

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 7**
Monitoring Dates: **21st – 26th October 2016**



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
Address: Noble House, Capital Drive, Linford Wood,
Milton Keynes. MK14 6QP.
Report Date: 9th January 2017
Report Author: Glyn Harrison
Report Approved By: Richard Harvey
Position: Principal Consultant
MCERTS Qualifications: Level 2, Technical Endorsements 1, 2, 3 & 4
MCERTS Registration No.: MM 02 020
Signature: 

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Section 1 – Executive Summary

1B.1 Result Summary

EN 14181 Test Type		QAL2				
Stack designation		Unit 7				
Measurand	Correlation coefficient of parallel data (R^2)	Derived Calibration function (y_i)		Calibrated Range	Extrapolated Calibrated Range	Variability Test
		$y_i =$	$a + bx_i$			
Nitric Oxide as total NOx (Procal 1)	0.9496	-2.02 ¹	1.06 ¹	0 – 875 mg/m ^{3 3}	0 – 1822 mg/m ^{3 4}	Pass
Sulphur Dioxide (Procal 1 – Low Range)	0.3252	-0.805 ²	1.004 ²	0 – 101 mg/m ^{3 3}	0 – 637 mg/m ^{3 4}	Pass
Sulphur Dioxide (Procal 1 – High Range)	0.3351	1.193 ²	0.985 ²	0 – 98.4 mg/m ^{3 3}	0 – 2286 mg/m ^{3 4}	Pass
Nitric Oxide as total NOx (Procal 2)	0.9407	-0.35 ¹	1.08 ¹	0 – 884 mg/m ^{3 3}	0 – 1863 mg/m ^{3 4}	Pass
Sulphur Dioxide (Procal 2 – Low Range)	0.5500	2.879 ²	1.023 ²	0 – 96.0 mg/m ^{3 3}	0 – 634 mg/m ^{3 4}	Pass
Sulphur Dioxide (Procal 2 – High Range)	0.4490	-4.635 ²	0.999 ²	0 – 88 mg/m ^{3 5}	0 – 2286 mg/m ^{3 4}	Pass

Notes

- 1 – Calibration function derived using Method B.
- 2 – Calibration function derived using Method C
- 3 – Calibrated range derived using QAL2 parallel test data extended 10%.
- 4 – Extrapolated calibrated range derived using reference materials
- 5 – Calibrated range determined as 20% of ELV

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	March 2016 AST – Procal 1 & 2

Regulated Determinands

Determinand	Emission Point	Daily Mean	Calendar Monthly	Uncertainty Requirement
Oxides of Nitrogen	Unit 7	1080 mg/m ³ (NO _x as NO ₂)	1050 mg/m ³ (NO _x as NO ₂)	20% at the ELV
Sulphur Dioxide	Unit 7	440 mg/m ³	350 mg/m ³	20% at the ELV

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

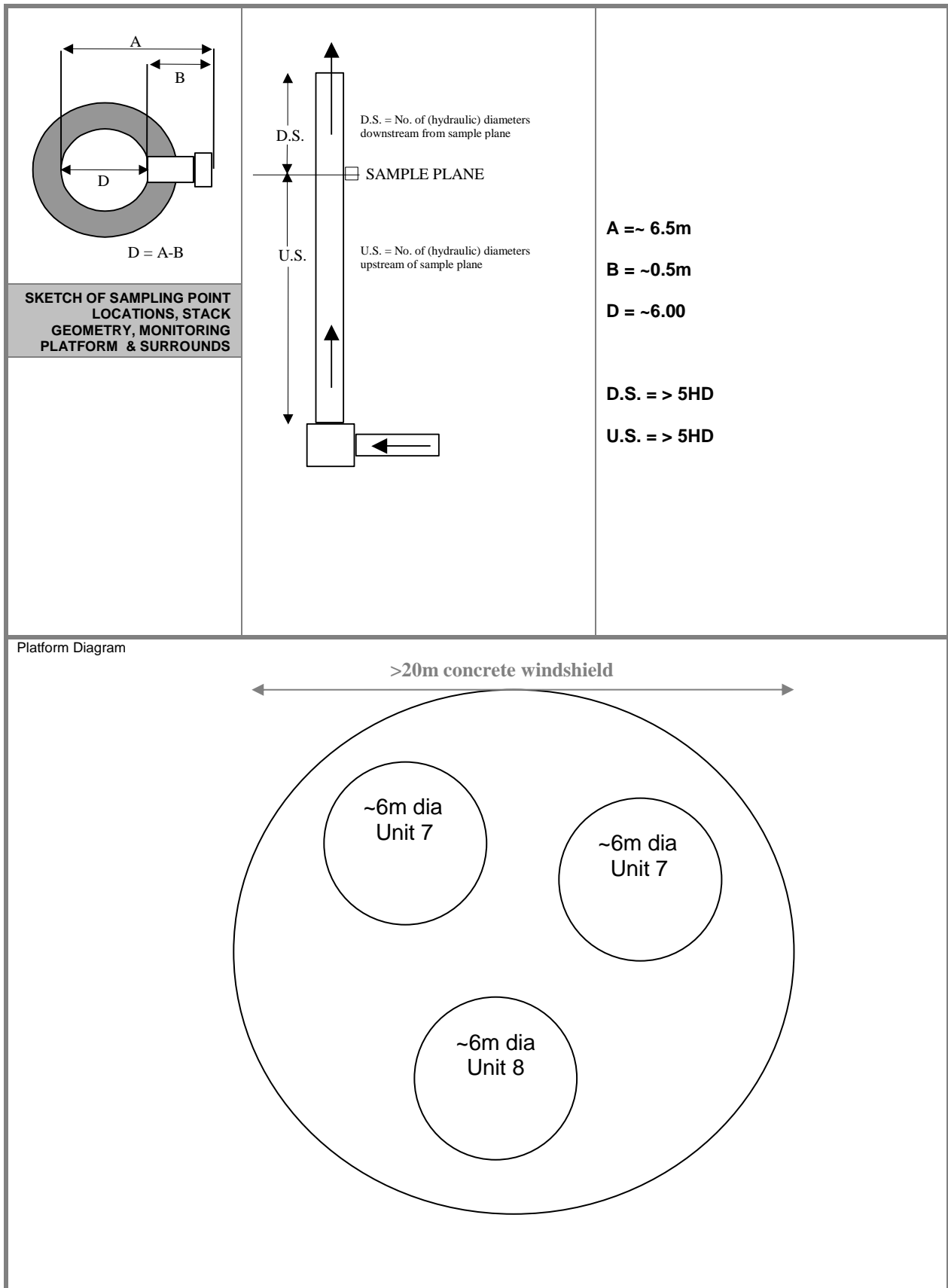
2.2 Operational Information and site monitoring provisions

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	850 - 1050 mg/m ³ as NO ₂ – variable
2 Sulphur Dioxide	40 - 87 mg/m ³ – variable
3 Oxygen	6 – 7 % – constant
Possible low level emissions	Sulphur Dioxide
Provision to deal with low level emissions	Method C - Use values from linearity checks along with parallel test data to derive calibration function & calibrated ranges.
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>

2.4.1 Continuous Emissions Monitoring Systems at the installation

	Procal 1 & 2	ABB
Determinand	NO _x & SO ₂ & H ₂ O	Oxygen
Type	In Situ IR	Zirconia Cell
Make	Procal	ABB
Model	Pulsi 200 series	AZ20
MCERTS Certificate	MC990006/13	MC110191/01
QAL1 Compliance?	Yes	Yes
Certification ranges	NO = 0 – 1000 ppm SO ₂ low = 0 – 250 ppm SO ₂ high = 0 – 1000 ppm H ₂ O = 0 – 30 %	0 to 25% 0 to 5%
Operational ranges	As Above	0 to 25%vol
Principle	Dual wavelength infra-red	Zirconia Cell
Raw data units	SO ₂ & NO = ppm H ₂ O = %	%
Reference condition of raw data	(SO ₂ & NO only) wet gas, no oxygen correction	wet gas
Signal output	4-20 mA	4 – 20mA
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

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	12/21	
			4	07/20	

Site Team	Position	MCERTS Level	Technical Endorsements	Expiry Dates	MCERTS Registration Number
Edwin Powell	Consultant	2	1	12/17	MM 05 621
			2	12/17	
			3	12/17	
			4	12/17	
Daniel Lewis	Technician	1	--	-	MM 14 1291

Report Author	Position	MCERTS Level	Technical Endorsements	Expiry Dates	MCERTS Registration Number
Glyn Harrison	Operations Manager (Stack Emissions)	2	1	10/19	MM 03 228
			2	06/17	
			3	12/21	
			4	07/20	

Report Reviewer	Position	MCERTS Level	Technical Endorsements	Expiry Dates	MCERTS Registration Number
Richard Harvey	Principal Consultant	2	1	11/17	MM 02 020
			2	03/20	
			3	03/21	
			4	12/20	

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

Equipment details

Emission Parameter	Analysis Technique	Analyser	Analyser Certification Status	Certified Ranges	Operational Ranges	Operating Principle
Oxygen	Zirconia Cell	Horiba PG 250	MCERTs certificate No MC 050056/04	0 – 25%	0-25%	Extractive, multicomponent dry gas analyser. Sample extracted through sample probe and 5metre heated sample line (with integral heated filter) – line temperature 180°C. Sample line connected directly to a gas conditioner (peltier cooler) set at 3°C. Cold dry sample then passes to analyser. Sample is drawn through system by integral pump built into analyser.
Oxides of Nitrogen	Chemiluminescence	Horiba PG 250	MCERTs certificate No MC 050056/04	0 – 125 mg/m ³ NO/NO _x	0 – 500ppm	
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%	

Section 4A1: Data & calculations – QAL2 – Unit 7, Procal 1

4A1.1 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		NO (ppm)	(%)	(%)	NOx (ppm)	(%)	(%)	NOx (ppm)
1	21-Oct-16	11:00	12:00	335.82	6.63	2.34	371.64	6.47	2.40	362.7
2	21-Oct-16	12:01	13:01	319.58	6.47	2.32	349.00	6.37	2.61	339.9
3	21-Oct-16	13:02	14:02	318.78	6.42	2.32	347.90	6.31	2.54	339.1
4	21-Oct-16	14:03	15:03	330.62	6.39	2.28	358.81	6.30	2.31	350.5
5	24-Oct-16	11:30	12:30	352.48	6.18	2.02	380.47	6.09	2.43	371.2
6	24-Oct-16	12:31	13:31	338.18	6.26	2.32	368.79	6.15	2.55	359.4
7	24-Oct-16	13:32	14:32	324.26	6.18	2.44	354.97	6.02	2.78	345.1
8	24-Oct-16	14:33	15:33	320.95	6.15	2.47	349.27	5.99	2.57	340.3
9	24-Oct-16	15:34	16:34	318.58	6.07	2.50	341.42	5.91	2.56	332.7
10	24-Oct-16	16:35	17:35	311.86	6.09	2.35	333.14	5.94	2.39	325.2
11	24-Oct-16	17:36	18:36	316.29	6.09	2.33	334.52	5.93	2.34	326.7
12	24-Oct-16	18:37	19:37	320.57	6.10	2.35	340.84	5.94	2.34	332.9
13	24-Oct-16	19:38	20:38	320.47	6.11	2.38	342.47	5.97	2.37	334.3
14	24-Oct-16	20:39	21:39	323.94	6.33	2.47	347.76	6.14	2.45	339.2
15	24-Oct-16	21:40	22:40	320.31	6.29	2.41	345.01	6.09	2.36	336.9
16	24-Oct-16	22:41	23:41	314.46	6.22	2.40	338.63	6.06	2.33	330.7
17	24-25/10/2016	23:42	0:42	308.08	6.19	2.40	330.70	6.04	2.31	323.1
18	25-Oct-16	0:43	1:43	305.63	6.07	2.41	327.61	5.94	2.31	320.1
19	25-Oct-16	1:44	2:44	311.03	5.83	2.56	335.64	5.71	2.48	327.3
20	25-Oct-16	2:45	3:45	316.61	5.89	2.56	344.28	5.77	2.49	335.7
21	25-Oct-16	3:46	4:46	324.94	6.25	2.59	354.37	6.08	2.49	345.5
22	25-Oct-16	4:47	5:47	323.76	6.22	2.53	350.61	6.08	2.41	342.2
23	25-Oct-16	5:48	6:48	317.67	6.17	2.47	342.16	6.04	2.34	334.2
24	25-Oct-16	6:49	7:49	321.95	6.27	2.48	347.05	6.12	2.35	338.9
25	25-Oct-16	7:50	8:50	341.43	6.38	2.50	368.11	6.21	2.36	359.4
26	25-Oct-16	8:51	9:51	341.96	6.28	2.55	371.64	6.13	2.41	362.7
27	25-Oct-16	10:45	11:45	343.07	6.27	2.52	368.47	6.17	2.52	359.2
28	25-Oct-16	11:46	12:46	337.75	6.18	2.20	368.04	6.13	2.57	358.6
29	25-Oct-16	12:47	13:47	321.04	6.17	1.99	356.72	6.06	2.56	347.6
30	25-Oct-16	13:48	14:48	325.24	6.13	2.07	349.23	6.04	2.61	340.1
31	25-Oct-16	14:49	15:49	308.63	5.96	2.17	336.49	5.88	2.80	327.1
32	25-Oct-16	15:50	16:50	315.43	6.03	2.17	344.52	5.96	2.80	334.9
33	25-Oct-16	16:51	17:51	319.49	6.10	2.18	348.86	6.02	2.79	339.1
34	25-Oct-16	17:52	18:52	325.23	6.14	2.13	352.60	6.04	2.72	343.0
35	25-Oct-16	18:53	19:53	324.63	6.10	2.04	351.24	6.02	2.56	342.2
36	25-Oct-16	19:54	20:54	321.26	6.12	2.06	347.54	6.04	2.60	338.5
37	25-Oct-16	20:55	21:55	314.34	6.19	2.07	342.08	6.11	2.60	333.2
38	25-Oct-16	21:56	22:56	311.21	6.32	2.17	341.26	6.20	2.72	332.0
39	25-Oct-16	22:57	23:57	308.98	6.27	2.08	338.87	6.18	2.66	329.9
40	25-26/10/2016	23:58	0:58	309.36	6.11	2.04	336.32	6.04	2.59	327.6
41	26-Oct-16	0:59	1:59	325.14	5.85	2.01	349.92	5.85	2.57	340.9
42	26-Oct-16	2:00	3:00	336.30	5.96	1.99	364.23	5.86	2.55	355.0
43	26-Oct-16	3:01	4:01	334.77	6.09	1.99	365.12	6.02	2.55	355.8
44	26-Oct-16	4:02	5:02	337.38	6.27	2.07	367.40	6.23	2.63	357.8
45	26-Oct-16	5:03	6:03	334.34	6.28	2.16	367.40	6.19	2.77	357.2
46	26-Oct-16	6:04	7:04	339.56	6.34	2.16	374.05	6.25	2.77	363.7
47	26-Oct-16	7:05	8:05	348.78	6.41	2.00	383.57	6.33	2.54	373.8
48	26-Oct-16	8:06	9:06	348.30	6.44	2.03	379.17	6.38	2.59	369.3

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

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

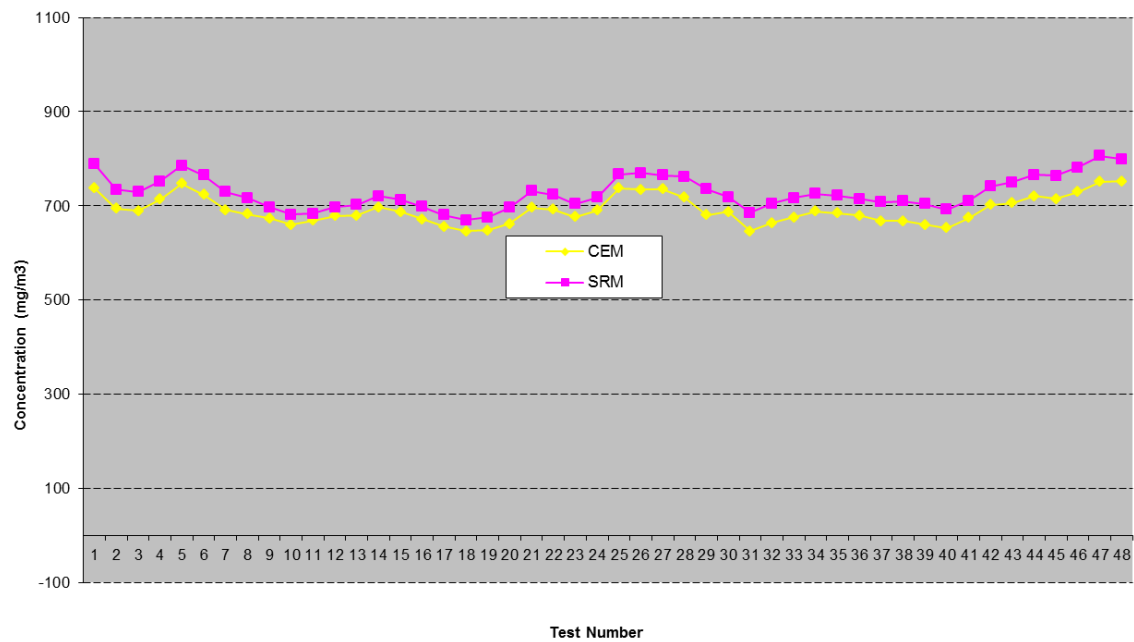
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(NOx as NO2 mg/m3)	(NOx as NO2 mg/m3)	(mg/m3)
1	21-Oct-16	11:00	12:00	737.2	788.1	26
2	21-Oct-16	12:01	13:01	694.0	734.7	24
3	21-Oct-16	13:02	14:02	689.6	729.4	24
4	21-Oct-16	14:03	15:03	713.7	751.9	25
5	24-Oct-16	11:30	12:30	747.6	786.1	26
6	24-Oct-16	12:31	13:31	723.7	765.0	25
7	24-Oct-16	13:32	14:32	691.1	729.7	24
8	24-Oct-16	14:33	15:33	682.9	716.8	23
9	24-Oct-16	15:34	16:34	674.2	697.1	23
10	24-Oct-16	16:35	17:35	659.9	681.4	22
11	24-Oct-16	17:36	18:36	668.9	684.0	22
12	24-Oct-16	18:37	19:37	678.7	697.0	23
13	24-Oct-16	19:38	20:38	679.2	701.8	23
14	24-Oct-16	20:39	21:39	697.7	721.1	24
15	24-Oct-16	21:40	22:40	687.6	713.0	23
16	24-Oct-16	22:41	23:41	671.4	698.1	23
17	24-25/10/2016	23:42	0:42	656.6	680.9	22
18	25-Oct-16	0:43	1:43	646.3	670.1	22
19	25-Oct-16	1:44	2:44	648.0	676.2	22
20	25-Oct-16	2:45	3:45	662.4	696.2	23
21	25-Oct-16	3:46	4:46	696.6	731.5	24
22	25-Oct-16	4:47	5:47	692.5	723.9	24
23	25-Oct-16	5:48	6:48	676.8	704.4	23
24	25-Oct-16	6:49	7:49	690.4	718.3	24
25	25-Oct-16	7:50	8:50	737.7	766.8	25
26	25-Oct-16	8:51	9:51	734.6	769.7	25
27	25-Oct-16	10:45	11:45	736.0	765.3	25
28	25-Oct-16	11:46	12:46	717.8	762.3	25
29	25-Oct-16	12:47	13:47	680.4	735.4	24
30	25-Oct-16	13:48	14:48	687.8	719.2	24
31	25-Oct-16	14:49	15:49	646.0	685.4	22
32	25-Oct-16	15:50	16:50	663.6	705.4	23
33	25-Oct-16	16:51	17:51	675.4	717.2	24
34	25-Oct-16	17:52	18:52	688.7	726.3	24
35	25-Oct-16	18:53	19:53	685.0	722.3	24
36	25-Oct-16	19:54	20:54	679.3	715.5	24
37	25-Oct-16	20:55	21:55	667.7	707.7	23
38	25-Oct-16	21:56	22:56	667.8	710.6	23
39	25-Oct-16	22:57	23:57	660.0	704.3	23
40	25-26/10/2016	23:58	0:58	653.3	692.5	23
41	26-Oct-16	0:59	1:59	674.6	711.4	23
42	26-Oct-16	2:00	3:00	702.7	741.1	24
43	26-Oct-16	3:01	4:01	705.9	750.6	25
44	26-Oct-16	4:02	5:02	720.5	766.1	25
45	26-Oct-16	5:03	6:03	715.4	764.3	25
46	26-Oct-16	6:04	7:04	729.5	781.3	26
47	26-Oct-16	7:05	8:05	751.6	805.8	26
48	26-Oct-16	8:06	9:06	752.5	799.2	26

Note:

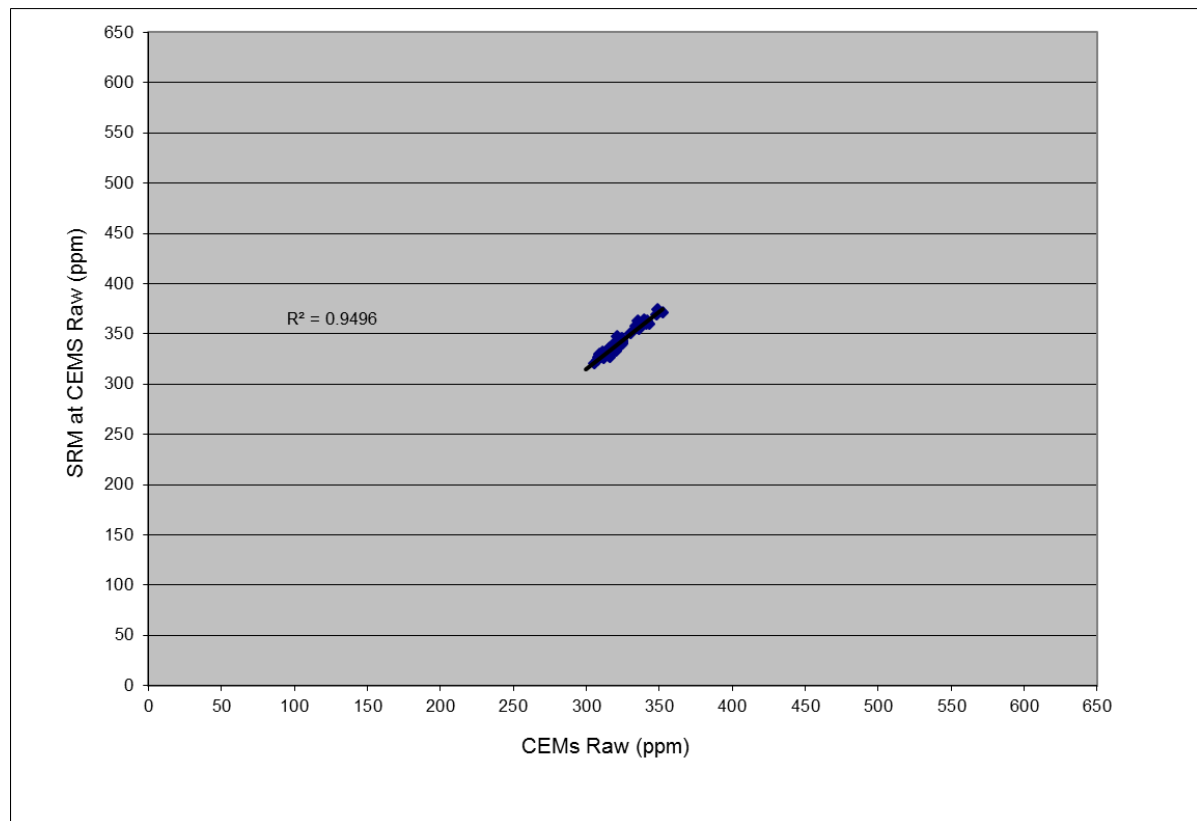
Emission concentrations expressed at reference conditions 273K,

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



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 0.9496, an outlier test has not been undertaken.

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

Test No	Test Start Time	Test End Time	SRM measured value (y)	SRM O2	SRM Standardised
	hr:min		(ppm)	(%)	(mg/m3)
1	11:00	12:00	371.6	6.5	788.1
2	12:01	13:01	349.0	6.4	734.7
3	13:02	14:02	347.9	6.3	729.4
4	14:03	15:03	358.8	6.3	751.9
5	11:30	12:30	380.5	6.1	786.1
6	12:31	13:31	368.8	6.2	765.0
7	13:32	14:32	355.0	6.0	729.7
8	14:33	15:33	349.3	6.0	716.8
9	15:34	16:34	341.4	5.9	697.1
10	16:35	17:35	333.1	5.9	681.4
11	17:36	18:36	334.5	5.9	684.0
12	18:37	19:37	340.8	5.9	697.0
13	19:38	20:38	342.5	6.0	701.8
14	20:39	21:39	347.8	6.1	721.1
15	21:40	22:40	345.0	6.1	713.0
16	22:41	23:41	338.6	6.1	698.1
17	23:42	0:42	330.7	6.0	680.9
18	0:43	1:43	327.6	5.9	670.1
19	1:44	2:44	335.6	5.7	676.2
20	2:45	3:45	344.3	5.8	696.2
21	3:46	4:46	354.4	6.1	731.5
22	4:47	5:47	350.6	6.1	723.9
23	5:48	6:48	342.2	6.0	704.4
24	6:49	7:49	347.0	6.1	718.3
25	7:50	8:50	368.1	6.2	766.8
26	8:51	9:51	371.6	6.1	769.7
27	10:45	11:45	368.5	6.2	765.3
28	11:46	12:46	368.0	6.1	762.3
29	12:47	13:47	356.7	6.1	735.4
30	13:48	14:48	349.2	6.0	719.2
31	14:49	15:49	336.5	5.9	685.4
32	15:50	16:50	344.5	6.0	705.4
33	16:51	17:51	348.9	6.0	717.2
34	17:52	18:52	352.6	6.0	726.3
35	18:53	19:53	351.2	6.0	722.3
36	19:54	20:54	347.5	6.0	715.5
37	20:55	21:55	342.1	6.1	707.7
38	21:56	22:56	341.3	6.2	710.6
39	22:57	23:57	338.9	6.2	704.3
40	23:58	0:58	336.3	6.0	692.5
41	0:59	1:59	349.9	5.8	711.4
42	2:00	3:00	364.2	5.9	741.1
43	3:01	4:01	365.1	6.0	750.6
44	4:02	5:02	367.4	6.2	766.1
45	5:03	6:03	367.4	6.2	764.3
46	6:04	7:04	374.0	6.3	781.3
47	7:05	8:05	383.6	6.3	805.8
48	8:06	9:06	379.2	6.4	799.2
Sum			16909.87		
Emission Limit Value (ELV) =			1080 mg/Nm ³	Y _{max}	805.77
Maximum Permissible uncertainty =			20 %	Y _{min}	670.06
Maximum Permissible uncertainty (at 1			216 mg/Nm ³		
15% of the ELV =			162 mg/Nm ³		
Is Ymax - Ymin > MPU at ELV?			No	Y _{max} - Y _{min}	135.71
Is Ymin > 15% of ELV?			Yes		

Derivation of Calibration Function	Method B
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4A1.6.1 Table 4.3.1 - Data used to derive calibration function - Oxides of Nitrogen,

Test No	Test Start Time	Test End Time	SRM measured value (y)	CEMS measured signal (x)
	hr:min		(ppm)	(ppm)
1	Reference		0.0	1.9
2	11:00	12:00	362.7	335.8
3	12:01	13:01	339.9	319.6
4	13:02	14:02	339.1	318.8
5	14:03	15:03	350.5	330.6
6	11:30	12:30	371.2	352.5
7	12:31	13:31	359.4	338.2
8	13:32	14:32	345.1	324.3
9	14:33	15:33	340.3	321.0
10	15:34	16:34	332.7	318.6
11	16:35	17:35	325.2	311.9
12	17:36	18:36	326.7	316.3
13	18:37	19:37	332.9	320.6
14	19:38	20:38	334.3	320.5
15	20:39	21:39	339.2	323.9
16	21:40	22:40	336.9	320.3
17	22:41	23:41	330.7	314.5
18	23:42	0:42	323.1	308.1
19	0:43	1:43	320.1	305.6
20	1:44	2:44	327.3	311.0
21	2:45	3:45	335.7	316.6
22	3:46	4:46	345.5	324.9
23	4:47	5:47	342.2	323.8
24	5:48	6:48	334.2	317.7
25	6:49	7:49	338.9	321.9
26	7:50	8:50	359.4	341.4
27	8:51	9:51	362.7	342.0
28	10:45	11:45	359.2	343.1
29	11:46	12:46	358.6	337.8
30	12:47	13:47	347.6	321.0
31	13:48	14:48	340.1	325.2
32	14:49	15:49	327.1	308.6
33	15:50	16:50	334.9	315.4
34	16:51	17:51	339.1	319.5
35	17:52	18:52	343.0	325.2
36	18:53	19:53	342.2	324.6
37	19:54	20:54	338.5	321.3
38	20:55	21:55	333.2	314.3
39	21:56	22:56	332.0	311.2
40	22:57	23:57	329.9	309.0
41	23:58	0:58	327.6	309.4
42	0:59	1:59	340.9	325.1
43	2:00	3:00	355.0	336.3
44	3:01	4:01	355.8	334.8
45	4:02	5:02	357.8	337.4
46	5:03	6:03	357.2	334.3
47	6:04	7:04	363.7	339.6
48	7:05	8:05	373.8	348.8
49	8:06	9:06	369.3	348.3
Sum			16482.24	15592.32

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

Method B

Formulae:- Number of tests conducted =	N	49
If Ymax-Ymin <15% of the ELV, the following formulae are used:		
$b = (y/(x-Z)) \quad x = (1/\text{No. AMS Tests}) * \text{Total AMS}$		
$x = (1/49) * 15592.$	or -	$x = 318.21$
$a = (-\beta.Z) \quad y = (1/\text{No. SRM Tests}) * \text{Total SRM}$		
$y = (1/49) * 16482$	or -	$y = 336.37$
The Slope is calculated by :		
$\beta = y/(x-Z) \quad 336.3 / (318.2 - 1.9)$	$\beta =$	1.063
The offset is calculated by:		
$\alpha = -\beta.Z \quad -1.06 * 1.9$	$\alpha =$	-2.02
The calibration is function $y_{im} = \alpha + \beta_{xi,m}$ or $y_i = -2.02 + 1.06 * X_i$		

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

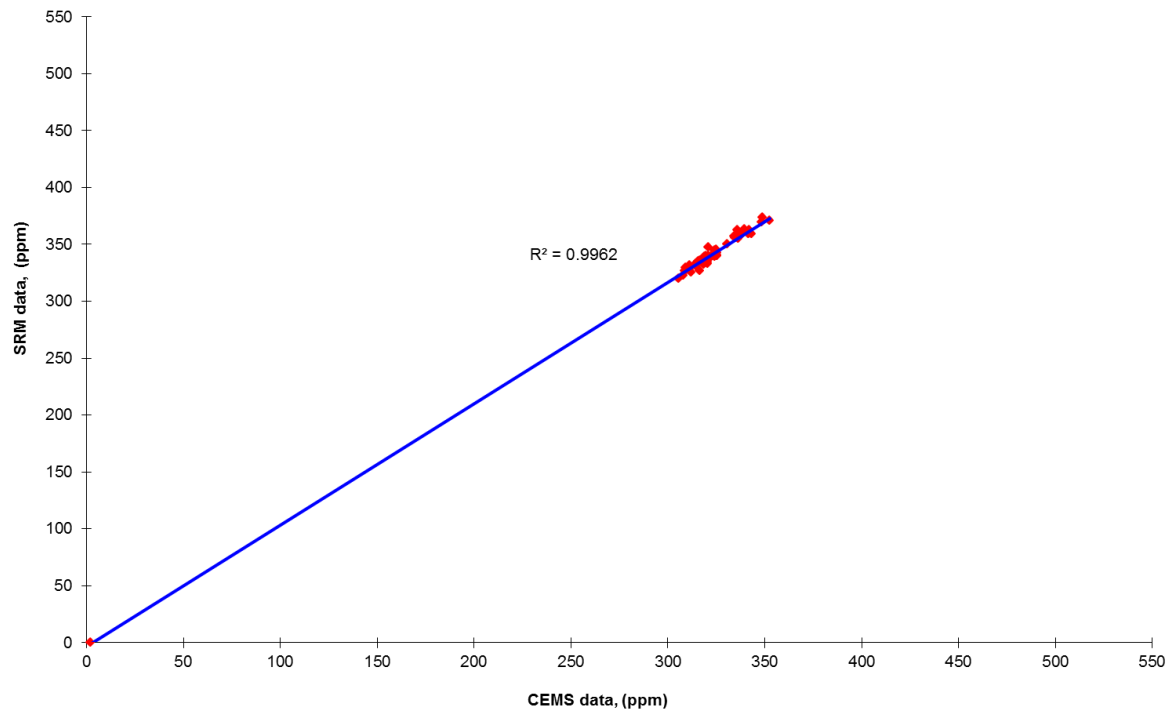
Test No	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
	hr:min		(ppm)	(ppm)	(%)	(%)	(mg/Nm ³)	(mg/Nm ³)	(mg/Nm ³)
1	Reference		1.9	0.0	N/A	N/A	1.9	0.0	0.0
2	11:00	12:00	335.8	355.1	6.6	2.3	737.2	779.5	788.1
3	12:01	13:01	319.6	337.8	6.5	2.3	694.0	733.6	734.7
4	13:02	14:02	318.8	337.0	6.4	2.3	689.6	728.9	729.4
5	14:03	15:03	330.6	349.6	6.4	2.3	713.7	754.6	751.9
6	11:30	12:30	352.5	372.8	6.2	2.0	747.6	790.8	786.1
7	12:31	13:31	338.2	357.6	6.3	2.3	723.7	765.2	765.0
8	13:32	14:32	324.3	342.8	6.2	2.4	691.1	730.6	729.7
9	14:33	15:33	321.0	339.3	6.2	2.5	682.9	721.9	716.8
10	15:34	16:34	318.6	336.8	6.1	2.5	674.2	712.6	697.1
11	16:35	17:35	311.9	329.6	6.1	2.3	659.9	697.4	681.4
12	17:36	18:36	316.3	334.3	6.1	2.3	668.9	707.1	684.0
13	18:37	19:37	320.6	338.9	6.1	2.3	678.7	717.4	697.0
14	19:38	20:38	320.5	338.8	6.1	2.4	679.2	718.0	701.8
15	20:39	21:39	323.9	342.5	6.3	2.5	697.7	737.6	721.1
16	21:40	22:40	320.3	338.6	6.3	2.4	687.6	726.9	713.0
17	22:41	23:41	314.5	332.4	6.2	2.4	671.4	709.7	698.1
18	23:42	00:42	308.1	325.6	6.2	2.4	656.6	693.9	680.9
19	00:43	01:43	305.6	323.0	6.1	2.4	646.3	683.0	670.1
20	01:44	02:44	311.0	328.7	5.8	2.6	648.0	684.9	676.2
21	02:45	03:45	316.6	334.7	5.9	2.6	662.4	700.2	696.2
22	03:46	04:46	324.9	343.5	6.2	2.6	696.6	736.5	731.5
23	04:47	05:47	323.8	342.3	6.2	2.5	692.5	732.1	723.9
24	05:48	06:48	317.7	335.8	6.2	2.5	676.8	715.4	704.4
25	06:49	07:49	321.9	340.3	6.3	2.5	690.4	729.8	718.3
26	07:50	08:50	341.4	361.1	6.4	2.5	737.7	780.1	766.8
27	08:51	09:51	342.0	361.6	6.3	2.5	734.6	776.8	769.7
28	10:45	11:45	343.1	362.8	6.3	2.5	736.0	778.3	765.3
29	11:46	12:46	337.8	357.2	6.2	2.2	717.8	759.0	762.3
30	12:47	13:47	321.0	339.4	6.2	2.0	680.4	719.3	735.4
31	13:48	14:48	325.2	343.8	6.1	2.1	687.8	727.2	719.2
32	14:49	15:49	308.6	326.2	6.0	2.2	646.0	682.8	685.4
33	15:50	16:50	315.4	333.4	6.0	2.2	663.6	701.5	705.4
34	16:51	17:51	319.5	337.7	6.1	2.2	675.4	714.0	717.2
35	17:52	18:52	325.2	343.8	6.1	2.1	688.7	728.1	726.3
36	18:53	19:53	324.6	343.2	6.1	2.0	685.0	724.2	722.3
37	19:54	20:54	321.3	339.6	6.1	2.1	679.3	718.1	715.5
38	20:55	21:55	314.3	332.3	6.2	2.1	667.7	705.8	707.7
39	21:56	22:56	311.2	328.9	6.3	2.2	667.8	705.8	710.6
40	22:57	23:57	309.0	326.6	6.3	2.1	660.0	697.5	704.3
41	23:58	00:58	309.4	327.0	6.1	2.0	653.3	690.5	692.5
42	00:59	01:59	325.1	343.7	5.9	2.0	674.6	713.2	711.4
43	02:00	03:00	336.3	355.6	6.0	2.0	702.7	743.0	741.1
44	03:01	04:01	334.8	354.0	6.1	2.0	705.9	746.4	750.6
45	04:02	05:02	337.4	356.8	6.3	2.1	720.5	761.9	766.1
46	05:03	06:03	334.3	353.5	6.3	2.2	715.4	756.4	764.3
47	06:04	07:04	339.6	359.1	6.3	2.2	729.5	771.4	781.3
48	07:05	08:05	348.8	368.9	6.4	2.0	751.6	794.9	805.8
49	08:06	09:06	348.3	368.4	6.4	2.0	752.5	795.8	799.2
Sum							33202.23		
Emission Limit Value (ELV) =			1080	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.



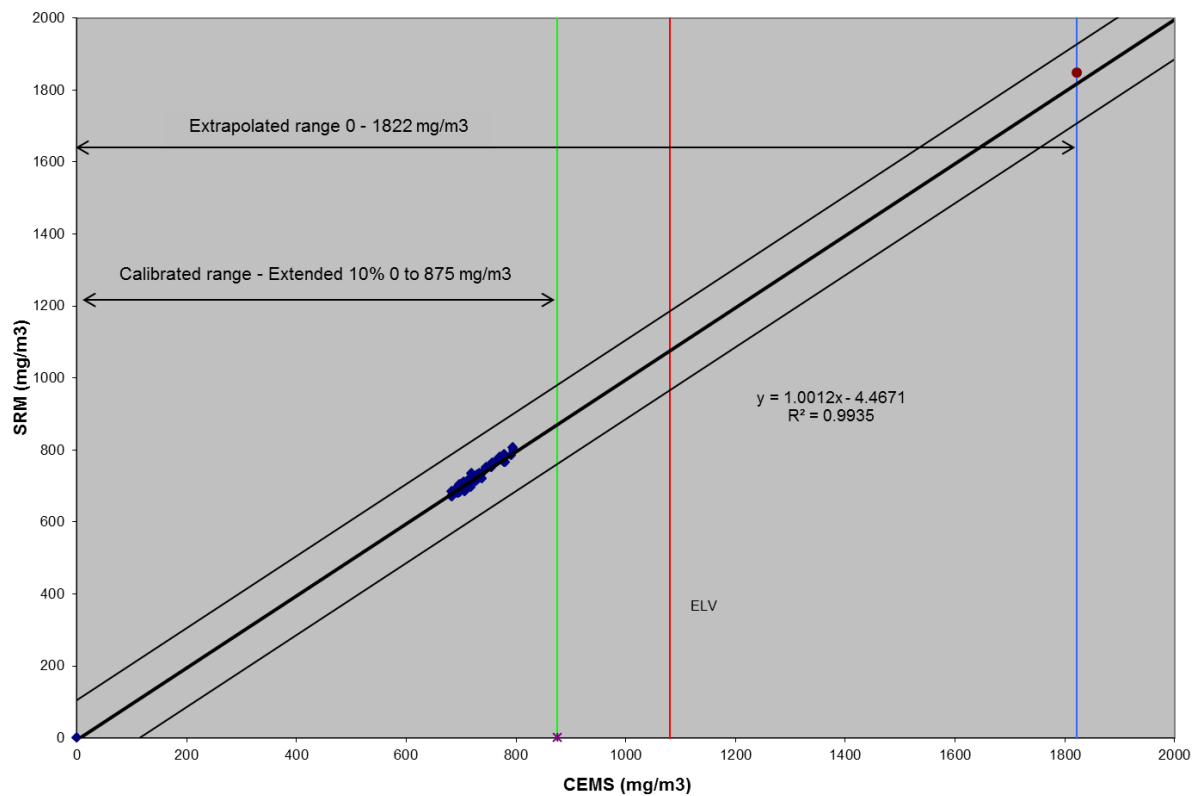
4A1.10.1 Table 4.5.1 – Data used for the Variability Test – Oxides of Nitrogen

Test No	Test 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			
2	11:00	12:00	779.5	788.1	8.65	12.34	152.15
3	12:01	13:01	733.6	734.7	1.12	4.80	23.08
4	13:02	14:02	728.9	729.4	0.51	4.20	17.61
5	14:03	15:03	754.6	751.9	-2.63	1.05	1.10
6	11:30	12:30	790.8	786.1	-4.63	-0.95	0.90
7	12:31	13:31	765.2	765.0	-0.19	3.49	12.21
8	13:32	14:32	730.6	729.7	-0.90	2.78	7.72
9	14:33	15:33	721.9	716.8	-5.05	-1.36	1.86
10	15:34	16:34	712.6	697.1	-15.58	-11.90	141.59
11	16:35	17:35	697.4	681.4	-16.00	-12.31	151.60
12	17:36	18:36	707.1	684.0	-23.14	-19.46	378.54
13	18:37	19:37	717.4	697.0	-20.43	-16.74	280.33
14	19:38	20:38	718.0	701.8	-16.28	-12.60	158.77
15	20:39	21:39	737.6	721.1	-16.49	-12.80	163.92
16	21:40	22:40	726.9	713.0	-13.84	-10.16	103.27
17	22:41	23:41	709.7	698.1	-11.57	-7.89	62.26
18	23:42	00:42	693.9	680.9	-13.00	-9.32	86.82
19	00:43	01:43	683.0	670.1	-12.92	-9.24	85.34
20	01:44	02:44	684.9	676.2	-8.67	-4.98	24.83
21	02:45	03:45	700.2	696.2	-3.91	-0.23	0.05
22	03:46	04:46	736.5	731.5	-4.93	-1.25	1.56
23	04:47	05:47	732.1	723.9	-8.14	-4.46	19.90
24	05:48	06:48	715.4	704.4	-10.97	-7.28	53.06
25	06:49	07:49	729.8	718.3	-11.49	-7.80	60.90
26	07:50	08:50	780.1	766.8	-13.35	-9.67	93.55
27	08:51	09:51	776.8	769.7	-7.08	-3.40	11.53
28	10:45	11:45	778.3	765.3	-12.95	-9.27	85.88
29	11:46	12:46	759.0	762.3	3.32	7.00	48.97
30	12:47	13:47	719.3	735.4	16.11	19.80	391.85
31	13:48	14:48	727.2	719.2	-7.94	-4.26	18.15
32	14:49	15:49	682.8	685.4	2.65	6.33	40.11
33	15:50	16:50	701.5	705.4	3.92	7.61	57.87
34	16:51	17:51	714.0	717.2	3.27	6.95	48.37
35	17:52	18:52	728.1	726.3	-1.88	1.80	3.25
36	18:53	19:53	724.2	722.3	-1.85	1.84	3.37
37	19:54	20:54	718.1	715.5	-2.63	1.05	1.10
38	20:55	21:55	705.8	707.7	1.93	5.61	31.47
39	21:56	22:56	705.8	710.6	4.78	8.47	71.67
40	22:57	23:57	697.5	704.3	6.82	10.50	110.34
41	23:58	00:58	690.5	692.5	2.04	5.73	32.78
42	00:59	01:59	713.2	711.4	-1.83	1.85	3.42
43	02:00	03:00	743.0	741.1	-1.93	1.75	3.05
44	03:01	04:01	746.4	750.6	4.19	7.87	61.93
45	04:02	05:02	761.9	766.1	4.22	7.90	62.38
46	05:03	06:03	756.4	764.3	7.85	11.53	132.91
47	06:04	07:04	771.4	781.3	9.89	13.57	184.17
48	07:05	08:05	794.9	805.8	10.82	14.50	210.30
49	08:06	09:06	795.8	799.2	3.36	7.04	49.59
48 Tests		Mean			-3.68		
Sum							3747.38

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

SD=	$\text{Root}(1-\text{Number}).\text{Integral}(D1-D)^2$	8.93	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 =	$0.2 \times 1080 \text{ mg/m3 (s,d,6\%O2)}/1.96$	110.20	mg/m3(s,d),6%O2
For 48 tests, kv =	0.9885		
Therefore variability=	$8.93 \leq 110.2 \times 0.9885$		
or	$8.93 \leq 108.94$		
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 NO_2) – 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	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	21-Oct-16	12:01	13:01	23.76	6.47	2.32	17.71	6.37	2.61	17.7
2	21-Oct-16	13:02	14:02	26.24	6.42	2.32	20.64	6.31	2.54	20.6
3	21-Oct-16	14:03	15:03	29.30	6.39	2.28	22.26	6.30	2.31	22.3
4	24-Oct-16	11:30	12:30	22.32	6.18	2.31	20.42	6.09	2.43	20.4
5	24-Oct-16	12:31	13:31	22.46	6.26	2.32	19.76	6.15	2.55	19.8
6	24-Oct-16	13:32	14:32	22.66	6.18	2.44	20.03	6.02	2.78	20.0
7	24-Oct-16	14:33	15:33	24.57	6.15	2.47	20.80	5.99	2.57	20.8
8	24-Oct-16	15:34	16:34	25.02	6.07	2.50	21.45	5.91	2.56	21.5
9	24-Oct-16	16:35	17:35	25.29	6.09	2.35	22.12	5.94	2.39	22.1
10	24-Oct-16	17:36	18:36	25.80	6.09	2.33	22.00	5.93	2.34	22.0
11	24-Oct-16	18:37	19:37	22.69	6.10	2.35	19.47	5.94	2.34	19.5
12	24-Oct-16	19:38	20:38	21.38	6.11	2.38	18.45	5.97	2.37	18.4
13	24-Oct-16	20:39	21:39	21.52	6.33	2.47	17.78	6.14	2.45	17.8
14	24-Oct-16	21:40	22:40	20.96	6.29	2.41	17.50	6.09	2.36	17.5
15	24-Oct-16	22:41	23:41	20.74	6.22	2.40	17.19	6.06	2.33	17.2
16	24-25/10/2016	23:42	0:42	19.99	6.19	2.40	16.72	6.04	2.31	16.7
17	25-Oct-16	0:43	1:43	18.75	6.07	2.41	16.20	5.94	2.31	16.2
18	25-Oct-16	1:44	2:44	24.94	5.83	2.56	22.13	5.71	2.48	22.1
19	25-Oct-16	2:45	3:45	18.23	5.89	2.56	16.94	5.77	2.49	16.9
20	25-Oct-16	3:46	4:46	19.36	6.25	2.59	16.67	6.08	2.49	16.7
21	25-Oct-16	4:47	5:47	20.01	6.22	2.53	16.71	6.08	2.41	16.7
22	25-Oct-16	5:48	6:48	19.78	6.17	2.47	17.16	6.04	2.34	17.2
23	25-Oct-16	6:49	7:49	20.53	6.27	2.48	17.35	6.12	2.35	17.3
24	25-Oct-16	7:50	8:50	20.62	6.38	2.50	16.88	6.21	2.36	16.9
25	25-Oct-16	8:51	9:51	21.55	6.28	2.55	17.42	6.13	2.41	17.4
26	25-Oct-16	10:45	11:45	21.63	6.27	2.52	20.49	6.17	2.52	20.5
27	25-Oct-16	11:46	12:46	22.91	6.18	2.20	20.91	6.13	2.57	20.9
28	25-Oct-16	12:47	13:47	21.18	6.17	1.99	20.12	6.06	2.56	20.1
29	25-Oct-16	13:48	14:48	19.68	6.13	2.07	19.28	6.04	2.61	19.3
30	25-Oct-16	14:49	15:49	17.52	5.96	2.17	19.75	5.88	2.80	19.7
31	25-Oct-16	15:50	16:50	17.05	6.03	2.17	19.75	5.96	2.80	19.7
32	25-Oct-16	16:51	17:51	16.48	6.10	2.18	19.20	6.02	2.79	19.2
33	25-Oct-16	17:52	18:52	16.19	6.14	2.13	19.12	6.04	2.72	19.1
34	25-Oct-16	18:53	19:53	14.66	6.10	2.04	17.99	6.02	2.56	18.0
35	25-Oct-16	19:54	20:54	13.56	6.12	2.06	16.89	6.04	2.60	16.9
36	25-Oct-16	20:55	21:55	13.84	6.19	2.07	17.35	6.11	2.60	17.3
37	25-Oct-16	21:56	22:56	16.64	6.32	2.17	19.23	6.20	2.72	19.2
38	25-Oct-16	22:57	23:57	18.80	6.27	2.08	21.28	6.18	2.66	21.3
39	25-26/10/2016	23:58	0:58	21.87	6.11	2.04	24.64	6.04	2.59	24.6
40	26-Oct-16	0:59	1:59	21.84	5.85	2.01	25.54	5.85	2.57	25.5
41	26-Oct-16	2:00	3:00	17.30	5.96	1.99	21.37	5.86	2.55	21.4
42	26-Oct-16	3:01	4:01	15.72	6.09	1.99	19.10	6.02	2.55	19.1
43	26-Oct-16	4:02	5:02	15.71	6.27	2.07	18.84	6.23	2.63	18.8
44	26-Oct-16	5:03	6:03	17.55	6.28	2.16	20.56	6.19	2.77	20.6
45	26-Oct-16	6:04	7:04	31.27	6.34	2.16	33.46	6.25	2.77	33.5
46	26-Oct-16	7:05	8:05	19.02	6.41	2.00	21.49	6.33	2.54	21.5
47	26-Oct-16	8:06	9:06	17.09	6.44	2.03	20.06	6.38	2.59	20.1

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

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

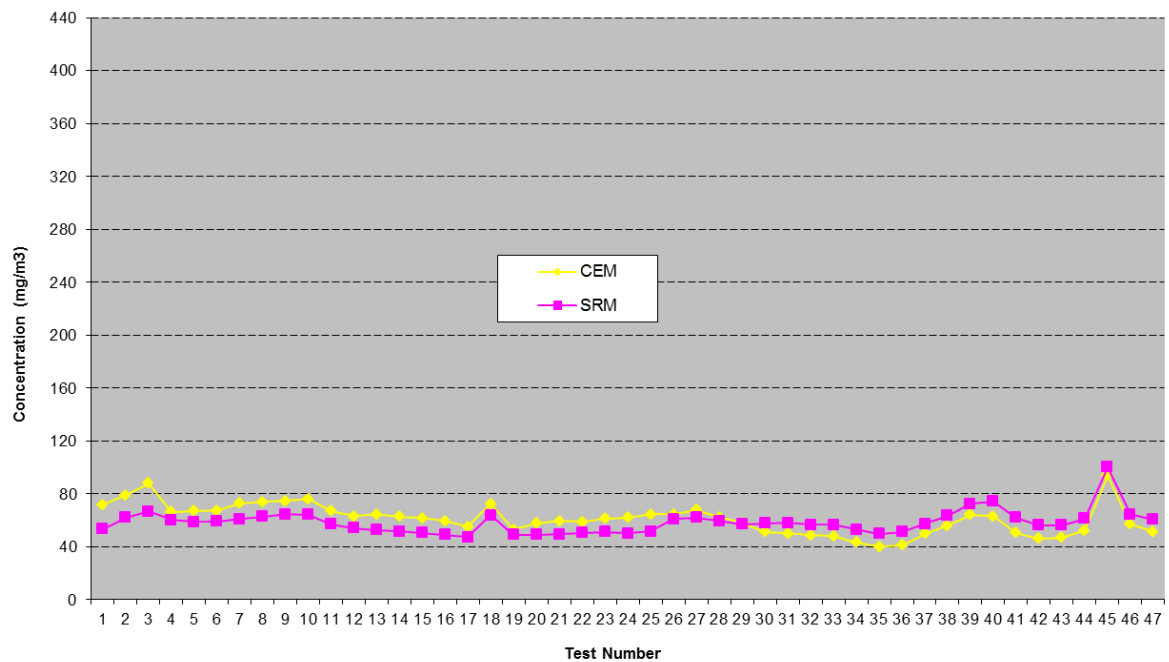
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(SO ₂ mg/m ³)	(SO ₂ mg/m ³)	(mg/m ³)
1	21-Oct-16	12:01	13:01	71.8	53.3	2.4
2	21-Oct-16	13:02	14:02	79.0	61.8	2.8
3	21-Oct-16	14:03	15:03	88.0	66.4	3.0
4	24-Oct-16	11:30	12:30	66.1	60.2	2.7
5	24-Oct-16	12:31	13:31	66.9	58.5	2.6
6	24-Oct-16	13:32	14:32	67.2	58.9	2.6
7	24-Oct-16	14:33	15:33	72.7	61.0	2.7
8	24-Oct-16	15:34	16:34	73.7	62.5	2.8
9	24-Oct-16	16:35	17:35	74.5	64.5	2.9
10	24-Oct-16	17:36	18:36	75.9	64.1	2.9
11	24-Oct-16	18:37	19:37	66.8	56.7	2.5
12	24-Oct-16	19:38	20:38	63.1	53.9	2.4
13	24-Oct-16	20:39	21:39	64.5	52.6	2.4
14	24-Oct-16	21:40	22:40	62.6	51.5	2.3
15	24-Oct-16	22:41	23:41	61.6	50.5	2.3
16	24-25/10/2016	23:42	0:42	59.3	49.0	2.2
17	25-Oct-16	0:43	1:43	55.2	47.2	2.1
18	25-Oct-16	1:44	2:44	72.3	63.6	2.9
19	25-Oct-16	2:45	3:45	53.1	48.9	2.2
20	25-Oct-16	3:46	4:46	57.7	49.1	2.2
21	25-Oct-16	4:47	5:47	59.5	49.2	2.2
22	25-Oct-16	5:48	6:48	58.6	50.3	2.3
23	25-Oct-16	6:49	7:49	61.3	51.2	2.3
24	25-Oct-16	7:50	8:50	62.0	50.1	2.3
25	25-Oct-16	8:51	9:51	64.4	51.4	2.3
26	25-Oct-16	10:45	11:45	64.6	60.7	2.7
27	25-Oct-16	11:46	12:46	67.7	61.9	2.8
28	25-Oct-16	12:47	13:47	62.4	59.2	2.7
29	25-Oct-16	13:48	14:48	57.9	56.7	2.5
30	25-Oct-16	14:49	15:49	51.0	57.6	2.6
31	25-Oct-16	15:50	16:50	49.9	57.9	2.6
32	25-Oct-16	16:51	17:51	48.5	56.5	2.5
33	25-Oct-16	17:52	18:52	47.7	56.3	2.5
34	25-Oct-16	18:53	19:53	43.0	52.8	2.4
35	25-Oct-16	19:54	20:54	39.9	49.7	2.2
36	25-Oct-16	20:55	21:55	40.9	51.3	2.3
37	25-Oct-16	21:56	22:56	49.7	57.3	2.6
38	25-Oct-16	22:57	23:57	55.9	63.2	2.8
39	25-26/10/2016	23:58	0:58	64.2	72.5	3.3
40	26-Oct-16	0:59	1:59	63.0	74.2	3.3
41	26-Oct-16	2:00	3:00	50.3	62.1	2.8
42	26-Oct-16	3:01	4:01	46.1	56.1	2.5
43	26-Oct-16	4:02	5:02	46.7	56.1	2.5
44	26-Oct-16	5:03	6:03	52.2	61.2	2.7
45	26-Oct-16	6:04	7:04	93.5	100.0	4.5
46	26-Oct-16	7:05	8:05	57.0	64.4	2.9
47	26-Oct-16	8:06	9:06	51.4	60.4	2.7

Note:

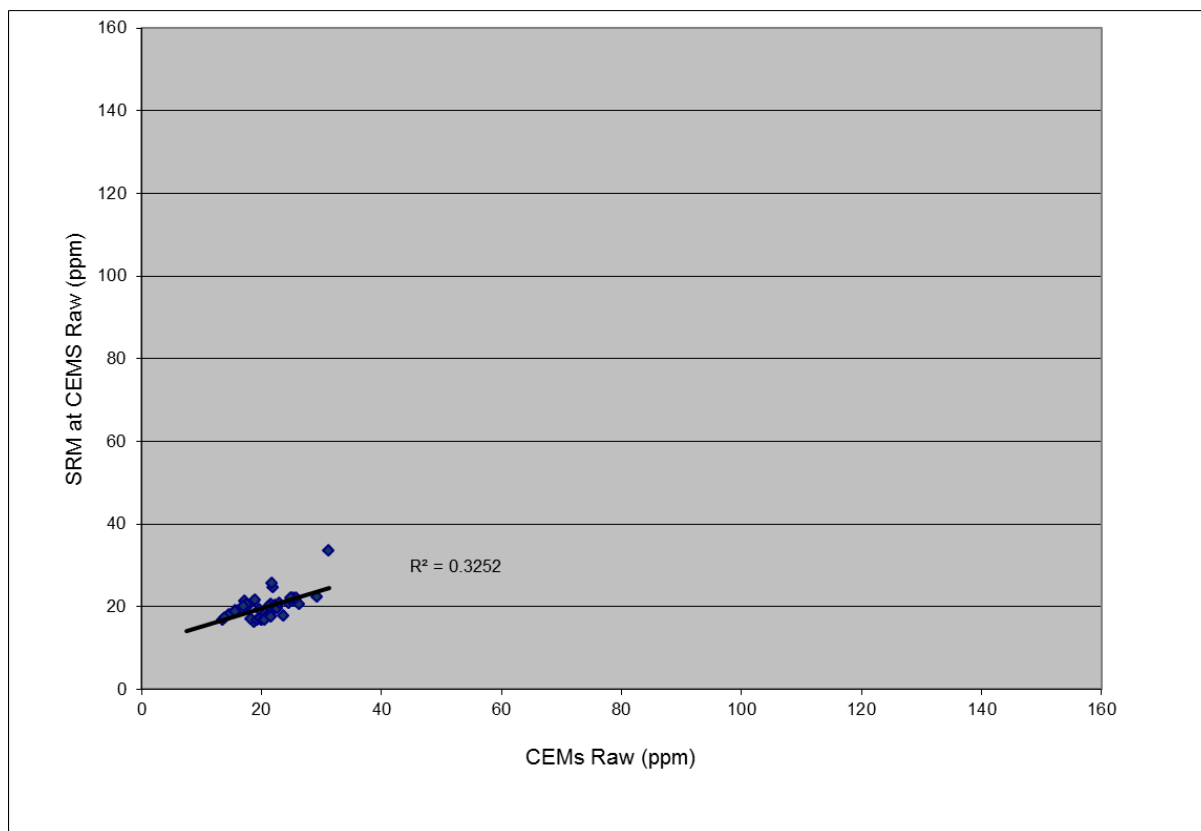
Emission concentrations expressed at reference conditions 273K,

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.



4A1.4.2 (Cont..) – 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 - Di	Is Result an Outlier - Di - Di > 2SD
	hr:min		(ppm)	(ppm)			
1	12:01	13:01	23.8	17.7	-6.05	-5.24	No
2	13:02	14:02	26.2	20.6	-5.60	-4.80	No
3	14:03	15:03	29.3	22.3	-7.04	-6.23	No
4	11:30	12:30	22.3	20.4	-1.90	-1.10	No
5	12:31	13:31	22.5	19.8	-2.70	-1.90	No
6	13:32	14:32	22.7	20.0	-2.63	-1.83	No
7	14:33	15:33	24.6	20.8	-3.77	-2.97	No
8	15:34	16:34	25.0	21.5	-3.57	-2.76	No
9	16:35	17:35	25.3	22.1	-3.17	-2.37	No
10	17:36	18:36	25.8	22.0	-3.81	-3.00	No
11	18:37	19:37	22.7	19.5	-3.22	-2.42	No
12	19:38	20:38	21.4	18.4	-2.94	-2.13	No
13	20:39	21:39	21.5	17.8	-3.74	-2.94	No
14	21:40	22:40	21.0	17.5	-3.46	-2.66	No
15	22:41	23:41	20.7	17.2	-3.56	-2.75	No
16	23:42	00:42	20.0	16.7	-3.27	-2.47	No
17	00:43	01:43	18.8	16.2	-2.56	-1.75	No
18	01:44	02:44	24.9	22.1	-2.81	-2.00	No
19	02:45	03:45	18.2	16.9	-1.28	-0.48	No
20	03:46	04:46	19.4	16.7	-2.69	-1.88	No
21	04:47	05:47	20.0	16.7	-3.29	-2.49	No
22	05:48	06:48	19.8	17.2	-2.61	-1.81	No
23	06:49	07:49	20.5	17.3	-3.18	-2.38	No
24	07:50	08:50	20.6	16.9	-3.75	-2.94	No
25	08:51	09:51	21.6	17.4	-4.13	-3.33	No
26	10:45	11:45	21.6	20.5	-1.14	-0.34	No
27	11:46	12:46	22.9	20.9	-2.00	-1.19	No
28	12:47	13:47	21.2	20.1	-1.06	-0.25	No
29	13:48	14:48	19.7	19.3	-0.40	0.40	No
30	14:49	15:49	17.5	19.7	2.23	3.03	No
31	15:50	16:50	17.1	19.7	2.69	3.50	No
32	16:51	17:51	16.5	19.2	2.72	3.53	No
33	17:52	18:52	16.2	19.1	2.94	3.74	No
34	18:53	19:53	14.7	18.0	3.32	4.13	No
35	19:54	20:54	13.6	16.9	3.33	4.13	No
36	20:55	21:55	13.8	17.3	3.51	4.31	No
37	21:56	22:56	16.6	19.2	2.59	3.39	No
38	22:57	23:57	18.8	21.3	2.48	3.29	No
39	23:58	00:58	21.9	24.6	2.77	3.58	No
40	00:59	01:59	21.8	25.5	3.70	4.51	No
41	02:00	03:00	17.3	21.4	4.07	4.87	No
42	03:01	04:01	15.7	19.1	3.38	4.18	No
43	04:02	05:02	15.7	18.8	3.13	3.94	No
44	05:03	06:03	17.5	20.6	3.01	3.81	No
45	06:04	07:04	31.3	33.5	2.19	2.99	No
46	07:05	08:05	19.0	21.5	2.47	3.27	No
47	08:06	09:06	17.1	20.1	2.98	3.78	No
				Average Di	-0.80		
			Standard Deviation		3.22		
			Standard Deviation x2		6.44		

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

Test No	Test Start Time	Test End Time	SRM measured value (y)	SRM O2	SRM Standardised
	hr:min		(ppm)	(%)	(mg/m3)
1	12:01	13:01	17.7	6.4	53.3
2	13:02	14:02	20.6	6.3	61.8
3	14:03	15:03	22.3	6.3	66.4
4	11:30	12:30	20.4	6.1	60.2
5	12:31	13:31	19.8	6.2	58.5
6	13:32	14:32	20.0	6.0	58.9
7	14:33	15:33	20.8	6.0	61.0
8	15:34	16:34	21.5	5.9	62.5
9	16:35	17:35	22.1	5.9	64.5
10	17:36	18:36	22.0	5.9	64.1
11	18:37	19:37	19.5	5.9	56.7
12	19:38	20:38	18.4	6.0	53.9
13	20:39	21:39	17.8	6.1	52.6
14	21:40	22:40	17.5	6.1	51.5
15	22:41	23:41	17.2	6.1	50.5
16	23:42	0:42	16.7	6.0	49.0
17	0:43	1:43	16.2	5.9	47.2
18	1:44	2:44	22.1	5.7	63.6
19	2:45	3:45	16.9	5.8	48.9
20	3:46	4:46	16.7	6.1	49.1
21	4:47	5:47	16.7	6.1	49.2
22	5:48	6:48	17.2	6.0	50.3
23	6:49	7:49	17.3	6.1	51.2
24	7:50	8:50	16.9	6.2	50.1
25	8:51	9:51	17.4	6.1	51.4
26	10:45	11:45	20.5	6.2	60.7
27	11:46	12:46	20.9	6.1	61.9
28	12:47	13:47	20.1	6.1	59.2
29	13:48	14:48	19.3	6.0	56.7
30	14:49	15:49	19.7	5.9	57.6
31	15:50	16:50	19.7	6.0	57.9
32	16:51	17:51	19.2	6.0	56.5
33	17:52	18:52	19.1	6.0	56.3
34	18:53	19:53	18.0	6.0	52.8
35	19:54	20:54	16.9	6.0	49.7
36	20:55	21:55	17.3	6.1	51.3
37	21:56	22:56	19.2	6.2	57.3
38	22:57	23:57	21.3	6.2	63.2
39	23:58	0:58	24.6	6.0	72.5
40	0:59	1:59	25.5	5.8	74.2
41	2:00	3:00	21.4	5.9	62.1
42	3:01	4:01	19.1	6.0	56.1
43	4:02	5:02	18.8	6.2	56.1
44	5:03	6:03	20.6	6.2	61.2
45	6:04	7:04	33.5	6.3	100.0
46	7:05	8:05	21.5	6.3	64.4
47	8:06	9:06	20.1	6.4	60.4
Sum			928.18		
Emission Limit Value (ELV) =			440 mg/Nm ³	Y _{max}	100.02
Maximum Permissible uncertainty =			20 %	Y _{min}	47.17
Maximum Permissible uncertainty (at 1			88 mg/Nm ³		
15% of the ELV =			66 mg/Nm ³		
Is Y _{max} - Y _{min} > MPU at ELV?			No	Y _{max} - Y _{min}	52.85
Is Y _{min} > 15% of ELV?			No		

Derivation of Calibration Function	Method C
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4A1.6.2 Table 4.3.2 - Data used to derive calibration function - Sulphur Dioxide, Low Range.

Test No	Test Start Time	Test End Time	SRM measured value (y)	CEMS measured signal (x)	Yi	Xi	Xi * Yi	Xi ²	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference Zero		0.0	-0.7	-23.53	-24.90	586.05	620.10	
2	Reference Span		225.0	223.0	201.47	198.75	40040.94	39500.84	
3	12:01	13:01	17.7	23.8	-5.82	-0.49	2.87	0.24	
4	13:02	14:02	20.6	26.2	-2.89	1.99	-5.76	3.97	
5	14:03	15:03	22.3	29.3	-1.28	5.04	-6.44	25.45	
6	11:30	12:30	20.4	22.3	-3.12	-1.93	6.01	3.72	
7	12:31	13:31	19.8	22.5	-3.78	-1.79	6.77	3.21	
8	13:32	14:32	20.0	22.7	-3.50	-1.59	5.56	2.52	
9	14:33	15:33	20.8	24.6	-2.73	0.32	-0.88	0.10	
10	15:34	16:34	21.5	25.0	-2.08	0.77	-1.60	0.59	
11	16:35	17:35	22.1	25.3	-1.41	1.04	-1.47	1.09	
12	17:36	18:36	22.0	25.8	-1.54	1.55	-2.39	2.41	
13	18:37	19:37	19.5	22.7	-4.06	-1.56	6.34	2.43	
14	19:38	20:38	18.4	21.4	-5.09	-2.87	14.60	8.23	
15	20:39	21:39	17.8	21.5	-5.75	-2.73	15.72	7.46	
16	21:40	22:40	17.5	21.0	-6.03	-3.29	19.84	10.81	
17	22:41	23:41	17.2	20.7	-6.35	-3.51	22.27	12.31	
18	23:42	0:42	16.7	20.0	-6.81	-4.26	29.03	18.15	
19	0:43	1:43	16.2	18.8	-7.34	-5.50	40.35	30.23	
20	1:44	2:44	22.1	24.9	-1.40	0.69	-0.96	0.47	
21	2:45	3:45	16.9	18.2	-6.59	-6.03	39.72	36.30	
22	3:46	4:46	16.7	19.4	-6.87	-4.90	33.63	23.98	
23	4:47	5:47	16.7	20.0	-6.82	-4.24	28.95	18.02	
24	5:48	6:48	17.2	19.8	-6.37	-4.47	28.50	20.01	
25	6:49	7:49	17.3	20.5	-6.19	-3.72	23.01	13.84	
26	7:50	8:50	16.9	20.6	-6.66	-3.63	24.16	13.17	
27	8:51	9:51	17.4	21.6	-6.11	-2.70	16.49	7.28	
28	10:45	11:45	20.5	21.6	-3.05	-2.62	7.99	6.88	
29	11:46	12:46	20.9	22.9	-2.62	-1.34	3.51	1.80	
30	12:47	13:47	20.1	21.2	-3.41	-3.08	10.50	9.46	
31	13:48	14:48	19.3	19.7	-4.26	-4.57	19.48	20.92	
32	14:49	15:49	19.7	17.5	-3.79	-6.74	25.52	45.36	
33	15:50	16:50	19.7	17.1	-3.79	-7.20	27.26	51.80	
34	16:51	17:51	19.2	16.5	-4.33	-7.77	33.68	60.42	
35	17:52	18:52	19.1	16.2	-4.41	-8.06	35.57	65.04	
36	18:53	19:53	18.0	14.7	-5.55	-9.59	53.19	91.94	
37	19:54	20:54	16.9	13.6	-6.65	-10.69	71.08	114.38	
38	20:55	21:55	17.3	13.8	-6.19	-10.42	64.45	108.47	
39	21:56	22:56	19.2	16.6	-4.30	-7.61	32.73	57.90	
40	22:57	23:57	21.3	18.8	-2.26	-5.46	12.31	29.77	
41	23:58	0:58	24.6	21.9	1.10	-2.39	-2.63	5.69	
42	0:59	1:59	25.5	21.8	2.01	-2.41	-4.84	5.82	
43	2:00	3:00	21.4	17.3	-2.16	-6.95	15.05	48.32	
44	3:01	4:01	19.1	15.7	-4.43	-8.53	37.80	72.74	
45	4:02	5:02	18.8	15.7	-4.69	-8.54	40.08	72.99	
46	5:03	6:03	20.6	17.5	-2.98	-6.71	19.98	44.98	
47	6:04	7:04	33.5	31.3	9.93	7.02	69.73	49.31	
48	7:05	8:05	21.5	19.0	-2.05	-5.23	10.72	27.40	
49	8:06	9:06	20.1	17.1	-3.47	-7.17	24.88	51.36	
Sum			1153.18	1188.34	0.00	0.00	41579.33	41429.72	1.00

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

Method C

If Ymax-Ymin >15% of the ELV, the following formulae are used:

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

$$\bar{x} = \frac{1}{N} \sum_{i=1}^N x_i$$

$$\bar{y} = \frac{1}{N} \sum_{i=1}^N y_i$$

$$a = \bar{y} - b\bar{x}$$

$\bar{x} = 24.25$
 $\bar{y} = 23.53$
 $b = 1.004$
 $a = -0.805$

The calibration is function $y_i = a + b x_i$ or $y_i = -0.805 + 1.004 * x_i$

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

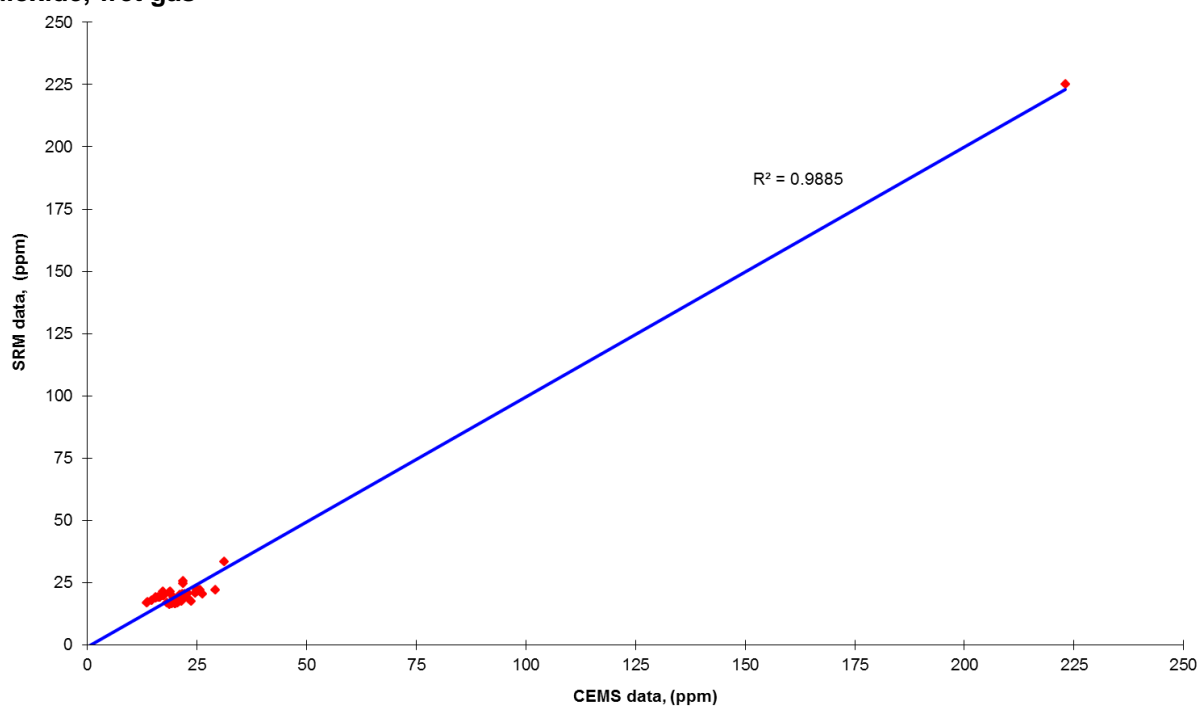
Test No	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
	hr:min		(ppm)	(ppm)	(%)	(%)	(mg/Nm ³)	(mg/Nm ³)	(mg/m3)
1	Reference Zero		-0.7	-1.5	N/A	N/A	-0.7	-4.2	0.0
2	Reference Span		223.0	223.0	N/A	N/A	223.0	637.1	642.9
3	12:01	13:01	23.8	23.0	6.5	2.3	71.8	69.6	53.3
4	13:02	14:02	26.2	25.5	6.4	2.3	79.0	76.8	61.8
5	14:03	15:03	29.3	28.6	6.4	2.3	88.0	85.9	66.4
6	11:30	12:30	22.3	21.6	6.2	2.3	66.1	63.9	60.2
7	12:31	13:31	22.5	21.7	6.3	2.3	66.9	64.7	58.5
8	13:32	14:32	22.7	21.9	6.2	2.4	67.2	65.1	58.9
9	14:33	15:33	24.6	23.9	6.2	2.5	72.7	70.6	61.0
10	15:34	16:34	25.0	24.3	6.1	2.5	73.7	71.6	62.5
11	16:35	17:35	25.3	24.6	6.1	2.3	74.5	72.4	64.5
12	17:36	18:36	25.8	25.1	6.1	2.3	75.9	73.8	64.1
13	18:37	19:37	22.7	22.0	6.1	2.3	66.8	64.7	56.7
14	19:38	20:38	21.4	20.7	6.1	2.4	63.1	60.9	53.9
15	20:39	21:39	21.5	20.8	6.3	2.5	64.5	62.3	52.6
16	21:40	22:40	21.0	20.2	6.3	2.4	62.6	60.4	51.5
17	22:41	23:41	20.7	20.0	6.2	2.4	61.6	59.5	50.5
18	23:42	00:42	20.0	19.3	6.2	2.4	59.3	57.1	49.0
19	00:43	01:43	18.8	18.0	6.1	2.4	55.2	53.0	47.2
20	01:44	02:44	24.9	24.2	5.8	2.6	72.3	70.2	63.6
21	02:45	03:45	18.2	17.5	5.9	2.6	53.1	50.9	48.9
22	03:46	04:46	19.4	18.6	6.2	2.6	57.7	55.5	49.1
23	04:47	05:47	20.0	19.3	6.2	2.5	59.5	57.4	49.2
24	05:48	06:48	19.8	19.0	6.2	2.5	58.6	56.4	50.3
25	06:49	07:49	20.5	19.8	6.3	2.5	61.3	59.1	51.2
26	07:50	08:50	20.6	19.9	6.4	2.5	62.0	59.8	50.1
27	08:51	09:51	21.6	20.8	6.3	2.5	64.4	62.2	51.4
28	10:45	11:45	21.6	20.9	6.3	2.5	64.6	62.4	60.7
29	11:46	12:46	22.9	22.2	6.2	2.2	67.7	65.6	61.9
30	12:47	13:47	21.2	20.4	6.2	2.0	62.4	60.3	59.2
31	13:48	14:48	19.7	18.9	6.1	2.1	57.9	55.7	56.7
32	14:49	15:49	17.5	16.8	6.0	2.2	51.0	48.9	57.6
33	15:50	16:50	17.1	16.3	6.0	2.2	49.9	47.7	57.9
34	16:51	17:51	16.5	15.7	6.1	2.2	48.5	46.3	56.5
35	17:52	18:52	16.2	15.4	6.1	2.1	47.7	45.5	56.3
36	18:53	19:53	14.7	13.9	6.1	2.0	43.0	40.8	52.8
37	19:54	20:54	13.6	12.8	6.1	2.1	39.9	37.7	49.7
38	20:55	21:55	13.8	13.1	6.2	2.1	40.9	38.7	51.3
39	21:56	22:56	16.6	15.9	6.3	2.2	49.7	47.5	57.3
40	22:57	23:57	18.8	18.1	6.3	2.1	55.9	53.7	63.2
41	23:58	00:58	21.9	21.1	6.1	2.0	64.2	62.1	72.5
42	00:59	01:59	21.8	21.1	5.9	2.0	63.0	60.9	74.2
43	02:00	03:00	17.3	16.6	6.0	2.0	50.3	48.1	62.1
44	03:01	04:01	15.7	15.0	6.1	2.0	46.1	43.9	56.1
45	04:02	05:02	15.7	15.0	6.3	2.1	46.7	44.4	56.1
46	05:03	06:03	17.5	16.8	6.3	2.2	52.2	50.0	61.2
47	06:04	07:04	31.3	30.6	6.3	2.2	93.5	91.4	100.0
48	07:05	08:05	19.0	18.3	6.4	2.0	57.0	54.8	64.4
49	08:06	09:06	17.1	16.3	6.4	2.0	51.4	49.1	60.4
Sum							3083.58		
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



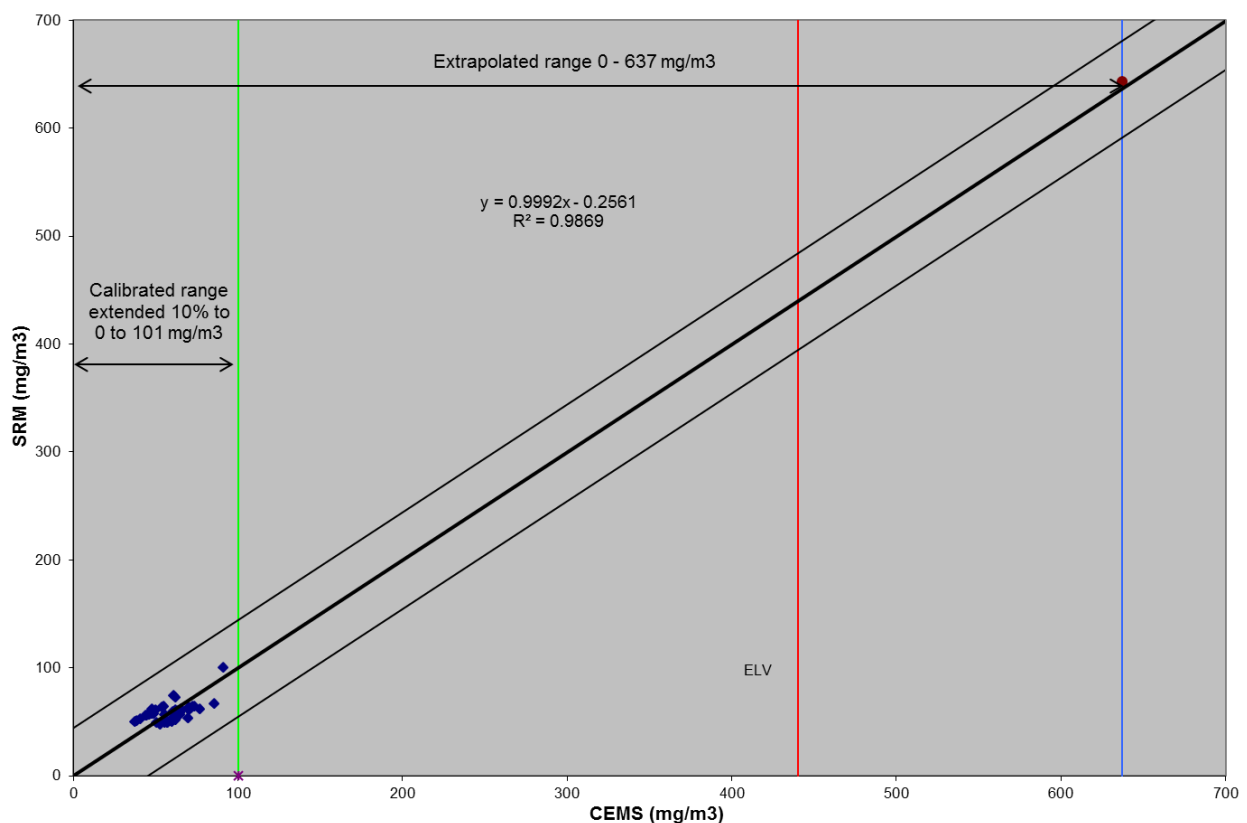
4A1.10.2 Table 4.5.2 – Data used for the Variability Test – Sulphur Dioxide, Low Range.

Test No	Test 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			
3	12:01	13:01	69.6	53.3	-16.34	-15.80	249.74
4	13:02	14:02	76.8	61.8	-15.06	-14.52	210.89
5	14:03	15:03	85.9	66.4	-19.45	-18.92	357.93
6	11:30	12:30	63.9	60.2	-3.76	-3.23	10.43
7	12:31	13:31	64.7	58.5	-6.20	-5.66	32.05
8	13:32	14:32	65.1	58.9	-6.13	-5.59	31.29
9	14:33	15:33	70.6	61.0	-9.66	-9.12	83.21
10	15:34	16:34	71.6	62.5	-9.02	-8.49	72.09
11	16:35	17:35	72.4	64.5	-7.86	-7.32	53.61
12	17:36	18:36	73.8	64.1	-9.76	-9.23	85.12
13	18:37	19:37	64.7	56.7	-7.98	-7.45	55.48
14	19:38	20:38	60.9	53.9	-7.04	-6.51	42.32
15	20:39	21:39	62.3	52.6	-9.73	-9.19	84.51
16	21:40	22:40	60.4	51.5	-8.90	-8.36	69.96
17	22:41	23:41	59.5	50.5	-8.98	-8.44	71.26
18	23:42	00:42	57.1	49.0	-8.08	-7.54	56.86
19	00:43	01:43	53.0	47.2	-5.83	-5.30	28.05
20	01:44	02:44	70.2	63.6	-6.60	-6.06	36.75
21	02:45	03:45	50.9	48.9	-2.02	-1.48	2.20
22	03:46	04:46	55.5	49.1	-6.45	-5.91	34.98
23	04:47	05:47	57.4	49.2	-8.16	-7.62	58.09
24	05:48	06:48	56.4	50.3	-6.11	-5.57	31.06
25	06:49	07:49	59.1	51.2	-7.92	-7.38	54.48
26	07:50	08:50	59.8	50.1	-9.71	-9.17	84.15
27	08:51	09:51	62.2	51.4	-10.80	-10.26	105.29
28	10:45	11:45	62.4	60.7	-1.65	-1.11	1.24
29	11:46	12:46	65.6	61.9	-3.75	-3.21	10.32
30	12:47	13:47	60.3	59.2	-1.07	-0.53	0.28
31	13:48	14:48	55.7	56.7	0.97	1.51	2.27
32	14:49	15:49	48.9	57.6	8.72	9.25	85.60
33	15:50	16:50	47.7	57.9	10.13	10.66	113.73
34	16:51	17:51	46.3	56.5	10.22	10.76	115.69
35	17:52	18:52	45.5	56.3	10.84	11.38	129.46
36	18:53	19:53	40.8	52.8	11.98	12.51	156.58
37	19:54	20:54	37.7	49.7	12.00	12.54	157.16
38	20:55	21:55	38.7	51.3	12.60	13.13	172.52
39	21:56	22:56	47.5	57.3	9.82	10.35	107.14
40	22:57	23:57	53.7	63.2	9.55	10.08	101.69
41	23:58	00:58	62.1	72.5	10.35	10.89	118.53
42	00:59	01:59	60.9	74.2	13.20	13.74	188.71
43	02:00	03:00	48.1	62.1	13.94	14.48	209.54
44	03:01	04:01	43.9	56.1	12.14	12.67	160.56
45	04:02	05:02	44.4	56.1	11.69	12.22	149.44
46	05:03	06:03	50.0	61.2	11.16	11.70	136.88
47	06:04	07:04	91.4	100.0	8.62	9.15	83.77
48	07:05	08:05	54.8	64.4	9.62	10.16	103.20
49	08:06	09:06	49.1	60.4	11.28	11.82	139.65
47 Tests		Mean			-0.53		
Sum							4445.74

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

SD=	Root(1-Number).Integral(D1-D) ²	9.83	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 mg/m3 (s,d,6%O2)/1.96	44.90	mg/m3(s,d),6%O2
For 47 tests, kv =	0.9885		
Therefore variability=	9.83 <= 44.9 * 0.9885		
or	9.83 <=	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	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	21-Oct-16	12:01	13:01	21.78	6.47	2.32	17.71	6.37	2.61	17.7
2	21-Oct-16	13:02	14:02	24.08	6.42	2.32	20.64	6.31	2.54	20.6
3	21-Oct-16	14:03	15:03	26.91	6.39	2.28	22.26	6.30	2.31	22.3
4	24-Oct-16	11:30	12:30	20.44	6.18	2.31	20.42	6.09	2.43	20.4
5	24-Oct-16	12:31	13:31	20.57	6.26	2.32	19.76	6.15	2.55	19.8
6	24-Oct-16	13:32	14:32	20.76	6.18	2.44	20.03	6.02	2.78	20.0
7	24-Oct-16	14:33	15:33	22.53	6.15	2.47	20.80	5.99	2.57	20.8
8	24-Oct-16	15:34	16:34	22.94	6.07	2.50	21.45	5.91	2.56	21.5
9	24-Oct-16	16:35	17:35	23.19	6.09	2.35	22.12	5.94	2.39	22.1
10	24-Oct-16	17:36	18:36	23.67	6.09	2.33	22.00	5.93	2.34	22.0
11	24-Oct-16	18:37	19:37	20.79	6.10	2.35	19.47	5.94	2.34	19.5
12	24-Oct-16	19:38	20:38	19.58	6.11	2.38	18.45	5.97	2.37	18.4
13	24-Oct-16	20:39	21:39	19.70	6.33	2.47	17.78	6.14	2.45	17.8
14	24-Oct-16	21:40	22:40	19.19	6.29	2.41	17.50	6.09	2.36	17.5
15	24-Oct-16	22:41	23:41	18.99	6.22	2.40	17.19	6.06	2.33	17.2
16	24-25/10/2016	23:42	0:42	18.29	6.19	2.40	16.72	6.04	2.31	16.7
17	25-Oct-16	0:43	1:43	17.15	6.07	2.41	16.19	5.94	2.31	16.2
18	25-Oct-16	1:44	2:44	22.99	5.83	2.56	22.13	5.71	2.48	22.1
19	25-Oct-16	2:45	3:45	16.67	5.89	2.56	16.94	5.77	2.49	16.9
20	25-Oct-16	3:46	4:46	17.70	6.25	2.59	16.67	6.08	2.49	16.7
21	25-Oct-16	4:47	5:47	18.30	6.22	2.53	16.71	6.08	2.41	16.7
22	25-Oct-16	5:48	6:48	18.09	6.17	2.47	17.16	6.04	2.34	17.2
23	25-Oct-16	6:49	7:49	18.79	6.27	2.48	17.35	6.12	2.35	17.3
24	25-Oct-16	7:50	8:50	18.88	6.38	2.50	16.87	6.21	2.36	16.9
25	25-Oct-16	8:51	9:51	19.73	6.28	2.55	17.42	6.13	2.41	17.4
26	25-Oct-16	10:45	11:45	19.81	6.27	2.52	20.49	6.17	2.52	20.5
27	25-Oct-16	11:46	12:46	21.00	6.18	2.20	20.91	6.13	2.57	20.9
28	25-Oct-16	12:47	13:47	19.39	6.17	1.99	20.12	6.06	2.56	20.1
29	25-Oct-16	13:48	14:48	18.00	6.13	2.07	19.27	6.04	2.61	19.3
30	25-Oct-16	14:49	15:49	16.01	5.96	2.17	19.74	5.88	2.80	19.7
31	25-Oct-16	15:50	16:50	15.59	6.03	2.17	19.75	5.96	2.80	19.7
32	25-Oct-16	16:51	17:51	15.06	6.10	2.18	19.20	6.02	2.79	19.2
33	25-Oct-16	17:52	18:52	14.78	6.14	2.13	19.12	6.04	2.72	19.1
34	25-Oct-16	18:53	19:53	13.39	6.10	2.04	17.99	6.02	2.56	18.0
35	25-Oct-16	19:54	20:54	12.37	6.12	2.06	16.89	6.04	2.60	16.9
36	25-Oct-16	20:55	21:55	12.63	6.19	2.07	17.34	6.11	2.60	17.3
37	25-Oct-16	21:56	22:56	15.20	6.32	2.17	19.23	6.20	2.72	19.2
38	25-Oct-16	22:57	23:57	17.18	6.27	2.08	21.28	6.18	2.66	21.3
39	25-26/10/2016	23:58	0:58	20.02	6.11	2.04	24.64	6.04	2.59	24.6
40	26-Oct-16	0:59	1:59	20.00	5.85	2.01	25.54	5.85	2.57	25.5
41	26-Oct-16	2:00	3:00	15.82	5.96	1.99	21.37	5.86	2.55	21.4
42	26-Oct-16	3:01	4:01	14.36	6.09	1.99	19.10	6.02	2.55	19.1
43	26-Oct-16	4:02	5:02	14.34	6.27	2.07	18.84	6.23	2.63	18.8
44	26-Oct-16	5:03	6:03	16.04	6.28	2.16	20.55	6.19	2.77	20.6
45	26-Oct-16	6:04	7:04	29.16	6.34	2.16	33.46	6.25	2.77	33.5
46	26-Oct-16	7:05	8:05	17.40	6.41	2.00	21.48	6.33	2.54	21.5
47	26-Oct-16	8:06	9:06	15.62	6.44	2.03	20.06	6.38	2.59	20.1

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

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

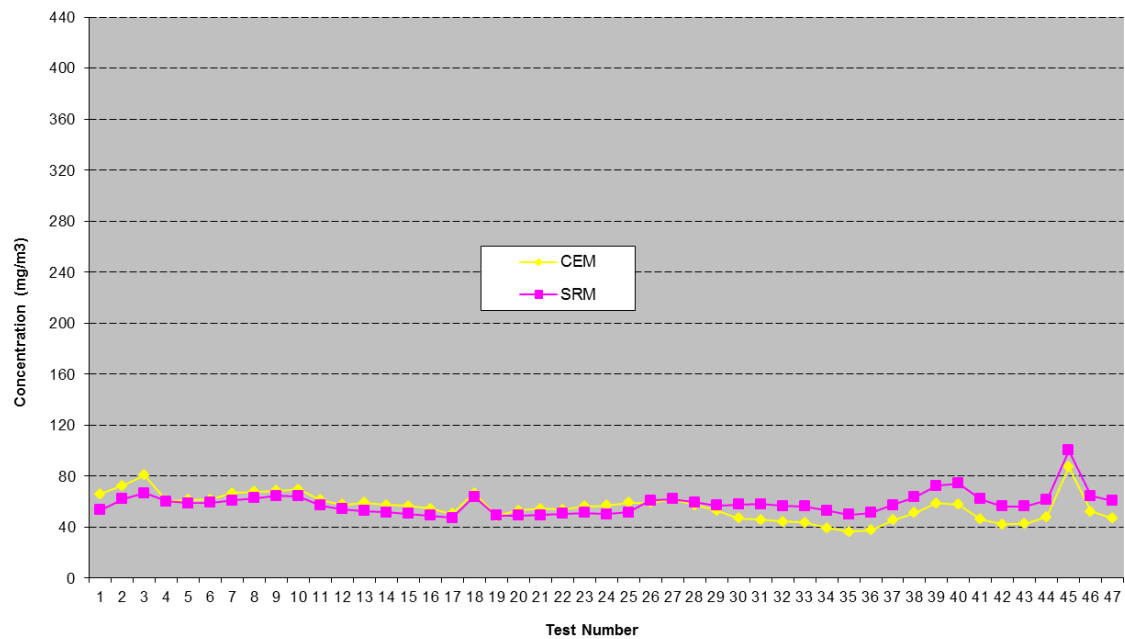
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(SO ₂ mg/m ³)	(SO ₂ mg/m ³)	(mg/m ³)
1	21-Oct-16	12:01	13:01	65.8	53.3	2.4
2	21-Oct-16	13:02	14:02	72.5	61.8	2.8
3	21-Oct-16	14:03	15:03	80.8	66.4	3.0
4	24-Oct-16	11:30	12:30	60.5	60.2	2.7
5	24-Oct-16	12:31	13:31	61.2	58.5	2.6
6	24-Oct-16	13:32	14:32	61.6	58.9	2.6
7	24-Oct-16	14:33	15:33	66.7	61.0	2.7
8	24-Oct-16	15:34	16:34	67.5	62.5	2.8
9	24-Oct-16	16:35	17:35	68.3	64.5	2.9
10	24-Oct-16	17:36	18:36	69.6	64.1	2.9
11	24-Oct-16	18:37	19:37	61.2	56.7	2.5
12	24-Oct-16	19:38	20:38	57.7	53.9	2.4
13	24-Oct-16	20:39	21:39	59.0	52.6	2.4
14	24-Oct-16	21:40	22:40	57.3	51.5	2.3
15	24-Oct-16	22:41	23:41	56.4	50.5	2.3
16	24-25/10/2016	23:42	0:42	54.2	49.0	2.2
17	25-Oct-16	0:43	1:43	50.5	47.2	2.1
18	25-Oct-16	1:44	2:44	66.6	63.6	2.9
19	25-Oct-16	2:45	3:45	48.5	48.9	2.2
20	25-Oct-16	3:46	4:46	52.8	49.1	2.2
21	25-Oct-16	4:47	5:47	54.5	49.2	2.2
22	25-Oct-16	5:48	6:48	53.6	50.3	2.3
23	25-Oct-16	6:49	7:49	56.1	51.2	2.3
24	25-Oct-16	7:50	8:50	56.8	50.1	2.3
25	25-Oct-16	8:51	9:51	59.0	51.4	2.3
26	25-Oct-16	10:45	11:45	59.1	60.7	2.7
27	25-Oct-16	11:46	12:46	62.1	61.9	2.8
28	25-Oct-16	12:47	13:47	57.2	59.2	2.7
29	25-Oct-16	13:48	14:48	53.0	56.7	2.5
30	25-Oct-16	14:49	15:49	46.6	57.6	2.6
31	25-Oct-16	15:50	16:50	45.6	57.9	2.6
32	25-Oct-16	16:51	17:51	44.3	56.5	2.5
33	25-Oct-16	17:52	18:52	43.6	56.3	2.5
34	25-Oct-16	18:53	19:53	39.3	52.8	2.4
35	25-Oct-16	19:54	20:54	36.4	49.7	2.2
36	25-Oct-16	20:55	21:55	37.3	51.3	2.3
37	25-Oct-16	21:56	22:56	45.4	57.3	2.6
38	25-Oct-16	22:57	23:57	51.1	63.2	2.8
39	25-26/10/2016	23:58	0:58	58.8	72.5	3.3
40	26-Oct-16	0:59	1:59	57.7	74.1	3.3
41	26-Oct-16	2:00	3:00	46.0	62.1	2.8
42	26-Oct-16	3:01	4:01	42.1	56.1	2.5
43	26-Oct-16	4:02	5:02	42.6	56.1	2.5
44	26-Oct-16	5:03	6:03	47.7	61.2	2.7
45	26-Oct-16	6:04	7:04	87.2	100.0	4.5
46	26-Oct-16	7:05	8:05	52.2	64.4	2.9
47	26-Oct-16	8:06	9:06	46.9	60.4	2.7

Note:

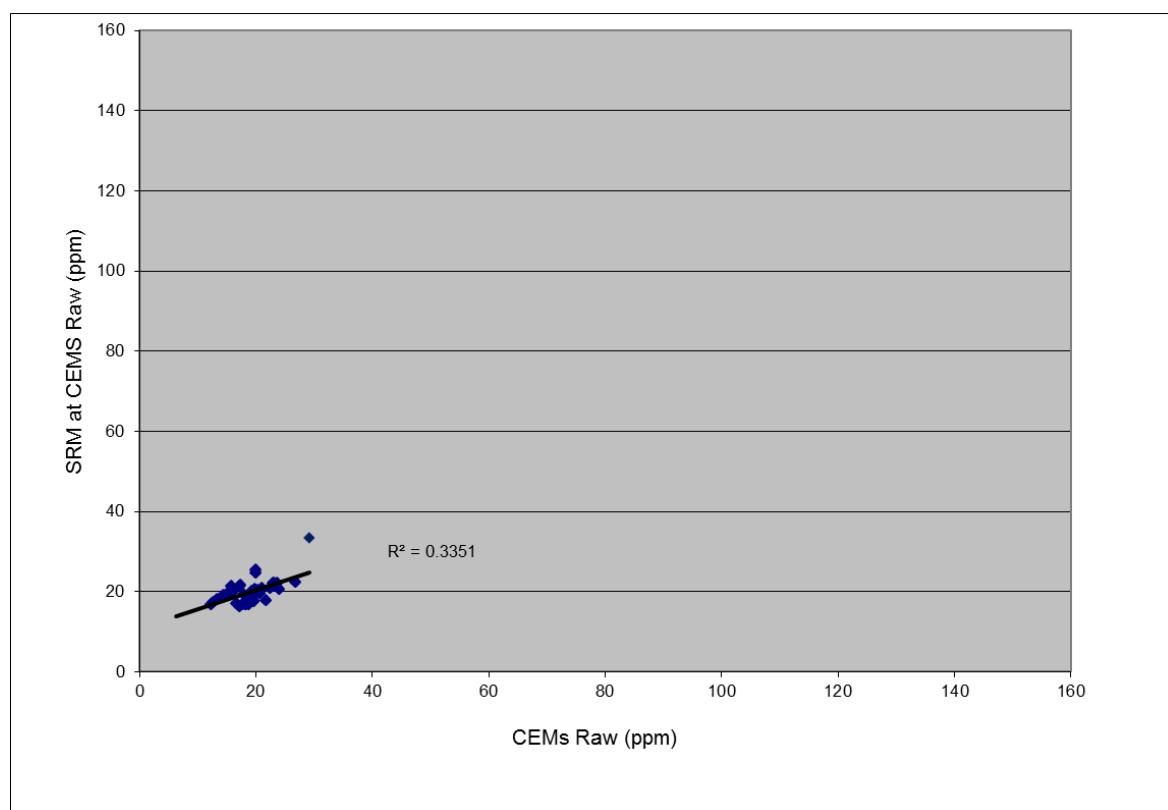
Emission concentrations expressed at reference conditions 273K,

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.



4A1.4.3 (Cont...) – 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 - Di	Is Result an Outlier - Di - Di > 2SD
	hr:min		(ppm)	(ppm)			
1	12:01	13:01	21.8	17.7	-4.07	-4.99	No
2	13:02	14:02	24.1	20.6	-3.44	-4.36	No
3	14:03	15:03	26.9	22.3	-4.65	-5.57	No
4	11:30	12:30	20.4	20.4	-0.02	-0.94	No
5	12:31	13:31	20.6	19.8	-0.81	-1.73	No
6	13:32	14:32	20.8	20.0	-0.73	-1.65	No
7	14:33	15:33	22.5	20.8	-1.72	-2.64	No
8	15:34	16:34	22.9	21.5	-1.49	-2.41	No
9	16:35	17:35	23.2	22.1	-1.07	-1.99	No
10	17:36	18:36	23.7	22.0	-1.67	-2.59	No
11	18:37	19:37	20.8	19.5	-1.32	-2.24	No
12	19:38	20:38	19.6	18.4	-1.13	-2.05	No
13	20:39	21:39	19.7	17.8	-1.92	-2.84	No
14	21:40	22:40	19.2	17.5	-1.69	-2.61	No
15	22:41	23:41	19.0	17.2	-1.80	-2.72	No
16	23:42	00:42	18.3	16.7	-1.58	-2.49	No
17	00:43	01:43	17.2	16.2	-0.96	-1.88	No
18	01:44	02:44	23.0	22.1	-0.86	-1.78	No
19	02:45	03:45	16.7	16.9	0.27	-0.65	No
20	03:46	04:46	17.7	16.7	-1.04	-1.95	No
21	04:47	05:47	18.3	16.7	-1.59	-2.51	No
22	05:48	06:48	18.1	17.2	-0.93	-1.85	No
23	06:49	07:49	18.8	17.3	-1.44	-2.36	No
24	07:50	08:50	18.9	16.9	-2.01	-2.92	No
25	08:51	09:51	19.7	17.4	-2.31	-3.23	No
26	10:45	11:45	19.8	20.5	0.68	-0.24	No
27	11:46	12:46	21.0	20.9	-0.09	-1.01	No
28	12:47	13:47	19.4	20.1	0.73	-0.19	No
29	13:48	14:48	18.0	19.3	1.27	0.35	No
30	14:49	15:49	16.0	19.7	3.73	2.81	No
31	15:50	16:50	15.6	19.7	4.16	3.24	No
32	16:51	17:51	15.1	19.2	4.14	3.22	No
33	17:52	18:52	14.8	19.1	4.34	3.42	No
34	18:53	19:53	13.4	18.0	4.59	3.67	No
35	19:54	20:54	12.4	16.9	4.52	3.60	No
36	20:55	21:55	12.6	17.3	4.72	3.80	No
37	21:56	22:56	15.2	19.2	4.03	3.11	No
38	22:57	23:57	17.2	21.3	4.09	3.17	No
39	23:58	00:58	20.0	24.6	4.61	3.69	No
40	00:59	01:59	20.0	25.5	5.54	4.62	No
41	02:00	03:00	15.8	21.4	5.55	4.63	No
42	03:01	04:01	14.4	19.1	4.74	3.82	No
43	04:02	05:02	14.3	18.8	4.50	3.58	No
44	05:03	06:03	16.0	20.6	4.52	3.60	No
45	06:04	07:04	29.2	33.5	4.30	3.38	No
46	07:05	08:05	17.4	21.5	4.09	3.17	No
47	08:06	09:06	15.6	20.1	4.44	3.52	No
				Average Di	0.92		
			Standard Deviation		3.02		
			Standard Deviation x2		6.05		

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

Test No	Test Start Time	Test End Time	SRM measured value (y)	SRM O2	SRM Standardised
	hr:min		(ppm)	(%)	(mg/m3)
1	12:01	13:01	17.7	6.4	53.3
2	13:02	14:02	20.6	6.3	61.8
3	14:03	15:03	22.3	6.3	66.4
4	11:30	12:30	20.4	6.1	60.2
5	12:31	13:31	19.8	6.2	58.5
6	13:32	14:32	20.0	6.0	58.9
7	14:33	15:33	20.8	6.0	61.0
8	15:34	16:34	21.5	5.9	62.5
9	16:35	17:35	22.1	5.9	64.5
10	17:36	18:36	22.0	5.9	64.1
11	18:37	19:37	19.5	5.9	56.7
12	19:38	20:38	18.4	6.0	53.9
13	20:39	21:39	17.8	6.1	52.6
14	21:40	22:40	17.5	6.1	51.5
15	22:41	23:41	17.2	6.1	50.5
16	23:42	0:42	16.7	6.0	49.0
17	0:43	1:43	16.2	5.9	47.2
18	1:44	2:44	22.1	5.7	63.6
19	2:45	3:45	16.9	5.8	48.9
20	3:46	4:46	16.7	6.1	49.1
21	4:47	5:47	16.7	6.1	49.2
22	5:48	6:48	17.2	6.0	50.3
23	6:49	7:49	17.3	6.1	51.2
24	7:50	8:50	16.9	6.2	50.1
25	8:51	9:51	17.4	6.1	51.4
26	10:45	11:45	20.5	6.2	60.7
27	11:46	12:46	20.9	6.1	61.9
28	12:47	13:47	20.1	6.1	59.2
29	13:48	14:48	19.3	6.0	56.7
30	14:49	15:49	19.7	5.9	57.6
31	15:50	16:50	19.7	6.0	57.9
32	16:51	17:51	19.2	6.0	56.5
33	17:52	18:52	19.1	6.0	56.3
34	18:53	19:53	18.0	6.0	52.8
35	19:54	20:54	16.9	6.0	49.7
36	20:55	21:55	17.3	6.1	51.3
37	21:56	22:56	19.2	6.2	57.3
38	22:57	23:57	21.3	6.2	63.2
39	23:58	0:58	24.6	6.0	72.5
40	0:59	1:59	25.5	5.8	74.1
41	2:00	3:00	21.4	5.9	62.1
42	3:01	4:01	19.1	6.0	56.1
43	4:02	5:02	18.8	6.2	56.1
44	5:03	6:03	20.6	6.2	61.2
45	6:04	7:04	33.5	6.3	100.0
46	7:05	8:05	21.5	6.3	64.4
47	8:06	9:06	20.1	6.4	60.4
Sum			928.10		
Emission Limit Value (ELV) =		440	mg/Nm ³	Y _{max}	100.01
Maximum Permissible uncertainty =		20	%	Y _{min}	47.17
Maximum Permissible uncertainty (at I		88	mg/Nm ³		
15% of the ELV =		66	mg/Nm ³		
Is Ymax - Ymin > MPU at ELV?		No		Y _{max} - Y _{min}	52.85
Is Ymin > 15% of ELV?		No			

Derivation of Calibration Function	Method C
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4A1.6.3 Table 4.3.3 - Data used to derive calibration function - Sulphur Dioxide, High Range.

Test No	Test Start Time	Test End Time	SRM measured value (y)	CEMS measured signal (x)	Yi	Xi	Xi * Yi	Xi ²	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference Zero		0.0	-0.7	-37.31	-37.31	1391.89	1391.89	
2	Reference Span		900.0	912.0	862.69	875.34	755150.39	766223.60	
3	12:01	13:01	17.7	21.8	-19.60	-14.88	291.56	221.34	
4	13:02	14:02	20.6	24.1	-16.67	-12.58	209.66	158.26	
5	14:03	15:03	22.3	26.9	-15.05	-9.75	146.78	95.08	
6	11:30	12:30	20.4	20.4	-16.89	-16.22	273.93	262.98	
7	12:31	13:31	19.8	20.6	-17.55	-16.09	282.40	258.85	
8	13:32	14:32	20.0	20.8	-17.28	-15.89	274.58	252.61	
9	14:33	15:33	20.8	22.5	-16.51	-14.13	233.30	199.73	
10	15:34	16:34	21.5	22.9	-15.86	-13.72	217.53	188.18	
11	16:35	17:35	22.1	23.2	-15.19	-13.47	204.49	181.34	
12	17:36	18:36	22.0	23.7	-15.31	-12.99	198.89	168.70	
13	18:37	19:37	19.5	20.8	-17.84	-15.87	283.04	251.75	
14	19:38	20:38	18.4	19.6	-18.86	-17.08	322.22	291.79	
15	20:39	21:39	17.8	19.7	-19.53	-16.96	331.20	287.60	
16	21:40	22:40	17.5	19.2	-19.81	-17.47	346.06	305.19	
17	22:41	23:41	17.2	19.0	-20.12	-17.67	355.53	312.17	
18	23:42	0:42	16.7	18.3	-20.59	-18.36	378.10	337.23	
19	0:43	1:43	16.2	17.2	-21.11	-19.50	411.79	380.38	
20	1:44	2:44	22.1	23.0	-15.18	-13.66	207.36	186.70	
21	2:45	3:45	16.9	16.7	-20.37	-19.99	407.12	399.54	
22	3:46	4:46	16.7	17.7	-20.64	-18.96	391.34	359.39	
23	4:47	5:47	16.7	18.3	-20.60	-18.35	377.99	336.85	
24	5:48	6:48	17.2	18.1	-20.14	-18.57	374.03	344.74	
25	6:49	7:49	17.3	18.8	-19.96	-17.87	356.68	319.26	
26	7:50	8:50	16.9	18.9	-20.43	-17.78	363.26	316.06	
27	8:51	9:51	17.4	19.7	-19.89	-16.93	336.65	286.57	
28	10:45	11:45	20.5	19.8	-16.82	-16.85	283.50	284.02	
29	11:46	12:46	20.9	21.0	-16.40	-15.66	256.77	245.24	
30	12:47	13:47	20.1	19.4	-17.19	-17.27	296.86	298.24	
31	13:48	14:48	19.3	18.0	-18.03	-18.65	336.38	347.94	
32	14:49	15:49	19.7	16.0	-17.56	-20.65	362.63	426.27	
33	15:50	16:50	19.7	15.6	-17.56	-21.07	370.06	443.97	
34	16:51	17:51	19.2	15.1	-18.11	-21.60	391.19	466.65	
35	17:52	18:52	19.1	14.8	-18.19	-21.87	397.80	478.47	
36	18:53	19:53	18.0	13.4	-19.32	-23.27	449.54	541.26	
37	19:54	20:54	16.9	12.4	-20.42	-24.29	496.00	589.88	
38	20:55	21:55	17.3	12.6	-19.96	-24.03	479.74	577.46	
39	21:56	22:56	19.2	15.2	-18.08	-21.45	387.83	460.26	
40	22:57	23:57	21.3	17.2	-16.03	-19.48	312.21	379.28	
41	23:58	0:58	24.6	20.0	-12.67	-16.64	210.81	276.74	
42	0:59	1:59	25.5	20.0	-11.77	-16.66	196.04	277.47	
43	2:00	3:00	21.4	15.8	-15.94	-20.84	332.23	434.40	
44	3:01	4:01	19.1	14.4	-18.21	-22.29	405.92	497.01	
45	4:02	5:02	18.8	14.3	-18.47	-22.31	412.08	497.95	
46	5:03	6:03	20.6	16.0	-16.75	-20.62	345.51	425.26	
47	6:04	7:04	33.5	29.2	-3.85	-7.50	28.84	56.23	
48	7:05	8:05	21.5	17.4	-15.82	-19.26	304.76	370.95	
49	8:06	9:06	20.1	15.6	-17.25	-21.04	362.86	442.64	
Sum			1828.10	1796.24	0.00	0.00	771537.35	783135.37	0.99

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

Method C

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

N	N	N	N		
$b = \sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})$	$\bar{x} = 1/N \sum_{i=1}^N x_i$	$\bar{y} = 1/N \sum_{i=1}^N y_i$		$\bar{x} =$	36.66
				$\bar{y} =$	37.31
				$b =$	0.985
$a = \bar{y} - b\bar{x}$	$a = 37.31 - 36.66 * 0.985$			$a =$	1.193

The calibration is function $y_i = a + b x_i$ or $y_i = 1.193 + 0.985 * x_i$

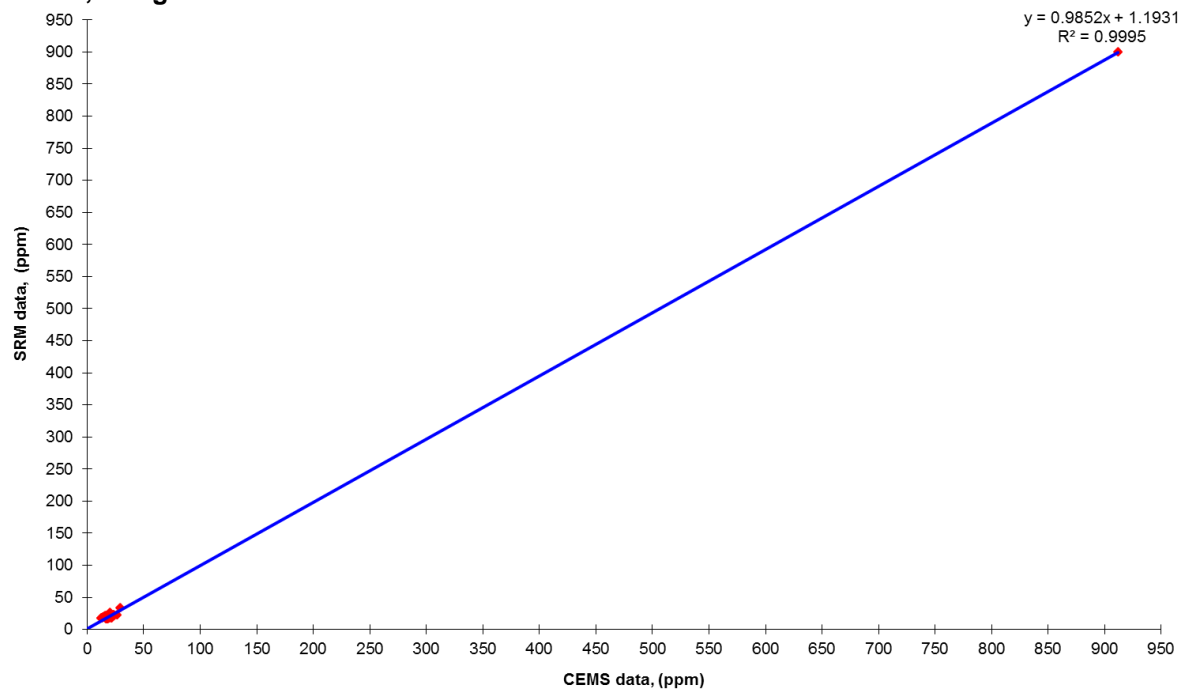
4A1.8.3 Table A.4.4.3 - Calculation of calibrated CEMS values - Sulphur Dioxide, High Range.

Test No	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	Reference Zero		-0.7	0.6	N/A	N/A	-0.7	1.6	0.0
2	Reference Span		912.0	899.7	N/A	N/A	912.0	2570.5	2571.4
3	12:01	13:01	21.8	22.7	6.5	2.3	65.8	68.4	53.3
4	13:02	14:02	24.1	24.9	6.4	2.3	72.5	75.0	61.8
5	14:03	15:03	26.9	27.7	6.4	2.3	80.8	83.2	66.4
6	11:30	12:30	20.4	21.3	6.2	2.3	60.5	63.1	60.2
7	12:31	13:31	20.6	21.5	6.3	2.3	61.2	63.9	58.5
8	13:32	14:32	20.8	21.6	6.2	2.4	61.6	64.2	58.9
9	14:33	15:33	22.5	23.4	6.2	2.5	66.7	69.2	61.0
10	15:34	16:34	22.9	23.8	6.1	2.5	67.5	70.1	62.5
11	16:35	17:35	23.2	24.0	6.1	2.3	68.3	70.8	64.5
12	17:36	18:36	23.7	24.5	6.1	2.3	69.6	72.1	64.1
13	18:37	19:37	20.8	21.7	6.1	2.3	61.2	63.8	56.7
14	19:38	20:38	19.6	20.5	6.1	2.4	57.7	60.4	53.9
15	20:39	21:39	19.7	20.6	6.3	2.5	59.0	61.7	52.6
16	21:40	22:40	19.2	20.1	6.3	2.4	57.3	60.0	51.5
17	22:41	23:41	19.0	19.9	6.2	2.4	56.4	59.1	50.5
18	23:42	00:42	18.3	19.2	6.2	2.4	54.2	57.0	49.0
19	00:43	01:43	17.2	18.1	6.1	2.4	50.5	53.2	47.2
20	01:44	02:44	23.0	23.8	5.8	2.6	66.6	69.1	63.6
21	02:45	03:45	16.7	17.6	5.9	2.6	48.5	51.3	48.9
22	03:46	04:46	17.7	18.6	6.2	2.6	52.8	55.6	49.1
23	04:47	05:47	18.3	19.2	6.2	2.5	54.5	57.2	49.2
24	05:48	06:48	18.1	19.0	6.2	2.5	53.6	56.4	50.3
25	06:49	07:49	18.8	19.7	6.3	2.5	56.1	58.8	51.2
26	07:50	08:50	18.9	19.8	6.4	2.5	56.8	59.5	50.1
27	08:51	09:51	19.7	20.6	6.3	2.5	59.0	61.7	51.4
28	10:45	11:45	19.8	20.7	6.3	2.5	59.1	61.8	60.7
29	11:46	12:46	21.0	21.9	6.2	2.2	62.1	64.7	61.9
30	12:47	13:47	19.4	20.3	6.2	2.0	57.2	59.8	59.2
31	13:48	14:48	18.0	18.9	6.1	2.1	53.0	55.7	56.7
32	14:49	15:49	16.0	17.0	6.0	2.2	46.6	49.4	57.6
33	15:50	16:50	15.6	16.5	6.0	2.2	45.6	48.4	57.9
34	16:51	17:51	15.1	16.0	6.1	2.2	44.3	47.1	56.5
35	17:52	18:52	14.8	15.8	6.1	2.1	43.6	46.4	56.3
36	18:53	19:53	13.4	14.4	6.1	2.0	39.3	42.2	52.8
37	19:54	20:54	12.4	13.4	6.1	2.1	36.4	39.4	49.7
38	20:55	21:55	12.6	13.6	6.2	2.1	37.3	40.3	51.3
39	21:56	22:56	15.2	16.2	6.3	2.2	45.4	48.3	57.3
40	22:57	23:57	17.2	18.1	6.3	2.1	51.1	53.9	63.2
41	23:58	00:58	20.0	20.9	6.1	2.0	58.8	61.5	72.5
42	00:59	01:59	20.0	20.9	5.9	2.0	57.7	60.3	74.1
43	02:00	03:00	15.8	16.8	6.0	2.0	46.0	48.8	62.1
44	03:01	04:01	14.4	15.3	6.1	2.0	42.1	45.0	56.1
45	04:02	05:02	14.3	15.3	6.3	2.1	42.6	45.5	56.1
46	05:03	06:03	16.0	17.0	6.3	2.2	47.7	50.6	61.2
47	06:04	07:04	29.2	29.9	6.3	2.2	87.2	89.4	100.0
48	07:05	08:05	17.4	18.3	6.4	2.0	52.2	55.0	64.4
49	08:06	09:06	15.6	16.6	6.4	2.0	46.9	49.8	60.4
Sum							3532.38		
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.



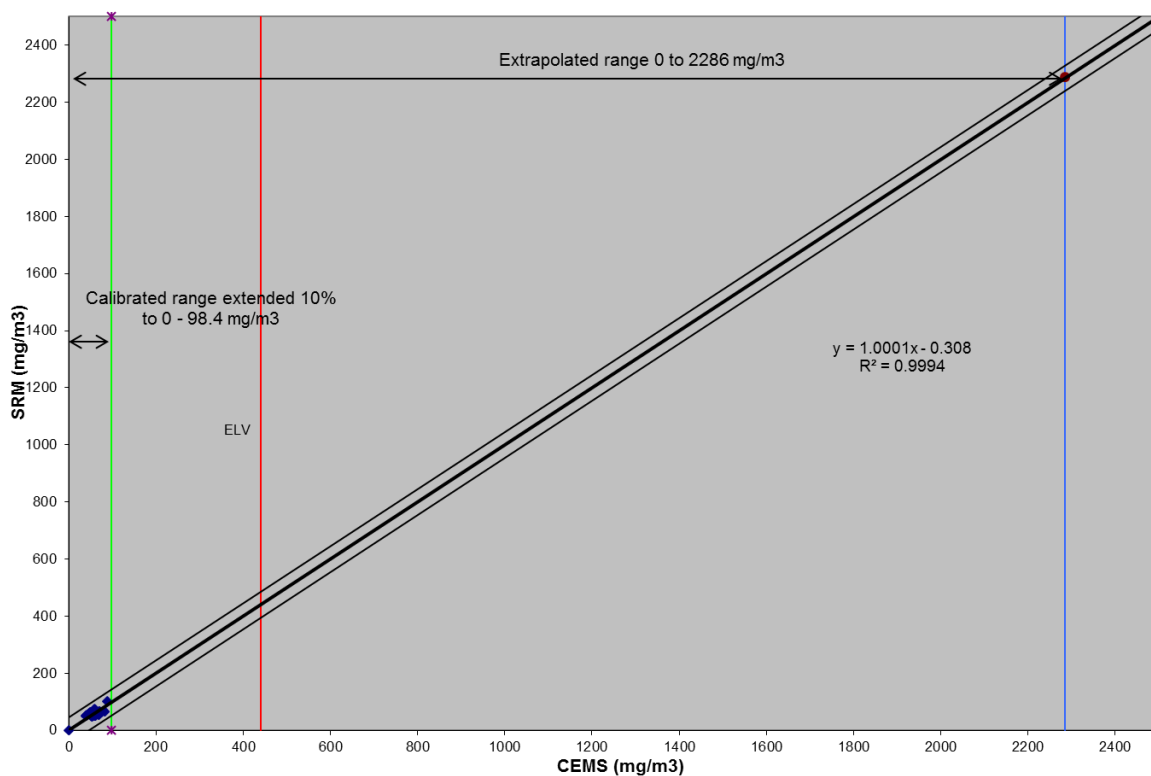
4A1.10.3 Table 4.5.3 – Data used for the Variability Test – Sulphur Dioxide, High Range.

Test No	Test 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			
3	12:01	13:01	68.4	53.3	-15.17	-14.87	221.17
4	13:02	14:02	75.0	61.8	-13.20	-12.90	166.31
5	14:03	15:03	83.2	66.4	-16.77	-16.47	271.29
6	11:30	12:30	63.1	60.2	-2.98	-2.68	7.19
7	12:31	13:31	63.9	58.5	-5.37	-5.08	25.76
8	13:32	14:32	64.2	58.9	-5.27	-4.97	24.70
9	14:33	15:33	69.2	61.0	-8.26	-7.96	63.37
10	15:34	16:34	70.1	62.5	-7.52	-7.22	52.14
11	16:35	17:35	70.8	64.5	-6.27	-5.98	35.70
12	17:36	18:36	72.1	64.1	-8.06	-7.76	60.19
13	18:37	19:37	63.8	56.7	-7.12	-6.83	46.59
14	19:38	20:38	60.4	53.9	-6.53	-6.23	38.78
15	20:39	21:39	61.7	52.6	-9.15	-8.86	78.41
16	21:40	22:40	60.0	51.5	-8.49	-8.19	67.13
17	22:41	23:41	59.1	50.5	-8.65	-8.35	69.76
18	23:42	00:42	57.0	49.0	-7.95	-7.65	58.58
19	00:43	01:43	53.2	47.2	-6.06	-5.76	33.21
20	01:44	02:44	69.1	63.6	-5.51	-5.21	27.11
21	02:45	03:45	51.3	48.9	-2.40	-2.10	4.39
22	03:46	04:46	55.6	49.1	-6.49	-6.19	38.28
23	04:47	05:47	57.2	49.2	-8.02	-7.72	59.58
24	05:48	06:48	56.4	50.3	-6.03	-5.73	32.82
25	06:49	07:49	58.8	51.2	-7.63	-7.34	53.80
26	07:50	08:50	59.5	50.1	-9.41	-9.12	83.10
27	08:51	09:51	61.7	51.4	-10.21	-9.91	98.30
28	10:45	11:45	61.8	60.7	-1.06	-0.76	0.58
29	11:46	12:46	64.7	61.9	-2.84	-2.54	6.45
30	12:47	13:47	59.8	59.2	-0.62	-0.32	0.10
31	13:48	14:48	55.7	56.7	1.00	1.30	1.70
32	14:49	15:49	49.4	57.6	8.15	8.45	71.40
33	15:50	16:50	48.4	57.9	9.43	9.73	94.59
34	16:51	17:51	47.1	56.5	9.36	9.66	93.23
35	17:52	18:52	46.4	56.3	9.90	10.20	104.07
36	18:53	19:53	42.2	52.8	10.58	10.87	118.25
37	19:54	20:54	39.4	49.7	10.29	10.59	112.19
38	20:55	21:55	40.3	51.3	10.96	11.26	126.87
39	21:56	22:56	48.3	57.3	8.99	9.29	86.32
40	22:57	23:57	53.9	63.2	9.36	9.66	93.24
41	23:58	00:58	61.5	72.5	10.99	11.29	127.54
42	00:59	01:59	60.3	74.1	13.82	14.12	199.33
43	02:00	03:00	48.8	62.1	13.30	13.60	185.06
44	03:01	04:01	45.0	56.1	11.05	11.34	128.71
45	04:02	05:02	45.5	56.1	10.60	10.90	118.88
46	05:03	06:03	50.6	61.2	10.60	10.90	118.77
47	06:04	07:04	89.4	100.0	10.59	10.89	118.52
48	07:05	08:05	55.0	64.4	9.46	9.76	95.26
49	08:06	09:06	49.8	60.4	10.56	10.86	117.90
47 Tests		Mean			-0.30		
Sum							3836.63

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

SD=	Root(1-Number).Integral(D1-D) ²	9.13	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 mg/m3 (s,d,6%O2)/1.96	44.90	mg/m3(s,d),6%O2
For 47 tests, kv =	0.9885		
Therefore variability=	9.13 <= 44.9 * 0.9885		
or	9.13 <=	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 7, Procal 2

4A2.1 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		NO (ppm)	(%)	(%)	NOx (ppm)	(%)	(%)	NOx (ppm)
1	21-Oct-16	11:00	12:00	332.17	6.63	2.32	371.64	6.47	2.40	362.7
2	21-Oct-16	12:01	13:01	318.88	6.47	2.31	349.00	6.37	2.61	339.9
3	21-Oct-16	13:02	14:02	311.58	6.42	2.10	347.90	6.31	2.54	339.1
4	21-Oct-16	14:03	15:03	323.69	6.39	2.06	358.81	6.30	2.31	350.5
5	24-Oct-16	11:30	12:30	344.24	6.18	1.96	380.47	6.09	2.43	371.2
6	24-Oct-16	12:31	13:31	326.52	6.26	1.53	368.79	6.15	2.55	359.4
7	24-Oct-16	13:32	14:32	318.74	6.18	2.03	354.97	6.02	2.78	345.1
8	24-Oct-16	14:33	15:33	317.78	6.15	2.18	349.27	5.99	2.57	340.3
9	24-Oct-16	15:34	16:34	310.45	6.07	2.21	341.42	5.91	2.56	332.7
10	24-Oct-16	16:35	17:35	305.16	6.09	2.20	333.14	5.94	2.39	325.2
11	24-Oct-16	17:36	18:36	307.23	6.09	2.18	334.52	5.93	2.34	326.7
12	24-Oct-16	18:37	19:37	312.33	6.10	2.17	340.84	5.94	2.34	332.9
13	24-Oct-16	19:38	20:38	312.30	6.11	2.15	342.47	5.97	2.37	334.3
14	24-Oct-16	20:39	21:39	317.54	6.33	2.15	347.76	6.14	2.45	339.2
15	24-Oct-16	21:40	22:40	318.37	6.29	2.14	345.01	6.09	2.36	336.9
16	24-Oct-16	22:41	23:41	309.81	6.22	2.13	338.63	6.06	2.33	330.7
17	24-25/10/2016	23:42	0:42	302.97	6.19	2.13	330.70	6.04	2.31	323.1
18	25-Oct-16	0:43	1:43	292.90	6.07	1.92	327.61	5.94	2.31	320.1
19	25-Oct-16	1:44	2:44	301.21	5.83	1.81	335.64	5.71	2.48	327.3
20	25-Oct-16	2:45	3:45	307.55	5.89	1.86	344.28	5.77	2.49	335.7
21	25-Oct-16	3:46	4:46	316.99	6.25	1.85	354.37	6.08	2.49	345.5
22	25-Oct-16	4:47	5:47	315.23	6.22	1.84	350.61	6.08	2.41	342.2
23	25-Oct-16	5:48	6:48	309.44	6.17	1.83	342.16	6.04	2.34	334.2
24	25-Oct-16	6:49	7:49	311.25	6.27	1.82	347.05	6.12	2.35	338.9
25	25-Oct-16	7:50	8:50	326.39	6.38	1.81	368.11	6.21	2.36	359.4
26	25-Oct-16	8:51	9:51	330.38	6.28	1.80	371.64	6.13	2.41	362.7
27	25-Oct-16	10:45	11:45	331.65	6.27	1.79	368.47	6.17	2.52	359.2
28	25-Oct-16	11:46	12:46	331.11	6.18	1.81	368.04	6.13	2.57	358.6
29	25-Oct-16	12:47	13:47	323.70	6.17	1.67	356.72	6.06	2.56	347.6
30	25-Oct-16	13:48	14:48	315.04	6.13	1.61	349.23	6.04	2.61	340.1
31	25-Oct-16	14:49	15:49	302.89	5.96	1.77	336.49	5.88	2.80	327.1
32	25-Oct-16	15:50	16:50	309.98	6.03	1.76	344.52	5.96	2.80	334.9
33	25-Oct-16	16:51	17:51	313.79	6.10	1.76	348.86	6.02	2.79	339.1
34	25-Oct-16	17:52	18:52	316.13	6.14	1.76	352.60	6.04	2.72	343.0
35	25-Oct-16	18:53	19:53	317.46	6.10	1.76	351.24	6.02	2.56	342.2
36	25-Oct-16	19:54	20:54	315.37	6.12	1.75	347.54	6.04	2.60	338.5
37	25-Oct-16	20:55	21:55	308.16	6.19	1.75	342.08	6.11	2.60	333.2
38	25-Oct-16	21:56	22:56	304.49	6.32	1.75	341.26	6.20	2.72	332.0
39	25-Oct-16	22:57	23:57	304.10	6.27	1.73	338.87	6.18	2.66	329.9
40	25-26/10/2016	23:58	0:58	302.03	6.11	1.71	336.32	6.04	2.59	327.6
41	26-Oct-16	0:59	1:59	310.56	5.85	1.48	349.92	5.85	2.57	340.9
42	26-Oct-16	2:00	3:00	325.26	5.96	1.64	364.23	5.86	2.55	355.0
43	26-Oct-16	3:01	4:01	324.85	6.09	1.72	365.12	6.02	2.55	355.8
44	26-Oct-16	4:02	5:02	328.16	6.27	1.77	367.40	6.23	2.63	357.8
45	26-Oct-16	5:03	6:03	325.39	6.28	1.86	367.40	6.19	2.77	357.2
46	26-Oct-16	6:04	7:04	332.54	6.34	1.88	374.05	6.25	2.77	363.7
47	26-Oct-16	7:05	8:05	345.49	6.41	1.76	383.57	6.33	2.54	373.8
48	26-Oct-16	8:06	9:06	343.46	6.44	1.71	379.17	6.38	2.59	369.3

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

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

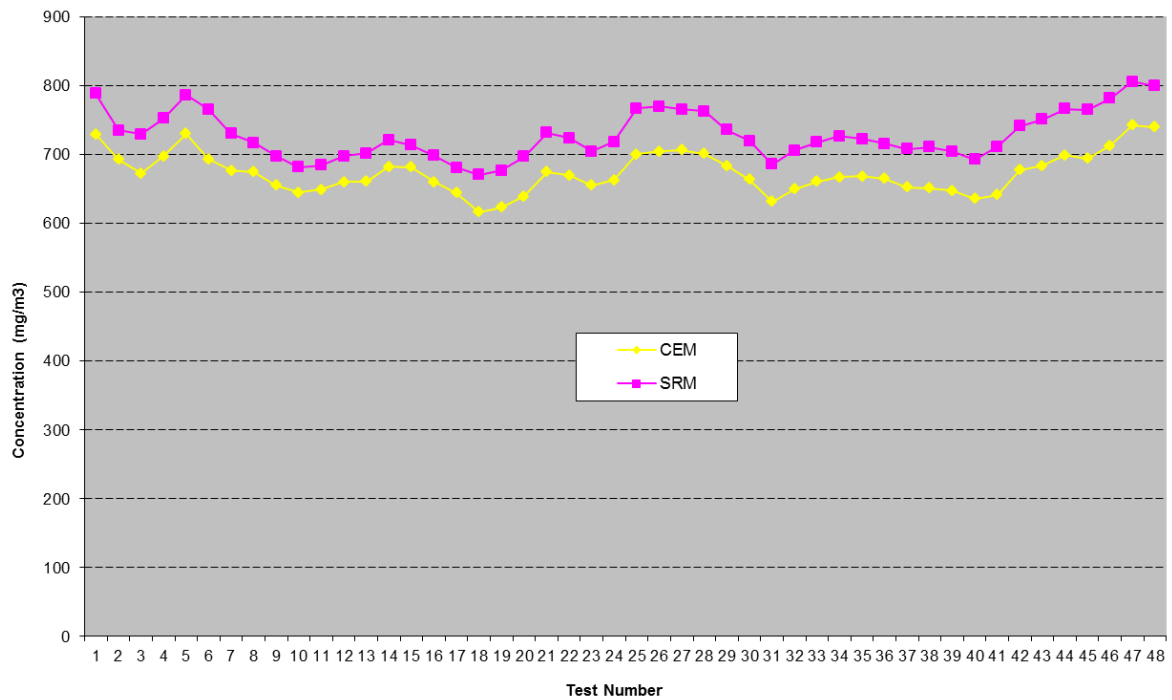
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(NOx as NO2 mg/m3)	(NOx as NO2 mg/m3)	(mg/m3)
1	21-Oct-16	11:00	12:00	729.0	788.1	26
2	21-Oct-16	12:01	13:01	692.4	734.7	24
3	21-Oct-16	13:02	14:02	672.5	729.4	24
4	21-Oct-16	14:03	15:03	697.2	751.9	25
5	24-Oct-16	11:30	12:30	729.7	786.1	26
6	24-Oct-16	12:31	13:31	693.1	765.0	25
7	24-Oct-16	13:32	14:32	676.5	729.7	24
8	24-Oct-16	14:33	15:33	674.2	716.8	23
9	24-Oct-16	15:34	16:34	655.0	697.1	23
10	24-Oct-16	16:35	17:35	644.7	681.4	22
11	24-Oct-16	17:36	18:36	648.8	684.0	22
12	24-Oct-16	18:37	19:37	660.0	697.0	23
13	24-Oct-16	19:38	20:38	660.4	701.8	23
14	24-Oct-16	20:39	21:39	681.7	721.1	24
15	24-Oct-16	21:40	22:40	681.6	713.0	23
16	24-Oct-16	22:41	23:41	659.7	698.1	23
17	24-25/10/2016	23:42	0:42	643.9	680.9	22
18	25-Oct-16	0:43	1:43	616.3	670.1	22
19	25-Oct-16	1:44	2:44	622.7	676.2	22
20	25-Oct-16	2:45	3:45	638.9	696.2	23
21	25-Oct-16	3:46	4:46	674.5	731.5	24
22	25-Oct-16	4:47	5:47	669.5	723.9	24
23	25-Oct-16	5:48	6:48	655.0	704.4	23
24	25-Oct-16	6:49	7:49	662.9	718.3	24
25	25-Oct-16	7:50	8:50	700.2	766.8	25
26	25-Oct-16	8:51	9:51	704.3	769.7	25
27	25-Oct-16	10:45	11:45	706.2	765.3	25
28	25-Oct-16	11:46	12:46	700.8	762.3	25
29	25-Oct-16	12:47	13:47	683.7	735.4	24
30	25-Oct-16	13:48	14:48	663.1	719.2	24
31	25-Oct-16	14:49	15:49	631.4	685.4	22
32	25-Oct-16	15:50	16:50	649.5	705.4	23
33	25-Oct-16	16:51	17:51	660.5	717.2	24
34	25-Oct-16	17:52	18:52	666.9	726.3	24
35	25-Oct-16	18:53	19:53	667.9	722.3	24
36	25-Oct-16	19:54	20:54	664.8	715.5	24
37	25-Oct-16	20:55	21:55	652.5	707.7	23
38	25-Oct-16	21:56	22:56	650.5	710.6	23
39	25-Oct-16	22:57	23:57	647.2	704.3	23
40	25-26/10/2016	23:58	0:58	635.7	692.5	23
41	26-Oct-16	0:59	1:59	640.9	711.4	23
42	26-Oct-16	2:00	3:00	677.2	741.1	24
43	26-Oct-16	3:01	4:01	683.1	750.6	25
44	26-Oct-16	4:02	5:02	698.6	766.1	25
45	26-Oct-16	5:03	6:03	694.1	764.3	25
46	26-Oct-16	6:04	7:04	712.3	781.3	26
47	26-Oct-16	7:05	8:05	742.7	805.8	26
48	26-Oct-16	8:06	9:06	739.6	799.2	26

Note:

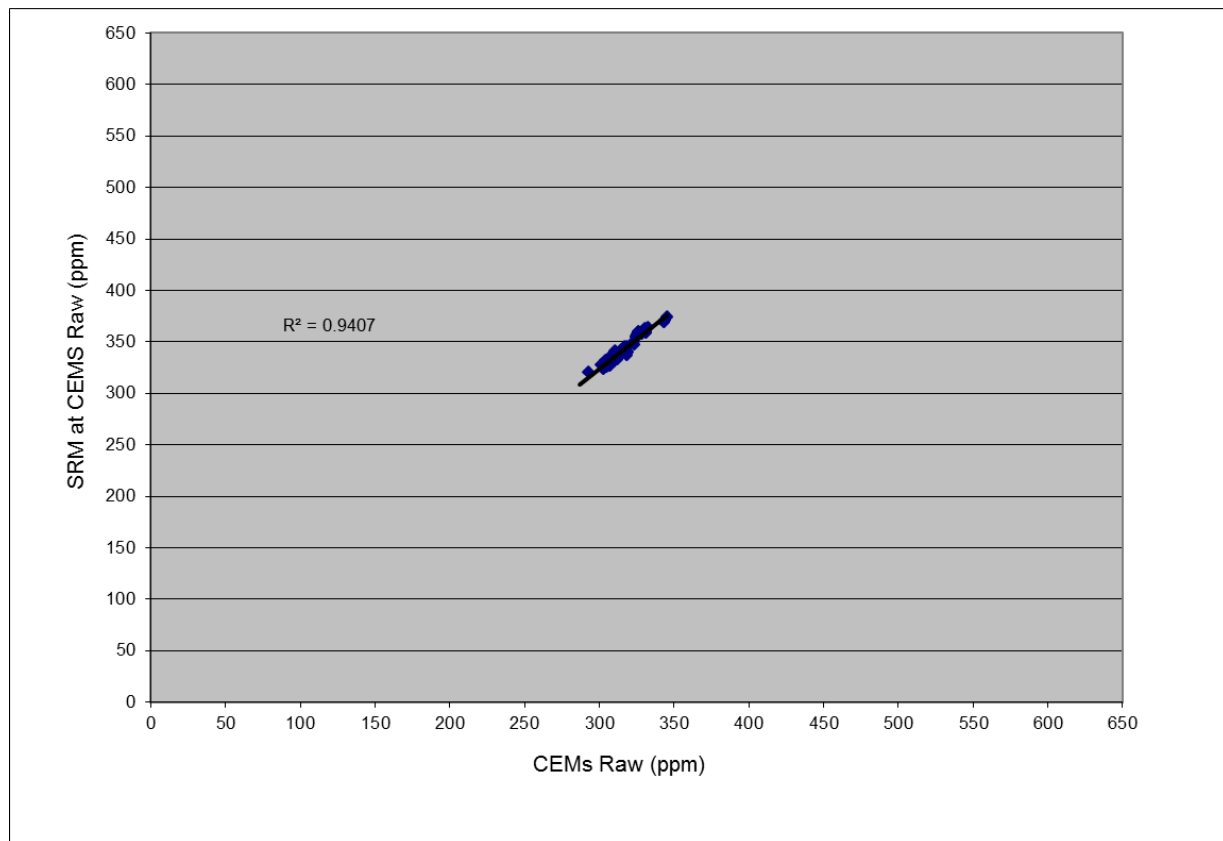
Emission concentrations expressed at reference conditions 273K,

6 % Oxygen, dry gas

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



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



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

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

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

As the R^2 value for this determinand was 0.9407, an outlier test has not been undertaken.

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

Test No	Test Start Time	Test End Time	SRM measured value (y)	SRM O2	SRM Standardised
	hr:min		(ppm)	(%)	(mg/m3)
1	11:00	12:00	371.6	6.5	788.1
2	12:01	13:01	349.0	6.4	734.7
3	13:02	14:02	347.9	6.3	729.4
4	14:03	15:03	358.8	6.3	751.9
5	11:30	12:30	380.5	6.1	786.1
6	12:31	13:31	368.8	6.2	765.0
7	13:32	14:32	355.0	6.0	729.7
8	14:33	15:33	349.3	6.0	716.8
9	15:34	16:34	341.4	5.9	697.1
10	16:35	17:35	333.1	5.9	681.4
11	17:36	18:36	334.5	5.9	684.0
12	18:37	19:37	340.8	5.9	697.0
13	19:38	20:38	342.5	6.0	701.8
14	20:39	21:39	347.8	6.1	721.1
15	21:40	22:40	345.0	6.1	713.0
16	22:41	23:41	338.6	6.1	698.1
17	23:42	0:42	330.7	6.0	680.9
18	0:43	1:43	327.6	5.9	670.1
19	1:44	2:44	335.6	5.7	676.2
20	2:45	3:45	344.3	5.8	696.2
21	3:46	4:46	354.4	6.1	731.5
22	4:47	5:47	350.6	6.1	723.9
23	5:48	6:48	342.2	6.0	704.4
24	6:49	7:49	347.0	6.1	718.3
25	7:50	8:50	368.1	6.2	766.8
26	8:51	9:51	371.6	6.1	769.7
27	10:45	11:45	368.5	6.2	765.3
28	11:46	12:46	368.0	6.1	762.3
29	12:47	13:47	356.7	6.1	735.4
30	13:48	14:48	349.2	6.0	719.2
31	14:49	15:49	336.5	5.9	685.4
32	15:50	16:50	344.5	6.0	705.4
33	16:51	17:51	348.9	6.0	717.2
34	17:52	18:52	352.6	6.0	726.3
35	18:53	19:53	351.2	6.0	722.3
36	19:54	20:54	347.5	6.0	715.5
37	20:55	21:55	342.1	6.1	707.7
38	21:56	22:56	341.3	6.2	710.6
39	22:57	23:57	338.9	6.2	704.3
40	23:58	0:58	336.3	6.0	692.5
41	0:59	1:59	349.9	5.8	711.4
42	2:00	3:00	364.2	5.9	741.1
43	3:01	4:01	365.1	6.0	750.6
44	4:02	5:02	367.4	6.2	766.1
45	5:03	6:03	367.4	6.2	764.3
46	6:04	7:04	374.0	6.3	781.3
47	7:05	8:05	383.6	6.3	805.8
48	8:06	9:06	379.2	6.4	799.2
Sum			16909.87		
Emission Limit Value (ELV) =			1080 mg/Nm ³	Y _{max}	805.77
Maximum Permissible uncertainty =			20 %	Y _{min}	670.06
Maximum Permissible uncertainty (at 1			216 mg/Nm ³		
15% of the ELV =			162 mg/Nm ³		
Is Y _{max} - Y _{min} > MPU at ELV?			No	Y _{max} - Y _{min}	135.71
Is Y _{min} > 15% of ELV?			Yes		

Derivation of Calibration Function	Method B
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4A2.6.1 Table 4.3.1 - Data used to derive calibration function - Oxides of Nitrogen,

Test No	Test Start Time	Test End Time	SRM measured value (y)	CEMS measured signal (x)
	hr:min		(ppm)	(ppm)
1	Reference		0.0	0.3
2	11:00	12:00	362.7	332.2
3	12:01	13:01	339.9	318.9
4	13:02	14:02	339.1	311.6
5	14:03	15:03	350.5	323.7
6	11:30	12:30	371.2	344.2
7	12:31	13:31	359.4	326.5
8	13:32	14:32	345.1	318.7
9	14:33	15:33	340.3	317.8
10	15:34	16:34	332.7	310.5
11	16:35	17:35	325.2	305.2
12	17:36	18:36	326.7	307.2
13	18:37	19:37	332.9	312.3
14	19:38	20:38	334.3	312.3
15	20:39	21:39	339.2	317.5
16	21:40	22:40	336.9	318.4
17	22:41	23:41	330.7	309.8
18	23:42	0:42	323.1	303.0
19	0:43	1:43	320.1	292.9
20	1:44	2:44	327.3	301.2
21	2:45	3:45	335.7	307.5
22	3:46	4:46	345.5	317.0
23	4:47	5:47	342.2	315.2
24	5:48	6:48	334.2	309.4
25	6:49	7:49	338.9	311.2
26	7:50	8:50	359.4	326.4
27	8:51	9:51	362.7	330.4
28	10:45	11:45	359.2	331.6
29	11:46	12:46	358.6	331.1
30	12:47	13:47	347.6	323.7
31	13:48	14:48	340.1	315.0
32	14:49	15:49	327.1	302.9
33	15:50	16:50	334.9	310.0
34	16:51	17:51	339.1	313.8
35	17:52	18:52	343.0	316.1
36	18:53	19:53	342.2	317.5
37	19:54	20:54	338.5	315.4
38	20:55	21:55	333.2	308.2
39	21:56	22:56	332.0	304.5
40	22:57	23:57	329.9	304.1
41	23:58	0:58	327.6	302.0
42	0:59	1:59	340.9	310.6
43	2:00	3:00	355.0	325.3
44	3:01	4:01	355.8	324.9
45	4:02	5:02	357.8	328.2
46	5:03	6:03	357.2	325.4
47	6:04	7:04	363.7	332.5
48	7:05	8:05	373.8	345.5
49	8:06	9:06	369.3	343.5
Sum			16482.24	15233.04

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

Method B

Formulae:- Number of tests conducted = N 49

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

$b = (y / (x - Z))$ $x = (1 / \text{No. AMS Tests}) * \text{Total AMS}$

$x = (1 / 49) * 15233$ or - $x = 310.88$

$a = (-\beta \cdot Z)$ $y = (1 / \text{No. SRM Tests}) * \text{Total SRM}$

$y = (1 / 49) * 16482$ or - $y = 336.37$

The Slope is calculated by :

$\beta = y / (x - Z)$ $336.3 / (310.8 - 0.33)$ $\beta = 1.083$

The offset is calculated by:

$\alpha = -\beta \cdot Z$ $-1.08 * 0.33$ $\alpha = -0.36$

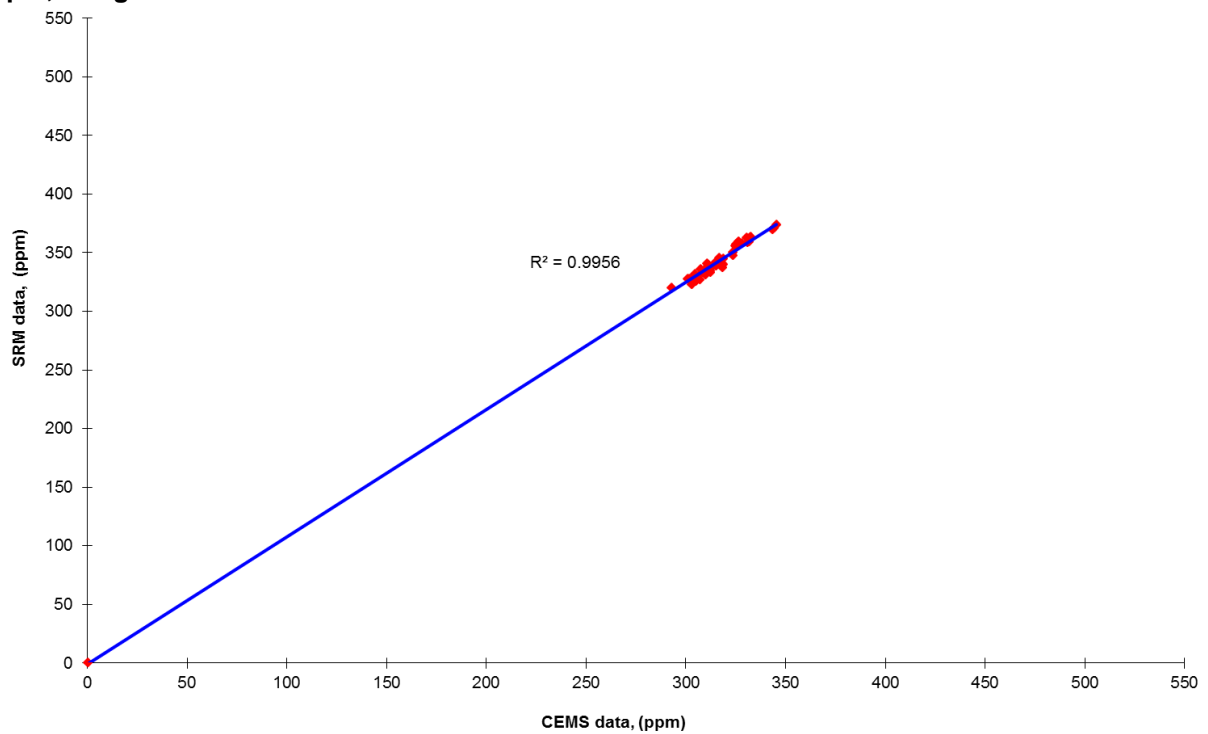
The calibration is function $y_{im} = \alpha + \beta_{xi,m}$ or $y_i = -0.35 + 1.08 * X_i$

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

Test No	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/Nm ³)
1	Reference		0.3	0.0	N/A	N/A	0.3	0.0	0.0
2	11:00	12:00	332.2	359.4	6.6	2.3	729.0	788.9	788.1
3	12:01	13:01	318.9	345.0	6.5	2.3	692.4	749.2	734.7
4	13:02	14:02	311.6	337.1	6.4	2.1	672.5	727.7	729.4
5	14:03	15:03	323.7	350.2	6.4	2.1	697.2	754.4	751.9
6	11:30	12:30	344.2	372.5	6.2	2.0	729.7	789.6	786.1
7	12:31	13:31	326.5	353.3	6.3	1.5	693.1	750.0	765.0
8	13:32	14:32	318.7	344.9	6.2	2.0	676.5	732.0	729.7
9	14:33	15:33	317.8	343.8	6.2	2.2	674.2	729.5	716.8
10	15:34	16:34	310.5	335.9	6.1	2.2	655.0	708.8	697.1
11	16:35	17:35	305.2	330.2	6.1	2.2	644.7	697.5	681.4
12	17:36	18:36	307.2	332.4	6.1	2.2	648.8	702.0	684.0
13	18:37	19:37	312.3	337.9	6.1	2.2	660.0	714.1	697.0
14	19:38	20:38	312.3	337.9	6.1	2.2	660.4	714.5	701.8
15	20:39	21:39	317.5	343.6	6.3	2.1	681.7	737.6	721.1
16	21:40	22:40	318.4	344.5	6.3	2.1	681.6	737.5	713.0
17	22:41	23:41	309.8	335.2	6.2	2.1	659.7	713.8	698.1
18	23:42	00:42	303.0	327.8	6.2	2.1	643.9	696.7	680.9
19	00:43	01:43	292.9	316.9	6.1	1.9	616.3	666.8	670.1
20	01:44	02:44	301.2	325.9	5.8	1.8	622.7	673.7	676.2
21	02:45	03:45	307.5	332.8	5.9	1.9	638.9	691.3	696.2
22	03:46	04:46	317.0	343.0	6.2	1.9	674.5	729.8	731.5
23	04:47	05:47	315.2	341.1	6.2	1.8	669.5	724.4	723.9
24	05:48	06:48	309.4	334.8	6.2	1.8	655.0	708.7	704.4
25	06:49	07:49	311.2	336.8	6.3	1.8	662.9	717.3	718.3
26	07:50	08:50	326.4	353.2	6.4	1.8	700.2	757.7	766.8
27	08:51	09:51	330.4	357.5	6.3	1.8	704.3	762.1	769.7
28	10:45	11:45	331.6	358.9	6.3	1.8	706.2	764.1	765.3
29	11:46	12:46	331.1	358.3	6.2	1.8	700.8	758.3	762.3
30	12:47	13:47	323.7	350.3	6.2	1.7	683.7	739.8	735.4
31	13:48	14:48	315.0	340.9	6.1	1.6	663.1	717.5	719.2
32	14:49	15:49	302.9	327.7	6.0	1.8	631.4	683.2	685.4
33	15:50	16:50	310.0	335.4	6.0	1.8	649.5	702.7	705.4
34	16:51	17:51	313.8	339.5	6.1	1.8	660.5	714.7	717.2
35	17:52	18:52	316.1	342.1	6.1	1.8	666.9	721.6	726.3
36	18:53	19:53	317.5	343.5	6.1	1.8	667.9	722.7	722.3
37	19:54	20:54	315.4	341.2	6.1	1.8	664.8	719.3	715.5
38	20:55	21:55	308.2	333.4	6.2	1.8	652.5	706.0	707.7
39	21:56	22:56	304.5	329.5	6.3	1.7	650.5	703.9	710.6
40	22:57	23:57	304.1	329.0	6.3	1.7	647.2	700.3	704.3
41	23:58	00:58	302.0	326.8	6.1	1.7	635.7	687.8	692.5
42	00:59	01:59	310.6	336.0	5.9	1.5	640.9	693.5	711.4
43	02:00	03:00	325.3	352.0	6.0	1.6	677.2	732.7	741.1
44	03:01	04:01	324.9	351.5	6.1	1.7	683.1	739.2	750.6
45	04:02	05:02	328.2	355.1	6.3	1.8	698.6	755.9	766.1
46	05:03	06:03	325.4	352.1	6.3	1.9	694.1	751.0	764.3
47	06:04	07:04	332.5	359.8	6.3	1.9	712.3	770.8	781.3
48	07:05	08:05	345.5	373.9	6.4	1.8	742.7	803.7	805.8
49	08:06	09:06	343.5	371.7	6.4	1.7	739.6	800.3	799.2
Sum							32313.92		
Emission Limit Value (ELV) =			1080	mg/Nm ³					

Reference Oxygen 6 %

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



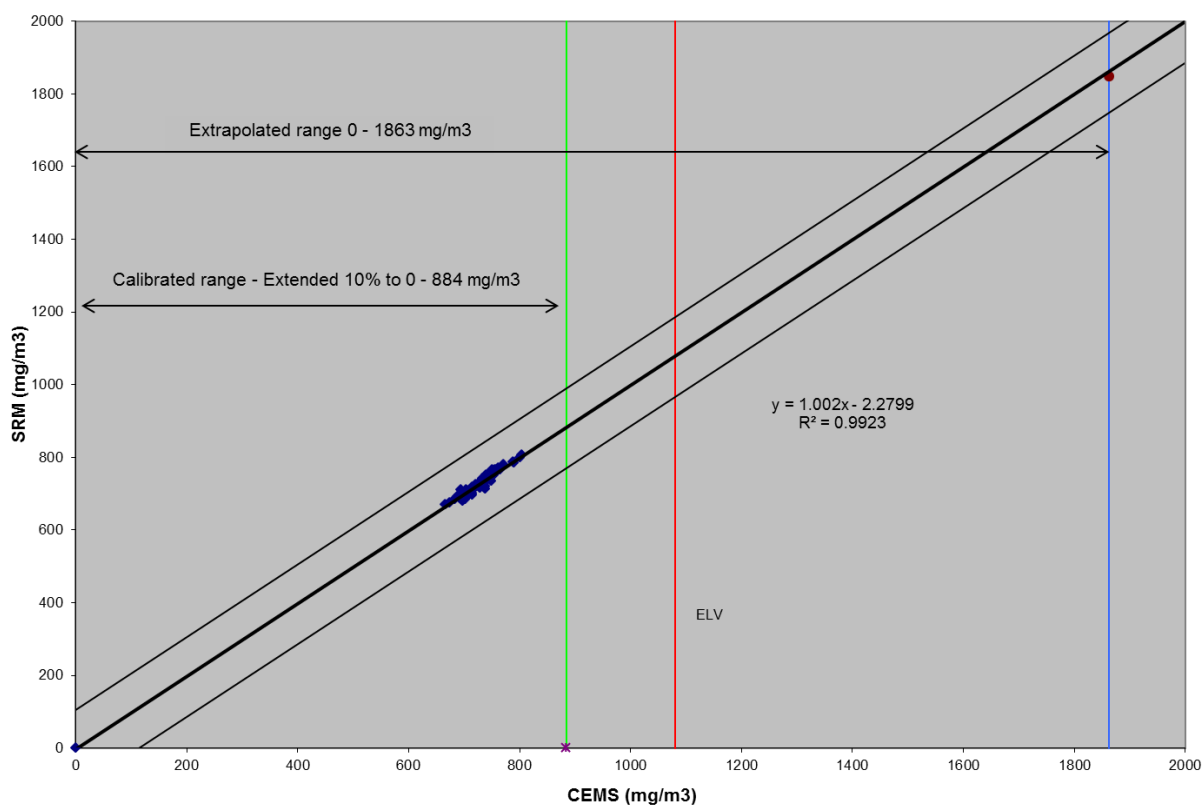
4A2.10.1 Table 4.5.1 – Data used for the Variability Test – Oxides of Nitrogen

Test No	Test 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			
2	11:00	12:00	788.9	788.1	-0.75	0.12	0.01
3	12:01	13:01	749.2	734.7	-14.48	-13.61	185.30
4	13:02	14:02	727.7	729.4	1.78	2.64	6.97
5	14:03	15:03	754.4	751.9	-2.42	-1.55	2.41
6	11:30	12:30	789.6	786.1	-3.47	-2.61	6.81
7	12:31	13:31	750.0	765.0	15.06	15.93	253.73
8	13:32	14:32	732.0	729.7	-2.25	-1.39	1.93
9	14:33	15:33	729.5	716.8	-12.61	-11.74	137.86
10	15:34	16:34	708.8	697.1	-11.69	-10.82	117.14
11	16:35	17:35	697.5	681.4	-16.10	-15.24	232.19
12	17:36	18:36	702.0	684.0	-18.06	-17.20	295.69
13	18:37	19:37	714.1	697.0	-17.13	-16.27	264.71
14	19:38	20:38	714.5	701.8	-12.77	-11.91	141.75
15	20:39	21:39	737.6	721.1	-16.47	-15.60	243.41
16	21:40	22:40	737.5	713.0	-24.42	-23.56	554.95
17	22:41	23:41	713.8	698.1	-15.65	-14.79	218.60
18	23:42	00:42	696.7	680.9	-15.75	-14.89	221.68
19	00:43	01:43	666.8	670.1	3.30	4.16	17.33
20	01:44	02:44	673.7	676.2	2.45	3.32	11.01
21	02:45	03:45	691.3	696.2	4.99	5.86	34.29
22	03:46	04:46	729.8	731.5	1.72	2.58	6.68
23	04:47	05:47	724.4	723.9	-0.47	0.39	0.15
24	05:48	06:48	708.7	704.4	-4.22	-3.35	11.25
25	06:49	07:49	717.3	718.3	1.07	1.93	3.74
26	07:50	08:50	757.7	766.8	9.08	9.94	98.81
27	08:51	09:51	762.1	769.7	7.69	8.55	73.12
28	10:45	11:45	764.1	765.3	1.22	2.08	4.32
29	11:46	12:46	758.3	762.3	3.97	4.84	23.42
30	12:47	13:47	739.8	735.4	-4.47	-3.60	12.97
31	13:48	14:48	717.5	719.2	1.70	2.56	6.56
32	14:49	15:49	683.2	685.4	2.23	3.10	9.59
33	15:50	16:50	702.7	705.4	2.67	3.54	12.52
34	16:51	17:51	714.7	717.2	2.54	3.41	11.61
35	17:52	18:52	721.6	726.3	4.63	5.49	30.17
36	18:53	19:53	722.7	722.3	-0.35	0.51	0.26
37	19:54	20:54	719.3	715.5	-3.81	-2.95	8.68
38	20:55	21:55	706.0	707.7	1.73	2.59	6.73
39	21:56	22:56	703.9	710.6	6.69	7.56	57.08
40	22:57	23:57	700.3	704.3	4.07	4.93	24.33
41	23:58	00:58	687.8	692.5	4.71	5.57	31.06
42	00:59	01:59	693.5	711.4	17.92	18.79	352.96
43	02:00	03:00	732.7	741.1	8.37	9.23	85.19
44	03:01	04:01	739.2	750.6	11.44	12.31	151.42
45	04:02	05:02	755.9	766.1	10.15	11.02	121.39
46	05:03	06:03	751.0	764.3	13.24	14.10	198.95
47	06:04	07:04	770.8	781.3	10.49	11.36	129.03
48	07:05	08:05	803.7	805.8	2.07	2.93	8.59
49	08:06	09:06	800.3	799.2	-1.14	-0.28	0.08
48 Tests		Mean			-0.86		
Sum							4428.45

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

SD=	$\text{Root}(1-\text{Number}).\text{Integral}(D1-D)^2$	9.71	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 =	$0.2 \cdot 1080 \text{ mg/m3 (s,d,6\%O2)}/1.96$	110.20	mg/m3(s,d),6%O2
For 48 tests, kv =	0.9885		
Therefore variability=		$9.71 \leq 110.2 \cdot 0.9885$	
or	9.71	\leq	108.94
Which is TRUE therefore the CEMS passes the test			

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



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

Test No	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	21-Oct-16	12:01	13:01	25.55	6.47	2.31	17.71	6.37	2.61	17.7
2	21-Oct-16	13:02	14:02	25.81	6.42	2.10	20.64	6.31	2.54	20.6
3	21-Oct-16	14:03	15:03	27.16	6.39	2.06	22.26	6.30	2.31	22.3
4	24-Oct-16	11:30	12:30	22.92	6.18	1.96	20.42	6.09	2.43	20.4
5	24-Oct-16	12:31	13:31	21.43	6.26	1.53	19.76	6.15	2.55	19.8
6	24-Oct-16	13:32	14:32	24.10	6.18	2.03	20.03	6.02	2.78	20.0
7	24-Oct-16	14:33	15:33	24.85	6.15	2.18	20.80	5.99	2.57	20.8
8	24-Oct-16	15:34	16:34	25.14	6.07	2.21	21.45	5.91	2.56	21.5
9	24-Oct-16	16:35	17:35	25.88	6.09	2.20	22.12	5.94	2.39	22.1
10	24-Oct-16	17:36	18:36	27.32	6.09	2.18	22.00	5.93	2.34	22.0
11	24-Oct-16	18:37	19:37	23.70	6.10	2.17	19.47	5.94	2.34	19.5
12	24-Oct-16	19:38	20:38	22.41	6.11	2.15	18.45	5.97	2.37	18.4
13	24-Oct-16	20:39	21:39	20.88	6.33	2.15	17.78	6.14	2.45	17.8
14	24-Oct-16	21:40	22:40	21.37	6.29	2.14	17.50	6.09	2.36	17.5
15	24-Oct-16	22:41	23:41	20.70	6.22	2.13	17.19	6.06	2.33	17.2
16	24-25/10/2016	23:42	0:42	21.52	6.19	2.13	16.72	6.04	2.31	16.7
17	25-Oct-16	0:43	1:43	19.98	6.07	1.92	16.19	5.94	2.31	16.2
18	25-Oct-16	1:44	2:44	27.26	5.83	1.81	22.13	5.71	2.48	22.1
19	25-Oct-16	2:45	3:45	21.33	5.89	1.86	16.94	5.77	2.49	16.9
20	25-Oct-16	3:46	4:46	19.89	6.25	1.85	16.67	6.08	2.49	16.7
21	25-Oct-16	4:47	5:47	21.79	6.22	1.84	16.71	6.08	2.41	16.7
22	25-Oct-16	5:48	6:48	21.91	6.17	1.83	17.16	6.04	2.34	17.2
23	25-Oct-16	6:49	7:49	21.49	6.27	1.82	17.35	6.12	2.35	17.3
24	25-Oct-16	7:50	8:50	19.53	6.38	1.81	16.87	6.21	2.36	16.9
25	25-Oct-16	8:51	9:51	20.98	6.28	1.80	17.42	6.13	2.41	17.4
26	25-Oct-16	10:45	11:45	21.15	6.27	1.79	20.49	6.17	2.52	20.5
27	25-Oct-16	11:46	12:46	22.30	6.18	1.81	20.91	6.13	2.57	20.9
28	25-Oct-16	12:47	13:47	21.37	6.17	1.67	20.12	6.06	2.56	20.1
29	25-Oct-16	13:48	14:48	21.27	6.13	1.61	19.27	6.04	2.61	19.3
30	25-Oct-16	14:49	15:49	21.68	5.96	1.77	19.74	5.88	2.80	19.7
31	25-Oct-16	15:50	16:50	21.49	6.03	1.76	19.75	5.96	2.80	19.7
32	25-Oct-16	16:51	17:51	19.67	6.10	1.76	19.20	6.02	2.79	19.2
33	25-Oct-16	17:52	18:52	20.11	6.14	1.76	19.12	6.04	2.72	19.1
34	25-Oct-16	18:53	19:53	18.70	6.10	1.76	17.99	6.02	2.56	18.0
35	25-Oct-16	19:54	20:54	17.91	6.12	1.75	16.89	6.04	2.60	16.9
36	25-Oct-16	20:55	21:55	18.60	6.19	1.75	17.34	6.11	2.60	17.3
37	25-Oct-16	21:56	22:56	20.28	6.32	1.75	19.23	6.20	2.72	19.2
38	25-Oct-16	22:57	23:57	22.37	6.27	1.73	21.28	6.18	2.66	21.3
39	25-26/10/2016	23:58	0:58	24.69	6.11	1.71	24.64	6.04	2.59	24.6
40	26-Oct-16	0:59	1:59	24.82	5.85	1.48	25.54	5.85	2.57	25.5
41	26-Oct-16	2:00	3:00	21.36	5.96	1.64	21.37	5.86	2.55	21.4
42	26-Oct-16	3:01	4:01	19.70	6.09	1.72	19.10	6.02	2.55	19.1
43	26-Oct-16	4:02	5:02	18.49	6.27	1.77	18.84	6.23	2.63	18.8
44	26-Oct-16	5:03	6:03	20.11	6.28	1.86	20.55	6.19	2.77	20.6
45	26-Oct-16	6:04	7:04	31.53	6.34	1.88	33.46	6.25	2.77	33.5
46	26-Oct-16	7:05	8:05	21.77	6.41	1.76	21.48	6.33	2.54	21.5
47	26-Oct-16	8:06	9:06	20.82	6.44	1.71	20.06	6.38	2.59	20.1

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

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

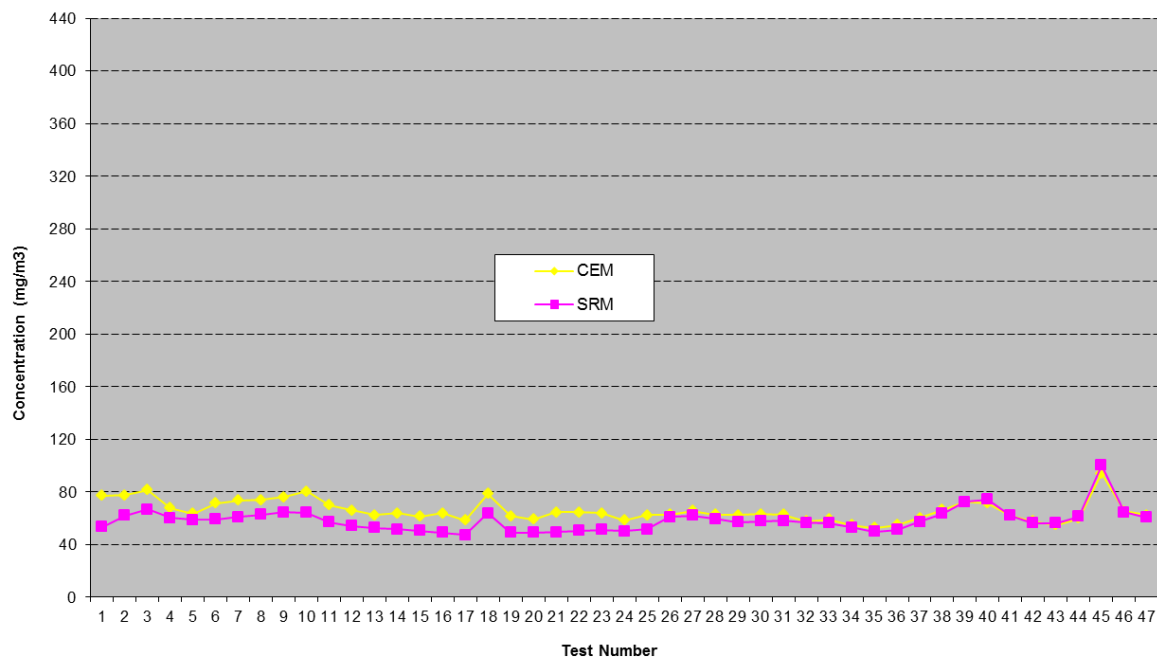
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(SO ₂ mg/m ³)	(SO ₂ mg/m ³)	(mg/m ³)
1	21-Oct-16	12:01	13:01	77.2	53.3	2.4
2	21-Oct-16	13:02	14:02	77.5	61.8	2.8
3	21-Oct-16	14:03	15:03	81.4	66.4	3.0
4	24-Oct-16	11:30	12:30	67.6	60.2	2.7
5	24-Oct-16	12:31	13:31	63.3	58.5	2.6
6	24-Oct-16	13:32	14:32	71.2	58.9	2.6
7	24-Oct-16	14:33	15:33	73.4	61.0	2.7
8	24-Oct-16	15:34	16:34	73.8	62.5	2.8
9	24-Oct-16	16:35	17:35	76.1	64.5	2.9
10	24-Oct-16	17:36	18:36	80.3	64.1	2.9
11	24-Oct-16	18:37	19:37	69.7	56.7	2.5
12	24-Oct-16	19:38	20:38	65.9	53.9	2.4
13	24-Oct-16	20:39	21:39	62.4	52.6	2.4
14	24-Oct-16	21:40	22:40	63.6	51.5	2.3
15	24-Oct-16	22:41	23:41	61.3	50.5	2.3
16	24-25/10/2016	23:42	0:42	63.6	49.0	2.2
17	25-Oct-16	0:43	1:43	58.5	47.2	2.1
18	25-Oct-16	1:44	2:44	78.4	63.6	2.9
19	25-Oct-16	2:45	3:45	61.6	48.9	2.2
20	25-Oct-16	3:46	4:46	58.9	49.1	2.2
21	25-Oct-16	4:47	5:47	64.4	49.2	2.2
22	25-Oct-16	5:48	6:48	64.5	50.3	2.3
23	25-Oct-16	6:49	7:49	63.7	51.2	2.3
24	25-Oct-16	7:50	8:50	58.3	50.1	2.3
25	25-Oct-16	8:51	9:51	62.2	51.4	2.3
26	25-Oct-16	10:45	11:45	62.6	60.7	2.7
27	25-Oct-16	11:46	12:46	65.7	61.9	2.8
28	25-Oct-16	12:47	13:47	62.8	59.2	2.7
29	25-Oct-16	13:48	14:48	62.3	56.7	2.5
30	25-Oct-16	14:49	15:49	62.9	57.6	2.6
31	25-Oct-16	15:50	16:50	62.7	57.9	2.6
32	25-Oct-16	16:51	17:51	57.6	56.5	2.5
33	25-Oct-16	17:52	18:52	59.0	56.3	2.5
34	25-Oct-16	18:53	19:53	54.7	52.8	2.4
35	25-Oct-16	19:54	20:54	52.5	49.7	2.2
36	25-Oct-16	20:55	21:55	54.8	51.3	2.3
37	25-Oct-16	21:56	22:56	60.3	57.3	2.6
38	25-Oct-16	22:57	23:57	66.2	63.2	2.8
39	25-26/10/2016	23:58	0:58	72.3	72.5	3.3
40	26-Oct-16	0:59	1:59	71.3	74.1	3.3
41	26-Oct-16	2:00	3:00	61.9	62.1	2.8
42	26-Oct-16	3:01	4:01	57.6	56.1	2.5
43	26-Oct-16	4:02	5:02	54.8	56.1	2.5
44	26-Oct-16	5:03	6:03	59.7	61.2	2.7
45	26-Oct-16	6:04	7:04	94.0	100.0	4.5
46	26-Oct-16	7:05	8:05	65.1	64.4	2.9
47	26-Oct-16	8:06	9:06	62.4	60.4	2.7

Note:

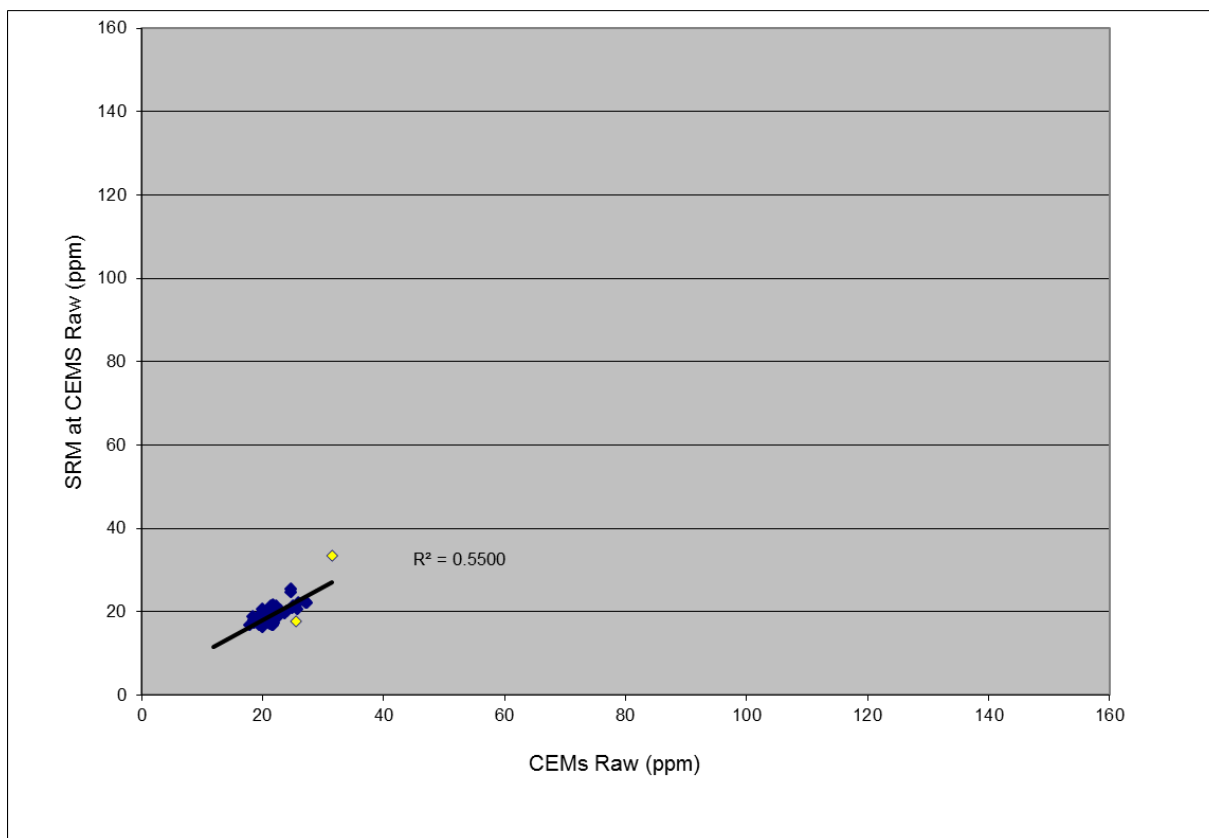
Emission concentrations expressed at reference conditions 273K,

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.



4A2.4.2 (Cont...) – 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{D}_i	Is Result an Outlier - $D_i - \bar{D}_i > 2SD$
	hr:min		(ppm)	(ppm)			
1	12:01	13:01	25.5	17.7	-7.84	-5.35	Yes
2	13:02	14:02	25.8	20.6	-5.17	-2.68	No
3	14:03	15:03	27.2	22.3	-4.90	-2.41	No
4	11:30	12:30	22.9	20.4	-2.50	-0.01	No
5	12:31	13:31	21.4	19.8	-1.68	0.81	No
6	13:32	14:32	24.1	20.0	-4.07	-1.58	No
7	14:33	15:33	24.9	20.8	-4.05	-1.56	No
8	15:34	16:34	25.1	21.5	-3.69	-1.20	No
9	16:35	17:35	25.9	22.1	-3.76	-1.27	No
10	17:36	18:36	27.3	22.0	-5.32	-2.83	No
11	18:37	19:37	23.7	19.5	-4.23	-1.74	No
12	19:38	20:38	22.4	18.4	-3.96	-1.47	No
13	20:39	21:39	20.9	17.8	-3.10	-0.61	No
14	21:40	22:40	21.4	17.5	-3.87	-1.38	No
15	22:41	23:41	20.7	17.2	-3.52	-1.03	No
16	23:42	00:42	21.5	16.7	-4.80	-2.31	No
17	00:43	01:43	20.0	16.2	-3.79	-1.30	No
18	01:44	02:44	27.3	22.1	-5.13	-2.64	No
19	02:45	03:45	21.3	16.9	-4.39	-1.90	No
20	03:46	04:46	19.9	16.7	-3.22	-0.74	No
21	04:47	05:47	21.8	16.7	-5.08	-2.59	No
22	05:48	06:48	21.9	17.2	-4.75	-2.26	No
23	06:49	07:49	21.5	17.3	-4.14	-1.65	No
24	07:50	08:50	19.5	16.9	-2.65	-0.16	No
25	08:51	09:51	21.0	17.4	-3.56	-1.07	No
26	10:45	11:45	21.1	20.5	-0.66	1.83	No
27	11:46	12:46	22.3	20.9	-1.39	1.10	No
28	12:47	13:47	21.4	20.1	-1.26	1.23	No
29	13:48	14:48	21.3	19.3	-1.99	0.50	No
30	14:49	15:49	21.7	19.7	-1.93	0.55	No
31	15:50	16:50	21.5	19.7	-1.75	0.74	No
32	16:51	17:51	19.7	19.2	-0.47	2.02	No
33	17:52	18:52	20.1	19.1	-0.99	1.50	No
34	18:53	19:53	18.7	18.0	-0.72	1.77	No
35	19:54	20:54	17.9	16.9	-1.02	1.47	No
36	20:55	21:55	18.6	17.3	-1.26	1.23	No
37	21:56	22:56	20.3	19.2	-1.05	1.44	No
38	22:57	23:57	22.4	21.3	-1.09	1.40	No
39	23:58	00:58	24.7	24.6	-0.05	2.44	No
40	00:59	01:59	24.8	25.5	0.72	3.21	No
41	02:00	03:00	21.4	21.4	0.01	2.50	No
42	03:01	04:01	19.7	19.1	-0.60	1.89	No
43	04:02	05:02	18.5	18.8	0.35	2.84	No
44	05:03	06:03	20.1	20.6	0.45	2.94	No
45	06:04	07:04	31.5	33.5	1.93	4.42	Yes
46	07:05	08:05	21.8	21.5	-0.29	2.20	No
47	08:06	09:06	20.8	20.1	-0.75	1.73	No
				Average \bar{D}_i	-2.49		
			Standard Deviation		2.06		
			Standard Deviation x2		4.12		

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

Test No	Test Start Time	Test End Time	SRM measured value (y)	SRM O2	SRM Standardised
	hr:min		(ppm)	(%)	(mg/m3)
2	13:02	14:02	20.6	6.3	61.8
3	14:03	15:03	22.3	6.3	66.4
4	11:30	12:30	20.4	6.1	60.2
5	12:31	13:31	19.8	6.2	58.5
6	13:32	14:32	20.0	6.0	58.9
7	14:33	15:33	20.8	6.0	61.0
8	15:34	16:34	21.5	5.9	62.5
9	16:35	17:35	22.1	5.9	64.5
10	17:36	18:36	22.0	5.9	64.1
11	18:37	19:37	19.5	5.9	56.7
12	19:38	20:38	18.4	6.0	53.9
13	20:39	21:39	17.8	6.1	52.6
14	21:40	22:40	17.5	6.1	51.5
15	22:41	23:41	17.2	6.1	50.5
16	23:42	0:42	16.7	6.0	49.0
17	0:43	1:43	16.2	5.9	47.2
18	1:44	2:44	22.1	5.7	63.6
19	2:45	3:45	16.9	5.8	48.9
20	3:46	4:46	16.7	6.1	49.1
21	4:47	5:47	16.7	6.1	49.2
22	5:48	6:48	17.2	6.0	50.3
23	6:49	7:49	17.3	6.1	51.2
24	7:50	8:50	16.9	6.2	50.1
25	8:51	9:51	17.4	6.1	51.4
26	10:45	11:45	20.5	6.2	60.7
27	11:46	12:46	20.9	6.1	61.9
28	12:47	13:47	20.1	6.1	59.2
29	13:48	14:48	19.3	6.0	56.7
30	14:49	15:49	19.7	5.9	57.6
31	15:50	16:50	19.7	6.0	57.9
32	16:51	17:51	19.2	6.0	56.5
33	17:52	18:52	19.1	6.0	56.3
34	18:53	19:53	18.0	6.0	52.8
35	19:54	20:54	16.9	6.0	49.7
36	20:55	21:55	17.3	6.1	51.3
37	21:56	22:56	19.2	6.2	57.3
38	22:57	23:57	21.3	6.2	63.2
39	23:58	0:58	24.6	6.0	72.5
40	0:59	1:59	25.5	5.8	74.1
41	2:00	3:00	21.4	5.9	62.1
42	3:01	4:01	19.1	6.0	56.1
43	4:02	5:02	18.8	6.2	56.1
44	5:03	6:03	20.6	6.2	61.2
46	7:05	8:05	21.5	6.3	64.4
47	8:06	9:06	20.1	6.4	60.4
Sum			876.93		
Emission Limit Value (ELV) =			440 mg/Nm ³	Y _{max}	74.15
Maximum Permissible uncertainty =			20 %	Y _{min}	47.17
Maximum Permissible uncertainty (at 1			88 mg/Nm ³		
15% of the ELV =			66 mg/Nm ³		
Is Y _{max} - Y _{min} > MPU at ELV?			No	Y _{max} - Y _{min}	26.98
Is Y _{min} > 15% of ELV?			No		

Derivation of Calibration Function	Method C
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4A2.6.2 Table 4.3.2 - Data used to derive calibration function - Sulphur Dioxide, Low Range.

Test No	Test Start Time	Test End Time	SRM measured value (y)	CEMS measured signal (x)	Yi	Xi	Xi * Yi	Xi ²	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference Zero		0.0	-0.2	-23.45	-25.91	607.49	671.38	
2	Reference Span		225.0	222.0	201.55	196.26	39556.91	38517.57	
4	13:02	14:02	20.6	25.8	-2.80	0.07	-0.19	0.00	
5	14:03	15:03	22.3	27.2	-1.19	1.42	-1.69	2.01	
6	11:30	12:30	20.4	22.9	-3.03	-2.82	8.55	7.97	
7	12:31	13:31	19.8	21.4	-3.69	-4.31	15.90	18.57	
8	13:32	14:32	20.0	24.1	-3.41	-1.64	5.59	2.69	
9	14:33	15:33	20.8	24.9	-2.64	-0.89	2.35	0.79	
10	15:34	16:34	21.5	25.1	-1.99	-0.60	1.20	0.36	
11	16:35	17:35	22.1	25.9	-1.32	0.14	-0.19	0.02	
12	17:36	18:36	22.0	27.3	-1.45	1.57	-2.28	2.48	
13	18:37	19:37	19.5	23.7	-3.98	-2.05	8.13	4.18	
14	19:38	20:38	18.4	22.4	-5.00	-3.33	16.67	11.12	
15	20:39	21:39	17.8	20.9	-5.67	-4.86	27.54	23.61	
16	21:40	22:40	17.5	21.4	-5.95	-4.38	26.02	19.14	
17	22:41	23:41	17.2	20.7	-6.26	-5.04	31.53	25.37	
18	23:42	0:42	16.7	21.5	-6.73	-4.23	28.42	17.86	
19	0:43	1:43	16.2	20.0	-7.25	-5.76	41.77	33.19	
20	1:44	2:44	22.1	27.3	-1.31	1.52	-2.00	2.32	
21	2:45	3:45	16.9	21.3	-6.50	-4.41	28.71	19.48	
22	3:46	4:46	16.7	19.9	-6.78	-5.85	39.67	34.24	
23	4:47	5:47	16.7	21.8	-6.73	-3.95	26.58	15.59	
24	5:48	6:48	17.2	21.9	-6.28	-3.83	24.07	14.67	
25	6:49	7:49	17.3	21.5	-6.10	-4.25	25.93	18.08	
26	7:50	8:50	16.9	19.5	-6.57	-6.21	40.83	38.61	
27	8:51	9:51	17.4	21.0	-6.02	-4.76	28.67	22.65	
28	10:45	11:45	20.5	21.1	-2.96	-4.59	13.59	21.10	
29	11:46	12:46	20.9	22.3	-2.53	-3.44	8.71	11.82	
30	12:47	13:47	20.1	21.4	-3.33	-4.37	14.53	19.07	
31	13:48	14:48	19.3	21.3	-4.17	-4.47	18.66	20.01	
32	14:49	15:49	19.7	21.7	-3.70	-4.06	15.03	16.50	
33	15:50	16:50	19.7	21.5	-3.70	-4.25	15.72	18.05	
34	16:51	17:51	19.2	19.7	-4.25	-6.07	25.78	36.86	
35	17:52	18:52	19.1	20.1	-4.32	-5.63	24.35	31.73	
36	18:53	19:53	18.0	18.7	-5.46	-7.04	38.42	49.52	
37	19:54	20:54	16.9	17.9	-6.56	-7.84	51.39	61.39	
38	20:55	21:55	17.3	18.6	-6.10	-7.14	43.54	50.93	
39	21:56	22:56	19.2	20.3	-4.21	-5.46	23.01	29.82	
40	22:57	23:57	21.3	22.4	-2.17	-3.37	7.31	11.37	
41	23:58	0:58	24.6	24.7	1.19	-1.05	-1.25	1.11	
42	0:59	1:59	25.5	24.8	2.09	-0.92	-1.94	0.86	
43	2:00	3:00	21.4	21.4	-2.08	-4.38	9.10	19.21	
44	3:01	4:01	19.1	19.7	-4.34	-6.04	26.24	36.48	
45	4:02	5:02	18.8	18.5	-4.60	-7.25	33.37	52.53	
46	5:03	6:03	20.6	20.1	-2.89	-5.64	16.30	31.77	
48	7:05	8:05	21.5	21.8	-1.96	-3.97	7.78	15.76	
49	8:06	9:06	20.1	20.8	-3.38	-4.93	16.67	24.26	
Sum			1101.93	1209.83	0.00	0.00	40992.52	40084.10	1.02

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

Method C

If Ymax-Ymin >15% of the ELV, the following formulae are used:

N	N	N	N		
$b = \sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})$	$\bar{x} = 1/N \sum_{i=1}^N x_i$	$\bar{y} = 1/N \sum_{i=1}^N y_i$		x=	25.74
				y=	23.45
				b=	1.023
a=y-bx	a = 23.45 - 25.75 * 1.022			a=	-2.879

The calibration is function $y_i = a + b x_i$ or $y_i = -2.879 + 1.023 * x_i$

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

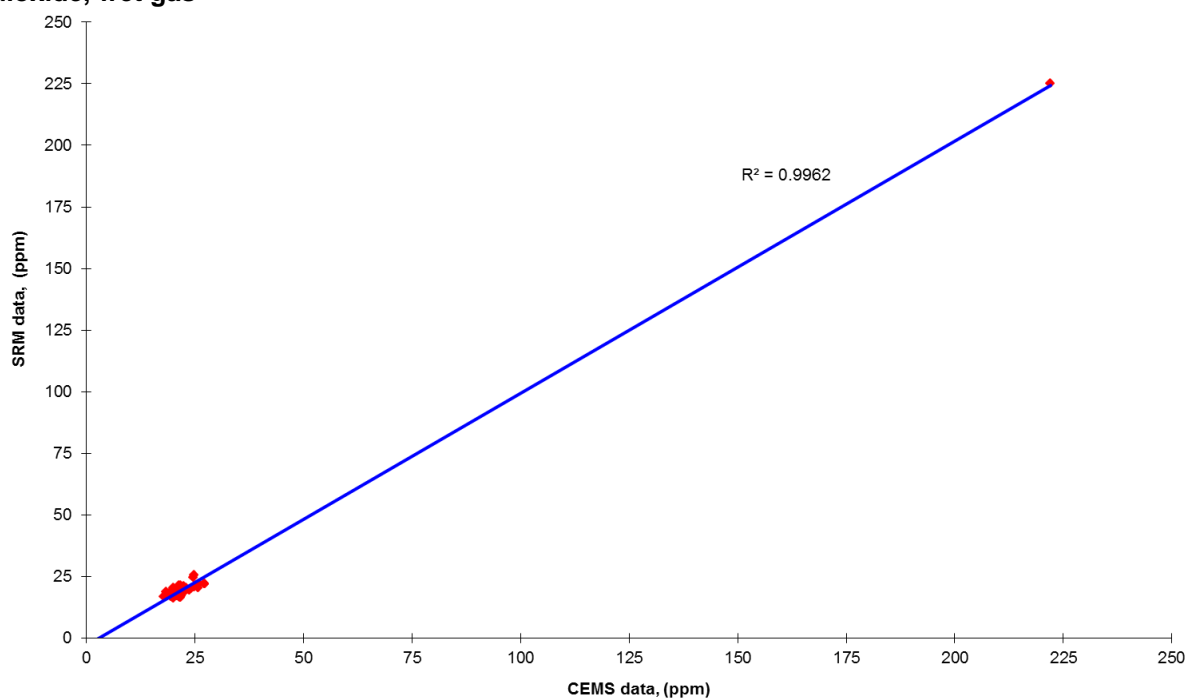
Test No	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
	hr:min		(ppm)	(ppm)	(%)	(%)	(mg/Nm ³)	(mg/Nm ³)	(mg/m3)
1	Reference Zero		-0.2	-3.1	N/A	N/A	-0.2	-8.7	0.0
2	Reference Span		222.0	224.2	N/A	N/A	222.0	640.4	642.9
4	13:02	14:02	25.8	23.5	6.4	2.1	77.5	70.6	61.8
5	14:03	15:03	27.2	24.9	6.4	2.1	81.4	74.6	66.4
6	11:30	12:30	22.9	20.6	6.2	2.0	67.6	60.6	60.2
7	12:31	13:31	21.4	19.0	6.3	1.5	63.3	56.2	58.5
8	13:32	14:32	24.1	21.8	6.2	2.0	71.2	64.3	58.9
9	14:33	15:33	24.9	22.5	6.2	2.2	73.4	66.5	61.0
10	15:34	16:34	25.1	22.8	6.1	2.2	73.8	67.0	62.5
11	16:35	17:35	25.9	23.6	6.1	2.2	76.1	69.3	64.5
12	17:36	18:36	27.3	25.1	6.1	2.2	80.3	73.6	64.1
13	18:37	19:37	23.7	21.4	6.1	2.2	69.7	62.8	56.7
14	19:38	20:38	22.4	20.0	6.1	2.2	65.9	58.9	53.9
15	20:39	21:39	20.9	18.5	6.3	2.1	62.4	55.2	52.6
16	21:40	22:40	21.4	19.0	6.3	2.1	63.6	56.5	51.5
17	22:41	23:41	20.7	18.3	6.2	2.1	61.3	54.2	50.5
18	23:42	00:42	21.5	19.1	6.2	2.1	63.6	56.5	49.0
19	00:43	01:43	20.0	17.6	6.1	1.9	58.5	51.4	47.2
20	01:44	02:44	27.3	25.0	5.8	1.8	78.4	71.9	63.6
21	02:45	03:45	21.3	18.9	5.9	1.9	61.6	54.7	48.9
22	03:46	04:46	19.9	17.5	6.2	1.9	58.9	51.7	49.1
23	04:47	05:47	21.8	19.4	6.2	1.8	64.4	57.3	49.2
24	05:48	06:48	21.9	19.5	6.2	1.8	64.5	57.5	50.3
25	06:49	07:49	21.5	19.1	6.3	1.8	63.7	56.6	51.2
26	07:50	08:50	19.5	17.1	6.4	1.8	58.3	51.0	50.1
27	08:51	09:51	21.0	18.6	6.3	1.8	62.2	55.1	51.4
28	10:45	11:45	21.1	18.7	6.3	1.8	62.6	55.5	60.7
29	11:46	12:46	22.3	19.9	6.2	1.8	65.7	58.7	61.9
30	12:47	13:47	21.4	19.0	6.2	1.7	62.8	55.8	59.2
31	13:48	14:48	21.3	18.9	6.1	1.6	62.3	55.3	56.7
32	14:49	15:49	21.7	19.3	6.0	1.8	62.9	56.0	57.6
33	15:50	16:50	21.5	19.1	6.0	1.8	62.7	55.7	57.9
34	16:51	17:51	19.7	17.2	6.1	1.8	57.6	50.5	56.5
35	17:52	18:52	20.1	17.7	6.1	1.8	59.0	51.9	56.3
36	18:53	19:53	18.7	16.2	6.1	1.8	54.7	47.6	52.8
37	19:54	20:54	17.9	15.4	6.1	1.8	52.5	45.3	49.7
38	20:55	21:55	18.6	16.1	6.2	1.8	54.8	47.6	51.3
39	21:56	22:56	20.3	17.9	6.3	1.7	60.3	53.1	57.3
40	22:57	23:57	22.4	20.0	6.3	1.7	66.2	59.2	63.2
41	23:58	00:58	24.7	22.4	6.1	1.7	72.3	65.5	72.5
42	00:59	01:59	24.8	22.5	5.9	1.5	71.3	64.6	74.1
43	02:00	03:00	21.4	19.0	6.0	1.6	61.9	54.9	62.1
44	03:01	04:01	19.7	17.3	6.1	1.7	57.6	50.5	56.1
45	04:02	05:02	18.5	16.0	6.3	1.8	54.8	47.5	56.1
46	05:03	06:03	20.1	17.7	6.3	1.9	59.7	52.5	61.2
48	07:05	08:05	21.8	19.4	6.4	1.8	65.1	58.0	64.4
49	08:06	09:06	20.8	18.4	6.4	1.7	62.4	55.2	60.4
Sum							3132.49		
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



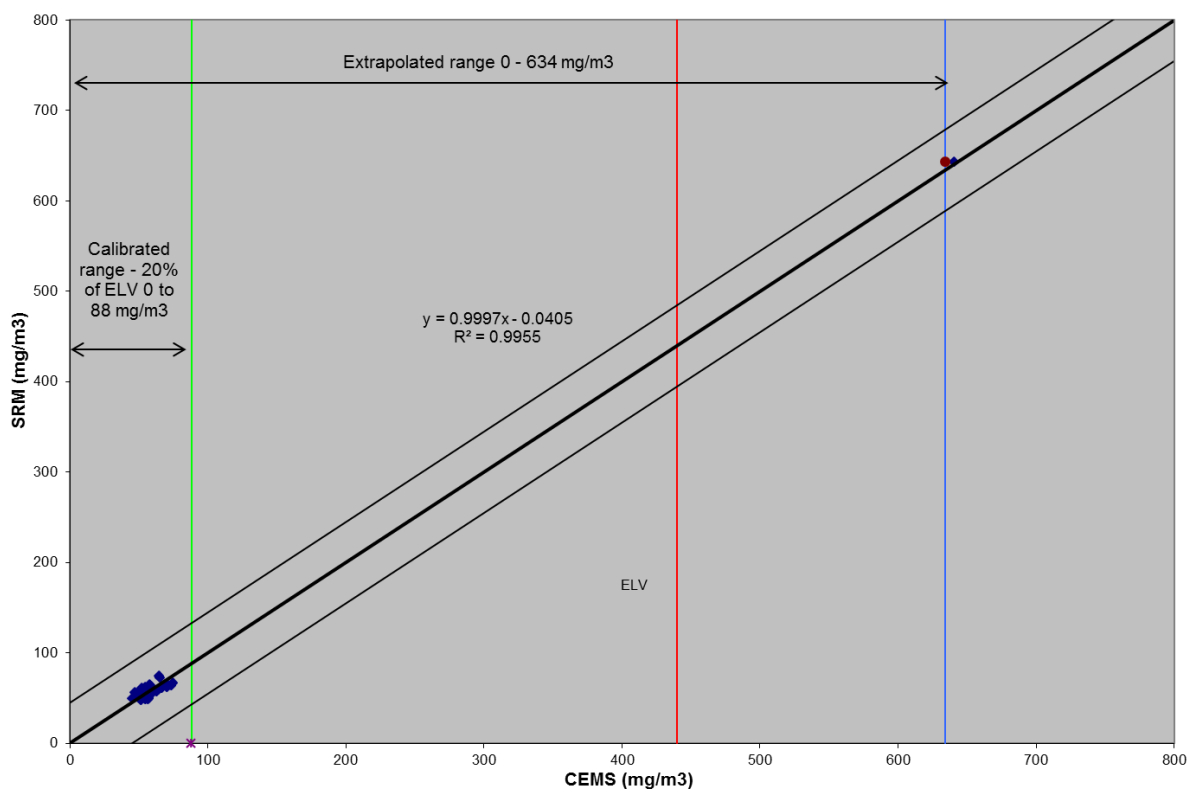
4A2.10.2 Table 4.5.2 – Data used for the Variability Test – Sulphur Dioxide, Low Range.

Test No	Test 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			
4	13:02	14:02	70.6	61.8	-8.83	-8.52	72.60
5	14:03	15:03	74.6	66.4	-8.17	-7.86	61.83
6	11:30	12:30	60.6	60.2	-0.47	-0.16	0.03
7	12:31	13:31	56.2	58.5	2.29	2.60	6.74
8	13:32	14:32	64.3	58.9	-5.35	-5.04	25.39
9	14:33	15:33	66.5	61.0	-5.55	-5.24	27.45
10	15:34	16:34	67.0	62.5	-4.49	-4.18	17.47
11	16:35	17:35	69.3	64.5	-4.84	-4.53	20.55
12	17:36	18:36	73.6	64.1	-9.55	-9.24	85.31
13	18:37	19:37	62.8	56.7	-6.06	-5.75	33.03
14	19:38	20:38	58.9	53.9	-5.08	-4.77	22.73
15	20:39	21:39	55.2	52.6	-2.60	-2.29	5.25
16	21:40	22:40	56.5	51.5	-4.97	-4.66	21.72
17	22:41	23:41	54.2	50.5	-3.73	-3.42	11.67
18	23:42	00:42	56.5	49.0	-7.52	-7.21	51.98
19	00:43	01:43	51.4	47.2	-4.22	-3.90	15.25
20	01:44	02:44	71.9	63.6	-8.30	-7.99	63.88
21	02:45	03:45	54.7	48.9	-5.84	-5.52	30.52
22	03:46	04:46	51.7	49.1	-2.61	-2.30	5.27
23	04:47	05:47	57.3	49.2	-8.15	-7.84	61.42
24	05:48	06:48	57.5	50.3	-7.17	-6.86	47.00
25	06:49	07:49	56.6	51.2	-5.43	-5.12	26.25
26	07:50	08:50	51.0	50.1	-0.93	-0.62	0.38
27	08:51	09:51	55.1	51.4	-3.65	-3.34	11.17
28	10:45	11:45	55.5	60.7	5.19	5.50	30.30
29	11:46	12:46	58.7	61.9	3.17	3.48	12.09
30	12:47	13:47	55.8	59.2	3.44	3.75	14.09
31	13:48	14:48	55.3	56.7	1.44	1.75	3.08
32	14:49	15:49	56.0	57.6	1.61	1.93	3.71
33	15:50	16:50	55.7	57.9	2.19	2.50	6.27
34	16:51	17:51	50.5	56.5	6.01	6.33	40.01
35	17:52	18:52	51.9	56.3	4.42	4.73	22.41
36	18:53	19:53	47.6	52.8	5.25	5.56	30.95
37	19:54	20:54	45.3	49.7	4.40	4.71	22.17
38	20:55	21:55	47.6	51.3	3.69	4.00	16.02
39	21:56	22:56	53.1	57.3	4.18	4.49	20.15
40	22:57	23:57	59.2	63.2	4.00	4.31	18.58
41	23:58	00:58	65.5	72.5	6.95	7.26	52.73
42	00:59	01:59	64.6	74.1	9.54	9.86	97.13
43	02:00	03:00	54.9	62.1	7.14	7.45	55.56
44	03:01	04:01	50.5	56.1	5.54	5.85	34.22
45	04:02	05:02	47.5	56.1	8.65	8.96	80.23
46	05:03	06:03	52.5	61.2	8.71	9.02	81.32
48	07:05	08:05	58.0	64.4	6.45	6.76	45.67
49	08:06	09:06	55.2	60.4	5.25	5.56	30.88
45 Tests		Mean			-0.31		
Sum							1442.47

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

SD=	Root(1-Number).Integral(D1-D) ²	5.73	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 mg/m3 (s,d,6%O2)/1.96	44.90	mg/m3(s,d),6%O2
For 45 tests, kv =	0.9885		
Therefore variability=	5.73 <= 44.9 * 0.9885		
or	5.73	<=	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	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	21-Oct-16	12:01	13:01	28.25	6.47	2.31	17.71	6.37	2.61	17.7
2	21-Oct-16	13:02	14:02	28.47	6.42	2.10	20.64	6.31	2.54	20.6
3	21-Oct-16	14:03	15:03	29.83	6.39	2.06	22.26	6.30	2.31	22.3
4	24-Oct-16	11:30	12:30	25.56	6.18	1.96	20.42	6.09	2.43	20.4
5	24-Oct-16	12:31	13:31	31.60	6.26	1.53	19.76	6.15	2.55	19.8
6	24-Oct-16	13:32	14:32	26.91	6.18	2.03	20.03	6.02	2.78	20.0
7	24-Oct-16	14:33	15:33	27.70	6.15	2.18	20.80	5.99	2.57	20.8
8	24-Oct-16	15:34	16:34	27.97	6.07	2.21	21.45	5.91	2.56	21.5
9	24-Oct-16	16:35	17:35	28.65	6.09	2.20	22.12	5.94	2.39	22.1
10	24-Oct-16	17:36	18:36	30.14	6.09	2.18	22.00	5.93	2.34	22.0
11	24-Oct-16	18:37	19:37	26.34	6.10	2.17	19.47	5.94	2.34	19.5
12	24-Oct-16	19:38	20:38	25.02	6.11	2.15	18.45	5.97	2.37	18.4
13	24-Oct-16	20:39	21:39	23.44	6.33	2.15	17.78	6.14	2.45	17.8
14	24-Oct-16	21:40	22:40	23.95	6.29	2.14	17.50	6.09	2.36	17.5
15	24-Oct-16	22:41	23:41	23.25	6.22	2.13	17.19	6.06	2.33	17.2
16	24-25/10/2016	23:42	0:42	24.11	6.19	2.13	16.72	6.04	2.31	16.7
17	25-Oct-16	0:43	1:43	22.40	6.07	1.92	16.20	5.94	2.31	16.2
18	25-Oct-16	1:44	2:44	29.89	5.83	1.81	22.13	5.71	2.48	22.1
19	25-Oct-16	2:45	3:45	23.72	5.89	1.86	16.94	5.77	2.49	16.9
20	25-Oct-16	3:46	4:46	22.27	6.25	1.85	16.67	6.08	2.49	16.7
21	25-Oct-16	4:47	5:47	24.22	6.22	1.84	16.71	6.08	2.41	16.7
22	25-Oct-16	5:48	6:48	24.24	6.17	1.83	17.16	6.04	2.34	17.2
23	25-Oct-16	6:49	7:49	23.87	6.27	1.82	17.35	6.12	2.35	17.3
24	25-Oct-16	7:50	8:50	21.80	6.38	1.81	16.88	6.21	2.36	16.9
25	25-Oct-16	8:51	9:51	23.32	6.28	1.80	17.42	6.13	2.41	17.4
26	25-Oct-16	10:45	11:45	23.49	6.27	1.79	20.49	6.17	2.52	20.5
27	25-Oct-16	11:46	12:46	24.71	6.18	1.81	20.91	6.13	2.57	20.9
28	25-Oct-16	12:47	13:47	23.68	6.17	1.67	20.12	6.06	2.56	20.1
29	25-Oct-16	13:48	14:48	23.48	6.13	1.61	19.28	6.04	2.61	19.3
30	25-Oct-16	14:49	15:49	23.93	5.96	1.77	19.75	5.88	2.80	19.7
31	25-Oct-16	15:50	16:50	23.74	6.03	1.76	19.75	5.96	2.80	19.7
32	25-Oct-16	16:51	17:51	21.84	6.10	1.76	19.20	6.02	2.79	19.2
33	25-Oct-16	17:52	18:52	22.21	6.14	1.76	19.12	6.04	2.72	19.1
34	25-Oct-16	18:53	19:53	20.74	6.10	1.76	17.99	6.02	2.56	18.0
35	25-Oct-16	19:54	20:54	19.96	6.12	1.75	16.89	6.04	2.60	16.9
36	25-Oct-16	20:55	21:55	20.67	6.19	1.75	17.35	6.11	2.60	17.3
37	25-Oct-16	21:56	22:56	22.41	6.32	1.75	19.23	6.20	2.72	19.2
38	25-Oct-16	22:57	23:57	24.55	6.27	1.73	21.28	6.18	2.66	21.3
39	25-26/10/2016	23:58	0:58	26.98	6.11	1.71	24.64	6.04	2.59	24.6
40	26-Oct-16	0:59	1:59	27.07	5.85	1.48	25.54	5.85	2.57	25.5
41	26-Oct-16	2:00	3:00	23.52	5.96	1.64	21.37	5.86	2.55	21.4
42	26-Oct-16	3:01	4:01	21.81	6.09	1.72	19.10	6.02	2.55	19.1
43	26-Oct-16	4:02	5:02	20.54	6.27	1.77	18.84	6.23	2.63	18.8
44	26-Oct-16	5:03	6:03	22.24	6.28	1.86	20.56	6.19	2.77	20.6
45	26-Oct-16	6:04	7:04	33.95	6.34	1.88	33.46	6.25	2.77	33.5
46	26-Oct-16	7:05	8:05	23.93	6.41	1.76	21.49	6.33	2.54	21.5
47	26-Oct-16	8:06	9:06	22.90	6.44	1.71	20.06	6.38	2.59	20.1

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

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

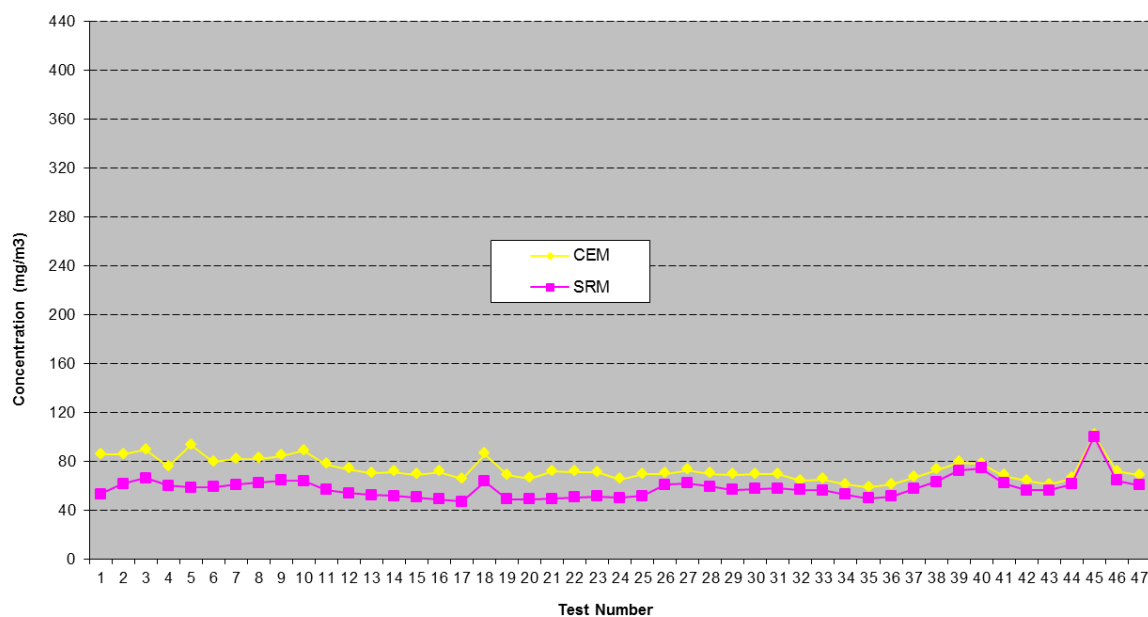
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(SO ₂ mg/m ³)	(SO ₂ mg/m ³)	(mg/m ³)
1	21-Oct-16	12:01	13:01	85.3	53.3	2.4
2	21-Oct-16	13:02	14:02	85.5	61.8	2.8
3	21-Oct-16	14:03	15:03	89.4	66.4	3.0
4	24-Oct-16	11:30	12:30	75.4	60.2	2.7
5	24-Oct-16	12:31	13:31	93.3	58.5	2.6
6	24-Oct-16	13:32	14:32	79.5	58.9	2.6
7	24-Oct-16	14:33	15:33	81.7	61.0	2.7
8	24-Oct-16	15:34	16:34	82.1	62.5	2.8
9	24-Oct-16	16:35	17:35	84.2	64.5	2.9
10	24-Oct-16	17:36	18:36	88.6	64.1	2.9
11	24-Oct-16	18:37	19:37	77.4	56.7	2.5
12	24-Oct-16	19:38	20:38	73.6	53.9	2.4
13	24-Oct-16	20:39	21:39	70.0	52.6	2.4
14	24-Oct-16	21:40	22:40	71.3	51.5	2.3
15	24-Oct-16	22:41	23:41	68.9	50.5	2.3
16	24-25/10/2016	23:42	0:42	71.3	49.0	2.2
17	25-Oct-16	0:43	1:43	65.6	47.2	2.1
18	25-Oct-16	1:44	2:44	86.0	63.6	2.9
19	25-Oct-16	2:45	3:45	68.6	48.9	2.2
20	25-Oct-16	3:46	4:46	65.9	49.1	2.2
21	25-Oct-16	4:47	5:47	71.6	49.2	2.2
22	25-Oct-16	5:48	6:48	71.4	50.3	2.3
23	25-Oct-16	6:49	7:49	70.7	51.2	2.3
24	25-Oct-16	7:50	8:50	65.1	50.1	2.3
25	25-Oct-16	8:51	9:51	69.2	51.4	2.3
26	25-Oct-16	10:45	11:45	69.6	60.7	2.7
27	25-Oct-16	11:46	12:46	72.8	61.9	2.8
28	25-Oct-16	12:47	13:47	69.6	59.2	2.7
29	25-Oct-16	13:48	14:48	68.8	56.7	2.5
30	25-Oct-16	14:49	15:49	69.4	57.6	2.6
31	25-Oct-16	15:50	16:50	69.2	57.9	2.6
32	25-Oct-16	16:51	17:51	64.0	56.5	2.5
33	25-Oct-16	17:52	18:52	65.2	56.3	2.5
34	25-Oct-16	18:53	19:53	60.7	52.8	2.4
35	25-Oct-16	19:54	20:54	58.5	49.7	2.2
36	25-Oct-16	20:55	21:55	60.9	51.3	2.3
37	25-Oct-16	21:56	22:56	66.6	57.3	2.6
38	25-Oct-16	22:57	23:57	72.7	63.2	2.8
39	25-26/10/2016	23:58	0:58	79.0	72.5	3.3
40	26-Oct-16	0:59	1:59	77.7	74.2	3.3
41	26-Oct-16	2:00	3:00	68.1	62.1	2.8
42	26-Oct-16	3:01	4:01	63.8	56.1	2.5
43	26-Oct-16	4:02	5:02	60.8	56.1	2.5
44	26-Oct-16	5:03	6:03	66.0	61.2	2.7
45	26-Oct-16	6:04	7:04	101.2	100.0	4.5
46	26-Oct-16	7:05	8:05	71.6	64.4	2.9
47	26-Oct-16	8:06	9:06	68.6	60.4	2.7

Note:

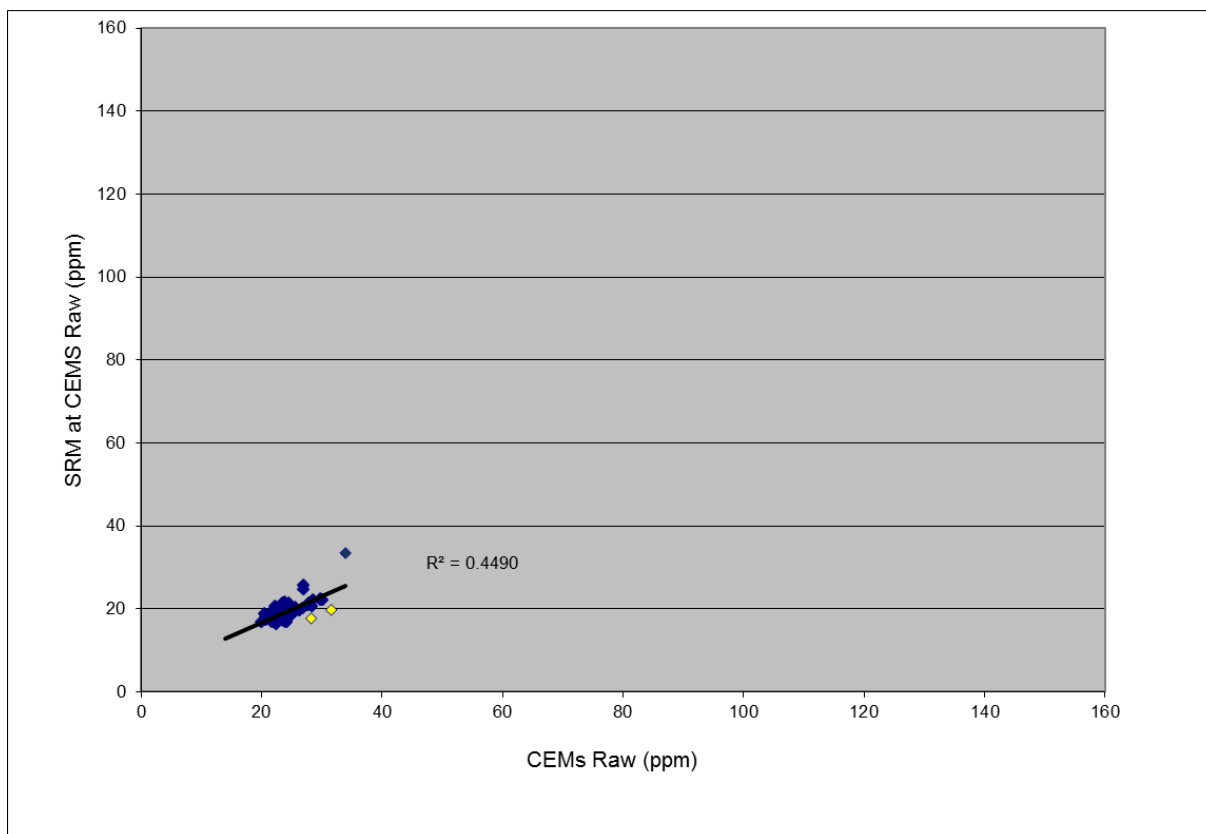
Emission concentrations expressed at reference conditions 273K,

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.



4A2.4.3 (Cont...) – 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{D}_i	Is Result an Outlier - $D_i - \bar{D}_i > 2SD$
	hr:min		(ppm)	(ppm)			
1	12:01	13:01	28.3	17.7	-10.54	-5.50	Yes
2	13:02	14:02	28.5	20.6	-7.83	-2.79	No
3	14:03	15:03	29.8	22.3	-7.57	-2.52	No
4	11:30	12:30	25.6	20.4	-5.14	-0.10	No
5	12:31	13:31	31.6	19.8	-11.84	-6.80	Yes
6	13:32	14:32	26.9	20.0	-6.88	-1.84	No
7	14:33	15:33	27.7	20.8	-6.89	-1.85	No
8	15:34	16:34	28.0	21.5	-6.52	-1.47	No
9	16:35	17:35	28.6	22.1	-6.52	-1.48	No
10	17:36	18:36	30.1	22.0	-8.14	-3.10	No
11	18:37	19:37	26.3	19.5	-6.87	-1.83	No
12	19:38	20:38	25.0	18.4	-6.57	-1.53	No
13	20:39	21:39	23.4	17.8	-5.66	-0.62	No
14	21:40	22:40	24.0	17.5	-6.45	-1.41	No
15	22:41	23:41	23.3	17.2	-6.07	-1.02	No
16	23:42	00:42	24.1	16.7	-7.39	-2.34	No
17	00:43	01:43	22.4	16.2	-6.20	-1.16	No
18	01:44	02:44	29.9	22.1	-7.75	-2.71	No
19	02:45	03:45	23.7	16.9	-6.78	-1.74	No
20	03:46	04:46	22.3	16.7	-5.60	-0.56	No
21	04:47	05:47	24.2	16.7	-7.50	-2.46	No
22	05:48	06:48	24.2	17.2	-7.08	-2.03	No
23	06:49	07:49	23.9	17.3	-6.52	-1.48	No
24	07:50	08:50	21.8	16.9	-4.92	0.12	No
25	08:51	09:51	23.3	17.4	-5.90	-0.86	No
26	10:45	11:45	23.5	20.5	-3.01	2.04	No
27	11:46	12:46	24.7	20.9	-3.80	1.24	No
28	12:47	13:47	23.7	20.1	-3.56	1.49	No
29	13:48	14:48	23.5	19.3	-4.21	0.84	No
30	14:49	15:49	23.9	19.7	-4.18	0.86	No
31	15:50	16:50	23.7	19.7	-3.99	1.06	No
32	16:51	17:51	21.8	19.2	-2.64	2.41	No
33	17:52	18:52	22.2	19.1	-3.09	1.95	No
34	18:53	19:53	20.7	18.0	-2.75	2.30	No
35	19:54	20:54	20.0	16.9	-3.07	1.98	No
36	20:55	21:55	20.7	17.3	-3.32	1.72	No
37	21:56	22:56	22.4	19.2	-3.18	1.87	No
38	22:57	23:57	24.5	21.3	-3.27	1.78	No
39	23:58	00:58	27.0	24.6	-2.35	2.70	No
40	00:59	01:59	27.1	25.5	-1.53	3.51	No
41	02:00	03:00	23.5	21.4	-2.15	2.89	No
42	03:01	04:01	21.8	19.1	-2.71	2.33	No
43	04:02	05:02	20.5	18.8	-1.69	3.35	No
44	05:03	06:03	22.2	20.6	-1.68	3.36	No
45	06:04	07:04	33.9	33.5	-0.48	4.56	No
46	07:05	08:05	23.9	21.5	-2.45	2.60	No
47	08:06	09:06	22.9	20.1	-2.84	2.20	No
				Average \bar{D}_i	-5.04		
			Standard Deviation		2.46		
			Standard Deviation x2		4.92		

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

Test No	Test Start Time	Test End Time	SRM measured value (y)	SRM O2	SRM Standardised
	hr:min		(ppm)	(%)	(mg/m3)
2	13:02	14:02	20.6	6.3	61.8
3	11:30	12:30	22.3	6.3	66.4
5	13:32	14:32	19.8	6.2	58.5
6	14:33	15:33	20.0	6.0	58.9
7	15:34	16:34	20.8	6.0	61.0
8	16:35	17:35	21.5	5.9	62.5
9	17:36	18:36	22.1	5.9	64.5
10	18:37	19:37	22.0	5.9	64.1
11	19:38	20:38	19.5	5.9	56.7
12	20:39	21:39	18.4	6.0	53.9
13	21:40	22:40	17.8	6.1	52.6
14	22:41	23:41	17.5	6.1	51.5
15	23:42	0:42	17.2	6.1	50.5
16	0:43	1:43	16.7	6.0	49.0
17	1:44	2:44	16.2	5.9	47.2
18	2:45	3:45	22.1	5.7	63.6
19	3:46	4:46	16.9	5.8	48.9
20	4:47	5:47	16.7	6.1	49.1
21	5:48	6:48	16.7	6.1	49.2
22	6:49	7:49	17.2	6.0	50.3
23	7:50	8:50	17.3	6.1	51.2
24	8:51	9:51	16.9	6.2	50.1
25	10:45	11:45	17.4	6.1	51.4
26	11:46	12:46	20.5	6.2	60.7
27	12:47	13:47	20.9	6.1	61.9
28	13:48	14:48	20.1	6.1	59.2
29	14:49	15:49	19.3	6.0	56.7
30	15:50	16:50	19.7	5.9	57.6
31	16:51	17:51	19.7	6.0	57.9
32	17:52	18:52	19.2	6.0	56.5
33	18:53	19:53	19.1	6.0	56.3
34	19:54	20:54	18.0	6.0	52.8
35	20:55	21:55	16.9	6.0	49.7
36	21:56	22:56	17.3	6.1	51.3
37	22:57	23:57	19.2	6.2	57.3
38	23:58	0:58	21.3	6.2	63.2
39	0:59	1:59	24.6	6.0	72.5
40	2:00	3:00	25.5	5.8	74.2
41	3:01	4:01	21.4	5.9	62.1
42	4:02	5:02	19.1	6.0	56.1
43	5:03	6:03	18.8	6.2	56.1
44	6:04	7:04	20.6	6.2	61.2
45	7:05	8:05	33.5	6.3	100.0
46	8:06	9:06	21.5	6.3	64.4
47	0:00	0:00	20.1	6.4	60.4
Sum			890.05		
Emission Limit Value (ELV) =			440 mg/Nm ³	Y _{max}	100.02
Maximum Permissible uncertainty =			20 %	Y _{min}	47.17
Maximum Permissible uncertainty (at 1			88 mg/Nm ³		
15% of the ELV =			66 mg/Nm ³		
Is Ymax - Ymin > MPU at ELV?			No	Y _{max} - Y _{min}	52.85
Is Ymin > 15% of ELV?			No		

Derivation of Calibration Function	Method C
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4A2.6.3 Table 4.3.3 - Data used to derive calibration function - Sulphur Dioxide, High Range.

Test No	Test Start Time	Test End Time	SRM measured value (y)	CEMS measured signal (x)	Yi	Xi	Xi * Yi	Xi ²	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference Zero		0.0	-0.2	-38.10	-42.95	1636.31	1844.49	
2	Reference Span		900.0	905.3	861.90	862.52	743407.91	743944.99	
4	13:02	14:02	20.6	28.5	-17.46	-14.30	249.68	204.58	
5	14:03	15:03	22.3	29.8	-15.84	-12.95	205.19	167.74	
6	11:30	12:30	20.4	25.6	-17.68	-17.22	304.42	296.41	
8	13:32	14:32	20.0	26.9	-18.07	-15.86	286.58	251.63	
9	14:33	15:33	20.8	27.7	-17.30	-15.08	260.88	227.45	
10	15:34	16:34	21.5	28.0	-16.65	-14.81	246.53	219.31	
11	16:35	17:35	22.1	28.6	-15.98	-14.13	225.77	199.73	
12	17:36	18:36	22.0	30.1	-16.10	-12.64	203.49	159.69	
13	18:37	19:37	19.5	26.3	-18.63	-16.44	306.20	270.16	
14	19:38	20:38	18.4	25.0	-19.65	-17.76	348.99	315.31	
15	20:39	21:39	17.8	23.4	-20.32	-19.33	392.86	373.78	
16	21:40	22:40	17.5	24.0	-20.60	-18.82	387.78	354.36	
17	22:41	23:41	17.2	23.3	-20.91	-19.52	408.30	381.18	
18	23:42	0:42	16.7	24.1	-21.38	-18.67	399.15	348.56	
19	0:43	1:43	16.2	22.4	-21.90	-20.38	446.40	415.32	
20	1:44	2:44	22.1	29.9	-15.97	-12.89	205.78	166.13	
21	2:45	3:45	16.9	23.7	-21.16	-19.05	403.17	363.09	
22	3:46	4:46	16.7	22.3	-21.43	-20.51	439.54	420.54	
23	4:47	5:47	16.7	24.2	-21.39	-18.56	396.91	344.46	
24	5:48	6:48	17.2	24.2	-20.94	-18.54	388.07	343.60	
25	6:49	7:49	17.3	23.9	-20.75	-18.91	392.42	357.57	
26	7:50	8:50	16.9	21.8	-21.22	-20.98	445.30	440.21	
27	8:51	9:51	17.4	23.3	-20.68	-19.45	402.25	378.46	
28	10:45	11:45	20.5	23.5	-17.61	-19.28	339.62	371.84	
29	11:46	12:46	20.9	24.7	-17.19	-18.06	310.48	326.34	
30	12:47	13:47	20.1	23.7	-17.98	-19.10	343.45	364.87	
31	13:48	14:48	19.3	23.5	-18.82	-19.29	363.18	372.25	
32	14:49	15:49	19.7	23.9	-18.35	-18.85	345.96	355.30	
33	15:50	16:50	19.7	23.7	-18.35	-19.04	349.47	362.58	
34	16:51	17:51	19.2	21.8	-18.90	-20.94	395.77	438.53	
35	17:52	18:52	19.1	22.2	-18.98	-20.56	390.23	422.88	
36	18:53	19:53	18.0	20.7	-20.11	-22.04	443.34	485.85	
37	19:54	20:54	16.9	20.0	-21.21	-22.82	484.09	520.79	
38	20:55	21:55	17.3	20.7	-20.75	-22.11	458.84	488.76	
39	21:56	22:56	19.2	22.4	-18.87	-20.37	384.32	414.89	
40	22:57	23:57	21.3	24.5	-16.82	-18.23	306.66	332.35	
41	23:58	0:58	24.6	27.0	-13.46	-15.79	212.64	249.47	
42	0:59	1:59	25.5	27.1	-12.56	-15.70	197.22	246.60	
43	2:00	3:00	21.4	23.5	-16.73	-19.26	322.18	370.83	
44	3:01	4:01	19.1	21.8	-19.00	-20.96	398.29	439.51	
45	4:02	5:02	18.8	20.5	-19.26	-22.24	428.32	494.71	
46	5:03	6:03	20.6	22.2	-17.54	-20.54	360.42	421.99	
47	6:04	7:04	33.5	33.9	-4.64	-8.83	40.94	78.01	
48	7:05	8:05	21.5	23.9	-16.61	-18.84	313.06	355.09	
49	8:06	9:06	20.1	22.9	-18.04	-19.88	358.50	395.02	
Sum			1790.71	2010.54	0.00	0.00	760336.89	761097.20	1.00

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

Method C

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

N	N	N	N		
$b = \sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})$ where	$\bar{x} = 1/N \sum_{i=1}^N x_i$	$\bar{y} = 1/N \sum_{i=1}^N y_i$		$x =$	42.78
$i=1$	$i=1$	$i=1$	$i=1$	$y =$	38.10
				$b =$	0.999
$a = y - bx$	$a = 38.11 - 42.78 * 0.999$			$a =$	-4.635

The calibration is function $y_i = a + b x_i$ or $y_i = -4.635 + 0.999 * x_i$

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

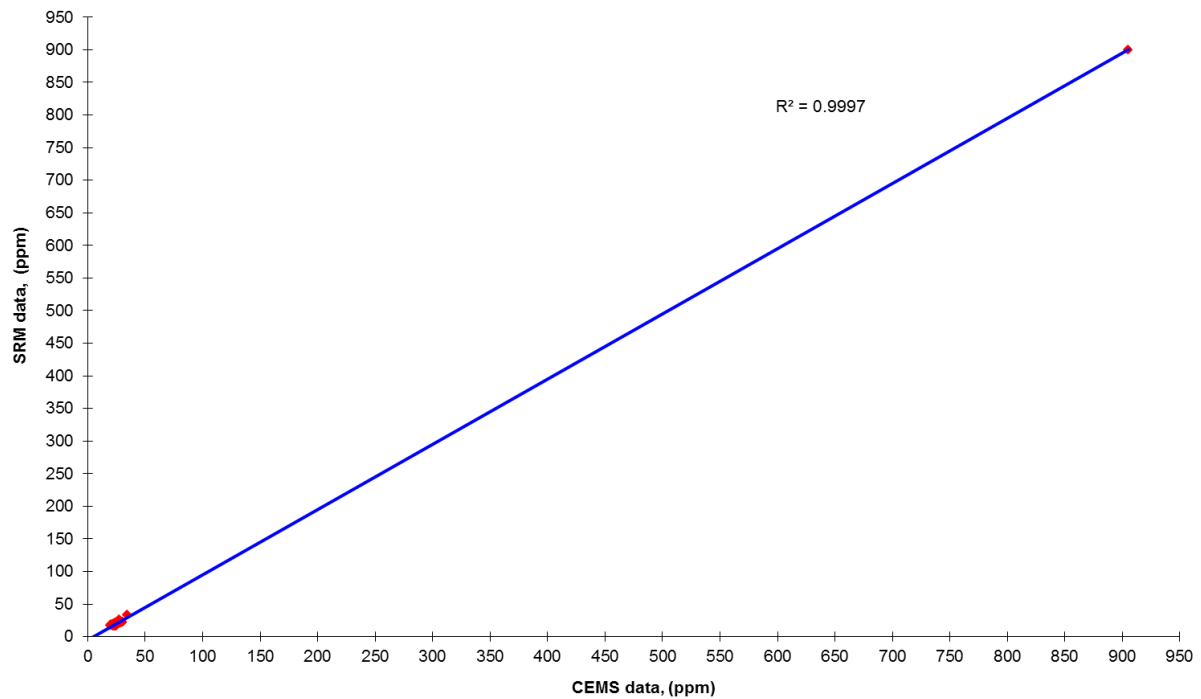
Test No	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
	hr:min		(ppm)	(ppm)	(%)	(%)	(mg/Nm ³)	(mg/Nm ³)	(mg/m ³)
1	Reference Zero		-0.2	-4.8	N/A	N/A	-0.2	-13.7	0.0
2	Reference Span		905.3	899.8	N/A	N/A	905.3	2570.7	2571.4
4	13:02	14:02	28.5	23.8	6.4	2.1	85.5	71.5	61.8
5	14:03	15:03	29.8	25.2	6.4	2.1	89.4	75.4	66.4
6	11:30	12:30	25.6	20.9	6.2	2.0	75.4	61.6	60.2
8	13:32	14:32	26.9	22.3	6.2	2.0	79.5	65.7	58.9
9	14:33	15:33	27.7	23.0	6.2	2.2	81.7	68.0	61.0
10	15:34	16:34	28.0	23.3	6.1	2.2	82.1	68.4	62.5
11	16:35	17:35	28.6	24.0	6.1	2.2	84.2	70.5	64.5
12	17:36	18:36	30.1	25.5	6.1	2.2	88.6	74.9	64.1
13	18:37	19:37	26.3	21.7	6.1	2.2	77.4	63.7	56.7
14	19:38	20:38	25.0	20.4	6.1	2.2	73.6	59.9	53.9
15	20:39	21:39	23.4	18.8	6.3	2.1	70.0	56.1	52.6
16	21:40	22:40	24.0	19.3	6.3	2.1	71.3	57.5	51.5
17	22:41	23:41	23.3	18.6	6.2	2.1	68.9	55.1	50.5
18	23:42	00:42	24.1	19.4	6.2	2.1	71.3	57.5	49.0
19	00:43	01:43	22.4	17.7	6.1	1.9	65.6	51.9	47.2
20	01:44	02:44	29.9	25.2	5.8	1.8	86.0	72.6	63.6
21	02:45	03:45	23.7	19.1	5.9	1.9	68.6	55.1	48.9
22	03:46	04:46	22.3	17.6	6.2	1.9	65.9	52.1	49.1
23	04:47	05:47	24.2	19.6	6.2	1.8	71.6	57.8	49.2
24	05:48	06:48	24.2	19.6	6.2	1.8	71.4	57.7	50.3
25	06:49	07:49	23.9	19.2	6.3	1.8	70.7	56.9	51.2
26	07:50	08:50	21.8	17.1	6.4	1.8	65.1	51.2	50.1
27	08:51	09:51	23.3	18.7	6.3	1.8	69.2	55.4	51.4
28	10:45	11:45	23.5	18.8	6.3	1.8	69.6	55.8	60.7
29	11:46	12:46	24.7	20.1	6.2	1.8	72.8	59.1	61.9
30	12:47	13:47	23.7	19.0	6.2	1.7	69.6	55.9	59.2
31	13:48	14:48	23.5	18.8	6.1	1.6	68.8	55.1	56.7
32	14:49	15:49	23.9	19.3	6.0	1.8	69.4	55.9	57.6
33	15:50	16:50	23.7	19.1	6.0	1.8	69.2	55.6	57.9
34	16:51	17:51	21.8	17.2	6.1	1.8	64.0	50.3	56.5
35	17:52	18:52	22.2	17.6	6.1	1.8	65.2	51.5	56.3
36	18:53	19:53	20.7	16.1	6.1	1.8	60.7	47.1	52.8
37	19:54	20:54	20.0	15.3	6.1	1.8	58.5	44.9	49.7
38	20:55	21:55	20.7	16.0	6.2	1.8	60.9	47.2	51.3
39	21:56	22:56	22.4	17.8	6.3	1.7	66.6	52.8	57.3
40	22:57	23:57	24.5	19.9	6.3	1.7	72.7	58.9	63.2
41	23:58	00:58	27.0	22.3	6.1	1.7	79.0	65.4	72.5
42	00:59	01:59	27.1	22.4	5.9	1.5	77.7	64.4	74.2
43	02:00	03:00	23.5	18.9	6.0	1.6	68.1	54.6	62.1
44	03:01	04:01	21.8	17.2	6.1	1.7	63.8	50.2	56.1
45	04:02	05:02	20.5	15.9	6.3	1.8	60.8	47.0	56.1
46	05:03	06:03	22.2	17.6	6.3	1.9	66.0	52.2	61.2
47	06:04	07:04	33.9	29.3	6.3	1.9	101.2	87.3	100.0
48	07:05	08:05	23.9	19.3	6.4	1.8	71.6	57.7	64.4
49	08:06	09:06	22.9	18.2	6.4	1.7	68.6	54.7	60.4
Sum							4162.75		
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.



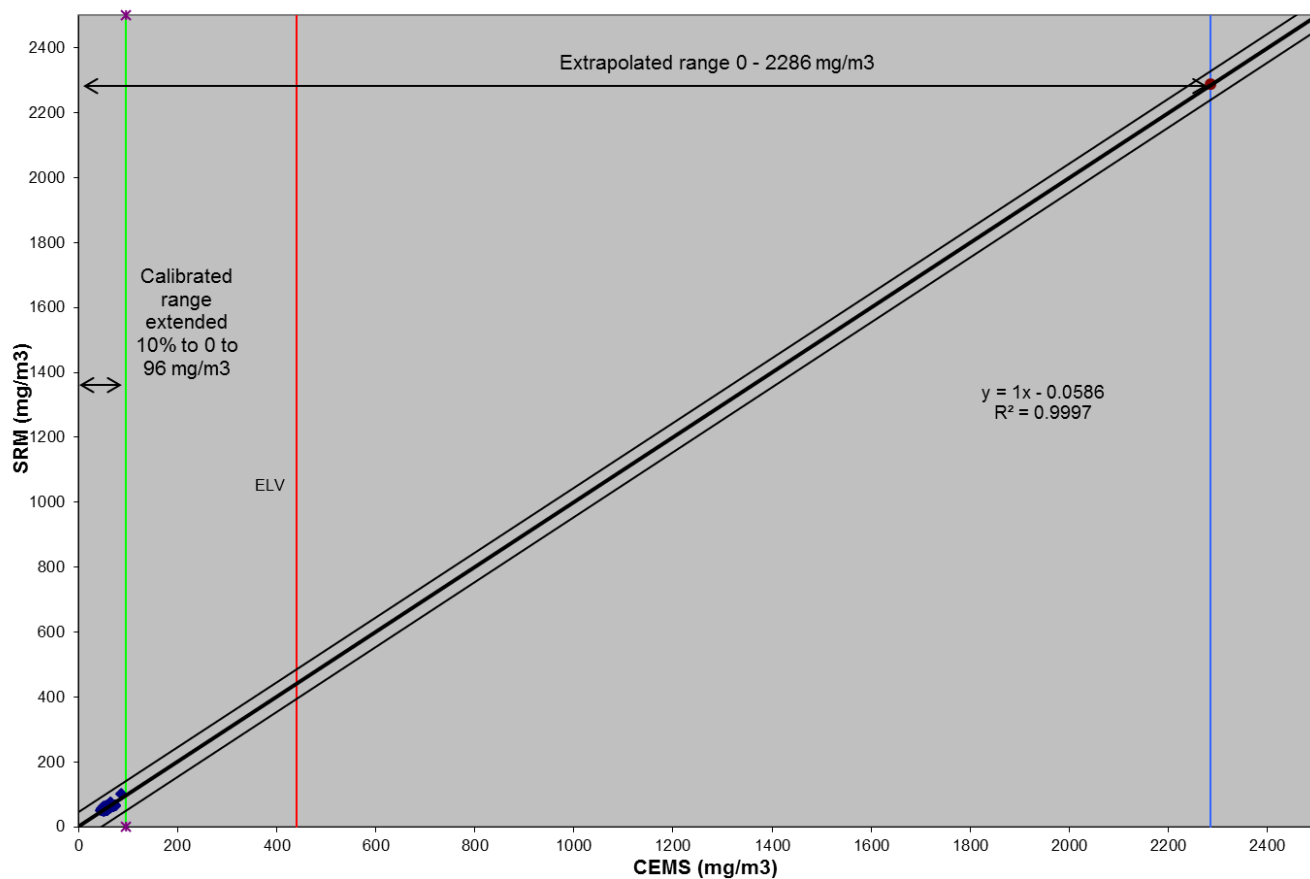
4A2.10.3 Table 4.5.3 – Data used for the Variability Test – Sulphur Dioxide, High Range.

Test No	Test 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			
4	13:02	14:02	71.5	61.8	-9.72	-9.33	87.13
5	14:03	15:03	75.4	66.4	-8.97	-8.59	73.75
6	11:30	12:30	61.6	60.2	-1.48	-1.10	1.21
8	13:32	14:32	65.7	58.9	-6.77	-6.39	40.88
9	14:33	15:33	68.0	61.0	-7.02	-6.64	44.02
10	15:34	16:34	68.4	62.5	-5.88	-5.50	30.21
11	16:35	17:35	70.5	64.5	-5.99	-5.60	31.41
12	17:36	18:36	74.9	64.1	-10.78	-10.40	108.08
13	18:37	19:37	63.7	56.7	-7.01	-6.63	44.00
14	19:38	20:38	59.9	53.9	-6.03	-5.65	31.94
15	20:39	21:39	56.1	52.6	-3.53	-3.14	9.89
16	21:40	22:40	57.5	51.5	-5.93	-5.55	30.81
17	22:41	23:41	55.1	50.5	-4.62	-4.24	17.94
18	23:42	00:42	57.5	49.0	-8.48	-8.10	65.56
19	00:43	01:43	51.9	47.2	-4.76	-4.38	19.18
20	01:44	02:44	72.6	63.6	-8.93	-8.55	73.13
21	02:45	03:45	55.1	48.9	-6.22	-5.83	34.05
22	03:46	04:46	52.1	49.1	-3.05	-2.67	7.14
23	04:47	05:47	57.8	49.2	-8.59	-8.21	67.43
24	05:48	06:48	57.7	50.3	-7.32	-6.94	48.20
25	06:49	07:49	56.9	51.2	-5.76	-5.38	28.97
26	07:50	08:50	51.2	50.1	-1.07	-0.69	0.47
27	08:51	09:51	55.4	51.4	-3.91	-3.53	12.44
28	10:45	11:45	55.8	60.7	4.94	5.32	28.26
29	11:46	12:46	59.1	61.9	2.81	3.19	10.16
30	12:47	13:47	55.9	59.2	3.34	3.72	13.81
31	13:48	14:48	55.1	56.7	1.58	1.96	3.84
32	14:49	15:49	55.9	57.6	1.68	2.06	4.25
33	15:50	16:50	55.6	57.9	2.26	2.64	7.00
34	16:51	17:51	50.3	56.5	6.18	6.56	43.10
35	17:52	18:52	51.5	56.3	4.80	5.18	26.88
36	18:53	19:53	47.1	52.8	5.75	6.13	37.58
37	19:54	20:54	44.9	49.7	4.78	5.16	26.67
38	20:55	21:55	47.2	51.3	4.09	4.47	19.96
39	21:56	22:56	52.8	57.3	4.51	4.89	23.91
40	22:57	23:57	58.9	63.2	4.33	4.71	22.15
41	23:58	00:58	65.4	72.5	7.10	7.48	55.94
42	00:59	01:59	64.4	74.2	9.80	10.18	103.67
43	02:00	03:00	54.6	62.1	7.44	7.82	61.17
44	03:01	04:01	50.2	56.1	5.87	6.25	39.10
45	04:02	05:02	47.0	56.1	9.10	9.48	89.95
46	05:03	06:03	52.2	61.2	9.02	9.40	88.35
47	06:04	07:04	87.3	100.0	12.77	13.15	173.00
48	07:05	08:05	57.7	64.4	6.78	7.16	51.33
49	08:06	09:06	54.7	60.4	5.74	6.12	37.46
45 Tests		Mean			-0.38		
Sum							1875.38

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

SD=	Root(1-Number).Integral(D1-D) ²	6.53	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 mg/m3 (s,d,6%O2)/1.96	44.90	mg/m3(s,d),6%O2
For 45 tests, kv =	0.9885		
Therefore variability=	6.53 <= 44.9 * 0.9885		
or	6.53 <=	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 5 – Results of Functional tests

Table 5.1 - Audit of functional tests

Operator	RWE Generation UK plc.	
Site	Aberthaw Power Plant	
Stack	Unit 7	
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	
Parameters Tested	Daily ELV	Certified range
NO & NO₂	1080 mg/m ³ (NO _x as NO ₂)	PROCAL: NO = 0 – 1000 ppm
SO₂	440 mg/m ³	PROCAL = SO2 low = 0 – 250 ppm SO2 high = 0 – 1000 ppm
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	1 st – 11 th October 2016	

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</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>N/A</p>	<p>Procal – N/A</p>
<p>Results of leak check compliant with requirements of relevant standards</p>	<p>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>Yes</p>	<p>Procal – Yes</p>
<p>Results compliant with requirements of relevant standards</p> <p>Parameter:</p>		
<p>NO</p> <p>SO₂</p>	<p>Yes (Procal)</p> <p>Yes (Procal)</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 analysers are in situ type and therefore there is as such, no 'full system'.
5 – NOx converter efficiency check	N/A	
6 - Linearity The linearity of the analysers shall be checked using five different reference materials, including zero concentration.	Yes	Procal – Yes
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
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.	Yes	Procal – Yes
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>
Linearity Test Pass		Procal – Yes
Parameter		
NO, SO ₂ & TPM	Yes	
6 – Interferences (only required in the event of a failure of the QAL 2/AST)	N/A	
7 – Zero and Span Drift (Audit)	Yes	
<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>	Yes	Procal – Yes

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
• Gases used – certificate numbers, expiry dates, type	No	Copy of gas certificates offered 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	



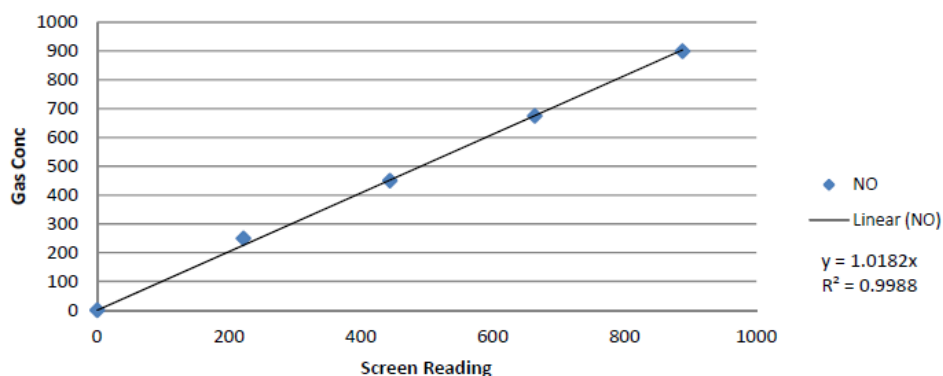
LINEARISATION RESULTS

Site	Aberthaw	
Date	04/10/2016	
Instrument	Unit 7 Primary	
Instrument Ref	8800623	8500442M
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.

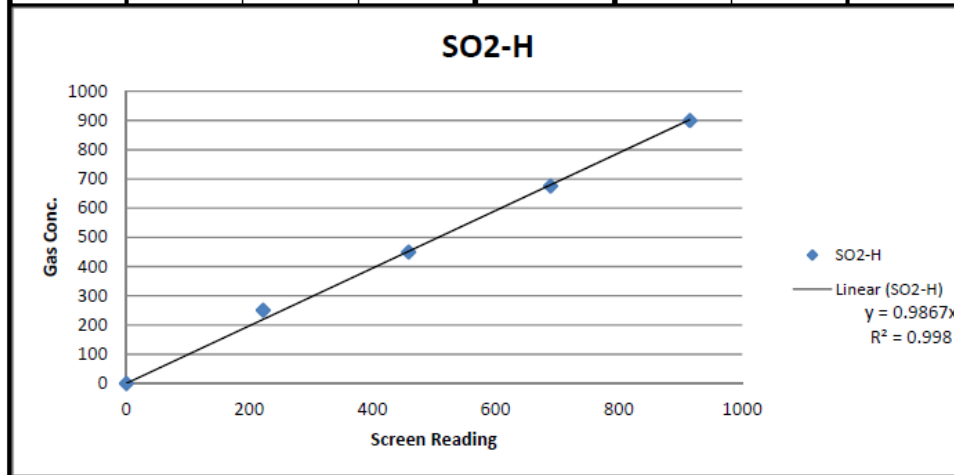
Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
NO	PPM	1000	900	4000619281	888	888	-1.2
					888	888	-1.2
					885	885	-1.5
NO	PPM	1000	675		664	664	-1.1
					666	666	-0.9
					666	666	-0.9
NO	PPM	1000	450		444	444	-0.6
					447	447	-0.3
					447	447	-0.3
NO	PPM	1000	225		222	222	-0.3
					224	224	-0.1
					222	222	-0.3

NO



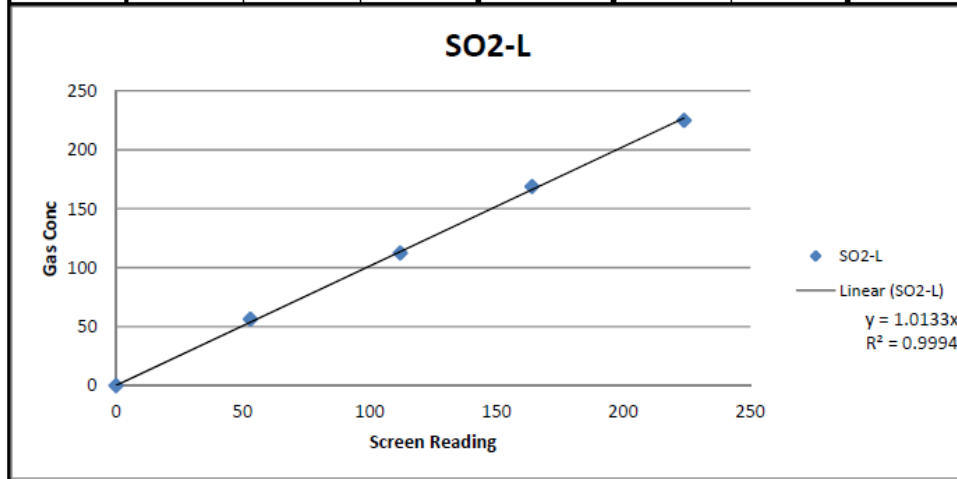
Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK
Tel: +44 (0) 17336 232495 Email: procal@parker.com Website: www.procal.com

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
SO2-H	PPM	1000	900	40006192554	915	915	1.5
					910	910	1.0
					912	912	1.2
SO2-H	PPM	1000	675		689	689	1.4
					685	685	1.0
					685	685	1.0
SO2-H	PPM	1000	450		458	458	0.8
					458	458	0.8
					458	458	0.8
SO2-H	PPM	1000	225		222	222	-0.3
					224	224	-0.1
					222	222	-0.3



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
					pre cal	post cal	FSD
SO2-L	PPM	250	225	40006192686	224	224	-0.4
					222	222	-1.2
					223	223	-0.8
SO2-L	PPM	250	168.75		164	164	-1.9
					172	172	1.3
					171	171	0.9
SO2-L	PPM	250	112.5		112	112	-0.2
					113	113	0.2
					112	112	-0.2
SO2-L	PPM	250	56.25		53	53	-1.3
					53	53	-1.3
					56	56	-0.1



Zero	H2O	CO2	CO	NO	SO2-H	SO2-L
#1	0.1	3	-1	-0.4	0.1	0.1
#2	0.1	4	6	3	0	0
#3	0	0	0	0	-1	-1
#4	0	1	-1	3	3	3
#5	0	1	0	3	-2	-2
#6	0	-2	0	3	-4	-4

Signature: *M. Findley*

M.Findley

Procal Customer Support Engineer

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Functionality Test Results

DECLARATION OF CONFORMITY

We,

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Woodston
Peterborough
Cambridgeshire
PE2 7HU
United Kingdom

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Web site: www.procal.com

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

Customer	Aberthaw Power Station
Control Unit Serial Number	8800623
P200 Serial Number	8500442M
Site Identification	Unit 7 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
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Technical Standards Used:

EN 15267-2	Dated: 2009
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: 04/10/2016

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Change Note: 7008144

Date: 24/09/10

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1.0 Alignment and Cleanliness.

1.1 Internal Check of Analyser

Analyser under test	Status	Notes
Optical path clear	Yes	
Optics clean	No	Optical levels ok
Internal wiring ok	Yes	
Air supply on	Yes	
Purge flow >300 ltrs/hr	Yes	
Pressure differential <80mBar	Yes	47mbar

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	134	354	225	23	22	30.9	132	1021
Zero conc	0	1	-1	3	3	3	31	129	1068
% 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	400	500	1000	1000	250			
Zero Conc	0	2	0	3	3	3	31	129	1068
Test Gas Conc			336	659	674	225	31	130	1084
Cert number			Site Gas		Site Gas	6192686			
Response Conc			335	662	679	224			
% Error			>2	>2	>2	>2			
Pass/Fail			Pass	Pass	Pass	Pass			
T90 time				70	90	75			

2.3 Filter Level Checks

All on zero air	F6	F2	F7	F5G	F3	F1G	F4	F8	
Factory	1890	3979	4090	2306	3471	2218	539	3481	
Last visit	1543	3058	3379	1923	2817	1876	484	2911	
This visit	1455	2824	3129	1781	2651	1760	469	2793	



2.4 Interference Checks

Component:	H2O	CO2	CO	NO	SO2-H	SO2-L
Units:	%	mAU	ppm	ppm	ppm	ppm
ZERO	0	-3	0	-1	-4	-4
CO2 15%	0	148	0	9	-2	-2
H2O 2%	1.9	-1	4	-10	-3	3
H2O 2% & CO2 14.95%	2	148	3	-2	-3	-3

3.0 Data Acquisition.

Displayed \ Component	H2O	CO2	CO	NO	SO2-H	SO2-L
Analysers	0	1	0	3	-2	-2
Zero DCS						
4-20mA						
Analysers	2	148	335	662	679	224
Span DCS						
4-20mA						

4.0 Linear coefficient record.

Coefficient \ Component	H2O	CO2	CO	NO	SO2-H	SO2-L
Linear	2.160E-2	1	8.152E0	1.342E1	4.609E0	4.804E+0
Last test Squared	4.210E-5	0	1.202E-1	4.310E-2	-4.802E-4	1.555E-3
Cubed						
Linear						
This test Squared	2.160E-2	1	7.772E0	1.311E1	4.870E0	5.367E0
Cubed	4.210E-5	0	1.146E-1	4.210E-2	-5.074E-4	-1.220E-2

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	√	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-alignment required
• Alignment of the measuring system	√	No alignment required
• Contamination control (internal check of optical surfaces)	√	Filter levels ok after inspection of test screen readings
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 MK3 customer DCS during testing

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Requirement		Notes
DCS logged values should be included in the instrument service report.	√	Data collected on ACU MK3 & 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. 	<ul style="list-style-type: none"> √ Interference checks made with Water vapour, CO2 and each gas species
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 has 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 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 	<ul style="list-style-type: none"> √ Procal Method Statement
<ul style="list-style-type: none"> Instrument manufacturer 	<ul style="list-style-type: none"> √ Procal
<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"> √ 8500442M
<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"> √ Unit 7 Primary
<ul style="list-style-type: none"> Date and time work was undertaken 	<ul style="list-style-type: none"> √ 04/10/2016
<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 #8
<ul style="list-style-type: none"> Gases used - certificate numbers, expiry dates, binary / mix 	<ul style="list-style-type: none"> √ Copy of Gas Certs at customer request can be emailed
<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)



CALIBRATION CERTIFICATE

Site	Aberthaw	
Date	01/10/2016	
Instrument	Unit 7 Primary	
Instrument Ref	8800623	8500442M
Engineer	Michael Findley	

Results:

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
H2O	%	10	P9000	Pcal #8	n/A	n/a	
CO2	mAU	400	14.95%	6351862	n/a	n/a	
CO	PPM	500	336	Site Gas	351	335	-0.2
NO	PPM	1000	659		679	662	0.3
SO2-H	PPM	1000	674	Site Gas	704	679	0.5
SO2-L	PPM	250	225	6192686	230	224	-0.4

Cross sensitivity tests:

Test/	Response			% Error FSD		
	CO	NO	SO2-H	CO	NO	SO2-H
CO2 14.95%	0	9	-2	0.0	0.9	-0.2
H2O 2%	4	-10	-3	0.8	-1.0	-0.3
CO2 14.95% & H2O 2%	3	-2	-3	-3.0	-0.2	-0.3

Test/	Response			% Error FSD		
	SO2-L			SO2-L		
CO2 14.95%	-2			-0.8		
H2O 2%	-3			-1.2		
CO2 14.95% & H2O 2%	-3			-1.2		

Signature:

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



Visit Ref:0001290

Service Engineers Report

Client Aberthaw Power Station RWE INNOGY PLC THE LEYS (NEAR BARRY) SOUTH GLAMORGAN Contact Tel No. 01446 750271	Job Category Chargeable UK Activity Functionality inc. Linearisation Date of Visit 03/10/2016 Analysers/System No. 8800623 8500442 U7 Primary 8800539 8500916 U8 Primary 8800624 8500705 U7 Secondary 8800624 8500726 U8 Secondary
--	--

Qty	Description	Part No.

Travel Time	4 days	Mileage driven	1140
Site Time	4 days	Expenses incurred	£750
Engineer	Michael Findley	For Client	

Aim of Visit

To carry out functionality and Linearisation on stack instruments and also survey of the FGD instruments

Summary of work completed:

- Functionality and linearisation completed on U7 Primary & secondary and U8 Primary
- Analysis of the three FGD instruments for work to be carried out at a future date

Outstanding actions/comments:

- Test house to carry out their own testing to assess the performance of the stack instruments
- Work to be carried out on FGD instruments at a later date

Visit details:

Unit 7 Primary & Secondary instruments

Functionality and linearisation completed on both instruments.

Filter levels check to assess any deterioration of optics. Filter levels above 70% of original despatch signals on both instruments no requirement to remove instruments.

Dry gas test carried out on measured channels using site gas bottles. Adjustments required to some measured gas channels on both instruments.

CO2 Xsense test carried out @15% to check for Interference with any other measured channels, no adjustment required to any channels.

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Water vapour testing carried out checking for interference with any other measured channels on both instruments .
Some adjustments required to both instruments on certain measured channels .

CO2 & H2O combined test for interference on both instruments adjustment required to certain measured channels on both instruments.

Linearisation completed on both instruments adjustments made certain measured channels on both instruments .

Unit 8 Primary

Functionality and linearisation completed.

Filter levels check to assess any deterioration of optics. Filter levels above 60% of original despatch signals no requirement to remove instruments.

Dry gas test carried out on measured channels using site gas bottles . Adjustments required to some measured gas channels.

CO2 Xsense test carried out @15% to check for Interference with any other measured channels no adjustments required to any channels.

H2O tests carried out checking for interference with measured channels channel . I ran a series of H2O points collecting data at each concentration of vapour. From this no adjustments required to any interfering channel.

CO2 & H2O combined test for interference with measured channels an adjustment required to the NO channel .
Linearisation completed on both instruments adjustments made certain channels.

Linearisation completed including H2O and made some changes to certain measured channels.

A Functionality, linearisation and calibration certificate is provided with the results of all instruments.

FGD Instruments

A review of the FGD instruments was carried out and below are the actions required for each instrument when service and calibration is due to be carried out.

8501044M

Instrument to be removed for replacement of sinter and possible optics inspection.

8501046M

Instrument to be removed to replace new anti-vibration gasket required and possible optics inspection.

8501214M

Filter levels less than 50% instrument will need removing for inspection of all optics.

Spare 8501045 Instrumentation Dept

Instrument to be strip down to check optics and ensure correctly fitted due uneven filter levels. There is a possibility of a leaky NO gas cell.

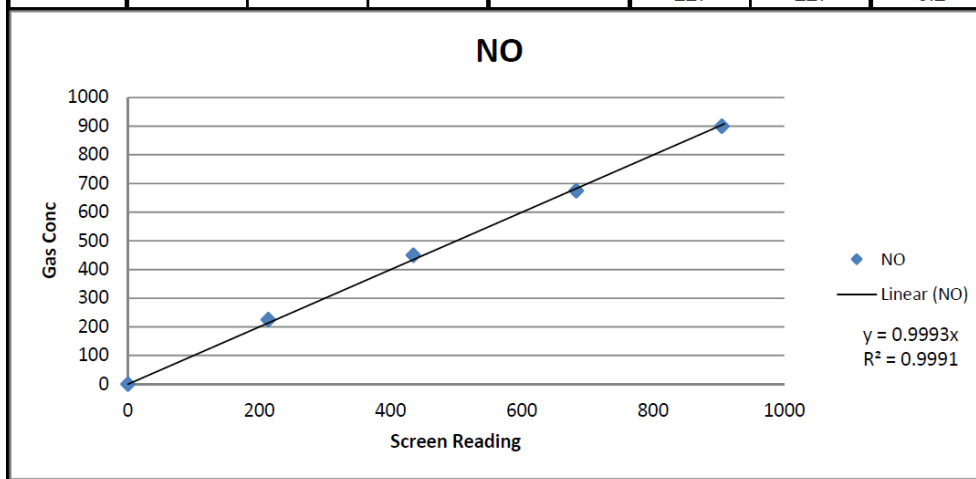


LINEARISATION RESULTS

Site	Aberthaw	
Date	11/10/2016	
Instrument	Unit 7 Back Up	
Instrument Ref	8800624	8500705
Engineer	Michael Findley	

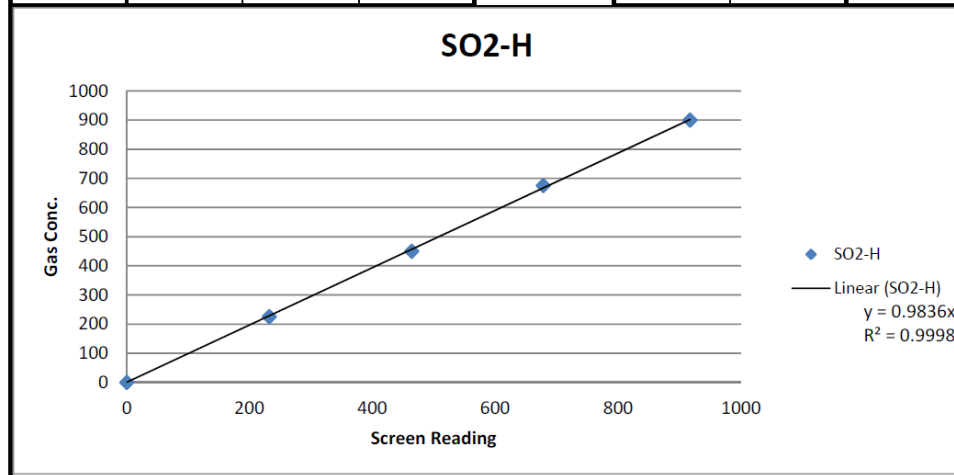
The above analyser has undergone a linearisation check and calibration, if required, in accordance with the company's quality system. The following results were obtained.

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
NO	PPM	1000	900	4000619281	905	905	0.5
					907	907	0.7
					909	909	0.9
NO	PPM	1000	675	4000619281	683	683	0.8
					682	682	0.7
					680	680	0.5
NO	PPM	1000	450	4000619281	435	435	-1.5
					444	444	-0.6
					443	443	-0.7
NO	PPM	1000	225	4000619281	214	214	-1.1
					227	227	0.2
					227	227	0.2



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Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
SO2-H	PPM	1000	900	40006192554	917	917	1.7
					903	903	0.3
					896	896	-0.4
SO2-H	PPM	1000	675	40006192554	678	678	0.3
					675	675	0.0
					676	676	0.1
SO2-H	PPM	1000	450	40006192554	464	464	1.4
					449	449	-0.1
					449	449	-0.1
SO2-H	PPM	1000	225	40006192554	232	232	0.7
					222	222	-0.3
					223	223	-0.2



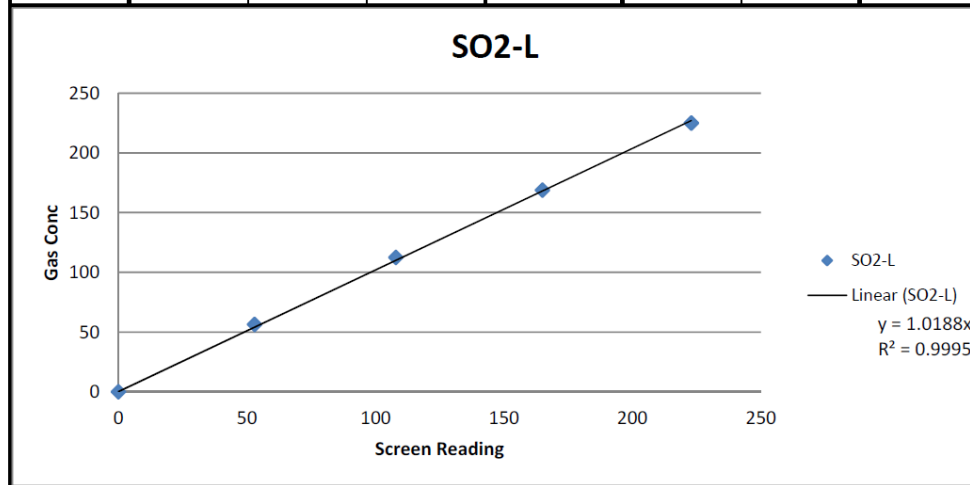
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E-mail: asampson@procal.com Website: www.procal.com

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	225	4006192686	223	223	-0.8
					222	222	-1.2
					221	221	-1.6
SO2-L	PPM	250	168.75	4006192686	165	165	-1.5
					166	166	-1.1
					164	164	-1.9
SO2-L	PPM	250	112.5	4006192686	108	108	-1.8
					108	108	-1.8
					108	108	-1.8
SO2-L	PPM	250	56.25	4006192686	53	53	-1.3
					54	54	-0.9
					53	53	-1.3



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

Signature: *M. Findley*

M.Findley
Procal Customer Support Engineer

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7-7862-04 Linearisation Certificate

Change note: 7009251

Date: 30/07/12



Functionality Test Results

DECLARATION OF CONFORMITY

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

Customer	Aberthaw
Control Unit Serial Number	8800624
P200 Serial Number	8500705
Site Identification	Stack 7 Back Up

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	
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United Kingdom	Web site: www.siracertification.com

Quality System:

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

Technical Standards Used:

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

Signed:.....

Date: ...11/10/2016.....

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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	19 mbar

2.0 Zero and Span Checks.

2.1 Zero Check

Component: Units:	H2O %	CO2 mAU	CO ppm	NO ppm	SO2-H ppm	SO2-L ppm	Ta	Ts	Ps
Process conc	2.2	200	535	288	63	63	29.6	129	1024
Zero conc	0	-2	-2	-1	2	2	29.6	128	1043
% error	<2	<2	<2	<2	<2	<2			
Pass/Fail	Pass	Pass	Pass	Pass	Pass	Pass			
T90 recovery									

2.2 Span Check

Component: Units:	H2O %	CO2 mAU	CO ppm	NO ppm	SO2-H ppm	SO2-L ppm	Ta	Ts	Ps
Full range	10	-	500	1000	1000	250			
Zero Conc	0	-1	-1	-3	1	1	29.7	129	1042
Test Gas Conc			336	659	674	225			
Cert number			Site gas		Site gas	6192686			
Response Conc			342	659	681	223	30	129	1045
% Error			<2	<2	<2	<2			
Pass/Fail			Pass	Pass	Pass	Pass			
T90 time			95	70	95				

2.3 Filter Level Checks

All on zero air	F2	F4	F6	F1G	F7	F5G	F8	F3	
Factory	2093	3650	3904	2426	3776	2399	463	2281	
Last visit	1728	3043	3271	2118	3264	2337	414	1977	
This visit	1706	3180	3389	2183	3333	2393	420	1994	



2.4 Interference Checks

Component: Units:	H2O %	CO2 mAU	CO ppm	NO ppm	SO2-H ppm	SO2-L ppm
ZERO	0	-1	-1	-3	1	1
CO2 15%	-0.1	226	2	-11	1	1
H2O 2.5%	2	2	-1	-7	8	7
H2O + CO2	2.2	234	3	-19	6	4

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	1.650e-2	1.000e+0	7.400e+0	1.153e+1	6.202e+0	5.96e+0
	Squared	4.400e-5	0.000e+0	1.120e-1	3.988e-2	-1.528e-3	5.94e-3
	Cubed						
This test	Linear	1.650e-2	1.000e+0	7.201e+0	1.139e+1	6.466e+0	5.833e+0
	Squared	4.400e-5	0.000e+0	1.090e-1	3.939e-2	-1.593e-3	5.813e-3
	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	√	
• 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. 	<ul style="list-style-type: none"> ✓ Interference checks made with Water vapour, CO2 and each gas species
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 has 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 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 	<ul style="list-style-type: none"> ✓ Procal Method Statement
<ul style="list-style-type: none"> Instrument manufacturer 	<ul style="list-style-type: none"> ✓ Procal
<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"> ✓ 8500705
<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"> ✓ Stack 7 Back Up
<ul style="list-style-type: none"> Date and time work was undertaken 	<ul style="list-style-type: none"> ✓ 16/02/2016
<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 #1
<ul style="list-style-type: none"> Gases used - certificate numbers, expiry dates, binary / mix 	<ul style="list-style-type: none"> ✓ Copy of Gas certs emailed to customer
<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)



CALIBRATION CERTIFICATE

Site	Aberthaw	
Date	11/10/2016	
Instrument	Unit 7 Back Up	
Instrument Ref	8800624	8500705M
Engineer	Michael Findley	

Results:

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
H2O	%	10	n/a				
CO2	mAU	400	n/a				
CO	PPM	500	336	site gas	345	342	1.2
NO	PPM	1000	659		667	659	0.0
SO2-H	PPM	1000	674	site gas	647	681	0.7
SO2-L	PPM	250	225	6192686	232	223	-0.8

Cross sensitivity tests:

Test/	Response			% Error FSD		
	CO	NO	SO2-H	CO	NO	SO2-H
CO2 15%	2	-11	1	0.4	-1.1	0.1
H2O 3%	0	3	0	0.0	0.3	0.0
CO2 15% + H2O 3%	3	-19	6	0.6	-1.9	0.6

Test/	Response			% Error FSD		
	SO2-L			SO2-L		
CO2 15%	1			0.4		
H2O 3%	7			2.8		
CO2 15% + H2O 3%	4			1.6		

Signature: *M. Findley*

M.Findley
Procal Customer Support Engineer

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

7-7853-02 cal cert site visit general use

Change note: 7007110

Date: 17/03/09

CERTIFICATE OF CALIBRATION

Unit No	U 7
Application	Stack Flue Gas Oxygen Analyser
Probe Serial No	3K220000139813
WOC No	3-16-513044-00

TESTED AGAINST		
Calibration Meter	Type	Beamex
	Serial No	25514526
	Calibration Date	05-02-16
2 % Oxygen	Certified Input Valve	1.98 %
	Cylinder No	S1358263
	Expiry Date	04/10/2017
	Theoretical Output	7.168mA
8 % Oxygen	Certified Input Valve	8.04 %
	Cylinder No	S1144548
	Expiry Date	19/06/2019
	Theoretical Output	16.864mA

Results

		Local Display	Current	Procal ACU Display
1.98 % Oxygen (7.168 mA)	Before	1.97%	7.133mA	2%
	After			
8.04 % Oxygen (16.864 mA)	Before	7.94%	16.7mA	8%
	After			

Signed – Ian Jauncey

Date – 16/02/16

RWE Npower
C & I Department
Aberthaw Power Station
West Aberthaw
The Leys
Barry
CF62 4ZW



Table 5.2 - Functional Tests carried out by RPS

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

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

APPENDIX 1: SRM Calibration Data

Table A1.1– SRM On-Site Calibrations

Sample Date	Equipment Name	Equipment ID Number	Span Gas Type	ID Number	Span Gas Concentration	Pre-Sampling Result*		Post-Sampling Result*	
						Zero	Span	Zero	Span
21/10/16	Horiba PG 250	00955	NO (V.U.)	222094	405.7 ppm	0 ppm	405.7 ppm	0 ppm	409.0 ppm
			O ₂ (V.U.)	216463	14.63 %	0.00%	14.63 %	0.14 %	14.59 %
	Gasmet DX4000	01610	SO ₂ (V.U.)	237324	201 ppm	0.0 ppm	196.2 ppm	0.0 ppm	194.0 ppm
24-25/10/16	Horiba PG 250	00955	NO (17025)	83649	405.7 ppm	1.8 ppm	402.9 ppm	2.5 ppm	402.7 ppm
			O ₂ (V.U.)	216463	14.63 %	0.06%	14.44 %	0.09%	14.50 %
	Gasmet DX4000	01610	SO ₂ (V.U.)	237324	201 ppm	0.0 ppm	194.2 ppm	0.0 ppm	194.2 ppm
25-26/11/16	Horiba PG 250	00955	NO (V.U.)	83649	405.7 ppm	2.5 ppm	402.7 ppm	2.3ppm	405.6 ppm
			O ₂ (V.U.)	216463	14.63 %	0.09%	14.50 %	0.01 %	14.55 %
	Gasmet DX4000	01610	SO ₂ (V.U.)	237324	201 ppm	0.0 ppm	194.2 ppm	0.1 ppm	198.0 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

2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

 <p>1709</p> <p>Accredited to ISO/IEC 17025:2005</p>	<p>The Environmental Consultancy Ltd trading as RPS Consultants</p> <p>Issue No: 066 Issue date: 15 April 2016</p> <table border="1"> <tr> <td data-bbox="497 566 826 712"> 35 New Bridge Street, London EC4V 6BW </td><td data-bbox="826 566 1308 712"> 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>	35 New Bridge Street, London EC4V 6BW	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
35 New Bridge Street, London EC4V 6BW	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 35 New Bridge Street London EC4V 6BW United Kingdom	Local contact Mr D Blyton Tel: +44 (0)20 7280 3200 Fax: +44 (0) 20 7283 9248 Email: rpslo@rpsgroup.com	Health and Hygiene 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 M Bates 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 S Pepper Tel: +44 (0) 161 6549069 Fax: +44 (0)161 6436495 Email: rpswn@rpsgroup.com	Health and Hygiene	F


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	London - K Milton Keynes - L Middleton - M
Customers sites requiring Stack Emissions Testing	Stack emissions Testing	Milton Keynes - L
Mobile Laboratories	Health and Hygiene	London - J


DETAIL OF ACCREDITATION


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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	<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)	L
Testing of Stack Emissions to Atmosphere	<u>Sampling and On-Line Analysis</u>		
	Pressure, Temperature and Velocity	BS EN 13284-1:2002 BS ISO 9096:2003 (RPSCE/1/2)	L
Testing of Stack Emissions to Atmosphere	<u>Sampling with subsequent analysis by an ISO/IEC 17025 accredited laboratory</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)	L
	Hydrogen Chloride	BS EN 1911:2010 (RPSCE/1/8b)	L
	Halides and Halogens: Hydrogen Bromide Chlorine Bromine	US EPA Method 26 and 26A (RPSCE/1/8a)	L


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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	
	Sulphur dioxide	BS EN 14791:2005 (RPSCE/1/23)	L
	Hydrogen Fluoride	BS ISO 15713:2006 (RPSCE/1/8c)	L
	Mercury	BS EN 13211:2002 (RPSCE/1/9b)	L
	Metals	BS EN 14385:2004 (RPSCE/1/9c)	L
	Dioxins and furans	BS EN 1948-1:2006 (RPSCE/1/10b)	L
	Dioxin-like Polychlorinated Biphenyls (PCBs)	BS EN 1948-4:2010 (RPSCE/1/10b)	L
	Polycyclic Aromatic hydrocarbons (PAH's)	BS ISO 11338-1:2003 (RPSCE/1/10c)	L
	Formaldehyde	US EPA Method 316 (RPSCE/1/22)	L
	Formaldehyde – sorbent tube method	PD CEN/TS 13649:2014 RPSCE/1/19b Rev D	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	
	Speciated VOCs (carbon and other suitable tubes) (Dry stacks only): Aliphatic VOCs Aromatic VOCs Aliphatic amines Aromatic amines Cresols Phenols Acetic acid	PD CEN/TS 13649:2014 (RPSCE/1/19b)	L
	Amines (Total aromatic and aliphatic)	PD CEN/TS 13649:2014, NIOSH method 2010 + 2002 (RPSCE/1/19c)	L
	Isocyanates	USEPA Method 207-1 (documented in-house method RPSCE/1/18C)	L
	Isocyanates	USEPA CTM 036 (documented in-house method RPSCE/1/18D Rev A)	L
	Hydrogen cyanide	US EPA OTM 29 (RPSCE/1/16a)	L
	Hydrogen sulphide	US EPA Method 11 (RPSCE/1/17)	L
	Ammonia	BS EN 14791:2005 (RPSCE/1/14b)	L

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<p>The Environmental Consultancy Ltd trading as RPS Consultants</p> <p>Issue No: 066 Issue date: 15 April 2016</p>			
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</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	
	PM ₁₀ /PM _{2.5} at low concentrations (0-40 mg/m ³)	BS EN ISO 23210 (RPSCE/1/26 Rev A)	L
	Chrome VI	USEPA Method 0061 (RPSCE/1/9d Rev A)	L
Testing of Stack Emissions to Atmosphere	<u>Sampling and On-Site Analysis</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	
	Water Vapour	BS EN 14790:2005 (RPSCE/1/12b)	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-Line Analysis</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	
	Pressure, Temperature and Velocity (Point Velocity Method)	BS EN 16911-1:2013 (RPSCE/1/2 – Differential Pressure Device (Pitot Tube) Method	L
	Water Vapour*	EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	L
	Carbon Monoxide*	BS EN 15058:2006 (RPSCE/1/21h - NDIR analyser) EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	L
	Carbon Dioxide*	ISO 12039:2001 (RPSCE/1/21e - NDIR analyser) EA TGN M22 (RPSCE/1/24 - FTIR analyser)	L
	Nitrogen Monoxide (NO)*	BS EN 14792:2005 (RPSCE/1/21f - Chemiluminescence analyser) EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	L
	Nitrogen Dioxide (NO ₂)*	EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	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-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	
	Oxides of Nitrogen (NOx)*	BS EN 14792:2005 (RPSCE/1/21f - Chemiluminescence analyser) EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	L
	Nitrous Oxide (N ₂ O)	EA TGN M22 (RPSCE/1/24 Rev B - Validated FTIR analyser)	L
	Sulphur dioxide*	EA TGN M22 (RPSCE/1/24 - FTIR analyser)	L
	Oxygen*	BS EN 14789:2005 (RPSCE/1/21g - validated Zirconium cell analyser)	L
	Total Gaseous Organic Carbon* (TOC/VOC) (0 to 1000 mg/m ³)	BS EN 12619:2013 (RPSCE/1/4b - FID analyser)	L

 1709 Accredited to ISO/IEC 17025:2005	Schedule of Accreditation issued by United Kingdom Accreditation Service 2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK		
	The Environmental Consultancy Ltd trading as RPS Consultants Issue No: 066 Issue date: 15 April 2016		
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 14181:2014, Environment Agency MID 14181 (TGN M20 Annex A) and other requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007	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.