

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 9**
Monitoring Dates: **10th – 25th 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: Ian Baggley
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Position: Principal Consultant
MCERTS Qualifications: Level 2, Technical Endorsements 1, 2, 3 & 4
MCERTS Registration No.: MM 02 020
Signature: 

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Section 1 – Executive Summary

1B.1 Result Summary – AST

EN 14181 Test Type		AST						
Stack designation		Unit 9						
Measurand	Correlation coefficient of parallel data (R^2)	Derived Calibration function (y_i)		Established Calibrated Range ²	AST Calibrated Range	Extrapolated Calibrated Range	Variability Test	Test of Calibration Function
		$y =$	$a + bx_i$					
Nitric Oxide as total NOx (Procal 1)	0.749	-6.232 ¹	1.091 ¹	0 – 1649 mg/m ^{3 2}	0 – 1249 mg/m ^{3 2}	-	Pass	Pass
Sulphur Dioxide (Procal 1 – Low Range)	0.9867 (outlier removed)	0.536 ¹	1.078 ¹	0 – 308 mg/m ^{3 2}	0 – 606 mg/m ^{3 2}	0 – 576 mg/m ^{3 4}	Pass	Pass
Sulphur Dioxide (Procal 1 – High Range)	0.9866 (outlier removed)	-0.9 ¹	1.049 ¹	0 – 293 mg/m ^{3 2}	0 – 556 mg/m ^{3 2}	0 – 2256 mg/m ^{3 4}	Pass	Pass
Nitric Oxide as total NOx (Procal 2)	0.9431	5.408 ¹	1.076 ¹	0 – 1364 mg/m ^{3 2}	0 – 1191 mg/m ^{3 2}	0 – 1642 mg/m ^{3 4}	Pass	Pass
Sulphur Dioxide (Procal 2 – Low Range)	0.9823	-3.208 ¹	1.210 ¹	0 – 245mg/m ^{3 2}	-	-	Pass	Fail
Sulphur Dioxide (Procal 2 – High Range)	0.9824	-2.971 ¹	0.844 ¹	0 – 253 mg/m ^{3 2}	-	-	Pass	Fail
Particulate Matter (Erwin SICK)	0.4941	-0.099 ¹	1.52 ¹	0 – 72.6 mg/m ^{3 3}	-	Not applicable	Fail	Pass

1B.2 Result Summary – QAL2

EN 14181 Test Type		QAL2				
Stack designation		Unit 9				
Measurand	Correlation coefficient of parallel data (R^2)	Derived Calibration function (y_i)		Calibrated Range	Extrapolated Calibrated Range	Variability Test
		$y_i =$	$a + bx_i$			
Oxides of Nitrogen (GM32)	0.8453	8.739	0.934	0 - 1313 mg/m ³	0 – 2158 mg/m ³	Pass
Sulphur Dioxide (GM32 – Low Range)	0.9967	0.252	1.067	0 – 564 mg/m ³	-	Pass
Sulphur Dioxide (GM32 – High Range)	0.9966	0.211	1.067	0 – 563 mg/m ³	0 – 2087 mg/m ³	Pass
Sulphur Dioxide (Procal 2 – Low Range)	0.9944	-0.89	1.449	0 – 569 mg/m ³	-	Pass
Sulphur Dioxide (Procal 2 – High Range)	0.9944	-4.752	1.017	0 – 566 mg/m ³	-	Pass

Notes:

- 1 – Calibration function derived using Method A.
- 2 – Calibrated range derived using AST parallel test data extended 10%.
- 3 - Calibrated range derived using QAL2 parallel test data extended 100%.
- 4 – Extrapolated calibrated range from QAL 2 - derived 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	May 2014 AST – Procal 1 & 2, SICK OMD 41. May 2014, QAL2 – SICK GM32

Regulated Determinands

Determinand	Emission Point	48-Hour Mean	Calendar Monthly	Uncertainty Requirement
Oxides of Nitrogen	Unit 9	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 9	440 mg/m ³	400 mg/m ³	20% at the ELV
Total particulate Matter	Unit 9	55 mg/m ³	25 mg/m ³	30% at the ELV

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

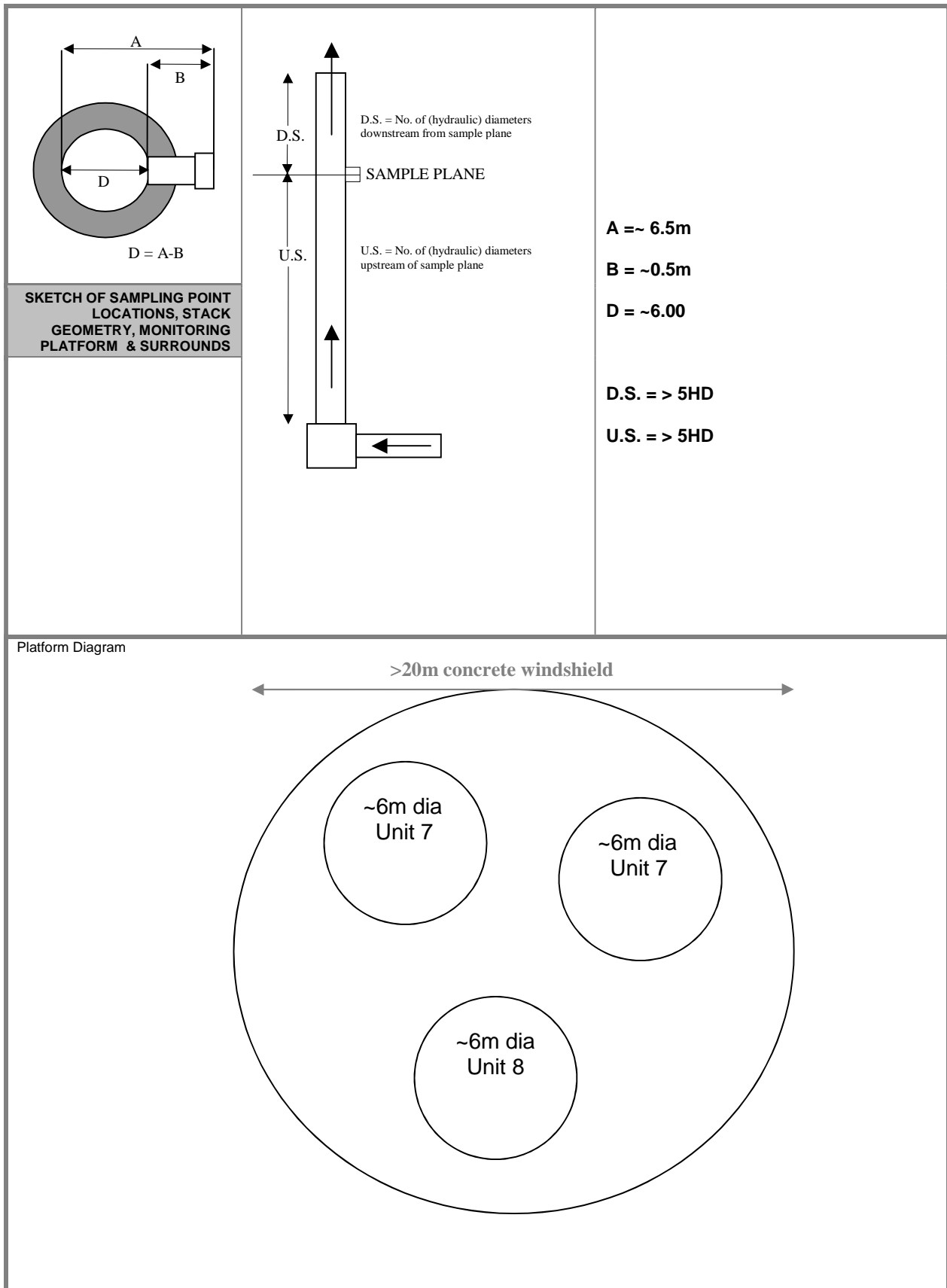
2.2 Operational Information and site monitoring provisions

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: 23/03/15
Site Name: Aberthaw | Run: 1
Sampling Point Ref: Unit 9 | Barometric Press. Mbar: 1008
Project Reference: FTBS 29312 | Stack Diameter (m): 6.00
Stack Static press.mm H₂O: -26 | Stack Area (m²): 28.274

Traverse Point No.	Port A			Port B			Port C			Port D		
	Δ p, mm H ₂ O	Root Δ p	Stack Temp °C	Δ p, mm H ₂ O	Root Δ p	Stack Temp °C	Δ p, mm H ₂ O	Root Δ p	Stack Temp °C	Δ p, mm H ₂ O	Root Δ p	Stack Temp °C
1	24	4.899	70	26	5.099	70						
2	26	5.099	70	28	5.292	70						
3	30	5.477	70	32	5.657	70						
4												
5												
6												
7												
8							26	5.099	70	28	5.292	70
9							28	5.292	70	30	5.477	70
10							32	5.657	70	34	5.831	70
Minimum	24.0	4.899	70	26.0	5.099	70	26.0	5.099	70	28.0	5.292	70
Maximum	30.0	5.477	70	32.0	5.657	70	32.0	5.657	70	34.0	5.831	70
Mean	26.7	5.158	70.0	28.7	5.349	70.0	28.7	5.349	70.0	30.7	5.533	70.0
Sum	80	15.475	210	86	16.047	210	86	16.047	210	86	16.047	210
Total Sum										338	63.617	840

Max. pitot press. = 34.0
Min. pitot press. = 24.0
Ratio Max:Min = 1.4 :1

Gas Data

Oxygen %	6.5
CO ₂ %	12.00
CO %	

Oxygen Correction

Required Correction Value	0
Actual Oxygen Factor	1
Enter 0 if correction is not required	

BS EN 13284-1 & M1 Sample Point Requirements	Requirement Met?
Duct gas Flow: angle with regard to duct access <15°?	Y
Duct Gas Flow Negative Velocity: Not Permitted	Y
Duct Gas Flow: Ratio of max to min velocity <3:1?	Y
Working Area > 5m ² ?	N
Handrails with removable chains / self closing gates across the top of the ladder?	Y
Handrails (approx 0.5 and 1.0 m high) and vertical baseboards (approx 0.25m high)?	Y
Scaffold Built to 'Heavy Duty' Scafftag Rating or at least 2.5kN/m ² loading	N/A
Handrails not restricting access to ports?	N
Room opposite sampling port equal or greater than the length of the sampling probe plus 1 metre?	N
Sufficient Power (Waterproof 110V BS4343 Standard) close or on the platform?	Y

2.4.1 Continuous Emissions Monitoring Systems at the installation

	Procal 1 & 2	SICK	SICK
Determinand	NOx & SO ₂	NOx & 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 SO2 low = 0 – 250 ppm SO2 high = 0 – 1000 ppm	Measuring path length 1.25m: NO 0 to 70 mg/m ³ & 0 to 700 mg/m ³ SO2 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 SO2 0 to 93.8 mg/m ³ and 0 to 1250 mg/m ³	0 – 0.3 extinction
Operational ranges	As Above	SO2 Low: 0 – 250 ppm SO2 High: 0 – 1000ppm NO: 0 – 1000ppm NO2: 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	03/19	
			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	
Will Doward	Technician	1	--	-	MM 13 1249

Report Author	Position	MCERTS Level	Technical Endorsements	Expiry Dates	MCERTS Registration Number
Ian Baggley	Consultant	2	1	06/18	MM 05 642
			2	03/19	
			3	12/17	
			4	03/17	

Report Reviewer	Position	MCERTS Level	Technical Endorsements	Expiry Dates	MCERTS Registration Number
Richard Harvey	Principal Consultant	2	1	11/17	MM 02 020
			2	03/19	
			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 SRM	MCERTs certificate No MC110186/03	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 SRM	MCERTs certificate No MC110186/03	0 – 130 mg/m ³ as NO 0 – 200 mg/m ³ as NO ₂	0 – 1000ppm	
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 9, SICK GM32

Section 4A – 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 (dry)	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	10/03/2015	15:30	16:30	460.6	6.80	1.89	453.19	7.0	2.6	441.3
2	10/03/2015	17:30	18:30	464.0	6.88	1.70	458.04	7.1	2.4	446.8
3	10/03/2015	19:30	20:30	492.0	7.15	1.68	483.88	7.4	2.4	472.4
4	10/03/2015	21:30	22:30	478.1	7.11	1.71	466.19	7.5	2.4	455.0
5	10/03/2015	23:30	00:30	517.6	7.07	1.61	500.86	7.5	2.3	489.5
6	11/03/2015	01:30	02:30	489.7	7.08	1.65	477.00	7.5	2.3	466.0
7	11/03/2015	03:30	04:30	446.0	7.43	1.68	439.40	7.9	2.3	429.1
8	11/03/2015	05:30	06:30	482.2	7.04	1.61	468.07	7.4	2.3	457.3
9	11/03/2015	07:30	08:30	487.8	7.31	1.60	468.88	7.7	2.3	458.2
10	11/03/2015	09:30	10:30	472.1	7.15	1.64	454.77	7.6	2.3	444.3
11	11/03/2015	11:30	12:30	459.5	6.98	1.71	450.18	7.1	2.5	438.9
12	11/03/2015	13:30	14:30	448.4	6.96	1.72	435.62	7.2	2.5	424.8
13	11/03/2015	15:30	16:30	458.3	6.86	1.80	441.00	7.3	2.6	429.8
14	11/03/2015	17:30	18:30	465.8	6.97	1.76	442.91	7.4	2.5	432.0
15	11/03/2015	19:30	20:30	486.2	7.02	1.74	461.44	7.5	2.4	450.2
16	11/03/2015	21:30	22:30	479.2	7.07	1.71	449.35	7.6	2.4	438.6
17	11/03/2015	23:30	00:30	481.1	7.13	1.78	449.55	7.7	2.5	438.3
18	12/03/2015	01:30	02:30	405.7	8.23	1.64	385.63	8.8	2.3	376.6
19	12/03/2015	05:30	06:30	430.8	6.95	1.66	390.26	7.5	2.5	380.5
20	12/03/2015	07:30	08:30	472.0	6.87	1.78	434.98	7.4	2.5	424.0
21	12/03/2015	11:30	12:30	553.8	6.91	1.72	525.19	7.2	2.5	512.3
22	12/03/2015	13:30	14:30	561.8	6.98	1.75	532.35	7.4	2.5	519.1
23	24/03/2015	09:40	10:40	438.8	7.05	1.91	446.94	7.2	2.5	435.8
24	24/03/2015	11:40	12:40	438.4	7.04	1.90	442.96	7.2	2.4	432.4
25	24/03/2015	13:40	14:40	436.7	6.90	1.29	438.19	7.2	2.4	427.8
26	24/03/2015	15:40	16:40	432.3	6.85	2.03	436.32	7.2	2.5	425.2
27	24/03/2015	17:40	18:40	492.2	6.93	1.86	495.46	7.3	2.3	484.1
28	24/03/2015	19:40	20:40	494.7	6.92	1.82	498.86	7.3	2.2	487.8
29	24/03/2015	21:40	22:40	490.3	6.96	1.81	493.75	7.3	2.2	482.8
30	24/03/2015	23:40	00:40	466.4	7.01	1.79	466.87	7.4	2.2	456.6
31	25/03/2015	01:40	02:40	423.4	6.99	1.83	422.51	7.4	2.2	413.0
32	25/03/2015	03:40	04:40	424.1	7.10	1.73	422.30	7.5	2.2	413.2
33	25/03/2015	05:40	06:40	449.2	7.01	1.66	443.56	7.5	2.1	434.4
34	25/03/2015	07:40	08:40	472.9	7.07	1.77	465.49	7.6	2.2	455.1

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

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

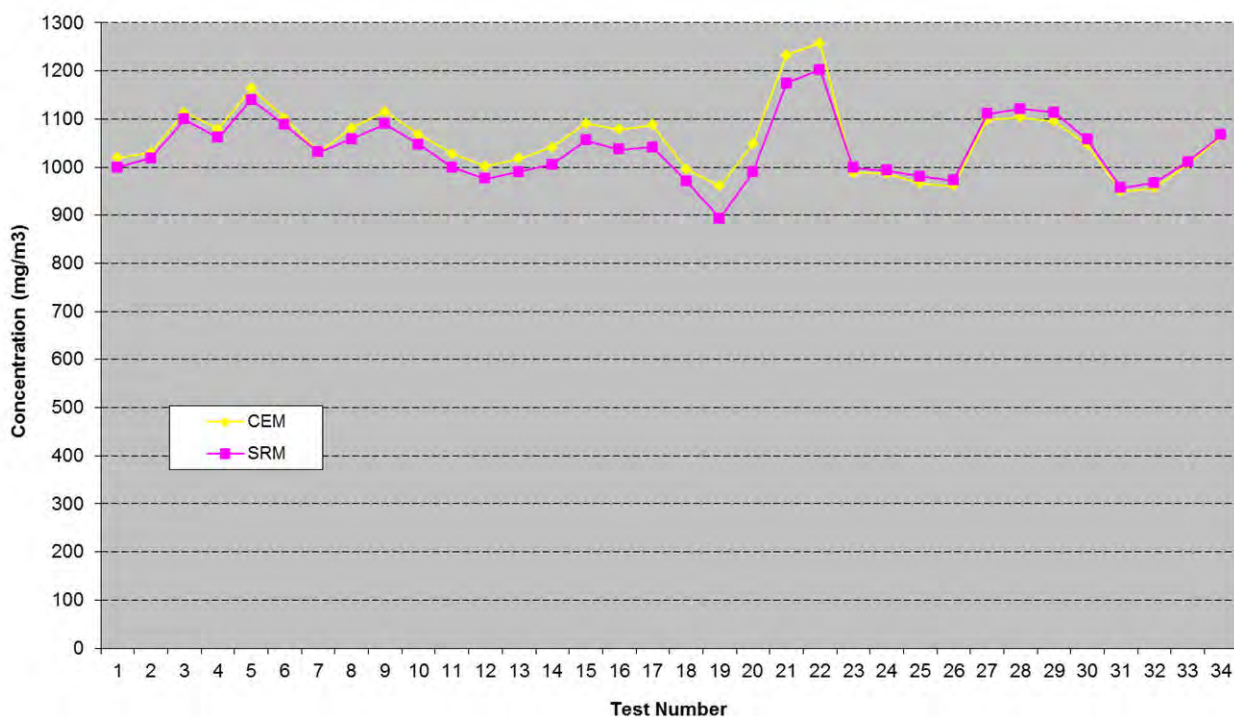
Test No	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
	hr:min		NO as NO ₂ (mg/m ³)	NOx as NO ₂ (mg/m ³)	(mg/m ³)
1	15:30	16:30	1019.1	999.5	43
2	17:30	18:30	1030.2	1018.3	43
3	19:30	20:30	1113.8	1099.6	45
4	21:30	22:30	1079.5	1061.3	44
5	23:30	0:30	1164.0	1139.7	46
6	1:30	2:30	1102.2	1087.5	45
7	3:30	4:30	1030.1	1030.9	43
8	5:30	6:30	1081.6	1058.1	44
9	7:30	8:30	1115.8	1089.3	45
10	9:30	10:30	1067.9	1047.2	44
11	11:30	12:30	1027.8	999.5	43
12	13:30	14:30	1001.4	976.3	42
13	15:30	16:30	1017.3	990.0	43
14	17:30	18:30	1041.7	1005.7	43
15	19:30	20:30	1090.8	1055.6	44
16	21:30	22:30	1078.4	1036.6	43
17	23:30	0:30	1088.3	1041.3	44
18	1:30	2:30	995.7	971.5	42
19	5:30	6:30	960.5	893.4	41
20	7:30	8:30	1048.5	988.8	43
21	11:30	12:30	1232.6	1174.6	46
22	13:30	14:30	1257.4	1202.2	47
23	9:40	10:40	988.4	998.8	43
24	11:40	12:40	986.6	992.6	43
25	13:40	14:40	966.7	980.2	42
26	15:40	16:40	960.7	971.9	42
27	17:40	18:40	1098.4	1110.9	45
28	19:40	20:40	1103.0	1120.7	45
29	21:40	22:40	1095.6	1113.6	45
30	23:40	0:40	1046.3	1057.6	44
31	1:40	2:40	949.0	956.9	42
32	3:40	4:40	957.1	967.2	42
33	5:40	6:40	1006.5	1010.9	43
34	7:40	8:40	1065.1	1067.2	44

Note:

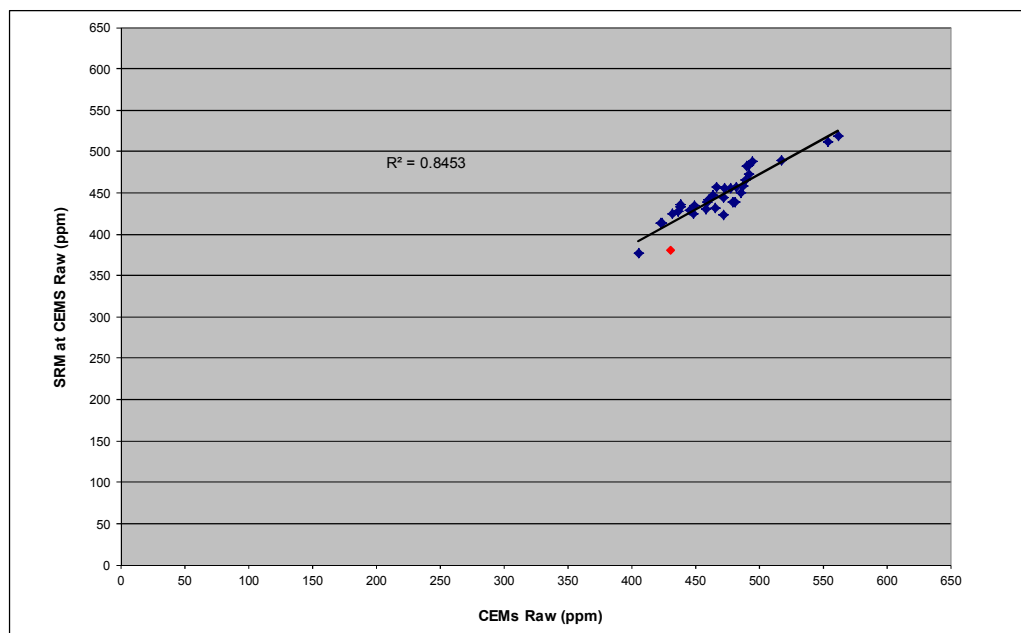
Emission concentrations expressed at reference conditions 273K, 101.3kPa

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	10-Mar-15	15:30	16:30	460.6	441.3	-19.24	3.66	No
2	10-Mar-15	17:30	18:30	464.0	446.8	-17.17	5.73	No
3	10-Mar-15	19:30	20:30	492.0	472.4	-19.59	3.30	No
4	10-Mar-15	21:30	22:30	478.1	455.0	-23.03	-0.14	No
5	10-Mar-15	23:30	00:30	517.6	489.5	-28.10	-5.21	No
6	11-Mar-15	01:30	02:30	489.7	466.0	-23.69	-0.80	No
7	11-Mar-15	03:30	04:30	446.0	429.1	-16.81	6.08	No
8	11-Mar-15	05:30	06:30	482.2	457.3	-24.98	-2.08	No
9	11-Mar-15	07:30	08:30	487.8	458.2	-29.59	-6.69	No
10	11-Mar-15	09:30	10:30	472.1	444.3	-27.85	-4.95	No
11	11-Mar-15	11:30	12:30	459.5	438.9	-20.55	2.34	No
12	11-Mar-15	13:30	14:30	448.4	424.8	-23.57	-0.67	No
13	11-Mar-15	15:30	16:30	458.3	429.8	-28.55	-5.66	No
14	11-Mar-15	17:30	18:30	465.8	432.0	-33.79	-10.89	No
15	11-Mar-15	19:30	20:30	486.2	450.2	-36.03	-13.13	No
16	11-Mar-15	21:30	22:30	479.2	438.6	-40.56	-17.67	No
17	11-Mar-15	23:30	00:30	481.1	438.3	-42.76	-19.86	No
18	12-Mar-15	01:30	02:30	405.7	376.6	-29.03	-6.14	No
19	12-Mar-15	05:30	06:30	430.8	380.5	-50.26	-27.36	Yes
20	12-Mar-15	07:30	08:30	472.0	424.0	-48.07	-25.18	No
21	12-Mar-15	11:30	12:30	553.8	512.3	-41.50	-18.61	No
22	12-Mar-15	13:30	14:30	561.8	519.1	-42.73	-19.83	No
23	24-Mar-15	09:40	10:40	438.8	435.8	-2.99	19.90	No
24	24-Mar-15	11:40	12:40	438.4	432.4	-5.96	16.94	No
25	24-Mar-15	13:40	14:40	436.7	427.8	-8.82	14.08	No
26	24-Mar-15	15:40	16:40	432.3	425.2	-7.05	15.84	No
27	24-Mar-15	17:40	18:40	492.2	484.1	-8.09	14.81	No
28	24-Mar-15	19:40	20:40	494.7	487.8	-6.91	15.99	No
29	24-Mar-15	21:40	22:40	490.3	482.8	-7.50	15.40	No
30	24-Mar-15	23:40	00:40	466.4	456.6	-9.85	13.05	No
31	25-Mar-15	01:40	02:40	423.4	413.0	-10.37	12.53	No
32	25-Mar-15	03:40	04:40	424.1	413.2	-10.89	12.01	No
33	25-Mar-15	05:40	06:40	449.2	434.4	-14.77	8.13	No
34	25-Mar-15	07:40	08:40	472.9	455.1	-17.80	5.09	No
Average Di						-22.90		
Standard Deviation						13.26		
Standard Deviation x2						26.51		

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	10-Mar-15	15:30	16:30	453.2		7.0	999.5
2	10-Mar-15	17:30	18:30	458.0		7.1	1018.3
3	10-Mar-15	19:30	20:30	483.9		7.4	1099.6
4	10-Mar-15	21:30	22:30	466.2		7.5	1061.3
5	10-Mar-15	23:30	0:30	500.9		7.5	1139.7
6	11-Mar-15	1:30	2:30	477.0		7.5	1087.5
7	11-Mar-15	3:30	4:30	439.4		7.9	1030.9
8	11-Mar-15	5:30	6:30	468.1		7.4	1058.1
9	11-Mar-15	7:30	8:30	468.9		7.7	1089.3
10	11-Mar-15	9:30	10:30	454.8		7.6	1047.2
11	11-Mar-15	11:30	12:30	450.2		7.1	999.5
12	11-Mar-15	13:30	14:30	435.6		7.2	976.3
13	11-Mar-15	15:30	16:30	441.0		7.3	990.0
14	11-Mar-15	17:30	18:30	442.9		7.4	1005.7
15	11-Mar-15	19:30	20:30	461.4		7.5	1055.6
16	11-Mar-15	21:30	22:30	449.4		7.6	1036.6
17	11-Mar-15	23:30	0:30	449.5		7.7	1041.3
18	12-Mar-15	1:30	2:30	385.6		8.8	971.5
20	12-Mar-15	7:30	8:30	435.0		7.4	988.8
21	12-Mar-15	11:30	12:30	525.2		7.2	1174.6
22	12-Mar-15	13:30	14:30	532.4		7.4	1202.2
23	24-Mar-15	9:40	10:40	446.9		7.2	998.8
24	24-Mar-15	11:40	12:40	443.0		7.2	992.6
25	24-Mar-15	21:40	22:40	438.2		7.3	988.3
26	24-Mar-15	23:40	0:40	436.3		7.4	988.4
27	24-Mar-15	1:40	2:40	495.5		7.4	1122.1
28	24-Mar-15	3:40	4:40	498.9		7.5	1142.5
29	24-Mar-15	21:40	22:40	493.8		7.3	1113.6
30	24-Mar-15	23:40	0:40	466.9		7.4	1057.6
31	25-Mar-15	1:40	2:40	422.5		7.4	956.9
32	25-Mar-15	3:40	4:40	422.3		7.5	967.2
33	25-Mar-15	5:40	6:40	443.6		7.5	1010.9
34	25-Mar-15	7:40	8:40	465.5		7.6	1067.2
Sum				15151.70			
Emission Limit Value (ELV) =				1210	Y _{max}		1202.25
15% of the ELV =				181.5			956.91
Therefore Ymax - Ymin > 15% of the ELV				Method A			245.33

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)
		hr:min		NOx (ppm)	NO (ppm)
1	17-Feb-15	Reference		0	0.33
2	10-Mar-15	15:30	16:30	441.3	460.6
3	10-Mar-15	17:30	18:30	446.8	464.0
4	10-Mar-15	19:30	20:30	472.4	492.0
5	10-Mar-15	21:30	22:30	455.0	478.1
6	10-Mar-15	23:30	0:30	489.5	517.6
7	11-Mar-15	1:30	2:30	466.0	489.7
8	11-Mar-15	3:30	4:30	429.1	446.0
9	11-Mar-15	5:30	6:30	457.3	482.2
10	11-Mar-15	7:30	8:30	458.2	487.8
11	11-Mar-15	9:30	10:30	444.3	472.1
12	11-Mar-15	11:30	12:30	438.9	459.5
13	11-Mar-15	13:30	14:30	424.8	448.4
14	11-Mar-15	15:30	16:30	429.8	458.3
15	11-Mar-15	17:30	18:30	432.0	465.8
16	11-Mar-15	19:30	20:30	450.2	486.2
17	11-Mar-15	21:30	22:30	438.6	479.2
18	11-Mar-15	23:30	0:30	438.3	481.1
19	12-Mar-15	1:30	2:30	376.6	405.7
21	12-Mar-15	7:30	8:30	424.0	472.0
22	12-Mar-15	11:30	12:30	512.3	553.8
23	12-Mar-15	13:30	14:30	519.1	561.8
24	24-Mar-15	9:40	10:40	435.8	438.8
25	24-Mar-15	11:40	12:40	432.4	438.4
26	24-Mar-15	13:40	14:40	427.8	436.7
27	24-Mar-15	15:40	16:40	425.2	432.3
28	24-Mar-15	17:40	18:40	484.1	492.2
29	24-Mar-15	19:40	20:40	487.8	494.7
30	24-Mar-15	21:40	22:40	482.8	490.3
31	24-Mar-15	23:40	0:40	456.6	466.4
32	25-Mar-15	1:40	2:40	413.0	423.4
33	25-Mar-15	3:40	4:40	413.2	424.1
34	25-Mar-15	5:40	6:40	434.4	449.2
35	25-Mar-15	7:40	8:40	455.1	472.9
Sum				14793.03	15521.55

Yi	Xi	Xi * Yi	Xi ²	b
1	2	3	4	
-435.0891727	-456.1862146	198481.6827	208105.8624	
6.25	4.06	25.41	16.52	
11.75	7.49	88.07	56.14	
37.34	35.50	1325.45	1260.29	
19.96	21.56	430.38	464.97	
54.43	61.11	3326.28	3734.26	
30.90	33.17	1024.83	1099.94	
-5.94	-10.56	62.74	111.46	
22.17	25.72	570.11	661.39	
23.14	31.31	724.56	980.02	
9.19	15.61	143.53	243.82	
3.86	2.98	11.51	8.90	
-10.30	-8.15	83.94	66.47	
-5.34	1.79	-9.55	3.20	
-3.10	9.26	-28.68	85.82	
15.13	29.73	449.88	883.96	
3.54	22.67	80.17	514.05	
3.23	24.56	79.29	603.06	
-58.46	-50.85	2972.39	2585.56	
-11.12	15.52	-172.66	240.96	
77.22	97.29	7512.95	9466.16	
84.01	105.31	8846.45	11089.61	
0.70	-17.74	-12.38	314.64	
-2.69	-18.15	48.78	329.59	
-7.25	-19.86	144.09	394.53	
-9.87	-24.24	239.22	587.71	
49.04	35.70	1750.89	1274.72	
52.66	38.14	2008.72	1454.92	
47.70	33.77	1610.66	1140.30	
21.49	9.91	213.07	98.29	
-22.06	-33.12	730.58	1096.80	
-21.90	-32.44	710.40	1052.35	
-0.64	-7.31	4.71	53.38	
20.05	16.42	329.28	269.75	
0.00	0.00	233806.75	250349.41	0.93

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

Method A

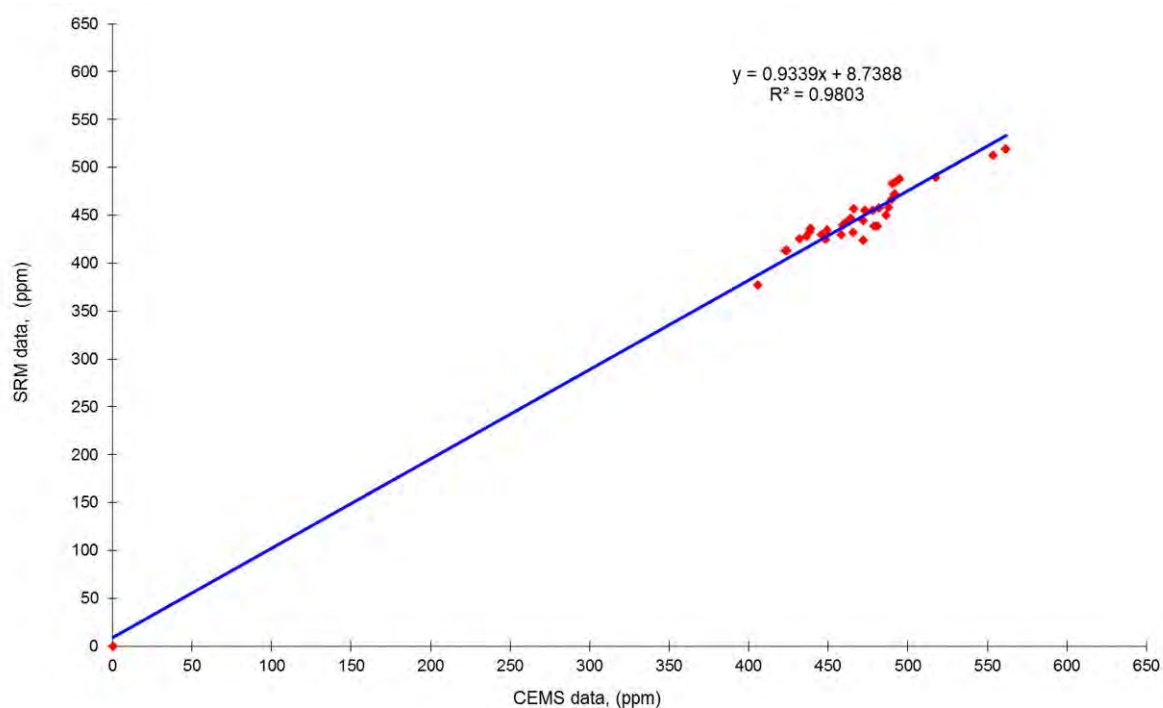
If $Y_{\max} - Y_{\min} > 15\%$ of the ELV, the following formulae are used:

$b = \frac{\sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^N (x_i - \bar{x})^2}$	where	$\bar{x} = \frac{1}{N} \sum_{i=1}^N x_i$	$\bar{y} = \frac{1}{N} \sum_{i=1}^N y_i$	$x =$	456.52
				$y =$	435.09
				$b =$	0.934
$a = \bar{y} - b\bar{x}$	$a = 435.09 - 456.52 * 0.933$			$a =$	8.739
The calibration is function $y_i = a + b x_i$ or			$y_i =$	$8.739 + 0.934 * x_i$	

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 wet Oxygen	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		NO (ppm)	NO (ppm)	(%)	(%)	NO as NO2 (mg/m3)	NOx as NO2 (mg/m3)
1	17-Feb-15	Reference Gas		0.3	9.0			9.0	0.0
2	10-Mar-15	15:30	16:30	460.6	438.9	1.9	6.8	971.0	999.5
3	10-Mar-15	17:30	18:30	464.0	442.1	1.7	6.9	981.5	1018.3
4	10-Mar-15	19:30	20:30	492.0	468.2	1.7	7.2	1060.0	1099.6
5	10-Mar-15	21:30	22:30	478.1	455.2	1.7	7.1	1027.9	1061.3
6	10-Mar-15	23:30	00:30	517.6	492.2	1.6	7.1	1106.8	1139.7
7	11-Mar-15	01:30	02:30	489.7	466.1	1.7	7.1	1049.0	1087.5
8	11-Mar-15	03:30	04:30	446.0	425.2	1.7	7.4	982.3	1030.9
9	11-Mar-15	05:30	06:30	482.2	459.1	1.6	7.0	1029.7	1058.1
10	11-Mar-15	07:30	08:30	487.8	464.3	1.6	7.3	1062.0	1089.3
11	11-Mar-15	09:30	10:30	472.1	449.7	1.6	7.1	1017.1	1047.2
12	11-Mar-15	11:30	12:30	459.5	437.9	1.7	7.0	979.4	999.5
13	11-Mar-15	13:30	14:30	448.4	427.5	1.7	7.0	954.7	976.3
14	11-Mar-15	15:30	16:30	458.3	436.8	1.8	6.9	969.5	990.0
15	11-Mar-15	17:30	18:30	465.8	443.7	1.8	7.0	992.4	1005.7
16	11-Mar-15	19:30	20:30	486.2	462.9	1.7	7.0	1038.3	1055.6
17	11-Mar-15	21:30	22:30	479.2	456.3	1.7	7.1	1026.8	1036.6
18	11-Mar-15	23:30	00:30	481.1	458.0	1.8	7.1	1036.2	1041.3
19	12-Mar-15	01:30	02:30	405.7	387.6	1.6	8.2	951.4	971.5
21	12-Mar-15	07:30	08:30	472.0	449.6	1.8	6.9	998.6	988.8
22	12-Mar-15	11:30	12:30	553.8	526.0	1.7	6.9	1170.6	1174.6
23	12-Mar-15	13:30	14:30	561.8	533.4	1.7	7.0	1193.8	1202.2
24	24-Mar-15	09:40	10:40	438.8	418.5	1.9	7.1	942.8	998.8
25	24-Mar-15	11:40	12:40	438.4	418.1	1.9	7.0	941.1	992.6
26	24-Mar-15	13:40	14:40	436.7	416.5	1.3	6.9	922.2	980.2
27	24-Mar-15	15:40	16:40	432.3	412.4	2.0	6.8	916.6	971.9
28	24-Mar-15	17:40	18:40	492.2	468.4	1.9	6.9	1045.3	1110.9
29	24-Mar-15	19:40	20:40	494.7	470.7	1.8	6.9	1049.6	1120.7
30	24-Mar-15	21:40	22:40	490.3	466.6	1.8	7.0	1042.8	1113.6
31	24-Mar-15	23:40	00:40	466.4	444.3	1.8	7.0	996.8	1057.6
32	25-Mar-15	01:40	02:40	423.4	404.2	1.8	7.0	905.9	956.9
33	25-Mar-15	03:40	04:40	424.1	404.8	1.7	7.1	913.6	967.2
34	25-Mar-15	05:40	06:40	449.2	428.3	1.7	7.0	959.6	1010.9
35	25-Mar-15	07:40	08:40	472.9	450.4	1.8	7.1	1014.4	1067.2
Sum								33258.6	
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.



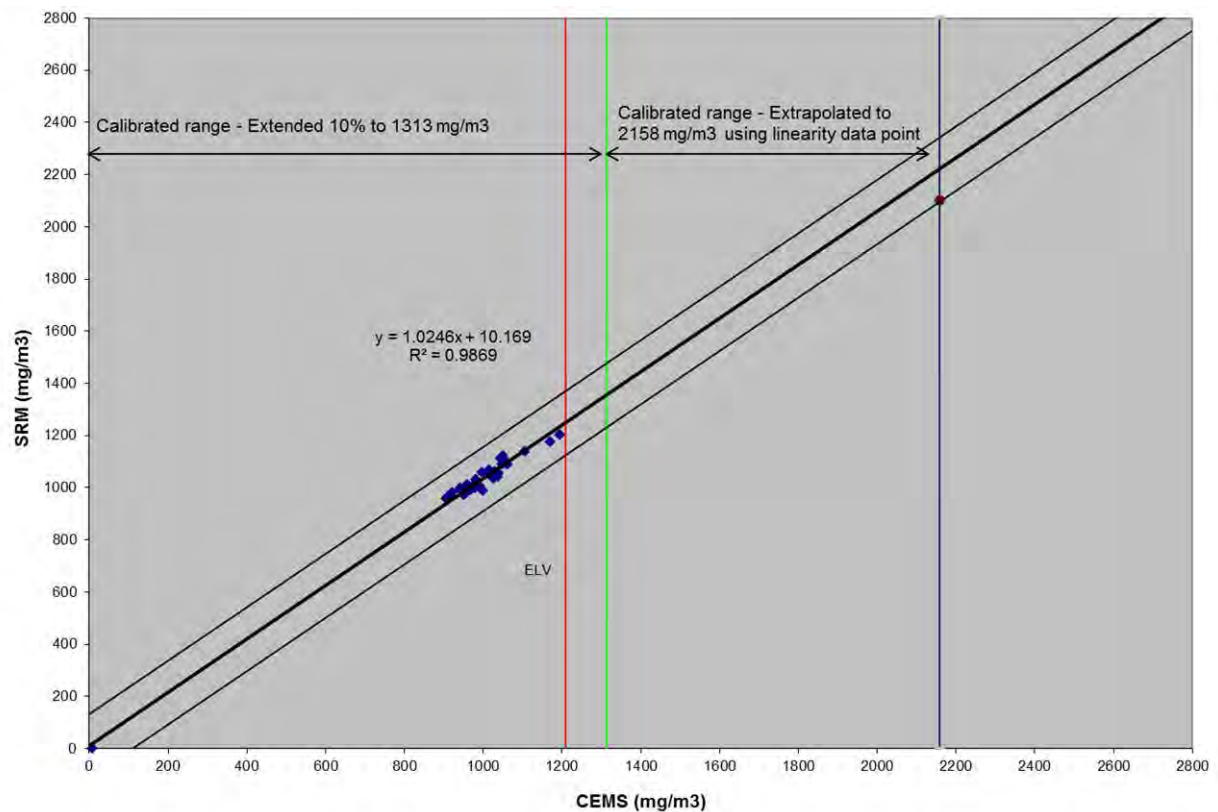
4A1.10.1 Table 4.5.1 – Data used for the Variability Test – Oxides of Nitrogen

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		9.0	0.0	-9.05	-43.27	1872.51
2	10-Mar-15	15:30	16:30	971.0	999.5	28.47	-5.76	33.13
3	10-Mar-15	17:30	18:30	981.5	1018.3	36.79	2.57	6.58
4	10-Mar-15	19:30	20:30	1060.0	1099.6	39.65	5.43	29.46
5	10-Mar-15	21:30	22:30	1027.9	1061.3	33.44	-0.79	0.62
6	10-Mar-15	23:30	00:30	1106.8	1139.7	32.95	-1.28	1.64
7	11-Mar-15	01:30	02:30	1049.0	1087.5	38.46	4.23	17.93
8	11-Mar-15	03:30	04:30	982.3	1030.9	48.63	14.40	207.43
9	11-Mar-15	05:30	06:30	1029.7	1058.1	28.40	-5.83	33.96
10	11-Mar-15	07:30	08:30	1062.0	1089.3	27.31	-6.91	47.79
11	11-Mar-15	09:30	10:30	1017.1	1047.2	30.11	-4.11	16.93
12	11-Mar-15	11:30	12:30	979.4	999.5	20.09	-14.14	199.83
13	11-Mar-15	13:30	14:30	954.7	976.3	21.64	-12.59	158.48
14	11-Mar-15	15:30	16:30	969.5	990.0	20.51	-13.72	188.12
15	11-Mar-15	17:30	18:30	992.4	1005.7	13.34	-20.89	436.25
16	11-Mar-15	19:30	20:30	1038.3	1055.6	17.35	-16.88	284.95
17	11-Mar-15	21:30	22:30	1026.8	1036.6	9.79	-24.44	597.08
18	11-Mar-15	23:30	00:30	1036.2	1041.3	5.12	-29.10	846.84
19	12-Mar-15	01:30	02:30	951.4	971.5	20.14	-14.09	198.46
21	12-Mar-15	07:30	08:30	998.6	988.8	-9.74	-43.96	1932.91
22	12-Mar-15	11:30	12:30	1170.6	1174.6	4.02	-30.21	912.39
23	12-Mar-15	13:30	14:30	1193.8	1202.2	8.41	-25.81	666.23
24	24-Mar-15	09:40	10:40	942.8	998.8	55.98	21.75	473.24
25	24-Mar-15	11:40	12:40	941.1	992.6	51.52	17.30	299.21
26	24-Mar-15	13:40	14:40	922.2	980.2	57.97	23.75	563.86
27	24-Mar-15	15:40	16:40	916.6	971.9	55.24	21.01	441.57
28	24-Mar-15	17:40	18:40	1045.3	1110.9	65.63	31.40	985.97
29	24-Mar-15	19:40	20:40	1049.6	1120.7	71.12	36.89	1361.17
30	24-Mar-15	21:40	22:40	1042.8	1113.6	70.83	36.60	1339.68
31	24-Mar-15	23:40	00:40	996.8	1057.6	60.83	26.60	707.80
32	25-Mar-15	01:40	02:40	905.9	956.9	51.04	16.81	282.59
33	25-Mar-15	03:40	04:40	913.6	967.2	53.60	19.38	375.40
34	25-Mar-15	05:40	06:40	959.6	1010.9	51.27	17.05	290.54
35	25-Mar-15	07:40	08:40	1014.4	1067.2	52.82	18.59	345.61
34	Tests		Mean			34.23		
	Sum							16156.15

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

SD=	Root(1-Number).Integral(D1-D) ²	22.13	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 30 tests, k _v =	0.9885		
Therefore variability=	22.13 <= 123.47 * 0.9885		
	or 22.13 <= 122.05		
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 (dry)	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	10/03/2015	15:30	16:30	42.8	6.80	1.89	48.03	7.0	2.6	48.0
2	10/03/2015	17:30	18:30	42.5	6.88	1.70	48.15	7.1	2.4	48.1
3	10/03/2015	19:30	20:30	42.9	7.15	1.68	47.96	7.4	2.4	48.0
4	10/03/2015	21:30	22:30	43.1	7.11	1.71	48.09	7.5	2.4	48.1
5	10/03/2015	23:30	00:30	45.4	7.07	1.61	48.97	7.5	2.3	49.0
6	11/03/2015	01:30	02:30	45.3	7.08	1.65	49.17	7.5	2.3	49.2
7	11/03/2015	03:30	04:30	43.7	7.43	1.68	47.62	7.9	2.3	47.6
8	11/03/2015	05:30	06:30	47.2	7.04	1.61	51.06	7.4	2.3	51.1
9	11/03/2015	07:30	08:30	43.6	7.31	1.60	47.29	7.7	2.3	47.3
10	11/03/2015	09:30	10:30	43.7	7.15	1.64	46.74	7.6	2.3	46.7
11	11/03/2015	11:30	12:30	42.1	6.98	1.71	47.00	7.1	2.5	47.0
12	11/03/2015	13:30	14:30	40.8	6.96	1.72	45.26	7.2	2.5	45.3
13	11/03/2015	15:30	16:30	42.6	6.86	1.80	45.08	7.3	2.6	45.1
14	11/03/2015	17:30	18:30	49.7	6.97	1.76	51.62	7.4	2.5	51.6
15	11/03/2015	19:30	20:30	54.8	7.02	1.74	57.71	7.5	2.4	57.7
16	11/03/2015	21:30	22:30	74.2	7.07	1.71	77.16	7.6	2.4	77.2
17	11/03/2015	23:30	00:30	93.7	7.13	1.78	96.49	7.7	2.5	96.5
18	12/03/2015	01:30	02:30	98.2	8.23	1.64	104.00	8.8	2.3	104.0
19	12/03/2015	05:30	06:30	108.7	6.95	1.66	115.01	7.5	2.5	115.0
20	12/03/2015	07:30	08:30	110.5	6.87	1.78	114.75	7.4	2.5	114.7
21	12/03/2015	11:30	12:30	98.6	6.91	1.72	106.20	7.2	2.5	106.2
22	12/03/2015	13:30	14:30	88.8	6.98	1.75	94.16	7.4	2.5	94.2
23	24/03/2015	09:40	10:40	117.3	7.05	1.91	124.59	7.2	2.5	124.6
24	24/03/2015	11:40	12:40	112.8	7.04	1.90	120.11	7.2	2.4	120.1
25	24/03/2015	13:40	14:40	115.2	6.90	1.29	121.99	7.2	2.4	122.0
26	24/03/2015	15:40	16:40	104.9	6.85	2.03	109.06	7.2	2.5	109.1
27	24/03/2015	17:40	18:40	110.6	6.93	1.86	115.95	7.3	2.3	115.9
28	24/03/2015	19:40	20:40	128.6	6.92	1.82	134.83	7.3	2.2	134.8
29	24/03/2015	21:40	22:40	131.6	6.96	1.81	138.24	7.3	2.2	138.2
30	24/03/2015	23:40	00:40	138.4	7.01	1.79	152.38	7.4	2.2	152.4
31	25/03/2015	01:40	02:40	151.4	6.99	1.83	166.86	7.4	2.2	166.9
32	25/03/2015	03:40	04:40	152.7	7.10	1.73	167.74	7.5	2.2	167.7
33	25/03/2015	05:40	06:40	142.3	7.01	1.66	156.14	7.5	2.1	156.1
34	25/03/2015	07:40	08:40	125.3	7.07	1.77	129.88	7.6	2.2	129.9

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

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

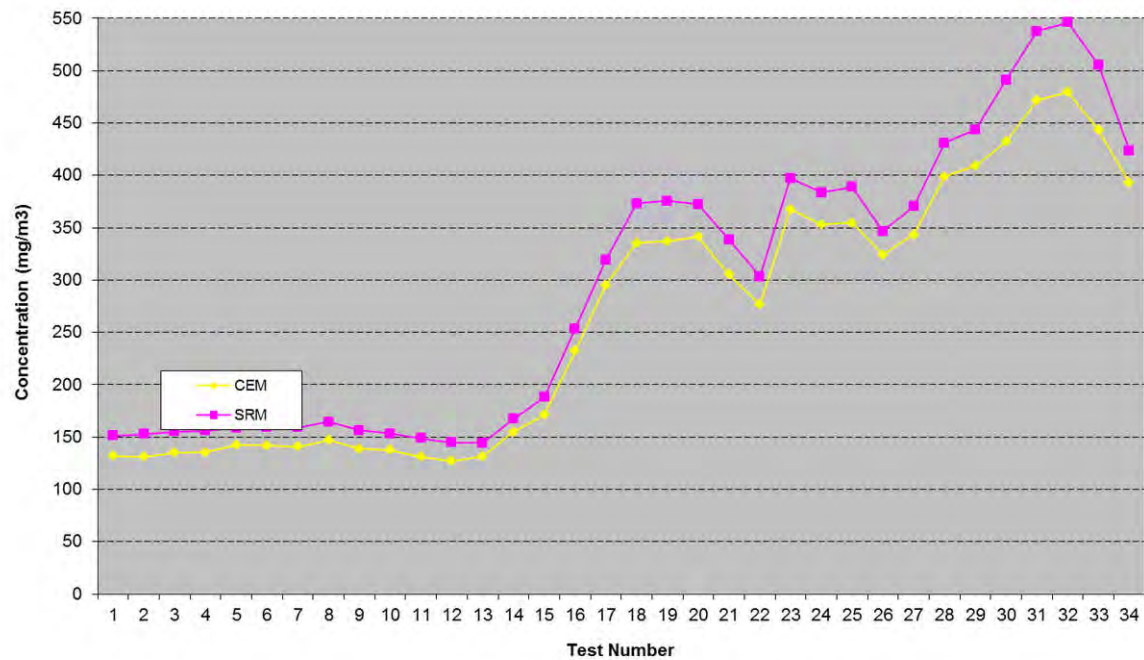
Test No	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
	hr:min		SO ₂ (mg/m3)	SO ₂ (mg/m3)	(mg/m3)
1	15:30	16:30	131.8	151.3	7.8
2	17:30	18:30	131.3	152.7	7.8
3	19:30	20:30	135.2	155.3	8.0
4	21:30	22:30	135.4	156.0	8.0
5	23:30	0:30	142.1	158.6	8.2
6	1:30	2:30	141.9	159.6	8.2
7	3:30	4:30	140.6	159.1	8.2
8	5:30	6:30	147.3	164.4	8.5
9	7:30	8:30	138.8	156.4	8.0
10	9:30	10:30	137.5	153.3	7.9
11	11:30	12:30	131.0	148.9	7.7
12	13:30	14:30	126.9	144.7	7.5
13	15:30	16:30	131.6	144.5	7.5
14	17:30	18:30	154.8	167.2	8.6
15	19:30	20:30	171.2	188.3	9.7
16	21:30	22:30	232.4	253.7	13.1
17	23:30	0:30	294.9	318.9	16.4
18	1:30	2:30	335.5	373.2	19.2
19	5:30	6:30	337.2	375.7	19.4
20	7:30	8:30	341.6	372.4	19.2
21	11:30	12:30	305.3	338.8	17.4
22	13:30	14:30	276.5	303.4	15.6
23	9:40	10:40	367.5	397.3	20.5
24	11:40	12:40	353.1	383.6	19.8
25	13:40	14:40	354.8	388.8	20.1
26	15:40	16:40	324.3	346.8	17.9
27	17:40	18:40	343.3	370.2	19.1
28	19:40	20:40	398.8	431.0	22.2
29	21:40	22:40	409.1	443.7	22.9
30	23:40	0:40	432.1	491.1	25.3
31	1:40	2:40	472.1	537.9	27.7
32	3:40	4:40	479.5	546.3	28.2
33	5:40	6:40	443.5	505.5	26.1
34	7:40	8:40	392.6	423.7	21.9

Note:

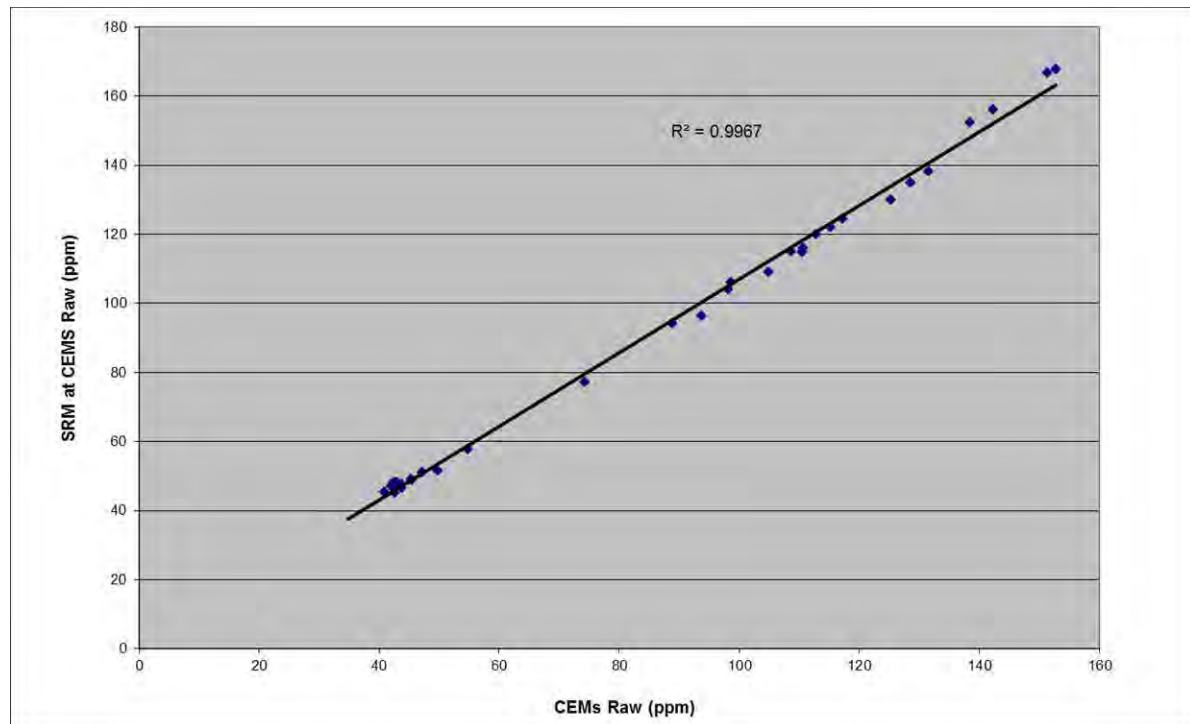
Emission concentrations expressed at reference conditions 273K, 101.3kPa

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 0.9967, 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	10-Mar-15	15:30	16:30	48.0	2.61	7.0	151.3
2	10-Mar-15	17:30	18:30	48.1	2.44	7.1	152.7
3	10-Mar-15	19:30	20:30	48.0	2.37	7.4	155.3
4	10-Mar-15	21:30	22:30	48.1	2.39	7.5	156.0
5	10-Mar-15	23:30	0:30	49.0	2.26	7.5	158.6
6	11-Mar-15	1:30	2:30	49.2	2.31	7.5	159.6
7	11-Mar-15	3:30	4:30	47.6	2.33	7.9	159.1
8	11-Mar-15	5:30	6:30	51.1	2.31	7.4	164.4
9	11-Mar-15	7:30	8:30	47.3	2.27	7.7	156.4
10	11-Mar-15	9:30	10:30	46.7	2.31	7.6	153.3
11	11-Mar-15	11:30	12:30	47.0	2.50	7.1	148.9
12	11-Mar-15	13:30	14:30	45.3	2.49	7.2	144.7
13	11-Mar-15	15:30	16:30	45.1	2.55	7.3	144.5
14	11-Mar-15	17:30	18:30	51.6	2.47	7.4	167.2
15	11-Mar-15	19:30	20:30	57.7	2.43	7.5	188.3
16	11-Mar-15	21:30	22:30	77.2	2.39	7.6	253.7
17	11-Mar-15	23:30	0:30	96.5	2.50	7.7	318.9
18	12-Mar-15	1:30	2:30	104.0	2.33	8.8	373.2
19	12-Mar-15	5:30	6:30	115.0	2.50	7.5	375.7
20	12-Mar-15	7:30	8:30	114.7	2.53	7.4	372.4
21	12-Mar-15	11:30	12:30	106.2	2.45	7.2	338.8
22	12-Mar-15	13:30	14:30	94.2	2.49	7.4	303.4
23	24-Mar-15	9:40	10:40	124.6	2.50	7.2	397.3
24	24-Mar-15	11:40	12:40	120.1	2.38	7.2	383.6
25	24-Mar-15	13:40	14:40	122.0	2.36	7.2	388.8
26	24-Mar-15	15:40	16:40	109.1	2.54	7.2	346.8
27	24-Mar-15	17:40	18:40	115.9	2.29	7.3	370.2
28	24-Mar-15	19:40	20:40	134.8	2.23	7.3	431.0
29	24-Mar-15	21:40	22:40	138.2	2.22	7.3	443.7
30	24-Mar-15	23:40	0:40	152.4	2.20	7.4	491.1
31	25-Mar-15	1:40	2:40	166.9	2.24	7.4	537.9
32	25-Mar-15	3:40	4:40	167.7	2.16	7.5	546.3
33	25-Mar-15	5:40	6:40	156.1	2.05	7.5	505.5
34	25-Mar-15	7:40	8:40	129.9	2.22	7.6	423.7
Sum				3075.26			
Emission Limit Value (ELV) =				440			Y _{max} 546.29
15% of the ELV =				66			Y _{min} 144.47
Therefore Ymax - Ymin > 15% of the ELV				Method A			Y _{max} - Ymin 401.82

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	17-Feb-15	Reference Gas		0	0.37	-87.86467978	-81.75937485	7183.76129	6684.595376	
2	10-Mar-15	15:30	16:30	48.0	42.8	-39.83	-39.30	1565.38	1544.32	
3	10-Mar-15	17:30	18:30	48.1	42.5	-39.72	-39.64	1574.39	1571.16	
4	10-Mar-15	19:30	20:30	48.0	42.9	-39.90	-39.21	1564.74	1537.59	
5	10-Mar-15	21:30	22:30	48.1	43.1	-39.78	-39.03	1552.53	1523.28	
6	10-Mar-15	23:30	0:30	49.0	45.4	-38.90	-36.70	1427.45	1346.87	
7	11-Mar-15	1:30	2:30	49.2	45.3	-38.70	-36.81	1424.28	1354.80	
8	11-Mar-15	3:30	4:30	47.6	43.7	-40.25	-38.38	1544.88	1473.31	
9	11-Mar-15	5:30	6:30	51.1	47.2	-36.81	-34.92	1285.19	1219.26	
10	11-Mar-15	7:30	8:30	47.3	43.6	-40.57	-38.53	1563.07	1484.31	
11	11-Mar-15	9:30	10:30	46.7	43.7	-41.13	-38.43	1580.31	1476.63	
12	11-Mar-15	11:30	12:30	47.0	42.1	-40.86	-40.03	1635.66	1602.15	
13	11-Mar-15	13:30	14:30	45.3	40.8	-42.60	-41.28	1758.73	1704.36	
14	11-Mar-15	15:30	16:30	45.1	42.6	-42.79	-39.53	1691.37	1562.51	
15	11-Mar-15	17:30	18:30	51.6	49.7	-36.25	-32.39	1174.06	1049.10	
16	11-Mar-15	19:30	20:30	57.7	54.8	-30.15	-27.28	822.58	744.36	
17	11-Mar-15	21:30	22:30	77.2	74.2	-10.71	-7.90	84.56	62.37	
18	11-Mar-15	23:30	0:30	96.5	93.7	8.63	11.56	99.71	133.56	
19	12-Mar-15	1:30	2:30	104.0	98.2	16.13	16.12	259.99	259.76	
20	12-Mar-15	5:30	6:30	115.0	108.7	27.14	26.56	720.91	705.38	
21	12-Mar-15	7:30	8:30	114.7	110.5	26.88	28.40	763.53	806.82	
22	12-Mar-15	11:30	12:30	106.2	98.6	18.34	16.45	301.71	270.73	
23	12-Mar-15	13:30	14:30	94.2	88.8	6.29	6.67	42.00	44.54	
24	24-Mar-15	9:40	10:40	124.6	117.3	36.72	35.13	1289.98	1234.10	
25	24-Mar-15	11:40	12:40	120.1	112.8	32.24	30.63	987.50	937.96	
26	24-Mar-15	13:40	14:40	122.0	115.2	34.12	33.06	1128.23	1093.19	
27	24-Mar-15	15:40	16:40	109.1	104.9	21.19	22.77	482.44	518.30	
28	24-Mar-15	17:40	18:40	115.9	110.6	28.08	28.45	798.85	809.13	
29	24-Mar-15	19:40	20:40	134.8	128.6	46.96	46.43	2180.32	2155.36	
30	24-Mar-15	21:40	22:40	138.2	131.6	50.38	49.45	2491.01	2444.88	
31	24-Mar-15	23:40	0:40	152.4	138.4	64.52	56.31	3633.08	3170.95	
32	25-Mar-15	1:40	2:40	166.9	151.4	78.99	69.25	5470.04	4795.05	
33	25-Mar-15	3:40	4:40	167.7	152.7	79.88	70.58	5637.83	4981.87	
34	25-Mar-15	5:40	6:40	156.1	142.3	68.28	60.13	4105.17	3615.22	
35	25-Mar-15	7:40	8:40	129.9	125.3	42.02	43.17	1814.19	1864.01	
Sum				3075.26	2874.53	0.00	0.00	61639.45	57781.79	1.07

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

Method A

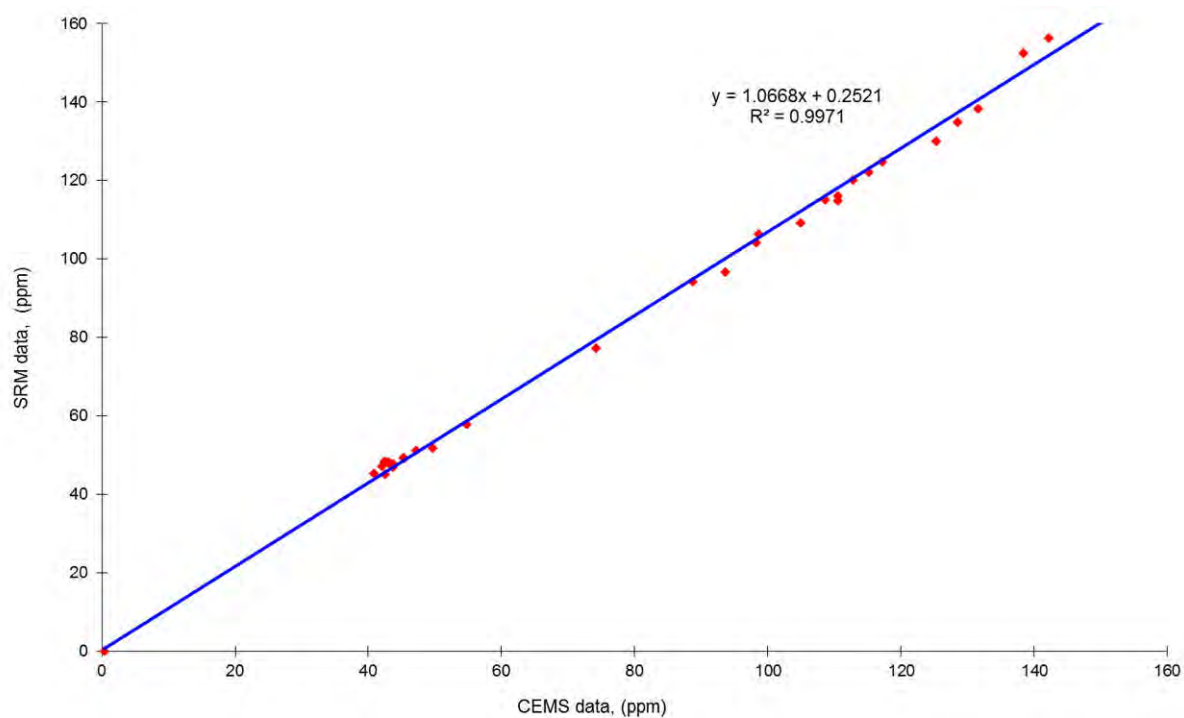
If $Y_{max} - Y_{min} > 15\%$ of the ELV, the following formulae are used:

$b = \frac{\sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^N (x_i - \bar{x})^2}$	where	$\bar{x} = \frac{1}{N} \sum_{i=1}^N x_i$	$\bar{y} = \frac{1}{N} \sum_{i=1}^N y_i$	$x =$	82.13
				$y =$	87.86
				$b =$	1.067
$a = \bar{y} - b\bar{x}$		$a = 87.87 - 82.13 * 1.066$		$a =$	0.252
The calibration is function $y_i = a + b x_i$ or			$y_i =$	$0.252 + 1.067 * x_i$	

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 dry 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		0.4	0.6			1.8	0.0
2	10-Mar-15	15:30	16:30	42.8	45.9	1.9	6.8	141.4	151.3
3	10-Mar-15	17:30	18:30	42.5	45.6	1.7	6.9	140.8	152.7
4	10-Mar-15	19:30	20:30	42.9	46.0	1.7	7.2	145.0	155.3
5	10-Mar-15	21:30	22:30	43.1	46.2	1.7	7.1	145.2	156.0
6	10-Mar-15	23:30	00:30	45.4	48.7	1.6	7.1	152.4	158.6
7	11-Mar-15	01:30	02:30	45.3	48.6	1.7	7.1	152.2	159.6
8	11-Mar-15	03:30	04:30	43.7	46.9	1.7	7.4	150.8	159.1
9	11-Mar-15	05:30	06:30	47.2	50.6	1.6	7.0	157.9	164.4
10	11-Mar-15	07:30	08:30	43.6	46.8	1.6	7.3	148.8	156.4
11	11-Mar-15	09:30	10:30	43.7	46.9	1.6	7.1	147.5	153.3
12	11-Mar-15	11:30	12:30	42.1	45.2	1.7	7.0	140.6	148.9
13	11-Mar-15	13:30	14:30	40.8	43.8	1.7	7.0	136.2	144.7
14	11-Mar-15	15:30	16:30	42.6	45.7	1.8	6.9	141.1	144.5
15	11-Mar-15	17:30	18:30	49.7	53.3	1.8	7.0	165.9	167.2
16	11-Mar-15	19:30	20:30	54.8	58.8	1.7	7.0	183.4	188.3
17	11-Mar-15	21:30	22:30	74.2	79.4	1.7	7.1	248.7	253.7
18	11-Mar-15	23:30	00:30	93.7	100.2	1.8	7.1	315.4	318.9
19	12-Mar-15	01:30	02:30	98.2	105.1	1.6	8.2	358.8	373.2
20	12-Mar-15	05:30	06:30	108.7	116.2	1.7	6.9	360.5	375.7
21	12-Mar-15	07:30	08:30	110.5	118.2	1.8	6.9	365.2	372.4
22	12-Mar-15	11:30	12:30	98.6	105.4	1.7	6.9	326.4	338.8
23	12-Mar-15	13:30	14:30	88.8	95.0	1.7	7.0	295.8	303.4
24	24-Mar-15	09:40	10:40	117.3	125.3	1.9	7.1	392.8	397.3
25	24-Mar-15	11:40	12:40	112.8	120.5	1.9	7.0	377.4	383.6
26	24-Mar-15	13:40	14:40	115.2	123.1	1.3	6.9	379.3	388.8
27	24-Mar-15	15:40	16:40	104.9	112.2	2.0	6.8	346.8	346.8
28	24-Mar-15	17:40	18:40	110.6	118.2	1.9	6.9	367.0	370.2
29	24-Mar-15	19:40	20:40	128.6	137.4	1.8	6.9	426.2	431.0
30	24-Mar-15	21:40	22:40	131.6	140.6	1.8	7.0	437.2	443.7
31	24-Mar-15	23:40	00:40	138.4	147.9	1.8	7.0	461.7	491.1
32	25-Mar-15	01:40	02:40	151.4	161.7	1.8	7.0	504.4	537.9
33	25-Mar-15	03:40	04:40	152.7	163.2	1.7	7.1	512.3	546.3
34	25-Mar-15	05:40	06:40	142.3	152.0	1.7	7.0	473.9	505.5
35	25-Mar-15	07:40	08:40	125.3	133.9	1.8	7.1	419.6	423.7
Sum								9620.4	
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, wet gas



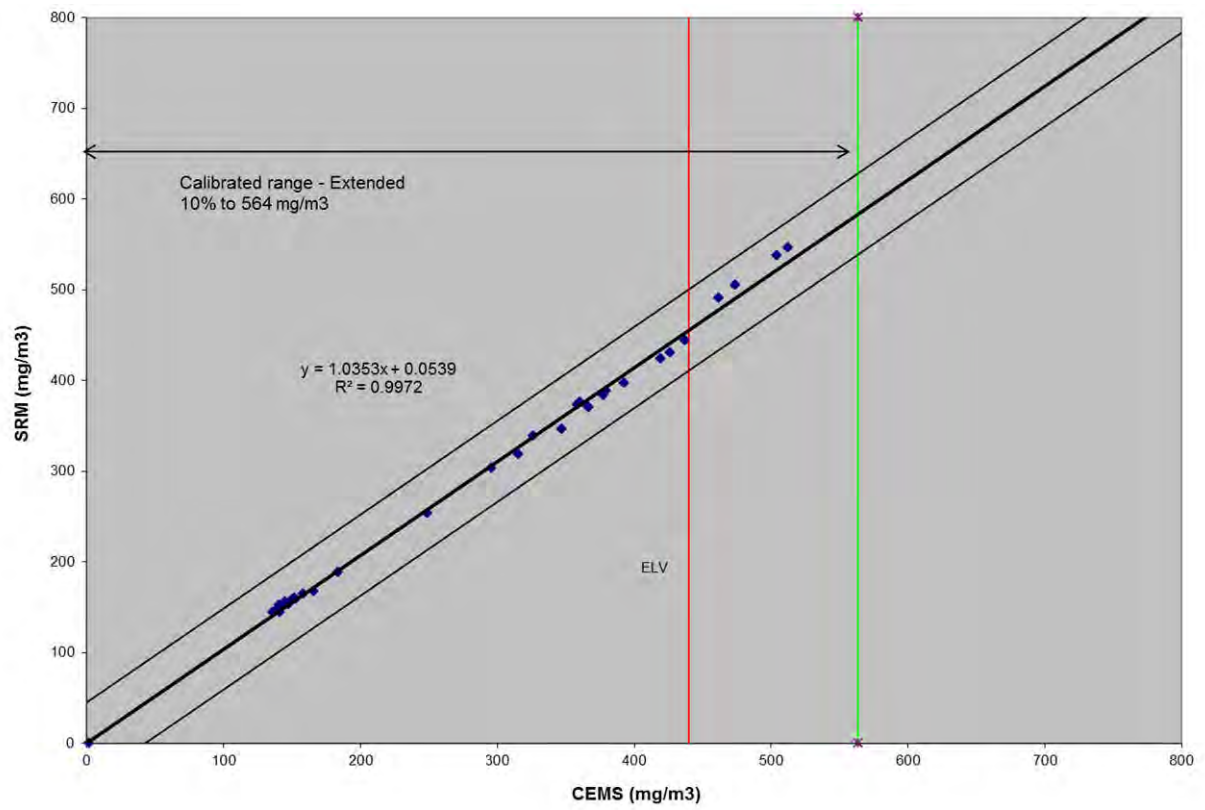
4A1.10.2 Table 4.5.2 – Data used for the Variability Test – Sulphur Dioxide, Low Range.

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	17-Feb-15	Reference Gas		1.8	0.0	-1.85	-11.62	134.94
2	10-Mar-15	15:30	16:30	141.4	151.3	9.91	0.15	0.02
3	10-Mar-15	17:30	18:30	140.8	152.7	11.86	2.09	4.36
4	10-Mar-15	19:30	20:30	145.0	155.3	10.33	0.56	0.31
5	10-Mar-15	21:30	22:30	145.2	156.0	10.81	1.04	1.08
6	10-Mar-15	23:30	00:30	152.4	158.6	6.21	-3.56	12.68
7	11-Mar-15	01:30	02:30	152.2	159.6	7.45	-2.31	5.35
8	11-Mar-15	03:30	04:30	150.8	159.1	8.35	-1.41	2.00
9	11-Mar-15	05:30	06:30	157.9	164.4	6.44	-3.33	11.08
10	11-Mar-15	07:30	08:30	148.8	156.4	7.60	-2.17	4.69
11	11-Mar-15	09:30	10:30	147.5	153.3	5.77	-3.99	15.95
12	11-Mar-15	11:30	12:30	140.6	148.9	8.35	-1.42	2.02
13	11-Mar-15	13:30	14:30	136.2	144.7	8.57	-1.20	1.44
14	11-Mar-15	15:30	16:30	141.1	144.5	3.35	-6.42	41.25
15	11-Mar-15	17:30	18:30	165.9	167.2	1.31	-8.46	71.56
16	11-Mar-15	19:30	20:30	183.4	188.3	4.89	-4.88	23.84
17	11-Mar-15	21:30	22:30	248.7	253.7	4.96	-4.81	23.10
18	11-Mar-15	23:30	00:30	315.4	318.9	3.58	-6.19	38.33
19	12-Mar-15	01:30	02:30	358.8	373.2	14.45	4.68	21.94
20	12-Mar-15	05:30	06:30	360.5	375.7	15.23	5.47	29.87
21	12-Mar-15	07:30	08:30	365.2	372.4	7.19	-2.58	6.64
22	12-Mar-15	11:30	12:30	326.4	338.8	12.35	2.58	6.65
23	12-Mar-15	13:30	14:30	295.8	303.4	7.65	-2.12	4.49
24	24-Mar-15	09:40	10:40	392.8	397.3	4.43	-5.34	28.47
25	24-Mar-15	11:40	12:40	377.4	383.6	6.16	-3.60	12.99
26	24-Mar-15	13:40	14:40	379.3	388.8	9.54	-0.23	0.05
27	24-Mar-15	15:40	16:40	346.8	346.8	0.01	-9.76	95.20
28	24-Mar-15	17:40	18:40	367.0	370.2	3.18	-6.59	43.44
29	24-Mar-15	19:40	20:40	426.2	431.0	4.79	-4.98	24.77
30	24-Mar-15	21:40	22:40	437.2	443.7	6.47	-3.30	10.90
31	24-Mar-15	23:40	00:40	461.7	491.1	29.38	19.62	384.78
32	25-Mar-15	01:40	02:40	504.4	537.9	33.49	23.72	562.83
33	25-Mar-15	03:40	04:40	512.3	546.3	33.96	24.19	585.03
34	25-Mar-15	05:40	06:40	473.9	505.5	31.60	21.84	476.77
35	25-Mar-15	07:40	08:40	419.6	423.7	4.11	-5.66	32.01
35	Tests		Mean			9.77		
	Sum							2720.83

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

SD=	Root(1-Number).Integral(D1-D) ²	8.95	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 30 tests, k _v =	0.9885		
Therefore variability=	8.95 <= 44.9 * 0.9885		
	or 8.95 <=	44.38	
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 6% oxygen, 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 (dry)	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	10/03/2015	15:30	16:30	42.9	6.80	1.89	48.03	7.0	2.6	48.0
2	10/03/2015	17:30	18:30	42.5	6.88	1.70	48.15	7.1	2.4	48.1
3	10/03/2015	19:30	20:30	42.9	7.15	1.68	47.96	7.4	2.4	48.0
4	10/03/2015	21:30	22:30	43.1	7.11	1.71	48.09	7.5	2.4	48.1
5	10/03/2015	23:30	00:30	45.4	7.07	1.61	48.97	7.5	2.3	49.0
6	11/03/2015	01:30	02:30	45.3	7.08	1.65	49.17	7.5	2.3	49.2
7	11/03/2015	03:30	04:30	43.7	7.43	1.68	47.62	7.9	2.3	47.6
8	11/03/2015	05:30	06:30	47.2	7.04	1.61	51.06	7.4	2.3	51.1
9	11/03/2015	07:30	08:30	43.6	7.31	1.60	47.29	7.7	2.3	47.3
10	11/03/2015	09:30	10:30	43.7	7.15	1.64	46.74	7.6	2.3	46.7
11	11/03/2015	11:30	12:30	42.1	6.98	1.71	47.00	7.1	2.5	47.0
12	11/03/2015	13:30	14:30	40.9	6.96	1.72	45.26	7.2	2.5	45.3
13	11/03/2015	15:30	16:30	42.6	6.86	1.80	45.08	7.3	2.6	45.1
14	11/03/2015	17:30	18:30	49.8	6.97	1.76	51.62	7.4	2.5	51.6
15	11/03/2015	19:30	20:30	54.9	7.02	1.74	57.71	7.5	2.4	57.7
16	11/03/2015	21:30	22:30	74.3	7.07	1.71	77.16	7.6	2.4	77.2
17	11/03/2015	23:30	00:30	93.7	7.13	1.78	96.49	7.7	2.5	96.5
18	12/03/2015	01:30	02:30	98.3	8.23	1.64	104.00	8.8	2.3	104.0
19	12/03/2015	05:30	06:30	108.7	6.95	1.66	115.01	7.5	2.5	115.0
20	12/03/2015	07:30	08:30	110.6	6.87	1.78	114.75	7.4	2.5	114.7
21	12/03/2015	11:30	12:30	98.6	6.91	1.72	106.20	7.2	2.5	106.2
22	12/03/2015	13:30	14:30	88.9	6.98	1.75	94.16	7.4	2.5	94.2
23	24/03/2015	09:40	10:40	117.3	7.05	1.91	124.59	7.2	2.5	124.6
24	24/03/2015	11:40	12:40	112.8	7.04	1.90	120.11	7.2	2.4	120.1
25	24/03/2015	13:40	14:40	115.2	6.90	1.29	121.99	7.2	2.4	122.0
26	24/03/2015	15:40	16:40	104.9	6.85	2.03	109.06	7.2	2.5	109.1
27	24/03/2015	17:40	18:40	110.6	6.93	1.86	115.95	7.3	2.3	115.9
28	24/03/2015	19:40	20:40	128.6	6.92	1.82	134.83	7.3	2.2	134.8
29	24/03/2015	21:40	22:40	131.6	6.96	1.81	138.24	7.3	2.2	138.2
30	24/03/2015	23:40	00:40	138.4	7.01	1.79	152.38	7.4	2.2	152.4
31	25/03/2015	01:40	02:40	151.3	6.99	1.83	166.86	7.4	2.2	166.9
32	25/03/2015	03:40	04:40	152.7	7.10	1.73	167.74	7.5	2.2	167.7
33	25/03/2015	05:40	06:40	142.2	7.01	1.66	156.14	7.5	2.1	156.1
34	25/03/2015	07:40	08:40	125.2	7.07	1.77	129.88	7.6	2.2	129.9

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

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

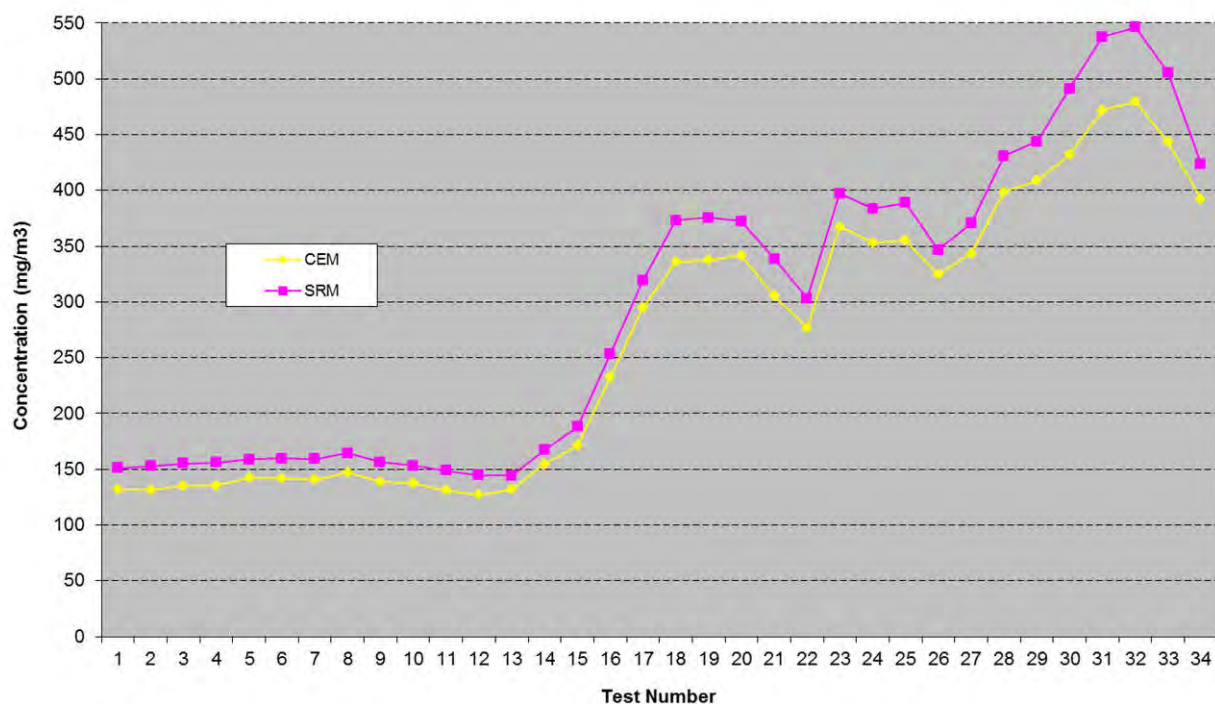
Test No	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
	hr:min		SO ₂ (mg/m3)	SO ₂ (mg/m3)	(mg/m3)
1	15:30	16:30	131.9	151.3	7.8
2	17:30	18:30	131.4	152.7	7.8
3	19:30	20:30	135.3	155.3	8.0
4	21:30	22:30	135.5	156.0	8.0
5	23:30	0:30	142.2	158.6	8.2
6	1:30	2:30	141.9	159.6	8.2
7	3:30	4:30	140.5	159.1	8.2
8	5:30	6:30	147.3	164.4	8.5
9	7:30	8:30	138.7	156.4	8.0
10	9:30	10:30	137.5	153.3	7.9
11	11:30	12:30	131.1	148.9	7.7
12	13:30	14:30	127.0	144.7	7.5
13	15:30	16:30	131.7	144.5	7.5
14	17:30	18:30	155.0	167.2	8.6
15	19:30	20:30	171.4	188.3	9.7
16	21:30	22:30	232.7	253.7	13.1
17	23:30	0:30	294.9	318.9	16.4
18	1:30	2:30	335.7	373.2	19.2
19	5:30	6:30	337.3	375.7	19.4
20	7:30	8:30	341.7	372.4	19.2
21	11:30	12:30	305.4	338.8	17.4
22	13:30	14:30	276.8	303.4	15.6
23	9:40	10:40	367.5	397.3	20.5
24	11:40	12:40	353.1	383.6	19.8
25	13:40	14:40	354.9	388.8	20.1
26	15:40	16:40	324.4	346.8	17.9
27	17:40	18:40	343.3	370.2	19.1
28	19:40	20:40	398.8	431.0	22.2
29	21:40	22:40	409.0	443.7	22.9
30	23:40	0:40	432.1	491.1	25.3
31	1:40	2:40	472.0	537.9	27.7
32	3:40	4:40	479.4	546.3	28.2
33	5:40	6:40	443.2	505.5	26.1
34	7:40	8:40	392.5	423.7	21.9

Note:

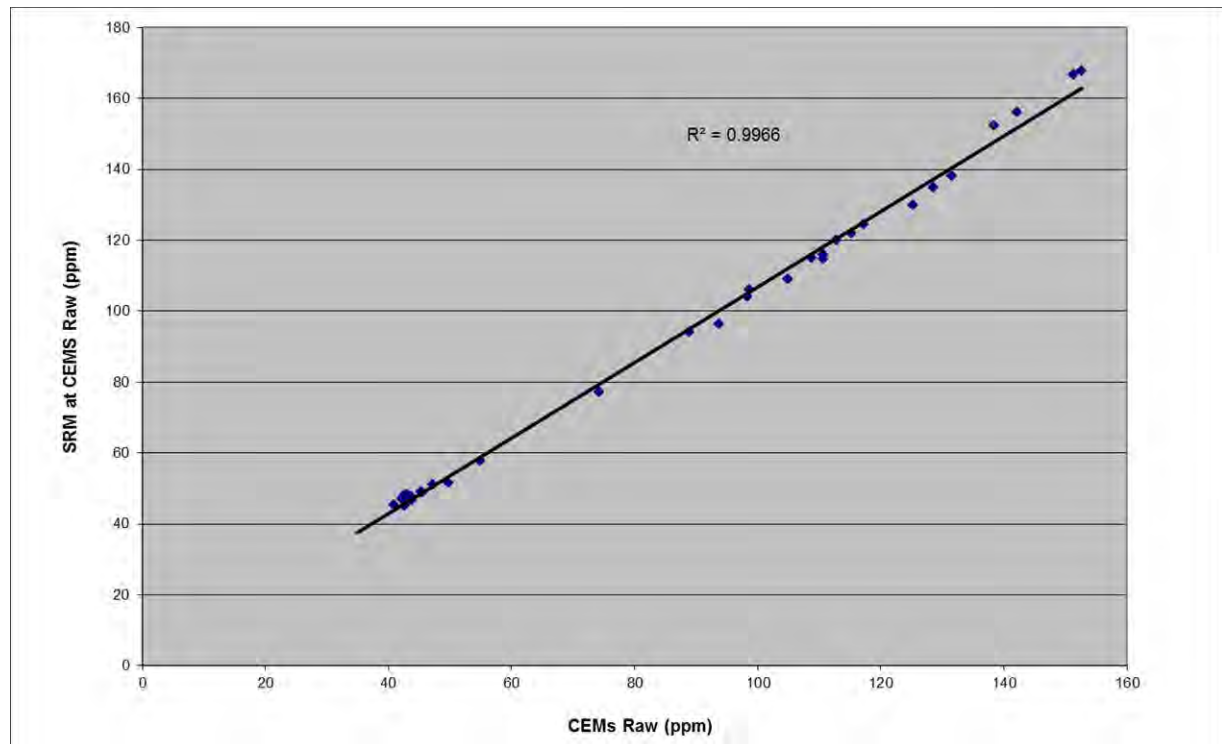
Emission concentrations expressed at reference conditions 273K, 101.3kPa

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 0.9966, 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	10-Mar-15	15:30	16:30	48.0	2.61	7.0	151.3
2	10-Mar-15	17:30	18:30	48.1	2.44	7.1	152.7
3	10-Mar-15	19:30	20:30	48.0	2.37	7.4	155.3
4	10-Mar-15	21:30	22:30	48.1	2.39	7.5	156.0
5	10-Mar-15	23:30	0:30	49.0	2.26	7.5	158.6
6	11-Mar-15	1:30	2:30	49.2	2.31	7.5	159.6
7	11-Mar-15	3:30	4:30	47.6	2.33	7.9	159.1
8	11-Mar-15	5:30	6:30	51.1	2.31	7.4	164.4
9	11-Mar-15	7:30	8:30	47.3	2.27	7.7	156.4
10	11-Mar-15	9:30	10:30	46.7	2.31	7.6	153.3
11	11-Mar-15	11:30	12:30	47.0	2.50	7.1	148.9
12	11-Mar-15	13:30	14:30	45.3	2.49	7.2	144.7
13	11-Mar-15	15:30	16:30	45.1	2.55	7.3	144.5
14	11-Mar-15	17:30	18:30	51.6	2.47	7.4	167.2
15	11-Mar-15	19:30	20:30	57.7	2.43	7.5	188.3
16	11-Mar-15	21:30	22:30	77.2	2.39	7.6	253.7
17	11-Mar-15	23:30	0:30	96.5	2.50	7.7	318.9
18	12-Mar-15	1:30	2:30	104.0	2.33	8.8	373.2
19	12-Mar-15	5:30	6:30	115.0	2.50	7.5	375.7
20	12-Mar-15	7:30	8:30	114.7	2.53	7.4	372.4
21	12-Mar-15	11:30	12:30	106.2	2.45	7.2	338.8
22	12-Mar-15	13:30	14:30	94.2	2.49	7.4	303.4
23	24-Mar-15	9:40	10:40	124.6	2.50	7.2	397.3
24	24-Mar-15	11:40	12:40	120.1	2.38	7.2	383.6
25	24-Mar-15	13:40	14:40	122.0	2.36	7.2	388.8
26	24-Mar-15	15:40	16:40	109.1	2.54	7.2	346.8
27	24-Mar-15	17:40	18:40	115.9	2.29	7.3	370.2
28	24-Mar-15	19:40	20:40	134.8	2.23	7.3	431.0
29	24-Mar-15	21:40	22:40	138.2	2.22	7.3	443.7
30	24-Mar-15	23:40	0:40	152.4	2.20	7.4	491.1
31	25-Mar-15	1:40	2:40	166.9	2.24	7.4	537.9
32	25-Mar-15	3:40	4:40	167.7	2.16	7.5	546.3
33	25-Mar-15	5:40	6:40	156.1	2.05	7.5	505.5
34	25-Mar-15	7:40	8:40	129.9	2.22	7.6	423.7
Sum				3075.26			
Emission Limit Value (ELV) =				440	mg/Nm ³		Y _{max} 546.29
15% of the ELV =				66	mg/Nm ³		Y _{min} 144.47
Therefore Ymax - Ymin > 15% of the ELV				Method A		Y _{max} - Ymin	401.82

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)	Yi	Xi	Xi * Yi	Xi ²	b
		hr:min		SO2 (ppm)	SO2 (ppm)	1	2	3	4	
1	17-Feb-15	Reference Gas		0	0.37	-87.86467978	-81.77507455	7185.140739	6687.162817	
2	10-Mar-15	15:30	16:30	48.0	42.9	-39.83	-39.29	1565.22	1544.00	
3	10-Mar-15	17:30	18:30	48.1	42.5	-39.72	-39.61	1573.27	1568.93	
4	10-Mar-15	19:30	20:30	48.0	42.9	-39.90	-39.20	1564.13	1536.40	
5	10-Mar-15	21:30	22:30	48.1	43.1	-39.78	-39.03	1552.40	1523.01	
6	10-Mar-15	23:30	0:30	49.0	45.4	-38.90	-36.70	1427.41	1346.80	
7	11-Mar-15	1:30	2:30	49.2	45.3	-38.70	-36.82	1424.87	1355.93	
8	11-Mar-15	3:30	4:30	47.6	43.7	-40.25	-38.42	1546.21	1475.85	
9	11-Mar-15	5:30	6:30	51.1	47.2	-36.81	-34.96	1286.56	1221.87	
10	11-Mar-15	7:30	8:30	47.3	43.6	-40.57	-38.56	1564.55	1487.12	
11	11-Mar-15	9:30	10:30	46.7	43.7	-41.13	-38.44	1581.04	1477.98	
12	11-Mar-15	11:30	12:30	47.0	42.1	-40.86	-40.01	1635.16	1601.17	
13	11-Mar-15	13:30	14:30	45.3	40.9	-42.60	-41.27	1757.96	1702.87	
14	11-Mar-15	15:30	16:30	45.1	42.6	-42.79	-39.50	1690.12	1560.20	
15	11-Mar-15	17:30	18:30	51.6	49.8	-36.25	-32.34	1172.39	1046.12	
16	11-Mar-15	19:30	20:30	57.7	54.9	-30.15	-27.23	820.92	741.35	
17	11-Mar-15	21:30	22:30	77.2	74.3	-10.71	-7.84	83.92	61.42	
18	11-Mar-15	23:30	0:30	96.5	93.7	8.63	11.56	99.78	133.74	
19	12-Mar-15	1:30	2:30	104.0	98.3	16.13	16.16	260.75	261.28	
20	12-Mar-15	5:30	6:30	115.0	108.7	27.14	26.57	721.27	706.08	
21	12-Mar-15	7:30	8:30	114.7	110.6	26.88	28.44	764.61	809.10	
22	12-Mar-15	11:30	12:30	106.2	98.6	18.34	16.49	302.39	271.95	
23	12-Mar-15	13:30	14:30	94.2	88.9	6.29	6.74	42.39	45.38	
24	24-Mar-15	9:40	10:40	124.6	117.3	36.72	35.12	1289.49	1233.17	
25	24-Mar-15	11:40	12:40	120.1	112.8	32.24	30.63	987.59	938.12	
26	24-Mar-15	13:40	14:40	122.0	115.2	34.12	33.08	1128.62	1093.96	
27	24-Mar-15	15:40	16:40	109.1	104.9	21.19	22.77	482.52	518.48	
28	24-Mar-15	17:40	18:40	115.9	110.6	28.08	28.44	798.81	809.06	
29	24-Mar-15	19:40	20:40	134.8	128.6	46.96	46.41	2179.80	2154.33	
30	24-Mar-15	21:40	22:40	138.2	131.6	50.38	49.42	2489.56	2442.04	
31	24-Mar-15	23:40	0:40	152.4	138.4	64.52	56.30	3632.09	3169.22	
32	25-Mar-15	1:40	2:40	166.9	151.3	78.99	69.20	5466.35	4788.58	
33	25-Mar-15	3:40	4:40	167.7	152.7	79.88	70.52	5632.79	4972.96	
34	25-Mar-15	5:40	6:40	156.1	142.2	68.28	60.04	4098.96	3604.29	
35	25-Mar-15	7:40	8:40	129.9	125.2	42.02	43.10	1811.17	1857.81	
Sum				3075.26	2875.08	0.00	0.00	61620.23	57747.74	1.07

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:

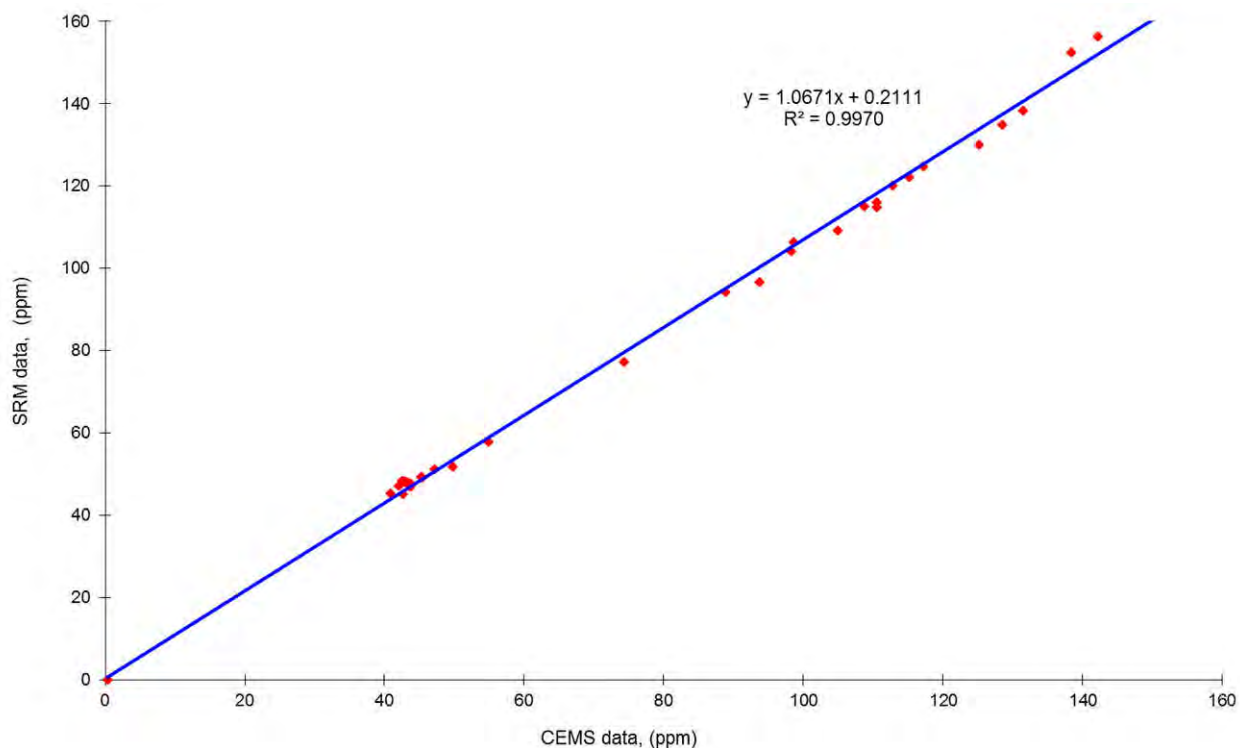
$b = \frac{\sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^N (x_i - \bar{x})^2}$	where	$\bar{x} = \frac{1}{N} \sum_{i=1}^N x_i$	$\bar{y} = \frac{1}{N} \sum_{i=1}^N y_i$	$x =$	82.15
				$y =$	87.86
				$b =$	1.067
$a = y - bx$	$a = 87.87 - 82.15 * 1.067$			$a =$	0.211

The calibration is function $y_i = a + b x_i$ or $y_i = 0.211 + 1.067 * x_i$

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 dry 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		0.4	0.6			1.7	0.0
2	10-Mar-15	15:30	16:30	42.9	45.9	1.9	6.8	141.4	151.3
3	10-Mar-15	17:30	18:30	42.5	45.6	1.7	6.9	140.9	152.7
4	10-Mar-15	19:30	20:30	42.9	46.0	1.7	7.2	145.0	155.3
5	10-Mar-15	21:30	22:30	43.1	46.2	1.7	7.1	145.2	156.0
6	10-Mar-15	23:30	00:30	45.4	48.7	1.6	7.1	152.4	158.6
7	11-Mar-15	01:30	02:30	45.3	48.6	1.7	7.1	152.1	159.6
8	11-Mar-15	03:30	04:30	43.7	46.9	1.7	7.4	150.6	159.1
9	11-Mar-15	05:30	06:30	47.2	50.6	1.6	7.0	157.8	164.4
10	11-Mar-15	07:30	08:30	43.6	46.7	1.6	7.3	148.7	156.4
11	11-Mar-15	09:30	10:30	43.7	46.8	1.6	7.1	147.4	153.3
12	11-Mar-15	11:30	12:30	42.1	45.2	1.7	7.0	140.6	148.9
13	11-Mar-15	13:30	14:30	40.9	43.8	1.7	7.0	136.2	144.7
14	11-Mar-15	15:30	16:30	42.6	45.7	1.8	6.9	141.2	144.5
15	11-Mar-15	17:30	18:30	49.8	53.4	1.8	7.0	166.0	167.2
16	11-Mar-15	19:30	20:30	54.9	58.8	1.7	7.0	183.5	188.3
17	11-Mar-15	21:30	22:30	74.3	79.5	1.7	7.1	248.9	253.7
18	11-Mar-15	23:30	00:30	93.7	100.2	1.8	7.1	315.4	318.9
19	12-Mar-15	01:30	02:30	98.3	105.1	1.6	8.2	359.0	373.2
20	12-Mar-15	05:30	06:30	108.7	116.2	1.7	6.9	360.5	375.7
21	12-Mar-15	07:30	08:30	110.6	118.2	1.8	6.9	365.3	372.4
22	12-Mar-15	11:30	12:30	98.6	105.5	1.7	6.9	326.6	338.8
23	12-Mar-15	13:30	14:30	88.9	95.1	1.7	7.0	296.0	303.4
24	24-Mar-15	09:40	10:40	117.3	125.3	1.9	7.1	392.8	397.3
25	24-Mar-15	11:40	12:40	112.8	120.5	1.9	7.0	377.5	383.6
26	24-Mar-15	13:40	14:40	115.2	123.2	1.3	6.9	379.4	388.8
27	24-Mar-15	15:40	16:40	104.9	112.2	2.0	6.8	346.8	346.8
28	24-Mar-15	17:40	18:40	110.6	118.2	1.9	6.9	367.0	370.2
29	24-Mar-15	19:40	20:40	128.6	137.4	1.8	6.9	426.2	431.0
30	24-Mar-15	21:40	22:40	131.6	140.6	1.8	7.0	437.1	443.7
31	24-Mar-15	23:40	00:40	138.4	147.9	1.8	7.0	461.7	491.1
32	25-Mar-15	01:40	02:40	151.3	161.7	1.8	7.0	504.3	537.9
33	25-Mar-15	03:40	04:40	152.7	163.1	1.7	7.1	512.2	546.3
34	25-Mar-15	05:40	06:40	142.2	151.9	1.7	7.0	473.6	505.5
35	25-Mar-15	07:40	08:40	125.2	133.9	1.8	7.1	419.4	423.7
Sum								9620.5	
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, wet gas.



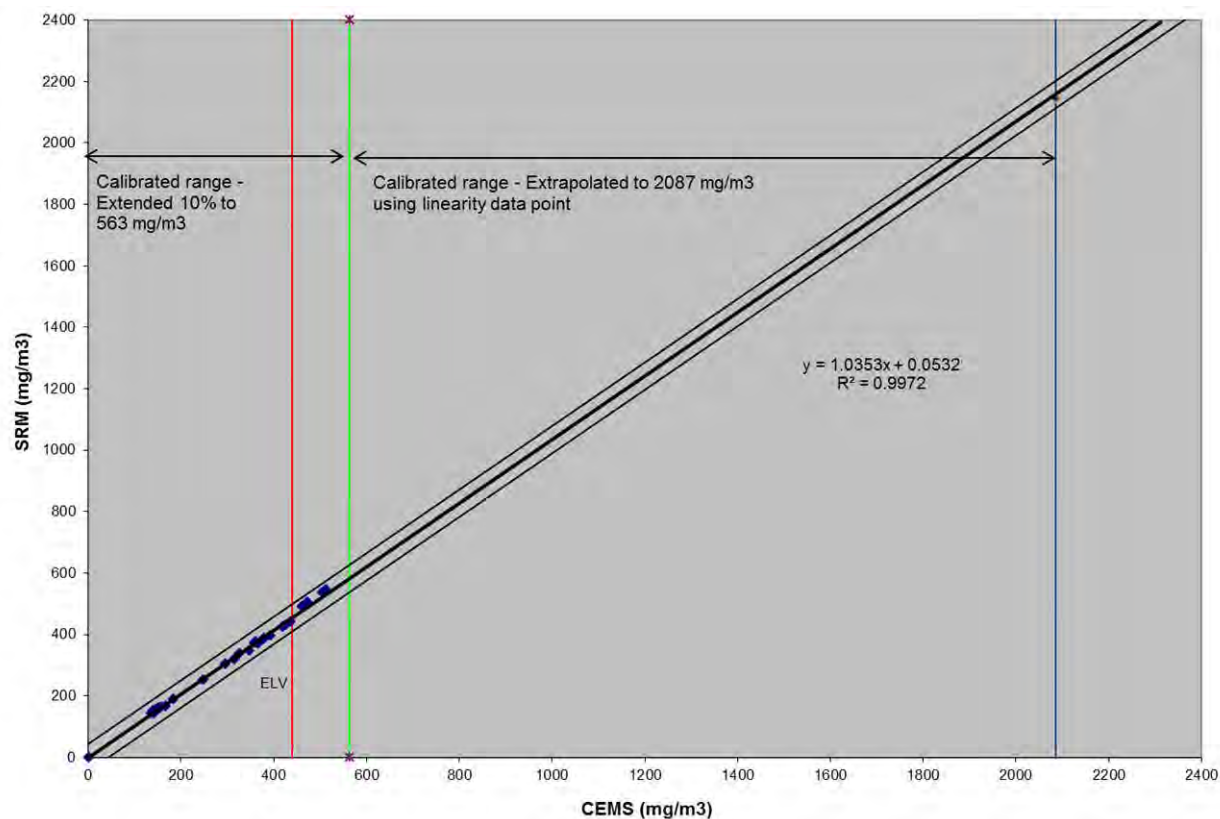
4A1.10.3 Table 4.5.3 – Data used for the Variability Test – Sulphur Dioxide, High Range.

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	17-Feb-15	Reference Gas		1.7	0.0	-1.73	-11.50	132.23
2	10-Mar-15	15:30	16:30	141.4	151.3	9.94	0.17	0.03
3	10-Mar-15	17:30	18:30	140.9	152.7	11.80	2.03	4.12
4	10-Mar-15	19:30	20:30	145.0	155.3	10.31	0.55	0.30
5	10-Mar-15	21:30	22:30	145.2	156.0	10.83	1.06	1.13
6	10-Mar-15	23:30	00:30	152.4	158.6	6.24	-3.53	12.46
7	11-Mar-15	01:30	02:30	152.1	159.6	7.54	-2.23	4.96
8	11-Mar-15	03:30	04:30	150.6	159.1	8.50	-1.26	1.60
9	11-Mar-15	05:30	06:30	157.8	164.4	6.60	-3.17	10.06
10	11-Mar-15	07:30	08:30	148.7	156.4	7.76	-2.01	4.02
11	11-Mar-15	09:30	10:30	147.4	153.3	5.87	-3.90	15.20
12	11-Mar-15	11:30	12:30	140.6	148.9	8.34	-1.42	2.03
13	11-Mar-15	13:30	14:30	136.2	144.7	8.55	-1.22	1.49
14	11-Mar-15	15:30	16:30	141.2	144.5	3.29	-6.48	42.02
15	11-Mar-15	17:30	18:30	166.0	167.2	1.19	-8.58	73.64
16	11-Mar-15	19:30	20:30	183.5	188.3	4.73	-5.04	25.41
17	11-Mar-15	21:30	22:30	248.9	253.7	4.77	-5.00	24.99
18	11-Mar-15	23:30	00:30	315.4	318.9	3.54	-6.23	38.79
19	12-Mar-15	01:30	02:30	359.0	373.2	14.26	4.50	20.22
20	12-Mar-15	05:30	06:30	360.5	375.7	15.17	5.40	29.13
21	12-Mar-15	07:30	08:30	365.3	372.4	7.03	-2.74	7.48
22	12-Mar-15	11:30	12:30	326.6	338.8	12.21	2.44	5.97
23	12-Mar-15	13:30	14:30	296.0	303.4	7.44	-2.33	5.44
24	24-Mar-15	09:40	10:40	392.8	397.3	4.44	-5.32	28.35
25	24-Mar-15	11:40	12:40	377.5	383.6	6.13	-3.64	13.25
26	24-Mar-15	13:40	14:40	379.4	388.8	9.47	-0.29	0.09
27	24-Mar-15	15:40	16:40	346.8	346.8	-0.02	-9.79	95.85
28	24-Mar-15	17:40	18:40	367.0	370.2	3.16	-6.61	43.72
29	24-Mar-15	19:40	20:40	426.2	431.0	4.79	-4.98	24.82
30	24-Mar-15	21:40	22:40	437.1	443.7	6.52	-3.25	10.57
31	24-Mar-15	23:40	00:40	461.7	491.1	29.38	19.62	384.76
32	25-Mar-15	01:40	02:40	504.3	537.9	33.58	23.82	567.21
33	25-Mar-15	03:40	04:40	512.2	546.3	34.10	24.33	592.13
34	25-Mar-15	05:40	06:40	473.6	505.5	31.85	22.08	487.63
35	25-Mar-15	07:40	08:40	419.4	423.7	4.31	-5.46	29.78
35	Tests		Mean			9.77		
	Sum							2740.89

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

SD=	Root(1-Number).Integral(D1-D) ²	8.98	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 30 tests, k _v =	0.9885		
Therefore variability=	8.98 <= 44.9 * 0.9885		
	or 8.98	<=	44.38
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 9, Procal 2

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 (dry)	CEMS Moisture	SRM Raw Value (Wet)	SRM Oxygen (Dry)	SRM Moisture	SRM at CEMS Raw conditions (wet)
		hr:min		SO ₂ (ppm)	(%)	(%)	SO ₂ (ppm)	(%)	(%)	SO ₂ (ppm)
1	10/03/2015	15:30	16:30	31.9	6.80	1.89	48.03	7.0	2.6	48.0
2	10/03/2015	17:30	18:30	32.7	6.88	1.70	48.15	7.1	2.4	48.1
3	10/03/2015	19:30	20:30	31.7	7.15	1.68	47.96	7.4	2.4	48.0
4	10/03/2015	21:30	22:30	32.4	7.11	1.71	48.09	7.5	2.4	48.1
5	10/03/2015	23:30	00:30	32.4	7.07	1.61	48.97	7.5	2.3	49.0
6	11/03/2015	01:30	02:30	34.1	7.08	1.65	49.17	7.5	2.3	49.2
7	11/03/2015	03:30	04:30	33.6	7.43	1.68	47.62	7.9	2.3	47.6
8	11/03/2015	05:30	06:30	37.3	7.04	1.61	51.06	7.4	2.3	51.1
9	11/03/2015	07:30	08:30	33.9	7.31	1.60	47.29	7.7	2.3	47.3
10	11/03/2015	09:30	10:30	35.1	7.15	1.64	46.74	7.6	2.3	46.7
11	11/03/2015	11:30	12:30	33.1	6.98	1.71	47.00	7.1	2.5	47.0
12	11/03/2015	13:30	14:30	32.9	6.96	1.72	45.26	7.2	2.5	45.3
13	11/03/2015	15:30	16:30	31.4	6.86	1.80	45.08	7.3	2.6	45.1
14	11/03/2015	17:30	18:30	36.6	6.97	1.76	51.62	7.4	2.5	51.6
15	11/03/2015	19:30	20:30	41.5	7.02	1.74	57.71	7.5	2.4	57.7
16	11/03/2015	21:30	22:30	56.7	7.07	1.71	77.16	7.6	2.4	77.2
17	11/03/2015	23:30	00:30	70.6	7.13	1.78	96.49	7.7	2.5	96.5
18	12/03/2015	01:30	02:30	76.4	8.23	1.64	104.00	8.8	2.3	104.0
19	12/03/2015	05:30	06:30	78.7	6.95	1.66	115.01	7.5	2.5	115.0
20	12/03/2015	07:30	08:30	78.5	6.87	1.78	114.75	7.4	2.5	114.7
21	12/03/2015	11:30	12:30	69.3	6.91	1.72	106.20	7.2	2.5	106.2
22	12/03/2015	13:30	14:30	62.0	6.98	1.75	94.16	7.4	2.5	94.2
23	24/03/2015	09:40	10:40	86.3	7.05	1.91	124.59	7.2	2.5	124.6
24	24/03/2015	11:40	12:40	82.9	7.04	1.90	120.11	7.2	2.4	120.1
25	24/03/2015	13:40	14:40	86.5	6.90	1.29	121.99	7.2	2.4	122.0
26	24/03/2015	15:40	16:40	77.2	6.85	2.03	109.06	7.2	2.5	109.1
27	24/03/2015	17:40	18:40	82.8	6.93	1.86	115.95	7.3	2.3	115.9
28	24/03/2015	19:40	20:40	96.2	6.92	1.82	134.83	7.3	2.2	134.8
29	24/03/2015	21:40	22:40	98.0	6.96	1.81	138.24	7.3	2.2	138.2
30	24/03/2015	23:40	00:40	103.2	7.01	1.79	152.38	7.4	2.2	152.4
31	25/03/2015	01:40	02:40	111.7	6.99	1.83	166.86	7.4	2.2	166.9
32	25/03/2015	03:40	04:40	114.4	7.10	1.73	167.74	7.5	2.2	167.7
33	25/03/2015	05:40	06:40	108.2	7.01	1.66	156.14	7.5	2.1	156.1
34	25/03/2015	07:40	08:40	93.4	7.07	1.77	129.88	7.6	2.2	129.9

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

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

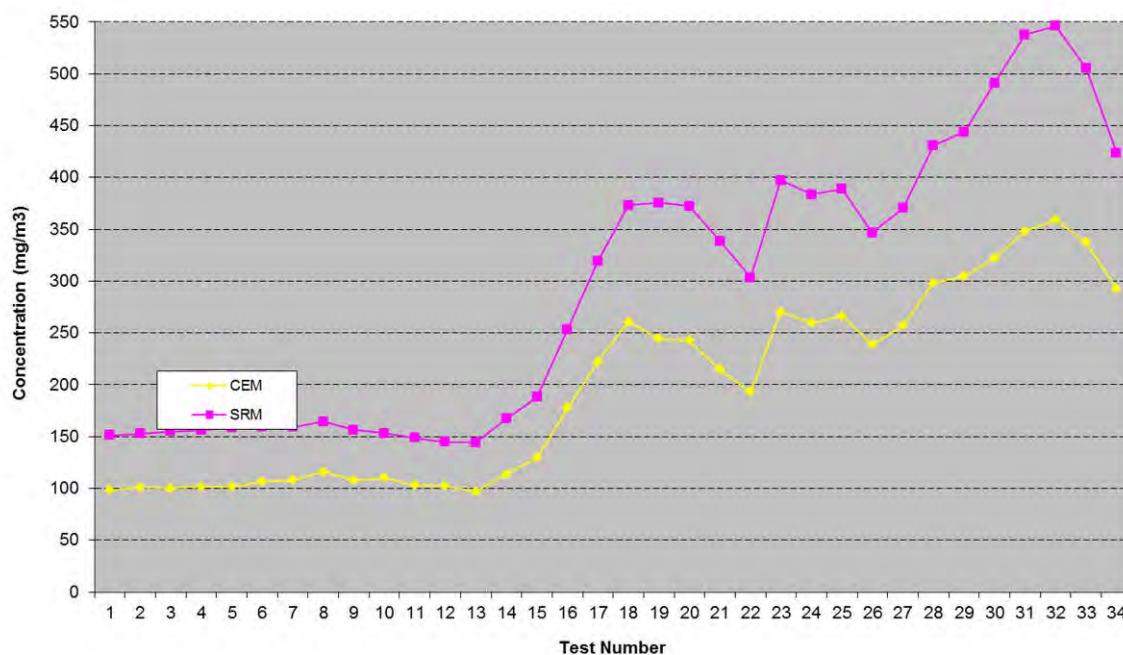
Test No	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
	hr:min		SO ₂ (mg/m3)	SO ₂ (mg/m3)	(mg/m3)
1	15:30	16:30	98.3	151.3	8
2	17:30	18:30	100.9	152.7	8
3	19:30	20:30	100.0	155.3	8
4	21:30	22:30	101.8	156.0	8
5	23:30	0:30	101.5	158.6	8
6	1:30	2:30	106.7	159.6	8
7	3:30	4:30	107.9	159.1	8
8	5:30	6:30	116.4	164.4	9
9	7:30	8:30	107.8	156.4	8
10	9:30	10:30	110.4	153.3	8
11	11:30	12:30	103.0	148.9	8
12	13:30	14:30	102.4	144.7	8
13	15:30	16:30	97.0	144.5	8
14	17:30	18:30	113.8	167.2	9
15	19:30	20:30	129.6	188.3	10
16	21:30	22:30	177.5	253.7	13
17	23:30	0:30	222.3	318.9	16
18	1:30	2:30	260.9	373.2	19
19	5:30	6:30	244.3	375.7	19
20	7:30	8:30	242.5	372.4	19
21	11:30	12:30	214.4	338.8	17
22	13:30	14:30	192.9	303.4	16
23	9:40	10:40	270.4	397.3	21
24	11:40	12:40	259.6	383.6	20
25	13:40	14:40	266.4	388.8	20
26	15:40	16:40	238.8	346.8	18
27	17:40	18:40	257.1	370.2	19
28	19:40	20:40	298.5	431.0	22
29	21:40	22:40	304.5	443.7	23
30	23:40	0:40	322.0	491.1	25
31	1:40	2:40	348.3	537.9	28
32	3:40	4:40	359.2	546.3	28
33	5:40	6:40	337.2	505.5	26
34	7:40	8:40	292.7	423.7	22

Note:

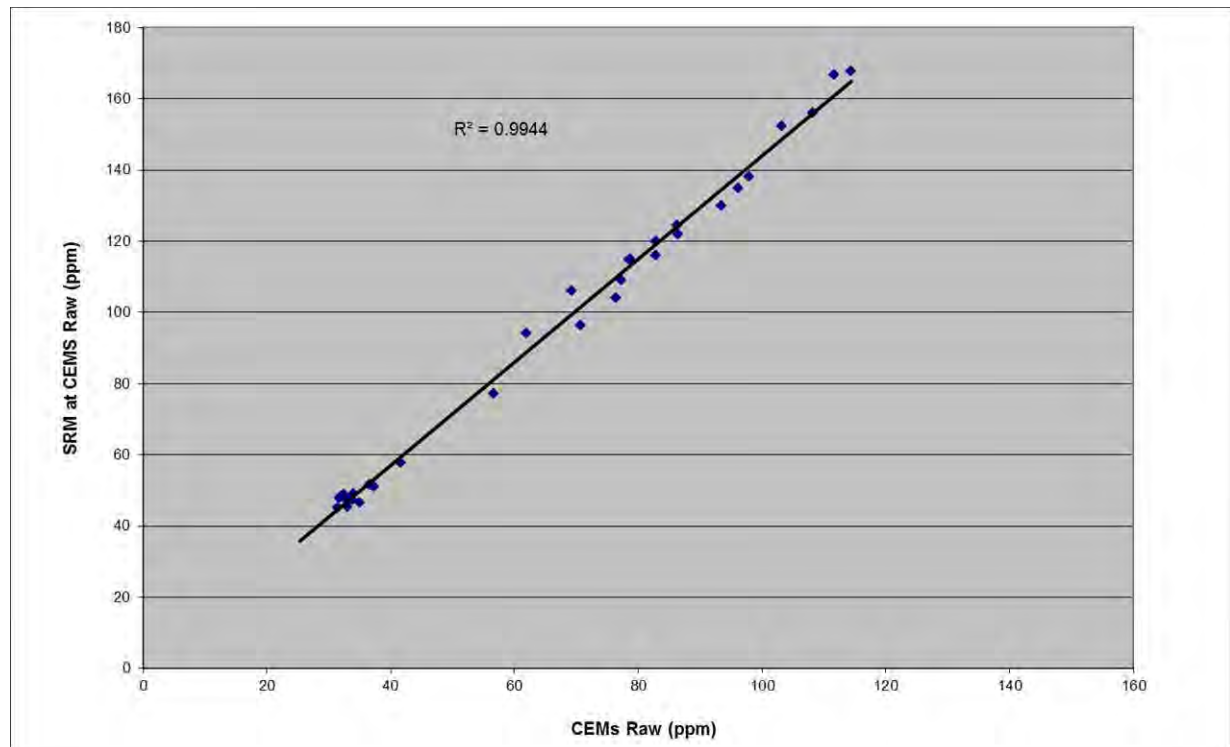
Emission concentrations expressed at reference conditions 273K, 101.3kPa

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 0.9944, 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	10-Mar-15	15:30	16:30	48.0	2.61	7.0	151.3
2	10-Mar-15	17:30	18:30	48.1	2.44	7.1	152.7
3	10-Mar-15	19:30	20:30	48.0	2.37	7.4	155.3
4	10-Mar-15	21:30	22:30	48.1	2.39	7.5	156.0
5	10-Mar-15	23:30	0:30	49.0	2.26	7.5	158.6
6	11-Mar-15	1:30	2:30	49.2	2.31	7.5	159.6
7	11-Mar-15	3:30	4:30	47.6	2.33	7.9	159.1
8	11-Mar-15	5:30	6:30	51.1	2.31	7.4	164.4
9	11-Mar-15	7:30	8:30	47.3	2.27	7.7	156.4
10	11-Mar-15	9:30	10:30	46.7	2.31	7.6	153.3
11	11-Mar-15	11:30	12:30	47.0	2.50	7.1	148.9
12	11-Mar-15	13:30	14:30	45.3	2.49	7.2	144.7
13	11-Mar-15	15:30	16:30	45.1	2.55	7.3	144.5
14	11-Mar-15	17:30	18:30	51.6	2.47	7.4	167.2
15	11-Mar-15	19:30	20:30	57.7	2.43	7.5	188.3
16	11-Mar-15	21:30	22:30	77.2	2.39	7.6	253.7
17	11-Mar-15	23:30	0:30	96.5	2.50	7.7	318.9
18	12-Mar-15	1:30	2:30	104.0	2.33	8.8	373.2
19	12-Mar-15	5:30	6:30	115.0	2.50	7.5	375.7
20	12-Mar-15	7:30	8:30	114.7	2.53	7.4	372.4
21	12-Mar-15	11:30	12:30	106.2	2.45	7.2	338.8
22	12-Mar-15	13:30	14:30	94.2	2.49	7.4	303.4
23	24-Mar-15	9:40	10:40	124.6	2.50	7.2	397.3
24	24-Mar-15	11:40	12:40	120.1	2.38	7.2	383.6
25	24-Mar-15	13:40	14:40	122.0	2.36	7.2	388.8
26	24-Mar-15	15:40	16:40	109.1	2.54	7.2	346.8
27	24-Mar-15	17:40	18:40	115.9	2.29	7.3	370.2
28	24-Mar-15	19:40	20:40	134.8	2.23	7.3	431.0
29	24-Mar-15	21:40	22:40	138.2	2.22	7.3	443.7
30	24-Mar-15	23:40	0:40	152.4	2.20	7.4	491.1
31	25-Mar-15	1:40	2:40	166.9	2.24	7.4	537.9
32	25-Mar-15	3:40	4:40	167.7	2.16	7.5	546.3
33	25-Mar-15	5:40	6:40	156.1	2.05	7.5	505.5
34	25-Mar-15	7:40	8:40	129.9	2.22	7.6	423.7
Sum				3075.26			
Emission Limit Value (ELV) =				440			546.29
15% of the ELV =				66			144.47
Therefore Ymax - Ymin > 15% of the ELV				Method A			401.82

4A2.6.2 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	18-Feb-15	Reference Gas		0	0.7	-87.86467978	-60.59496716	5324.157386	3671.750045	
2	10-Mar-15	15:30	16:30	48.0	31.9	-39.83	-29.34	1168.73	860.84	
3	10-Mar-15	17:30	18:30	48.1	32.7	-39.72	-28.59	1135.73	817.61	
4	10-Mar-15	19:30	20:30	48.0	31.7	-39.90	-29.51	1177.65	870.95	
5	10-Mar-15	21:30	22:30	48.1	32.4	-39.78	-28.86	1148.09	833.01	
6	10-Mar-15	23:30	0:30	49.0	32.4	-38.90	-28.82	1120.93	830.54	
7	11-Mar-15	1:30	2:30	49.2	34.1	-38.70	-27.19	1052.30	739.55	
8	11-Mar-15	3:30	4:30	47.6	33.6	-40.25	-27.68	1113.99	766.08	
9	11-Mar-15	5:30	6:30	51.1	37.3	-36.81	-23.97	882.36	574.72	
10	11-Mar-15	7:30	8:30	47.3	33.9	-40.57	-27.39	1111.05	749.96	
11	11-Mar-15	9:30	10:30	46.7	35.1	-41.13	-26.19	1077.01	685.85	
12	11-Mar-15	11:30	12:30	47.0	33.1	-40.86	-28.15	1150.42	792.56	
13	11-Mar-15	13:30	14:30	45.3	32.9	-42.60	-28.31	1206.12	801.58	
14	11-Mar-15	15:30	16:30	45.1	31.4	-42.79	-29.86	1277.84	891.87	
15	11-Mar-15	17:30	18:30	51.6	36.6	-36.25	-24.69	894.84	609.43	
16	11-Mar-15	19:30	20:30	57.7	41.5	-30.15	-19.73	594.74	389.12	
17	11-Mar-15	21:30	22:30	77.2	56.7	-10.71	-4.58	49.03	20.96	
18	11-Mar-15	23:30	0:30	96.5	70.6	8.63	9.38	80.94	88.00	
19	12-Mar-15	1:30	2:30	104.0	76.4	16.13	15.13	244.14	229.06	
20	12-Mar-15	5:30	6:30	115.0	78.7	27.14	17.48	474.54	305.63	
21	12-Mar-15	7:30	8:30	114.7	78.5	26.88	17.22	462.98	296.65	
22	12-Mar-15	11:30	12:30	106.2	69.3	18.34	7.99	146.52	63.85	
23	12-Mar-15	13:30	14:30	94.2	62.0	6.29	0.70	4.43	0.50	
24	24-Mar-15	9:40	10:40	124.6	86.3	36.72	25.01	918.38	625.50	
25	24-Mar-15	11:40	12:40	120.1	82.9	32.24	21.63	697.41	467.82	
26	24-Mar-15	13:40	14:40	122.0	86.5	34.12	25.21	860.29	635.62	
27	24-Mar-15	15:40	16:40	109.1	77.2	21.19	15.98	338.65	255.39	
28	24-Mar-15	17:40	18:40	115.9	82.8	28.08	21.54	605.01	464.11	
29	24-Mar-15	19:40	20:40	134.8	96.2	46.96	34.95	1641.35	1221.46	
30	24-Mar-15	21:40	22:40	138.2	98.0	50.38	36.69	1848.37	1346.12	
31	24-Mar-15	23:40	0:40	152.4	103.2	64.52	41.91	2704.12	1756.68	
32	25-Mar-15	1:40	2:40	166.9	111.7	78.99	50.41	3982.39	2541.56	
33	25-Mar-15	3:40	4:40	167.7	114.4	79.88	53.15	4245.08	2824.49	
34	25-Mar-15	5:40	6:40	156.1	108.2	68.28	46.91	3203.11	2200.98	
35	25-Mar-15	7:40	8:40	129.9	93.4	42.02	32.15	1350.75	1033.32	
Sum				3075.26	2144.16	0.00	0.00	45293.49	31263.12	1.45

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

Method A

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

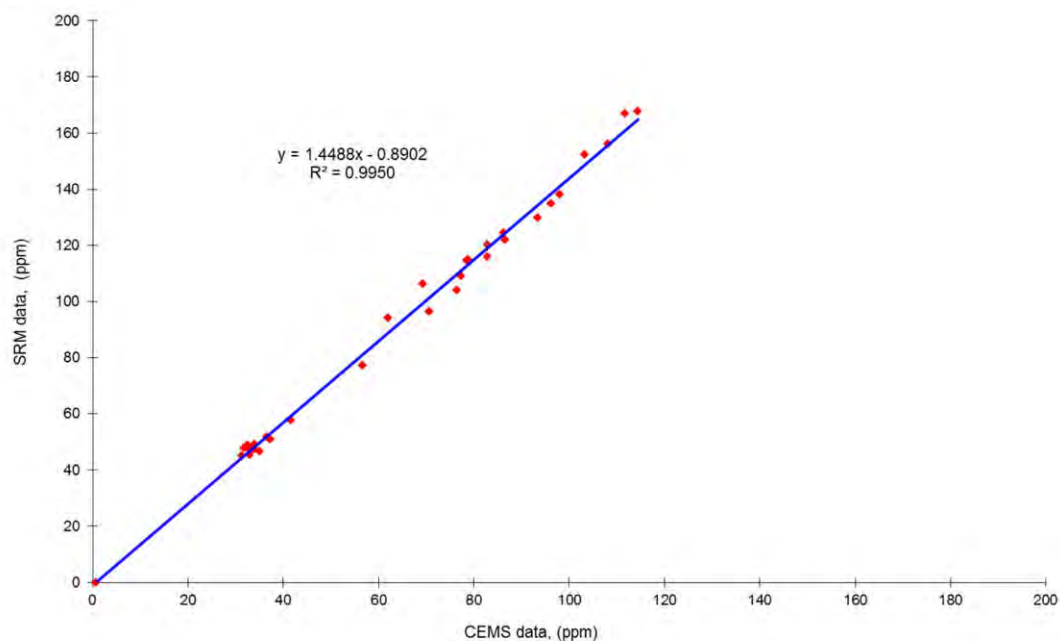
$b = \frac{\sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^N (x_i - \bar{x})^2}$	where	$\bar{x} = \frac{1}{N} \sum_{i=1}^N x_i$	$\bar{y} = \frac{1}{N} \sum_{i=1}^N y_i$	$x =$	61.26
				$y =$	87.86
				$b =$	1.449
$a = \bar{y} - b\bar{x}$		$a = 87.87 - 61.27 * 1.448$		$a =$	-0.890

The calibration is function $y_i = a + b x_i$ or $y_i = -0.89 + 1.449 * x_i$

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 dry Oxygen	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		SO2 (ppm)	SO2 (ppm)	(%)	(%)	SO2 (mg/m3)	SO2 (mg/m3)
1	18-Feb-15	Reference Gas		0.7	0.1			0.2	0.0
2	10-Mar-15	15:30	16:30	31.9	45.4	1.9	6.8	139.6	151.3
3	10-Mar-15	17:30	18:30	32.7	46.4	1.7	6.9	143.4	152.7
4	10-Mar-15	19:30	20:30	31.7	45.1	1.7	7.2	142.1	155.3
5	10-Mar-15	21:30	22:30	32.4	46.1	1.7	7.1	144.7	156.0
6	10-Mar-15	23:30	00:30	32.4	46.1	1.6	7.1	144.3	158.6
7	11-Mar-15	01:30	02:30	34.1	48.5	1.7	7.1	151.8	159.6
8	11-Mar-15	03:30	04:30	33.6	47.8	1.7	7.4	153.5	159.1
9	11-Mar-15	05:30	06:30	37.3	53.1	1.6	7.0	165.8	164.4
10	11-Mar-15	07:30	08:30	33.9	48.2	1.6	7.3	153.4	156.4
11	11-Mar-15	09:30	10:30	35.1	49.9	1.6	7.1	157.1	153.3
12	11-Mar-15	11:30	12:30	33.1	47.1	1.7	7.0	146.5	148.9
13	11-Mar-15	13:30	14:30	32.9	46.8	1.7	7.0	145.6	144.7
14	11-Mar-15	15:30	16:30	31.4	44.6	1.8	6.9	137.7	144.5
15	11-Mar-15	17:30	18:30	36.6	52.1	1.8	7.0	162.1	167.2
16	11-Mar-15	19:30	20:30	41.5	59.3	1.7	7.0	185.0	188.3
17	11-Mar-15	21:30	22:30	56.7	81.2	1.7	7.1	254.3	253.7
18	11-Mar-15	23:30	00:30	70.6	101.5	1.8	7.1	319.3	318.9
19	12-Mar-15	01:30	02:30	76.4	109.8	1.6	8.2	374.9	373.2
20	12-Mar-15	05:30	06:30	78.7	113.2	1.7	6.9	351.2	375.7
21	12-Mar-15	07:30	08:30	78.5	112.8	1.8	6.9	348.6	372.4
22	12-Mar-15	11:30	12:30	69.3	99.4	1.7	6.9	307.9	338.8
23	12-Mar-15	13:30	14:30	62.0	88.9	1.7	7.0	276.8	303.4
24	24-Mar-15	09:40	10:40	86.3	124.1	1.9	7.1	389.0	397.3
25	24-Mar-15	11:40	12:40	82.9	119.2	1.9	7.0	373.3	383.6
26	24-Mar-15	13:40	14:40	86.5	124.4	1.3	6.9	383.2	388.8
27	24-Mar-15	15:40	16:40	77.2	111.0	2.0	6.8	343.3	346.8
28	24-Mar-15	17:40	18:40	82.8	119.1	1.9	6.9	369.7	370.2
29	24-Mar-15	19:40	20:40	96.2	138.5	1.8	6.9	429.7	431.0
30	24-Mar-15	21:40	22:40	98.0	141.0	1.8	7.0	438.5	443.7
31	24-Mar-15	23:40	00:40	103.2	148.6	1.8	7.0	463.7	491.1
32	25-Mar-15	01:40	02:40	111.7	160.9	1.8	7.0	501.8	537.9
33	25-Mar-15	03:40	04:40	114.4	164.9	1.7	7.1	517.7	546.3
34	25-Mar-15	05:40	06:40	108.2	155.8	1.7	7.0	485.8	505.5
35	25-Mar-15	07:40	08:40	93.4	134.4	1.8	7.1	421.2	423.7
Sum								9622.6	
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, wet gas



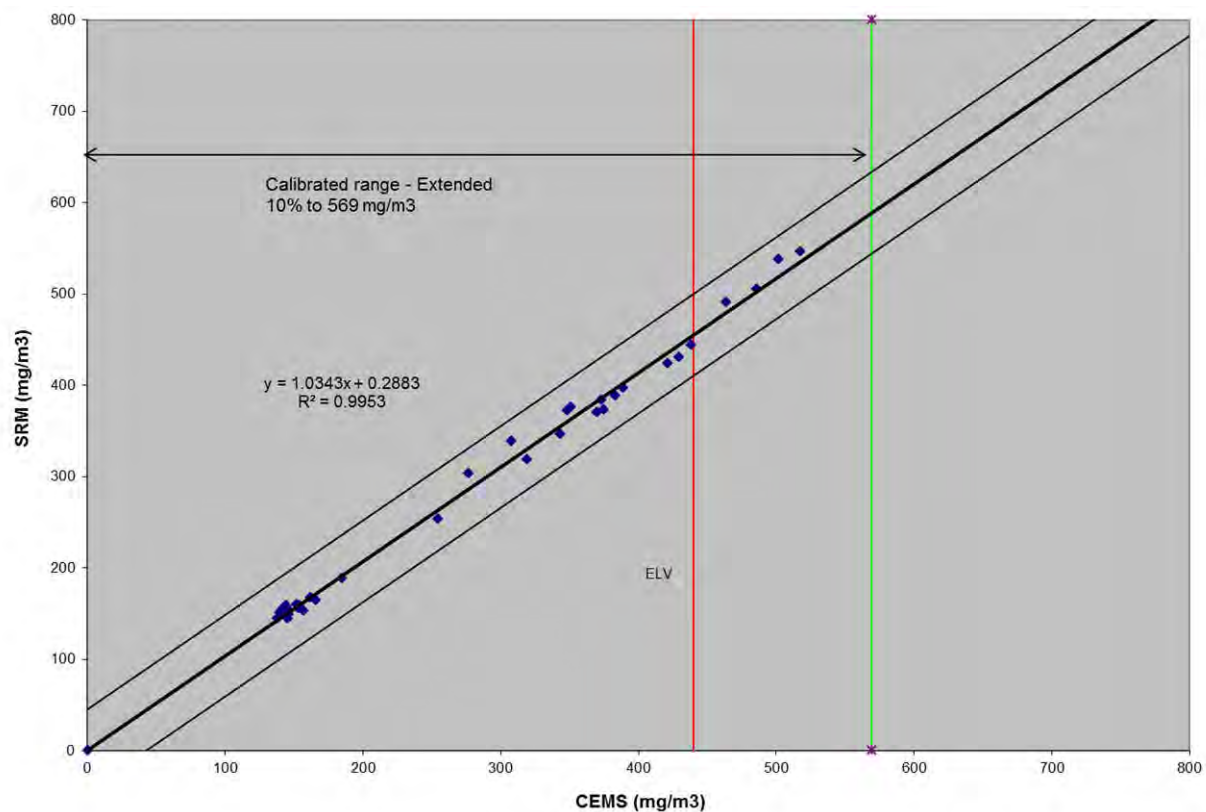
4A2.10.2 Table 4.5.2 – Data used for the Variability Test – Sulphur Dioxide, Low Range.

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	18-Feb-15	Reference Gas		0.2	0.0	-0.22	-9.92	98.48
2	10-Mar-15	15:30	16:30	139.6	151.3	11.72	2.01	4.04
3	10-Mar-15	17:30	18:30	143.4	152.7	9.21	-0.50	0.25
4	10-Mar-15	19:30	20:30	142.1	155.3	13.25	3.54	12.52
5	10-Mar-15	21:30	22:30	144.7	156.0	11.37	1.66	2.77
6	10-Mar-15	23:30	00:30	144.3	158.6	14.35	4.64	21.56
7	11-Mar-15	01:30	02:30	151.8	159.6	7.88	-1.83	3.36
8	11-Mar-15	03:30	04:30	153.5	159.1	5.63	-4.08	16.61
9	11-Mar-15	05:30	06:30	165.8	164.4	-1.41	-11.12	123.71
10	11-Mar-15	07:30	08:30	153.4	156.4	3.07	-6.63	44.02
11	11-Mar-15	09:30	10:30	157.1	153.3	-3.83	-13.53	183.16
12	11-Mar-15	11:30	12:30	146.5	148.9	2.40	-7.31	53.46
13	11-Mar-15	13:30	14:30	145.6	144.7	-0.82	-10.53	110.89
14	11-Mar-15	15:30	16:30	137.7	144.5	6.74	-2.97	8.81
15	11-Mar-15	17:30	18:30	162.1	167.2	5.08	-4.62	21.37
16	11-Mar-15	19:30	20:30	185.0	188.3	3.25	-6.46	41.76
17	11-Mar-15	21:30	22:30	254.3	253.7	-0.65	-10.35	107.19
18	11-Mar-15	23:30	00:30	319.3	318.9	-0.40	-10.10	102.10
19	12-Mar-15	01:30	02:30	374.9	373.2	-1.71	-11.42	130.46
20	12-Mar-15	05:30	06:30	351.2	375.7	24.55	14.85	220.38
21	12-Mar-15	07:30	08:30	348.6	372.4	23.72	14.01	196.26
22	12-Mar-15	11:30	12:30	307.9	338.8	30.85	21.15	447.12
23	12-Mar-15	13:30	14:30	276.8	303.4	26.64	16.94	286.80
24	24-Mar-15	09:40	10:40	389.0	397.3	8.32	-1.39	1.92
25	24-Mar-15	11:40	12:40	373.3	383.6	10.34	0.64	0.41
26	24-Mar-15	13:40	14:40	383.2	388.8	5.68	-4.03	16.26
27	24-Mar-15	15:40	16:40	343.3	346.8	3.51	-6.19	38.35
28	24-Mar-15	17:40	18:40	369.7	370.2	0.49	-9.22	85.05
29	24-Mar-15	19:40	20:40	429.7	431.0	1.35	-8.36	69.82
30	24-Mar-15	21:40	22:40	438.5	443.7	5.20	-4.51	20.34
31	24-Mar-15	23:40	00:40	463.7	491.1	27.35	17.64	311.25
32	25-Mar-15	01:40	02:40	501.8	537.9	36.08	26.37	695.64
33	25-Mar-15	03:40	04:40	517.7	546.3	28.61	18.90	357.31
34	25-Mar-15	05:40	06:40	485.8	505.5	19.67	9.96	99.24
35	25-Mar-15	07:40	08:40	421.2	423.7	2.50	-7.21	51.99
35	Tests		Mean			9.71		
	Sum							3984.67

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

SD=	Root(1-Number).Integral(D1-D) ²	10.83	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 30 tests, k _v =	0.9885		
Therefore variability=	10.83 <= 44.9 * 0.9885		
	or 10.83 <=	44.38	
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 6% oxygen, 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 (dry)	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	10/03/2015	15:30	16:30	50.4	6.80	1.89	48.03	7.0	2.6	48.0
2	10/03/2015	17:30	18:30	50.5	6.88	1.70	48.15	7.1	2.4	48.1
3	10/03/2015	19:30	20:30	49.4	7.15	1.68	47.96	7.4	2.4	48.0
4	10/03/2015	21:30	22:30	50.4	7.11	1.71	48.09	7.5	2.4	48.1
5	10/03/2015	23:30	00:30	50.4	7.07	1.61	48.97	7.5	2.3	49.0
6	11/03/2015	01:30	02:30	52.6	7.08	1.65	49.17	7.5	2.3	49.2
7	11/03/2015	03:30	04:30	52.0	7.43	1.68	47.62	7.9	2.3	47.6
8	11/03/2015	05:30	06:30	57.2	7.04	1.61	51.06	7.4	2.3	51.1
9	11/03/2015	07:30	08:30	52.3	7.31	1.60	47.29	7.7	2.3	47.3
10	11/03/2015	09:30	10:30	54.0	7.15	1.64	46.74	7.6	2.3	46.7
11	11/03/2015	11:30	12:30	51.5	6.98	1.71	47.00	7.1	2.5	47.0
12	11/03/2015	13:30	14:30	51.3	6.96	1.72	45.26	7.2	2.5	45.3
13	11/03/2015	15:30	16:30	49.1	6.86	1.80	45.08	7.3	2.6	45.1
14	11/03/2015	17:30	18:30	56.1	6.97	1.76	51.62	7.4	2.5	51.6
15	11/03/2015	19:30	20:30	63.1	7.02	1.74	57.71	7.5	2.4	57.7
16	11/03/2015	21:30	22:30	84.0	7.07	1.71	77.16	7.6	2.4	77.2
17	11/03/2015	23:30	00:30	104.2	7.13	1.78	96.49	7.7	2.5	96.5
18	12/03/2015	01:30	02:30	110.0	8.23	1.64	104.00	8.8	2.3	104.0
19	12/03/2015	05:30	06:30	114.9	6.95	1.66	115.01	7.5	2.5	115.0
20	12/03/2015	07:30	08:30	116.0	6.87	1.78	114.75	7.4	2.5	114.7
21	12/03/2015	11:30	12:30	103.2	6.91	1.72	106.20	7.2	2.5	106.2
22	12/03/2015	13:30	14:30	93.3	6.98	1.75	94.16	7.4	2.5	94.2
23	24/03/2015	09:40	10:40	127.6	7.05	1.91	124.59	7.2	2.5	124.6
24	24/03/2015	11:40	12:40	122.7	7.04	1.90	120.11	7.2	2.4	120.1
25	24/03/2015	13:40	14:40	127.6	6.90	1.29	121.99	7.2	2.4	122.0
26	24/03/2015	15:40	16:40	115.8	6.85	2.03	109.06	7.2	2.5	109.1
27	24/03/2015	17:40	18:40	122.2	6.93	1.86	115.95	7.3	2.3	115.9
28	24/03/2015	19:40	20:40	140.7	6.92	1.82	134.83	7.3	2.2	134.8
29	24/03/2015	21:40	22:40	143.0	6.96	1.81	138.24	7.3	2.2	138.2
30	24/03/2015	23:40	00:40	149.8	7.01	1.79	152.38	7.4	2.2	152.4
31	25/03/2015	01:40	02:40	162.1	6.99	1.83	166.86	7.4	2.2	166.9
32	25/03/2015	03:40	04:40	165.7	7.10	1.73	167.74	7.5	2.2	167.7
33	25/03/2015	05:40	06:40	156.1	7.01	1.66	156.14	7.5	2.1	156.1
34	25/03/2015	07:40	08:40	137.5	7.07	1.77	129.88	7.6	2.2	129.9

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

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

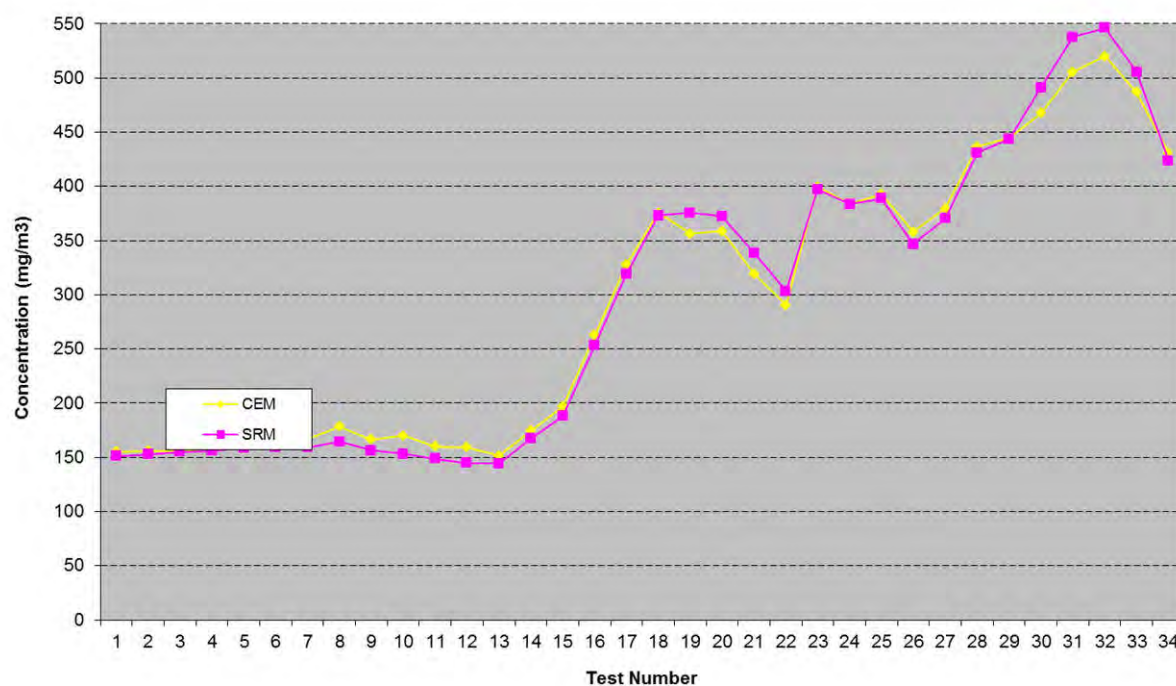
Test No	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
	hr:min		SO ₂ (mg/m3)	SO ₂ (mg/m3)	(mg/m3)
1	15:30	16:30	155.1	151.3	11
2	17:30	18:30	156.0	152.7	10
3	19:30	20:30	155.7	155.3	10
4	21:30	22:30	158.4	156.0	10
5	23:30	0:30	157.8	158.6	9
6	1:30	2:30	164.6	159.6	9
7	3:30	4:30	167.0	159.1	9
8	5:30	6:30	178.6	164.4	9
9	7:30	8:30	166.4	156.4	9
10	9:30	10:30	170.0	153.3	9
11	11:30	12:30	160.1	148.9	9
12	13:30	14:30	159.3	144.7	9
13	15:30	16:30	151.6	144.5	9
14	17:30	18:30	174.6	167.2	9
15	19:30	20:30	196.9	188.3	9
16	21:30	22:30	262.9	253.7	9
17	23:30	0:30	327.8	318.9	9
18	1:30	2:30	375.6	373.2	9
19	5:30	6:30	356.4	375.7	9
20	7:30	8:30	358.5	372.4	10
21	11:30	12:30	319.4	338.8	10
22	13:30	14:30	290.5	303.4	11
23	9:40	10:40	399.8	397.3	11
24	11:40	12:40	384.1	383.6	12
25	13:40	14:40	393.0	388.8	12
26	15:40	16:40	358.0	346.8	13
27	17:40	18:40	379.4	370.2	14
28	19:40	20:40	436.4	431.0	15
29	21:40	22:40	444.6	443.7	16
30	23:40	0:40	467.5	491.1	12
31	1:40	2:40	505.5	537.9	13
32	3:40	4:40	520.2	546.3	13
33	5:40	6:40	486.6	505.5	12
34	7:40	8:40	431.0	423.7	11

Note:

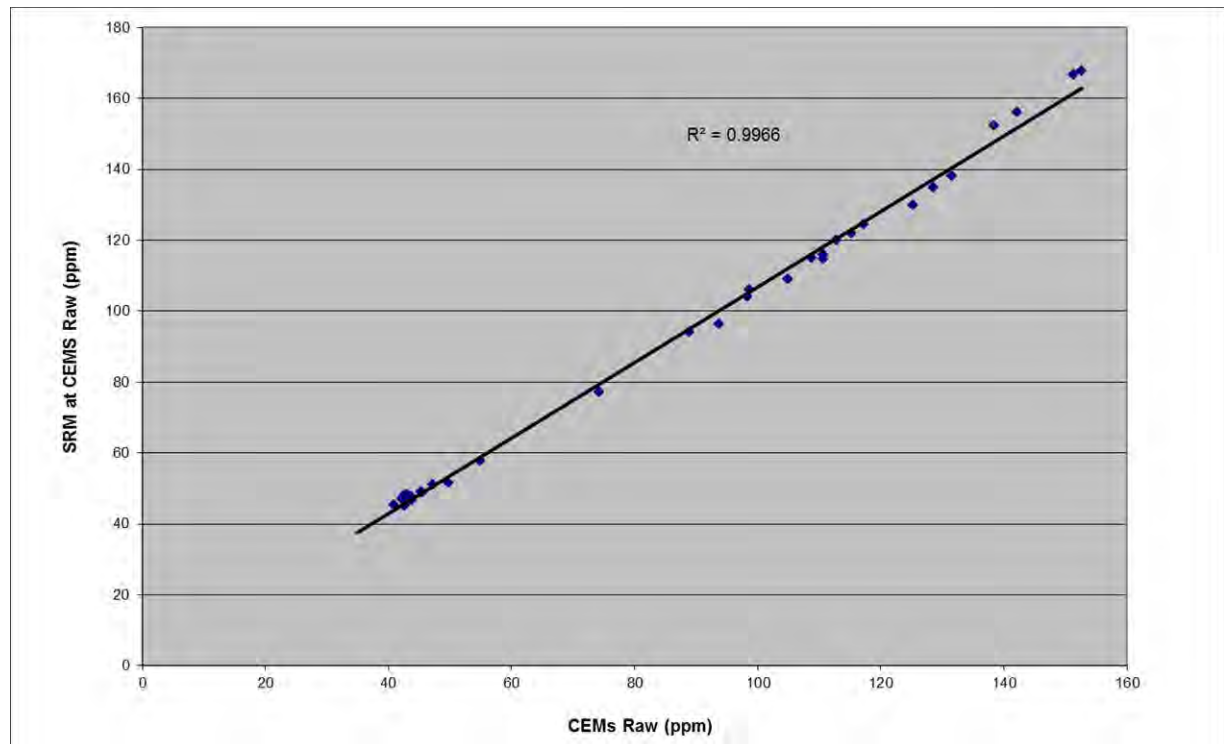
Emission concentrations expressed at reference conditions 273K, 101.3kPa

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 0.9966, 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	10-Mar-15	15:30	16:30	48.0	2.61	7.0	151.3
2	10-Mar-15	17:30	18:30	48.1	2.44	7.1	152.7
3	10-Mar-15	19:30	20:30	48.0	2.37	7.4	155.3
4	10-Mar-15	21:30	22:30	48.1	2.39	7.5	156.0
5	10-Mar-15	23:30	0:30	49.0	2.26	7.5	158.6
6	11-Mar-15	1:30	2:30	49.2	2.31	7.5	159.6
7	11-Mar-15	3:30	4:30	47.6	2.33	7.9	159.1
8	11-Mar-15	5:30	6:30	51.1	2.31	7.4	164.4
9	11-Mar-15	7:30	8:30	47.3	2.27	7.7	156.4
10	11-Mar-15	9:30	10:30	46.7	2.31	7.6	153.3
11	11-Mar-15	11:30	12:30	47.0	2.50	7.1	148.9
12	11-Mar-15	13:30	14:30	45.3	2.49	7.2	144.7
13	11-Mar-15	15:30	16:30	45.1	2.55	7.3	144.5
14	11-Mar-15	17:30	18:30	51.6	2.47	7.4	167.2
15	11-Mar-15	19:30	20:30	57.7	2.43	7.5	188.3
16	11-Mar-15	21:30	22:30	77.2	2.39	7.6	253.7
17	11-Mar-15	23:30	0:30	96.5	2.50	7.7	318.9
18	12-Mar-15	1:30	2:30	104.0	2.33	8.8	373.2
19	12-Mar-15	5:30	6:30	115.0	2.50	7.5	375.7
20	12-Mar-15	7:30	8:30	114.7	2.53	7.4	372.4
21	12-Mar-15	11:30	12:30	106.2	2.45	7.2	338.8
22	12-Mar-15	13:30	14:30	94.2	2.49	7.4	303.4
23	24-Mar-15	9:40	10:40	124.6	2.50	7.2	397.3
24	24-Mar-15	11:40	12:40	120.1	2.38	7.2	383.6
25	24-Mar-15	13:40	14:40	122.0	2.36	7.2	388.8
26	24-Mar-15	15:40	16:40	109.1	2.54	7.2	346.8
27	24-Mar-15	17:40	18:40	115.9	2.29	7.3	370.2
28	24-Mar-15	19:40	20:40	134.8	2.23	7.3	431.0
29	24-Mar-15	21:40	22:40	138.2	2.22	7.3	443.7
30	24-Mar-15	23:40	0:40	152.4	2.20	7.4	491.1
31	25-Mar-15	1:40	2:40	166.9	2.24	7.4	537.9
32	25-Mar-15	3:40	4:40	167.7	2.16	7.5	546.3
33	25-Mar-15	5:40	6:40	156.1	2.05	7.5	505.5
34	25-Mar-15	7:40	8:40	129.9	2.22	7.6	423.7
Sum				3075.26			
Emission Limit Value (ELV) =				440		Y _{max}	546.29
15% of the ELV =				66		Y _{min}	144.47
Therefore Ymax - Ymin > 15% of the ELV				Method A		Y _{max} - Ymin	401.82

4A2.6.3 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)
		hr:min		SO ₂ (ppm)	SO ₂ (ppm)
1	18-Feb-15	Reference Gas		0	-0.17
2	10-Mar-15	15:30	16:30	48.0	50.4
3	10-Mar-15	17:30	18:30	48.1	50.5
4	10-Mar-15	19:30	20:30	48.0	49.4
5	10-Mar-15	21:30	22:30	48.1	50.4
6	10-Mar-15	23:30	0:30	49.0	50.4
7	11-Mar-15	1:30	2:30	49.2	52.6
8	11-Mar-15	3:30	4:30	47.6	52.0
9	11-Mar-15	5:30	6:30	51.1	57.2
10	11-Mar-15	7:30	8:30	47.3	52.3
11	11-Mar-15	9:30	10:30	46.7	54.0
12	11-Mar-15	11:30	12:30	47.0	51.5
13	11-Mar-15	13:30	14:30	45.3	51.3
14	11-Mar-15	15:30	16:30	45.1	49.1
15	11-Mar-15	17:30	18:30	51.6	56.1
16	11-Mar-15	19:30	20:30	57.7	63.1
17	11-Mar-15	21:30	22:30	77.2	84.0
18	11-Mar-15	23:30	0:30	96.5	104.2
19	12-Mar-15	1:30	2:30	104.0	110.0
20	12-Mar-15	5:30	6:30	115.0	114.9
21	12-Mar-15	7:30	8:30	114.7	116.0
22	12-Mar-15	11:30	12:30	106.2	103.2
23	12-Mar-15	13:30	14:30	94.2	93.3
24	24-Mar-15	9:40	10:40	124.6	127.6
25	24-Mar-15	11:40	12:40	120.1	122.7
26	24-Mar-15	13:40	14:40	122.0	127.6
27	24-Mar-15	15:40	16:40	109.1	115.8
28	24-Mar-15	17:40	18:40	115.9	122.2
29	24-Mar-15	19:40	20:40	134.8	140.7
30	24-Mar-15	21:40	22:40	138.2	143.0
31	24-Mar-15	23:40	0:40	152.4	149.8
32	25-Mar-15	1:40	2:40	166.9	162.1
33	25-Mar-15	3:40	4:40	167.7	165.7
34	25-Mar-15	5:40	6:40	156.1	156.1
35	25-Mar-15	7:40	8:40	129.9	137.5
Sum				3075.26	3186.28

Yi	Xi	Xi * Yi	Xi ²	b
1	2	3	4	
-87.86467978	-91.20337179	8013.555057	8318.055026	
-39.83	-40.65	1619.13	1652.18	
-39.72	-40.52	1609.54	1642.11	
-39.90	-41.61	1660.38	1731.32	
-39.78	-40.62	1615.77	1649.91	
-38.90	-40.60	1579.04	1648.14	
-38.70	-38.46	1488.29	1479.32	
-40.25	-39.08	1572.91	1527.26	
-36.81	-33.80	1243.89	1142.15	
-40.57	-38.74	1571.63	1500.62	
-41.13	-37.02	1522.31	1370.22	
-40.86	-39.58	1617.40	1566.58	
-42.60	-39.77	1694.37	1581.90	
-42.79	-41.94	1794.53	1758.92	
-36.25	-34.91	1265.41	1218.71	
-30.15	-27.94	842.50	780.85	
-10.71	-7.06	75.62	49.88	
8.63	13.12	113.23	172.22	
16.13	18.94	305.54	358.75	
27.14	23.85	647.27	568.63	
26.88	24.98	671.49	624.03	
18.34	12.11	222.14	146.75	
6.29	2.27	14.26	5.14	
36.72	36.52	1341.04	1333.73	
32.24	31.62	1019.56	999.85	
34.12	36.55	1247.07	1335.63	
21.19	24.76	524.62	612.90	
28.08	31.18	875.54	971.95	
46.96	49.64	2331.32	2464.23	
50.38	51.97	2618.35	2701.24	
64.52	58.75	3790.13	3451.01	
78.99	71.06	5613.70	5050.21	
79.88	74.63	5961.01	5569.39	
68.28	65.06	4441.75	4232.34	
42.02	46.50	1953.92	2162.19	
0.00	0.00	64478.23	63378.30	1.02

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

Method A

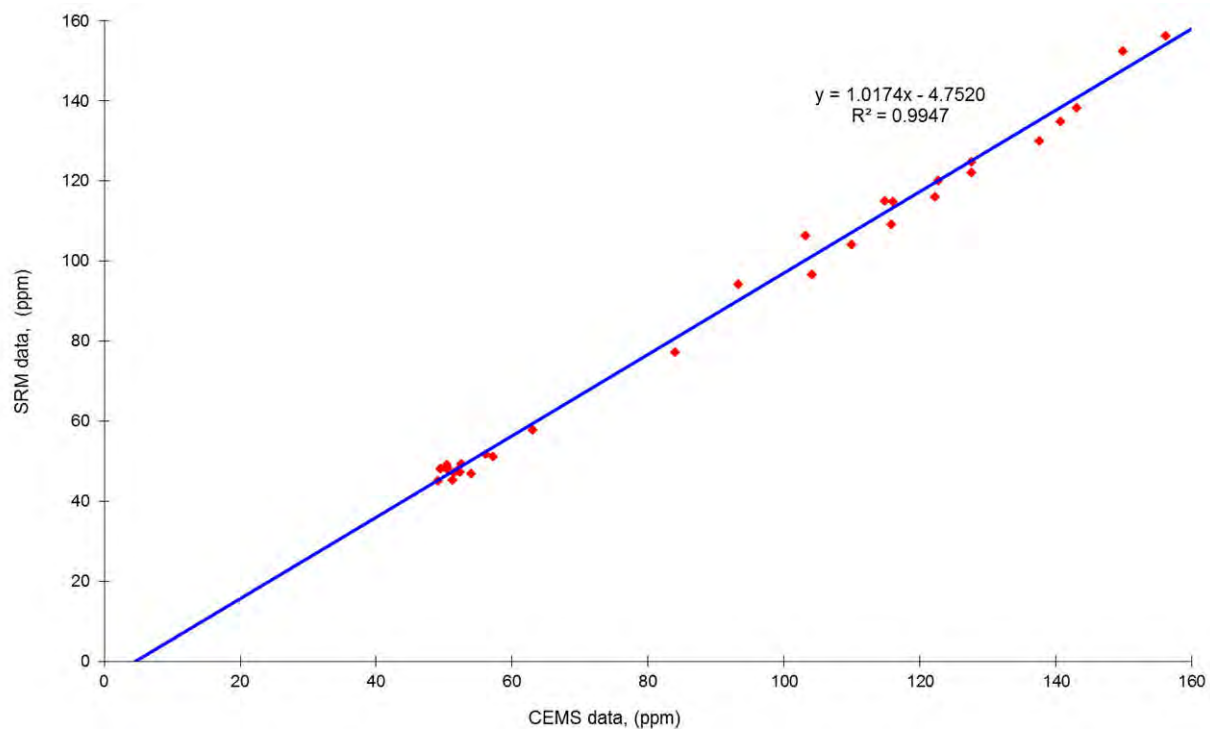
If $Y_{\max} - Y_{\min} > 15\%$ of the ELV, the following formulae are used:

$b = \frac{\sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^N (x_i - \bar{x})^2}$	where	$\bar{x} = \frac{1}{N} \sum_{i=1}^N x_i$	$\bar{y} = \frac{1}{N} \sum_{i=1}^N y_i$	$x =$	91.04
				$y =$	87.86
				$b =$	1.017
$a = \bar{y} - b\bar{x}$	$a = 87.87 - 91.04 * 1.017$			$a =$	-4.752
The calibration is function $y_i = a + bx_i$ or			$y_i =$	$-4.752 + 1.017 * x_i$	

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 dry Oxygen	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		SO2 (ppm)	SO2 (ppm)	(%)	(%)	SO2 (mg/m3)	SO2 (mg/m3)
1	18-Feb-15	Reference Gas		-0.2	-4.9			-14.1	0.0
2	10-Mar-15	15:30	16:30	50.4	46.5	1.9	6.8	143.2	151.3
3	10-Mar-15	17:30	18:30	50.5	46.6	1.7	6.9	144.1	152.7
4	10-Mar-15	19:30	20:30	49.4	45.5	1.7	7.2	143.4	155.3
5	10-Mar-15	21:30	22:30	50.4	46.5	1.7	7.1	146.2	156.0
6	10-Mar-15	23:30	00:30	50.4	46.6	1.6	7.1	145.7	158.6
7	11-Mar-15	01:30	02:30	52.6	48.7	1.7	7.1	152.6	159.6
8	11-Mar-15	03:30	04:30	52.0	48.1	1.7	7.4	154.6	159.1
9	11-Mar-15	05:30	06:30	57.2	53.5	1.6	7.0	166.9	164.4
10	11-Mar-15	07:30	08:30	52.3	48.5	1.6	7.3	154.2	156.4
11	11-Mar-15	09:30	10:30	54.0	50.2	1.6	7.1	158.0	153.3
12	11-Mar-15	11:30	12:30	51.5	47.6	1.7	7.0	148.1	148.9
13	11-Mar-15	13:30	14:30	51.3	47.4	1.7	7.0	147.3	144.7
14	11-Mar-15	15:30	16:30	49.1	45.2	1.8	6.9	139.6	144.5
15	11-Mar-15	17:30	18:30	56.1	52.3	1.8	7.0	162.9	167.2
16	11-Mar-15	19:30	20:30	63.1	59.4	1.7	7.0	185.5	188.3
17	11-Mar-15	21:30	22:30	84.0	80.7	1.7	7.1	252.6	253.7
18	11-Mar-15	23:30	00:30	104.2	101.2	1.8	7.1	318.6	318.9
19	12-Mar-15	01:30	02:30	110.0	107.1	1.6	8.2	365.9	373.2
20	12-Mar-15	05:30	06:30	114.9	112.1	1.7	6.9	347.8	375.7
21	12-Mar-15	07:30	08:30	116.0	113.3	1.8	6.9	350.1	372.4
22	12-Mar-15	11:30	12:30	103.2	100.2	1.7	6.9	310.2	338.8
23	12-Mar-15	13:30	14:30	93.3	90.2	1.7	7.0	280.8	303.4
24	24-Mar-15	09:40	10:40	127.6	125.0	1.9	7.1	391.8	397.3
25	24-Mar-15	11:40	12:40	122.7	120.0	1.9	7.0	375.9	383.6
26	24-Mar-15	13:40	14:40	127.6	125.0	1.3	6.9	385.2	388.8
27	24-Mar-15	15:40	16:40	115.8	113.1	2.0	6.8	349.6	346.8
28	24-Mar-15	17:40	18:40	122.2	119.6	1.9	6.9	371.3	370.2
29	24-Mar-15	19:40	20:40	140.7	138.4	1.8	6.9	429.3	431.0
30	24-Mar-15	21:40	22:40	143.0	140.7	1.8	7.0	437.6	443.7
31	24-Mar-15	23:40	00:40	149.8	147.6	1.8	7.0	460.8	491.1
32	25-Mar-15	01:40	02:40	162.1	160.2	1.8	7.0	499.5	537.9
33	25-Mar-15	03:40	04:40	165.7	163.8	1.7	7.1	514.3	546.3
34	25-Mar-15	05:40	06:40	156.1	154.1	1.7	7.0	480.2	505.5
35	25-Mar-15	07:40	08:40	137.5	135.2	1.8	7.1	423.5	423.7
Sum								9623.0	
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.



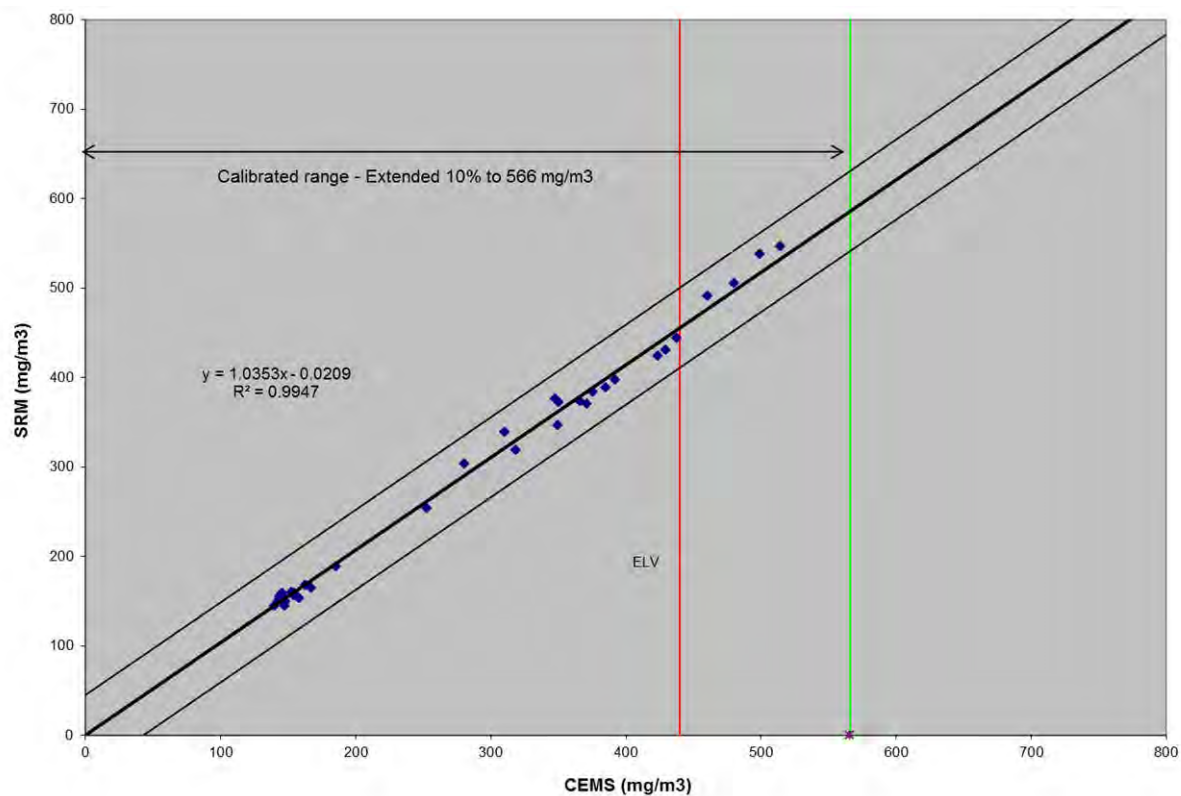
4A2.10.3 Table 4.5.3 – Data used for the Variability Test – Sulphur Dioxide, High Range.

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	18-Feb-15	Reference Gas		-14.1	0.0	14.06	4.37	19.06
2	10-Mar-15	15:30	16:30	143.2	151.3	8.16	-1.53	2.35
3	10-Mar-15	17:30	18:30	144.1	152.7	8.59	-1.11	1.23
4	10-Mar-15	19:30	20:30	143.4	155.3	11.91	2.21	4.89
5	10-Mar-15	21:30	22:30	146.2	156.0	9.83	0.13	0.02
6	10-Mar-15	23:30	00:30	145.7	158.6	12.94	3.25	10.53
7	11-Mar-15	01:30	02:30	152.6	159.6	7.03	-2.67	7.10
8	11-Mar-15	03:30	04:30	154.6	159.1	4.54	-5.16	26.62
9	11-Mar-15	05:30	06:30	166.9	164.4	-2.51	-12.20	148.90
10	11-Mar-15	07:30	08:30	154.2	156.4	2.23	-7.47	55.76
11	11-Mar-15	09:30	10:30	158.0	153.3	-4.72	-14.41	207.68
12	11-Mar-15	11:30	12:30	148.1	148.9	0.78	-8.92	79.52
13	11-Mar-15	13:30	14:30	147.3	144.7	-2.55	-12.24	149.86
14	11-Mar-15	15:30	16:30	139.6	144.5	4.89	-4.81	23.10
15	11-Mar-15	17:30	18:30	162.9	167.2	4.31	-5.39	29.03
16	11-Mar-15	19:30	20:30	185.5	188.3	2.78	-6.92	47.87
17	11-Mar-15	21:30	22:30	252.6	253.7	1.08	-8.61	74.21
18	11-Mar-15	23:30	00:30	318.6	318.9	0.36	-9.34	87.19
19	12-Mar-15	01:30	02:30	365.9	373.2	7.36	-2.33	5.45
20	12-Mar-15	05:30	06:30	347.8	375.7	27.87	18.17	330.22
21	12-Mar-15	07:30	08:30	350.1	372.4	22.29	12.60	158.69
22	12-Mar-15	11:30	12:30	310.2	338.8	28.54	18.84	355.00
23	12-Mar-15	13:30	14:30	280.8	303.4	22.64	12.94	167.54
24	24-Mar-15	09:40	10:40	391.8	397.3	5.44	-4.26	18.12
25	24-Mar-15	11:40	12:40	375.9	383.6	7.74	-1.96	3.84
26	24-Mar-15	13:40	14:40	385.2	388.8	3.66	-6.04	36.44
27	24-Mar-15	15:40	16:40	349.6	346.8	-2.77	-12.47	155.46
28	24-Mar-15	17:40	18:40	371.3	370.2	-1.08	-10.78	116.21
29	24-Mar-15	19:40	20:40	429.3	431.0	1.76	-7.94	62.97
30	24-Mar-15	21:40	22:40	437.6	443.7	6.07	-3.63	13.17
31	24-Mar-15	23:40	00:40	460.8	491.1	30.34	20.64	426.15
32	25-Mar-15	01:40	02:40	499.5	537.9	38.39	28.70	823.50
33	25-Mar-15	03:40	04:40	514.3	546.3	31.98	22.29	496.65
34	25-Mar-15	05:40	06:40	480.2	505.5	25.23	15.53	241.31
35	25-Mar-15	07:40	08:40	423.5	423.7	0.19	-9.50	90.26
35	Tests		Mean			9.70		
	Sum							4475.90

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

SD=	Root(1-Number).Integral(D1-D) ²	11.47	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 30 tests, k _v =	0.9885		
Therefore variability=	11.47 <= 44.9 * 0.9885		
	or 11.47 <=	44.38	
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 9, 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 (dry)	CEMS Moisture	SRM Raw value (dry)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMS Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	24-Mar-15	9:40	10:40	411.34	7.05	1.91	446.94	7.21	2.50	435.79
2	24-Mar-15	11:40	12:40	411.80	7.04	1.90	442.96	7.25	2.38	432.40
3	24-Mar-15	13:40	14:40	342.07	6.90	1.29	438.19	7.22	2.36	427.83
4	24-Mar-15	15:40	16:40	404.74	6.85	2.03	436.32	7.16	2.54	425.22
5	24-Mar-15	17:40	18:40	466.40	6.93	1.86	495.46	7.25	2.29	484.13
6	24-Mar-15	19:40	20:40	472.34	6.92	1.82	498.86	7.28	2.23	487.75
7	24-Mar-15	21:40	22:40	466.61	6.96	1.81	493.75	7.33	2.22	482.79
8	24-Mar-15	23:40	0:40	439.35	7.01	1.79	466.87	7.39	2.20	456.58
9	25-Mar-15	1:40	2:40	392.08	6.99	1.83	422.51	7.39	2.24	413.03
10	25-Mar-15	3:40	4:40	395.28	7.10	1.73	422.30	7.54	2.16	413.19
11	25-Mar-15	5:40	6:40	418.53	7.01	1.66	443.56	7.47	2.05	434.44
12	25-Mar-15	7:40	8:40	442.38	7.07	1.77	465.49	7.55	2.22	455.14

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

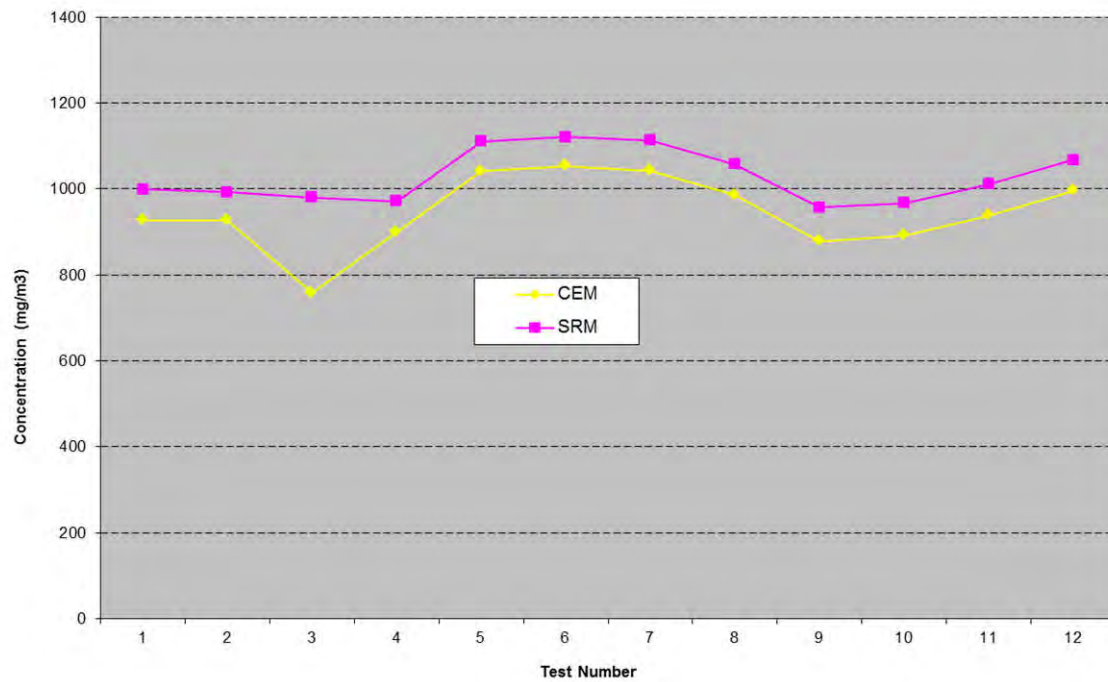
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(mg/m3)	(mg/m3)	(mg/m3)
1	24-Mar-15	9:40	10:40	926.6	998.8	43.0
2	24-Mar-15	11:40	12:40	926.8	992.6	43.0
3	24-Mar-15	13:40	14:40	757.3	980.2	42.0
4	24-Mar-15	15:40	16:40	899.5	971.9	42.0
5	24-Mar-15	17:40	18:40	1040.8	1110.9	45.0
6	24-Mar-15	19:40	20:40	1053.3	1120.7	45.0
7	24-Mar-15	21:40	22:40	1042.7	1113.6	45.0
8	24-Mar-15	23:40	0:40	985.6	1057.6	44.0
9	25-Mar-15	1:40	2:40	878.8	956.9	42.0
10	25-Mar-15	3:40	4:40	892.1	967.2	42.0
11	25-Mar-15	5:40	6:40	937.8	1010.9	43.0
12	25-Mar-15	7:40	8:40	996.3	1067.2	44.0

Note:

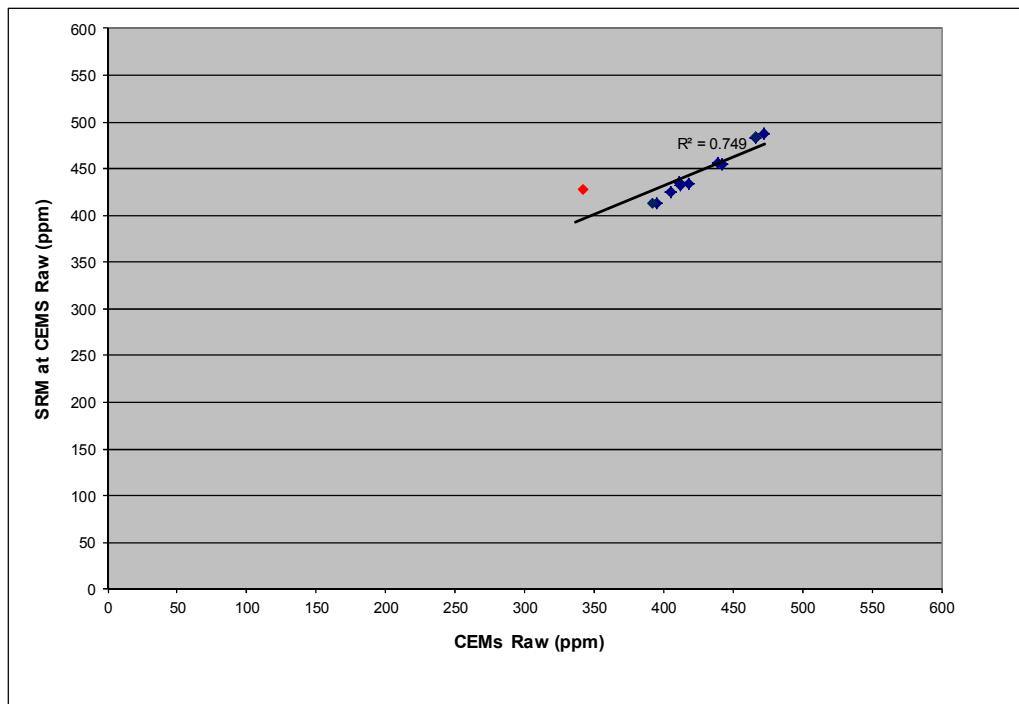
Emission concentrations expressed at reference conditions 273K, 101.3kPa

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.

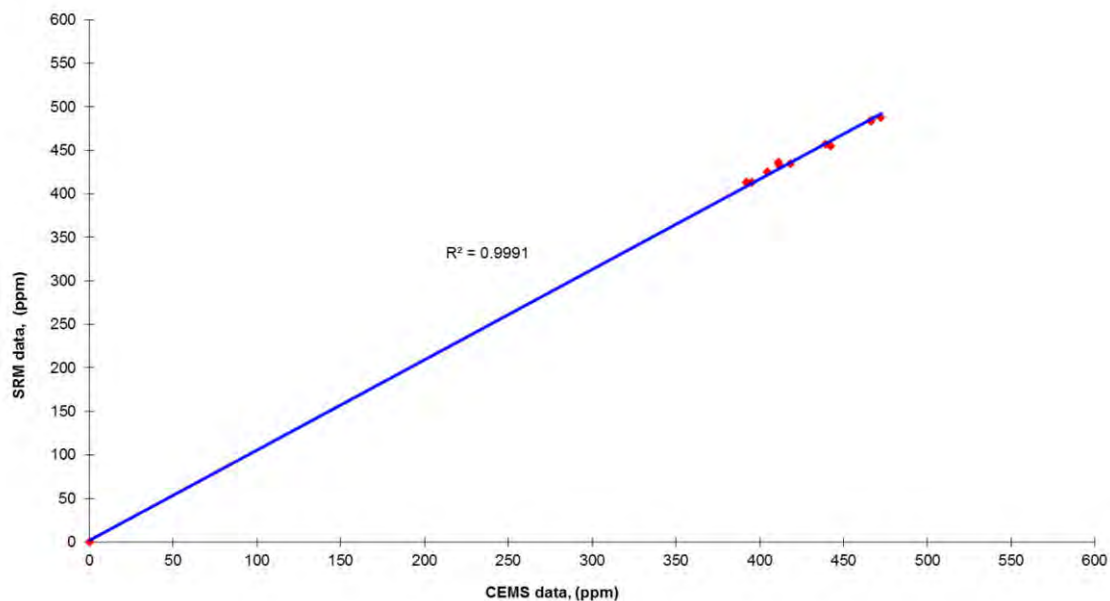


Test No	Test Start Time	Test End Time	CEMS Raw Value	SRM Value at CEMS Raw conditions	Difference Di	Difference Di - \bar{Di}	Is Result an Outlier - $ Di - \bar{Di} > 2SD$
	hr:min		(ppm)	(ppm)			
1	09:40	10:40	411.3	435.8	24.44	0.66	No
2	11:40	12:40	411.8	432.4	20.60	-3.18	No
3	13:40	14:40	342.1	427.8	85.76	61.98	Yes
4	15:40	16:40	404.7	425.2	20.48	-3.30	No
5	17:40	18:40	466.4	484.1	17.73	-6.05	No
6	19:40	20:40	472.3	487.8	15.41	-8.37	No
7	21:40	22:40	466.6	482.8	16.18	-7.60	No
8	23:40	00:40	439.3	456.6	17.23	-6.55	No
9	01:40	02:40	392.1	413.0	20.95	-2.83	No
10	03:40	04:40	395.3	413.2	17.91	-5.87	No
11	05:40	06:40	418.5	434.4	15.91	-7.87	No
12	07:40	08:40	442.4	455.1	12.76	-11.03	No
				Average \bar{Di}	23.78		
				Standard Deviation	19.76		
				Standard Deviation x2	39.53		

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 dry 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	17-Feb-15	Reference		0.3	-5.9			0.7	-12.0	0.0
2	24-Mar-15	09:40	10:40	411.3	442.5	7.05	1.91	926.6	996.9	998.8
3	24-Mar-15	11:40	12:40	411.8	443.0	7.04	1.90	926.8	997.1	992.6
5	24-Mar-15	15:40	16:40	404.7	435.3	6.85	2.03	899.5	967.5	971.9
6	24-Mar-15	17:40	18:40	466.4	502.6	6.93	1.86	1040.8	1121.6	1110.9
7	24-Mar-15	19:40	20:40	472.3	509.1	6.92	1.82	1053.3	1135.2	1120.7
8	24-Mar-15	21:40	22:40	466.6	502.8	6.96	1.81	1042.7	1123.7	1113.6
9	24-Mar-15	23:40	00:40	439.3	473.1	7.01	1.79	985.6	1061.3	1057.6
10	25-Mar-15	01:40	02:40	392.1	421.5	6.99	1.83	878.8	944.8	956.9
11	25-Mar-15	03:40	04:40	395.3	425.0	7.10	1.73	892.1	959.2	967.2
12	25-Mar-15	05:40	06:40	418.5	450.4	7.01	1.66	937.8	1009.1	1010.9
13	25-Mar-15	07:40	08:40	442.4	476.4	7.10	1.77	996.3	1075.7	1067.2
Sum								10580.96		
Emission Limit Value (ELV) =				1210	mg/Nm ³					
Reference Oxygen					6	%				
Established Calibration Function y _i =				-6.232 + 1.091x _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	17-Feb-15	Reference		-12.0	0.0	12.0	13.03	169.71
2	24-Mar-15	09:40	10:40	996.9	998.8	1.87	2.85	8.11
3	24-Mar-15	11:40	12:40	997.1	992.6	-4.54	-3.56	12.65
5	24-Mar-15	15:40	16:40	967.5	971.9	4.37	5.35	28.62
6	24-Mar-15	17:40	18:40	1121.6	1110.9	-10.64	-9.66	93.32
7	24-Mar-15	19:40	20:40	1135.2	1120.7	-14.47	-13.49	181.90
8	24-Mar-15	21:40	22:40	1123.7	1113.6	-10.09	-9.11	82.96
9	24-Mar-15	23:40	00:40	1061.3	1057.6	-3.66	-2.68	7.17
10	25-Mar-15	01:40	02:40	944.8	956.9	12.11	13.09	171.38
11	25-Mar-15	03:40	04:40	959.2	967.2	7.96	8.94	79.94
12	25-Mar-15	05:40	06:40	1009.1	1010.9	1.71	2.69	7.21
13	25-Mar-15	07:40	08:40	1075.7	1067.2	-8.43	-7.45	55.54
Mean						-0.98		
Sum								898.49

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

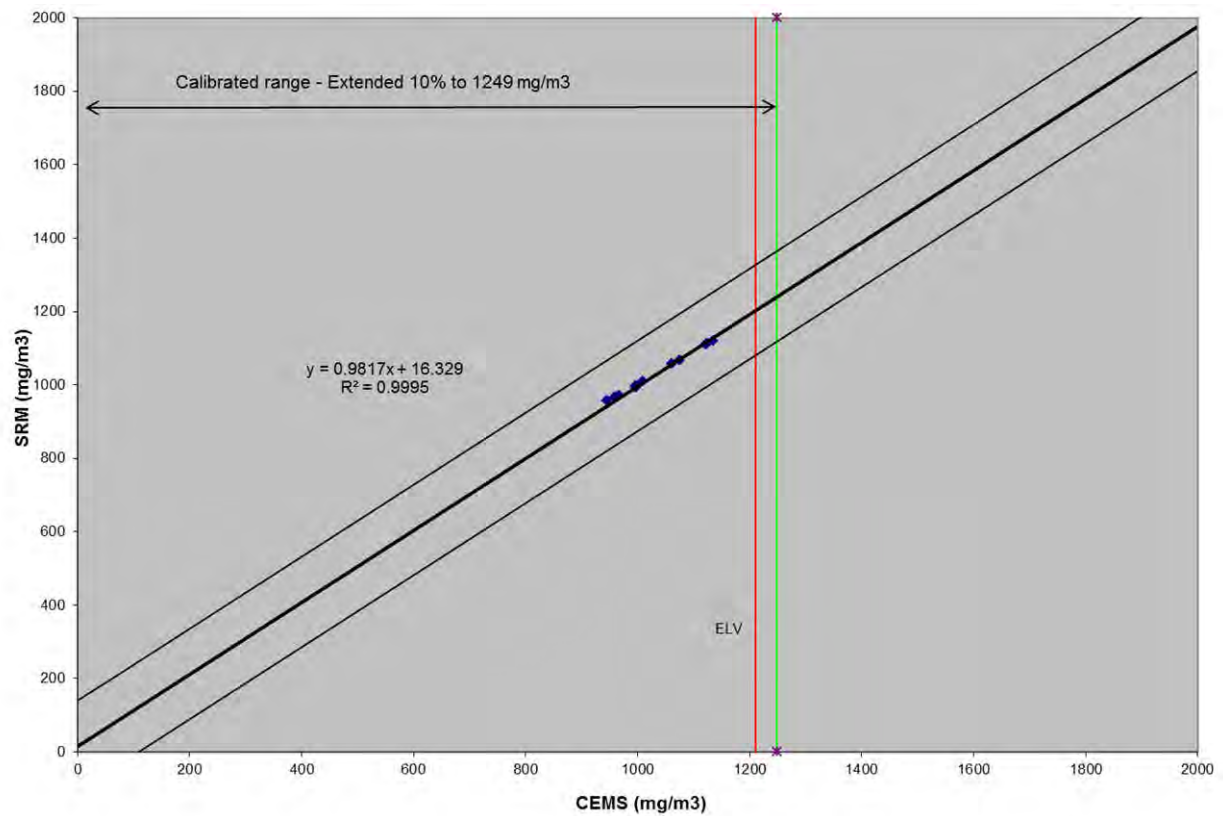
Variability Test

SD=	$\text{Root}(1-\text{Number}).\text{Integral}(\text{D1}-\text{D})^2$	9.04	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 12 tests, kv =	0.9695		
Therefore variability=	$9.04 \leq 123.47 * 0.9695 * 1.5$		
	or $9.04 \leq$	179.56	
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=	0.98
For 12 tests, $t_{0.95}(N-1)$:	1.796	
Therefore test of calibration =	$0.98 \leq 1.796 * (9.04/\text{root } 12) + 123.47$	
	or $0.98 \leq$	128.16
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.



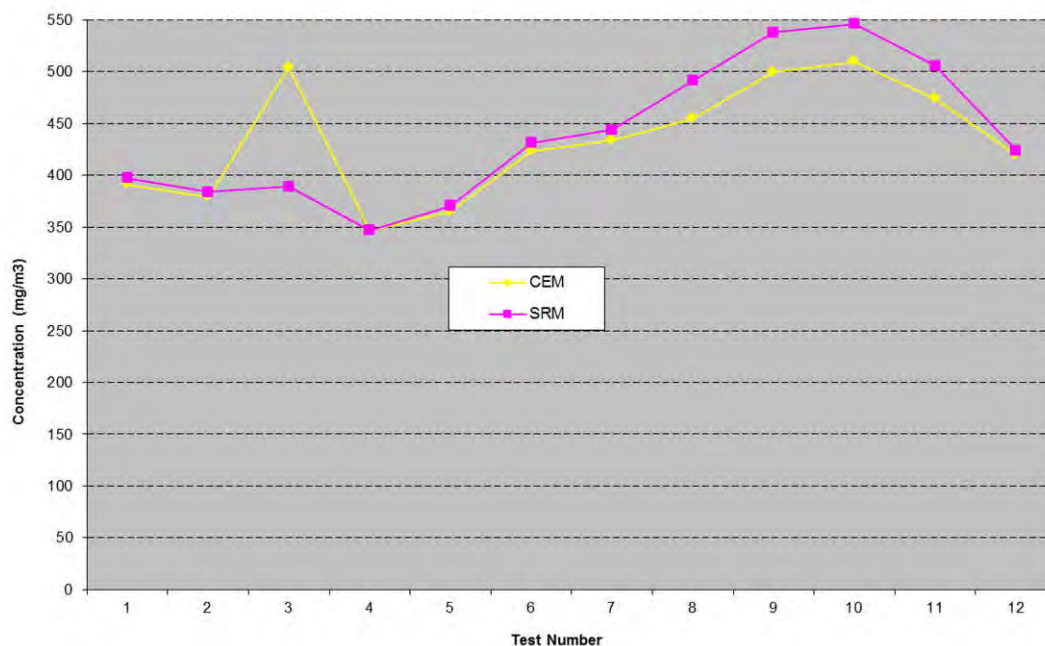
4B1 4.1.2 Table 4.1.2 – Raw monitoring Data – Sulphur Dioxide Low Range

Date	Test Start Time	Test End Time	CEMS Raw Value (wet)	CEMS Oxygen (dry)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRMat CEMs Raw conditions
	hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
24-Mar-15	9:40	10:40	124.80	7.05	1.91	124.59	7.21	2.50	124.59
24-Mar-15	11:40	12:40	121.10	7.04	1.90	120.11	7.25	2.38	120.11
24-Mar-15	13:40	14:40	163.58	6.90	1.29	121.99	7.22	2.36	121.99
24-Mar-15	15:40	16:40	112.03	6.85	2.03	109.06	7.16	2.54	109.06
24-Mar-15	17:40	18:40	117.50	6.93	1.86	115.95	7.25	2.29	115.95
24-Mar-15	19:40	20:40	136.43	6.92	1.82	134.83	7.28	2.23	134.83
24-Mar-15	21:40	22:40	139.55	6.96	1.81	138.24	7.33	2.22	138.24
24-Mar-15	23:40	0:40	145.68	7.01	1.79	152.38	7.39	2.20	152.38
25-Mar-15	1:40	2:40	160.17	6.99	1.83	166.86	7.39	2.24	166.86
25-Mar-15	3:40	4:40	162.24	7.10	1.73	167.74	7.54	2.16	167.74
25-Mar-15	5:40	6:40	151.97	7.01	1.66	156.14	7.47	2.05	156.14
25-Mar-15	7:40	8:40	133.81	7.07	1.77	129.88	7.55	2.22	129.88

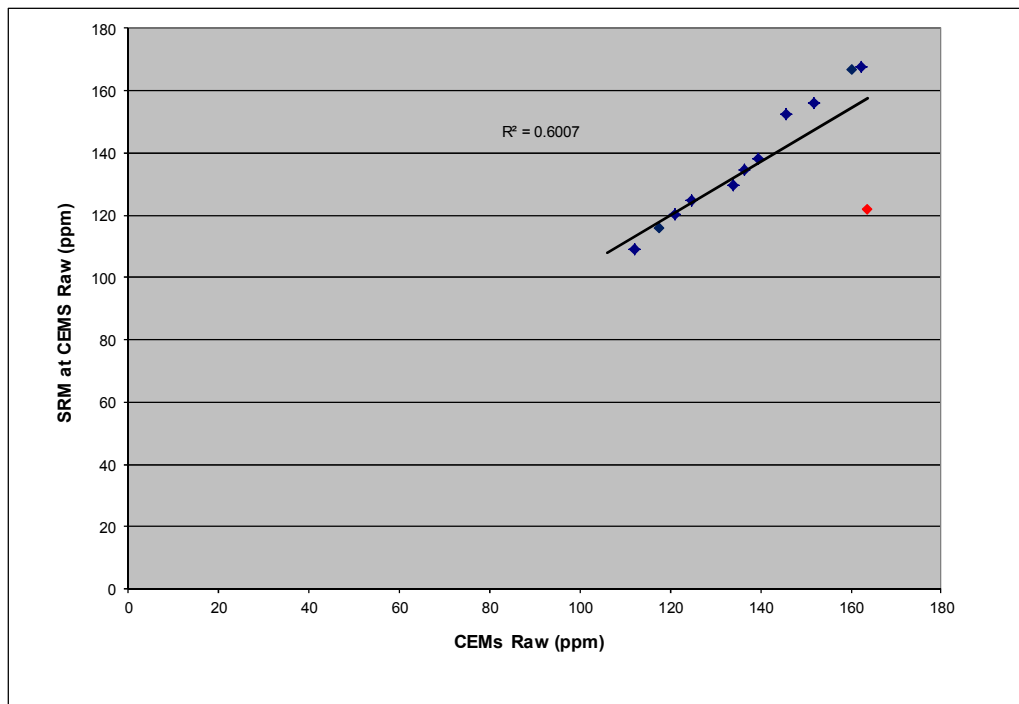
B1 4.2.2 Table 4.2.2 – Standardised monitoring Data – Sulphur Dioxide - Low Range

Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(mg/m3)	(mg/m3)	(mg/m3)
1	24-Mar-15	9:40	10:40	391.2	397.3	9.0
2	24-Mar-15	11:40	12:40	379.2	383.6	10.0
3	24-Mar-15	13:40	14:40	503.9	388.8	10.0
4	24-Mar-15	15:40	16:40	346.4	346.8	11.0
5	24-Mar-15	17:40	18:40	364.8	370.2	11.0
6	24-Mar-15	19:40	20:40	423.3	431.0	12.0
7	24-Mar-15	21:40	22:40	433.9	443.7	12.0
8	24-Mar-15	23:40	0:40	454.7	491.1	12.0
9	25-Mar-15	1:40	2:40	499.5	537.9	13.0
10	25-Mar-15	3:40	4:40	509.4	546.3	13.0
11	25-Mar-15	5:40	6:40	473.7	505.5	12.0
12	25-Mar-15	7:40	8:40	419.3	423.7	11.0

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.



Test No	Test Start Time	Test End Time	CEMS Raw Value	SRM Value at CEMS Raw conditions	Difference Di	Difference Di - \bar{Di}	Is Result an Outlier - $ Di - \bar{Di} > 2SD$
	hr:min		(ppm)	(ppm)			
1	09:40	10:40	124.8	124.6	-0.22	2.38	No
2	11:40	12:40	121.1	120.1	-1.00	1.60	No
3	13:40	14:40	163.6	122.0	-41.59	-39.00	Yes
4	15:40	16:40	112.0	109.1	-2.97	-0.38	No
5	17:40	18:40	117.5	115.9	-1.55	1.04	No
6	19:40	20:40	136.4	134.8	-1.60	0.99	No
7	21:40	22:40	139.6	138.2	-1.31	1.28	No
8	23:40	00:40	145.7	152.4	6.70	9.29	No
9	01:40	02:40	160.2	166.9	6.69	9.28	No
10	03:40	04:40	162.2	167.7	5.50	8.09	No
11	05:40	06:40	152.0	156.1	4.17	6.76	No
12	07:40	08:40	133.8	129.9	-3.92	-1.33	No
				Average \bar{Di}	-2.59		
			Standard Deviation		12.86		
			Standard Deviation x2		25.71		

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 dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		(ppm)	(ppm)	%	%	(mg/Nm ³)	(mg/Nm ³)	(mg/m ³)
1	17-Feb-15	Reference		-0.2	0.4			-0.2	1.0	0.0
2	24-Mar-15	09:40	10:40	124.8	135.1	7.05	1.91	391.2	423.3	397.3
3	24-Mar-15	11:40	12:40	121.1	131.1	7.04	1.90	379.2	410.5	383.6
5	24-Mar-15	15:40	16:40	112.0	121.3	6.85	2.03	346.4	375.1	346.8
6	24-Mar-15	17:40	18:40	117.5	127.2	6.93	1.86	364.8	394.9	370.2
7	24-Mar-15	19:40	20:40	136.4	147.6	6.92	1.82	423.3	457.9	431.0
8	24-Mar-15	21:40	22:40	139.6	151.0	6.96	1.81	433.9	469.4	443.7
9	24-Mar-15	23:40	00:40	145.7	157.6	7.01	1.79	454.7	491.8	491.1
10	25-Mar-15	01:40	02:40	160.2	173.2	6.99	1.83	499.5	540.1	537.9
11	25-Mar-15	03:40	04:40	162.2	175.4	7.10	1.73	509.4	550.9	546.3
12	25-Mar-15	05:40	06:40	152.0	164.4	7.01	1.66	473.7	512.4	505.5
13	25-Mar-15	07:40	08:40	133.8	144.8	7.10	1.77	419.3	454.8	423.7
Sum								4695.18		

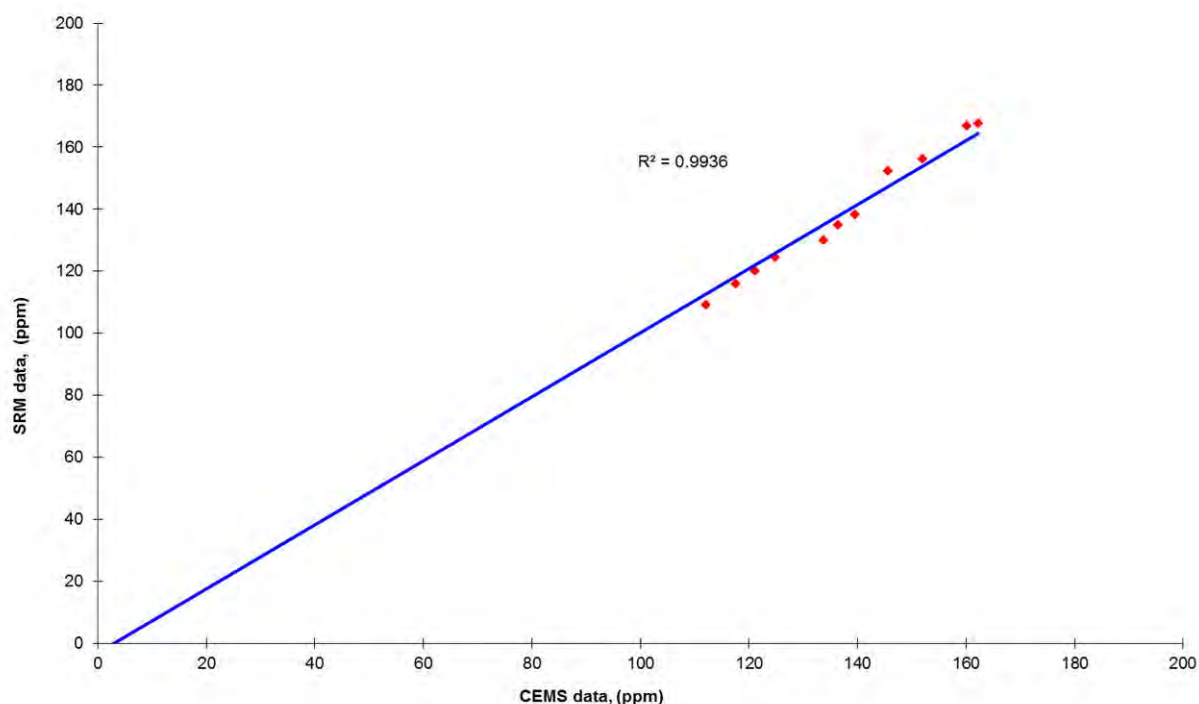
Emission Limit Value (ELV) = 440 mg/Nm³

Reference Oxygen

6 %

Established Calibration Function y= 0.536 + 1.078xi

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



4B1 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	17-Feb-15	Reference		1.0	0.0	-1.0	16.08	258.56
2	24-Mar-15	09:40	10:40	423.3	397.3	-26.07	-8.97	80.44
3	24-Mar-15	11:40	12:40	410.5	383.6	-26.87	-9.78	95.58
5	24-Mar-15	15:40	16:40	375.1	346.8	-28.28	-11.19	125.15
6	24-Mar-15	17:40	18:40	394.9	370.2	-24.74	-7.64	58.37
7	24-Mar-15	19:40	20:40	457.9	431.0	-26.91	-9.81	96.30
8	24-Mar-15	21:40	22:40	469.4	443.7	-25.74	-8.64	74.73
9	24-Mar-15	23:40	00:40	491.8	491.1	-0.72	16.37	268.10
10	25-Mar-15	01:40	02:40	540.1	537.9	-2.26	14.83	220.05
11	25-Mar-15	03:40	04:40	550.9	546.3	-4.57	12.53	156.89
12	25-Mar-15	05:40	06:40	512.4	505.5	-6.90	10.20	104.06
13	25-Mar-15	07:40	08:40	454.8	423.7	-31.08	-13.98	195.53
Mean						-17.10		
Sum								1733.77

4B1 4.7.2 - Variability Test and Test of Calibration Function Calculations – Sulphur Dioxide - Low Range.

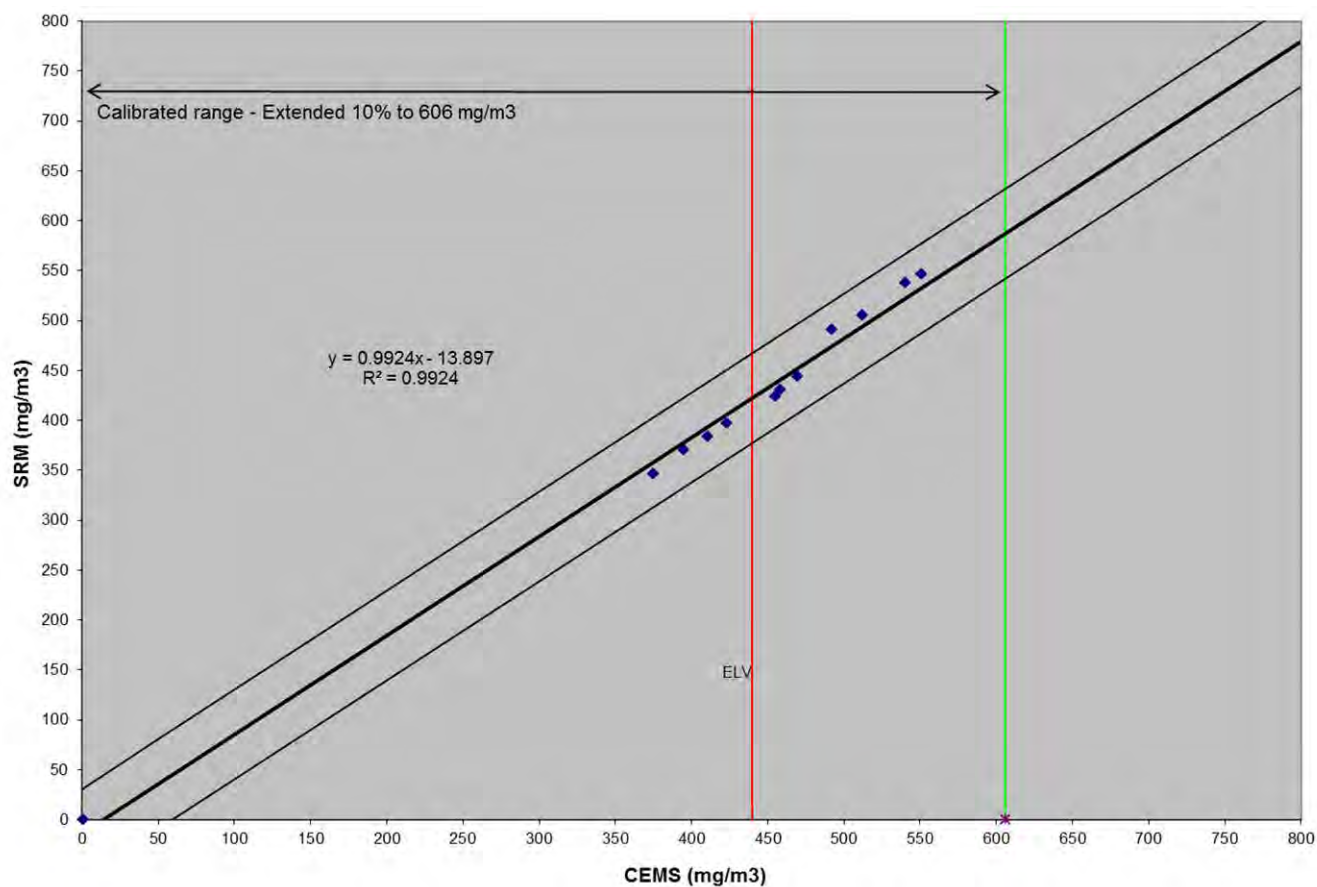
Variability Test

SD= $\text{Root}(1-\text{Number}).\text{Integral}(\text{D1}-\text{D})^2$ 12.55 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 12 tests, kv = 0.9695
 Therefore variability= $12.55 \leq 44.9 * 0.9695 * 1.5$
 or $12.55 \leq 65.29$
 Which is TRUE therefore the CEMS passes the test

Test of Calibration Function

The calibration of the AMS is accepted if: $\text{D1} \leq t_{0.95}(N-1) * (\text{s,d}/\text{root } N) + O_0$
 $\text{D1} = 17.10$
 For 12 tests, $t_{0.95}(N-1) : 1.796$
 Therefore test of calibration = $17.1 \leq 1.796 * (12.55/\text{root } 12) + 44.9$
 or $17.10 \leq 51.41$
 Which is TRUE therefore the calibration function is VALID

4B1 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 (dry)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMS Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	24-Mar-15	9:40	10:40	118.54	7.05	1.91	124.59	7.21	2.50	124.59
2	24-Mar-15	11:40	12:40	114.98	7.04	1.90	120.11	7.25	2.38	120.11
3	24-Mar-15	13:40	14:40	157.45	6.90	1.29	121.99	7.22	2.36	121.99
4	24-Mar-15	15:40	16:40	106.36	6.85	2.03	109.06	7.16	2.54	109.06
5	24-Mar-15	17:40	18:40	111.56	6.93	1.86	115.95	7.25	2.29	115.95
6	24-Mar-15	19:40	20:40	129.74	6.92	1.82	134.83	7.28	2.23	134.83
7	24-Mar-15	21:40	22:40	132.71	6.96	1.81	138.24	7.33	2.22	138.24
8	24-Mar-15	23:40	0:40	138.51	7.01	1.79	152.38	7.39	2.20	152.38
9	25-Mar-15	1:40	2:40	152.46	6.99	1.83	166.86	7.39	2.24	166.86
10	25-Mar-15	3:40	4:40	154.41	7.10	1.73	167.74	7.54	2.16	167.74
11	25-Mar-15	5:40	6:40	144.63	7.01	1.66	156.14	7.47	2.05	156.14
12	25-Mar-15	7:40	8:40	127.16	7.07	1.77	129.88	7.55	2.22	129.88

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

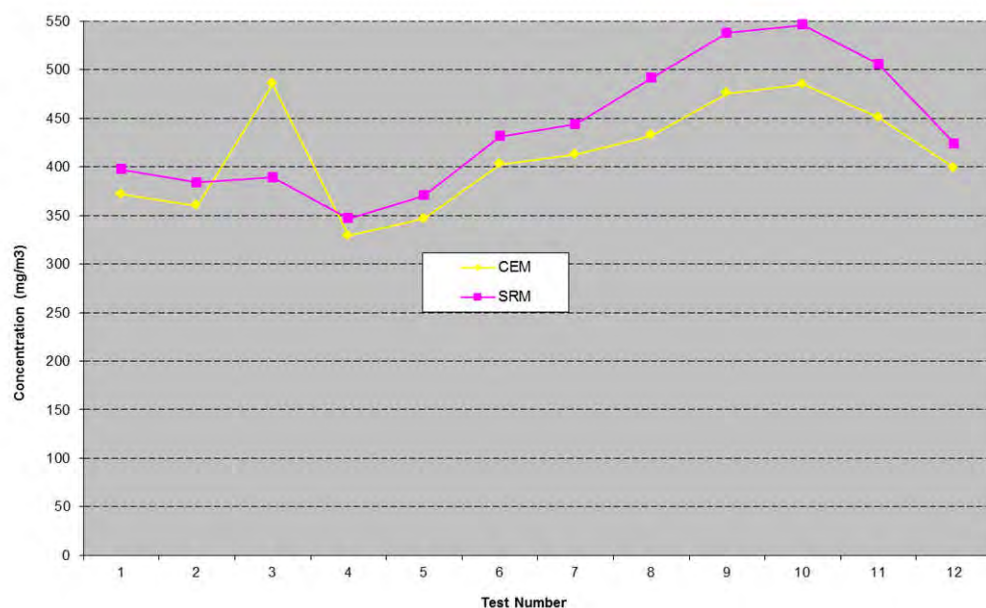
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(mg/m3)	(mg/m3)	(mg/m3)
1	24-Mar-15	9:40	10:40	371.5	397.3	9.0
2	24-Mar-15	11:40	12:40	360.1	383.6	10.0
3	24-Mar-15	13:40	14:40	485.0	388.8	10.0
4	24-Mar-15	15:40	16:40	328.9	346.8	11.0
5	24-Mar-15	17:40	18:40	346.3	370.2	11.0
6	24-Mar-15	19:40	20:40	402.5	431.0	12.0
7	24-Mar-15	21:40	22:40	412.6	443.7	12.0
8	24-Mar-15	23:40	0:40	432.3	491.1	12.0
9	25-Mar-15	1:40	2:40	475.4	537.9	13.0
10	25-Mar-15	3:40	4:40	484.9	546.3	13.0
11	25-Mar-15	5:40	6:40	450.9	505.5	12.0
12	25-Mar-15	7:40	8:40	398.4	423.7	11.0

Note:

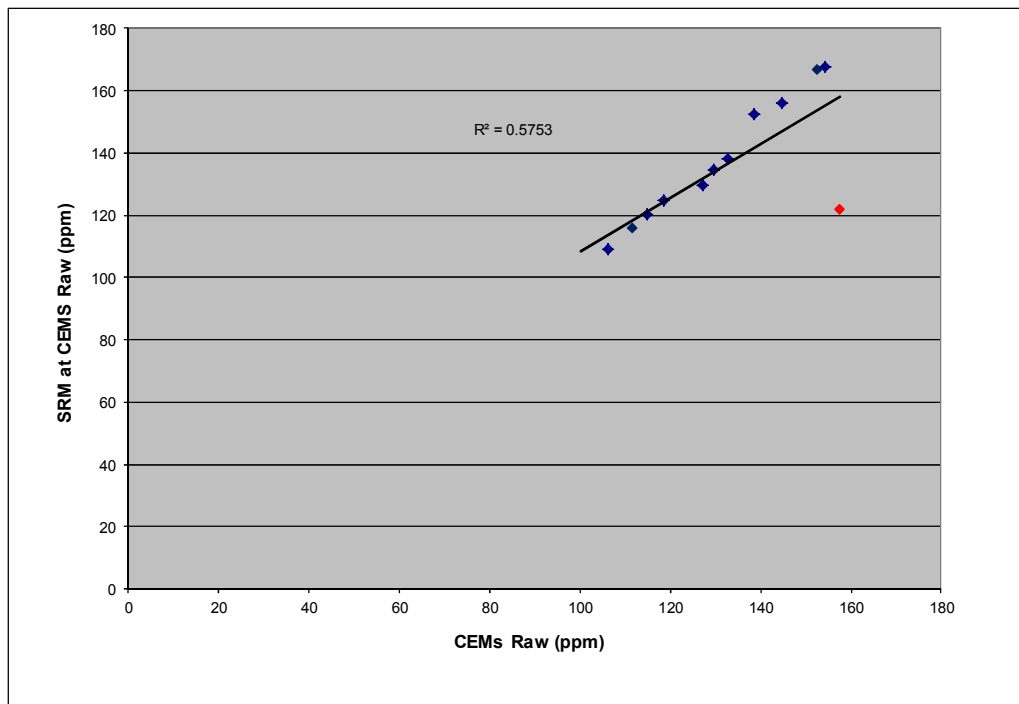
Emission concentrations expressed at reference conditions 273K, 101.3kPa

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.



Test No	Test Start Time	Test End Time	CEMS Raw Value	SRM Value at CEMS Raw conditions	Difference Di	Difference Di - \bar{Di}	Is Result an Outlier - $ Di - \bar{Di} > 2SD$
hr:min			(ppm)	(ppm)			
1	09:40	10:40	118.5	124.6	6.05	1.94	No
2	11:40	12:40	115.0	120.1	5.12	1.02	No
3	13:40	14:40	157.5	122.0	-35.47	-39.57	Yes
4	15:40	16:40	106.4	109.1	2.69	-1.41	No
5	17:40	18:40	111.6	115.9	4.39	0.29	No
6	19:40	20:40	129.7	134.8	5.09	0.99	No
7	21:40	22:40	132.7	138.2	5.53	1.42	No
8	23:40	00:40	138.5	152.4	13.87	9.77	No
9	01:40	02:40	152.5	166.9	14.40	10.29	No
10	03:40	04:40	154.4	167.7	13.33	9.23	No
11	05:40	06:40	144.6	156.1	11.51	7.40	No
12	07:40	08:40	127.2	129.9	2.73	-1.38	No
				Average \bar{Di}	4.10		
Standard Deviation					13.21		
Standard Deviation x2					26.42		

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 dry 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	17-Feb-15	Reference		-0.2	-1.1	0.00		-0.2	-3.1	0.0
2	24-Mar-15	09:40	10:40	118.5	123.4	7.05	1.91	371.5	386.9	397.3
3	24-Mar-15	11:40	12:40	115.0	119.7	7.04	1.90	360.1	374.9	383.6
5	24-Mar-15	15:40	16:40	106.4	110.7	6.85	2.03	328.9	342.2	346.8
6	24-Mar-15	17:40	18:40	111.6	116.1	6.93	1.86	346.3	360.5	370.2
7	24-Mar-15	19:40	20:40	129.7	135.2	6.92	1.82	402.5	419.4	431.0
8	24-Mar-15	21:40	22:40	132.7	138.3	6.96	1.81	412.6	430.1	443.7
9	24-Mar-15	23:40	00:40	138.5	144.4	7.01	1.79	432.3	450.7	491.1
10	25-Mar-15	01:40	02:40	152.5	159.0	6.99	1.83	475.4	495.9	537.9
11	25-Mar-15	03:40	04:40	154.4	161.1	7.10	1.73	484.9	505.8	546.3
12	25-Mar-15	05:40	06:40	144.6	150.8	7.01	1.66	450.9	470.2	505.5
13	25-Mar-15	07:40	08:40	127.2	132.5	7.10	1.77	398.4	416.2	423.7
Sum								4463.67		

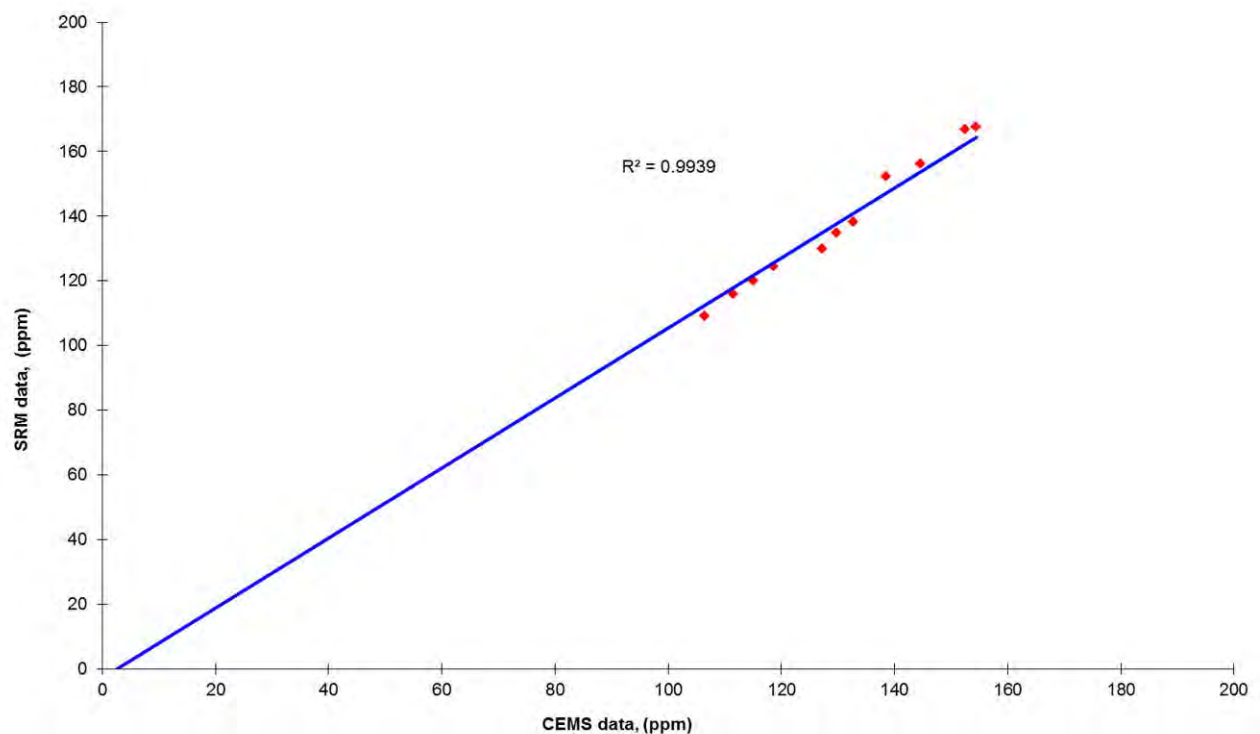
Emission Limit Value (ELV) = 440 mg/Nm³

Reference Oxygen

6 %

Established Calibration Function y= -0.9 + 1.049xi

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



4B1 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	17-Feb-15	Reference		-3.1	0.0	3.1	-15.87	251.85
2	24-Mar-15	09:40	10:40	386.9	397.3	10.36	-8.58	73.56
3	24-Mar-15	11:40	12:40	374.9	383.6	8.72	-10.22	104.38
5	24-Mar-15	15:40	16:40	342.2	346.8	4.57	-14.37	206.46
6	24-Mar-15	17:40	18:40	360.5	370.2	9.66	-9.28	86.20
7	24-Mar-15	19:40	20:40	419.4	431.0	11.60	-7.34	53.88
8	24-Mar-15	21:40	22:40	430.1	443.7	13.60	-5.34	28.54
9	24-Mar-15	23:40	00:40	450.7	491.1	40.43	21.49	461.97
10	25-Mar-15	01:40	02:40	495.9	537.9	41.92	22.98	528.10
11	25-Mar-15	03:40	04:40	505.8	546.3	40.50	21.56	464.67
12	25-Mar-15	05:40	06:40	470.2	505.5	35.30	16.36	267.77
13	25-Mar-15	07:40	08:40	416.2	423.7	7.55	-11.39	129.84
Mean						18.94		
Sum								2657.22

4B1 4.7.3 - Variability Test and Test of Calibration Function Calculations – Sulphur Dioxide - High Range.

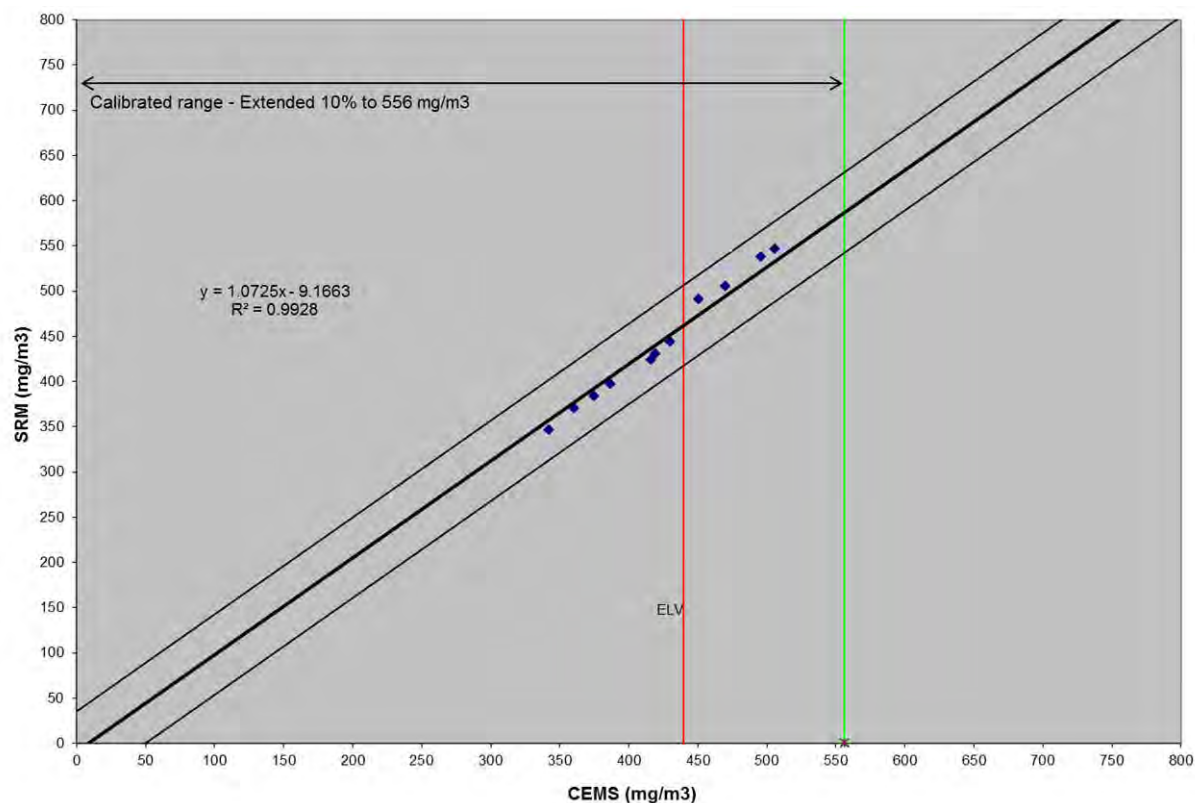
Variability Test

SD=	$\text{Root}(1-\text{Number}).\text{Integral}(\text{D1}-\text{D})^2$	15.54	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 12 tests, kv =	0.9695		
Therefore variability=	$15.54 \leq 44.9 * 0.9695*1.5$		
	or $15.54 \leq 65.29$		
Which is TRUE therefore the CEMS passes the test			

Test of Calibration Function

The calibration of the AMS is accepted if:	$\text{D1} \leq t_{0.95}(N-1)*(s,\text{d}/\text{root } N)+O_0$
	D1= 18.94
For 12 tests, t _{0.95} (N-1) :	1.796
Therefore test of calibration =	$18.94 \leq 1.796*(15.54/\text{root } 12)+44.9$
or	$18.94 \leq 52.96$
Which is TRUE therefore the calibration function is VALID	

4B1 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 9, Procal 2

Section 4B2 – Data and calculations – AST Procal 2

4B2 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 (dry)	CEMS Moisture	SRM Raw value (dry)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMS Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	24-Mar-15	9:40	10:40	415.20	7.05	1.91	446.94	7.21	2.50	435.79
2	24-Mar-15	11:40	12:40	417.92	7.04	1.90	442.96	7.25	2.38	432.40
3	24-Mar-15	13:40	14:40	414.44	6.90	1.29	438.19	7.22	2.36	427.83
4	24-Mar-15	15:40	16:40	412.93	6.85	2.03	436.32	7.16	2.54	425.22
5	24-Mar-15	17:40	18:40	467.41	6.93	1.86	495.46	7.25	2.29	484.13
6	24-Mar-15	19:40	20:40	468.57	6.92	1.82	498.86	7.28	2.23	487.75
7	24-Mar-15	21:40	22:40	468.55	6.96	1.81	493.75	7.33	2.22	482.79
8	24-Mar-15	23:40	0:40	440.64	7.01	1.79	466.87	7.39	2.20	456.58
9	25-Mar-15	1:40	2:40	404.32	6.99	1.83	422.51	7.39	2.24	413.03
10	25-Mar-15	3:40	4:40	412.47	7.10	1.73	422.30	7.54	2.16	413.19
11	25-Mar-15	5:40	6:40	430.02	7.01	1.66	443.56	7.47	2.05	434.44
12	25-Mar-15	7:40	8:40	453.95	7.07	1.77	465.49	7.55	2.22	455.14

4B2 4.2.1 Table 4.2.1 – Standardised monitoring Data – Oxides of Nitrogen

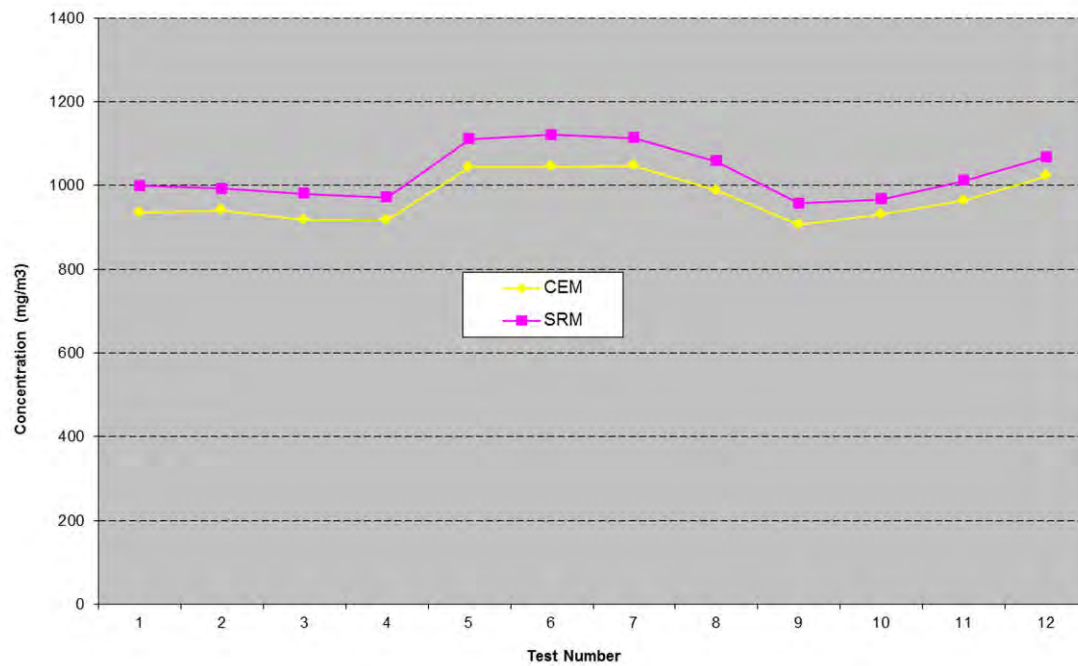
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(mg/m3)	(mg/m3)	(mg/m3)
1	24-Mar-15	9:40	10:40	935.3	998.8	48.0
2	24-Mar-15	11:40	12:40	940.6	992.6	45.0
3	24-Mar-15	13:40	14:40	917.5	980.2	44.0
4	24-Mar-15	15:40	16:40	917.7	971.9	46.0
5	24-Mar-15	17:40	18:40	1043.0	1110.9	46.0
6	24-Mar-15	19:40	20:40	1044.8	1120.7	45.0
7	24-Mar-15	21:40	22:40	1047.1	1113.6	46.0
8	24-Mar-15	23:40	0:40	988.5	1057.6	47.0
9	25-Mar-15	1:40	2:40	906.2	956.9	47.0
10	25-Mar-15	3:40	4:40	930.9	967.2	40.0
11	25-Mar-15	5:40	6:40	963.5	1010.9	38.0
12	25-Mar-15	7:40	8:40	1022.4	1067.2	38.0

Note:

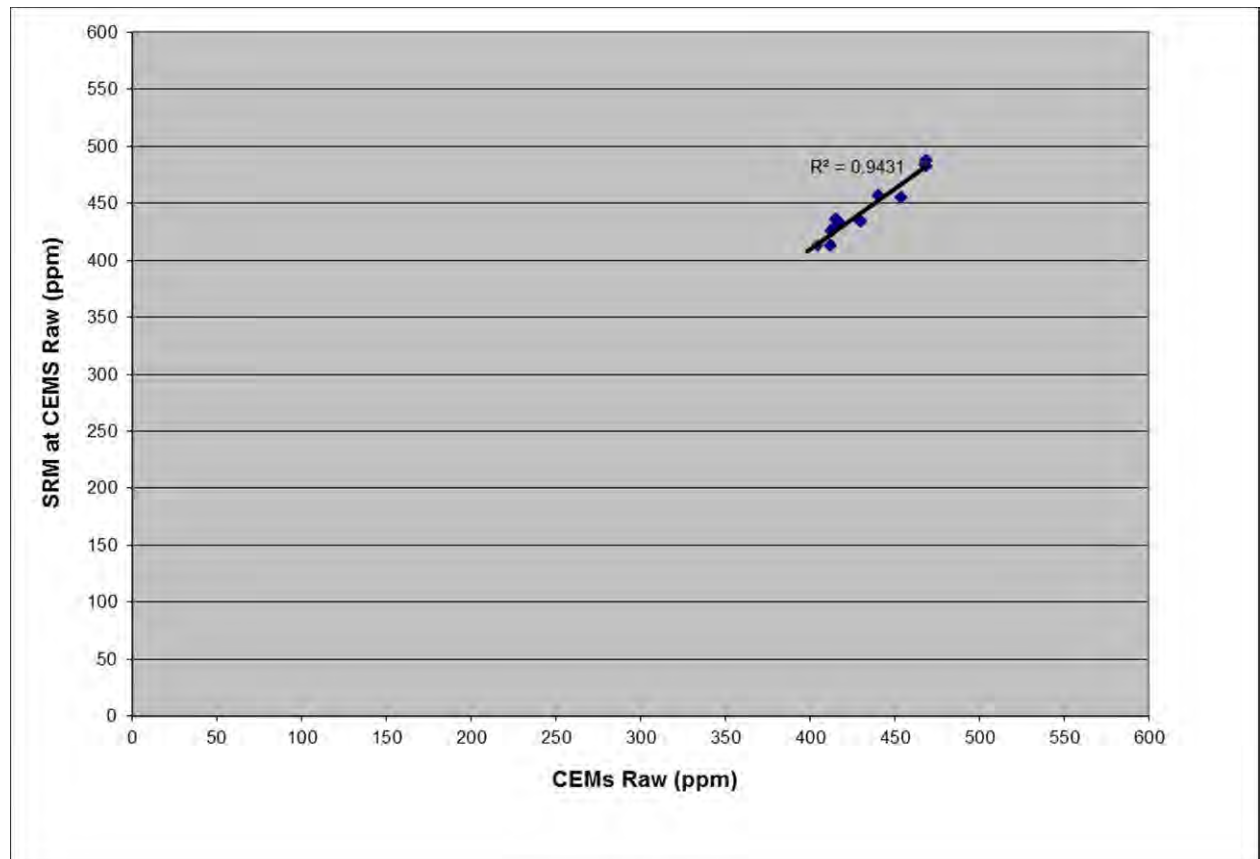
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

4B2 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.



4B2 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.

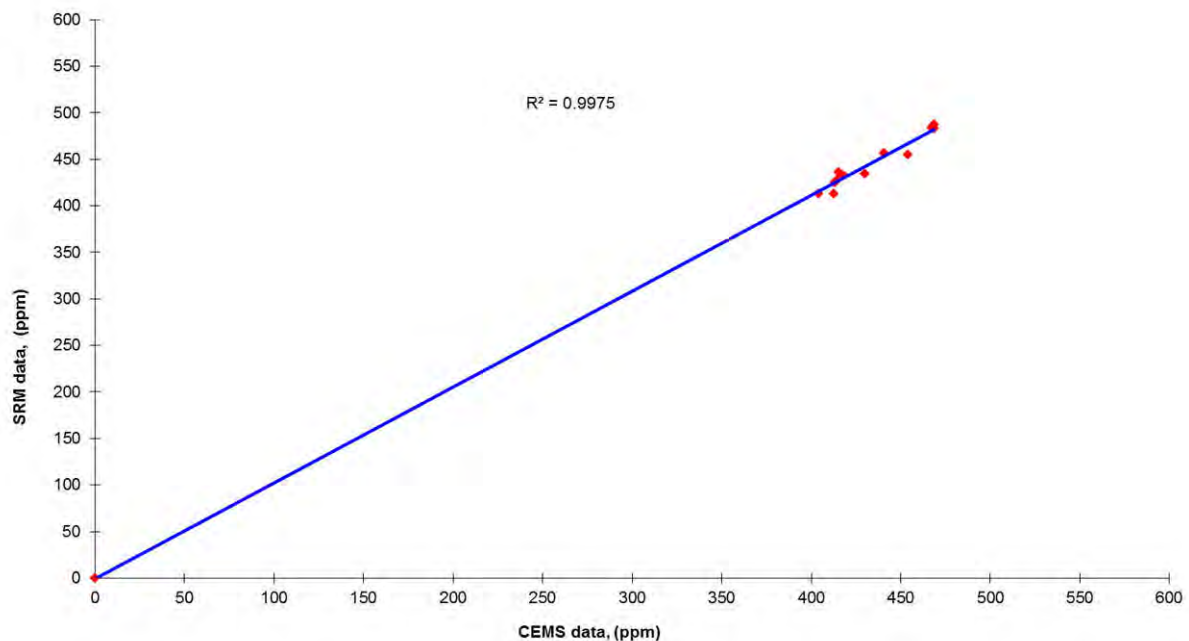
Additionally, any data points are not likely to be outliers unless they are more than three standard deviations from the regression line'

As the R^2 value for this determinand was 0.9431, an outlier test has not been undertaken.

4B2 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	18-Feb-15	Reference		0.2	-1.8	0.00		0.2	-1.8	0.0
2	24-Mar-15	09:40	10:40	415.2	429.0	7.05	1.91	935.3	966.5	998.8
3	24-Mar-15	11:40	12:40	417.9	431.8	7.04	1.90	940.6	971.9	992.6
4	24-Mar-15	13:40	14:40	414.4	428.2	6.90	1.29	917.5	948.1	980.2
5	24-Mar-15	15:40	16:40	412.9	426.7	6.85	2.03	917.7	948.2	971.9
6	24-Mar-15	17:40	18:40	467.4	483.2	6.93	1.86	1043.0	1078.3	1110.9
7	24-Mar-15	19:40	20:40	468.6	484.4	6.92	1.82	1044.8	1080.2	1120.7
8	24-Mar-15	21:40	22:40	468.6	484.4	6.96	1.81	1047.1	1082.5	1113.6
9	24-Mar-15	23:40	00:40	440.6	455.4	7.01	1.79	988.5	1021.6	1057.6
10	25-Mar-15	01:40	02:40	404.3	417.7	6.99	1.83	906.2	936.3	956.9
11	25-Mar-15	03:40	04:40	412.5	426.2	7.10	1.73	930.9	961.9	967.2
12	25-Mar-15	05:40	06:40	430.0	444.4	7.01	1.66	963.5	995.7	1010.9
13	25-Mar-15	07:40	08:40	453.9	469.2	7.10	1.77	1022.4	1059.5	1067.2
Sum								11657.75		
Emission Limit Value (ELV) =				1210	mg/Nm ³					
Reference Oxygen					6					
Established Calibration Function y _i =					-1.955 + 1.038x _i					
					%					

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



4B2 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	18-Feb-15	Reference		-1.8	0.0	1.8	-21.26	452.00
2	24-Mar-15	09:40	10:40	966.5	998.8	32.32	9.28	86.08
3	24-Mar-15	11:40	12:40	971.9	992.6	20.67	-2.37	5.62
4	24-Mar-15	13:40	14:40	948.1	980.2	32.07	9.03	81.48
5	24-Mar-15	15:40	16:40	948.2	971.9	23.65	0.60	0.36
6	24-Mar-15	17:40	18:40	1078.3	1110.9	32.63	9.59	91.87
7	24-Mar-15	19:40	20:40	1080.2	1120.7	40.55	17.51	306.64
8	24-Mar-15	21:40	22:40	1082.5	1113.6	31.10	8.06	64.99
9	24-Mar-15	23:40	00:40	1021.6	1057.6	35.98	12.94	167.36
10	25-Mar-15	01:40	02:40	936.3	956.9	20.63	-2.42	5.84
11	25-Mar-15	03:40	04:40	961.9	967.2	5.31	-17.73	314.34
12	25-Mar-15	05:40	06:40	995.7	1010.9	15.12	-7.93	62.82
13	25-Mar-15	07:40	08:40	1059.5	1067.2	7.74	-15.30	234.10
Mean						23.04		
Sum								1873.51

4B2 4.7.1 - Variability Test and Test of Calibration Function Calculations – Oxides of Nitrogen

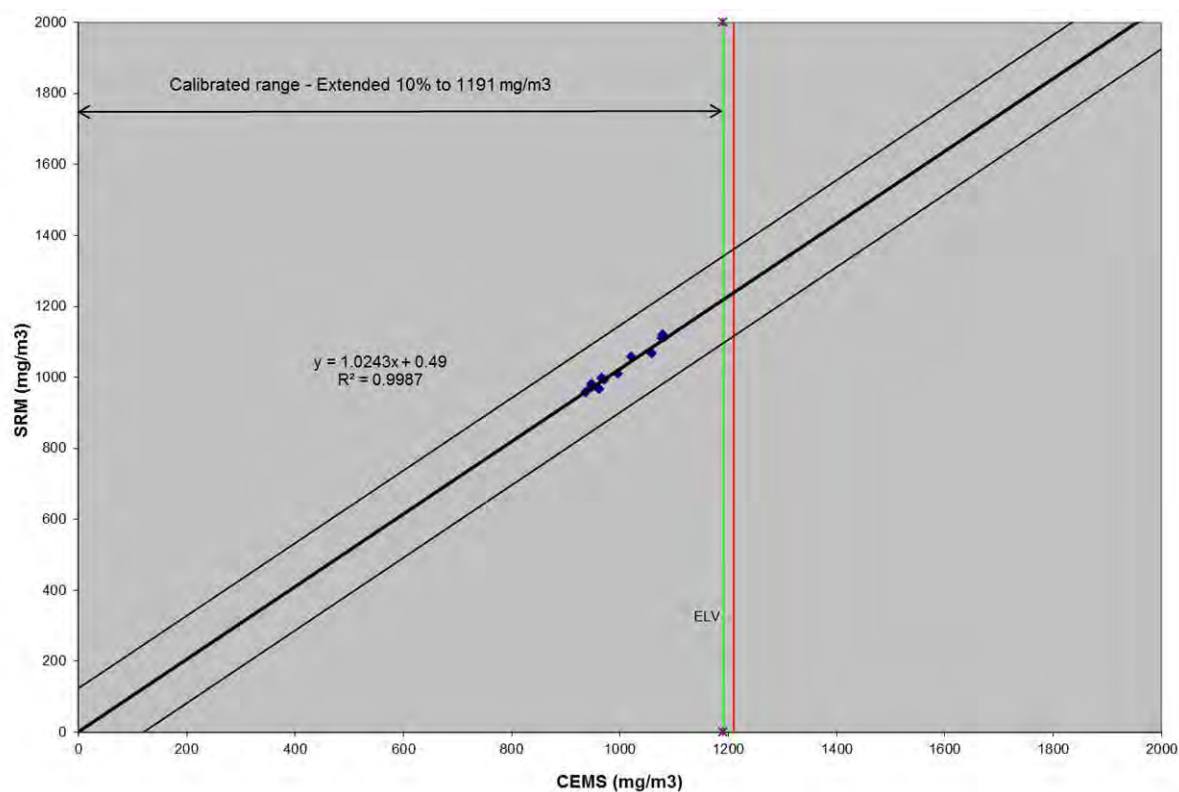
Variability Test

SD=	$\text{Root}(1-\text{Number}).\text{Integral}(\text{D1}-\text{D})^2$	12.50	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=	$12.5 \leq 123.47 * 0.9721 * 1.5$		
	or $12.50 \leq 180.04$		
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=	23.04
For 13 tests, $t_{0.95}(N-1)$:	1.782	
Therefore test of calibration =	$23.04 \leq 1.782 * (12.5/\text{root } 13) + 123.47$	
or	$23.04 \leq 129.64$	
Which is TRUE therefore the calibration function is VALID		

4B2 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.



4B2 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 (dry)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMS Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	24-Mar-15	9:40	10:40	86.27	7.05	1.91	124.59	7.21	2.50	124.59
2	24-Mar-15	11:40	12:40	82.89	7.04	1.90	120.11	7.25	2.38	120.11
3	24-Mar-15	13:40	14:40	86.47	6.90	1.29	121.99	7.22	2.36	121.99
4	24-Mar-15	15:40	16:40	77.24	6.85	2.03	109.06	7.16	2.54	109.06
5	24-Mar-15	17:40	18:40	82.80	6.93	1.86	115.95	7.25	2.29	115.95
6	24-Mar-15	19:40	20:40	96.21	6.92	1.82	134.83	7.28	2.23	134.83
7	24-Mar-15	21:40	22:40	97.95	6.96	1.81	138.24	7.33	2.22	138.24
8	24-Mar-15	23:40	0:40	103.17	7.01	1.79	152.38	7.39	2.20	152.38
9	25-Mar-15	1:40	2:40	111.68	6.99	1.83	166.86	7.39	2.24	166.86
10	25-Mar-15	3:40	4:40	114.41	7.10	1.73	167.74	7.54	2.16	167.74
11	25-Mar-15	5:40	6:40	108.18	7.01	1.66	156.14	7.47	2.05	156.14
12	25-Mar-15	7:40	8:40	93.41	7.07	1.77	129.88	7.55	2.22	129.88

4B2 4.2.2 Table 4.2.2 – Standardised monitoring Data – Sulphur Dioxide - Low Range

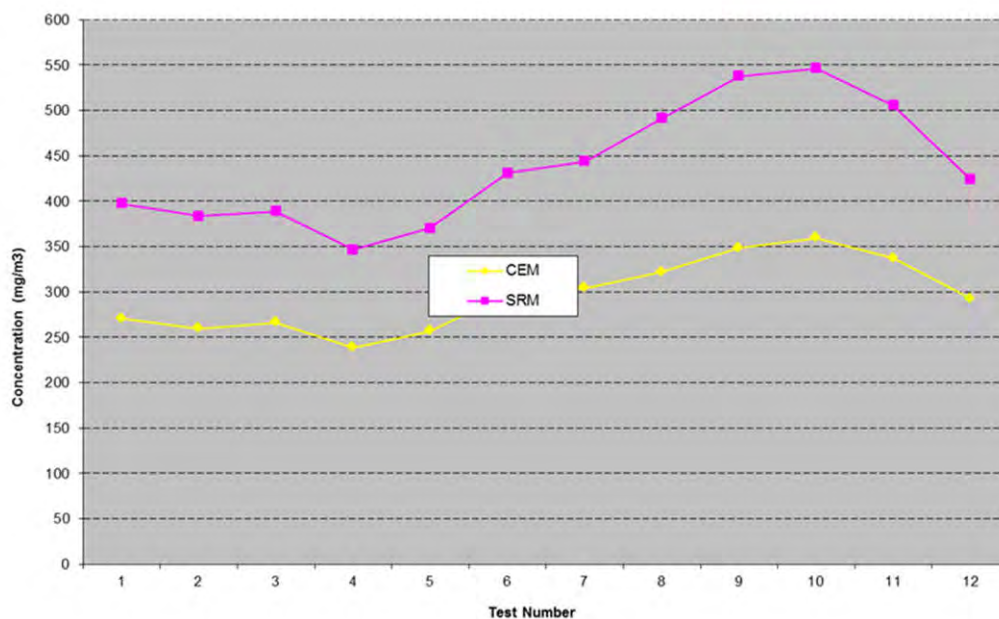
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(mg/m3)	(mg/m3)	(mg/m3)
1	24-Mar-15	9:40	10:40	270.4	397.3	9.0
2	24-Mar-15	11:40	12:40	259.6	383.6	10.0
3	24-Mar-15	13:40	14:40	266.4	388.8	10.0
4	24-Mar-15	15:40	16:40	238.8	346.8	11.0
5	24-Mar-15	17:40	18:40	257.1	370.2	11.0
6	24-Mar-15	19:40	20:40	298.5	431.0	12.0
7	24-Mar-15	21:40	22:40	304.5	443.7	12.0
8	24-Mar-15	23:40	0:40	322.0	491.1	12.0
9	25-Mar-15	1:40	2:40	348.3	537.9	13.0
10	25-Mar-15	3:40	4:40	359.2	546.3	13.0
11	25-Mar-15	5:40	6:40	337.2	505.5	12.0
12	25-Mar-15	7:40	8:40	292.7	423.7	11.0

Note:

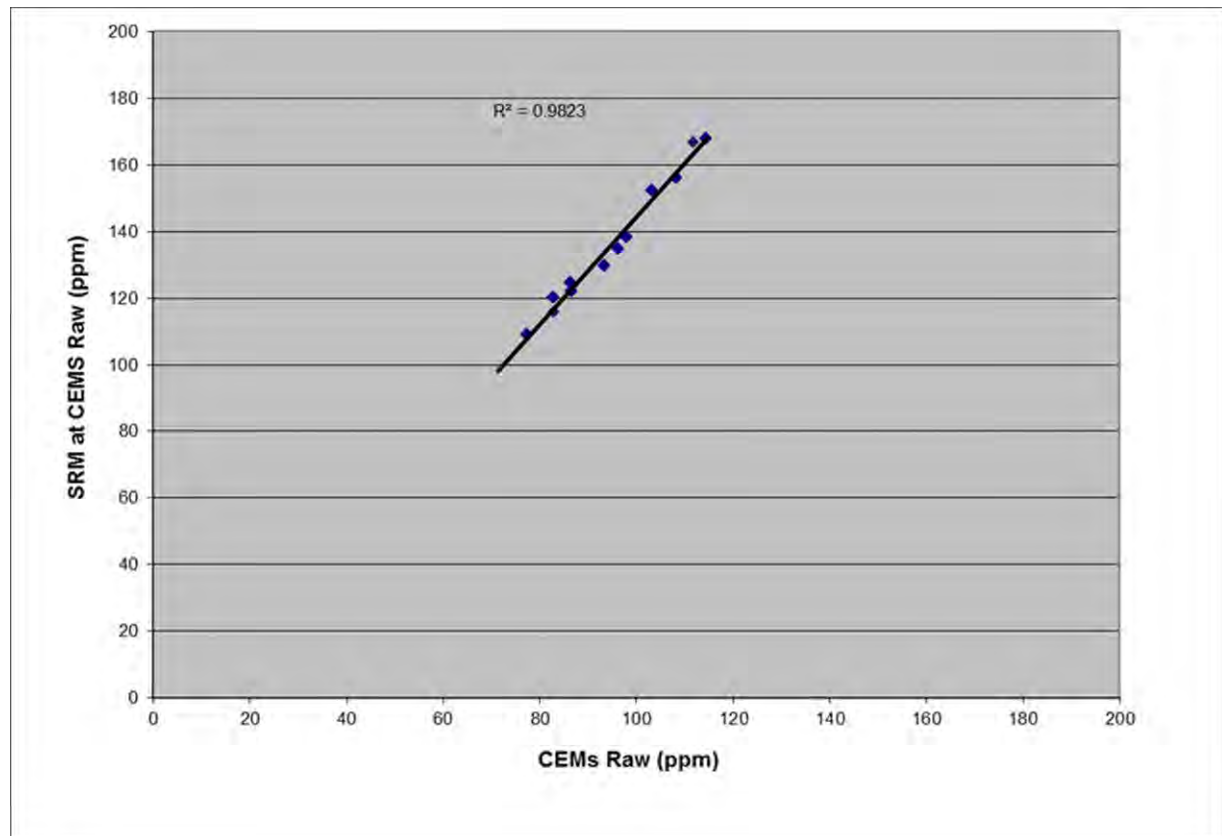
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

4B2 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.



4B2 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 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.

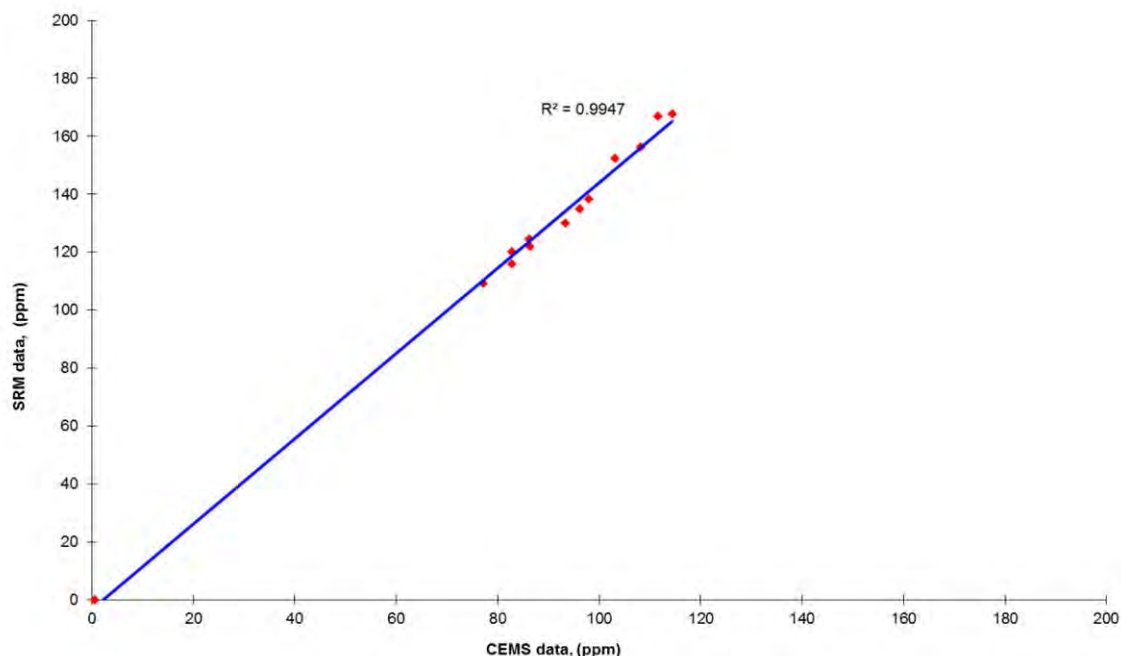
Additionally, any data points are not likely to be outliers unless they are more than three standard deviations from the regression line'

As the R^2 value for this determinand was 0.9823, an outlier test has not been undertaken.

4B2 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		0.7	-2.4	0.00		0.7	-6.9	0.0
2	24-Mar-15	09:40	10:40	86.3	101.2	7.05	1.91	270.4	317.1	397.3
3	24-Mar-15	11:40	12:40	82.9	97.1	7.04	1.90	259.6	304.0	383.6
4	24-Mar-15	13:40	14:40	86.5	101.4	6.90	1.29	266.4	312.4	388.8
5	24-Mar-15	15:40	16:40	77.2	90.3	6.85	2.03	238.8	279.1	346.8
6	24-Mar-15	17:40	18:40	82.8	97.0	6.93	1.86	257.1	301.1	370.2
7	24-Mar-15	19:40	20:40	96.2	113.2	6.92	1.82	298.5	351.2	431.0
8	24-Mar-15	21:40	22:40	98.0	115.3	6.96	1.81	304.5	358.5	443.7
9	24-Mar-15	23:40	00:40	103.2	121.6	7.01	1.79	322.0	379.6	491.1
10	25-Mar-15	01:40	02:40	111.7	131.9	6.99	1.83	348.3	411.4	537.9
11	25-Mar-15	03:40	04:40	114.4	135.2	7.10	1.73	359.2	424.6	546.3
12	25-Mar-15	05:40	06:40	108.2	127.7	7.01	1.66	337.2	398.0	505.5
13	25-Mar-15	07:40	08:40	93.4	109.8	7.10	1.77	292.7	345.0	423.7
Sum								3555.36		
Emission Limit Value (ELV) =					440	mg/Nm ³				
Reference Oxygen						6	%			
Established Calibration Function y=				-3.208 + 1.21xi						

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		-6.9	0.0	6.9	-77.03	5933.07
2	24-Mar-15	09:40	10:40	317.1	397.3	80.15	-3.73	13.95
3	24-Mar-15	11:40	12:40	304.0	383.6	79.58	-4.31	18.54
4	24-Mar-15	13:40	14:40	312.4	388.8	76.42	-7.47	55.81
5	24-Mar-15	15:40	16:40	279.1	346.8	67.71	-16.17	261.61
6	24-Mar-15	17:40	18:40	301.1	370.2	69.07	-14.82	219.60
7	24-Mar-15	19:40	20:40	351.2	431.0	79.82	-4.07	16.58
8	24-Mar-15	21:40	22:40	358.5	443.7	85.12	1.24	1.53
9	24-Mar-15	23:40	00:40	379.6	491.1	111.48	27.59	761.10
10	25-Mar-15	01:40	02:40	411.4	537.9	126.47	42.58	1813.11
11	25-Mar-15	03:40	04:40	424.6	546.3	121.67	37.78	1427.57
12	25-Mar-15	05:40	06:40	398.0	505.5	107.42	23.53	553.77
13	25-Mar-15	07:40	08:40	345.0	423.7	78.77	-5.12	26.19
Mean						83.89		
Sum								11102.43

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

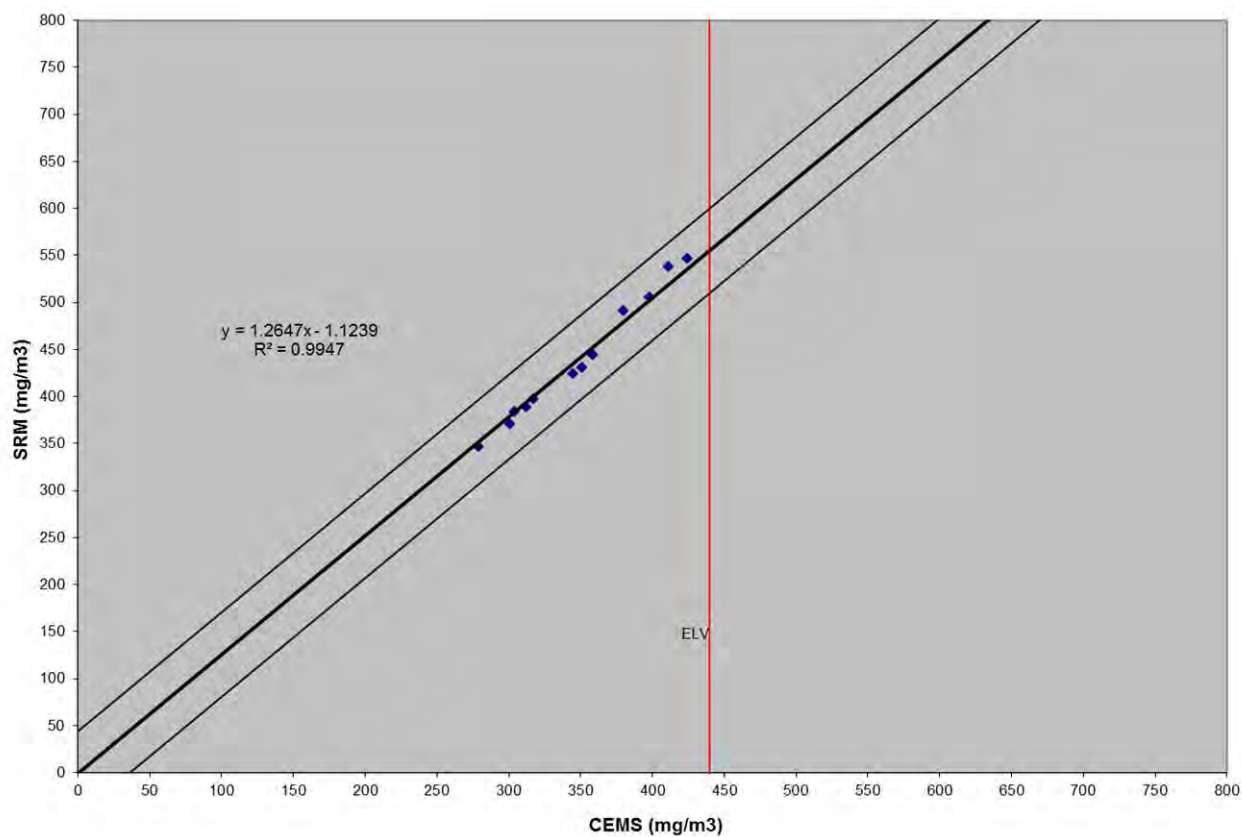
Variability Test

SD= $\text{Root}(1-\text{Number}).\text{Integral}(\text{D1}-\text{D})^2$ 30.42 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:-
 $O_0 = 0.2 \times 440 \text{ mg/m3 (s,d,6\%O}_2\text{)}/1.96$ 44.90 mg/m3(s,d),6%O2
For 13 tests, kv = 0.9721
Therefore variability= $30.42 \leq 44.9 \times 0.9721 \times 1.5$
or $30.42 \leq 65.47$
Which is TRUE therefore the CEMS passes the test

Test of Calibration Function

The calibration of the AMS is accepted if: $\text{D1} \leq t_{0.95}(N-1) \times (\text{s,d}/\text{root } N) + O_0$
D1= 83.89
For 13 tests, $t_{0.95}(N-1)$: 1.782
Therefore test of calibration = $83.89 \leq 1.782 \times (30.42/\text{root } 13) + 44.9$
or $83.89 \leq 59.93$
Which is FALSE therefore the calibration function is INVALID

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.



4B2 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 (dry)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMS Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	24-Mar-15	9:40	10:40	127.56	7.05	1.91	124.59	7.21	2.50	124.59
2	24-Mar-15	11:40	12:40	122.66	7.04	1.90	120.11	7.25	2.38	120.11
3	24-Mar-15	13:40	14:40	127.58	6.90	1.29	121.99	7.22	2.36	121.99
4	24-Mar-15	15:40	16:40	115.79	6.85	2.03	109.06	7.16	2.54	109.06
5	24-Mar-15	17:40	18:40	122.21	6.93	1.86	115.95	7.25	2.29	115.95
6	24-Mar-15	19:40	20:40	140.68	6.92	1.82	134.83	7.28	2.23	134.83
7	24-Mar-15	21:40	22:40	143.01	6.96	1.81	138.24	7.33	2.22	138.24
8	24-Mar-15	23:40	0:40	149.78	7.01	1.79	152.38	7.39	2.20	152.38
9	25-Mar-15	1:40	2:40	162.10	6.99	1.83	166.86	7.39	2.24	166.86
10	25-Mar-15	3:40	4:40	165.67	7.10	1.73	167.74	7.54	2.16	167.74
11	25-Mar-15	5:40	6:40	156.09	7.01	1.66	156.14	7.47	2.05	156.14
12	25-Mar-15	7:40	8:40	137.54	7.07	1.77	129.88	7.55	2.22	129.88

4B2 4.2.3 Table 4.2.3 – Standardised monitoring Data – Sulphur Dioxide - High Range

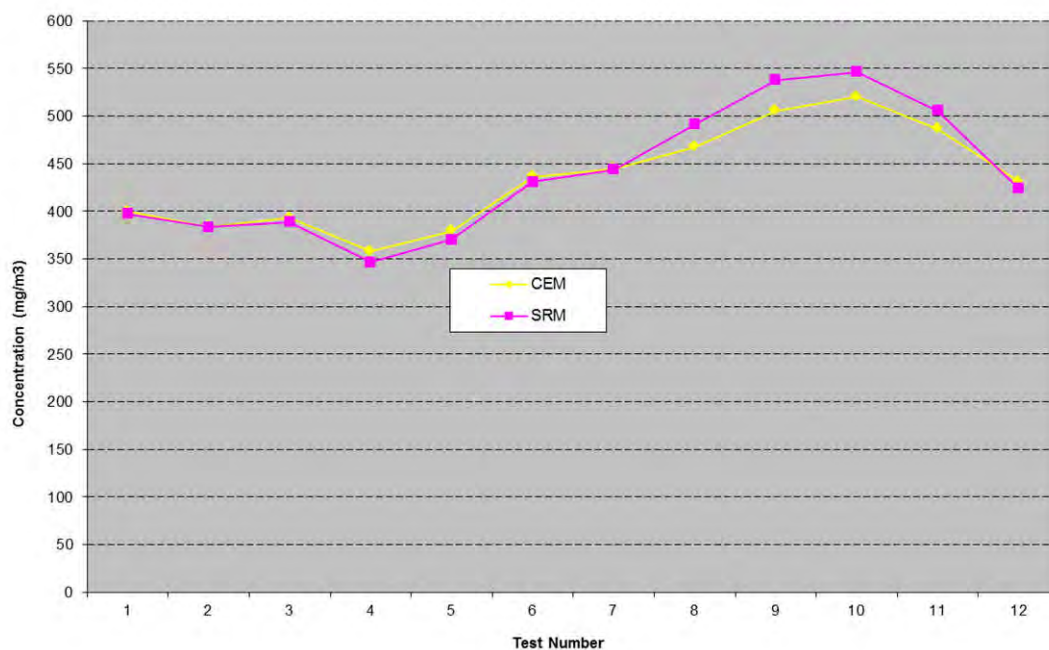
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(mg/m3)	(mg/m3)	(mg/m3)
1	24-Mar-15	9:40	10:40	399.8	397.3	9.0
2	24-Mar-15	11:40	12:40	384.1	383.6	10.0
3	24-Mar-15	13:40	14:40	393.0	388.8	10.0
4	24-Mar-15	15:40	16:40	358.0	346.8	11.0
5	24-Mar-15	17:40	18:40	379.4	370.2	11.0
6	24-Mar-15	19:40	20:40	436.4	431.0	12.0
7	24-Mar-15	21:40	22:40	444.6	443.7	12.0
8	24-Mar-15	23:40	0:40	467.5	491.1	12.0
9	25-Mar-15	1:40	2:40	505.5	537.9	13.0
10	25-Mar-15	3:40	4:40	520.2	546.3	13.0
11	25-Mar-15	5:40	6:40	486.6	505.5	12.0
12	25-Mar-15	7:40	8:40	431.0	423.7	11.0

Note:

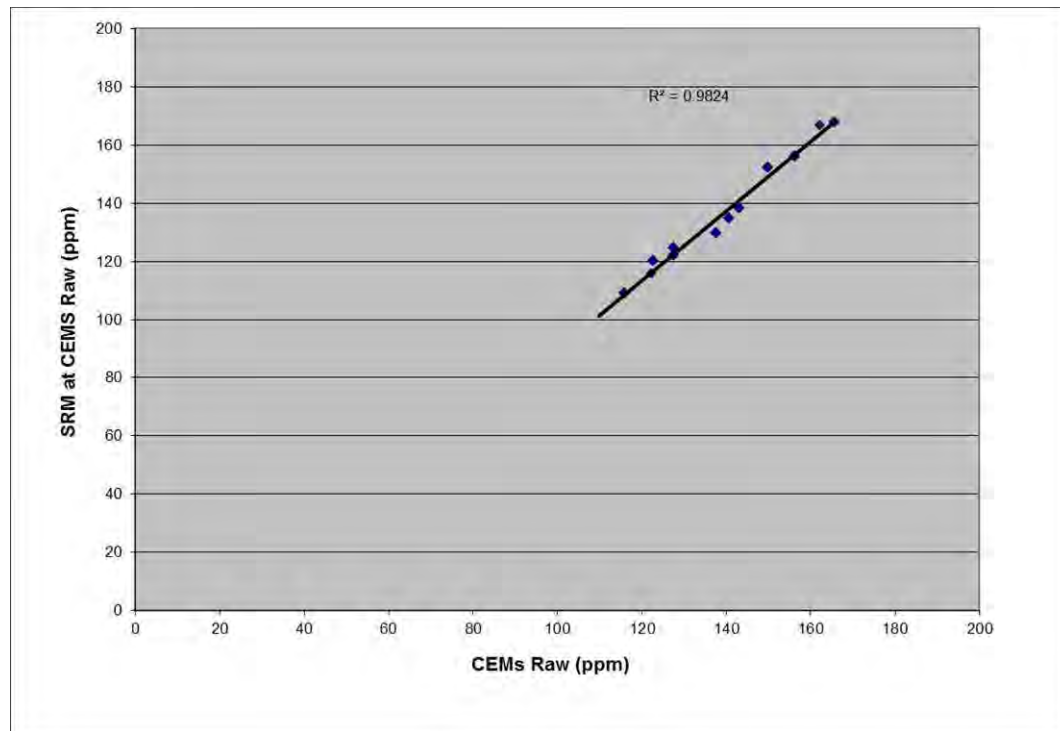
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

4B2 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.



4B2 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 0.9824, an outlier test has not been undertaken.

4B2 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 dry 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		0.7	-2.4	0.00		0.7	-6.9	0.0
2	24-Mar-15	09:40	10:40	127.6	104.7	7.05	1.91	399.8	328.1	397.3
3	24-Mar-15	11:40	12:40	122.7	100.6	7.04	1.90	384.1	314.9	383.6
4	24-Mar-15	13:40	14:40	127.6	104.7	6.90	1.29	393.0	322.5	388.8
5	24-Mar-15	15:40	16:40	115.8	94.8	6.85	2.03	358.0	293.0	346.8
6	24-Mar-15	17:40	18:40	122.2	100.2	6.93	1.86	379.4	311.0	370.2
7	24-Mar-15	19:40	20:40	140.7	115.8	6.92	1.82	436.4	359.1	431.0
8	24-Mar-15	21:40	22:40	143.0	117.7	6.96	1.81	444.6	366.0	443.7
9	24-Mar-15	23:40	00:40	149.8	123.4	7.01	1.79	467.5	385.3	491.1
10	25-Mar-15	01:40	02:40	162.1	133.8	6.99	1.83	505.5	417.4	537.9
11	25-Mar-15	03:40	04:40	165.7	136.9	7.10	1.73	520.2	429.7	546.3
12	25-Mar-15	05:40	06:40	156.1	128.8	7.01	1.66	486.6	401.4	505.5
13	25-Mar-15	07:40	08:40	137.5	113.1	7.10	1.77	431.0	355.3	423.7
Sum								5206.82		

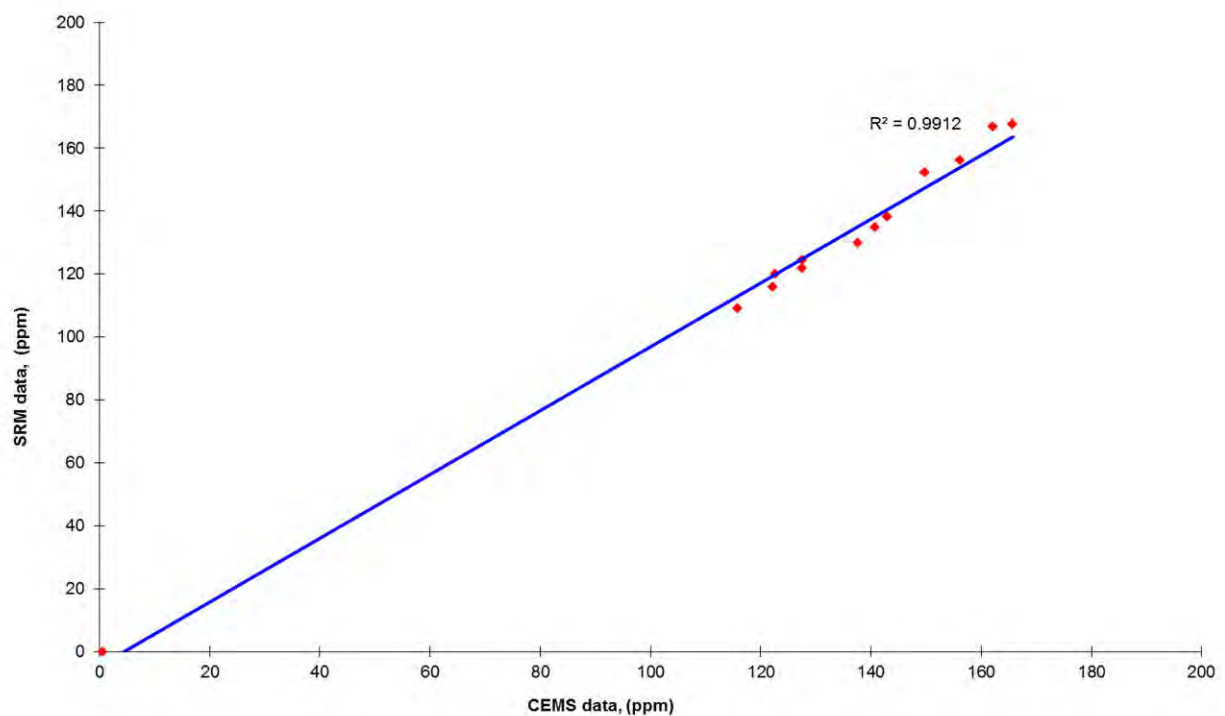
Emission Limit Value (ELV) = 440 mg/Nm³

Reference Oxygen

6 %

Established Calibration Function y= -2.971 + 0.844xi

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		-6.9	0.0	6.9	-69.18	4786.46
2	24-Mar-15	09:40	10:40	328.1	397.3	69.16	-6.90	47.65
3	24-Mar-15	11:40	12:40	314.9	383.6	68.74	-7.32	53.64
4	24-Mar-15	13:40	14:40	322.5	388.8	66.30	-9.77	95.37
5	24-Mar-15	15:40	16:40	293.0	346.8	53.79	-22.28	496.24
6	24-Mar-15	17:40	18:40	311.0	370.2	59.16	-16.90	285.71
7	24-Mar-15	19:40	20:40	359.1	431.0	71.89	-4.17	17.40
8	24-Mar-15	21:40	22:40	366.0	443.7	77.61	1.55	2.39
9	24-Mar-15	23:40	00:40	385.3	491.1	105.82	29.75	885.35
10	25-Mar-15	01:40	02:40	417.4	537.9	120.47	44.41	1971.81
11	25-Mar-15	03:40	04:40	429.7	546.3	116.57	40.50	1640.44
12	25-Mar-15	05:40	06:40	401.4	505.5	104.03	27.97	782.19
13	25-Mar-15	07:40	08:40	355.3	423.7	68.42	-7.65	58.48
Mean						76.07		
Sum								11123.13

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

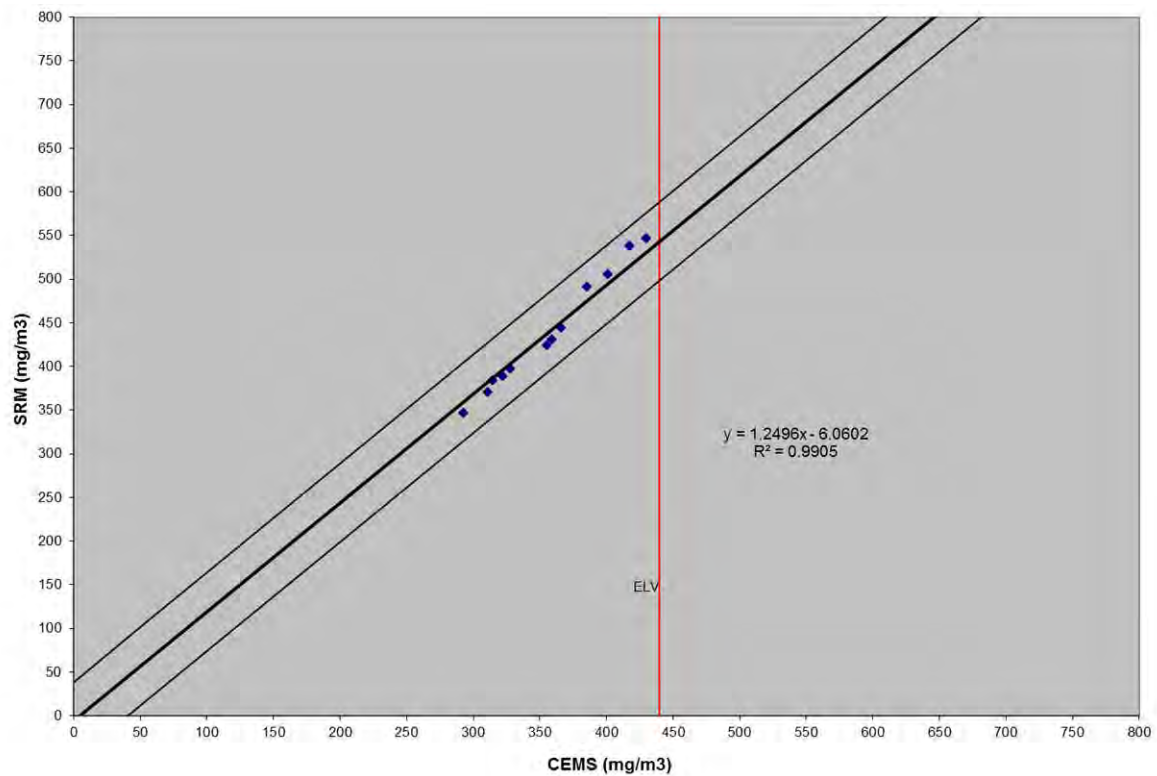
Variability Test

SD= $\text{Root}(1-\text{Number}).\text{Integral}(\text{D1}-\text{D})^2$ 30.45 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= $30.45 \leq 44.9 * 0.9721 * 1.5$
or $30.45 \leq 65.47$
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= 76.07
For 13 tests, $t_{0.95}(N-1) : 1.782$
Therefore test of calibration = $76.07 \leq 1.782 * (30.45/\text{root } 13) + 44.9$
or $76.07 \leq 59.95$
Which is FALSE therefore the calibration function is INVALID

4B2 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 4B3: Data & calculations – AST – Unit 9, SICK OMD 41

4B3 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 (dry)	CEMS Moisture (Wet)	CEM Stack Temp	CEM Stack Press	SRM Raw value (dry STP)	SRM Moisture	SRM Oxygen (Dry)	SRM Stack Temp	SRM Stack Press	SRM at CEMs Raw conditions (wet at Stack)
		hr:min		%	(%)	(%)	C	kpa	(mg/m3)	(%)	(%)	C	kpa	(mg/m3)
1	23-Mar-15	14:18	15:10	9.6	6.9	2.0	70.4	101.0	40.0	1.8	7.0	74.4	100.5	30.7
2	23-Mar-15	15:24	16:16	8.9	6.9	2.1	71.9	100.9	51.2	2.1	7.0	70.0	100.5	39.6
3	24-Mar-15	9:28	10:17	8.1	7.1	2.1	68.7	100.7	9.8	2.5	7.2	69.4	100.5	7.5
4	24-Mar-15	10:26	11:15	8.1	7.0	2.1	68.7	100.7	20.8	2.4	7.2	69.5	100.5	16.0
5	24-Mar-15	12:28	13:17	7.5	7.0	2.0	68.5	100.6	20.1	2.3	7.3	68.6	100.5	15.6
6	24-Mar-15	13:21	14:10	8.3	6.9	2.0	68.4	100.6	16.3	2.3	7.2	68.0	100.5	12.7

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

4B3 4.2 Table 4.2 – Standardised monitoring Data – Total Particulate Matter

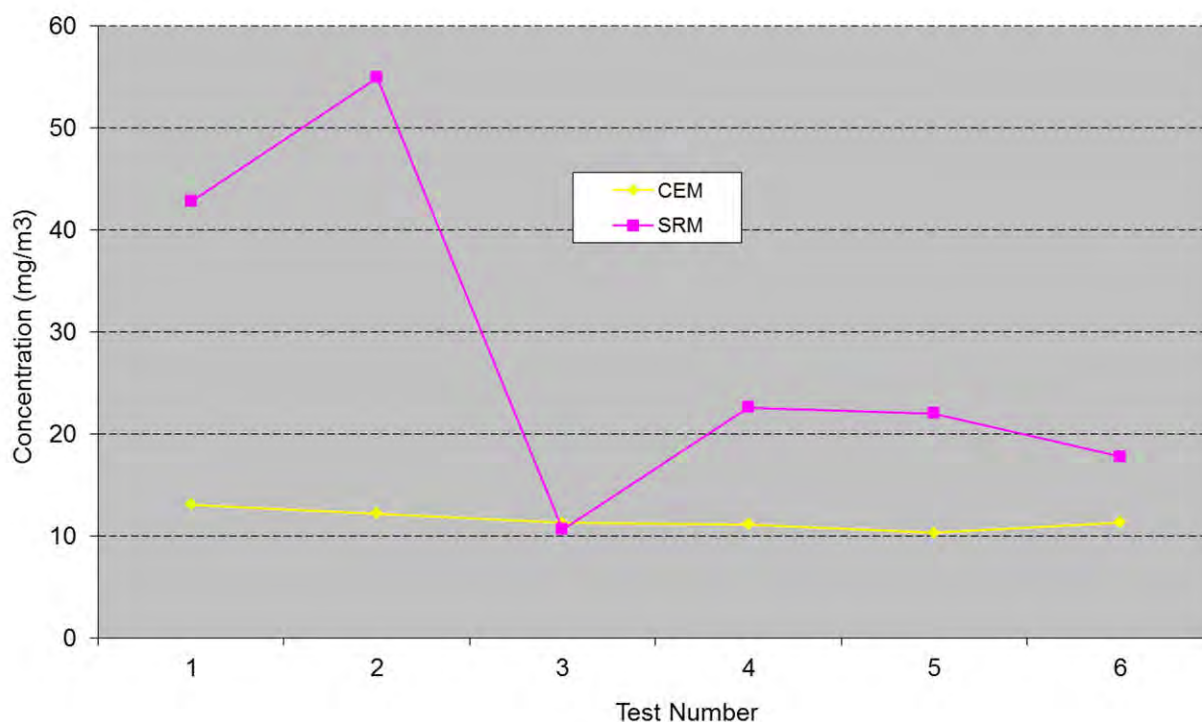
Test No	Date	Test Start Time	Test End Time	CEMS Standardised Value	SRM Standardised Value	SRM Uncertainty
		hr:min		As (mg/m3)	mg/m3)	(mg/m3)
1	23-Mar-15	14:18	15:10	13.1	42.8	0.77
2	23-Mar-15	15:24	16:16	12.2	54.9	0.89
3	24-Mar-15	9:28	10:17	11.3	10.6	0.49
4	24-Mar-15	10:26	11:15	11.1	22.6	0.51
5	24-Mar-15	12:28	13:17	10.3	22.0	1.32
6	24-Mar-15	13:21	14:10	11.3	17.8	0.94

Note:

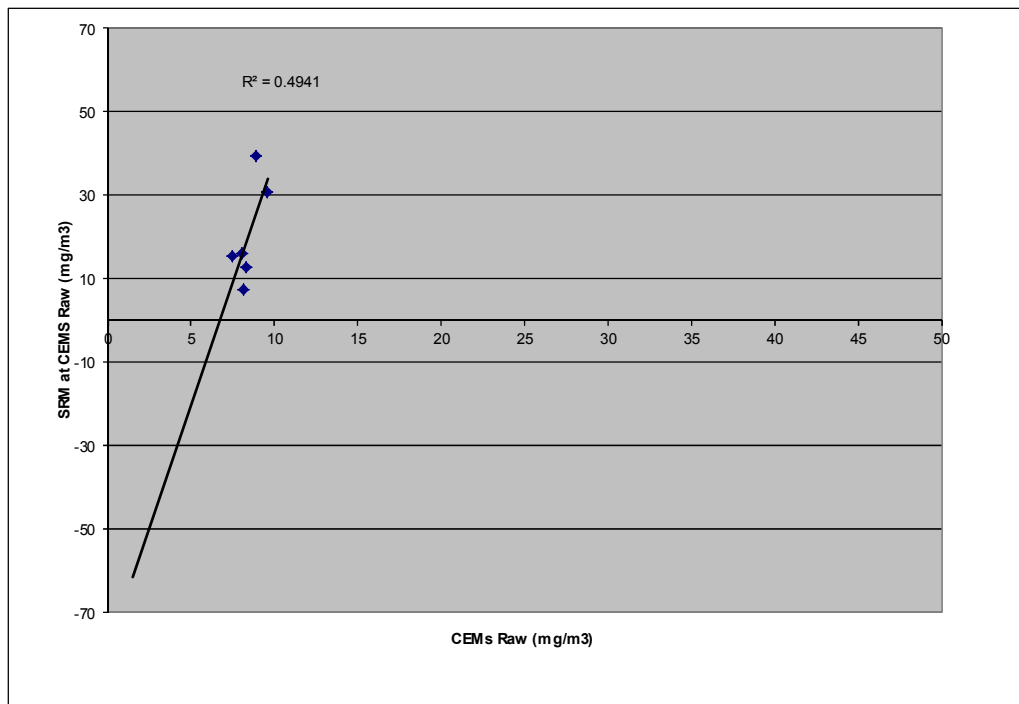
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

4B3 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.



4B3 4.4 – Elimination of Outliers – Total Particulate Matter.

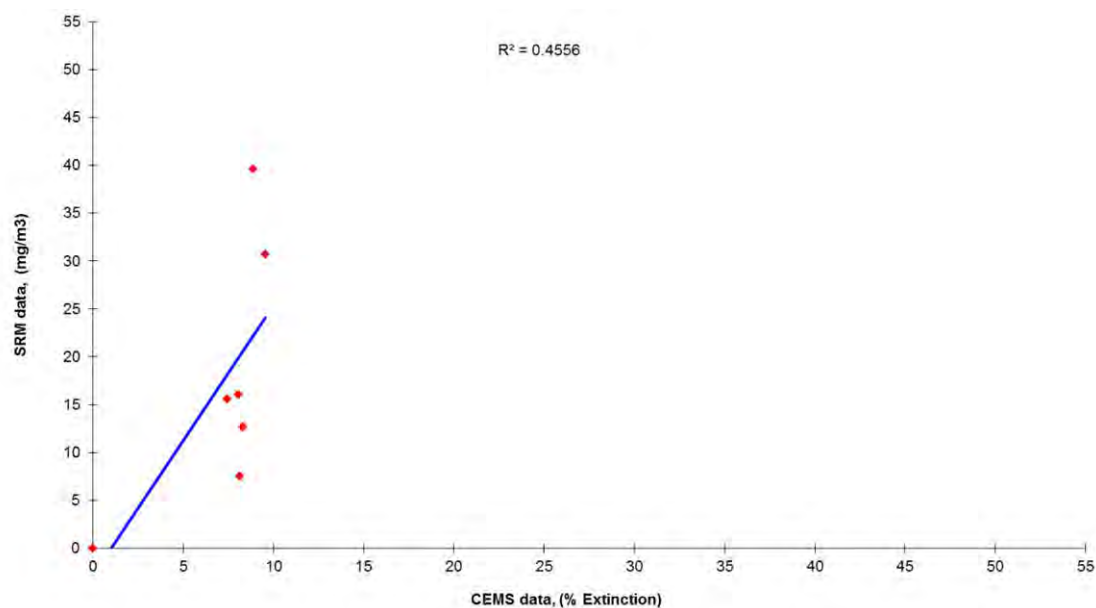


Test No	Test Start Time	Test End Time	CEMS Raw Value (Extinction)	SRM Value at CEMS Raw conditions	Difference D_i	Difference $D_i - \bar{D}_i$	Is Result an Outlier - $ D_i - \bar{D}_i > 2SD$
	hr:min		%	(mg/m3)			
1	14:18	15:10	9.6	30.7	21.11	9.17	No
2	15:24	16:16	8.9	39.6	30.73	18.78	No
3	09:28	10:17	8.1	7.5	-0.60	-12.55	No
4	10:26	11:15	8.1	16.0	7.96	-3.99	No
5	12:28	13:17	7.5	15.6	8.11	-3.84	No
6	13:21	14:10	8.3	12.7	4.39	-7.56	No
				Average \bar{D}_i	11.95		
				Standard Deviation	11.68		
				Standard Deviation x2	23.36		

4B3 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	-0.1	0.0			0.0	0.0	-0.1	0.0
2	14:18	15:10	9.6	14.4	2.0	70.4	101.0	6.9	13.1	19.7	42.8
3	15:24	16:16	8.9	13.4	2.1	71.9	100.9	6.9	12.2	18.4	54.9
4	09:28	10:17	8.1	12.3	2.1	68.7	100.7	7.1	11.3	17.0	10.6
5	10:26	11:15	8.1	12.2	2.1	68.7	100.7	7.0	11.1	16.8	22.6
6	12:28	13:17	7.5	11.2	2.0	68.5	100.6	7.0	10.3	15.5	22.0
7	13:21	14:10	8.3	12.5	2.0	68.4	100.6	6.9	11.3	17.1	17.8
Sum									69.33		
Emission Limit Value (ELV) = 55 mg/Nm ³											
Reference Oxygen				6 %							
Established Calibration Function y _i =				-0.099 + 1.52xi							

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



4B3 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		-0.1	0.0	0.10	-9.37	87.86
2	14:18	15:10	19.7	42.8	23.06	13.59	184.75
3	15:24	16:16	18.4	54.9	36.53	27.06	732.29
4	09:28	10:17	17.0	10.6	-6.38	-15.85	251.18
5	10:26	11:15	16.8	22.6	5.79	-3.69	13.59
6	12:28	13:17	15.5	22.0	6.50	-2.97	8.83
7	13:21	14:10	17.1	17.8	0.70	-8.77	76.97
7 Tests		Mean			9.47		
Sum							1355.47

4B3 4.7 - Variability Test and Test of Calibration Function Calculations – Total Particulate Matter.

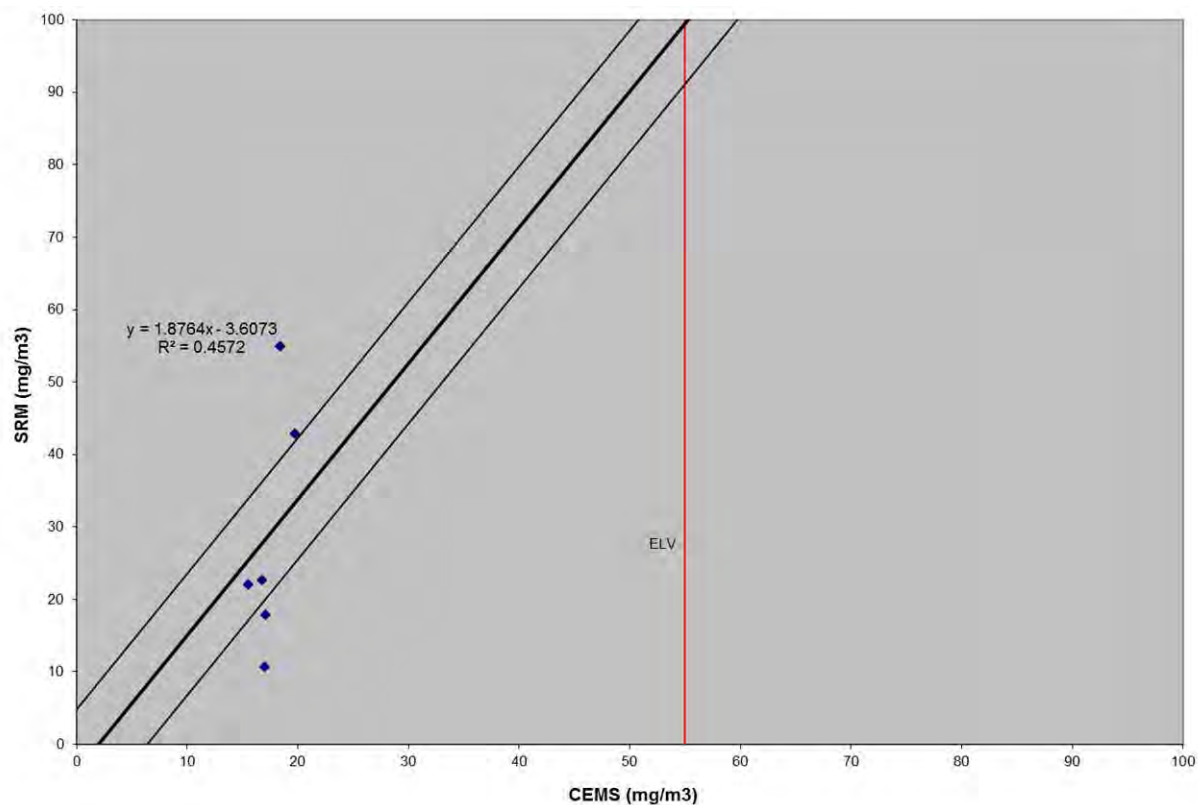
Variability Test

SD=	Root(1-Number).Integral(D1-D) ²	15.20	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*55 mg/m3 (s,d,6%O ₂)/1.96	8.42	mg/m3(s,d),6%O ₂
For 6 tests, k _v =	0.9941		
Therefore variability=	15.2 <= 8.42 * 0.9941 * 1.5		
or	15.20 <=	12.55	
Which is FALSE therefore the CEMS fails the test			

Test of Calibration Function

The calibration of the AMS is accepted if:		D1 <= t _{0.95} (N-1)*(s,d/root N)+O ₀	
	D1=	10.31	
For 7 tests, t _{0.95} (N-1) =	1.943		
Therefore test of calibration =	10.31 <= 1.943*(15.2/root 7)+8.42		
or	10.31 <=	27.52	
Which is TRUE therefore the calibration function is VALID			

4B3 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 9	
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 -	Parker/Procal
Status of organisation – CEMS manufacturer/operator/service contractor	CEMS OEM
Test engineer	M Findley
Date of tests	17 th – 19 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	25 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 (OMD 41) – Yes – although based on the use of filters SICK (GM32) – Yes, although based on the use of filters</p>
<p>NO</p> <p>SO₂</p> <p>TPM</p>	<p>Yes (Procal)</p> <p>Yes (Procal)</p> <p>Yes</p>	<p>SICK (GM32) – Span value of filters not stated, though analyser response recorded SICK (OMD41) - Span values recorded as mA signals</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, SICK OMD 41 No – SICK GM32	Procal – Yes SICK (OMD) – Yes – although based on the use of filters
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) - N/A
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) - N/A
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 Parameter		<p>Procal – Yes</p> <p>SICK (OMD) – Yes</p>
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	
<p>8- Response time</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>	See Note	<p>Procal – Yes</p> <p>SICK (OMD 41) – Yes</p> <p>SICK (GM 32) – No</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	Date only
• 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	N/A	Linearity carried out using filters. Filter numbers stated (F1 to F8)
• 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	N/A	No gases used
• NOx converter efficiency check	N/A	
• Calibration and linearity data	Yes	Calibration data only – linearities not carried out
• Logged data for period of calibration/linearity	Yes	Analyser readout checked against DCS values
• Name & signature of test engineer	Yes	



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.

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CALIBRATION CERTIFICATE

Site	Aberthaw	
Date	17/02/2015	
Instrument	Unit 9 Primary	
Instrument Ref	8800736	8500443M
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	319	334	0.2
NO	PPM	1000	667	Site Gas	669	673	0.6
SO2-H	PPM	1000	800	5501912	853	852	5.2
SO2-L	PPM	250	200	5503378	195	196	-1.6

Cross sensitivity tests:

Test/ Gas conc	Response			% Error FSD		
	CO	NO	SO2-H	CO	NO	SO2-H
CO2 15%	-4	13	3	-0.8	1.3	0.3
H2O 2.5%	1	-17	4	0.2	-1.7	0.4
CO2 15% & H2O 2.5%	3	-11	1	0.6	-1.1	0.1

Test/ Gas conc	Response			% Error FSD		
	SO2-L			SO2-L		
CO2 15%	4			1.6		
H2O 2.5%	4			1.6		
CO2 15% & H2O 2.5%	1			0.4		

Signature: *M. Findley*

M.Findley
Procal Customer Support Engineer

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7-7853-02 cal cert site visit general use

Change note: 7007110

Date: 17/03/09

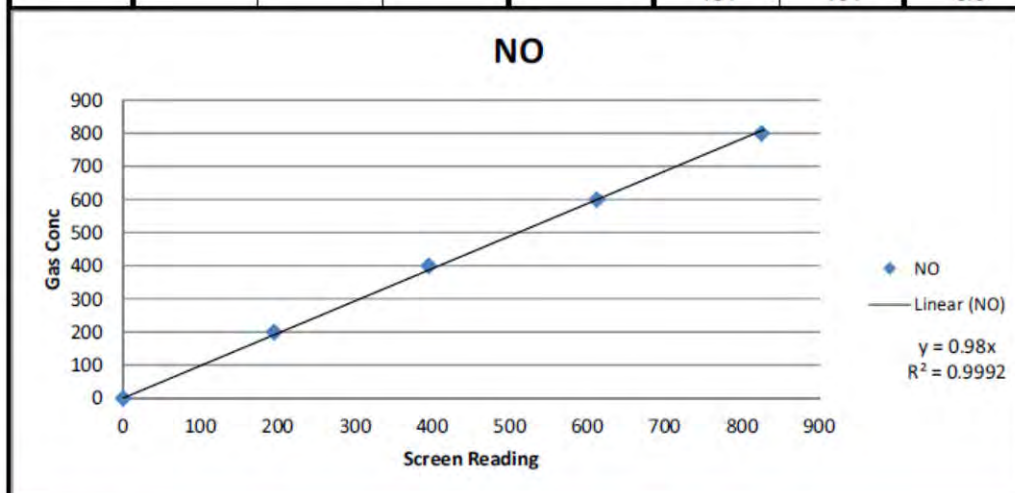


LINEARISATION RESULTS

Site	Aberthaw	
Date	17/02/2015	
Instrument	Unit 9 Primary	
Instrument Ref	8800736	8500443M
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	825	825	2.5
					824	824	2.4
					828	828	2.8
NO	PPM	1000	600	40005501912	612	612	1.2
					607	607	0.7
					606	606	0.6
NO	PPM	1000	400	40005501912	395	395	-0.5
					395	395	-0.5
					395	395	-0.5
NO	PPM	1000	200	40005501912	195	195	-0.5
					198	198	-0.2
					194	194	-0.6



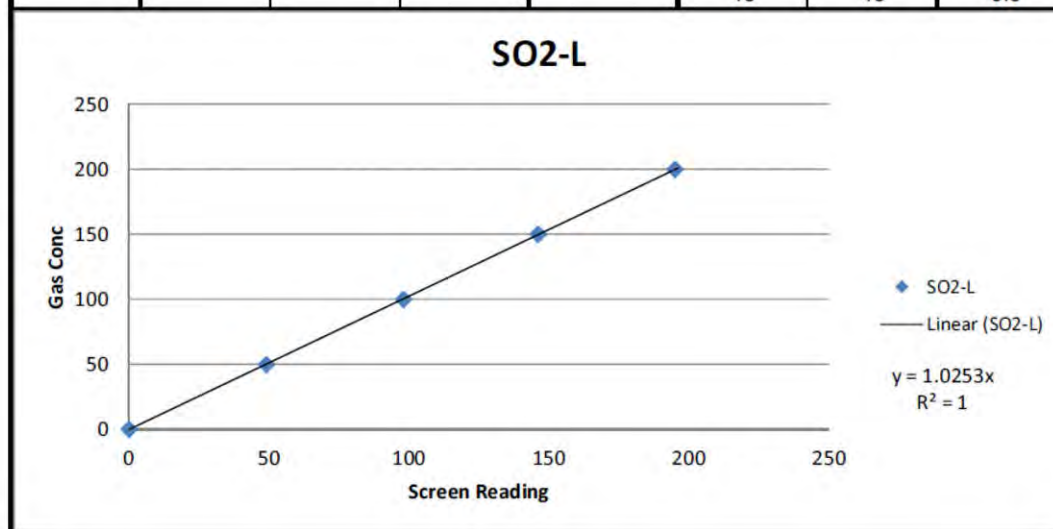
Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK
Tel: +44 (0) 17336 232495 Email: procalsales@parker.com Website: www.procal.com

7-7862-04 Linearisation Certificate

Change note: 7009251

Date: 30/07/1

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
SO2-L	PPM	250	200	40005503378	195	195	-2.0
					196	196	-1.6
					196	196	-1.6
SO2-L	PPM	250	150	40005503378	146	146	-1.6
					146	146	-1.6
					146	146	-1.6
SO2-L	PPM	250	100	40005503378	98	98	-0.8
					98	98	-0.8
					98	98	-0.8
SO2-L	PPM	250	50	40005503378	49	49	-0.4
					49	49	-0.4
					48	48	-0.8



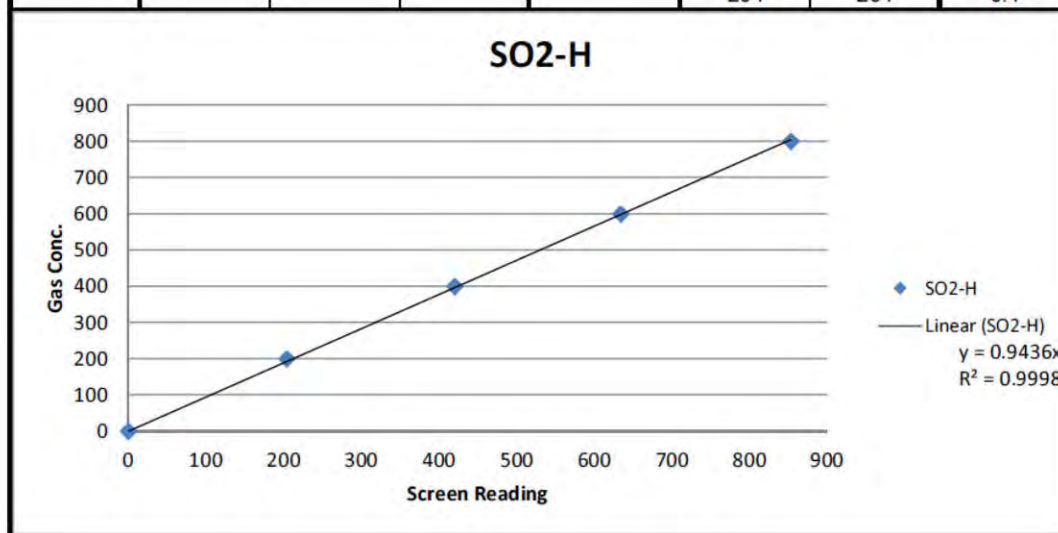
Zero	H2O	CO2	CO	NO	SO2 - H	SO2 - L
#1	0	-1	-1	-2	0	0
#2	0.1	2	1	7	0	0
#3	0	0	1	1	0	0
#4	0	0	0	1	0	0
#5	0	-2	-1	-3	-1	-1
#6	0	-1	-2	-2	0	0

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

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
SO2-H	PPM	1000	800	40005503378	853	853	5.3
					852	852	5.2
					853	853	5.3
SO2-H	PPM	1000	600	40005503378	634	634	3.4
					634	634	3.4
					635	635	3.5
SO2-H	PPM	1000	400	40005503378	420	420	2.0
					420	420	2.0
					420	420	2.0
SO2-H	PPM	1000	200	40005503378	204	204	0.4
					204	204	0.4
					204	204	0.4



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7-7862-04 Linearisation Certificate

Change note: 7009251

Date: 30/07/15



Functionality Test Results

DECLARATION OF CONFORMITY

We,

Kittiwake Procal Ltd
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Peterborough
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United Kingdom

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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	8800736
P200 Serial Number	8500443M
Site Identification	Unit 9 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

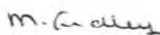
MCERTs Certification Body:

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	Technical Standards Used:
EN 15267-3	Dated: 2007	

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: 17/2/2015

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	√	
Optics clean	√	
Internal wiring ok	√	
Air supply on	√	
Purge flow >300 ltrs/hr	√	Ok
Pressure differential <80mBar	√	36

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	2.7	142	54	427	74	78	17.5	130	1040
Zero conc	0	0	1	1	0	0	17.7	129	1076
% 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	0	0	17.7	129	1076
Test Gas Conc			333	667	800	200			
Cert number			Site Gas	Site Gas	040005 501912	040005 503378			
Response Conc			334	673	853	196	17.8	129	1072
% Error			<2	<2	>2	<2			
Pass/Fail			Pass	Pass	Fail	Pass			
T90 time Seconds				85	70	90			

2.3 Filter Level Checks

All on zero air	F6	F2	F7	F5G	F3	F1G	F4	F8
Factory	2654	4200	3831	2222	3333	2070	859	4994
Last visit	2496	4127	3909	2322	3307	2293	863	4758
This visit	2664	4258	4074	2413	3470	2421	873	4831



2.4 Interference Checks

Component:	H2O	CO2	CO	NO	SO2-H	SO2-L
Units:	%	mau	PPM	PPM	PPM	PPM
ZERO	0	-1	-1	-2	0	0
CO2 15%	0	159	-4	13	3	4
H2O 2.5 %	1.9	2	1	-17	4	4
H2O 2.5% & CO2 15%	1.7	159	3	-11	1	1

3.0 Data Acquisition.

Displayed \ Component		H2O %	CO PPM	NO PPM	SO2-H PPM	SO2-L PPM
Zero	Analyser	0	1	1	0	0
	DCS					
	4-20mA					
Span	Analyser	1.9	333	667	800	200
	DCS					
	4-20mA					

4.0 Linear coefficient record.

Coefficient \ Component		H2O	CO2	CO	NO	SO2-H	SO2-L
Last test	Linear	1.53e-2	1	7.53e0	1.200e1	4.850e0	5.050e0
	Squared	5.67e-5	0	1.18e-1	6.570e-2	9.000e-4	-4.710e-4
	Cubed						
This test	Linear	1.53e-2	1	7.820e0	1.240e1	4.850e0	5.140e0
	Squared	5.67e-5	0	1.230e-1	6.750e-2	9.000e-4	-4.790e-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	√	Ok
• 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"> √ 8500443M
<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"> √ 17/02/2015
<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



Functionality Test Results

DECLARATION OF CONFORMITY

We,

Kittiwake Procal Ltd
5 Maxwell Road
Woodston
Peterborough
Cambridgeshire
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United Kingdom

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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	8500707
Site Identification	Unit 9 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	Technical Standards Used:
EN 15267-3	Dated: 2007	

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:....19/02/2015.....

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	40 mbar

2.0 Zero and Span Checks.

2.1 Zero Check

Component:	H2O	CO2	CO	NO	SO2-H	SO2-L	Ta	Ts	Ps
Units:	%	mAU	ppm	ppm	ppm	ppm			
Process conc	2.5	148	33	391	82	52	23.4	130.3	1019.4
Zero conc	0	0	-1	0	-4	-4	23.4	129.3	1059.2
% error	<2	<2	<2	<2	<2	<2			
Pass/Fail	Pass	Pass	Pass	Pass	Pass	Pass			
T90 recovery									

2.2 Span Check

Component:	H2O	CO2	CO	NO	SO2-H	SO2-L	Ta	Ts	Ps
Units:	%	mAU	ppm	ppm	ppm	ppm			
Full range	10		500	1000	1000	250			
Zero Conc	0	1	2	0	2	2	23.5	129.7	1047.4
Test Gas Conc			306	800	800	200			
Cert number			5682016	5501912	040005503377				
Response Conc			304	770	819	200			
% Error			2	>2	<2	<2			
Pass/Fail			Pass	Fail	Pass	Pass			
T90 time				70	70	70			

2.3 Filter Level Checks

All on zero air	F2	F4	F6	F1G	F7	F5G	F8	F3	
Factory	2316	3751	4570	2975	3045	1901	490	2442	
Last visit	1816	3401	3993	2640	2612	1790	531	2673	
This visit	1765	3114	3681	2435	2453	1692	494	2455	



2.4 Interference Checks

Component: Units:	H2O %	CO2 mAU	CO ppm	NO ppm	SO2-H ppm	SO2-L ppm
ZERO	0	0	1	-4	2	2
CO2 15%	-0.1	163	-3	7	1	1
H2O 2.5%	1.9	3	3	4	2	2
H2O + CO2	2.1	161	-1	6	3	2

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	1.570e-2		6.527e+0	1.081e+1	6.373e+0	5.923e+0
	Squared	4.210e-5		9.250e-2	2.728e-2	-2.549e-3	6.462e-4
	Cubed						
This test	Linear	1.570e-2		6.527e+0	1.081e+1	6.373e+0	5.923e+0
	Squared	4.210e-5		9.250e-2	2.728e-2	-2.549e-3	6.462e-4
	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.	√	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.	√	
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.	√	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	√	Procal Method Statement
<ul style="list-style-type: none">Instrument manufacturer	√	Procal
<ul style="list-style-type: none">Instrument type	√	Pulsi 2000
<ul style="list-style-type: none">Instrument model	√	P2000
<ul style="list-style-type: none">Instrument Serial No	√	8500707
<ul style="list-style-type: none">Operating principle	√	GFCIR & NIR
<ul style="list-style-type: none">Operating range	√	Recorded on this report
<ul style="list-style-type: none">Certification details	√	Mcirted
<ul style="list-style-type: none">Compliance with MCERTS (including certificate no.)	√	SIRA MC 990006/08
<ul style="list-style-type: none">Location	√	RWE Aberthaw
<ul style="list-style-type: none">Date and time work was undertaken	√	19/02/2015
<ul style="list-style-type: none">Equipment used - type, serial no's, calibration dates	√	Procal Water Generator/Gas divider Pcal #6
<ul style="list-style-type: none">Gases used - certificate numbers, expiry dates, binary / mix	√	Copy of Gas certs can be provided
<ul style="list-style-type: none">NOx converter efficiency test, if applicable	n/a	
<ul style="list-style-type: none">Calibration and linearity data as required by EN14181	√	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	√	See Linearity & Calcert Data



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

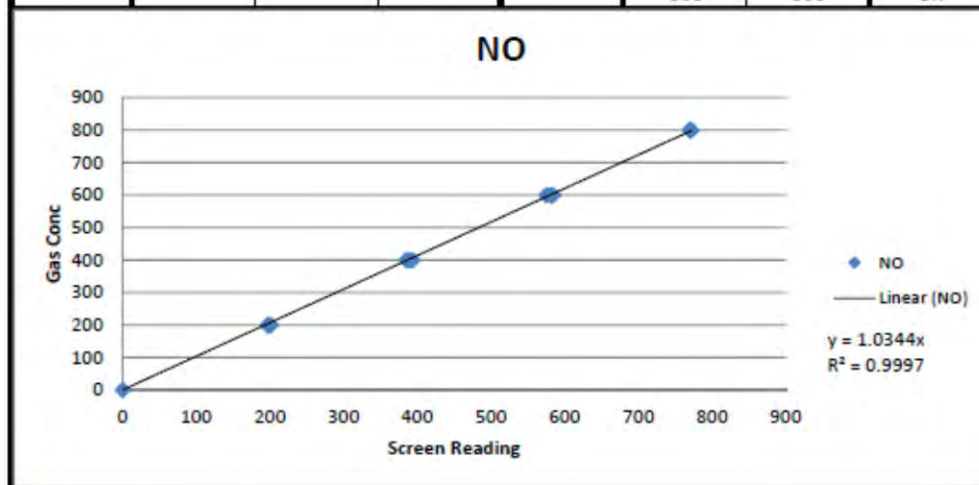


LINEARISATION RESULTS

Site	RWE Aberthaw	
Date	19/02/2015	
Instrument	Unit 9 Secondary	
Instrument Ref	8800624	8500707
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	770	770	-3.0
					772	772	-2.8
					770	770	-3.0
NO	ppm	1000	200	40005501912	198	198	-0.2
					201	201	0.1
					197	197	-0.3
NO	ppm	1000	600	40005501912	584	584	-1.6
					575	575	-2.5
					581	581	-1.9
NO	ppm	1000	400	40005501912	385	385	-1.5
					390	390	-1.0
					393	393	-0.7



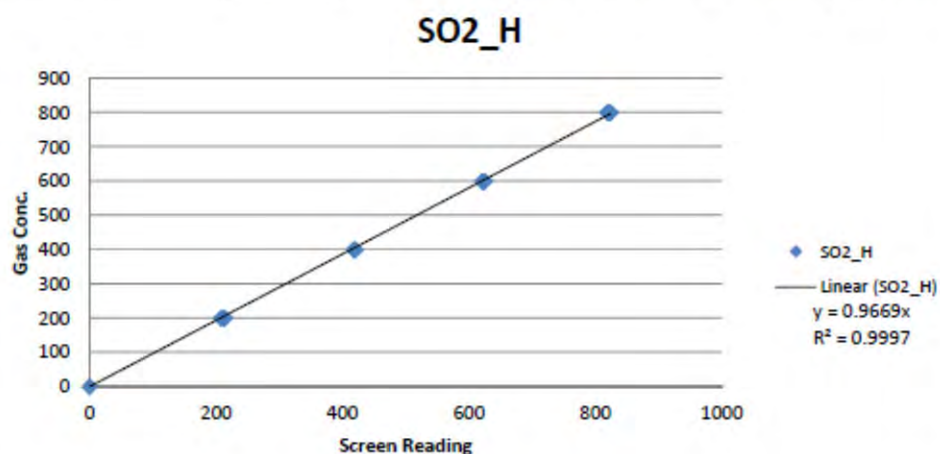
Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK
Tel: +44 (0) 17336 232495 Email: procalsales@parker.com Website: www.procal.com

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	819	819	1.9
					824	824	2.4
					822	822	2.2
SO2_H	ppm	1000	200	40005503377	212	212	1.2
					208	208	0.8
					214	214	1.4
SO2_H	ppm	1000	600	40005503377	621	621	2.1
					623	623	2.3
					625	625	2.5
SO2_H	ppm	1000	400	40005503377	418	418	1.8
					419	419	1.9
					420	420	2.0



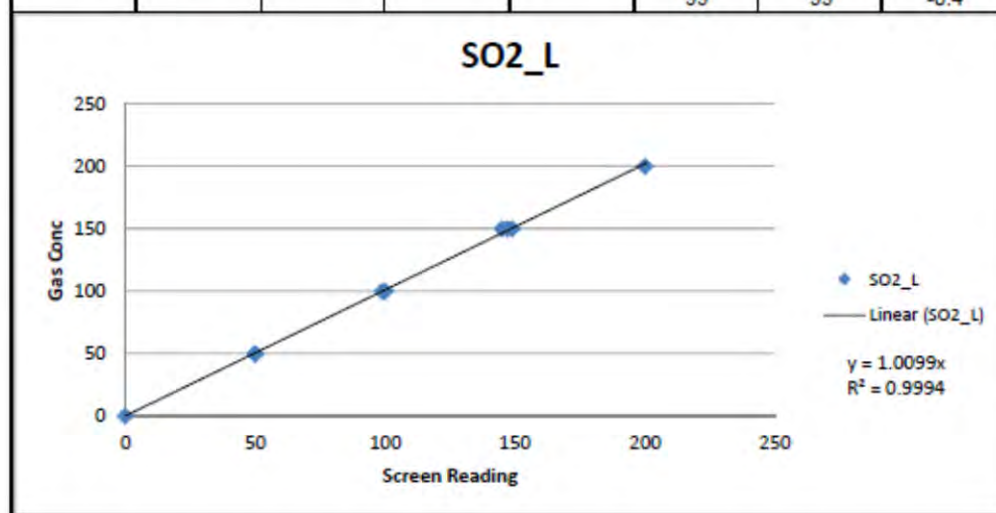
Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK TEL: +44(0)1733 23495 FAX: +44(0)1733 235255
E-mail: asampson@procal.com Website: www.procal.com

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	40005503377	200	200	0.0
					197	197	-1.2
					201	201	0.4
SO2_L	ppm	250	50	40005503373	50	50	0.0
					50	50	0.0
					50	50	0.0
SO2_L	ppm	250	150	40005503373	145	145	-2.0
					147	147	-1.2
					149	149	-0.4
SO2_L	ppm	250	100	40005503373	100	100	0.0
					100	100	0.0
					99	99	-0.4



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

Signature: 

PKC

Procal Customer Support Engineer

Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK TEL:+44(0)1733 23485 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

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
Maintenance Report OMD41		
<input checked="" type="checkbox"/> Maintenance <input type="checkbox"/> Repair		
Customer: RWE nPower	Customer no: FGD U9 Spare	
Country: UK	Location: Aberthaw, Barry	
Receiver: M221	Serial no.: 07128010	
Reflector: R22	Serial no.: 07128010	
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	0.1 mg/m ³
Contamination	mA	0.0%
Dust reading, measured values	mA	4.0
Control cycle, Zero point values	mA	4.02
Control cycle, Span value	mA	16.82

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 > 97xxxxxxx, 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 = 148 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%)	10.21 mA	10.22 mA	0.01	OK
Span 1 (aprox. 70%)	16.8 mA	16.8 mA	0.0	OK
Span 3 (100%)	20.00 mA	19.98 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/m ³
Contamination	mA 0.000%
Dust reading, measured values	mA 0.0 mg/m ³
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	<h1 style="color: blue; margin: 0;">SICK</h1>	Tel : 0044 (0)1727 831121 Fax : 0044 (0)1727 855332 E – Mail : info@sick.co.uk
Maintenance Report OMD41		
<input checked="" type="checkbox"/> Maintenance <input type="checkbox"/> Repair		
Customer: <u>RWE nPower</u>	Customer no: <u>FGD U9</u>	
Country: <u>UK</u>	Location: <u>Aberthaw, Barry</u>	
Receiver: <u>M221</u>	Serial no.: <u>07128009</u>	
Reflector: <u>R22</u>	Serial no.: <u>07128009</u>	
Eval.Unit: <u>A3</u>	Serial no.: <u>98078000</u>	
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/m ³
Contamination	mA	0.0%
Dust reading, measured values	mA	4.0
Control cycle, Zero point values	mA	4.0
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
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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 = 128 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	4.02 mA	0.02	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 : 09.02.2015	Plant person: _____ Technician: Rhodri Jones

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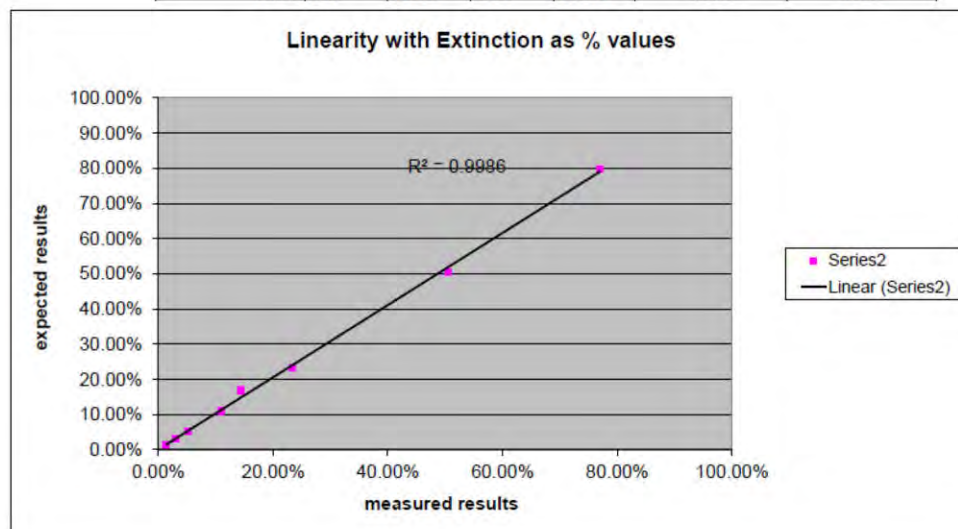
Tel: 0044 (0) 1727 831121
Fax:0044 (0) 1727 855332
E-Mail: info@sick.co.uk

Linearity Results Sheet			
Service Ref: SVON017322		Date: 13.02.2015	
		Customer Order No.: 0	
Customer:		Status:	Chargable
		Device-type:	OMD41-2
		Serial Number :	98078001
Contact: James Beveridge		Filter Box Serial Number :	95278033

Location	Unit 9
----------	--------

4 Results:

Component:		Particulate		Range	1.60	Extinction
	Expected Extinction	Expected %range	Measured Extinction	Measured %range	% Error of Range	Pass/Fail
Filter 1	0.022	1.363%	0.022	1.396%	0.03%	PASS
Filter 2	0.049	3.056%	0.050	3.125%	0.07%	PASS
Filter 3	0.083	5.181%	0.083	5.208%	0.03%	PASS
Filter 4	0.175	10.919%	0.174	10.896%	-0.02%	PASS
Filter 5	0.270	16.856%	0.230	14.375%	-2.48%	PASS
Filter 6	0.375	23.431%	0.374	23.375%	-0.06%	PASS
Filter 7	0.809	50.550%	0.809	50.583%	0.03%	PASS
Filter 8	1.276	79.763%	1.231	76.958%	-2.80%	PASS



Engineer's Comments : LINEARITY TEST WAS SUCCESSFUL


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U9 - 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 8001
Reflector S/N	9807 8001
Evaluation Unit S/N	9807 8000
Device Location	Unit 9
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 NO _x 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	4.03 mA	0.03	OK
Span 2 (approx. 30%)	14.06 mA	14.08 mA	0.02	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 @ 4.0 mA

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	0.0 mg/m ³	
Control cycle, Zero point values	mA	4.0	
Control cycle, Span value	mA	16.8	

Remarks
Analyser functioning correctly
Approved by customer Name: Position:

SICK

Unit 9 - GM32 Linearity Report

Customer	RWE Npower
Site	Aberthaw Power Station
Permit Ref	A1234
Contact	James Beveridge
Service Ref No.	SVON017322
Survey Date	17.02.2015
Device Type	GM32
Device Location	Unit 9
Serial Number	1303 8025
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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Unit 9 - GM32

BS EN 14181 – Functional Test & Maintenance Report

Customer	RWN nPower
Site	Aberthaw
Contact	James Beverage
Service Ref No.	SVON017322
Survey Dates	11 February 2015
Device Type	GM32 Probe version
Serial Number	1303 8025
Device Location	Unit 9
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	-	See post service
NO	ppm	0-1000	386	-	See post service
NO ₂	ppm	0-100	9.8	-	See post service
SO ₂ Lo	ppm	0-250	73.8	-	See post service
Temp.	°C	0-200	81	- X -	- X -
Press.	hPa	900-1200	1021	- X -	- X -

Lamp data			
Max. lamp intensity	19500	Exposure:	287 ms
		Lamp pulse:	0 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 found
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"/> 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"/> 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: 25.55	115V±1V: 113.9
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 zeroeched.
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: 506 B: 564		Good values
C: 494 D: 552		Good values
10.12	Check mirror steps	<input checked="" type="checkbox"/> OK
Dx: 0.018 Dy: -0.005		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 Reccomended	
Training requirements detected: NA	

13. Measurement values after check					
	Unit	Range	Reading	Zero point	Span point
SO ₂ Hi	ppm	0-1200	69	1.3	822.1
NO	ppm	0-100	394	-0.0	685.1
NO ₂	ppm	0-100	-0.2	1.9	68.5
SO ₂ Lo	ppm	0-250	68.5	1.3	171.3
Temp.	°C	0-200		- X -	- X -
Press.	hPa	900-1200		- X -	- X -

Remarks Check Cycle swivel element replaced P/N
Approved by customer Name: <div style="text-align: center;">Position:</div>

SICK

Unit 9 - GM32 Linearity Report

Customer	RWE Npower
Site	Aberthaw Power Station
Permit Ref	A1234
Contact	James Beveridge
Service Ref No.	SVON017322
Survey Date	17.02.2015
Device Type	GM32
Device Location	Unit 9
Serial Number	1303 8025
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	1303 8025
MCERTS Certificate Number	MC10016301
Location	Unit 9
Active Path Length (mm)	500
Gas Box Serial Number	0616 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	19.01.2018
Tolerance	2%

Site Permit Ref	A1234
SVON No	SVON017322
Order Number	AXC1235784133
QAL2/AST/Routine	QAL2
Date	17.02.2015
Engineer	Rhodri Jones

Response Time (T ₉₀) Seconds	30
Permit Daily ELV for SO ₂ (mg.m ⁻³)	440
Permit Daily ELV x 2 (mg.m ⁻³) (c _{EL})	880
Analysers Range	1200
Ambient Pressure (hPa)	1024
Results Visible on DCS?	Yes, when not in maintenance mode
Corrections Applied?	None - As measured (ppm)

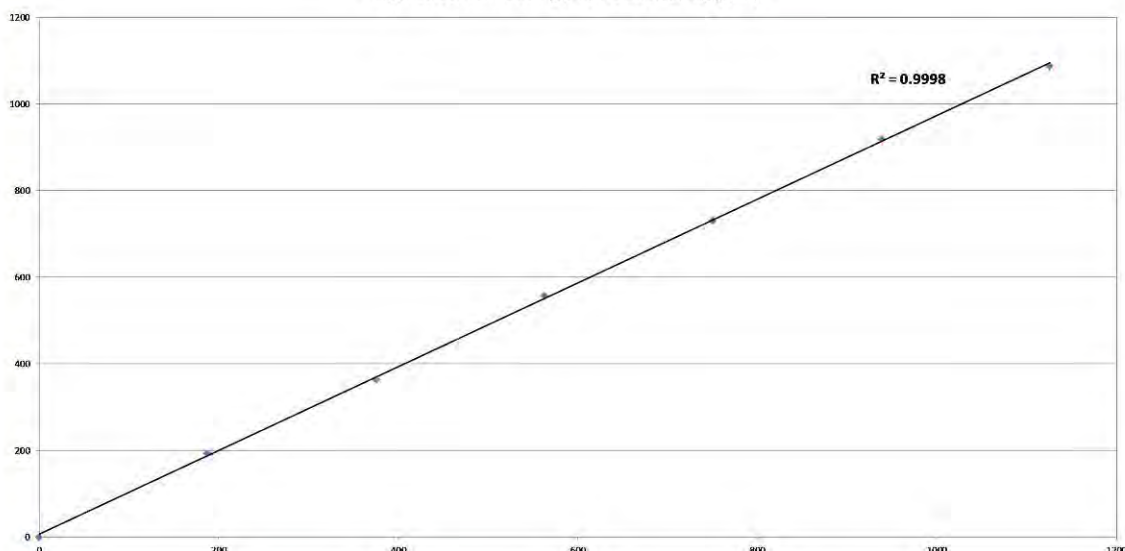
Component 1		SO ₂
Set Pt Time (4xT ₉₀) sec	120	
Log Time (3xT ₉₀) sec	90	
Gasbox Temperature (°C)	80	
Reference Temperature (K)	273	
ppm to mg.m ⁻³ for SO ₂	2.85	

Linearity Results									
% 2 x ELV	Test Cell Length (mm)	Expected (ppm)	Reading 1 (ppm)	Reading 2 (ppm)	Reading 3 (ppm)	Average Reading	DCS	Time	
244%	100	750.40	725.30	732.10	733.50	730.30		10:46 - 10:57	
183%	75	562.80	549.50	560.60	560.00	556.70		11:25 - 11:42	
305%	125	938.00	924.80	913.40	916.80	918.33		10:59 - 11:04	
61%	25	187.60	192.30	193.20	194.50	193.33		11:46 - 11:51	
122%	50	375.20	358.40	366.60	362.60	362.53		11:08 - 11:15	
366%	150	1125.60	1090.50	1078.00	1092.00	1086.83		10:38 - 10:44	

Zero Results			
ZERO	Analysers Reading (ppm)	DCS (ppm)	Time
Zero Reading 1	0.00		09:38
Zero Reading 2	0.20		09:42
Zero Reading 3	1.00		09:46
Zero Reading 4	1.00		11:53
Zero Reading 5	0.00		11:55
Zero Reading 6	0.00		11:58
AVERAGE	0.37		

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%	0.37	-0.42%	PASS
25mm	187.60	15.6%	61%	193.33	0.86%	PASS
50mm	375.20	31.3%	122%	362.53	-0.57%	PASS
75mm	562.80	46.9%	183%	556.70	0.85%	PASS
100mm	750.40	62.5%	244%	730.30	-0.08%	PASS
125mm	938.00	78.2%	305%	918.33	0.64%	PASS
150mm	1125.60	93.8%	366%	1086.83	-0.86%	PASS

Applied Concentration (ppm) v CEM Reading (ppm)



Engineer	Rhodri Jones
Signature	
Comments	

Version 2.0, 07/08/2014 - Uncontrolled when printed

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GM32 NO Linearity

Customer	RWE Npower
Site	Aberthaw Power Station
Product	GM32
Analysers Serial Number	1303 8025
MCERTS Certificate Number	MC100163/01
Location	Unit 9
Active Path Length (mm)	500

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%

Site Permit Ref	A1234
SVON No	SVON017322
Order Number	AXC123784133
QAL2/AST Routine	QAL2
Date	17.02.2015
Engineer	Rhodri Jones

Response Time (T ₉₀) Seconds	30
Permit Daily ELV for NO (mg.m ⁻³)	1210
Permit Daily ELV x 2 (mg.m ⁻³) (C _u)	2420
Analysers Range	1200
Ambient Pressure (hPa)	1024
Results Visible on DCS?	Yes, when not in maintenance mode
Corrections Applied?	None - As measured (ppm)

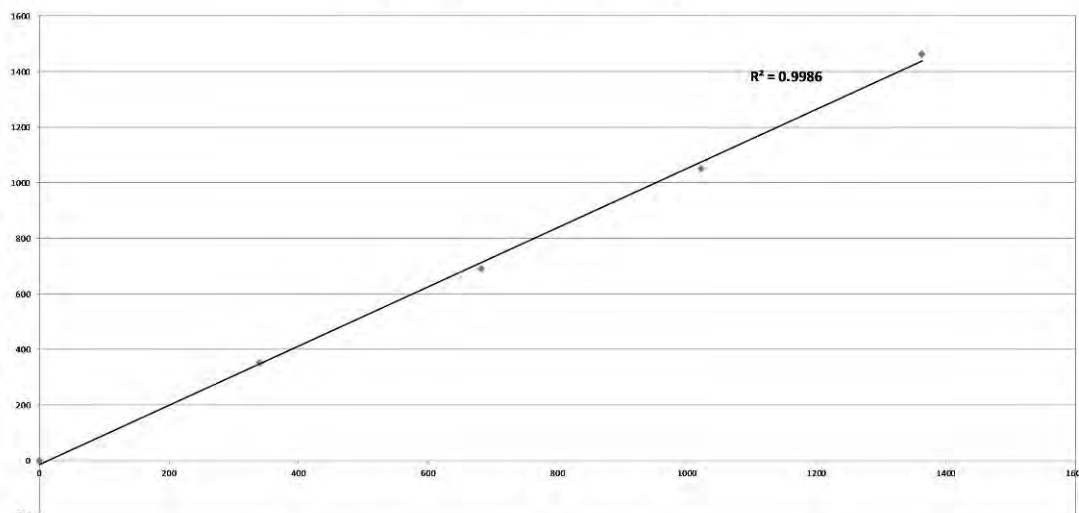
Component 1	NO
Set Pt Time (4xT ₉₀) sec	120
Log Time (3xT ₉₀) sec	90
Gasbox Temperature (°C)	80
Reference Temperature (K)	273
ppm to mg.m ⁻³ for NO	1.34

Linearity Results								
% 2 x ELV	Test Cell Length (mm)	Expected (ppm)	Reading 1 (ppm)	Reading 2 (ppm)	Reading 3 (ppm)	Average Reading	DCS	DCS Time
75%	100	1363.40	1460.00	1464.00	1467.00	1463.67		12:03 - 12:07
57%	75	1022.55	1053.00	1052.00	1049.00	1051.33		12:26 - 12:31
19%	25	340.85	351.00	350.00	351.00	350.67		12:10 - 12:15
38%	50	681.70	687.00	694.00	692.00	691.00		12:18 - 12:23

Zero Results			
ZERO	Analysers Reading (ppm)	DCS (ppm)	Time
Zero Reading 1	1.00		11:50
Zero Reading 2	0.00		11:55
Zero Reading 3	1.00		12:00
Zero Reading 4	0.00		12:40
Zero Reading 5	0.00		12:45
Zero Reading 6	0.00		12:50
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	0.37%	PASS
25mm	340.85	28.4%	14%	350.67	-0.07%	PASS
50mm	681.70	56.8%	28%	691.00	-0.92%	PASS
75mm	1022.55	85.2%	42%	1051.33	-0.94%	PASS
100mm	1363.40	113.6%	56%	1463.67	1.18%	PASS

Applied Concentration (ppm) v CEM Reading (ppm)



Engineer	Rhodri Jones
Signature	
Comments	

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Sick (UK) Ltd
Waldkirch House
39 Hedley Road
St Albans
Hertfordshire
AL1 5BN



Tel: 0044 (0) 1727 83112
Fax: 0044 (0) 1727 85533
E-Mail: info@sick.co.uk

GM32 NO₂ Linearity

Customer	RWE Npower
Site	Aberthaw Power Station
Product	GM32
Analysers Serial Number	1303 8025
MCERTS Certificate Number	MC10016301
Location	Unit 9
Active Path Length (mm)	500

Site Permit Ref	A1234
SVON No	SVON017322
Order Number	AXC1235784133
QAL2/AST/Routine	AST
Date	17.02.2015
Engineer	Rhodri Jones

Gas Box Serial Number	0616 8035
Calibration Date	01.12.2014
Calibration Gas Cylinder Ref:	VCD116712
Test Gas Conc. (ppm)	986
Test Gas Conc. (mg.m ⁻³)	2021
Gas Expiry Date	30.01.2018
Tolerance	2%

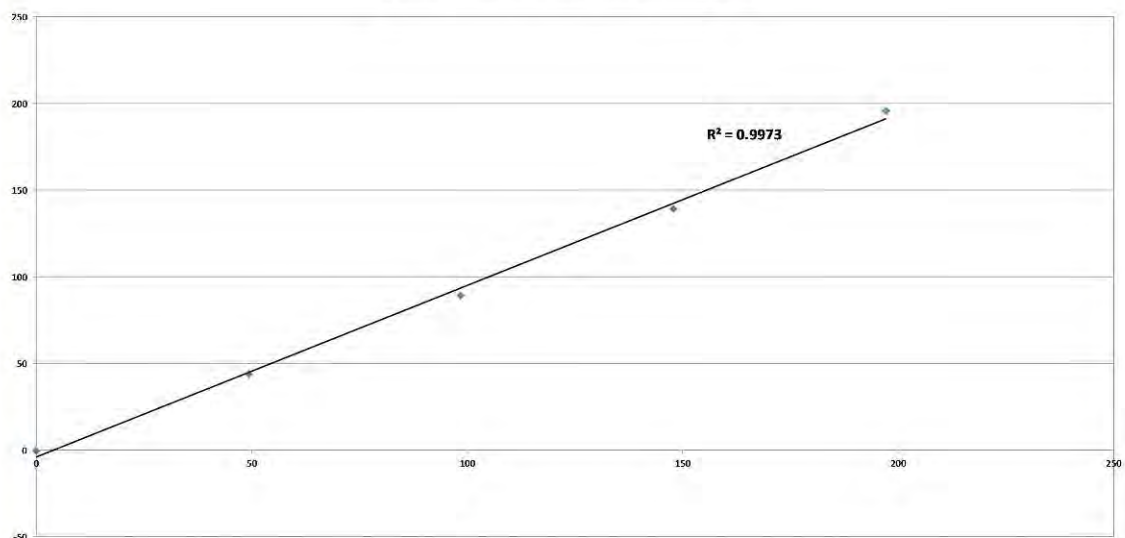
Response Time (T ₉₀) Seconds	50
Permit Daily ELV for NO ₂ (mg.m ⁻³)	121.0
Permit Daily ELV x 2 (mg.m ⁻³) (c _g)	242
Analysers Range	1200
Ambient Pressure (hPa)	970
Results Visible on DCS?	Yes, when not in maintenance mode
Corrections Applied?	None - As measured (ppm)

Component 1		Linearity Results							
NO ₂		% 2 x ELV	Test Cell Length (mm)	Expected (ppm)	Reading 1 (ppm)	Reading 2 (ppm)	Reading 3 (ppm)	Average Reading	DCS
Set Pt Time (4xT ₉₀) sec	200	167%	100	197.20	196.10	201.10	190.80	196.00	09:58 - 10:08
Log Time (3xT ₉₀) sec	150	125%	75	147.90	142.20	135.70	140.30	139.40	10:08 - 10:15
Gasbox Temperature (°C)	80	42%	25	49.30	45.20	43.90	43.00	44.03	10:17 - 10:23
Reference Temperature (K)	273	84%	50	98.60	92.60	86.30	89.00	89.30	10:26 - 10:32
ppm to mg.m ⁻³ for NO ₂	2.05								

Zero Results			
ZERO	Analysers Reading (ppm)	DCS (ppm)	Time
Zero Reading 1	-0.10		09:35
Zero Reading 2	-0.70		09:38
Zero Reading 3	0.10		10:32
Zero Reading 4	-0.30		10:38
Zero Reading 5			10:50
Zero Reading 6			11:00
AVERAGE	-0.25		

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%	-0.25	0.95%	PASS
25mm	49.30	4.1%	20%	44.03	-0.75%	PASS
50mm	98.60	8.2%	41%	89.30	-2.01%	PASS
75mm	147.90	12.3%	61%	139.40	-1.27%	PASS
100mm	197.20	18.4%	81%	196.00	2.15%	PASS

Applied Concentration (ppm) v CEM Reading (ppm)



Engineer	Rhodri Jones
Signature	
Comments	

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

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 Concentration	Pre-Sampling Result*		Post-Sampling Result*	
						Zero	Span	Zero	Span
10-12/03/15	Horiba PG 250	FYS 403	NO (17025)	183469	911 ppm	0 ppm	911 ppm	2 ppm	914 ppm
			O ₂ (17025 validated)	221743	15.04 %	0.06 %	15.08 %	0.05 %	15.05 %
	Gasmet DX4000	01610	SO ₂ (17025 validated)	116478	55 ppm	-0.52 ppm	54.81 ppm	-0.23 ppm	54.9 ppm
12/3/15	Horiba PG 250	FYS 403	NO (17025)	183469	911 ppm	2 ppm	914 ppm	2 ppm	913 ppm
			O ₂ (17025 validated)	221743	15.04 %	0.05 %	15.05 %	0.06 %	15.00 %
	Gasmet DX4000	01610	SO ₂ (17025 validated)	116478	55 ppm	-0.23 ppm	54.9 ppm	-0.48 ppm	54.31 ppm
23/3/15	Horiba PG 250	FYS 403	O ₂ (17025 validated)	221743	15.04 %	0.04 %	15.09 %	0.06 %	15.10 %
24/3/15	Horiba PG 250	FYS 403	NO (17025)	183469	911 ppm	1 ppm	909 ppm	2 ppm	912 ppm
			O ₂ (17025 validated)	221743	15.04 %	0.06 %	15.10 %	0.06 %	15.09 %
	Gasmet DX4000	01610	SO ₂ (17025 validated)	157958	181 ppm	-0.03 ppm	190.22 ppm	-0.89 ppm	190.53 ppm

Notes

- *- Calibration values are those for the entire sample system.
- - Zero gas 99.999% N₂

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 1118 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 A
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 B
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 D
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 E
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 F

 1709 Accredited to ISO/IEC 17025:2005	<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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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

Assessment Manager: LS3

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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 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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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.