checkbox"/> Checked. All ok

7. Purge air unit (only GMP and Cross-Duct)		
7.3	Check the hoses and clamps for hose	<input checked="" type="checkbox"/> Checked hoses & clamps. All ok
7.4	Exchange purge air filter (order no 5306091)	<input checked="" type="checkbox"/> Replaced purge air filter
7.5	Clean pre-filter housing	<input checked="" type="checkbox"/> Checked and cleaned
7.6	Check noise of blower	<input checked="" type="checkbox"/> Checked. OK
7.7	Check function of purge air heating and setting (option)	<input checked="" type="checkbox"/> Checked. Operating correctly
7.8	Check function of differential pressure monitor (option)	<input checked="" type="checkbox"/> Checked. Operating correctly

8. Probe (GMP or GPP)		
8.3	Clean probe	<input checked="" type="checkbox"/> The probe has been cleaned
8.4	Check Probe for corrosion	<input checked="" type="checkbox"/> Checked. No sign of corrosion
8.5	Check probe for damage and functionality	<input checked="" type="checkbox"/> Checked. No damage detected.

9. Connection unit		
9.3	Clean housing	<input checked="" type="checkbox"/> Cleaned housing
9.4	Check power supply	<input checked="" type="checkbox"/> Checked Power supply
	26V±0,3V: 25.75	115V±1V: 114.0
9.5	Check analogue input / output (option)	<input checked="" type="checkbox"/> Checked. OK
9.6	Check digital input / output (option)	<input checked="" type="checkbox"/> Checked. OK
9.7	Check parameterization of the I/O-Module	<input checked="" type="checkbox"/> Checked. OK

10. Sender / receiver unit (reflector)		
10.3	Check drying agent cartridges, exchange if req.	<input checked="" type="checkbox"/> Checked. Replacement not required.
10.4	Clean all optical surfaces.	<input checked="" type="checkbox"/> Cleaned all optical surfaces
10.5	Check stepper motor for proper function	<input checked="" type="checkbox"/> Checked Motor. OK
10.6	Check fans	<input checked="" type="checkbox"/> Fans are operating correctly.
10.7	Check spectrometer signals	<input checked="" type="checkbox"/> Checked spectrometer signal. All ok.
10.8	Check lamp	<input checked="" type="checkbox"/> Replaced Lamp
10.9	Check emission free zero point	<input checked="" type="checkbox"/> ChReading zeroecked.
10.10	Check the alignment adjust	<input checked="" type="checkbox"/> Checked & adjusted alignment
10.11	Check signal strength	<input checked="" type="checkbox"/> New Lamp - Good
	A: 524 B: 480	Good values
	C: 528 D: 463	Good values
10.12	Check mirror steps	<input checked="" type="checkbox"/> OK
	Dx: -0.012 Dy: -0.014	OK
10.13	Check parameterization	<input checked="" type="checkbox"/> As required

11. Final check		
11.3	Check function of complete measurement system	<input checked="" type="checkbox"/> Good
11.4	Check the availability of the system	<input checked="" type="checkbox"/> 100%
11.5	Save device data external	<input checked="" type="checkbox"/> Saved Data
11.6	Complete service report	<input checked="" type="checkbox"/> Service report complete

12. Additional comments	
Quality of maintenance work by plant personnel: Good	
Cleanliness of measuring station and devices: OK	
Maintenance work done (in addition to Annex 1): NA	
Problems found, solution applied: No problems	
Recommendation for repair, changes NA	
Availability of the unit:	100%
Proposal how to reach higher availability and better emission data quality:	NA
Training provided to plant personnel, proposal for settlement: Training Recommended	
Training requirements detected: NA	

13. Measurement values after check					
	Unit	Range	Reading	Zero point	Span point
SO ₂ Hi	ppm	0-1200	69	0.5	839.9
NO	ppm	0-100	394	0.2	698.7
NO ₂	ppm	0-100	-0.2	1.0	70.6
SO ₂ Lo	ppm	0-250	68.5	0.5	174.6
Temp.	°C	0-200		- X -	- X -
Press.	hPa	900-1200		- X -	- X -

Remarks
Approved by customer Name: Position:

Table 5.2 - Functional Tests carried out by RPS

Requirement	Compliance	Notes
<p>10 Documentation of Records</p> <p>The following documentation shall be controlled, readily accessible and up to date:</p> <ul style="list-style-type: none"> - a plan of the CEMS; 	<p>Yes</p>	<p>A plan of the AMS resides in the Electrical Control & Instrumentation section offices and at the analyser.</p>
<ul style="list-style-type: none"> - all manuals (maintenance, users, etc.); 	<p>Yes</p>	<p>.</p>
<ul style="list-style-type: none"> - log books to document possible malfunctions and action taken; 	<p>Yes</p>	
<ul style="list-style-type: none"> - service reports; 	<p>Yes</p>	<p>All service reports are filed.</p>
<ul style="list-style-type: none"> - QAL 3 documentation including actions taken as a result of out of control situations 	<p>Yes</p>	<p>There is a well established QAL3 system in place and analyser drift is routinely monitored using shewart charts. Evidence was provided to RPS.</p>
<p>Management system procedures for maintenance, calibration and training;</p>	<p>Yes</p>	<p>The Performance dept manage and review maintenance and calibration and training carried out by the EC&I team.</p>
<p>Training records/certificates</p>	<p>Yes</p>	<p>Evidence was provided to RPS</p>

Requirement	Compliance	Notes
Maintenance schedules.	Yes	Maintenance scheduled by Performance.
Auditing Plans & Records – Evidence that the operator includes procedures for the management of the CEMS within the auditing cycle of the management system.	Yes	Carried out using dedicated Technical Team from Swindon Head Office. An auditor witnessed the parallel tests, which suggest a good level of organisation.

APPENDIX 1: SRM Calibration Data

Table A1.1– SRM On Site Calibrations

Sample Date	Equipment Name	Equipment ID Number	Span Gas Type	ID Number	Span Gas Blended Concentration	Pre-Sampling Result*		Post-Sampling Result*	
						Zero	Span	Zero	Span
3 rd – 4 th March 2015	Horiba PG-250	FYS403	NO (17025)	183469	911 ppm	1ppm	912ppm	2ppm	913ppm
			O ₂ (V.U.)	221743	15.04 %	0.04%	15.09%	0.03%	15.31%
	Gasmet DX400 FTIR	1610	SO ₂ (17025)	P208042/65 20A	20.4 ppm	0.28ppm	20.68ppm	0.16ppm	21.92ppm

Sample Date	Equipment Name	Equipment ID Number	Span Gas Type	ID Number	Span Gas Blended Concentration	Pre-Sampling Result*		Post-Sampling Result*	
						Zero	Span	Zero	Span
4 th – 5 th March 2015	Horiba PG-250	FYS403	NO (17025)	183469	911 ppm	1ppm	911ppm	1ppm	912ppm
			O ₂ (V.U.)	221743	15.04 %	0.07%	15.04%	0.05%	15.02%
	Gasmet DX400 FTIR	1610	SO ₂ (17025)	216990	54.98 ppm	-0.65ppm	22.16ppm	0.07ppm	58.98 [#] ppm

Notes

- *- Calibration values are those for the entire sample system.
- - Zero gas 99.999% N₂
- # Final result using blended concentration of 54.98ppm

APPENDIX 2 – Accreditation Schedule.

Schedule of Accreditation
issued by
United Kingdom Accreditation Service
21 - 47 High Street, Feltham, Middlesex, TW13 4UN, UK

 <p>UKAS TESTING 1709</p> <p>Accredited to ISO/IEC 17025:2005</p>	The Environmental Consultancy Ltd trading as RPS Consultants		
	Issue No: 060 Issue date: 11 December 2014		
	<table> <tr> <td data-bbox="491 577 603 667"> 14 Cornhill London EC3V 3ND </td><td data-bbox="847 577 1121 725"> Contact: Mr S Hurst Tel: +44 (0) 20 7280 3200 Fax: +44 (0) 20 7283 9248 E-Mail: hursts@rpsgroup.com Website: www.rpsgroup.com </td></tr> </table>	14 Cornhill London EC3V 3ND	Contact: Mr S Hurst Tel: +44 (0) 20 7280 3200 Fax: +44 (0) 20 7283 9248 E-Mail: hursts@rpsgroup.com Website: www.rpsgroup.com
14 Cornhill London EC3V 3ND	Contact: Mr S Hurst Tel: +44 (0) 20 7280 3200 Fax: +44 (0) 20 7283 9248 E-Mail: hursts@rpsgroup.com Website: www.rpsgroup.com		
Testing performed by the Organisation at the locations specified below			

Locations covered by the organisation and their relevant activities

Laboratory locations:

Location details	Activity	Location code
Address Unit A1 Lowfields Business Park Elland HX 5 9DE	Local contact Mr B Durden Tel: +44 (0)1422 324180 Fax: +44 (0)1422 324188 Email: rpslu@rpsgroup.com	Health and Hygiene
Address Tem Place Denmore Road Bridge of Don Aberdeen AB23 8JX	Local contact Mr I Edmans Tel: +44 (0)845 60 123 88 Fax: +44 (0)1224 706 998 Email: rpsasb@rpsgroup.com	Health and Hygiene
Address 14 Cornhill London EC3V 3ND	Local contact Mr D Blyton Tel: +44 (0)20 7280 3200 Fax: +44 (0) 20 7283 9248 Email: rpslo@rpsgroup.com	Support Functions: Quality Management, including contract review, document control, auditing and quality control
Address Noble House Capital Drive Linford Wood Milton Keynes MK14 6QP	Local contact Mr B Durden Tel: +44 (0)1235 437 100 Fax: +44 (0)1908 669899 Email: rpsmk@rpsgroup.com	Health and Hygiene
Address Suite 4C Rhodes Business Park Silburn Way Middleton Manchester M24 4NE	Local contact Mr B Durden Tel: +44 (0) 161 6549069 Fax: +44 (0)161 6436495 Email: rpswn@rpsgroup.com	Health and Hygiene

 <p>1709 Accredited to ISO/IEC 17025:2005</p>	<p align="center">Schedule of Accreditation issued by United Kingdom Accreditation Service 21 - 47 High Street, Feltham, Middlesex, TW13 4UN, UK</p>
	<p align="center">The Environmental Consultancy Ltd trading as RPS Consultants Issue No: 060 Issue date: 11 December 2014</p>
<p align="center">Testing performed by the Organisation at the locations specified</p>	


Site activities performed away from the locations listed above:


Location details	Activity	Location code
Premises including domestic, commercial and industrial	Health and Hygiene Environmental Sampling and Testing	Elland - H Aberdeen - I London - K Milton Keynes - L Middleton - M
Customers sites requiring Stack Emissions Testing	Stack emissions Testing	Elland - H Milton Keynes - L
Mobile Laboratories	Health and Hygiene	London - J


 <p>1709 Accredited to ISO/IEC 17025:2005</p>	<p align="center">Schedule of Accreditation issued by United Kingdom Accreditation Service 21 - 47 High Street, Feltham, Middlesex, TW13 4UN, UK</p> <hr/> <p align="center">The Environmental Consultancy Ltd trading as RPS Consultants</p> <p align="center">Issue No: 060 Issue date: 11 December 2014</p>
<p align="center">Testing performed by the Organisation at the locations specified</p>	


DETAIL OF ACCREDITATION


Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
ASBESTOS FIBRES IN AIR	<u>Health and Hygiene</u>	Health and Safety Executive Asbestos: The analysts' guide for sampling, analysis and clearance procedures (HSG 248)	
	Sampling of air for fibre counting	HSG 248:February 2005 (Documented In-House Procedure)	I, K, L, M
	Fibre counting	HSG 248:February 2005 (Documented In-House Procedure)	B, E, F, I, J, K, L, M
	4 Stage Clearance Process	HSG 248:February 2005 (Documented In-House Procedure)	I, K,L, M
ASBESTOS IN BULK MATERIALS including materials and products suspected of containing asbestos	Sampling of bulk materials for asbestos identification	HSG 248:February 2005 (Documented In-House Procedure)	I, K, L, M
	Identification of: Amosite Chrysotile Crocidolite Fibrous Actinolite Fibrous Anthophyllite Fibrous Tremolite	HSG 248:February 2005 (Documented In-House Procedure using stereo-microscopy, polarised light microscopy and dispersion staining)	B, F
Testing of Stack Emissions to Atmosphere	<u>Sampling with subsequent analysis by an ISO/IEC 17025 accredited laboratory</u>	National, International and other recognised standards using documented In-House work instructions to meet the requirements of DD CEN/TS 15675:2007/ BS EN 15259:2007	
	Gaseous Organic Compounds - sorbent tube method	USEPA Method 18 (RPSCE/1/19a)	L
	Total Particulate Matter (20 to 1000 mg/m ³)	BS ISO 9096:2003 (RPSCE/1/7/d)	H, L

 1709 Accredited to ISO/IEC 17025:2005	Schedule of Accreditation issued by United Kingdom Accreditation Service 21 - 47 High Street, Feltham, Middlesex, TW13 4UN, UK		
	The Environmental Consultancy Ltd trading as RPS Consultants Issue No: 060 Issue date: 11 December 2014		
Testing performed by the Organisation at the locations specified			
Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	<u>Sampling with subsequent analysis by an ISO/IEC 17025 accredited laboratory (cont'd)</u>	National, European, International and Environment Agency specified standards including MIDs and Documented In-House work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007	
	Total Particulate Matter	BS EN 13284-1:2002 (RPSCE/1/7c)	H, L
	Hydrogen Chloride	BS EN 1911:2010 (RPSCE/1/8b)	H, L
	Halides and Halogens: Hydrogen Bromide Chlorine Bromine	US EPA Method 26 and 26A (RPSCE/1/8a)	H, L
	Sulphur dioxide	BS EN 14791:2005 (RPSCE/1/23)	H, L
	Hydrogen Fluoride	BS ISO 15713:2006 (RPSCE/1/8c)	H, L
	Mercury	BS EN 13211:2002 (RPSCE/1/9b)	H, L
	Metals	BS EN 14385:2004 (RPSCE/1/9c)	H, L
	Dioxins and furans	BS EN 1948-1:2006 (RPSCE/1/10b)	H, L
	Dioxin-like Polychlorinated Biphenyls (PCBs)	BS EN 1948-4:2010 (RPSCE/1/10b)	H, L
	Polycyclic Aromatic hydrocarbons (PAH's)	BS ISO 11338-1:2003 (RPSCE/1/10c)	H, L

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Testing performed by the Organisation at the locations specified			
Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	<u>Sampling with subsequent analysis by an ISO/IEC 17025 accredited laboratory (cont'd)</u>	National, European, International and Environment Agency specified standards including MIDs and Documented In-House work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007 (cont'd)	
	Formaldehyde	US EPA Method 316 (RPSCE/1/22)	H, L
	Speciated VOCs (carbon and other suitable tubes) (Dry stacks only): Aliphatic VOCs Aromatic VOCs Aliphatic amines Aromatic amines Cresols Phenols Acetic acid	BS EN 13649:2002 (RPSCE/1/19b)	H, L
	Amines (Total aromatic and aliphatic)	BS EN 13649:2002, NIOSH method 2010 + 2002 (RPSCE/1/19c)	H, L
	Isocyanates	USEPA Method 207-1 (documented in-house method RPSCE/1/18C)	H, L
	Isocyanates	USEPA CTM 036 (documented in-house method RPSCE/1/18D Rev A)	H, L
	Hydrogen cyanide	US EPA OTM 29 (RPSCE/1/16a)	L
	Hydrogen sulphide	US EPA Method 11 (RPSCE/1/17)	H, L
	Ammonia	BS EN 14791:2005 (RPSCE/1/14b)	H, L

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	The Environmental Consultancy Ltd trading as RPS Consultants Issue No: 060 Issue date: 11 December 2014		
Testing performed by the Organisation at the locations specified			
Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	<u>Sampling and On-Site Analysis</u>	National, European, International and Environment Agency specified standards including MID's and Documented In-House work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007	
	Water Vapour	BS EN 14790:2005 (RPSCE/1/12b)	H, L
	<u>Sampling and On-Line Analysis</u>		
	Pressure, Temperature and Velocity (Point Velocity Method)	BS EN 16911-1:2013 (RPSCE 1/2 – Differential Pressure Device (Pitot Tube) Method	H, L
	Pressure, Temperature and Velocity	BS EN 13284-1:2002 BS ISO 9096:2003 (RPSCE/1/2)	H, L
	Water Vapour*	EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	H, L
	Carbon Monoxide*	BS EN 15058:2006 (RPSCE/1/21h - NDIR analyser) EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	H, L
	Carbon Dioxide*	ISO 12039:2001 (RPSCE/1/21e - NDIR analyser) EA TGN M22 (RPSCE/1/24 - FTIR analyser)	H, L
	Nitrogen Monoxide (NO)*	BS EN 14792:2005 (RPSCE/1/21f - Chemiluminescence analyser) EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	H, L

 1709 Accredited to ISO/IEC 17025:2005	Schedule of Accreditation issued by United Kingdom Accreditation Service 21 - 47 High Street, Feltham, Middlesex, TW13 4UN, UK		
	The Environmental Consultancy Ltd trading as RPS Consultants Issue No: 060 Issue date: 11 December 2014		
Testing performed by the Organisation at the locations specified			
Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	<u>Sampling and On-Line Analysis</u> (cont'd)	National, European, International and Environment Agency specified standards including MIDs and Documented In-House work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007 (cont'd)	
	Nitrogen Dioxide (NO ₂)*	EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	H, L
	Oxides of Nitrogen (NO _x)*	BS EN 14792:2005 (RPSCE/1/21f - Chemiluminescence analyser) EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	H, L
	Nitrous Oxide (N ₂ O)*	EA TGN M22 (RPSCE/1/24 Rev B - Validated FTIR analyser)	H, L
	Sulphur dioxide*	EA TGN M22 (RPSCE/1/24 - FTIR analyser)	H, L
	Oxygen*	BS EN 14789:2005 (RPSCE/1/21g - validated Zirconium cell analyser)	H, L
	Total Gaseous Organic Carbon* (TOC/VOC) (0 to 1000 mg/m ³)	BS EN 12619:2013 (RPSCE/1/4b - FID analyser)	H, L

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	The Environmental Consultancy Ltd trading as RPS Consultants Issue No: 060 Issue date: 11 December 2014		
Testing performed by the Organisation at the locations specified			
Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Stack Emissions - Continuous Emissions Monitoring Systems (CEMS)	QAL 2 and the Annual Surveillance Test (AST) for CEMS	Documented in house procedure RPSCE/1/25 to meet the requirements of BS EN 14181:2004, Environment Agency MID 14181 and other requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007	H, L
END			

* - The scale range of the analyser used for this test must be that detailed on its current MCERTS certificate or a range validated by the organisation to meet MCERTS requirements.