

## BS EN 14181 Report

Permit Number: **RP3133LD**  
Operator: **RWE Generation UK plc.**  
Installation: **Aberthaw Power Station**  
Installation Type: **Coal-Fired Power Station**  
Emission Point: **Unit 9**  
Monitoring Dates: **1<sup>st</sup> to 3<sup>rd</sup> March 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,  
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Report Date: 5<sup>th</sup> October 2016  
Report Author: Carl Redgrove  
Report Approved By: Glyn Harrison  
Position: Operational Manager  
MCERTS Qualifications: Level 2, Technical Endorsements 1, 2, 3 & 4  
MCERTS Registration No.: MM 03 228  
Signature:

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## Section 1 – Executive Summary

### 1B.1 Result Summary – QAL2

EN 14181 Test Type		QAL2				
Stack designation		Unit 9				
Measurand	Correlation coefficient of parallel data ( $R^2$ )	Derived Calibration function ( $y_i$ )		Calibrated Range	Extrapolated Calibrated Range	Variability Test
		$y_i =$	$a + bx_i$			
Oxides of Nitrogen (GM32)	0.5046	$0^2$	$1.02^2$	0 - 537 mg/m <sup>3 3</sup>	0 – 645 mg/m <sup>3 5</sup>	Pass
Sulphur Dioxide (GM32 – Low Range)	0.8069	$2.192^1$	$1.024^1$	0 - 276 mg/m <sup>3 3</sup>	0 – 482 mg/m <sup>3 5</sup>	Pass
Sulphur Dioxide (GM32 – High Range)	0.9618	$3.866^1$	$1.008^1$	0 – 279 mg/m <sup>3 3</sup>	0 – 482 mg/m <sup>3 5</sup>	Pass
Nitric Oxide as total NOx (Procal 1)	0.3138	$-0.69^2$	$1.03^2$	0 - 527 mg/m <sup>3 3</sup>	0 – 1684 mg/m <sup>3 5</sup>	Pass
Sulphur Dioxide (Procal 1 – Low Range)	0.9862	$0.304^1$	$1.028^1$	0 - 713 mg/m <sup>3 3</sup>	-	Pass
Sulphur Dioxide (Procal 1 – High Range)	0.9876	$1.637^1$	$1.004^1$	0 - 720 mg/m <sup>3 3</sup>	0 – 1133 mg/m <sup>3 5</sup>	Pass
Nitric Oxide as total NOx (Procal 2)	0.3647	$-1.58^2$	$0.92^2$	0 - 535 mg/m <sup>3 3</sup>	0 – 1248 mg/m <sup>3 5</sup>	Pass
Sulphur Dioxide (Procal 2 – Low Range)	0.3015	$2.219^1$	$0.955^1$	0 - 274 mg/m <sup>3 3</sup>	0 – 579 mg/m <sup>3 5</sup>	Pass
Sulphur Dioxide (Procal 2 – High Range)	0.9678	$-5.749^1$	$1.02^1$	0 - 697 mg/m <sup>3 3</sup>	0 – 2334 mg/m <sup>3 5</sup>	Pass
Particulate Matter (Erwin SICK)	0.0021	$0.919^1$	$1.262^1$	0 – 22.3 mg/m <sup>3 3</sup>	0 – 83.4 mg/m <sup>3 5</sup>	Pass

**Notes:**

- 1 – Calibration function derived using Method A.
- 2 – Calibration function derived using Method B.
- 3 – Calibrated range derived using AST parallel test data extended 10%.
- 4 - Calibrated range derived using QAL2 parallel test data extended 100%.
- 5 - Extrapolated calibrated range from QAL 2 - derived using reference materials

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

## 1C Deviations

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

## Section 2 - Information about the Regulated Installation

### 2.1 Regulatory Information

<b>Name of operator</b>	RWE Generation UK plc.
<b>Name of Installation</b>	Aberthaw Power Station
<b>Address of installation</b>	The Leys Aberthaw, Nr Barry South Glamorgan CF62 4ZW
<b>Sector</b>	LCPD
<b>Permit Number</b>	RP3133LD
<b>Date of last QAL 2/AST</b>	March 2015 AST – Procal 1 & 2, SICK OMD 41. March 2015, QAL2 – Procal 2, SICK GM32

### Regulated Determinands

<b>Determinand</b>	<b>Emission Point</b>	<b>Daily Mean</b>	<b>Calendar Monthly</b>	<b>Uncertainty Requirement</b>
Oxides of Nitrogen	Unit 9	1080 mg/m <sup>3</sup> (NO <sub>x</sub> as NO <sub>2</sub> )	1050mg/m <sup>3</sup> (NO <sub>x</sub> as NO <sub>2</sub> )	20% at the ELV
Sulphur Dioxide	Unit 9	440 mg/m <sup>3</sup>	350 mg/m <sup>3</sup>	20% at the ELV
Total particulate Matter	Unit 9	35 mg/m <sup>3</sup>	20 mg/m <sup>3</sup>	30% at the ELV

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

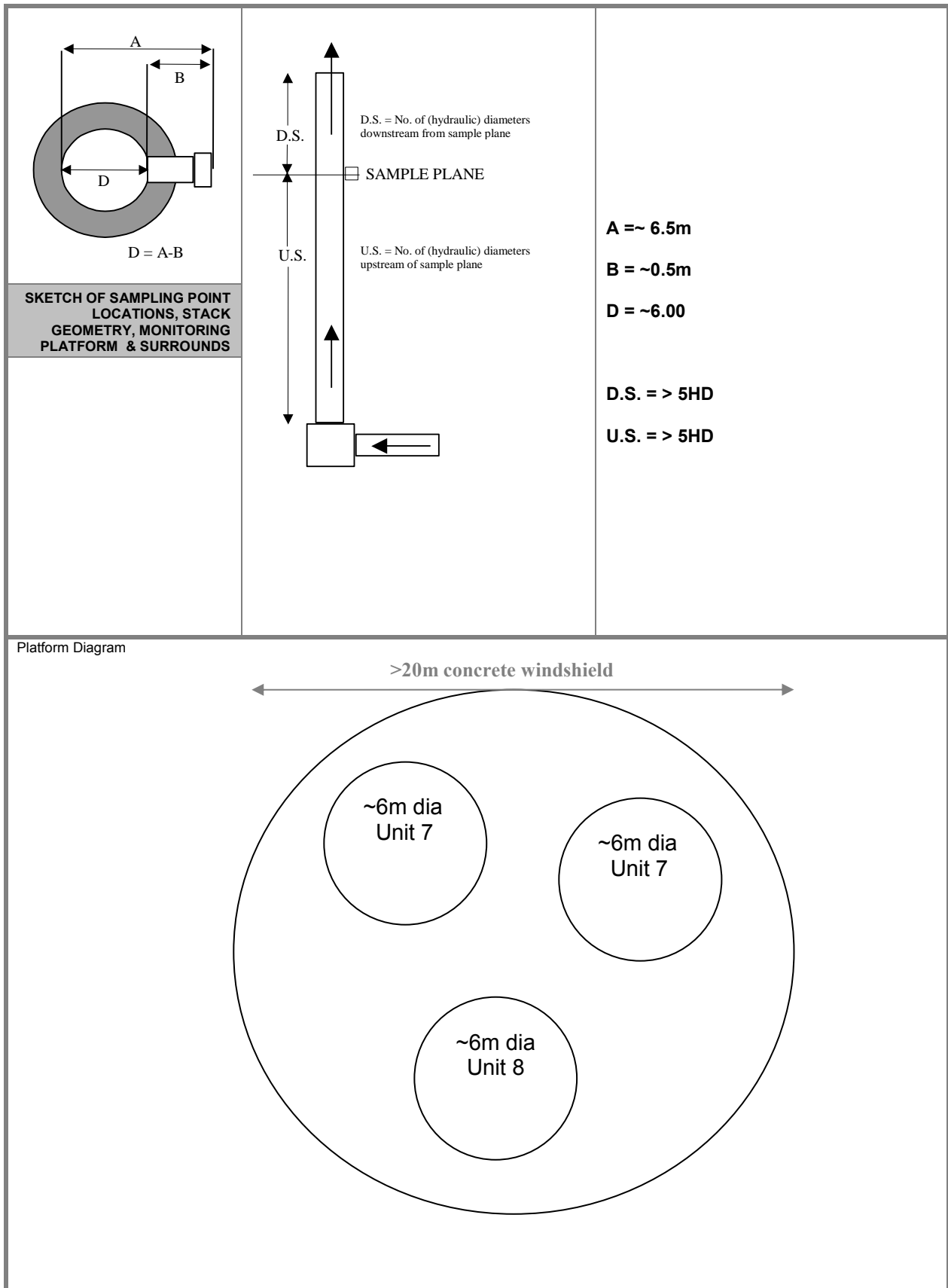
### 2.2 Operational Information and site monitoring provisions

#### 2.2.1 Process type and emissions variations

<b>Process Type</b>	Continuous - Coal-Fired Power Station
<b>Process Variations</b>	Once operational at maximum load variation is minimal
<b>Expected emissions variations</b>	
1 Oxides of nitrogen	400 - 600 mg/m <sup>3</sup> as NO <sub>2</sub> – constant
2 Sulphur Dioxide	200 - 300 mg/m <sup>3</sup> – constant
3 Oxygen	6 – 6.5% – constant
<b>Possible low level emissions</b>	None
<b>Provision to deal with low level emissions</b>	N/A
<b>Other factors affecting monitoring results</b>	None
<b>Fuel type</b>	Coal
<b>Abatement</b>	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"> <li>A safe and clean working environment with sufficient space and weather protections.</li> </ul>	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"> <li>Easy and safe access to the CEM.</li> </ul>	CEMS cabinet – Monitoring probe -	Stairways to the relevant levels.
<ul style="list-style-type: none"> <li>Adequate supplies of reference materials, tools and spare parts.</li> </ul>	Yes	
<ul style="list-style-type: none"> <li>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.</li> </ul>	N/A	There is no facility to introduce reference materials to the sample line or CEM. The CEMs are cross-duct IR (NO, NO <sub>2</sub> , SO <sub>2</sub> ) and cross-duct forward scatter (particulate).
<ul style="list-style-type: none"> <li>Compliance with TGN M1</li> </ul>	No	Unable to access sample port B
<ul style="list-style-type: none"> <li>Compliance with EN 15259 –</li> </ul> <p>flow stability criteria (if applicable),</p> <p>Stack gas homogeneity.</p>	<p>Yes</p> <p>Yes</p>	<p>Stack gas homogeneity carried out previously by Atkins.</p>

## Temperature and Velocity Profile

Company Name: Aberthaw F		ition		Date: 01/03/16	Mean Stack Temperature, °C	70.000
Site Name: Aberthaw				Run: TPM	Traverse Stack Velocity, m/s	18.024
Sampling Point Ref: Unit 9					Stack Gas Volume Flow Rate, m <sup>3</sup> /s (scms wet)	383.900
Project Reference: FTBS 29312					Stack Gas Volume Flow Rate, m <sup>3</sup> /s (scms DRY) O <sub>2</sub> Corrected	383.900

Δp Measurement units (Pa or mmH <sub>2</sub> O)	mmH <sub>2</sub> O	Pitot Coefficient	0.827
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<b>Barometric</b>	753	mmHg	<b>Leak Test</b>	
<b>Static</b>			Instrument range	250 mmH <sub>2</sub> O
Port A	-26	mmH <sub>2</sub> O	Δp for leak test	187.5 mmH <sub>2</sub> O
Port B	-26	mmH <sub>2</sub> O	Positive leakage rate	0 per 15secs
<b>Mean</b>	-26	mmH <sub>2</sub> O	Negative leakage rate	0 per 15secs
			Pass/Fail	Pass

<b>Stagnation Test</b>	
Static measurement	
Positive side	-26 mmH <sub>2</sub> O
Negative side	-26 mmH <sub>2</sub> O
Difference (Pa)	0
Pass/Fail	Pass

<b>Stack Dimensions</b>	
Rectangular A	(Width) m
Rectangular B	(Length) m
Circular diam A	6 m
Circular diam B	6 m
Circular Mean	6 m
Area	28.27431 m <sup>2</sup>

Traverse Point	Distance m	Port A					Swirl Degrees	Temp °C	Port B					Swirl Degrees	Temp °C
		Δ p. mmH <sub>2</sub> O			Average	Δ p. mmH <sub>2</sub> O			Average						
		Reading 1	Reading 2	Reading 3		Reading 1				Reading 2	Reading 3				
1	0.20	22	22	22	22	0	70	23	23	24	23.33333333	0	70		
2	0.63	23	23	23	23	0	70	25	25	25	25	0	70		
3	1.16	23	23	23	23	0	70	28	28	28	28	0	70		
4	1.94														
5	4.06														
6	4.84	26	26	26	26	0	70	28	28	28	28	0	70		
7	5.37	28	28	28	28	0	70	26	26	26	26	0	70		
8	5.80	32	32	32	32	0	70	27	27	27	27	0	70		
9															
10															

<b>Gas Data</b>	
Oxygen %	5.81
CO <sub>2</sub> %	13.56
CO %	

<b>Oxygen Correction</b>	
Required Correction Value	
Actual Oxygen Factor	1.00
<i>Enter 0 if correction is not required</i>	

<b>BS EN 13284-1 &amp; M1 Sample Point Requirements</b>		Requirement Met?
Duct gas Flow: angle with regard to duct access <15°?		Y
Duct Gas Flow: No Negative Velocity: Not Permitted		Y
Duct Gas Flow: Ratio of max to min velocity <3:1?		Y
Working Area > 5m <sup>2</sup> ?		Y
Handrails with removable chains / self closing gates across the top of the ladder?		Y
Handrails (approx 0.5 and 1.0 m high) and vertical baseboards (approx 0.25m high)?		Y
Scaffold Built to 'Heavy Duty' Scafftag Rating or at least 2.5kN/m <sup>2</sup> loading		N/A
Handrails not restricting access to ports?		Y
Room opposite sampling port equal or greater than the length of the sampling probe plus 1 metre?		Y
Sufficient Power (Waterproof 110V BS4343 Standard) close or on the platform?		Y

## 2.4.1 Continuous Emissions Monitoring Systems at the installation

	Procal 1 & 2	SICK	SICK	ABB
Determinand	NO <sub>x</sub> & SO <sub>2</sub> & H <sub>2</sub> O	NO <sub>x</sub> & SO <sub>2</sub>	Particulate	Oxygen
Type	In Situ IR	In-situ Probe – UV-DOAS	Cross Duct Forward Scatter	Zirconia Cell
Make	Procal	SICK Maihak GmbH	Erwin Sick	ABB
Model	Pulsi 200 series	GM32 – In-situ	Dusthunter	AZ20
MCERTS Certificate	MC990006/13	MC100163/01	MC040042/01	MC110191/01
QAL1 Compliance?	Yes	Yes	Yes	Yes
Certification ranges	NO = 0 – 1000 ppm SO <sub>2</sub> low = 0 – 250 ppm SO <sub>2</sub> high = 0 – 1000 ppm H <sub>2</sub> O = 0 – 30 %	Measuring path length 1.25m: NO 0 to 70 mg/m <sup>3</sup> & 0 to 700 mg/m <sup>3</sup> SO <sub>2</sub> 0 to 75mg/m <sup>3</sup> & 0 to 1000mg/m <sup>3</sup>  Measuring path length 1.00m NO 0 to 87.5 mg/m <sup>3</sup> & 0 to 875 mg/m <sup>3</sup> SO <sub>2</sub> 0 to 93.8 mg/m <sup>3</sup> and 0 to 1250 mg/m <sup>3</sup>	0 – 0.3 extinction	0 to 25% 0 to 5%
Operational ranges	As Above	SO <sub>2</sub> Low: 0 – 250 ppm SO <sub>2</sub> High: 0 – 1000ppm NO: 0 – 1000ppm NO <sub>2</sub> : 0 - 100ppm	0 – 50 mg/m <sup>3</sup>	0 to 25%vol
Principle	Dual wavelength infra-red	UV DOAS	Opacity	Zirconia Cell
Raw data units	SO <sub>2</sub> & NO = ppm H <sub>2</sub> O = %	ppm	Extinction	%
Reference condition of raw data	(SO <sub>2</sub> & NO only) wet gas, no oxygen correction	wet gas, no oxygen correction	wet gas, no oxygen, temp or pressure correction	wet gas
Signal output	4-20 mA	4 – 20mA	Fibre optics	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	Measured	Measured

### Section 3 – Information about the Monitoring campaign

**Table 3.1 - Monitoring Organisation Staff Details**

Project Manager	Position	MCERTS Level	Technical Endorsements	Expiry Dates	MCERTS Registration Number
Glyn Harrison	Operations Manager (Stack Emissions)	2	1	10/19	MM 03 228
			2	06/17	
			3	12/16	
			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
Carl Redgrove	Senior Consultant	2	1	10/19	MM 03 173
			2	03/20	
			3	03/21	
			4	06/21	

Report Reviewer	Position	MCERTS Level	Technical Endorsements	Expiry Dates	MCERTS Registration Number
Glyn Harrison	Operational Manager	2	1	10/19	MM 03 228
			2	06/17	
			3	12/16	
			4	07/20	

### 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 <sub>2</sub> )	BS EN 14792:2005	RPSCE/1/21f	MCERTS	Chemiluminescence	6	N/A	N/A	N/A
Oxygen	BS EN 14789:2005	RPSCE/1/21g	MCERTS	Zirconia Cell	5	N/A	N/A	N/A
Sulphur Dioxide	TGN M22	RPSCE/1/24	MCERTS	FTIR	10	N/A	N/A	N/A
Total particulate Matter	BS EN 13284:2002	RPSCE/1/7c	MCERTS	Gravimetric	10 - 30	D9	RPS	UKAS

## Equipment details

Emission Parameter	Analysis Technique	Analyser	Analyser Certification Status	Certified Ranges	Operational Ranges	Operating Principle
Oxygen	Zirconia Cell	Horiba PG 250 SRM	MCERTs certificate No MC110186/03	0 – 25%	0-25%	Extractive, multicomponent dry gas analyser. Sample extracted through sample probe and 5metre heated sample line (with integral heated filter) – line temperature 180°C. Sample line connected directly to a gas conditioner (peltier cooler) set at 3°C. Cold dry sample then passes to analyser. Sample is drawn through system by integral pump built into analyser.
Oxides of Nitrogen	Chemiluminescence	Horiba PG 250 SRM	MCERTs certificate No MC110186/03	0 – 130 mg/m <sup>3</sup> as NO 0 – 200 mg/m <sup>3</sup> as NO <sub>2</sub>	0 – 1000ppm	
Sulphur Dioxide	FTIR	Gasmeter DX4000	MCERTs certificate No MC30014/05	0 – 75mg/m <sup>3</sup>	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	Gasmeter DX4000	MCERTs certificate No MC30014/05	0-40%	0-40%	
Total Particulate Matter	Multipoint isokinetic sampling with in stack filtration	N/A	N/A	0 – 50mg/m <sup>3</sup>	-	Extractive manual test. Sample obtained isokinetically through sharp edged nozzle. Sample gas passed through a pre weighed, pre blown filter. Filter holder mounted in-stack.

## **Section 4A1: Data & calculations – QAL2 – Unit 9, SICK GM32**

## Section 4A1 – Data and calculations – QAL2 SICK GM32

### 4A1.1.1 Table 4.1.1 – Raw monitoring Data – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (Wet)	CEMS Oxygen (dry)	CEMS Moisture	SRM Raw Value (dry)	SRM Oxygen (Dry)	SRM Moisture	SRM at CEMs Raw conditions
		hr:min		NO (ppm)	(%)	(%)	NOx (ppm)	(%)	(%)	NOx (ppm)
1	01-Mar-16	13:00	14:00	204.24	6.27	1.57	231.17	6.15	1.95	226.7
2	01-Mar-16	14:01	15:01	201.38	6.52	1.57	198.67	6.61	1.93	194.8
3	01-Mar-16	15:02	16:02	203.66	6.46	1.57	207.83	6.29	1.94	203.8
4	01-Mar-16	16:03	17:03	205.98	6.53	1.60	210.67	6.28	1.97	206.5
5	01-Mar-16	18:00	19:00	211.20	6.50	1.61	216.17	6.53	2.10	211.6
6	01-Mar-16	19:01	20:01	214.76	6.43	1.59	218.17	6.24	2.04	213.7
7	01-Mar-16	20:02	21:02	214.97	6.50	1.49	223.33	6.07	1.93	219.0
8	01-Mar-16	21:03	22:03	218.19	6.50	1.36	223.83	6.14	1.76	219.9
9	01-Mar-16	22:04	23:04	220.73	6.49	1.51	227.67	6.10	1.94	223.2
10	01-02/03/2016	23:05	0:05	207.59	6.67	1.56	233.83	5.86	1.99	229.2
11	02-Mar-16	0:06	1:06	209.30	6.68	1.51	188.50	7.67	1.93	184.9
12	02-Mar-16	1:07	2:07	214.83	6.54	1.50	222.33	6.19	1.96	218.0
13	02-Mar-16	2:08	3:08	216.37	6.50	1.52	228.33	6.03	1.96	223.8
14	02-Mar-16	3:09	4:09	211.87	6.62	1.50	220.67	6.25	1.93	216.4
15	02-Mar-16	4:10	5:10	210.90	6.61	1.52	214.67	6.38	2.00	210.4
16	02-Mar-16	5:11	6:11	206.96	6.65	1.55	216.67	6.29	1.83	212.7
17	02-Mar-16	6:12	7:12	213.98	6.55	1.30	216.17	6.22	1.74	212.4
18	02-Mar-16	7:13	8:13	205.49	6.73	1.29	217.67	6.31	1.71	213.9
19	02-Mar-16	8:14	9:14	201.66	6.90	1.29	205.67	6.61	1.72	202.1
20	02-Mar-16	10:00	11:00	206.04	6.75	1.25	220.67	6.47	1.72	216.9
21	02-Mar-16	11:01	12:01	202.97	6.77	1.23	211.83	6.36	1.69	208.3
22	02-Mar-16	12:02	13:02	205.37	6.63	1.21	210.33	6.35	1.69	206.8
23	02-Mar-16	13:03	14:03	213.51	6.49	1.42	217.67	6.26	1.68	214.0
24	02-Mar-16	14:04	15:04	214.53	6.43	1.42	214.83	6.21	1.67	211.2
25	02-Mar-16	15:05	16:05	215.39	6.42	1.43	223.00	5.96	1.70	219.2
26	02-Mar-16	17:10	18:10	213.51	6.10	1.49	245.17	5.88	1.79	240.8
27	02-Mar-16	18:11	19:11	219.97	5.94	1.49	219.50	5.81	1.77	215.6
28	02-Mar-16	19:12	20:12	212.99	6.25	1.47	213.17	6.10	1.75	209.4
29	02-Mar-16	20:13	21:13	198.07	6.59	1.44	225.33	5.83	2.46	219.8
30	02-Mar-16	21:14	22:14	175.63	7.40	3.25	176.00	7.32	1.72	173.0
31	02-Mar-16	22:15	23:15	179.17	7.33	1.22	187.17	6.92	1.51	184.3
32	02-03/03/2016	23:16	0:16	181.98	7.25	1.24	187.83	6.98	1.52	185.0
33	03-Mar-16	0:17	1:17	183.23	7.23	1.25	190.00	6.94	1.52	187.1
34	03-Mar-16	1:18	2:18	182.55	7.25	1.25	201.00	6.49	1.50	198.0
35	03-Mar-16	2:19	3:19	180.51	7.33	1.24	192.50	6.88	1.51	189.6
36	03-Mar-16	3:20	4:20	180.44	7.35	1.23	190.50	6.88	1.51	187.6
37	03-Mar-16	4:21	5:21	186.66	7.05	1.28	203.33	6.45	1.57	200.1
38	03-Mar-16	5:22	6:22	211.18	6.33	1.36	215.83	6.01	1.62	212.3
39	03-Mar-16	6:23	7:23	210.01	6.37	1.34	215.83	6.08	1.68	212.2
40	03-Mar-16	7:24	8:24	200.11	6.66	1.39	210.50	5.99	1.60	207.1
41	03-Mar-16	9:30	10:30	186.44	7.06	1.29	196.50	6.93	1.33	193.9
42	03-Mar-16	10:31	11:31	207.55	6.55	1.23	174.67	7.72	1.68	171.7
43	03-Mar-16	11:32	12:32	199.47	6.70	1.45	229.33	5.90	1.70	225.4
44	03-Mar-16	12:33	13:33	184.37	7.21	1.24	185.50	6.93	1.61	182.5
45	03-Mar-16	13:34	14:34	184.11	6.92	1.38	203.83	6.41	1.65	200.5
46	03-Mar-16	14:35	15:35	189.40	6.51	1.43	195.33	6.30	1.68	192.0

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

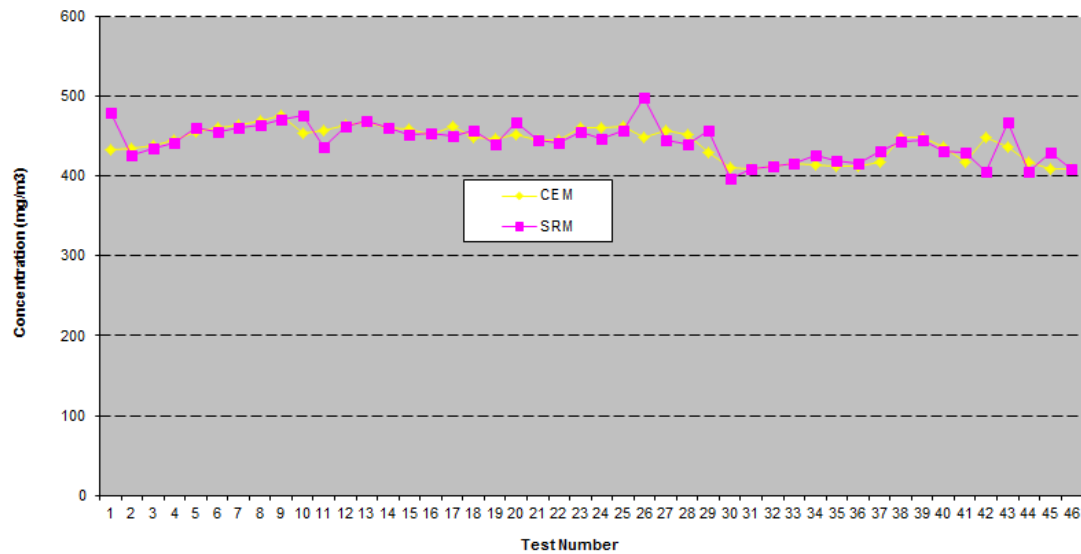
#### 4A1.2.1 Table 4.2.1 - Standardised monitoring Data – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(NO as NO <sub>2</sub> mg/m <sup>3</sup> )	(NO <sub>x</sub> as NO <sub>2</sub> mg/m <sup>3</sup> )	(mg/m <sup>3</sup> )
1	01-Mar-16	13:00	14:00	433.9	479.7	16.0
2	01-Mar-16	14:01	15:01	435.4	425.5	14.0
3	01-Mar-16	15:02	16:02	438.4	435.3	15.0
4	01-Mar-16	16:03	17:03	445.6	441.0	15.0
5	01-Mar-16	18:00	19:00	456.0	460.2	15.0
6	01-Mar-16	19:01	20:01	461.5	455.4	15.0
7	01-Mar-16	20:02	21:02	463.7	460.7	15.0
8	01-Mar-16	21:03	22:03	469.9	464.1	16.0
9	01-Mar-16	22:04	23:04	475.9	470.5	16.0
10	01-02/03/2016	23:05	0:05	453.3	475.8	16.0
11	02-Mar-16	0:06	1:06	457.4	435.9	15.0
12	02-Mar-16	1:07	2:07	464.6	462.6	16.0
13	02-Mar-16	2:08	3:08	466.8	469.7	16.0
14	02-Mar-16	3:09	4:09	461.0	460.7	15.0
15	02-Mar-16	4:10	5:10	458.6	452.5	15.0
16	02-Mar-16	5:11	6:11	451.4	453.9	15.0
17	02-Mar-16	6:12	7:12	462.2	450.7	15.0
18	02-Mar-16	7:13	8:13	449.4	456.4	15.0
19	02-Mar-16	8:14	9:14	446.4	440.4	15.0
20	02-Mar-16	10:00	11:00	451.3	468.0	16.0
21	02-Mar-16	11:01	12:01	445.1	445.6	15.0
22	02-Mar-16	12:02	13:02	445.9	442.3	15.0
23	02-Mar-16	13:03	14:03	459.9	454.9	15.0
24	02-Mar-16	14:04	15:04	460.3	447.5	15.0
25	02-Mar-16	15:05	16:05	461.7	456.6	15.0
26	02-Mar-16	17:10	18:10	448.1	499.4	17.0
27	02-Mar-16	18:11	19:11	456.8	445.1	15.0
28	02-Mar-16	19:12	20:12	451.3	440.7	15.0
29	02-Mar-16	20:13	21:13	429.6	457.6	15.0
30	02-Mar-16	21:14	22:14	411.4	396.6	13.0
31	02-Mar-16	22:15	23:15	408.9	409.6	14.0
32	02-03/03/2016	23:16	0:16	413.1	413.0	14.0
33	03-Mar-16	0:17	1:17	415.4	416.5	14.0
34	03-Mar-16	1:18	2:18	414.5	426.9	14.0
35	03-Mar-16	2:19	3:19	412.3	420.0	14.0
36	03-Mar-16	3:20	4:20	412.4	415.9	14.0
37	03-Mar-16	4:21	5:21	417.7	430.6	15.0
38	03-Mar-16	5:22	6:22	449.5	443.4	15.0
39	03-Mar-16	6:23	7:23	448.2	445.6	15.0
40	03-Mar-16	7:24	8:24	436.2	431.9	15.0
41	03-Mar-16	9:30	10:30	417.6	430.3	15.0
42	03-Mar-16	10:31	11:31	448.1	405.6	14.0
43	03-Mar-16	11:32	12:32	436.2	467.8	16.0
44	03-Mar-16	12:33	13:33	417.3	406.4	14.0
45	03-Mar-16	13:34	14:34	408.6	430.3	15.0
46	03-Mar-16	14:35	15:35	408.4	409.2	14.0

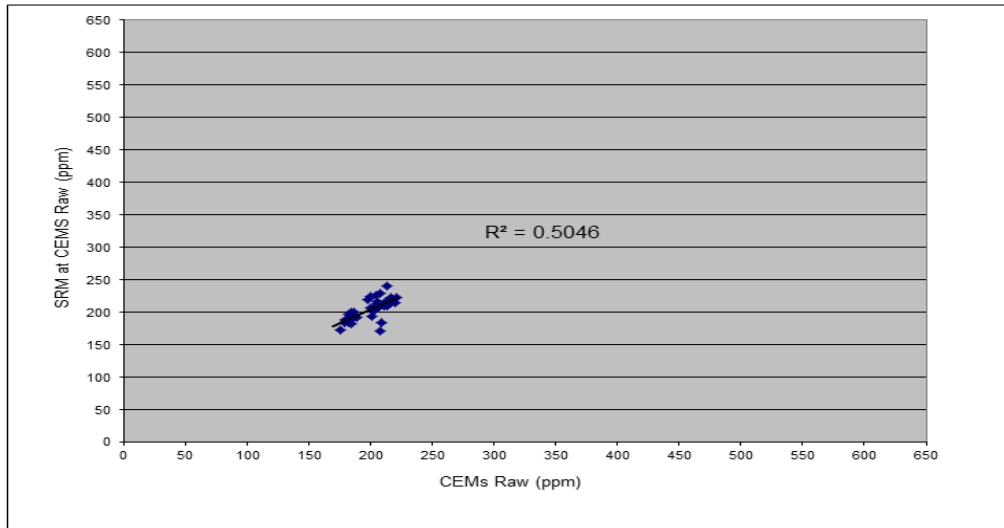
Note:  
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

**4A1.3.1 – 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)**



#### 4A1.4.1 – Elimination of Outliers – Oxides of Nitrogen,



Test No	Test Start Time	Test End Time	CEMS Raw Value	SRM Value at CEMS Raw conditions	Difference Di	Difference Di - Di	Is Result an Outlier - Di - Di > 2SD
	hr:min		(ppm)	(ppm)			
1	13:00	14:00	204.2	226.7	22.42	18.33	No
2	14:01	15:01	201.4	194.8	-6.55	-10.64	No
3	15:02	16:02	203.7	203.8	0.14	-3.96	No
4	16:03	17:03	206.0	206.5	0.54	-3.56	No
5	18:00	19:00	211.2	211.6	0.44	-3.66	No
6	19:01	20:01	214.8	213.7	-1.05	-5.15	No
7	20:02	21:02	215.0	219.0	4.06	-0.04	No
8	21:03	22:03	218.2	219.9	1.70	-2.40	No
9	22:04	23:04	220.7	223.2	2.52	-1.58	No
10	23:05	00:05	207.6	229.2	21.59	17.49	No
11	00:06	01:06	209.3	184.9	-24.43	-28.53	Yes
12	01:07	02:07	214.8	218.0	3.16	-0.94	No
13	02:08	03:08	216.4	223.8	7.48	3.38	No
14	03:09	04:09	211.9	216.4	4.55	0.45	No
15	04:10	05:10	210.9	210.4	-0.52	-4.61	No
16	05:11	06:11	207.0	212.7	5.74	1.64	No
17	06:12	07:12	214.0	212.4	-1.57	-5.67	No
18	07:13	08:13	205.5	213.9	8.45	4.35	No
19	08:14	09:14	201.7	202.1	0.48	-3.62	No
20	10:00	11:00	206.0	216.9	10.83	6.73	No
21	11:01	12:01	203.0	208.3	5.29	1.19	No
22	12:02	13:02	205.4	206.8	1.40	-2.69	No
23	13:03	14:03	213.5	214.0	0.49	-3.61	No
24	14:04	15:04	214.5	211.2	-3.29	-7.39	No
25	15:05	16:05	215.4	219.2	3.82	-0.28	No
26	17:10	18:10	213.5	240.8	27.26	23.16	Yes
27	18:11	19:11	220.0	215.6	-4.35	-8.44	No
28	19:12	20:12	213.0	209.4	-3.55	-7.65	No
29	20:13	21:13	198.1	219.8	21.71	17.61	No
30	21:14	22:14	175.6	173.0	-2.67	-6.77	No
31	22:15	23:15	179.2	184.3	5.18	1.09	No
32	23:16	00:16	182.0	185.0	3.00	-1.10	No
33	00:17	01:17	183.2	187.1	3.89	-0.21	No
34	01:18	02:18	182.6	198.0	15.44	11.34	No
35	02:19	03:19	180.5	189.6	9.09	5.00	No
36	03:20	04:20	180.4	187.6	7.19	3.09	No
37	04:21	05:21	186.7	200.1	13.48	9.38	No
38	05:22	06:22	211.2	212.3	1.15	-2.94	No
39	06:23	07:23	210.0	212.2	2.21	-1.89	No
40	07:24	08:24	200.1	207.1	7.02	2.92	No
41	09:30	10:30	186.4	193.9	7.45	3.35	No
42	10:31	11:31	207.6	171.7	-35.82	-39.91	Yes
43	11:32	12:32	199.5	225.4	25.97	21.87	No
44	12:33	13:33	184.4	182.5	-1.86	-5.96	No
45	13:34	14:34	184.1	200.5	16.36	12.26	No
46	14:35	15:35	189.4	192.0	2.65	-1.45	No
			Average Di		4.10		
			Standard Deviation		10.99		
			Standard Deviation x2		21.98		

#### 4A1.5.1 Determination of Method A or Method B - 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	13:00	14:00	231.2	6.2	479.7
2	14:01	15:01	198.7	6.6	425.5
3	15:02	16:02	207.8	6.3	435.3
4	16:03	17:03	210.7	6.3	441.0
5	18:00	19:00	216.2	6.5	460.2
6	19:01	20:01	218.2	6.2	455.4
7	20:02	21:02	223.3	6.1	460.7
8	21:03	22:03	223.8	6.1	464.1
9	22:04	23:04	227.7	6.1	470.5
10	23:05	0:05	233.8	5.9	475.8
12	1:07	2:07	222.3	6.2	462.6
13	2:08	3:08	228.3	6.0	469.7
14	3:09	4:09	220.7	6.2	460.7
15	4:10	5:10	214.7	6.4	452.5
16	5:11	6:11	216.7	6.3	453.9
17	6:12	7:12	216.2	6.2	450.7
18	7:13	8:13	217.7	6.3	456.4
19	8:14	9:14	205.7	6.6	440.4
20	10:00	11:00	220.7	6.5	468.0
21	11:01	12:01	211.8	6.4	445.6
22	12:02	13:02	210.3	6.4	442.3
23	13:03	14:03	217.7	6.3	454.9
24	14:04	15:04	214.8	6.2	447.5
25	15:05	16:05	223.0	6.0	456.6
27	18:11	19:11	219.5	5.8	445.1
28	19:12	20:12	213.2	6.1	440.7
29	20:13	21:13	225.3	5.8	457.6
30	21:14	22:14	176.0	7.3	396.6
31	22:15	23:15	187.2	6.9	409.6
32	23:16	0:16	187.8	7.0	413.0
33	0:17	1:17	190.0	6.9	416.5
34	1:18	2:18	201.0	6.5	426.9
35	2:19	3:19	192.5	6.9	420.0
36	3:20	4:20	190.5	6.9	415.9
37	4:21	5:21	203.3	6.5	430.6
38	5:22	6:22	215.8	6.0	443.4
39	6:23	7:23	215.8	6.1	445.6
40	7:24	8:24	210.5	6.0	431.9
41	9:30	10:30	196.5	6.9	430.3
43	11:32	12:32	229.3	5.9	467.8
44	12:33	13:33	185.5	6.9	406.4
45	13:34	14:34	203.8	6.4	430.3
46	14:35	15:35	195.3	6.3	409.2
Sum			9070.83		
Emission Limit Value (ELV) =		1080	mg/Nm <sup>3</sup>	Y <sub>max</sub>	479.65
Maximum Permissible uncertainty =		20	%	Y <sub>min</sub>	396.61
Maximum Permissible uncertainty (at E		216	mg/Nm <sup>3</sup>		
15% of the ELV =		162	mg/Nm <sup>3</sup>		
Is Ymax - Ymin > MPU at ELV?		No		Y <sub>max</sub> - Y <sub>min</sub>	83.04
Is Ymin > 15% of ELV?		Yes			
Derivation of Calibration Function		Method B			

**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)	Yi	Xi	Xi * Yi	Xi <sup>2</sup>	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference	16/02/2016	0.0	0.0	-202.51	-197.47	39989.85	38995.93	
2	13:00	14:00	226.7	204.2	24.15	6.76	163.38	45.75	
3	14:01	15:01	194.8	201.4	-7.67	3.91	-29.97	15.26	
4	15:02	16:02	203.8	203.7	1.29	6.19	7.98	38.29	
5	16:03	17:03	206.5	206.0	4.01	8.51	34.16	72.40	
6	18:00	19:00	211.6	211.2	9.13	13.72	125.27	188.29	
7	19:01	20:01	213.7	214.8	11.20	17.29	193.68	298.82	
8	20:02	21:02	219.0	215.0	16.52	17.50	289.06	306.09	
9	21:03	22:03	219.9	218.2	17.38	20.72	360.05	429.18	
10	22:04	23:04	223.2	220.7	20.74	23.25	482.36	540.79	
11	23:05	0:05	229.2	207.6	26.67	10.12	269.91	102.40	
13	1:07	2:07	218.0	214.8	15.48	17.35	268.61	301.18	
14	2:08	3:08	223.8	216.4	21.34	18.90	403.31	357.15	
15	3:09	4:09	216.4	211.9	13.91	14.39	200.20	207.21	
16	4:10	5:10	210.4	210.9	7.87	13.42	105.69	180.19	
17	5:11	6:11	212.7	207.0	10.18	9.48	96.57	89.90	
18	6:12	7:12	212.4	214.0	9.90	16.50	163.39	272.34	
19	7:13	8:13	213.9	205.5	11.43	8.02	91.66	64.29	
20	8:14	9:14	202.1	201.7	-0.37	4.18	-1.54	17.50	
21	10:00	11:00	216.9	206.0	14.37	8.57	123.12	73.44	
22	11:01	12:01	208.3	203.0	5.75	5.49	31.58	30.18	
23	12:02	13:02	206.8	205.4	4.27	7.90	33.72	62.38	
24	13:03	14:03	214.0	213.5	11.49	16.04	184.35	257.22	
25	14:04	15:04	211.2	214.5	8.74	17.06	149.06	291.07	
26	15:05	16:05	219.2	215.4	16.70	17.91	299.09	320.85	
28	18:11	19:11	215.6	220.0	13.12	22.49	295.02	505.99	
29	19:12	20:12	209.4	213.0	6.93	15.52	107.57	240.77	
30	20:13	21:13	219.8	198.1	17.27	0.60	10.30	0.36	
31	21:14	22:14	173.0	175.6	-29.54	-21.84	645.14	476.94	
32	22:15	23:15	184.3	179.2	-18.16	-18.31	332.41	335.14	
33	23:16	0:16	185.0	182.0	-17.53	-15.50	271.60	240.10	
34	0:17	1:17	187.1	183.2	-15.39	-14.25	219.30	202.95	
35	1:18	2:18	198.0	182.6	-4.51	-14.92	67.35	222.58	
36	2:19	3:19	189.6	180.5	-12.91	-16.97	218.98	287.89	
37	3:20	4:20	187.6	180.4	-14.88	-17.04	253.52	290.24	
38	4:21	5:21	200.1	186.7	-2.37	-10.82	25.65	116.98	
39	5:22	6:22	212.3	211.2	9.83	13.71	134.71	187.88	
40	6:23	7:23	212.2	210.0	9.71	12.54	121.75	157.20	
41	7:24	8:24	207.1	200.1	4.62	2.64	12.18	6.95	
42	9:30	10:30	193.9	186.4	-8.62	-11.04	95.13	121.82	
44	11:32	12:32	225.4	199.5	22.93	1.99	45.72	3.98	
45	12:33	13:33	182.5	184.4	-20.00	-13.10	262.11	171.74	
46	13:34	14:34	200.5	184.1	-2.03	-13.36	27.15	178.48	
47	14:35	15:35	192.0	189.4	-10.46	-8.07	84.39	65.13	
Sum			8910.31	8688.85	0.00	0.00	47264.54	47371.21	1.00

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

##### Method B

Formulae:- Number of tests conducted = N 44

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

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

$$x = (1 / 44) * 8688.8 \quad \text{or -} \quad x = 197.47$$

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

$$y = (1 / 44) * 8910. \quad \text{or -} \quad y = 202.51$$

The Slope is calculated by :

$$\beta = y / (x - Z) \quad 202.5 / (197.4 - 0) \quad \beta = 1.025$$

The offset is calculated by:

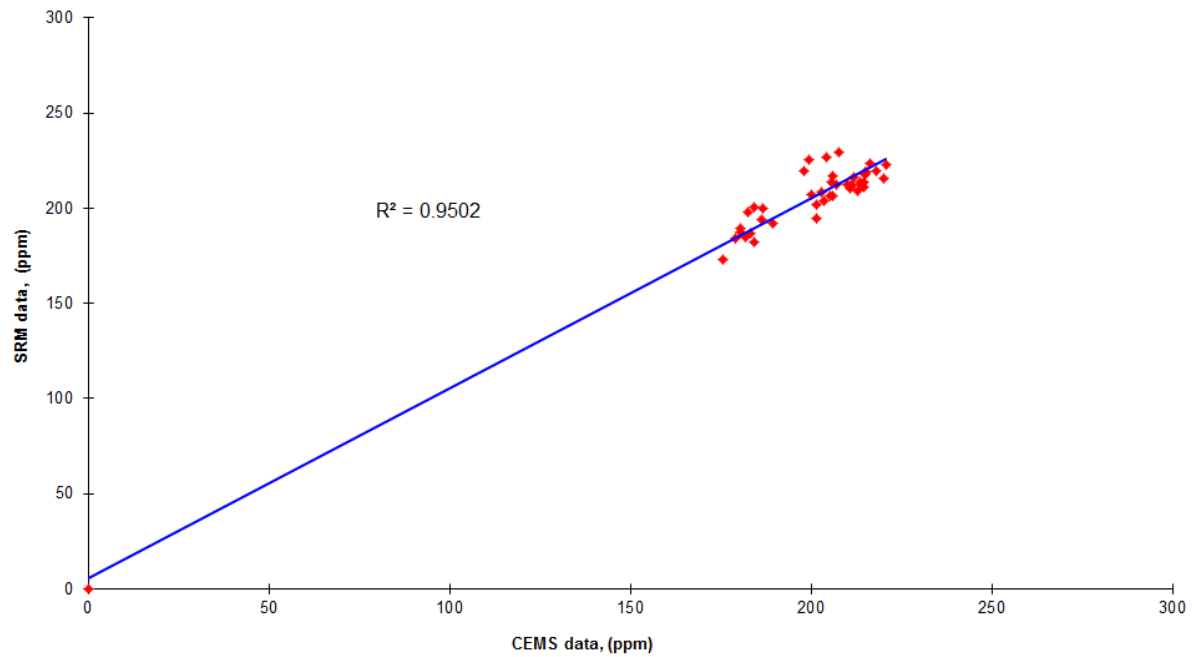
$$\alpha = -\beta \cdot Z \quad -1.02 * 0 \quad \alpha = 0.00$$

The calibration is function  $y_{im} = \alpha + \beta_{xi,m}$  or  $y_i = 0 + 1.02 * X_i$

#### 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		(mg/m3)	(mg/m3)	(%)	(%)	(mg/Nm <sup>3</sup> )	(mg/Nm <sup>3</sup> )	(mg/m3)
1	Reference	16/02/2016	0.0	0.0	0.0		0.0	0.0	0.0
2	13:00	14:00	204.2	209.4	6.3	1.6	433.9	444.9	479.7
3	14:01	15:01	201.4	206.5	6.5	1.6	435.4	446.5	425.5
4	15:02	16:02	203.7	208.9	6.5	1.6	438.4	449.6	435.3
5	16:03	17:03	206.0	211.2	6.5	1.6	445.6	457.0	441.0
6	18:00	19:00	211.2	216.6	6.5	1.6	456.0	467.7	460.2
7	19:01	20:01	214.8	220.2	6.4	1.6	461.5	473.2	455.4
8	20:02	21:02	215.0	220.4	6.5	1.5	463.7	475.5	460.7
9	21:03	22:03	218.2	223.8	6.5	1.4	469.9	481.9	464.1
10	22:04	23:04	220.7	226.4	6.5	1.5	475.9	488.0	470.5
11	23:05	00:05	207.6	212.9	6.7	1.6	453.3	464.9	475.8
13	01:07	02:07	214.8	220.3	6.5	1.5	464.6	476.5	462.6
14	02:08	03:08	216.4	221.9	6.5	1.5	466.8	478.7	469.7
15	03:09	04:09	211.9	217.3	6.6	1.5	461.0	472.7	460.7
16	04:10	05:10	210.9	216.3	6.6	1.5	458.6	470.3	452.5
17	05:11	06:11	207.0	212.2	6.7	1.5	451.4	462.9	453.9
18	06:12	07:12	214.0	219.4	6.5	1.3	462.2	474.0	450.7
19	07:13	08:13	205.5	210.7	6.7	1.3	449.4	460.9	456.4
20	08:14	09:14	201.7	206.8	6.9	1.3	446.4	457.7	440.4
21	10:00	11:00	206.0	211.3	6.8	1.3	451.3	462.8	468.0
22	11:01	12:01	203.0	208.1	6.8	1.2	445.1	456.4	445.6
23	12:02	13:02	205.4	210.6	6.6	1.2	445.9	457.3	442.3
24	13:03	14:03	213.5	219.0	6.5	1.4	459.9	471.6	454.9
25	14:04	15:04	214.5	220.0	6.4	1.4	460.3	472.1	447.5
26	15:05	16:05	215.4	220.9	6.4	1.4	461.7	473.4	456.6
28	18:11	19:11	220.0	225.6	5.9	1.5	456.8	468.5	445.1
29	19:12	20:12	213.0	218.4	6.2	1.5	451.3	462.8	440.7
30	20:13	21:13	198.1	203.1	6.6	1.4	429.6	440.6	457.6
31	21:14	22:14	175.6	180.1	7.4	3.3	411.4	421.9	396.6
32	22:15	23:15	179.2	183.7	7.3	1.2	408.9	419.3	409.6
33	23:16	00:16	182.0	186.6	7.3	1.2	413.1	423.7	413.0
34	00:17	01:17	183.2	187.9	7.2	1.2	415.4	426.0	416.5
35	01:18	02:18	182.6	187.2	7.3	1.2	414.5	425.1	426.9
36	02:19	03:19	180.5	185.1	7.3	1.2	412.3	422.8	420.0
37	03:20	04:20	180.4	185.0	7.3	1.2	412.4	423.0	415.9
38	04:21	05:21	186.7	191.4	7.1	1.3	417.7	428.4	430.6
39	05:22	06:22	211.2	216.6	6.3	1.4	449.5	460.9	443.4
40	06:23	07:23	210.0	215.4	6.4	1.3	448.2	459.7	445.6
41	07:24	08:24	200.1	205.2	6.7	1.4	436.2	447.3	431.9
42	09:30	10:30	186.4	191.2	7.1	1.3	417.6	428.2	430.3
44	11:32	12:32	199.5	204.6	6.7	1.4	436.2	447.4	467.8
45	12:33	13:33	184.4	189.1	7.2	1.2	417.3	428.0	406.4
46	13:34	14:34	184.1	188.8	6.9	1.4	408.6	419.0	430.3
47	14:35	15:35	189.4	194.2	6.5	1.4	408.4	418.9	409.2
Sum			8688.9				18983.95		
Emission Limit Value (ELV) =			1080	mg/Nm <sup>3</sup>					
Reference Oxygen					6	%			

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



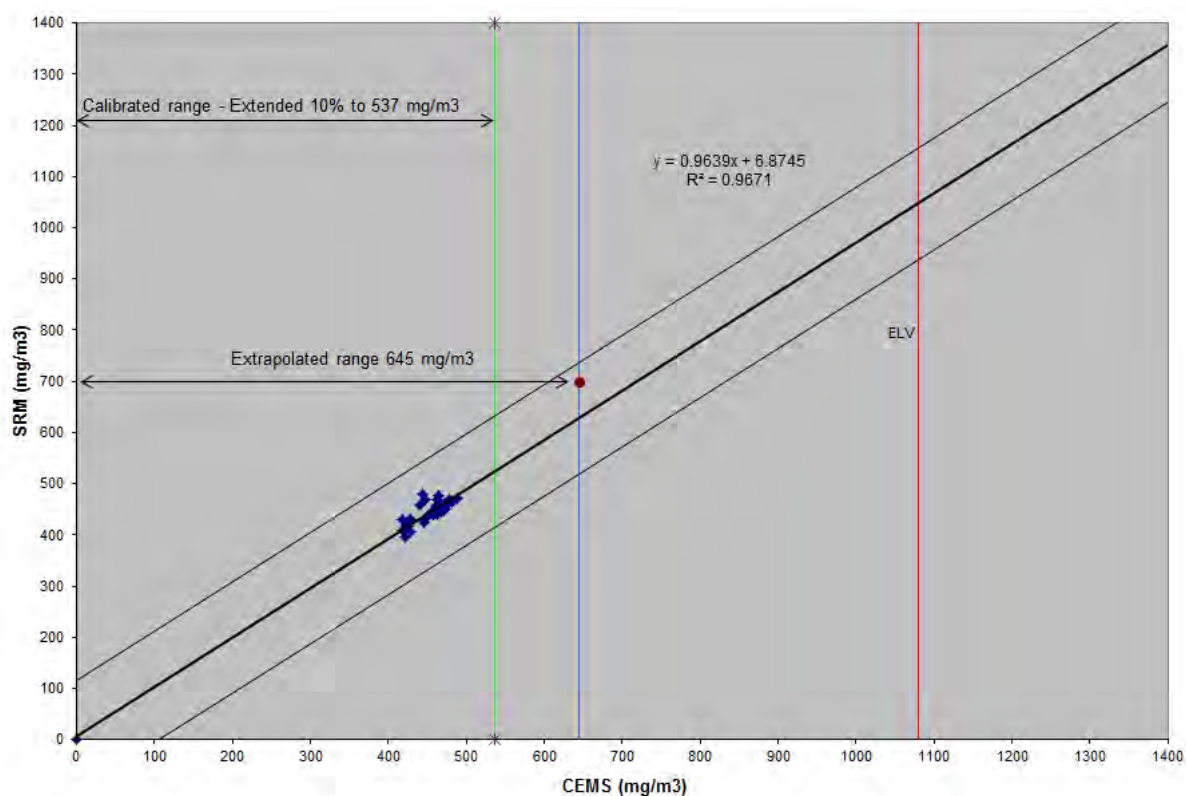
**4A1.10.1 Table 4.5.1 – Data used for the Variability Test – Oxides of Nitrogen**

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			
1	Reference	16/02/2016	0.0	0.0	0.00	9.10	82.73
2	13:00	14:00	444.9	479.7	34.71	43.81	1919.17
3	14:01	15:01	446.5	425.5	-21.02	-11.92	142.17
4	15:02	16:02	449.6	435.3	-14.32	-5.22	27.27
5	16:03	17:03	457.0	441.0	-16.01	-6.92	47.82
6	18:00	19:00	467.7	460.2	-7.44	1.66	2.74
7	19:01	20:01	473.2	455.4	-17.81	-8.72	75.99
8	20:02	21:02	475.5	460.7	-14.83	-5.74	32.92
9	21:03	22:03	481.9	464.1	-17.79	-8.69	75.54
10	22:04	23:04	488.0	470.5	-17.45	-8.36	69.81
11	23:05	00:05	464.9	475.8	10.96	20.06	402.27
13	01:07	02:07	476.5	462.6	-13.89	-4.79	22.97
14	02:08	03:08	478.7	469.7	-9.04	0.06	0.00
15	03:09	04:09	472.7	460.7	-12.01	-2.91	8.47
16	04:10	05:10	470.3	452.5	-17.79	-8.69	75.54
17	05:11	06:11	462.9	453.9	-9.04	0.06	0.00
18	06:12	07:12	474.0	450.7	-23.36	-14.27	203.54
19	07:13	08:13	460.9	456.4	-4.43	4.66	21.75
20	08:14	09:14	457.7	440.4	-17.31	-8.21	67.47
21	10:00	11:00	462.8	468.0	5.23	14.32	205.16
22	11:01	12:01	456.4	445.6	-10.77	-1.68	2.82
23	12:02	13:02	457.3	442.3	-14.94	-5.85	34.18
24	13:03	14:03	471.6	454.9	-16.71	-7.62	58.05
25	14:04	15:04	472.1	447.5	-24.52	-15.42	237.89
26	15:05	16:05	473.4	456.6	-16.81	-7.72	59.58
28	18:11	19:11	468.5	445.1	-23.37	-14.27	203.72
29	19:12	20:12	462.8	440.7	-22.13	-13.04	169.97
30	20:13	21:13	440.6	457.6	17.05	26.15	683.71
31	21:14	22:14	421.9	396.6	-25.24	-16.15	260.69
32	22:15	23:15	419.3	409.6	-9.78	-0.68	0.46
33	23:16	00:16	423.7	413.0	-10.64	-1.54	2.38
34	00:17	01:17	426.0	416.5	-9.50	-0.41	0.17
35	01:18	02:18	425.1	426.9	1.78	10.88	118.27
36	02:19	03:19	422.8	420.0	-2.79	6.31	39.78
37	03:20	04:20	423.0	415.9	-7.10	2.00	3.99
38	04:21	05:21	428.4	430.6	2.25	11.34	128.70
39	05:22	06:22	460.9	443.4	-17.55	-8.45	71.41
40	06:23	07:23	459.7	445.6	-14.05	-4.95	24.53
41	07:24	08:24	447.3	431.9	-15.39	-6.30	39.67
42	09:30	10:30	428.2	430.3	2.06	11.15	124.36
44	11:32	12:32	447.4	467.8	20.45	29.55	872.99
45	12:33	13:33	428.0	406.4	-21.54	-12.45	154.94
46	13:34	14:34	419.0	430.3	11.30	20.40	416.15
47	14:35	15:35	418.9	409.2	-9.63	-0.53	0.28
44 Tests		Mean			-9.10		
Sum							7192.05

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

SD=	$\text{Root}(1-\text{Number}).\text{Integral}(\text{D1}-\text{D})^2$	12.93	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 44 tests, kv =	0.9885		
Therefore variability=		$12.93 \leq 110.2 \times 0.9885$	
or	12.93	$\leq$	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 $\text{NO}_2$ ) – 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 (wet)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMs Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	01-Mar-16	13:00	14:00	75.29	6.27	1.57	79.94	6.15	1.95	79.9
2	01-Mar-16	14:01	15:01	72.42	6.52	1.57	77.83	6.61	1.93	77.8
3	01-Mar-16	15:02	16:02	74.26	6.46	1.57	79.59	6.29	1.94	79.6
4	01-Mar-16	16:03	17:03	72.24	6.53	1.60	79.25	6.28	1.97	79.2
5	01-Mar-16	18:00	19:00	71.90	6.50	1.61	75.92	6.53	2.10	75.9
6	01-Mar-16	19:01	20:01	66.70	6.43	1.59	71.82	6.24	2.04	71.8
7	01-Mar-16	20:02	21:02	62.18	6.50	1.49	68.37	6.07	1.93	68.4
8	01-Mar-16	21:03	22:03	61.15	6.50	1.36	65.83	6.14	1.76	65.8
9	01-Mar-16	22:04	23:04	60.96	6.49	1.51	65.23	6.10	1.94	65.2
10	01-02/03/2016	23:05	0:05	59.25	6.67	1.56	64.75	5.86	1.99	64.8
11	02-Mar-16	0:06	1:06	62.99	6.68	1.51	66.17	7.67	1.93	66.2
12	02-Mar-16	1:07	2:07	64.49	6.54	1.50	67.95	6.19	1.96	68.0
13	02-Mar-16	2:08	3:08	66.98	6.50	1.52	69.37	6.03	1.96	69.4
14	02-Mar-16	3:09	4:09	69.82	6.62	1.50	71.74	6.25	1.93	71.7
15	02-Mar-16	4:10	5:10	73.25	6.61	1.52	75.48	6.38	2.00	75.5
16	02-Mar-16	5:11	6:11	73.86	6.65	1.55	76.50	6.29	1.83	76.5
17	02-Mar-16	6:12	7:12	75.61	6.55	1.30	77.92	6.22	1.74	77.9
18	02-Mar-16	7:13	8:13	71.90	6.73	1.29	74.96	6.31	1.71	75.0
19	02-Mar-16	8:14	9:14	71.11	6.90	1.29	73.13	6.61	1.72	73.1
20	02-Mar-16	10:00	11:00	75.49	6.75	1.25	78.50	6.47	1.72	78.5
21	02-Mar-16	11:01	12:01	77.45	6.77	1.23	79.77	6.36	1.69	79.8
22	02-Mar-16	12:02	13:02	78.90	6.63	1.21	81.13	6.35	1.69	81.1
23	02-Mar-16	13:03	14:03	78.95	6.49	1.42	82.15	6.26	1.68	82.1
24	02-Mar-16	14:04	15:04	78.81	6.43	1.42	81.96	6.21	1.67	82.0
25	02-Mar-16	15:05	16:05	76.82	6.42	1.43	80.03	5.96	1.70	80.0
26	02-Mar-16	17:10	18:10	79.01	6.10	1.49	82.55	5.88	1.79	82.6
27	02-Mar-16	18:11	19:11	78.64	5.94	1.49	82.60	5.81	1.77	82.6
28	02-Mar-16	19:12	20:12	73.02	6.25	1.47	77.13	6.10	1.75	77.1
29	02-Mar-16	20:13	21:13	123.92	6.59	1.44	219.81	5.83	2.46	219.8
30	02-Mar-16	21:14	22:14	66.71	7.40	3.25	82.73	7.32	1.72	82.7
31	02-Mar-16	22:15	23:15	46.26	7.33	1.22	49.33	6.92	1.51	49.3
32	02-03/03/2016	23:16	0:16	44.26	7.25	1.24	48.33	6.98	1.52	48.3
33	03-Mar-16	0:17	1:17	44.09	7.23	1.25	48.03	6.94	1.52	48.0
34	03-Mar-16	1:18	2:18	44.22	7.25	1.25	48.66	6.49	1.50	48.7
35	03-Mar-16	2:19	3:19	44.24	7.33	1.24	49.31	6.88	1.51	49.3
36	03-Mar-16	3:20	4:20	46.78	7.35	1.23	50.35	6.88	1.51	50.4
37	03-Mar-16	4:21	5:21	50.91	7.05	1.28	53.98	6.45	1.57	54.0
38	03-Mar-16	5:22	6:22	54.39	6.33	1.36	58.49	6.01	1.62	58.5
39	03-Mar-16	6:23	7:23	55.31	6.37	1.34	58.93	6.08	1.68	58.9
40	03-Mar-16	7:24	8:24	54.35	6.66	1.39	57.19	5.99	1.60	57.2
41	03-Mar-16	9:30	10:30	54.42	7.06	1.29	50.79	6.93	1.33	50.8
42	03-Mar-16	10:31	11:31	58.32	6.55	1.23	62.53	7.72	1.68	62.5
43	03-Mar-16	11:32	12:32	57.19	6.70	1.45	61.50	5.90	1.70	61.5
44	03-Mar-16	12:33	13:33	64.97	7.21	1.24	65.90	6.93	1.61	65.9
45	03-Mar-16	13:34	14:34	70.28	6.92	1.38	72.82	6.41	1.65	72.8
46	03-Mar-16	14:35	15:35	70.11	6.51	1.43	76.17	6.30	1.68	76.2

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

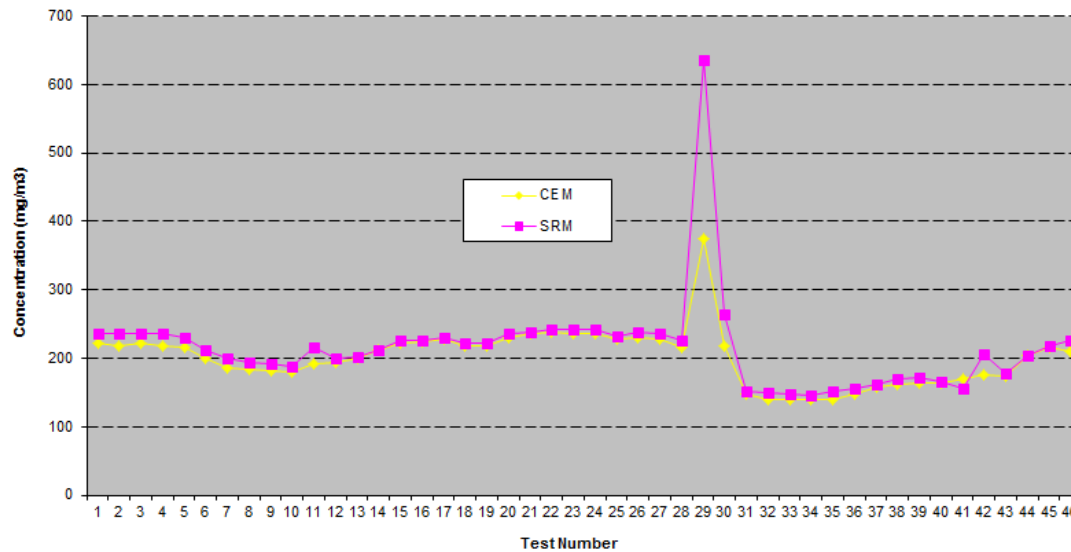
#### 4A1.2.2 Table 4.2.2 -Standardised monitoring Data – Sulphur Dioxide, Low Range

Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(SO <sub>2</sub> mg/m <sup>3</sup> )	(SO <sub>2</sub> mg/m <sup>3</sup> )	(mg/m <sup>3</sup> )
1	01-Mar-16	13:00	14:00	222.5	235.4	12.0
2	01-Mar-16	14:01	15:01	217.9	236.5	12.0
3	01-Mar-16	15:02	16:02	222.4	236.5	12.0
4	01-Mar-16	16:03	17:03	217.4	235.4	12.0
5	01-Mar-16	18:00	19:00	216.0	229.7	12.0
6	01-Mar-16	19:01	20:01	199.4	212.9	11.0
7	01-Mar-16	20:02	21:02	186.6	200.1	10.0
8	01-Mar-16	21:03	22:03	183.2	193.3	10.0
9	01-Mar-16	22:04	23:04	182.8	191.3	9.9
10	01-02/03/2016	23:05	0:05	180.0	187.1	9.7
11	02-Mar-16	0:06	1:06	191.5	217.1	11.0
12	02-Mar-16	1:07	2:07	194.0	200.6	10.0
13	02-Mar-16	2:08	3:08	201.0	202.5	11.0
14	02-Mar-16	3:09	4:09	211.4	212.5	11.0
15	02-Mar-16	4:10	5:10	221.6	225.9	12.0
16	02-Mar-16	5:11	6:11	224.1	227.1	12.0
17	02-Mar-16	6:12	7:12	227.2	230.0	12.0
18	02-Mar-16	7:13	8:13	218.8	222.5	12.0
19	02-Mar-16	8:14	9:14	219.0	221.7	12.0
20	02-Mar-16	10:00	11:00	230.0	235.7	12.0
21	02-Mar-16	11:01	12:01	236.3	237.5	12.0
22	02-Mar-16	12:02	13:02	238.3	241.5	13.0
23	02-Mar-16	13:03	14:03	236.6	243.0	13.0
24	02-Mar-16	14:04	15:04	235.3	241.6	13.0
25	02-Mar-16	15:05	16:05	229.1	231.9	12.0
26	02-Mar-16	17:10	18:10	230.7	238.2	12.0
27	02-Mar-16	18:11	19:11	227.2	237.2	12.0
28	02-Mar-16	19:12	20:12	215.3	225.8	12.0
29	02-Mar-16	20:13	21:13	374.0	636.8	33.0
30	02-Mar-16	21:14	22:14	217.4	263.9	14.0
31	02-Mar-16	22:15	23:15	146.9	152.5	7.9
32	02-03/03/2016	23:16	0:16	139.8	150.1	7.8
33	03-Mar-16	0:17	1:17	139.1	148.7	7.7
34	03-Mar-16	1:18	2:18	139.7	146.0	7.6
35	03-Mar-16	2:19	3:19	140.6	151.9	7.9
36	03-Mar-16	3:20	4:20	148.8	155.3	8.0
37	03-Mar-16	4:21	5:21	158.5	161.6	8.4
38	03-Mar-16	5:22	6:22	161.1	169.9	8.8
39	03-Mar-16	6:23	7:23	164.2	172.2	8.9
40	03-Mar-16	7:24	8:24	164.8	165.9	8.6
41	03-Mar-16	9:30	10:30	169.6	156.8	8.2
42	03-Mar-16	10:31	11:31	175.2	205.5	11.0
43	03-Mar-16	11:32	12:32	174.0	177.6	9.2
44	03-Mar-16	12:33	13:33	204.6	204.2	11.0
45	03-Mar-16	13:34	14:34	217.0	217.5	11.0
46	03-Mar-16	14:35	15:35	210.4	225.8	12.0

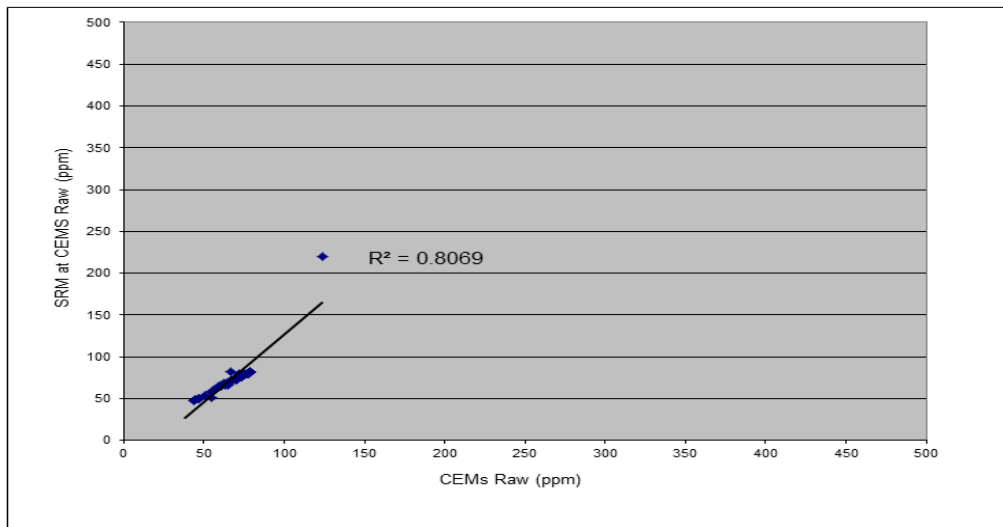
Note:  
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

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



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



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	13:00	14:00	75.3	79.9	4.65	-1.18	No
2	14:01	15:01	72.4	77.8	5.41	-0.42	No
3	15:02	16:02	74.3	79.6	5.32	-0.51	No
4	16:03	17:03	72.2	79.2	7.01	1.18	No
5	18:00	19:00	71.9	75.9	4.02	-1.81	No
6	19:01	20:01	66.7	71.8	5.11	-0.72	No
7	20:02	21:02	62.2	68.4	6.19	0.36	No
8	21:03	22:03	61.2	65.8	4.67	-1.16	No
9	22:04	23:04	61.0	65.2	4.27	-1.56	No
10	23:05	00:05	59.3	64.8	5.50	-0.33	No
11	00:06	01:06	63.0	66.2	3.18	-2.65	No
12	01:07	02:07	64.5	68.0	3.46	-2.37	No
13	02:08	03:08	67.0	69.4	2.40	-3.43	No
14	03:09	04:09	69.8	71.7	1.92	-3.91	No
15	04:10	05:10	73.2	75.5	2.24	-3.59	No
16	05:11	06:11	73.9	76.5	2.65	-3.18	No
17	06:12	07:12	75.6	77.9	2.32	-3.52	No
18	07:13	08:13	71.9	75.0	3.05	-2.78	No
19	08:14	09:14	71.1	73.1	2.02	-3.81	No
20	10:00	11:00	75.5	78.5	3.01	-2.82	No
21	11:01	12:01	77.5	79.8	2.32	-3.51	No
22	12:02	13:02	78.9	81.1	2.23	-3.60	No
23	13:03	14:03	78.9	82.1	3.20	-2.63	No
24	14:04	15:04	78.8	82.0	3.15	-2.68	No
25	15:05	16:05	76.8	80.0	3.21	-2.62	No
26	17:10	18:10	79.0	82.6	3.54	-2.29	No
27	18:11	19:11	78.6	82.6	3.95	-1.88	No
28	19:12	20:12	73.0	77.1	4.12	-1.71	No
29	20:13	21:13	123.9	219.8	95.90	90.07	Yes
30	21:14	22:14	66.7	82.7	16.02	10.19	No
31	22:15	23:15	46.3	49.3	3.06	-2.77	No
32	23:16	00:16	44.3	48.3	4.07	-1.76	No
33	00:17	01:17	44.1	48.0	3.94	-1.89	No
34	01:18	02:18	44.2	48.7	4.43	-1.40	No
35	02:19	03:19	44.2	49.3	5.06	-0.77	No
36	03:20	04:20	46.8	50.4	3.57	-2.26	No
37	04:21	05:21	50.9	54.0	3.06	-2.77	No
38	05:22	06:22	54.4	58.5	4.09	-1.74	No
39	06:23	07:23	55.3	58.9	3.63	-2.21	No
40	07:24	08:24	54.4	57.2	2.83	-3.00	No
41	09:30	10:30	54.4	50.8	-3.63	-9.46	No
42	10:31	11:31	58.3	62.5	4.20	-1.63	No
43	11:32	12:32	57.2	61.5	4.31	-1.52	No
44	12:33	13:33	65.0	65.9	0.93	-4.90	No
45	13:34	14:34	70.3	72.8	2.54	-3.29	No
46	14:35	15:35	70.1	76.2	6.06	0.23	No
				Average Di	5.83		
				Standard Deviation	13.80		
				Standard Deviation x2	27.59		

#### 4A1.5.2 Determination of Method A or Method B - 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	13:00	14:00	79.9	6.2	235.4
2	14:01	15:01	77.8	6.6	236.5
3	15:02	16:02	79.6	6.3	236.5
4	16:03	17:03	79.2	6.3	235.4
5	18:00	19:00	75.9	6.5	229.7
6	19:01	20:01	71.8	6.2	212.9
7	20:02	21:02	68.4	6.1	200.1
8	21:03	22:03	65.8	6.1	193.3
9	22:04	23:04	65.2	6.1	191.3
10	23:05	0:05	64.8	5.9	187.1
11	0:06	1:06	66.2	7.7	217.1
12	1:07	2:07	68.0	6.2	200.6
13	2:08	3:08	69.4	6.0	202.5
14	3:09	4:09	71.7	6.2	212.5
15	4:10	5:10	75.5	6.4	225.9
16	5:11	6:11	76.5	6.3	227.1
17	6:12	7:12	77.9	6.2	230.0
18	7:13	8:13	75.0	6.3	222.5
19	8:14	9:14	73.1	6.6	221.7
20	10:00	11:00	78.5	6.5	235.7
21	11:01	12:01	79.8	6.4	237.5
22	12:02	13:02	81.1	6.4	241.5
23	13:03	14:03	82.1	6.3	243.0
24	14:04	15:04	82.0	6.2	241.6
25	15:05	16:05	80.0	6.0	231.9
26	17:10	18:10	82.6	5.9	238.2
27	18:11	19:11	82.6	5.8	237.2
28	19:12	20:12	77.1	6.1	225.8
30	21:14	22:14	82.7	7.3	263.9
31	22:15	23:15	49.3	6.9	152.5
32	23:16	0:16	48.3	7.0	150.1
33	0:17	1:17	48.0	6.9	148.7
34	1:18	2:18	48.7	6.5	146.0
35	2:19	3:19	49.3	6.9	151.9
36	3:20	4:20	50.4	6.9	155.3
37	4:21	5:21	54.0	6.5	161.6
38	5:22	6:22	58.5	6.0	169.9
39	6:23	7:23	58.9	6.1	172.2
40	7:24	8:24	57.2	6.0	165.9
41	9:30	10:30	50.8	6.9	156.8
42	10:31	11:31	62.5	7.7	205.5
43	11:32	12:32	61.5	5.9	177.6
44	12:33	13:33	65.9	6.9	204.2
45	13:34	14:34	72.8	6.4	217.5
46	14:35	15:35	76.2	6.3	225.8
Sum			3102.60		
Emission Limit Value (ELV) =		440	mg/Nm <sup>3</sup>	Y <sub>max</sub>	263.93
Maximum Permissible uncertainty =		20	%	Y <sub>min</sub>	145.95
Maximum Permissible uncertainty (at 15% of the ELV) =		88	mg/Nm <sup>3</sup>		
		66	mg/Nm <sup>3</sup>		
Is Y <sub>max</sub> - Y <sub>min</sub> > MPU at ELV?		Yes		Y <sub>max</sub> - Y <sub>min</sub>	117.98
Is Y <sub>min</sub> > 15% of ELV?		Yes			
Derivation of Calibration Function		Method A			

**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 <sup>2</sup>	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference	16/02/2016	0.0	0.0	-67.45	-63.70	4296.53	4057.87	
2	13:00	14:00	79.9	75.3	12.49	11.59	144.77	134.29	
3	14:01	15:01	77.8	72.4	10.38	8.72	90.54	76.03	
4	15:02	16:02	79.6	74.3	12.14	10.56	128.22	111.57	
5	16:03	17:03	79.2	72.2	11.80	8.54	100.77	72.92	
6	18:00	19:00	75.9	71.9	8.47	8.20	69.47	67.22	
7	19:01	20:01	71.8	66.7	4.37	3.00	13.12	9.02	
8	20:02	21:02	68.4	62.2	0.92	-1.52	-1.40	2.33	
9	21:03	22:03	65.8	61.2	-1.62	-2.55	4.14	6.50	
10	22:04	23:04	65.2	61.0	-2.22	-2.74	6.08	7.51	
11	23:05	0:05	64.8	59.3	-2.69	-4.45	11.99	19.81	
12	0:06	1:06	66.2	63.0	-1.27	-0.71	0.91	0.51	
13	1:07	2:07	68.0	64.5	0.50	0.79	0.40	0.62	
14	2:08	3:08	69.4	67.0	1.93	3.27	6.31	10.72	
15	3:09	4:09	71.7	69.8	4.29	6.12	26.29	37.47	
16	4:10	5:10	75.5	73.2	8.04	9.54	76.69	91.08	
17	5:11	6:11	76.5	73.9	9.06	10.15	91.95	103.11	
18	6:12	7:12	77.9	75.6	10.48	11.91	124.72	141.75	
19	7:13	8:13	75.0	71.9	7.51	8.20	61.59	67.28	
20	8:14	9:14	73.1	71.1	5.68	7.41	42.10	54.88	
21	10:00	11:00	78.5	75.5	11.06	11.79	130.33	138.97	
22	11:01	12:01	79.8	77.5	12.32	13.75	169.48	189.12	
23	12:02	13:02	81.1	78.9	13.68	15.20	208.01	231.06	
24	13:03	14:03	82.1	78.9	14.70	15.24	224.08	232.37	
25	14:04	15:04	82.0	78.8	14.51	15.11	219.17	228.21	
26	15:05	16:05	80.0	76.8	12.58	13.12	165.05	172.04	
27	17:10	18:10	82.6	79.0	15.10	15.31	231.26	234.48	
28	18:11	19:11	82.6	78.6	15.15	14.94	226.33	223.28	
29	19:12	20:12	77.1	73.0	9.68	9.31	90.20	86.75	
31	21:14	22:14	82.7	66.7	15.28	3.01	45.97	9.05	
32	22:15	23:15	49.3	46.3	-18.12	-17.44	316.00	304.04	
33	23:16	0:16	48.3	44.3	-19.12	-19.44	371.78	378.06	
34	0:17	1:17	48.0	44.1	-19.42	-19.61	380.91	384.74	
35	1:18	2:18	48.7	44.2	-18.79	-19.48	366.00	379.40	
36	2:19	3:19	49.3	44.2	-18.14	-19.46	353.02	378.60	
37	3:20	4:20	50.4	46.8	-17.09	-16.92	289.26	286.35	
38	4:21	5:21	54.0	50.9	-13.47	-12.79	172.26	163.50	
39	5:22	6:22	58.5	54.4	-8.96	-9.31	83.43	86.66	
40	6:23	7:23	58.9	55.3	-8.51	-8.39	71.45	70.44	
41	7:24	8:24	57.2	54.4	-10.26	-9.35	95.92	87.39	
42	9:30	10:30	50.8	54.4	-16.66	-9.28	154.64	86.18	
43	10:31	11:31	62.5	58.3	-4.92	-5.38	26.45	28.91	
44	11:32	12:32	61.5	57.2	-5.95	-6.52	38.75	42.46	
45	12:33	13:33	65.9	65.0	-1.55	1.26	-1.96	1.60	
46	13:34	14:34	72.8	70.3	5.37	6.58	35.35	43.31	
47	14:35	15:35	76.2	70.1	8.73	6.41	55.91	41.06	
Sum			3102.60	2930.27	0.00	0.00	9814.20	9580.49	1.02

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

##### Method A

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

$N$	$N$	$N$	$N$		
$b = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2}$	$\bar{x} = \frac{1}{N} \sum x_i$	$\bar{y} = \frac{1}{N} \sum y_i$		$\bar{x} =$	63.70
$i=1$	$i=1$	$i=1$	$i=1$	$\bar{y} =$	67.45
				$b =$	1.024
$a = \bar{y} - b\bar{x}$	$a = 67.45 - 63.71 * 1.024$			$a =$	2.192

The calibration is function  $y_i = a + b x_i$  or  $y_i = 2.192 + 1.024 * x_i$

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

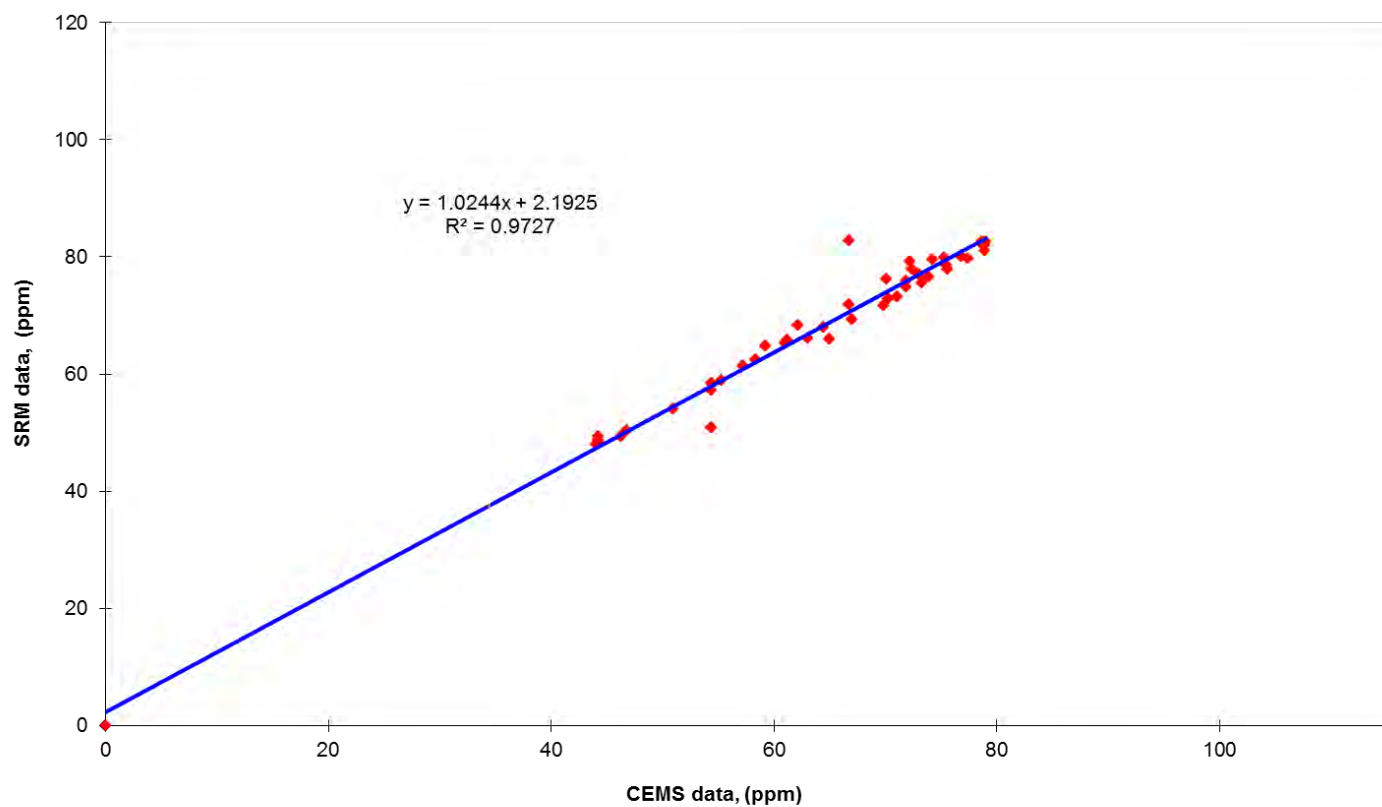
Test No	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
	hr:min		(ppm)	(ppm)	(%)	(%)	(mg/Nm <sup>3</sup> )	(mg/Nm <sup>3</sup> )	(mg/m3)
1	Reference	16/02/2016	0.0	2.2	0.0		0.0	6.3	0.0
2	13:00	14:00	75.3	79.3	6.3	1.6	222.5	234.4	235.4
3	14:01	15:01	72.4	76.4	6.5	1.6	217.9	229.8	236.5
4	15:02	16:02	74.3	78.3	6.5	1.6	222.4	234.4	236.5
5	16:03	17:03	72.2	76.2	6.5	1.6	217.4	229.3	235.4
6	18:00	19:00	71.9	75.8	6.5	1.6	216.0	227.9	229.7
7	19:01	20:01	66.7	70.5	6.4	1.6	199.4	210.8	212.9
8	20:02	21:02	62.2	65.9	6.5	1.5	186.6	197.7	200.1
9	21:03	22:03	61.2	64.8	6.5	1.4	183.2	194.3	193.3
10	22:04	23:04	61.0	64.6	6.5	1.5	182.8	193.9	191.3
11	23:05	00:05	59.3	62.9	6.7	1.6	180.0	191.1	187.1
12	00:06	01:06	63.0	66.7	6.7	1.5	191.5	202.9	217.1
13	01:07	02:07	64.5	68.3	6.5	1.5	194.0	205.4	200.6
14	02:08	03:08	67.0	70.8	6.5	1.5	201.0	212.5	202.5
15	03:09	04:09	69.8	73.7	6.6	1.5	211.4	223.2	212.5
16	04:10	05:10	73.2	77.2	6.6	1.5	221.6	233.6	225.9
17	05:11	06:11	73.9	77.8	6.7	1.5	224.1	236.2	227.1
18	06:12	07:12	75.6	79.6	6.5	1.3	227.2	239.4	230.0
19	07:13	08:13	71.9	75.9	6.7	1.3	218.8	230.8	222.5
20	08:14	09:14	71.1	75.0	6.9	1.3	219.0	231.1	221.7
21	10:00	11:00	75.5	79.5	6.8	1.3	230.0	242.3	235.7
22	11:01	12:01	77.5	81.5	6.8	1.2	236.3	248.8	237.5
23	12:02	13:02	78.9	83.0	6.6	1.2	238.3	250.8	241.5
24	13:03	14:03	78.9	83.1	6.5	1.4	236.6	248.9	243.0
25	14:04	15:04	78.8	82.9	6.4	1.4	235.3	247.5	241.6
26	15:05	16:05	76.8	80.9	6.4	1.4	229.1	241.2	231.9
27	17:10	18:10	79.0	83.1	6.1	1.5	230.7	242.8	238.2
28	18:11	19:11	78.6	82.8	5.9	1.5	227.2	239.1	237.2
29	19:12	20:12	73.0	77.0	6.2	1.5	215.3	227.0	225.8
31	21:14	22:14	66.7	70.5	6.6	1.4	217.4	212.8	263.9
32	22:15	23:15	46.3	49.6	7.4	3.3	146.9	161.6	152.5
33	23:16	00:16	44.3	47.5	7.3	1.2	139.8	150.9	150.1
34	00:17	01:17	44.1	47.4	7.3	1.2	139.1	149.6	148.7
35	01:18	02:18	44.2	47.5	7.2	1.2	139.7	149.8	146.0
36	02:19	03:19	44.2	47.5	7.3	1.2	140.6	150.1	151.9
37	03:20	04:20	46.8	50.1	7.3	1.2	148.8	159.2	155.3
38	04:21	05:21	50.9	54.3	7.3	1.2	158.5	172.8	161.6
39	05:22	06:22	54.4	57.9	7.1	1.3	161.1	180.3	169.9
40	06:23	07:23	55.3	58.9	6.3	1.4	164.2	174.3	172.2
41	07:24	08:24	54.4	57.9	6.4	1.3	164.8	171.9	165.9
42	09:30	10:30	54.4	57.9	6.7	1.4	169.6	175.7	156.8
43	10:31	11:31	58.3	61.9	7.1	1.3	175.2	193.0	205.5
44	11:32	12:32	57.2	60.8	6.6	1.2	174.0	182.5	177.6
45	12:33	13:33	65.0	68.7	6.7	1.4	204.6	209.2	204.2
46	13:34	14:34	70.3	74.2	7.2	1.2	217.0	233.7	217.5
47	14:35	15:35	70.1	74.0	6.9	1.4	210.4	228.5	225.8
Sum							8887.62		
Emission Limit Value (ELV) =			440	mg/Nm <sup>3</sup>					

Reference Oxygen

6

%

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



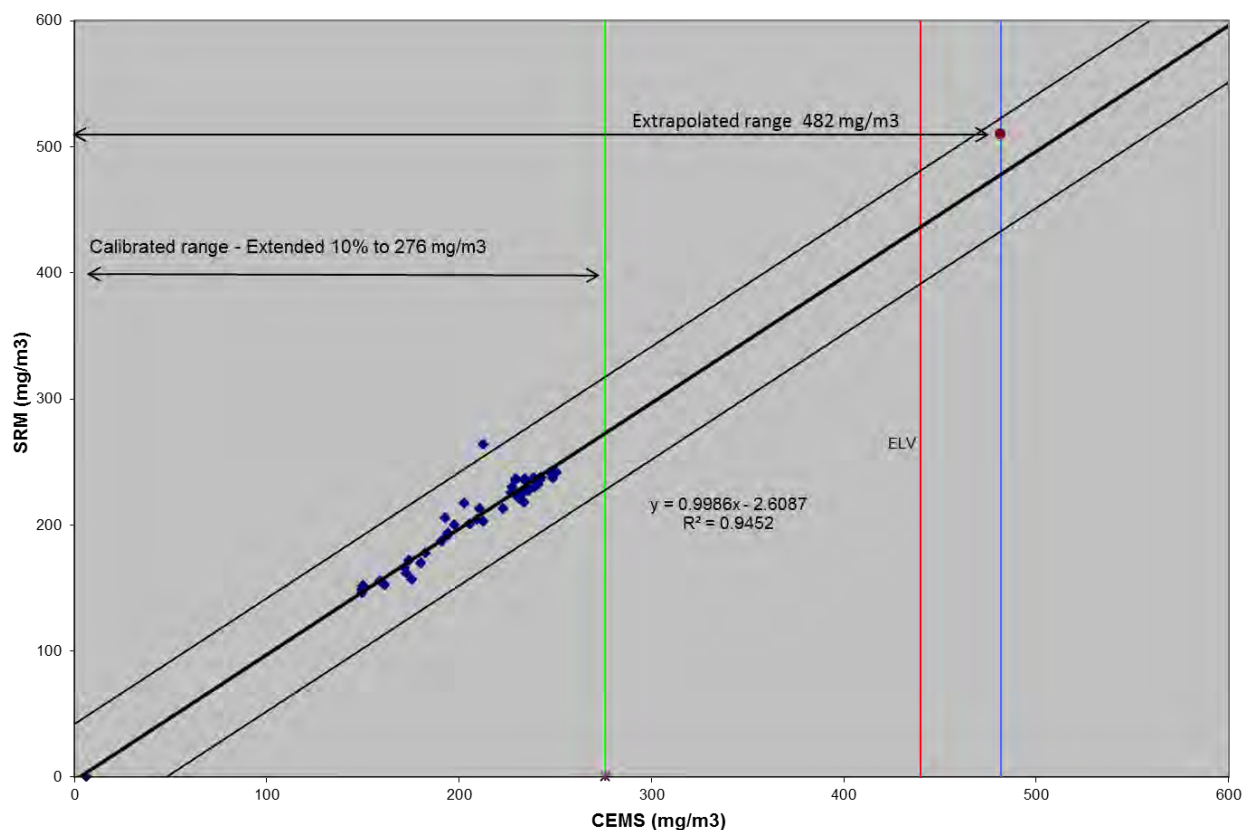
**4A1.10.2 Table 4.5.2 – Data used for the Variability Test – Sulphur Dioxide, Low Range.**

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			
2	13:00	14:00	234.4	235.4	0.92	3.75	14.06
3	14:01	15:01	229.8	236.5	6.71	9.54	91.08
4	15:02	16:02	234.4	236.5	2.08	4.91	24.12
5	16:03	17:03	229.3	235.4	6.08	8.91	79.36
6	18:00	19:00	227.9	229.7	1.84	4.67	21.77
7	19:01	20:01	210.8	212.9	2.09	4.92	24.20
8	20:02	21:02	197.7	200.1	2.34	5.17	26.71
9	21:03	22:03	194.3	193.3	-0.98	1.85	3.43
10	22:04	23:04	193.9	191.3	-2.61	0.22	0.05
11	23:05	00:05	191.1	187.1	-4.01	-1.18	1.40
12	00:06	01:06	202.9	217.1	14.23	17.06	290.97
13	01:07	02:07	205.4	200.6	-4.76	-1.93	3.71
14	02:08	03:08	212.5	202.5	-10.01	-7.18	51.56
15	03:09	04:09	223.2	212.5	-10.66	-7.83	61.36
16	04:10	05:10	233.6	225.9	-7.75	-4.92	24.22
17	05:11	06:11	236.2	227.1	-9.11	-6.28	39.49
18	06:12	07:12	239.4	230.0	-9.35	-6.52	42.57
19	07:13	08:13	230.8	222.5	-8.30	-5.47	29.95
20	08:14	09:14	231.1	221.7	-9.39	-6.57	43.10
21	10:00	11:00	242.3	235.7	-6.63	-3.80	14.46
22	11:01	12:01	248.8	237.5	-11.26	-8.43	71.02
23	12:02	13:02	250.8	241.5	-9.32	-6.49	42.11
24	13:03	14:03	248.9	243.0	-5.97	-3.15	9.90
25	14:04	15:04	247.5	241.6	-5.98	-3.15	9.92
26	15:05	16:05	241.2	231.9	-9.27	-6.44	41.45
27	17:10	18:10	242.8	238.2	-4.54	-1.71	2.91
28	18:11	19:11	239.1	237.2	-1.90	0.93	0.86
29	19:12	20:12	227.0	225.8	-1.17	1.66	2.76
31	21:14	22:14	212.8	263.9	51.09	53.92	2907.12
32	22:15	23:15	161.6	152.5	-9.12	-6.29	39.58
33	23:16	00:16	150.9	150.1	-0.79	2.04	4.15
34	00:17	01:17	149.6	148.7	-0.84	1.99	3.97
35	01:18	02:18	149.8	146.0	-3.87	-1.04	1.08
36	02:19	03:19	150.1	151.9	1.84	4.67	21.83
37	03:20	04:20	159.2	155.3	-3.96	-1.13	1.28
38	04:21	05:21	172.8	161.6	-11.26	-8.44	71.16
39	05:22	06:22	180.3	169.9	-10.40	-7.57	57.31
40	06:23	07:23	174.3	172.2	-2.09	0.74	0.54
41	07:24	08:24	171.9	165.9	-5.95	-3.12	9.74
42	09:30	10:30	175.7	156.8	-18.88	-16.05	257.62
43	10:31	11:31	193.0	205.5	12.45	15.28	233.33
44	11:32	12:32	182.5	177.6	-4.99	-2.16	4.67
45	12:33	13:33	209.2	204.2	-4.98	-2.16	4.65
46	13:34	14:34	233.7	217.5	-16.18	-13.35	178.13
47	14:35	15:35	228.5	225.8	-2.70	0.13	0.02
45 Tests		Mean			-2.83		
Sum							4864.67

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

SD=	Root(1-Number).Integral(D1-D) <sup>2</sup>	10.51	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O <sub>0</sub> is therefore calculated as:-			
O <sub>0</sub> =	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=	10.51 <= 44.9 * 0.9885		
or	10.51 <=	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	01-Mar-16	13:00	14:00	75.29	6.27	1.57	79.94	6.15	1.95	79.9
2	01-Mar-16	14:01	15:01	72.43	6.52	1.57	77.83	6.61	1.93	77.8
3	01-Mar-16	15:02	16:02	74.25	6.46	1.57	79.59	6.29	1.94	79.6
4	01-Mar-16	16:03	17:03	72.26	6.53	1.60	79.25	6.28	1.97	79.2
5	01-Mar-16	18:00	19:00	71.90	6.50	1.61	75.92	6.53	2.10	75.9
6	01-Mar-16	19:01	20:01	66.70	6.43	1.59	71.82	6.24	2.04	71.8
7	01-Mar-16	20:02	21:02	62.16	6.50	1.49	68.37	6.07	1.93	68.4
8	01-Mar-16	21:03	22:03	61.11	6.50	1.36	65.83	6.14	1.76	65.8
9	01-Mar-16	22:04	23:04	60.95	6.49	1.51	65.23	6.10	1.94	65.2
10	01-02/03/2016	23:05	0:05	59.16	6.67	1.56	64.75	5.86	1.99	64.8
11	02-Mar-16	0:06	1:06	58.88	6.68	1.51	66.17	7.67	1.93	66.2
12	02-Mar-16	1:07	2:07	63.55	6.54	1.50	67.95	6.19	1.96	68.0
13	02-Mar-16	2:08	3:08	66.06	6.50	1.52	69.37	6.03	1.96	69.4
14	02-Mar-16	3:09	4:09	69.73	6.62	1.50	71.74	6.25	1.93	71.7
15	02-Mar-16	4:10	5:10	71.21	6.61	1.52	75.48	6.38	2.00	75.5
16	02-Mar-16	5:11	6:11	71.95	6.65	1.55	76.50	6.29	1.83	76.5
17	02-Mar-16	6:12	7:12	77.36	6.55	1.30	77.92	6.22	1.74	77.9
18	02-Mar-16	7:13	8:13	73.92	6.73	1.29	74.96	6.31	1.71	75.0
19	02-Mar-16	8:14	9:14	69.47	6.90	1.29	73.13	6.61	1.72	73.1
20	02-Mar-16	10:00	11:00	76.06	6.75	1.25	78.50	6.47	1.72	78.5
21	02-Mar-16	11:01	12:01	76.88	6.77	1.23	79.77	6.36	1.69	79.8
22	02-Mar-16	12:02	13:02	78.60	6.63	1.21	81.13	6.35	1.69	81.1
23	02-Mar-16	13:03	14:03	78.95	6.49	1.42	82.15	6.26	1.68	82.1
24	02-Mar-16	14:04	15:04	80.18	6.43	1.42	81.96	6.21	1.67	82.0
25	02-Mar-16	15:05	16:05	76.82	6.42	1.43	80.03	5.96	1.70	80.0
26	02-Mar-16	17:10	18:10	74.22	6.10	1.49	82.55	5.88	1.79	82.6
27	02-Mar-16	18:11	19:11	77.05	5.94	1.49	82.60	5.81	1.77	82.6
28	02-Mar-16	19:12	20:12	76.94	6.25	1.47	77.13	6.10	1.75	77.1
29	02-Mar-16	20:13	21:13	289.77	6.59	1.44	219.81	5.83	2.46	219.8
30	02-Mar-16	21:14	22:14	59.98	7.40	3.25	82.73	7.32	1.72	82.7
31	02-Mar-16	22:15	23:15	48.26	7.33	1.22	49.33	6.92	1.51	49.3
32	02-03/03/2016	23:16	0:16	45.66	7.25	1.24	48.33	6.98	1.52	48.3
33	03-Mar-16	0:17	1:17	43.76	7.23	1.25	48.03	6.94	1.52	48.0
34	03-Mar-16	1:18	2:18	47.31	7.25	1.25	48.66	6.49	1.50	48.7
35	03-Mar-16	2:19	3:19	43.22	7.33	1.24	49.31	6.88	1.51	49.3
36	03-Mar-16	3:20	4:20	42.96	7.35	1.23	50.35	6.88	1.51	50.4
37	03-Mar-16	4:21	5:21	53.65	7.05	1.28	53.98	6.45	1.57	54.0
38	03-Mar-16	5:22	6:22	55.41	6.33	1.36	58.49	6.01	1.62	58.5
39	03-Mar-16	6:23	7:23	53.94	6.37	1.34	58.93	6.08	1.68	58.9
40	03-Mar-16	7:24	8:24	54.35	6.66	1.39	57.19	5.99	1.60	57.2
41	03-Mar-16	9:30	10:30	55.01	7.06	1.29	50.79	6.93	1.33	50.8
42	03-Mar-16	10:31	11:31	50.98	6.55	1.23	62.53	7.72	1.68	62.5
43	03-Mar-16	11:32	12:32	60.07	6.70	1.45	61.50	5.90	1.70	61.5
44	03-Mar-16	12:33	13:33	58.47	7.21	1.24	65.90	6.93	1.61	65.9
45	03-Mar-16	13:34	14:34	66.35	6.92	1.38	72.82	6.41	1.65	72.8
46	03-Mar-16	14:35	15:35	69.17	6.51	1.43	76.17	6.30	1.68	76.2

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

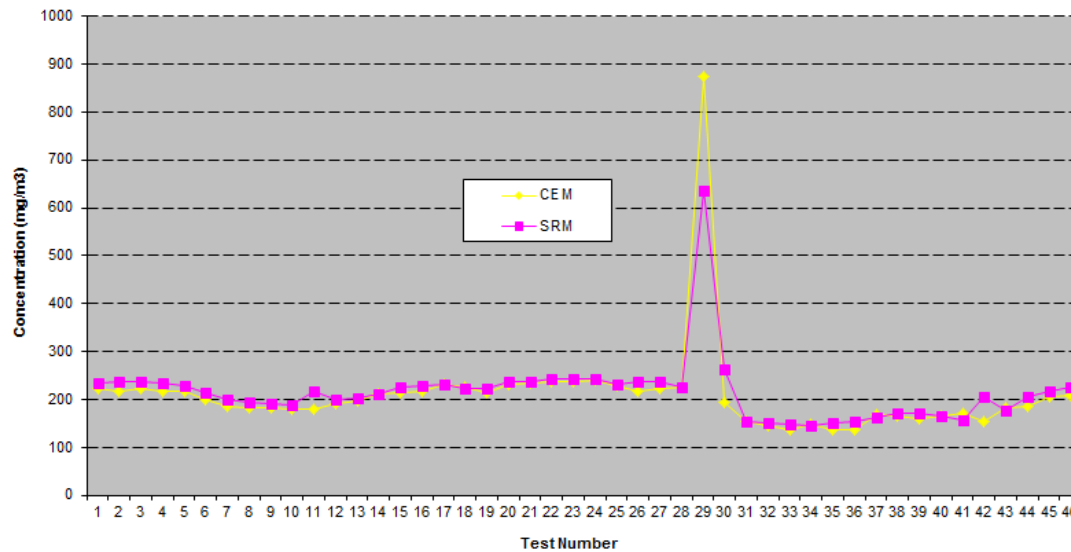
**4A1.2.3 Table 4.2.3 -Standardised monitoring Data – Sulphur Dioxide, High Range**

Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(SO <sub>2</sub> mg/m <sup>3</sup> )	(SO <sub>2</sub> mg/m <sup>3</sup> )	(mg/m <sup>3</sup> )
1	01-Mar-16	13:00	14:00	222.5	235.4	12.0
2	01-Mar-16	14:01	15:01	217.9	236.5	12.0
3	01-Mar-16	15:02	16:02	222.4	236.5	12.0
4	01-Mar-16	16:03	17:03	217.5	235.4	12.0
5	01-Mar-16	18:00	19:00	216.0	229.7	12.0
6	01-Mar-16	19:01	20:01	199.4	212.9	11.0
7	01-Mar-16	20:02	21:02	186.5	200.1	10.0
8	01-Mar-16	21:03	22:03	183.1	193.3	10.0
9	01-Mar-16	22:04	23:04	182.8	191.3	9.9
10	01-02/03/2016	23:05	0:05	179.7	187.1	9.7
11	02-Mar-16	0:06	1:06	179.0	217.1	11.0
12	02-Mar-16	1:07	2:07	191.2	200.6	10.0
13	02-Mar-16	2:08	3:08	198.3	202.5	11.0
14	02-Mar-16	3:09	4:09	211.1	212.5	11.0
15	02-Mar-16	4:10	5:10	215.5	225.9	12.0
16	02-Mar-16	5:11	6:11	218.4	227.1	12.0
17	02-Mar-16	6:12	7:12	232.5	230.0	12.0
18	02-Mar-16	7:13	8:13	224.9	222.5	12.0
19	02-Mar-16	8:14	9:14	213.9	221.7	12.0
20	02-Mar-16	10:00	11:00	231.8	235.7	12.0
21	02-Mar-16	11:01	12:01	234.5	237.5	12.0
22	02-Mar-16	12:02	13:02	237.4	241.5	13.0
23	02-Mar-16	13:03	14:03	236.6	243.0	13.0
24	02-Mar-16	14:04	15:04	239.4	241.6	13.0
25	02-Mar-16	15:05	16:05	229.1	231.9	12.0
26	02-Mar-16	17:10	18:10	216.7	238.2	12.0
27	02-Mar-16	18:11	19:11	222.6	237.2	12.0
28	02-Mar-16	19:12	20:12	226.8	225.8	12.0
29	02-Mar-16	20:13	21:13	874.5	636.8	33.0
30	02-Mar-16	21:14	22:14	195.5	263.9	14.0
31	02-Mar-16	22:15	23:15	153.3	152.5	7.9
32	02-03/03/2016	23:16	0:16	144.2	150.1	7.8
33	03-Mar-16	0:17	1:17	138.0	148.7	7.7
34	03-Mar-16	1:18	2:18	149.4	146.0	7.6
35	03-Mar-16	2:19	3:19	137.3	151.9	7.9
36	03-Mar-16	3:20	4:20	136.6	155.3	8.0
37	03-Mar-16	4:21	5:21	167.1	161.6	8.4
38	03-Mar-16	5:22	6:22	164.1	169.9	8.8
39	03-Mar-16	6:23	7:23	160.2	172.2	8.9
40	03-Mar-16	7:24	8:24	164.8	165.9	8.6
41	03-Mar-16	9:30	10:30	171.4	156.8	8.2
42	03-Mar-16	10:31	11:31	153.1	205.5	11.0
43	03-Mar-16	11:32	12:32	182.8	177.6	9.2
44	03-Mar-16	12:33	13:33	184.2	204.2	11.0
45	03-Mar-16	13:34	14:34	204.9	217.5	11.0
46	03-Mar-16	14:35	15:35	207.5	225.8	12.0

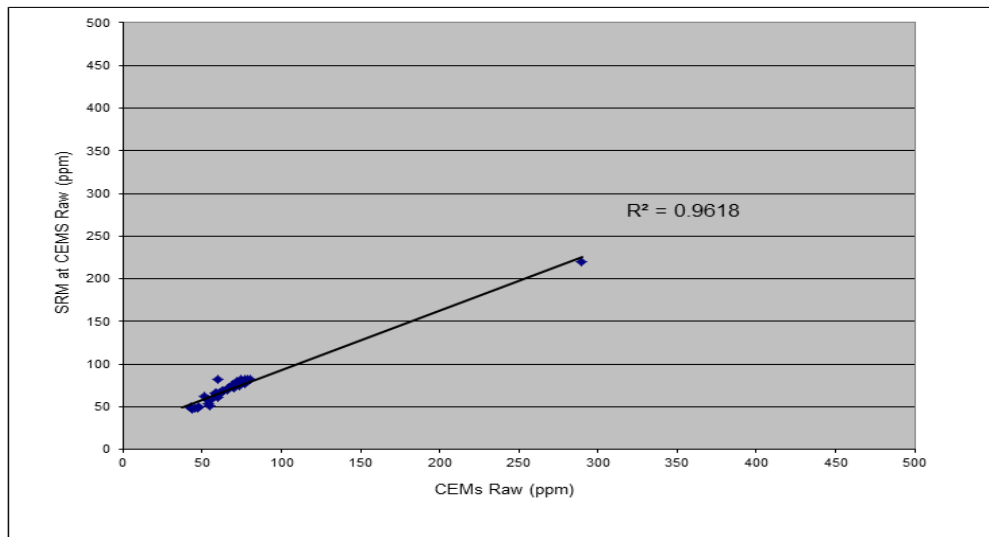
Note:  
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

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



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



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	13:00	14:00	75.3	79.9	4.65	1.82	No
2	14:01	15:01	72.4	77.8	5.40	2.57	No
3	15:02	16:02	74.2	79.6	5.34	2.51	No
4	16:03	17:03	72.3	79.2	6.99	4.16	No
5	18:00	19:00	71.9	75.9	4.02	1.20	No
6	19:01	20:01	66.7	71.8	5.12	2.29	No
7	20:02	21:02	62.2	68.4	6.21	3.38	No
8	21:03	22:03	61.1	65.8	4.71	1.89	No
9	22:04	23:04	61.0	65.2	4.27	1.45	No
10	23:05	00:05	59.2	64.8	5.59	2.76	No
11	00:06	01:06	58.9	66.2	7.29	4.47	No
12	01:07	02:07	63.6	68.0	4.40	1.57	No
13	02:08	03:08	66.1	69.4	3.31	0.48	No
14	03:09	04:09	69.7	71.7	2.01	-0.82	No
15	04:10	05:10	71.2	75.5	4.27	1.44	No
16	05:11	06:11	72.0	76.5	4.55	1.72	No
17	06:12	07:12	77.4	77.9	0.56	-2.27	No
18	07:13	08:13	73.9	75.0	1.03	-1.79	No
19	08:14	09:14	69.5	73.1	3.66	0.84	No
20	10:00	11:00	76.1	78.5	2.44	-0.39	No
21	11:01	12:01	76.9	79.8	2.89	0.06	No
22	12:02	13:02	78.6	81.1	2.53	-0.30	No
23	13:03	14:03	78.9	82.1	3.20	0.37	No
24	14:04	15:04	80.2	82.0	1.77	-1.06	No
25	15:05	16:05	76.8	80.0	3.21	0.38	No
26	17:10	18:10	74.2	82.6	8.33	5.50	No
27	18:11	19:11	77.1	82.6	5.54	2.72	No
28	19:12	20:12	76.9	77.1	0.20	-2.63	No
29	20:13	21:13	289.8	219.8	-69.96	-72.78	Yes
30	21:14	22:14	60.0	82.7	22.75	19.93	No
31	22:15	23:15	48.3	49.3	1.06	-1.77	No
32	23:16	00:16	45.7	48.3	2.67	-0.16	No
33	00:17	01:17	43.8	48.0	4.27	1.45	No
34	01:18	02:18	47.3	48.7	1.35	-1.47	No
35	02:19	03:19	43.2	49.3	6.09	3.26	No
36	03:20	04:20	43.0	50.4	7.39	4.57	No
37	04:21	05:21	53.7	54.0	0.32	-2.50	No
38	05:22	06:22	55.4	58.5	3.07	0.25	No
39	06:23	07:23	53.9	58.9	5.00	2.17	No
40	07:24	08:24	54.3	57.2	2.84	0.01	No
41	09:30	10:30	55.0	50.8	-4.22	-7.04	No
42	10:31	11:31	51.0	62.5	11.55	8.72	No
43	11:32	12:32	60.1	61.5	1.43	-1.40	No
44	12:33	13:33	58.5	65.9	7.43	4.60	No
45	13:34	14:34	66.4	72.8	6.47	3.64	No
46	14:35	15:35	69.2	76.2	7.00	4.18	No
				Average Di	2.83		
				Standard Deviation	11.62		
				Standard Deviation x2	23.23		

#### 4A1.5.3 Determination of Method A or Method B - 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	13:00	14:00	79.9	6.2	235.4
2	14:01	15:01	77.8	6.6	236.5
3	15:02	16:02	79.6	6.3	236.5
4	16:03	17:03	79.2	6.3	235.4
5	18:00	19:00	75.9	6.5	229.7
6	19:01	20:01	71.8	6.2	212.9
7	20:02	21:02	68.4	6.1	200.1
8	21:03	22:03	65.8	6.1	193.3
9	22:04	23:04	65.2	6.1	191.3
10	23:05	0:05	64.8	5.9	187.1
11	0:06	1:06	66.2	7.7	217.1
12	1:07	2:07	68.0	6.2	200.6
13	2:08	3:08	69.4	6.0	202.5
14	3:09	4:09	71.7	6.2	212.5
15	4:10	5:10	75.5	6.4	225.9
16	5:11	6:11	76.5	6.3	227.1
17	6:12	7:12	77.9	6.2	230.0
18	7:13	8:13	75.0	6.3	222.5
19	8:14	9:14	73.1	6.6	221.7
20	10:00	11:00	78.5	6.5	235.7
21	11:01	12:01	79.8	6.4	237.5
22	12:02	13:02	81.1	6.4	241.5
23	13:03	14:03	82.1	6.3	243.0
24	14:04	15:04	82.0	6.2	241.6
25	15:05	16:05	80.0	6.0	231.9
26	17:10	18:10	82.6	5.9	238.2
27	18:11	19:11	82.6	5.8	237.2
28	19:12	20:12	77.1	6.1	225.8
30	21:14	22:14	82.7	7.3	263.9
31	22:15	23:15	49.3	6.9	152.5
32	23:16	0:16	48.3	7.0	150.1
33	0:17	1:17	48.0	6.9	148.7
34	1:18	2:18	48.7	6.5	146.0
35	2:19	3:19	49.3	6.9	151.9
36	3:20	4:20	50.4	6.9	155.3
37	4:21	5:21	54.0	6.5	161.6
38	5:22	6:22	58.5	6.0	169.9
39	6:23	7:23	58.9	6.1	172.2
40	7:24	8:24	57.2	6.0	165.9
41	9:30	10:30	50.8	6.9	156.8
42	10:31	11:31	62.5	7.7	205.5
43	11:32	12:32	61.5	5.9	177.6
44	12:33	13:33	65.9	6.9	204.2
45	13:34	14:34	72.8	6.4	217.5
46	14:35	15:35	76.2	6.3	225.8
Sum			3102.60		
Emission Limit Value (ELV) =		440	mg/Nm <sup>3</sup>	Y <sub>max</sub>	263.93
Maximum Permissible uncertainty =		20	%	Y <sub>min</sub>	145.95
Maximum Permissible uncertainty (at 15% of the ELV) =		88	mg/Nm <sup>3</sup>		
		66	mg/Nm <sup>3</sup>		
Is Ymax - Ymin > MPU at ELV?		Yes		Y <sub>max</sub> - Y <sub>min</sub>	117.98
Is Ymin > 15% of ELV?		Yes			
Derivation of Calibration Function			Method A		

**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 <sup>2</sup>	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference	16/02/2016	0.0	0.0	-67.45	-63.10	4256.01	3981.70	
2	13:00	14:00	79.9	75.3	12.49	12.19	152.33	148.69	
3	14:01	15:01	77.8	72.4	10.38	9.33	96.91	87.12	
4	15:02	16:02	79.6	74.2	12.14	11.14	135.29	124.21	
5	16:03	17:03	79.2	72.3	11.80	9.16	108.10	83.93	
6	18:00	19:00	75.9	71.9	8.47	8.80	74.54	77.39	
7	19:01	20:01	71.8	66.7	4.37	3.60	15.71	12.93	
8	20:02	21:02	68.4	62.2	0.92	-0.94	-0.87	0.89	
9	21:03	22:03	65.8	61.1	-1.62	-1.99	3.23	3.96	
10	22:04	23:04	65.2	61.0	-2.22	-2.15	4.76	4.61	
11	23:05	0:05	64.8	59.2	-2.69	-3.94	10.61	15.50	
12	0:06	1:06	66.2	58.9	-1.27	-4.22	5.38	17.82	
13	1:07	2:07	68.0	63.6	0.50	0.45	0.23	0.21	
14	2:08	3:08	69.4	66.1	1.93	2.96	5.71	8.78	
15	3:09	4:09	71.7	69.7	4.29	6.63	28.48	43.99	
16	4:10	5:10	75.5	71.2	8.04	8.11	65.19	65.80	
17	5:11	6:11	76.5	72.0	9.06	8.85	80.17	78.39	
18	6:12	7:12	77.9	77.4	10.48	14.26	149.42	203.46	
19	7:13	8:13	75.0	73.9	7.51	10.82	81.26	117.11	
20	8:14	9:14	73.1	69.5	5.68	6.36	36.17	40.51	
21	10:00	11:00	78.5	76.1	11.06	12.96	143.32	168.05	
22	11:01	12:01	79.8	76.9	12.32	13.78	169.83	189.89	
23	12:02	13:02	81.1	78.6	13.68	15.50	212.17	240.38	
24	13:03	14:03	82.1	78.9	14.70	15.85	232.93	251.08	
25	14:04	15:04	82.0	80.2	14.51	17.08	247.85	291.86	
26	15:05	16:05	80.0	76.8	12.58	13.72	172.63	188.22	
27	17:10	18:10	82.6	74.2	15.10	11.12	167.95	123.67	
28	18:11	19:11	82.6	77.1	15.15	13.95	211.34	194.67	
29	19:12	20:12	77.1	76.9	9.68	13.84	133.99	191.42	
31	21:14	22:14	82.7	60.0	15.28	-3.12	-47.71	9.75	
32	22:15	23:15	49.3	48.3	-18.12	-14.84	268.87	220.12	
33	23:16	0:16	48.3	45.7	-19.12	-17.44	333.46	304.13	
34	0:17	1:17	48.0	43.8	-19.42	-19.34	375.67	374.22	
35	1:18	2:18	48.7	47.3	-18.79	-15.79	296.78	249.46	
36	2:19	3:19	49.3	43.2	-18.14	-19.88	360.71	395.29	
37	3:20	4:20	50.4	43.0	-17.09	-20.14	344.25	405.58	
38	4:21	5:21	54.0	53.7	-13.47	-9.45	127.27	89.25	
39	5:22	6:22	58.5	55.4	-8.96	-7.69	68.92	59.13	
40	6:23	7:23	58.9	53.9	-8.51	-9.17	78.03	84.00	
41	7:24	8:24	57.2	54.3	-10.26	-8.75	89.81	76.62	
42	9:30	10:30	50.8	55.0	-16.66	-8.09	134.82	65.50	
43	10:31	11:31	62.5	51.0	-4.92	-12.12	59.63	146.95	
44	11:32	12:32	61.5	60.1	-5.95	-3.03	18.00	9.16	
45	12:33	13:33	65.9	58.5	-1.55	-4.63	7.16	21.41	
46	13:34	14:34	72.8	66.4	5.37	3.25	17.47	10.58	
47	14:35	15:35	76.2	69.2	8.73	6.07	52.96	36.84	
Sum			3102.60	2902.63	0.00	0.00	9586.74	9514.24	1.01

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

##### Method A

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

$N$	$N$	$N$	$N$		
$b = \sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})$	$\bar{x} = 1/N \sum_{i=1}^N x_i$	$\bar{y} = 1/N \sum_{i=1}^N y_i$		$x =$	63.10
				$y =$	67.45
				$b =$	1.008
$a = y - bx$	$a = 67.45 - 63.11 * 1.007$			$a =$	3.866

The calibration is function  $y_i = a + b x_i$  or  $y_i = 3.866 + 1.008 * x_i$

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

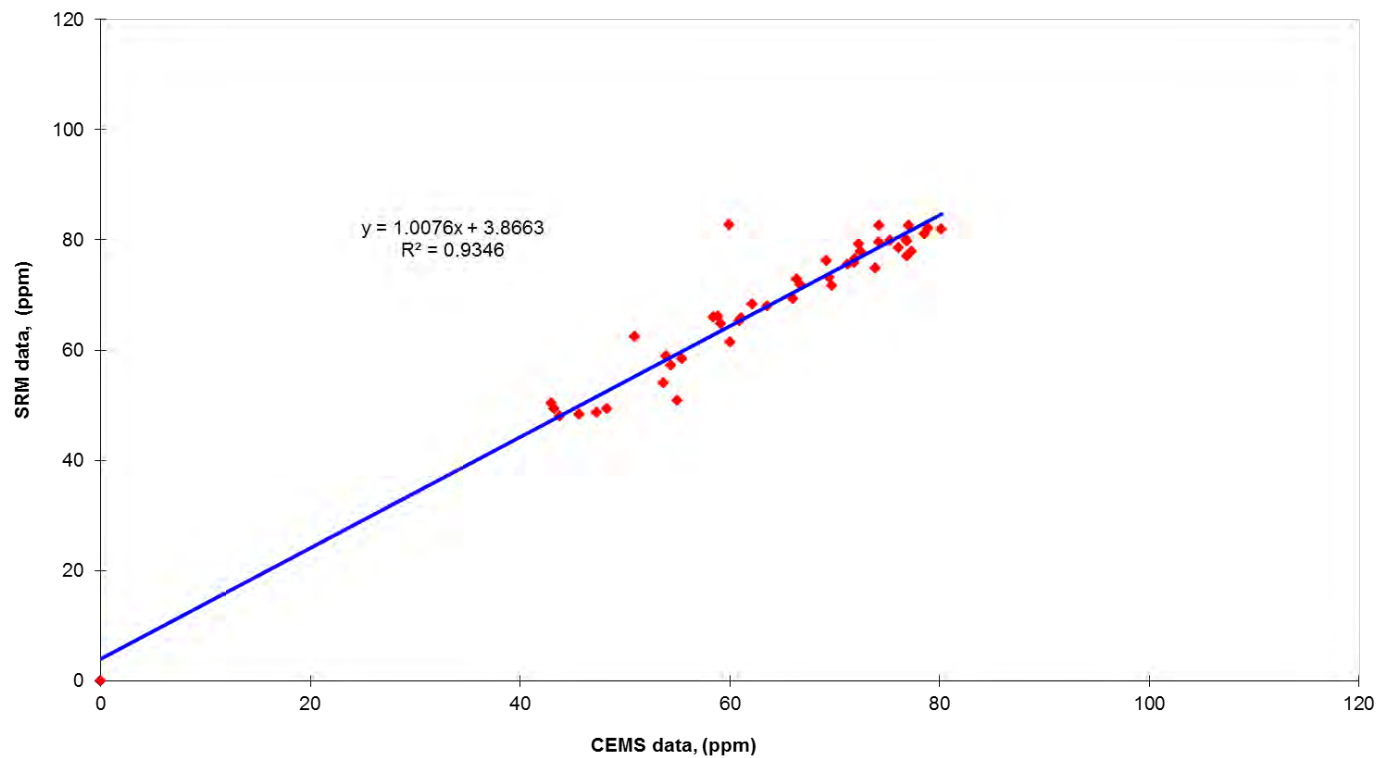
Test No	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
	hr:min		(ppm)	(ppm)	(%)	(%)	(mg/Nm <sup>3</sup> )	(mg/Nm <sup>3</sup> )	(mg/m3)
1	Reference	16/02/2016	0.0	3.9	0.0		0.0	11.0	0.0
2	13:00	14:00	75.3	79.7	6.3	1.9	222.5	236.6	235.4
3	14:01	15:01	72.4	76.9	6.5	1.9	217.9	232.0	236.5
4	15:02	16:02	74.2	78.7	6.5	1.9	222.4	236.5	236.5
5	16:03	17:03	72.3	76.7	6.5	2.0	217.5	231.7	235.4
6	18:00	19:00	71.9	76.3	6.5	2.1	216.0	230.4	229.7
7	19:01	20:01	66.7	71.1	6.4	2.0	199.4	213.5	212.9
8	20:02	21:02	62.2	66.5	6.5	1.9	186.5	200.5	200.1
9	21:03	22:03	61.1	65.4	6.5	1.8	183.1	196.9	193.3
10	22:04	23:04	61.0	65.3	6.5	1.9	182.8	196.7	191.3
11	23:05	00:05	59.2	63.5	6.7	2.0	179.7	193.7	187.1
12	00:06	01:06	58.9	63.2	6.7	1.9	179.0	193.0	217.1
13	01:07	02:07	63.6	67.9	6.5	2.0	191.2	205.3	200.6
14	02:08	03:08	66.1	70.4	6.5	2.0	198.3	212.4	202.5
15	03:09	04:09	69.7	74.1	6.6	1.9	211.1	225.4	212.5
16	04:10	05:10	71.2	75.6	6.6	2.0	215.5	229.9	225.9
17	05:11	06:11	72.0	76.4	6.7	1.8	218.4	232.4	227.1
18	06:12	07:12	77.4	81.8	6.5	1.7	232.5	247.0	230.0
19	07:13	08:13	73.9	78.4	6.7	1.7	224.9	239.4	222.5
20	08:14	09:14	69.5	73.9	6.9	1.7	213.9	228.5	221.7
21	10:00	11:00	76.1	80.5	6.8	1.7	231.8	246.5	235.7
22	11:01	12:01	76.9	81.3	6.8	1.7	234.5	249.3	237.5
23	12:02	13:02	78.6	83.1	6.6	1.7	237.4	252.2	241.5
24	13:03	14:03	78.9	83.4	6.5	1.7	236.6	250.7	243.0
25	14:04	15:04	80.2	84.7	6.4	1.7	239.4	253.4	241.6
26	15:05	16:05	76.8	81.3	6.4	1.7	229.1	243.0	231.9
27	17:10	18:10	74.2	78.7	6.1	1.8	216.7	230.4	238.2
28	18:11	19:11	77.1	81.5	5.9	1.8	222.6	236.2	237.2
29	19:12	20:12	76.9	81.4	6.2	1.7	226.8	240.6	225.8
31	21:14	22:14	60.0	64.3	7.4	1.7	195.5	206.3	263.9
32	22:15	23:15	48.3	52.5	7.3	1.5	153.3	167.2	152.5
33	23:16	00:16	45.7	49.9	7.3	1.5	144.2	158.0	150.1
34	00:17	01:17	43.8	48.0	7.2	1.5	138.0	151.7	148.7
35	01:18	02:18	47.3	51.5	7.3	1.5	149.4	163.2	146.0
36	02:19	03:19	43.2	47.4	7.3	1.5	137.3	151.1	151.9
37	03:20	04:20	43.0	47.2	7.3	1.5	136.6	150.4	155.3
38	04:21	05:21	53.7	57.9	7.1	1.6	167.1	180.9	161.6
39	05:22	06:22	55.4	59.7	6.3	1.6	164.1	177.2	169.9
40	06:23	07:23	53.9	58.2	6.4	1.7	160.2	173.5	172.2
41	07:24	08:24	54.3	58.6	6.7	1.6	164.8	178.2	165.9
42	09:30	10:30	55.0	59.3	7.1	1.3	171.4	184.9	156.8
43	10:31	11:31	51.0	55.2	6.6	1.7	153.1	166.7	205.5
44	11:32	12:32	60.1	64.4	6.7	1.7	182.8	196.5	177.6
45	12:33	13:33	58.5	62.8	7.2	1.6	184.2	198.5	204.2
46	13:34	14:34	66.4	70.7	6.9	1.6	204.9	219.0	217.5
47	14:35	15:35	69.2	73.6	6.5	1.7	207.5	221.3	225.8
Sum							8802.28		
Emission Limit Value (ELV) =			440	mg/Nm <sup>3</sup>					

Reference Oxygen

6

%

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



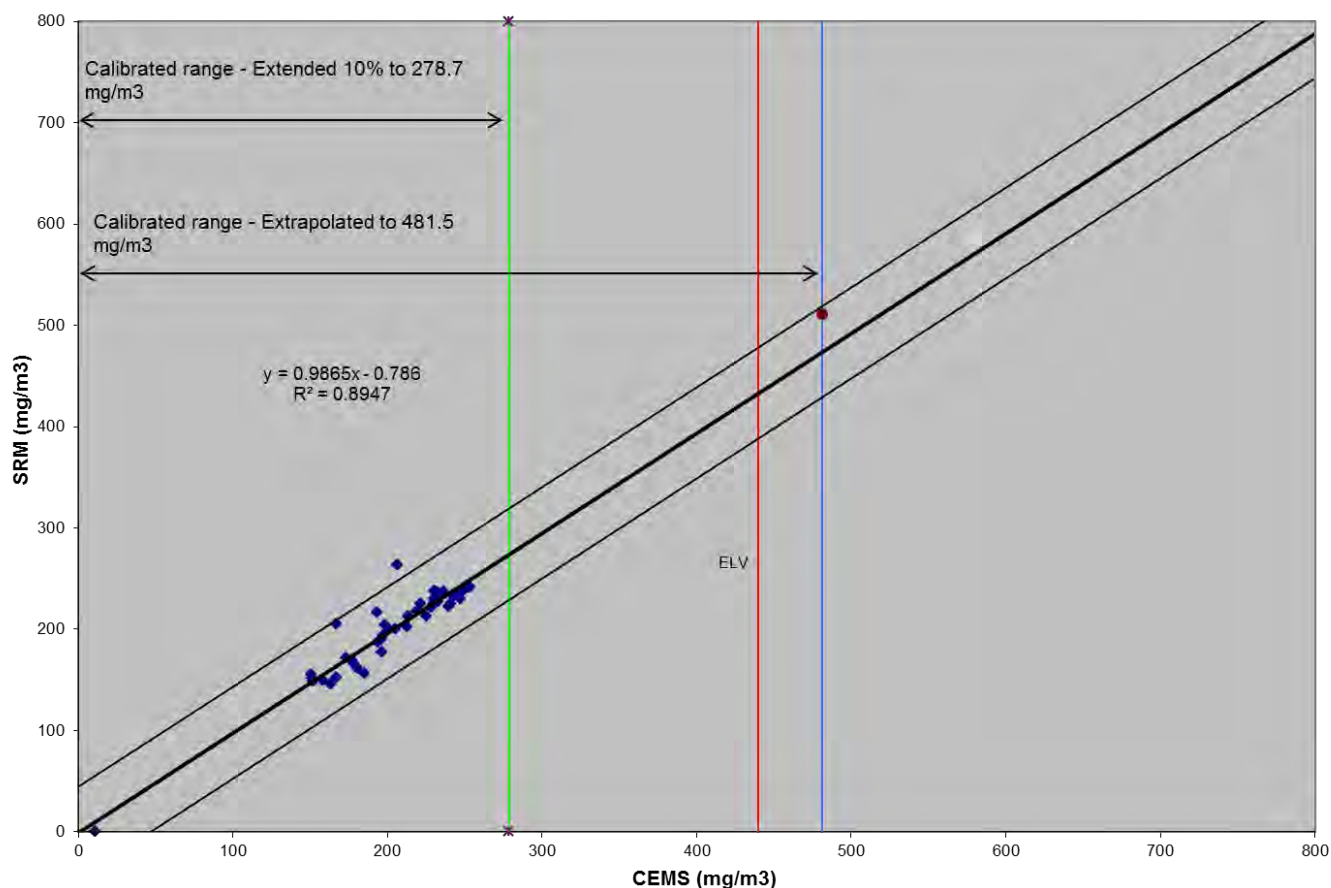
**4A1.10.3 Table 4.5.3 – Data used for the Variability Test – Sulphur Dioxide, High Range.**

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			
2	13:00	14:00	236.6	235.4	-1.22	2.16	4.68
3	14:01	15:01	232.0	236.5	4.44	7.82	61.22
4	15:02	16:02	236.5	236.5	-0.03	3.36	11.27
5	16:03	17:03	231.7	235.4	3.77	7.15	51.18
6	18:00	19:00	230.4	229.7	-0.70	2.69	7.23
7	19:01	20:01	213.5	212.9	-0.53	2.86	8.15
8	20:02	21:02	200.5	200.1	-0.40	2.99	8.92
9	21:03	22:03	196.9	193.3	-3.60	-0.22	0.05
10	22:04	23:04	196.7	191.3	-5.40	-2.01	4.04
11	23:05	00:05	193.7	187.1	-6.66	-3.27	10.71
12	00:06	01:06	193.0	217.1	24.12	27.50	756.46
13	01:07	02:07	205.3	200.6	-4.66	-1.27	1.62
14	02:08	03:08	212.4	202.5	-9.86	-6.47	41.92
15	03:09	04:09	225.4	212.5	-12.90	-9.51	90.41
16	04:10	05:10	229.9	225.9	-4.00	-0.62	0.38
17	05:11	06:11	232.4	227.1	-5.30	-1.91	3.65
18	06:12	07:12	247.0	230.0	-16.99	-13.60	184.90
19	07:13	08:13	239.4	222.5	-16.94	-13.55	183.73
20	08:14	09:14	228.5	221.7	-6.77	-3.38	11.42
21	10:00	11:00	246.5	235.7	-10.80	-7.41	54.90
22	11:01	12:01	249.3	237.5	-11.80	-8.41	70.79
23	12:02	13:02	252.2	241.5	-10.69	-7.30	53.29
24	13:03	14:03	250.7	243.0	-7.71	-4.32	18.67
25	14:04	15:04	253.4	241.6	-11.82	-8.43	71.08
26	15:05	16:05	243.0	231.9	-11.10	-7.71	59.49
27	17:10	18:10	230.4	238.2	7.84	11.23	126.12
28	18:11	19:11	236.2	237.2	1.04	4.43	19.64
29	19:12	20:12	240.6	225.8	-14.83	-11.44	130.89
31	21:14	22:14	206.3	263.9	57.65	61.03	3725.16
32	22:15	23:15	167.2	152.5	-14.73	-11.34	128.54
33	23:16	00:16	158.0	150.1	-7.86	-4.47	19.97
34	00:17	01:17	151.7	148.7	-2.94	0.44	0.20
35	01:18	02:18	163.2	146.0	-17.26	-13.87	192.40
36	02:19	03:19	151.1	151.9	0.88	4.27	18.22
37	03:20	04:20	150.4	155.3	4.89	8.28	68.54
38	04:21	05:21	180.9	161.6	-19.33	-15.94	254.13
39	05:22	06:22	177.2	169.9	-7.34	-3.95	15.60
40	06:23	07:23	173.5	172.2	-1.28	2.11	4.46
41	07:24	08:24	178.2	165.9	-12.27	-8.88	78.94
42	09:30	10:30	184.9	156.8	-28.03	-24.65	607.40
43	10:31	11:31	166.7	205.5	38.81	42.20	1780.63
44	11:32	12:32	196.5	177.6	-18.90	-15.51	240.52
45	12:33	13:33	198.5	204.2	5.71	9.09	82.70
46	13:34	14:34	219.0	217.5	-1.49	1.90	3.59
47	14:35	15:35	221.3	225.8	4.54	7.93	62.89
45 Tests		Mean			-3.39		
Sum							9330.68

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

SD=	Root(1-Number).Integral(D1-D) <sup>2</sup>	14.56	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O <sub>0</sub> is therefore calculated as:-			
O <sub>0</sub> =	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=	14.56	14.56 <= 44.9 * 0.9885	
or	14.56	<=	44.38
Which is TRUE therefore the CEMS passes the test			

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



## **Section 4A2: Data & calculations – QAL2 – Unit 9, Procal 1**

## Section 4A2 – Data and calculations – QAL2 Procal 1

### 4A2.1.1 Table 4.1.1 – Raw monitoring Data – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (Wet)	CEMS Oxygen (dry)	CEMS Moisture	SRM Raw Value (dry)	SRM Oxygen (Dry)	SRM Moisture	SRM at CEMS Raw conditions
		hr:min		NO (ppm)	(%)	(%)	NOx (ppm)	(%)	(%)	NOx (ppm)
1	01-Mar-16	13:00	14:00	201.53	6.27	1.57	231.17	6.15	1.95	226.7
2	01-Mar-16	14:01	15:01	196.02	6.52	1.57	198.67	6.61	1.93	194.8
3	01-Mar-16	15:02	16:02	198.17	6.46	1.57	207.83	6.29	1.94	203.8
4	01-Mar-16	16:03	17:03	199.81	6.53	1.60	210.67	6.28	1.97	206.5
5	01-Mar-16	18:00	19:00	202.27	6.50	1.61	216.17	6.53	2.10	211.6
6	01-Mar-16	19:01	20:01	206.29	6.43	1.59	218.17	6.24	2.04	213.7
7	01-Mar-16	20:02	21:02	208.83	6.50	1.49	223.33	6.07	1.93	219.0
8	01-Mar-16	21:03	22:03	212.08	6.50	1.36	223.83	6.14	1.76	219.9
9	01-Mar-16	22:04	23:04	212.62	6.49	1.51	227.67	6.10	1.94	223.2
10	01-02/03/2016	23:05	0:05	201.41	6.67	1.56	233.83	5.86	1.99	229.2
11	02-Mar-16	0:06	1:06	198.53	6.68	1.51	188.50	7.67	1.93	184.9
12	02-Mar-16	1:07	2:07	205.08	6.54	1.50	222.33	6.19	1.96	218.0
13	02-Mar-16	2:08	3:08	207.33	6.50	1.52	228.33	6.03	1.96	223.8
14	02-Mar-16	3:09	4:09	202.17	6.62	1.50	220.67	6.25	1.93	216.4
15	02-Mar-16	4:10	5:10	203.08	6.61	1.52	214.67	6.38	2.00	210.4
16	02-Mar-16	5:11	6:11	203.18	6.65	1.55	216.67	6.29	1.83	212.7
17	02-Mar-16	6:12	7:12	208.82	6.55	1.30	216.17	6.22	1.74	212.4
18	02-Mar-16	7:13	8:13	201.59	6.73	1.29	217.67	6.31	1.71	213.9
19	02-Mar-16	8:14	9:14	196.10	6.90	1.29	205.67	6.61	1.72	202.1
20	02-Mar-16	10:00	11:00	201.60	6.75	1.25	220.67	6.47	1.72	216.9
21	02-Mar-16	11:01	12:01	199.10	6.77	1.23	211.83	6.36	1.69	208.3
22	02-Mar-16	12:02	13:02	175.86	6.63	1.21	210.33	6.35	1.69	206.8
23	02-Mar-16	13:03	14:03	213.68	6.49	1.42	217.67	6.26	1.68	214.0
24	02-Mar-16	14:04	15:04	216.18	6.43	1.42	214.83	6.21	1.67	211.2
25	02-Mar-16	15:05	16:05	215.38	6.42	1.43	223.00	5.96	1.70	219.2
26	02-Mar-16	17:10	18:10	217.02	6.10	1.49	245.17	5.88	1.79	240.8
27	02-Mar-16	18:11	19:11	223.52	5.94	1.49	219.50	5.81	1.77	215.6
28	02-Mar-16	19:12	20:12	215.46	6.25	1.47	213.17	6.10	1.75	209.4
29	02-Mar-16	20:13	21:13	203.91	6.59	1.44	225.33	5.83	2.46	219.8
30	02-Mar-16	21:14	22:14	180.60	7.40	3.25	176.00	7.32	1.72	173.0
31	02-Mar-16	22:15	23:15	183.24	7.33	1.22	187.17	6.92	1.51	184.3
32	02-03/03/2016	23:16	0:16	185.46	7.25	1.24	187.83	6.98	1.52	185.0
33	03-Mar-16	0:17	1:17	186.40	7.23	1.25	190.00	6.94	1.52	187.1
34	03-Mar-16	1:18	2:18	187.29	7.25	1.25	201.00	6.49	1.50	198.0
35	03-Mar-16	2:19	3:19	184.22	7.33	1.24	192.50	6.88	1.51	189.6
36	03-Mar-16	3:20	4:20	183.43	7.35	1.23	190.50	6.88	1.51	187.6
37	03-Mar-16	4:21	5:21	190.03	7.05	1.28	203.33	6.45	1.57	200.1
38	03-Mar-16	5:22	6:22	213.73	6.33	1.36	215.83	6.01	1.62	212.3
39	03-Mar-16	6:23	7:23	212.65	6.37	1.34	215.83	6.08	1.68	212.2
40	03-Mar-16	7:24	8:24	202.86	6.66	1.39	210.50	5.99	1.60	207.1
41	03-Mar-16	9:30	10:30	189.23	7.06	1.29	196.50	6.93	1.33	193.9
42	03-Mar-16	10:31	11:31	209.73	6.55	1.23	174.67	7.72	1.68	171.7
43	03-Mar-16	11:32	12:32	179.09	6.70	1.45	229.33	5.90	1.70	225.4
44	03-Mar-16	12:33	13:33	192.47	7.21	1.24	185.50	6.93	1.61	182.5
45	03-Mar-16	13:34	14:34	193.42	6.92	1.38	203.83	6.41	1.65	200.5
46	03-Mar-16	14:35	15:35	197.70	6.51	1.43	195.33	6.30	1.68	192.0

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

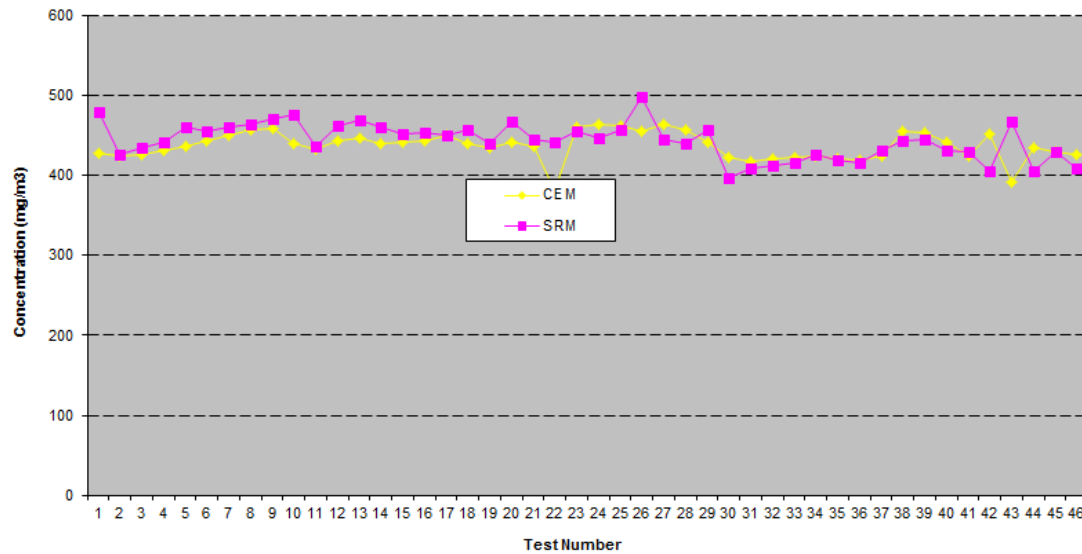
#### 4A2.2.1 Table 4.2.1 - Standardised monitoring Data – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(NOx as NO2 mg/m3)	(NOx as NO2 mg/m3)	(mg/m3)
1	01-Mar-16	13:00	14:00	428.1	479.7	16.0
2	01-Mar-16	14:01	15:01	423.8	425.5	14.0
3	01-Mar-16	15:02	16:02	426.6	435.3	15.0
4	01-Mar-16	16:03	17:03	432.3	441.0	15.0
5	01-Mar-16	18:00	19:00	436.8	460.2	15.0
6	01-Mar-16	19:01	20:01	443.3	455.4	15.0
7	01-Mar-16	20:02	21:02	450.5	460.7	15.0
8	01-Mar-16	21:03	22:03	456.8	464.1	16.0
9	01-Mar-16	22:04	23:04	458.4	470.5	16.0
10	01-02/03/2016	23:05	0:05	439.8	475.8	16.0
11	02-Mar-16	0:06	1:06	433.9	435.9	15.0
12	02-Mar-16	1:07	2:07	443.5	462.6	16.0
13	02-Mar-16	2:08	3:08	447.3	469.7	16.0
14	02-Mar-16	3:09	4:09	439.9	460.7	15.0
15	02-Mar-16	4:10	5:10	441.6	452.5	15.0
16	02-Mar-16	5:11	6:11	443.2	453.9	15.0
17	02-Mar-16	6:12	7:12	451.1	450.7	15.0
18	02-Mar-16	7:13	8:13	440.9	456.4	15.0
19	02-Mar-16	8:14	9:14	434.1	440.4	15.0
20	02-Mar-16	10:00	11:00	441.6	468.0	16.0
21	02-Mar-16	11:01	12:01	436.6	445.6	15.0
22	02-Mar-16	12:02	13:02	381.8	442.3	15.0
23	02-Mar-16	13:03	14:03	460.3	454.9	15.0
24	02-Mar-16	14:04	15:04	463.8	447.5	15.0
25	02-Mar-16	15:05	16:05	461.6	456.6	15.0
26	02-Mar-16	17:10	18:10	455.5	499.4	17.0
27	02-Mar-16	18:11	19:11	464.2	445.1	15.0
28	02-Mar-16	19:12	20:12	456.6	440.7	15.0
29	02-Mar-16	20:13	21:13	442.3	457.6	15.0
30	02-Mar-16	21:14	22:14	423.0	396.6	13.0
31	02-Mar-16	22:15	23:15	418.2	409.6	14.0
32	02-03/03/2016	23:16	0:16	421.1	413.0	14.0
33	03-Mar-16	0:17	1:17	422.6	416.5	14.0
34	03-Mar-16	1:18	2:18	425.2	426.9	14.0
35	03-Mar-16	2:19	3:19	420.7	420.0	14.0
36	03-Mar-16	3:20	4:20	419.3	415.9	14.0
37	03-Mar-16	4:21	5:21	425.3	430.6	15.0
38	03-Mar-16	5:22	6:22	454.9	443.4	15.0
39	03-Mar-16	6:23	7:23	453.9	445.6	15.0
40	03-Mar-16	7:24	8:24	442.2	431.9	15.0
41	03-Mar-16	9:30	10:30	423.8	430.3	15.0
42	03-Mar-16	10:31	11:31	452.8	405.6	14.0
43	03-Mar-16	11:32	12:32	391.7	467.8	16.0
44	03-Mar-16	12:33	13:33	435.7	406.4	14.0
45	03-Mar-16	13:34	14:34	429.3	430.3	15.0
46	03-Mar-16	14:35	15:35	426.3	409.2	14.0

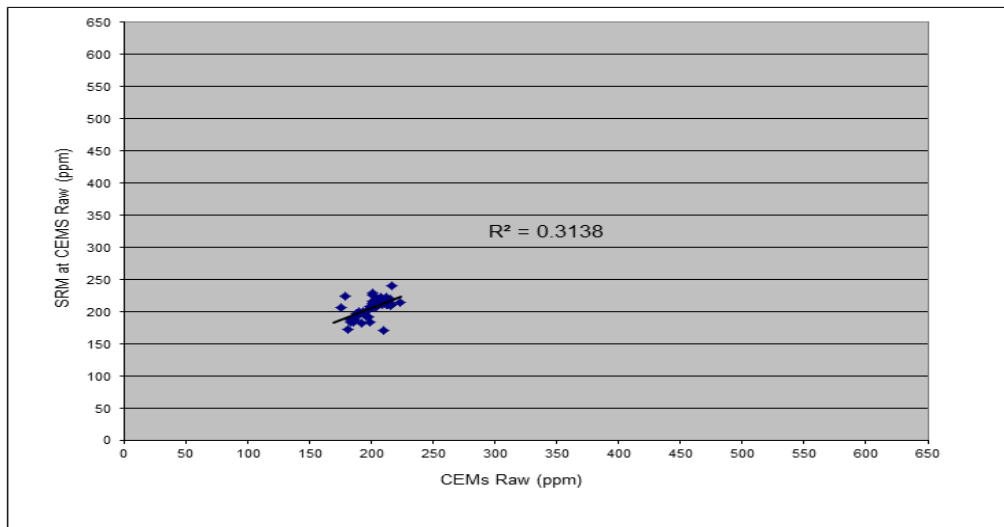
Note:  
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

**4A2.3.1 – 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)**



#### 4A2.4.1 – Elimination of Outliers – Oxides of Nitrogen,



Test No	Test Start Time	Test End Time	CEMS Raw Value	SRM Value at CEMS Raw conditions	Difference Di	Difference Di - Di	Is Result an Outlier - Di - Di > 2SD
	hr:min		(ppm)	(ppm)			
1	13:00	14:00	201.5	226.7	25.14	18.84	No
2	14:01	15:01	196.0	194.8	-1.19	-7.48	No
3	15:02	16:02	198.2	203.8	5.63	-0.66	No
4	16:03	17:03	199.8	206.5	6.71	0.42	No
5	18:00	19:00	202.3	211.6	9.37	3.07	No
6	19:01	20:01	206.3	213.7	7.42	1.13	No
7	20:02	21:02	208.8	219.0	10.20	3.91	No
8	21:03	22:03	212.1	219.9	7.81	1.51	No
9	22:04	23:04	212.6	223.2	10.63	4.33	No
10	23:05	00:05	201.4	229.2	27.77	21.47	No
11	00:06	01:06	198.5	184.9	-13.67	-19.96	No
12	01:07	02:07	205.1	218.0	12.90	6.61	No
13	02:08	03:08	207.3	223.8	16.52	10.23	No
14	03:09	04:09	202.2	216.4	14.24	7.95	No
15	04:10	05:10	203.1	210.4	7.30	1.01	No
16	05:11	06:11	203.2	212.7	9.52	3.22	No
17	06:12	07:12	208.8	212.4	3.58	-2.71	No
18	07:13	08:13	201.6	213.9	12.35	6.06	No
19	08:14	09:14	196.1	202.1	6.04	-0.26	No
20	10:00	11:00	201.6	216.9	15.27	8.98	No
21	11:01	12:01	199.1	208.3	9.16	2.86	No
22	12:02	13:02	175.9	206.8	30.91	24.62	No
23	13:03	14:03	213.7	214.0	0.32	-5.98	No
24	14:04	15:04	216.2	211.2	-4.93	-11.23	No
25	15:05	16:05	215.4	219.2	3.83	-2.47	No
26	17:10	18:10	217.0	240.8	23.76	17.46	No
27	18:11	19:11	223.5	215.6	-7.90	-14.19	No
28	19:12	20:12	215.5	209.4	-6.02	-12.31	No
29	20:13	21:13	203.9	219.8	15.87	9.57	No
30	21:14	22:14	180.6	173.0	-7.63	-13.92	No
31	22:15	23:15	183.2	184.3	1.11	-5.19	No
32	23:16	00:16	185.5	185.0	-0.48	-6.78	No
33	00:17	01:17	186.4	187.1	0.71	-5.58	No
34	01:18	02:18	187.3	198.0	10.71	4.41	No
35	02:19	03:19	184.2	189.6	5.38	-0.91	No
36	03:20	04:20	183.4	187.6	4.20	-2.10	No
37	04:21	05:21	190.0	200.1	10.11	3.81	No
38	05:22	06:22	213.7	212.3	-1.40	-7.69	No
39	06:23	07:23	212.6	212.2	-0.43	-6.72	No
40	07:24	08:24	202.9	207.1	4.26	-2.03	No
41	09:30	10:30	189.2	193.9	4.66	-1.64	No
42	10:31	11:31	209.7	171.7	-38.00	-44.29	Yes
43	11:32	12:32	179.1	225.4	46.35	40.05	Yes
44	12:33	13:33	192.5	182.5	-9.96	-16.25	No
45	13:34	14:34	193.4	200.5	7.06	0.76	No
46	14:35	15:35	197.7	192.0	-5.65	-11.94	No
				Average Di	6.29		
				Standard Deviation	13.01		
				Standard Deviation x2	26.02		

#### 4A2.5.1 Determination of Method A or Method B - 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	13:00	14:00	231.2	6.2	479.7
2	14:01	15:01	198.7	6.6	425.5
3	15:02	16:02	207.8	6.3	435.3
4	16:03	17:03	210.7	6.3	441.0
5	18:00	19:00	216.2	6.5	460.2
6	19:01	20:01	218.2	6.2	455.4
7	20:02	21:02	223.3	6.1	460.7
8	21:03	22:03	223.8	6.1	464.1
9	22:04	23:04	227.7	6.1	470.5
10	23:05	0:05	233.8	5.9	475.8
11	0:06	1:06	188.5	7.7	435.9
12	1:07	2:07	222.3	6.2	462.6
13	2:08	3:08	228.3	6.0	469.7
14	3:09	4:09	220.7	6.2	460.7
15	4:10	5:10	214.7	6.4	452.5
16	5:11	6:11	216.7	6.3	453.9
17	6:12	7:12	216.2	6.2	450.7
18	7:13	8:13	217.7	6.3	456.4
19	8:14	9:14	205.7	6.6	440.4
20	10:00	11:00	220.7	6.5	468.0
21	11:01	12:01	211.8	6.4	445.6
22	12:02	13:02	210.3	6.4	442.3
23	13:03	14:03	217.7	6.3	454.9
24	14:04	15:04	214.8	6.2	447.5
25	15:05	16:05	223.0	6.0	456.6
26	17:10	18:10	245.2	5.9	499.4
27	18:11	19:11	219.5	5.8	445.1
28	19:12	20:12	213.2	6.1	440.7
29	20:13	21:13	225.3	5.8	457.6
30	21:14	22:14	176.0	7.3	396.6
31	22:15	23:15	187.2	6.9	409.6
32	23:16	0:16	187.8	7.0	413.0
33	0:17	1:17	190.0	6.9	416.5
34	1:18	2:18	201.0	6.5	426.9
35	2:19	3:19	192.5	6.9	420.0
36	3:20	4:20	190.5	6.9	415.9
37	4:21	5:21	203.3	6.5	430.6
38	5:22	6:22	215.8	6.0	443.4
39	6:23	7:23	215.8	6.1	445.6
40	7:24	8:24	210.5	6.0	431.9
41	9:30	10:30	196.5	6.9	430.3
44	12:33	13:33	185.5	6.9	406.4
45	13:34	14:34	203.8	6.4	430.3
46	14:35	15:35	195.3	6.3	409.2
Sum			9275.17		
Emission Limit Value (ELV) =		1080	mg/Nm <sup>3</sup>	Y <sub>max</sub>	499.39
Maximum Permissible uncertainty =		20	%	Y <sub>min</sub>	396.61
Maximum Permissible uncertainty (at 15% of the ELV) =		216	mg/Nm <sup>3</sup>		
		162	mg/Nm <sup>3</sup>		
Is Y <sub>max</sub> - Y <sub>min</sub> > MPU at ELV?		No		Y <sub>max</sub> - Y <sub>min</sub>	102.78
Is Y <sub>min</sub> > 15% of ELV?		Yes			
Derivation of Calibration Function		Method B			

**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)	Yi	Xi	Xi * Yi	Xi <sup>2</sup>	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference	23/02/2016	0.0	0.7	-202.46	-195.55	39590.61	38240.59	
2	13:00	14:00	226.7	201.5	24.21	5.30	128.41	28.14	
3	14:01	15:01	194.8	196.0	-7.62	-0.20	1.54	0.04	
4	15:02	16:02	203.8	198.2	1.34	1.95	2.61	3.78	
5	16:03	17:03	206.5	199.8	4.07	3.59	14.59	12.88	
6	18:00	19:00	211.6	202.3	9.18	6.05	55.54	36.59	
7	19:01	20:01	213.7	206.3	11.26	10.07	113.30	101.34	
8	20:02	21:02	219.0	208.8	16.57	12.60	208.87	158.84	
9	21:03	22:03	219.9	212.1	17.43	15.86	276.42	251.48	
10	22:04	23:04	223.2	212.6	20.79	16.40	341.01	268.96	
11	23:05	0:05	229.2	201.4	26.72	5.19	138.77	26.96	
12	0:06	1:06	184.9	198.5	-17.59	2.31	-40.65	5.34	
13	1:07	2:07	218.0	205.1	15.53	8.86	137.61	78.53	
14	2:08	3:08	223.8	207.3	21.39	11.11	237.59	123.34	
15	3:09	4:09	216.4	202.2	13.96	5.95	83.07	35.41	
16	4:10	5:10	210.4	203.1	7.93	6.86	54.35	47.03	
17	5:11	6:11	212.7	203.2	10.24	6.95	71.18	48.36	
18	6:12	7:12	212.4	208.8	9.95	12.60	125.41	158.80	
19	7:13	8:13	213.9	201.6	11.48	5.37	61.61	28.79	
20	8:14	9:14	202.1	196.1	-0.32	-0.12	0.04	0.01	
21	10:00	11:00	216.9	201.6	14.42	5.38	77.54	28.92	
22	11:01	12:01	208.3	199.1	5.80	2.88	16.68	8.27	
23	12:02	13:02	206.8	175.9	4.32	-20.36	-87.97	414.50	
24	13:03	14:03	214.0	213.7	11.55	17.46	201.61	304.88	
25	14:04	15:04	211.2	216.2	8.79	19.96	175.37	398.22	
26	15:05	16:05	219.2	215.4	16.75	19.15	320.80	366.86	
27	17:10	18:10	240.8	217.0	38.31	20.79	796.68	432.35	
28	18:11	19:11	215.6	223.5	13.17	27.30	359.41	745.10	
29	19:12	20:12	209.4	215.5	6.98	19.23	134.33	369.94	
30	20:13	21:13	219.8	203.9	17.32	7.69	133.23	59.14	
31	21:14	22:14	173.0	180.6	-29.49	-15.63	460.81	244.18	
32	22:15	23:15	184.3	183.2	-18.11	-12.98	235.00	168.45	
33	23:16	0:16	185.0	185.5	-17.48	-10.76	188.06	115.78	
34	0:17	1:17	187.1	186.4	-15.34	-9.82	150.68	96.45	
35	1:18	2:18	198.0	187.3	-4.46	-8.94	39.89	79.87	
36	2:19	3:19	189.6	184.2	-12.85	-12.00	154.31	144.09	
37	3:20	4:20	187.6	183.4	-14.83	-12.79	189.74	163.71	
38	4:21	5:21	200.1	190.0	-2.32	-6.19	14.37	38.37	
39	5:22	6:22	212.3	213.7	9.88	17.51	172.99	306.60	
40	6:23	7:23	212.2	212.6	9.76	16.42	160.32	269.73	
41	7:24	8:24	207.1	202.9	4.67	6.64	31.03	44.12	
42	9:30	10:30	193.9	189.2	-8.57	-6.99	59.90	48.88	
45	12:33	13:33	182.5	192.5	-19.95	-3.76	74.92	14.10	
46	13:34	14:34	200.5	193.4	-1.98	-2.81	5.56	7.87	
47	14:35	15:35	192.0	197.7	-10.41	1.47	-15.33	2.17	
Sum			9110.51	8829.99	0.00	0.00	45651.81	44527.79	1.03

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

##### Method B

Formulae:- Number of tests conducted = N 45

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

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

$x = (1/45) * 8829.9$  or -  $x = 196.22$

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

$y = (1/45) * 9110.$  or -  $y = 202.46$

The Slope is calculated by :

$\beta = y/(x-Z)$   $202.4 / (196.2 - 0.67)$   $\beta = 1.035$

The offset is calculated by:

$\alpha = -\beta.Z$   $-1.03 * 0.67$   $\alpha = -0.69$

The calibration is function  $y_{im} = \alpha + \beta_{xi,m}$  or  $y_i = -0.69 + 1.03 * X_i$

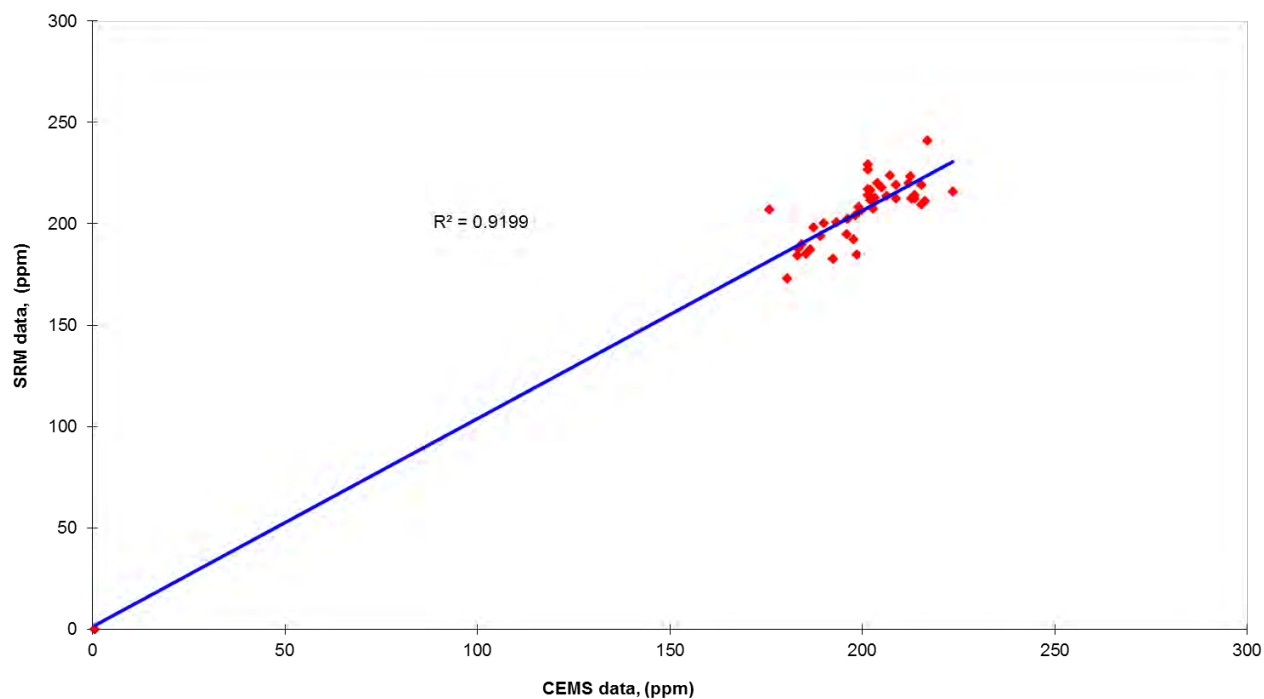
#### 4A2.8.1 Table 4.4.1 - Calculation of calibrated CEMS values - Oxides of Nitrogen

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 <sup>3</sup> )	(mg/Nm <sup>3</sup> )	(mg/m <sup>3</sup> )
1	Reference	23/02/2016	0.7	0.0	0.0		0.7	0.0	0.0
2	13:00	14:00	201.5	207.9	6.3	1.6	428.1	441.8	479.7
3	14:01	15:01	196.0	202.2	6.5	1.6	423.8	437.3	425.5
4	15:02	16:02	198.2	204.5	6.5	1.6	426.6	440.2	435.3
5	16:03	17:03	199.8	206.2	6.5	1.6	432.3	446.0	441.0
6	18:00	19:00	202.3	208.7	6.5	1.6	436.8	450.7	460.2
7	19:01	20:01	206.3	212.9	6.4	1.6	443.3	457.4	455.4
8	20:02	21:02	208.8	215.5	6.5	1.5	450.5	464.9	460.7
9	21:03	22:03	212.1	218.9	6.5	1.4	456.8	471.4	464.1
10	22:04	23:04	212.6	219.4	6.5	1.5	458.4	473.1	470.5
11	23:05	00:05	201.4	207.8	6.7	1.6	439.8	453.8	475.8
12	00:06	01:06	198.5	204.8	6.7	1.5	433.9	447.7	435.9
13	01:07	02:07	205.1	211.6	6.5	1.5	443.5	457.7	462.6
14	02:08	03:08	207.3	214.0	6.5	1.5	447.3	461.6	469.7
15	03:09	04:09	202.2	208.6	6.6	1.5	439.9	453.9	460.7
16	04:10	05:10	203.1	209.6	6.6	1.5	441.6	455.7	452.5
17	05:11	06:11	203.2	209.7	6.7	1.5	443.2	457.3	453.9
18	06:12	07:12	208.8	215.5	6.5	1.3	451.1	465.5	450.7
19	07:13	08:13	201.6	208.0	6.7	1.3	440.9	454.9	456.4
20	08:14	09:14	196.1	202.3	6.9	1.3	434.1	447.9	440.4
21	10:00	11:00	201.6	208.0	6.8	1.3	441.6	455.6	468.0
22	11:01	12:01	199.1	205.4	6.8	1.2	436.6	450.5	445.6
23	12:02	13:02	175.9	181.4	6.6	1.2	381.8	393.8	442.3
24	13:03	14:03	213.7	220.5	6.5	1.4	460.3	475.0	454.9
25	14:04	15:04	216.2	223.1	6.4	1.4	463.8	478.7	447.5
26	15:05	16:05	215.4	222.3	6.4	1.4	461.6	476.5	456.6
27	17:10	18:10	217.0	224.0	6.1	1.5	455.5	470.1	499.4
28	18:11	19:11	223.5	230.7	5.9	1.5	464.2	479.1	445.1
29	19:12	20:12	215.5	222.4	6.2	1.5	456.6	471.2	440.7
30	20:13	21:13	203.9	210.4	6.6	1.4	442.3	456.4	457.6
31	21:14	22:14	180.6	186.3	7.4	3.3	423.0	436.3	396.6
32	22:15	23:15	183.2	189.0	7.3	1.2	418.2	431.4	409.6
33	23:16	00:16	185.5	191.3	7.3	1.2	421.1	434.3	413.0
34	00:17	01:17	186.4	192.3	7.2	1.2	422.6	436.0	416.5
35	01:18	02:18	187.3	193.2	7.3	1.2	425.2	438.7	426.9
36	02:19	03:19	184.2	190.0	7.3	1.2	420.7	434.0	420.0
37	03:20	04:20	183.4	189.2	7.3	1.2	419.3	432.5	415.9
38	04:21	05:21	190.0	196.0	7.1	1.3	425.3	438.7	430.6
39	05:22	06:22	213.7	220.6	6.3	1.4	454.9	469.5	443.4
40	06:23	07:23	212.6	219.5	6.4	1.3	453.9	468.4	445.6
41	07:24	08:24	202.9	209.3	6.7	1.4	442.2	456.3	431.9
42	09:30	10:30	189.2	195.2	7.1	1.3	423.8	437.3	430.3
45	12:33	13:33	192.5	198.6	6.7	1.4	435.7	434.3	406.4
46	13:34	14:34	193.4	199.6	7.2	1.2	429.3	451.7	430.3
47	14:35	15:35	197.7	204.0	6.9	1.4	426.3	452.7	409.2
Sum							19278.08		
Emission Limit Value (ELV) =			1080	mg/Nm <sup>3</sup>					

Reference Oxygen

6 %

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



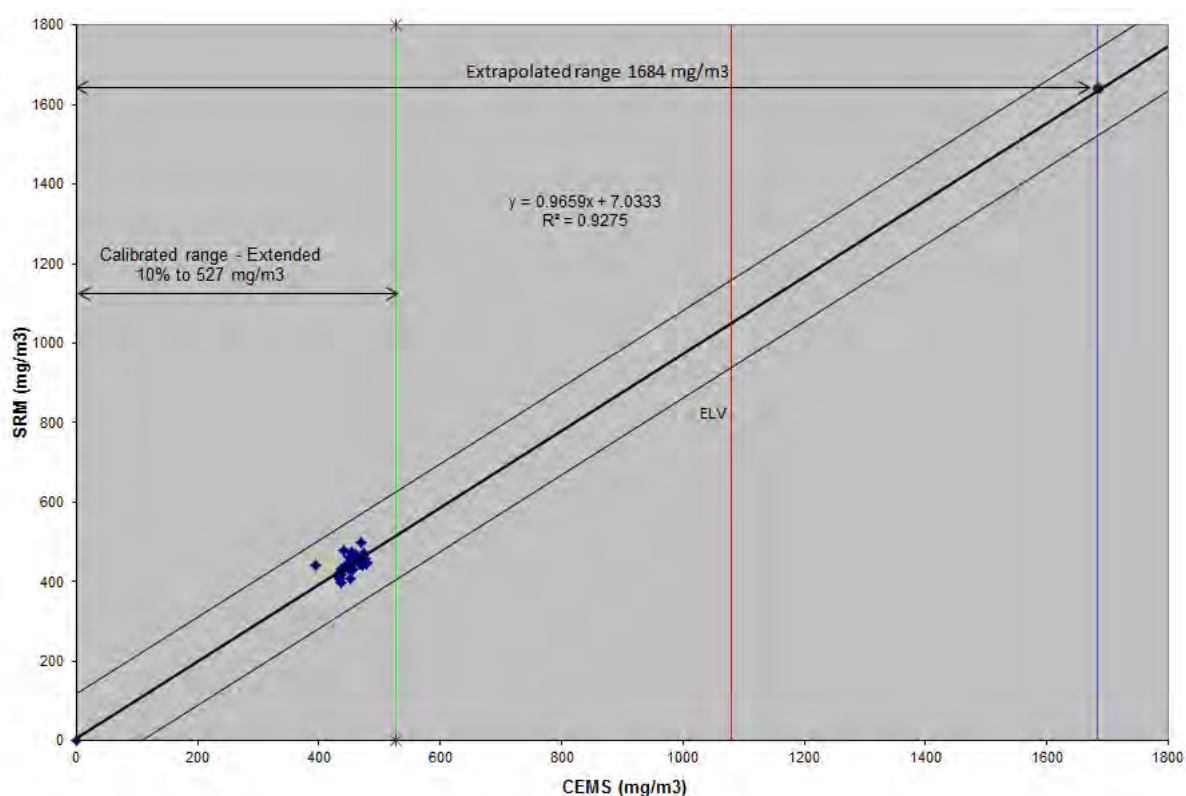
**4A2.10.1 Table 4.5.1 – Data used for the Variability Test – Oxides of Nitrogen**

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	13:00	14:00	441.8	479.7	37.89	46.13	2128.07
3	14:01	15:01	437.3	425.5	-11.79	-3.55	12.63
4	15:02	16:02	440.2	435.3	-4.88	3.36	11.28
5	16:03	17:03	446.0	441.0	-5.06	3.18	10.12
6	18:00	19:00	450.7	460.2	9.53	17.78	315.97
7	19:01	20:01	457.4	455.4	-2.01	6.24	38.88
8	20:02	21:02	464.9	460.7	-4.17	4.07	16.60
9	21:03	22:03	471.4	464.1	-7.28	0.96	0.92
10	22:04	23:04	473.1	470.5	-2.53	5.71	32.59
11	23:05	00:05	453.8	475.8	21.99	30.24	914.22
12	00:06	01:06	447.7	435.9	-11.77	-3.53	12.49
13	01:07	02:07	457.7	462.6	4.87	13.11	171.94
14	02:08	03:08	461.6	469.7	8.08	16.32	266.32
15	03:09	04:09	453.9	460.7	6.82	15.06	226.81
16	04:10	05:10	455.7	452.5	-3.18	5.06	25.62
17	05:11	06:11	457.3	453.9	-3.42	4.82	23.26
18	06:12	07:12	465.5	450.7	-14.88	-6.63	44.02
19	07:13	08:13	454.9	456.4	1.51	9.76	95.16
20	08:14	09:14	447.9	440.4	-7.42	0.82	0.67
21	10:00	11:00	455.6	468.0	12.39	20.63	425.80
22	11:01	12:01	450.5	445.6	-4.84	3.40	11.57
23	12:02	13:02	393.8	442.3	48.52	56.76	3221.69
24	13:03	14:03	475.0	454.9	-20.12	-11.87	141.01
25	14:04	15:04	478.7	447.5	-31.20	-22.96	527.06
26	15:05	16:05	476.5	456.6	-19.84	-11.59	134.43
27	17:10	18:10	470.1	499.4	29.30	37.54	1409.24
28	18:11	19:11	479.1	445.1	-34.05	-25.80	665.88
29	19:12	20:12	471.2	440.7	-30.50	-22.26	495.53
30	20:13	21:13	456.4	457.6	1.22	9.46	89.52
31	21:14	22:14	436.3	396.6	-39.68	-31.44	988.65
32	22:15	23:15	431.4	409.6	-21.84	-13.60	184.90
33	23:16	00:16	434.3	413.0	-21.31	-13.06	170.69
34	00:17	01:17	436.0	416.5	-19.46	-11.22	125.79
35	01:18	02:18	438.7	426.9	-11.83	-3.59	12.91
36	02:19	03:19	434.0	420.0	-14.03	-5.79	33.47
37	03:20	04:20	432.5	415.9	-16.64	-8.39	70.46
38	04:21	05:21	438.7	430.6	-8.11	0.14	0.02
39	05:22	06:22	469.5	443.4	-26.10	-17.86	319.06
40	06:23	07:23	468.4	445.6	-22.79	-14.55	211.57
41	07:24	08:24	456.3	431.9	-24.38	-16.14	260.48
42	09:30	10:30	437.3	430.3	-6.97	1.27	1.62
45	12:33	13:33	434.3	406.4	-27.83	-19.59	383.79
46	13:34	14:34	451.7	430.3	-21.38	-13.14	172.73
47	14:35	15:35	452.7	409.2	-43.47	-35.23	1241.19
44 Tests		Mean			-8.24		
Sum							15646.61

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

SD=	$\text{Root}(1-\text{Number}).\text{Integral}(\text{D1}-\text{D})^2$	19.08	mg/m <sup>3</sup> (s,d),6%O <sub>2</sub>
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O <sub>0</sub> is therefore calculated as:-			
O <sub>0</sub> =	$0.2 \times 1080 \text{ mg/m}^3 (\text{s,d},6\%\text{O}_2)/1.96$	110.20	mg/m <sup>3</sup> (s,d),6%O <sub>2</sub>
For 44 tests, kv =	0.9885		
Therefore variability=		$19.08 \leq 110.2 \times 0.9885$	
or	19.08	$\leq$	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 NO<sub>2</sub>) – 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 (wet)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMs Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	01-Mar-16	13:00	14:00	78.02	6.27	1.57	79.94	6.15	1.95	79.9
2	01-Mar-16	14:01	15:01	75.58	6.52	1.57	77.83	6.61	1.93	77.8
3	01-Mar-16	15:02	16:02	77.38	6.46	1.57	79.59	6.29	1.94	79.6
4	01-Mar-16	16:03	17:03	76.99	6.53	1.60	79.25	6.28	1.97	79.2
5	01-Mar-16	18:00	19:00	74.58	6.50	1.61	75.92	6.53	2.10	75.9
6	01-Mar-16	19:01	20:01	70.38	6.43	1.59	71.82	6.24	2.04	71.8
7	01-Mar-16	20:02	21:02	67.38	6.50	1.49	68.37	6.07	1.93	68.4
8	01-Mar-16	21:03	22:03	65.19	6.50	1.36	65.83	6.14	1.76	65.8
9	01-Mar-16	22:04	23:04	64.27	6.49	1.51	65.23	6.10	1.94	65.2
10	01-02/03/2016	23:05	0:05	63.27	6.67	1.56	64.75	5.86	1.99	64.8
11	02-Mar-16	0:06	1:06	64.77	6.68	1.51	66.17	7.67	1.93	66.2
12	02-Mar-16	1:07	2:07	66.20	6.54	1.50	67.95	6.19	1.96	68.0
13	02-Mar-16	2:08	3:08	67.83	6.50	1.52	69.37	6.03	1.96	69.4
14	02-Mar-16	3:09	4:09	70.83	6.62	1.50	71.74	6.25	1.93	71.7
15	02-Mar-16	4:10	5:10	74.80	6.61	1.52	75.48	6.38	2.00	75.5
16	02-Mar-16	5:11	6:11	75.58	6.65	1.55	76.50	6.29	1.83	76.5
17	02-Mar-16	6:12	7:12	77.26	6.55	1.30	77.92	6.22	1.74	77.9
18	02-Mar-16	7:13	8:13	74.44	6.73	1.29	74.96	6.31	1.71	75.0
19	02-Mar-16	8:14	9:14	73.35	6.90	1.29	73.13	6.61	1.72	73.1
20	02-Mar-16	10:00	11:00	77.41	6.75	1.25	78.50	6.47	1.72	78.5
21	02-Mar-16	11:01	12:01	78.32	6.77	1.23	79.77	6.36	1.69	79.8
22	02-Mar-16	12:02	13:02	68.01	6.63	1.21	81.13	6.35	1.69	81.1
23	02-Mar-16	13:03	14:03	80.67	6.49	1.42	82.15	6.26	1.68	82.1
24	02-Mar-16	14:04	15:04	80.18	6.43	1.42	81.96	6.21	1.67	82.0
25	02-Mar-16	15:05	16:05	78.39	6.42	1.43	80.03	5.96	1.70	80.0
26	02-Mar-16	17:10	18:10	80.30	6.10	1.49	82.55	5.88	1.79	82.6
27	02-Mar-16	18:11	19:11	80.16	5.94	1.49	82.60	5.81	1.77	82.6
28	02-Mar-16	19:12	20:12	74.88	6.25	1.47	77.13	6.10	1.75	77.1
29	02-Mar-16	20:13	21:13	208.58	6.59	1.44	219.81	5.83	2.46	219.8
30	02-Mar-16	21:14	22:14	86.91	7.40	3.25	82.73	7.32	1.72	82.7
31	02-Mar-16	22:15	23:15	45.55	7.33	1.22	49.33	6.92	1.51	49.3
32	02-03/03/2016	23:16	0:16	44.28	7.25	1.24	48.33	6.98	1.52	48.3
33	03-Mar-16	0:17	1:17	43.94	7.23	1.25	48.03	6.94	1.52	48.0
34	03-Mar-16	1:18	2:18	44.52	7.25	1.25	48.66	6.49	1.50	48.7
35	03-Mar-16	2:19	3:19	45.26	7.33	1.24	49.31	6.88	1.51	49.3
36	03-Mar-16	3:20	4:20	47.02	7.35	1.23	50.35	6.88	1.51	50.4
37	03-Mar-16	4:21	5:21	50.53	7.05	1.28	53.98	6.45	1.57	54.0
38	03-Mar-16	5:22	6:22	55.42	6.33	1.36	58.49	6.01	1.62	58.5
39	03-Mar-16	6:23	7:23	56.03	6.37	1.34	58.93	6.08	1.68	58.9
40	03-Mar-16	7:24	8:24	54.53	6.66	1.39	57.19	5.99	1.60	57.2
41	03-Mar-16	9:30	10:30	55.67	7.06	1.29	50.79	6.93	1.33	50.8
42	03-Mar-16	10:31	11:31	60.41	6.55	1.23	62.53	7.72	1.68	62.5
43	03-Mar-16	11:32	12:32	51.36	6.70	1.45	61.50	5.90	1.70	61.5
44	03-Mar-16	12:33	13:33	64.30	7.21	1.24	65.90	6.93	1.61	65.9
45	03-Mar-16	13:34	14:34	71.49	6.92	1.38	72.82	6.41	1.65	72.8
46	03-Mar-16	14:35	15:35	74.71	6.51	1.43	76.17	6.30	1.68	76.2

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

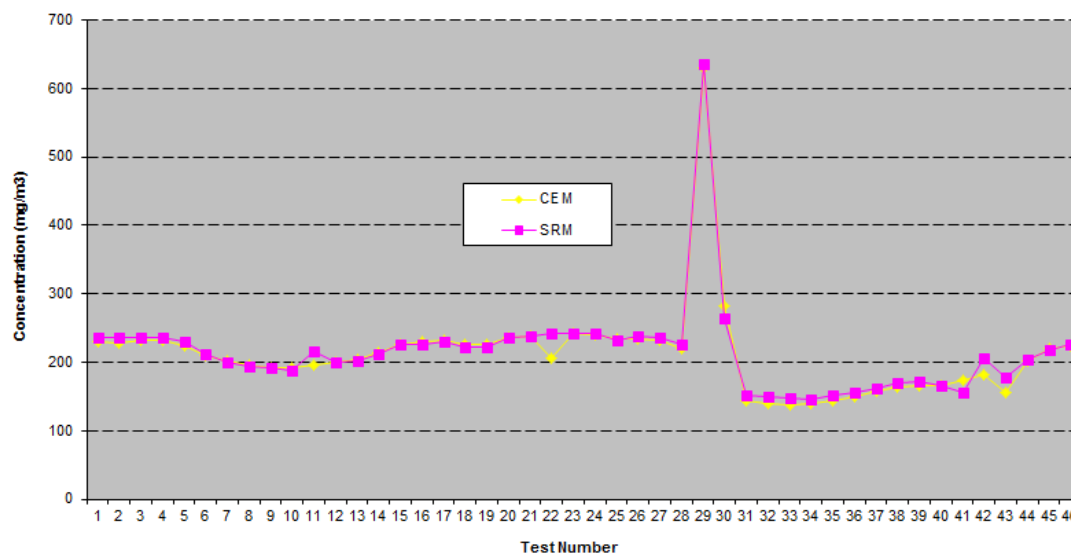
#### 4A2.2.2 Table 4.2.2 -Standardised monitoring Data – Sulphur Dioxide, Low Range

Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(SO <sub>2</sub> mg/m <sup>3</sup> )	(SO <sub>2</sub> mg/m <sup>3</sup> )	(mg/m <sup>3</sup> )
1	01-Mar-16	13:00	14:00	230.6	235.4	12.0
2	01-Mar-16	14:01	15:01	227.4	236.5	12.0
3	01-Mar-16	15:02	16:02	231.8	236.5	12.0
4	01-Mar-16	16:03	17:03	231.7	235.4	12.0
5	01-Mar-16	18:00	19:00	224.1	229.7	12.0
6	01-Mar-16	19:01	20:01	210.4	212.9	11.0
7	01-Mar-16	20:02	21:02	202.2	200.1	10.0
8	01-Mar-16	21:03	22:03	195.3	193.3	10.0
9	01-Mar-16	22:04	23:04	192.8	191.3	9.9
10	01-02/03/2016	23:05	0:05	192.2	187.1	9.7
11	02-Mar-16	0:06	1:06	196.9	217.1	11.0
12	02-Mar-16	1:07	2:07	199.2	200.6	10.0
13	02-Mar-16	2:08	3:08	203.6	202.5	11.0
14	02-Mar-16	3:09	4:09	214.4	212.5	11.0
15	02-Mar-16	4:10	5:10	226.3	225.9	12.0
16	02-Mar-16	5:11	6:11	229.4	227.1	12.0
17	02-Mar-16	6:12	7:12	232.2	230.0	12.0
18	02-Mar-16	7:13	8:13	226.5	222.5	12.0
19	02-Mar-16	8:14	9:14	225.9	221.7	12.0
20	02-Mar-16	10:00	11:00	235.9	235.7	12.0
21	02-Mar-16	11:01	12:01	238.9	237.5	12.0
22	02-Mar-16	12:02	13:02	205.4	241.5	13.0
23	02-Mar-16	13:03	14:03	241.8	243.0	13.0
24	02-Mar-16	14:04	15:04	239.4	241.6	13.0
25	02-Mar-16	15:05	16:05	233.8	231.9	12.0
26	02-Mar-16	17:10	18:10	234.5	238.2	12.0
27	02-Mar-16	18:11	19:11	231.6	237.2	12.0
28	02-Mar-16	19:12	20:12	220.8	225.8	12.0
29	02-Mar-16	20:13	21:13	629.5	636.8	33.0
30	02-Mar-16	21:14	22:14	283.2	263.9	14.0
31	02-Mar-16	22:15	23:15	144.6	152.5	7.9
32	02-03/03/2016	23:16	0:16	139.9	150.1	7.8
33	03-Mar-16	0:17	1:17	138.6	148.7	7.7
34	03-Mar-16	1:18	2:18	140.6	146.0	7.6
35	03-Mar-16	2:19	3:19	143.8	151.9	7.9
36	03-Mar-16	3:20	4:20	149.5	155.3	8.0
37	03-Mar-16	4:21	5:21	157.3	161.6	8.4
38	03-Mar-16	5:22	6:22	164.1	169.9	8.8
39	03-Mar-16	6:23	7:23	166.4	172.2	8.9
40	03-Mar-16	7:24	8:24	165.4	165.9	8.6
41	03-Mar-16	9:30	10:30	173.5	156.8	8.2
42	03-Mar-16	10:31	11:31	181.5	205.5	11.0
43	03-Mar-16	11:32	12:32	156.3	177.6	9.2
44	03-Mar-16	12:33	13:33	202.5	204.2	11.0
45	03-Mar-16	13:34	14:34	220.8	217.5	11.0
46	03-Mar-16	14:35	15:35	224.1	225.8	12.0

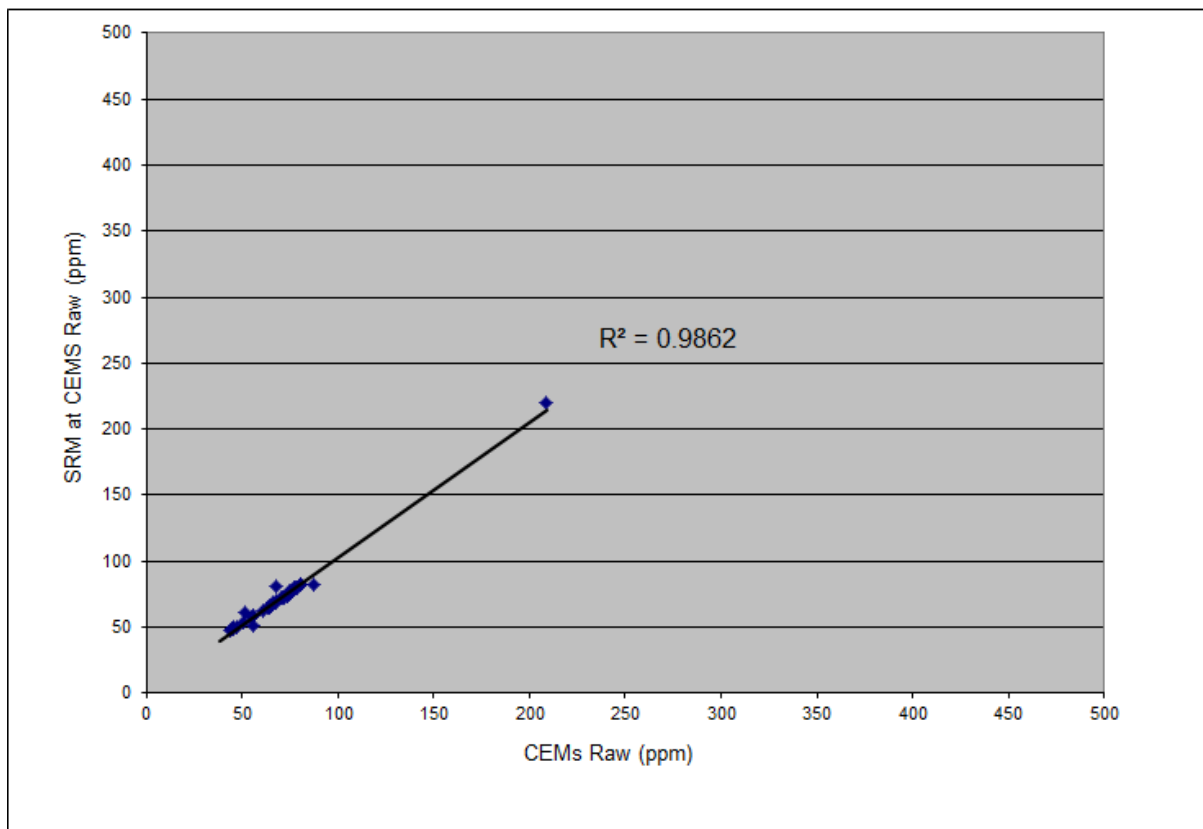
Note:  
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

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



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



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

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

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

As the  $R^2$  value for this determinand was 0.9862, an outlier test has not been undertaken.

#### 4A2.5.2 Determination of Method A or Method B - 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	13:00	14:00	79.9	6.2	235.4
2	14:01	15:01	77.8	6.6	236.5
3	15:02	16:02	79.6	6.3	236.5
4	16:03	17:03	79.2	6.3	235.4
5	18:00	19:00	75.9	6.5	229.7
6	19:01	20:01	71.8	6.2	212.9
7	20:02	21:02	68.4	6.1	200.1
8	21:03	22:03	65.8	6.1	193.3
9	22:04	23:04	65.2	6.1	191.3
10	23:05	0:05	64.8	5.9	187.1
11	0:06	1:06	66.2	7.7	217.1
12	1:07	2:07	68.0	6.2	200.6
13	2:08	3:08	69.4	6.0	202.5
14	3:09	4:09	71.7	6.2	212.5
15	4:10	5:10	75.5	6.4	225.9
16	5:11	6:11	76.5	6.3	227.1
17	6:12	7:12	77.9	6.2	230.0
18	7:13	8:13	75.0	6.3	222.5
19	8:14	9:14	73.1	6.6	221.7
20	10:00	11:00	78.5	6.5	235.7
21	11:01	12:01	79.8	6.4	237.5
22	12:02	13:02	81.1	6.4	241.5
23	13:03	14:03	82.1	6.3	243.0
24	14:04	15:04	82.0	6.2	241.6
25	15:05	16:05	80.0	6.0	231.9
26	17:10	18:10	82.6	5.9	238.2
27	18:11	19:11	82.6	5.8	237.2
28	19:12	20:12	77.1	6.1	225.8
29	20:13	21:13	219.8	5.8	636.8
30	21:14	22:14	82.7	7.3	263.9
31	22:15	23:15	49.3	6.9	152.5
32	23:16	0:16	48.3	7.0	150.1
33	0:17	1:17	48.0	6.9	148.7
34	1:18	2:18	48.7	6.5	146.0
35	2:19	3:19	49.3	6.9	151.9
36	3:20	4:20	50.4	6.9	155.3
37	4:21	5:21	54.0	6.5	161.6
38	5:22	6:22	58.5	6.0	169.9
39	6:23	7:23	58.9	6.1	172.2
40	7:24	8:24	57.2	6.0	165.9
41	9:30	10:30	50.8	6.9	156.8
42	10:31	11:31	62.5	7.7	205.5
43	11:32	12:32	61.5	5.9	177.6
44	12:33	13:33	65.9	6.9	204.2
45	13:34	14:34	72.8	6.4	217.5
46	14:35	15:35	76.2	6.3	225.8
Sum			3322.42		
Emission Limit Value (ELV) =		440	mg/Nm <sup>3</sup>	Y <sub>max</sub>	636.79
Maximum Permissible uncertainty =		20	%	Y <sub>min</sub>	145.95
Maximum Permissible uncertainty (a		88	mg/Nm <sup>3</sup>		
15% of the ELV =		66	mg/Nm <sup>3</sup>		
Is Ymax - Ymin > MPU at ELV?		Yes		Y <sub>max</sub> - Y <sub>min</sub>	490.84
Is Ymin > 15% of ELV?		Yes			
Derivation of Calibration Function			Method A		

**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 <sup>2</sup>	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference		0.0	0.0	-70.69	-68.45	4838.37	4684.74	
2	13:00	14:00	79.9	78.0	9.25	9.58	88.61	91.75	
3	14:01	15:01	77.8	75.6	7.14	7.14	50.96	50.91	
4	15:02	16:02	79.6	77.4	8.90	8.93	79.48	79.81	
5	16:03	17:03	79.2	77.0	8.56	8.54	73.10	72.97	
6	18:00	19:00	75.9	74.6	5.23	6.13	32.09	37.64	
7	19:01	20:01	71.8	70.4	1.13	1.94	2.18	3.75	
8	20:02	21:02	68.4	67.4	-2.32	-1.06	2.47	1.13	
9	21:03	22:03	65.8	65.2	-4.86	-3.26	15.84	10.60	
10	22:04	23:04	65.2	64.3	-5.46	-4.17	22.80	17.43	
11	23:05	0:05	64.8	63.3	-5.94	-5.18	30.73	26.81	
12	0:06	1:06	66.2	64.8	-4.52	-3.68	16.61	13.53	
13	1:07	2:07	68.0	66.2	-2.74	-2.24	6.14	5.03	
14	2:08	3:08	69.4	67.8	-1.32	-0.62	0.81	0.38	
15	3:09	4:09	71.7	70.8	1.05	2.38	2.51	5.68	
16	4:10	5:10	75.5	74.8	4.79	6.35	30.45	40.34	
17	5:11	6:11	76.5	75.6	5.81	7.14	41.49	50.93	
18	6:12	7:12	77.9	77.3	7.23	8.81	63.73	77.63	
19	7:13	8:13	75.0	74.4	4.27	5.99	25.58	35.93	
20	8:14	9:14	73.1	73.4	2.44	4.91	11.98	24.09	
21	10:00	11:00	78.5	77.4	7.81	8.96	70.03	80.32	
22	11:01	12:01	79.8	78.3	9.08	9.87	89.66	97.44	
23	12:02	13:02	81.1	68.0	10.44	-0.44	-4.54	0.19	
24	13:03	14:03	82.1	80.7	11.46	12.23	140.11	149.53	
25	14:04	15:04	82.0	80.2	11.27	11.73	132.18	137.66	
26	15:05	16:05	80.0	78.4	9.34	9.95	92.93	98.98	
27	17:10	18:10	82.6	80.3	11.86	11.85	140.59	140.50	
28	18:11	19:11	82.6	80.2	11.91	11.72	139.47	137.25	
29	19:12	20:12	77.1	74.9	6.44	6.44	41.48	41.46	
30	20:13	21:13	219.8	208.6	149.12	140.14	20897.94	19638.62	
31	21:14	22:14	82.7	86.9	12.04	18.47	222.34	341.00	
32	22:15	23:15	49.3	45.6	-21.36	-22.89	489.07	524.04	
33	23:16	0:16	48.3	44.3	-22.36	-24.17	540.42	583.99	
34	0:17	1:17	48.0	43.9	-22.66	-24.50	555.29	600.43	
35	1:18	2:18	48.7	44.5	-22.03	-23.93	527.13	572.45	
36	2:19	3:19	49.3	45.3	-21.38	-23.19	495.82	537.58	
37	3:20	4:20	50.4	47.0	-20.34	-21.43	435.74	459.14	
38	4:21	5:21	54.0	50.5	-16.71	-17.91	299.36	320.81	
39	5:22	6:22	58.5	55.4	-12.20	-13.03	158.97	169.68	
40	6:23	7:23	58.9	56.0	-11.76	-12.42	145.96	154.17	
41	7:24	8:24	57.2	54.5	-13.50	-13.91	187.85	193.54	
42	9:30	10:30	50.8	55.7	-19.90	-12.78	254.31	163.31	
43	10:31	11:31	62.5	60.4	-8.16	-8.04	65.60	64.61	
44	11:32	12:32	61.5	51.4	-9.19	-17.09	157.02	291.94	
45	12:33	13:33	65.9	64.3	-4.79	-4.15	19.86	17.19	
46	13:34	14:34	72.8	71.5	2.13	3.05	6.50	9.30	
47	14:35	15:35	76.2	74.7	5.48	6.26	34.33	39.19	
Sum			3322.42	3216.92	0.00	0.00	31771.35	30895.41	1.03

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

##### Method A

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

$N$	$N$	$N$	$N$		
$b = \sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})$	$\bar{x} = 1/N \sum_{i=1}^N x_i$	$\bar{y} = 1/N \sum_{i=1}^N y_i$		$\bar{x} =$	68.45
				$\bar{y} =$	70.69
				$b =$	1.028
$a = \bar{y} - b\bar{x}$	$a = 70.69 - 68.45 * 1.028$			$a =$	0.304

The calibration is function  $y_i = a + b x_i$  or  $y_i = 0.304 + 1.028 * x_i$

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

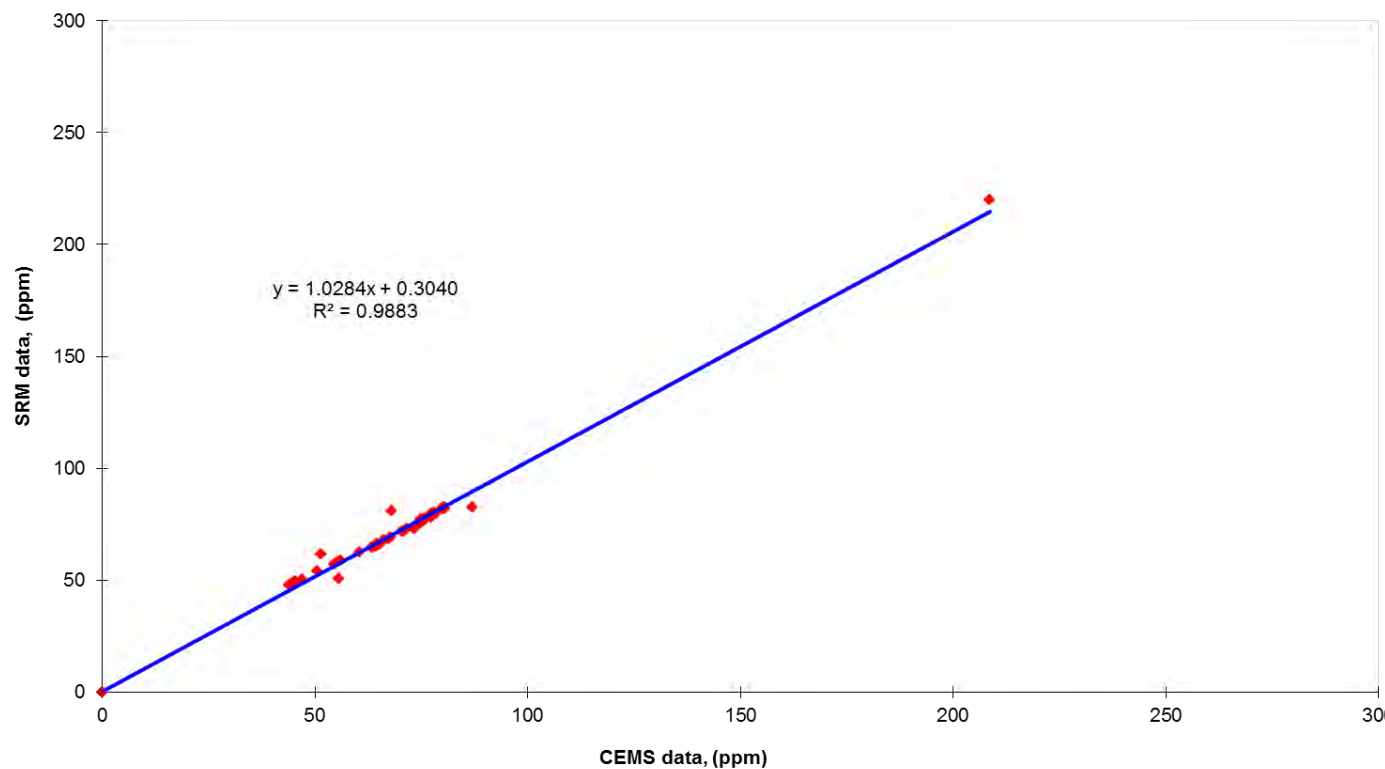
Test No	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
	hr:min		(ppm)	(ppm)	(%)	(%)	(mg/Nm <sup>3</sup> )	(mg/Nm <sup>3</sup> )	(mg/m3)
1	Reference		0.0	0.3	0.0		0.0	0.9	0.0
2	13:00	14:00	78.0	80.5	6.3	1.6	230.6	238.0	235.4
3	14:01	15:01	75.6	78.0	6.5	1.6	227.4	234.7	236.5
4	15:02	16:02	77.4	79.9	6.5	1.6	231.8	239.2	236.5
5	16:03	17:03	77.0	79.5	6.5	1.6	231.7	239.2	235.4
6	18:00	19:00	74.6	77.0	6.5	1.6	224.1	231.3	229.7
7	19:01	20:01	70.4	72.7	6.4	1.6	210.4	217.3	212.9
8	20:02	21:02	67.4	69.6	6.5	1.5	202.2	208.9	200.1
9	21:03	22:03	65.2	67.3	6.5	1.4	195.3	201.8	193.3
10	22:04	23:04	64.3	66.4	6.5	1.5	192.8	199.2	191.3
11	23:05	00:05	63.3	65.4	6.7	1.6	192.2	198.6	187.1
12	00:06	01:06	64.8	66.9	6.7	1.5	196.9	203.4	217.1
13	01:07	02:07	66.2	68.4	6.5	1.5	199.2	205.8	200.6
14	02:08	03:08	67.8	70.1	6.5	1.5	203.6	210.3	202.5
15	03:09	04:09	70.8	73.1	6.6	1.5	214.4	221.4	212.5
16	04:10	05:10	74.8	77.2	6.6	1.5	226.3	233.6	225.9
17	05:11	06:11	75.6	78.0	6.7	1.5	229.4	236.8	227.1
18	06:12	07:12	77.3	79.8	6.5	1.3	232.2	239.7	230.0
19	07:13	08:13	74.4	76.9	6.7	1.3	226.5	233.9	222.5
20	08:14	09:14	73.4	75.7	6.9	1.3	225.9	233.2	221.7
21	10:00	11:00	77.4	79.9	6.8	1.3	235.9	243.5	235.7
22	11:01	12:01	78.3	80.8	6.8	1.2	238.9	246.6	237.5
23	12:02	13:02	68.0	70.2	6.6	1.2	205.4	212.2	241.5
24	13:03	14:03	80.7	83.3	6.5	1.4	241.8	249.5	243.0
25	14:04	15:04	80.2	82.8	6.4	1.4	239.4	247.0	241.6
26	15:05	16:05	78.4	80.9	6.4	1.4	233.8	241.3	231.9
27	17:10	18:10	80.3	82.9	6.1	1.5	234.5	242.0	238.2
28	18:11	19:11	80.2	82.7	5.9	1.5	231.6	239.1	237.2
29	19:12	20:12	74.9	77.3	6.2	1.5	220.8	227.9	225.8
30	20:13	21:13	208.6	214.8	6.6	1.4	629.5	648.2	636.8
31	21:14	22:14	86.9	89.7	7.4	3.3	283.2	292.2	263.9
32	22:15	23:15	45.6	47.1	7.3	1.2	144.6	149.7	152.5
33	23:16	00:16	44.3	45.8	7.3	1.2	139.9	144.8	150.1
34	00:17	01:17	43.9	45.5	7.2	1.2	138.6	143.5	148.7
35	01:18	02:18	44.5	46.1	7.3	1.2	140.6	145.6	146.0
36	02:19	03:19	45.3	46.8	7.3	1.2	143.8	148.9	151.9
37	03:20	04:20	47.0	48.7	7.3	1.2	149.5	154.7	155.3
38	04:21	05:21	50.5	52.3	7.1	1.3	157.3	162.7	161.6
39	05:22	06:22	55.4	57.3	6.3	1.4	164.1	169.7	169.9
40	06:23	07:23	56.0	57.9	6.4	1.3	166.4	172.0	172.2
41	07:24	08:24	54.5	56.4	6.7	1.4	165.4	171.0	165.9
42	09:30	10:30	55.7	57.5	7.1	1.3	173.5	179.3	156.8
43	10:31	11:31	60.4	62.4	6.6	1.2	181.5	187.5	205.5
44	11:32	12:32	51.4	53.1	6.7	1.4	156.3	161.6	177.6
45	12:33	13:33	64.3	66.4	7.2	1.2	202.5	209.2	204.2
46	13:34	14:34	71.5	73.8	6.9	1.4	220.8	228.0	217.5
47	14:35	15:35	74.7	77.1	6.5	1.4	224.1	231.4	225.8
Sum							9756.51		
Emission Limit Value (ELV) =			440	mg/Nm <sup>3</sup>					

Reference Oxygen

6

%

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



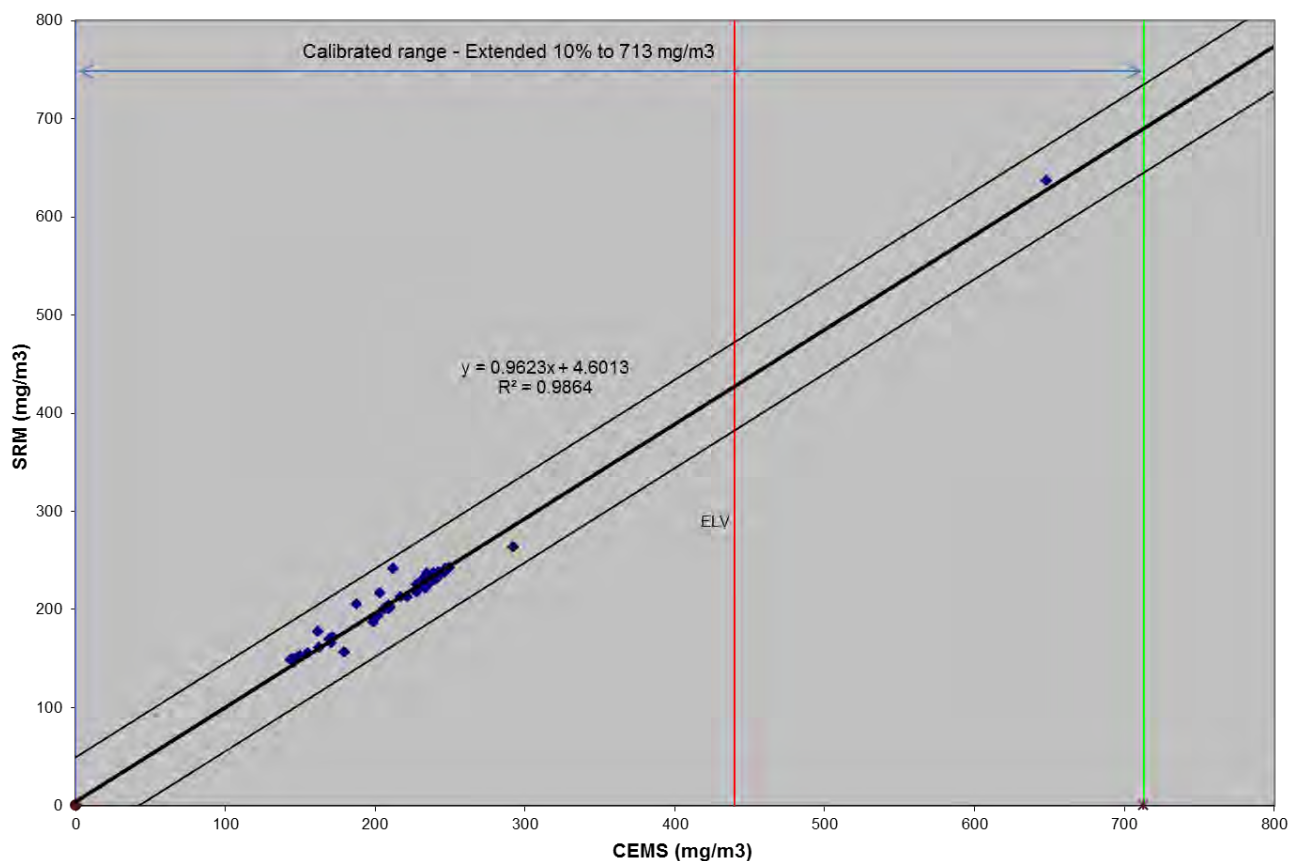
**4A2.10.2 Table 4.5.2 – Data used for the Variability Test – Sulphur Dioxide, Low Range.**

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			
2	13:00	14:00	238.0	235.4	-2.69	0.86	0.73
3	14:01	15:01	234.7	236.5	1.76	5.30	28.13
4	15:02	16:02	239.2	236.5	-2.74	0.81	0.65
5	16:03	17:03	239.2	235.4	-3.79	-0.24	0.06
6	18:00	19:00	231.3	229.7	-1.62	1.92	3.69
7	19:01	20:01	217.3	212.9	-4.36	-0.81	0.66
8	20:02	21:02	208.9	200.1	-8.79	-5.25	27.56
9	21:03	22:03	201.8	193.3	-8.48	-4.94	24.41
10	22:04	23:04	199.2	191.3	-7.87	-4.33	18.76
11	23:05	00:05	198.6	187.1	-11.54	-7.99	63.86
12	00:06	01:06	203.4	217.1	13.66	17.20	295.91
13	01:07	02:07	205.8	200.6	-5.15	-1.60	2.56
14	02:08	03:08	210.3	202.5	-7.77	-4.23	17.86
15	03:09	04:09	221.4	212.5	-8.91	-5.37	28.81
16	04:10	05:10	233.6	225.9	-7.74	-4.20	17.62
17	05:11	06:11	236.8	227.1	-9.65	-6.11	37.34
18	06:12	07:12	239.7	230.0	-9.67	-6.13	37.56
19	07:13	08:13	233.9	222.5	-11.35	-7.81	61.00
20	08:14	09:14	233.2	221.7	-11.55	-8.01	64.11
21	10:00	11:00	243.5	235.7	-7.79	-4.25	18.07
22	11:01	12:01	246.6	237.5	-9.14	-5.59	31.29
23	12:02	13:02	212.2	241.5	29.28	32.82	1077.35
24	13:03	14:03	249.5	243.0	-6.58	-3.03	9.20
25	14:04	15:04	247.0	241.6	-5.48	-1.93	3.74
26	15:05	16:05	241.3	231.9	-9.37	-5.83	34.00
27	17:10	18:10	242.0	238.2	-3.79	-0.25	0.06
28	18:11	19:11	239.1	237.2	-1.85	1.69	2.87
29	19:12	20:12	227.9	225.8	-2.12	1.43	2.03
30	20:13	21:13	648.2	636.8	-11.43	-7.89	62.20
31	21:14	22:14	292.2	263.9	-28.31	-24.76	613.16
32	22:15	23:15	149.7	152.5	2.75	6.29	39.60
33	23:16	00:16	144.8	150.1	5.34	8.89	79.00
34	00:17	01:17	143.5	148.7	5.24	8.79	77.23
35	01:18	02:18	145.6	146.0	0.36	3.91	15.25
36	02:19	03:19	148.9	151.9	3.09	6.63	44.02
37	03:20	04:20	154.7	155.3	0.54	4.09	16.72
38	04:21	05:21	162.7	161.6	-1.17	2.38	5.64
39	05:22	06:22	169.7	169.9	0.25	3.80	14.41
40	06:23	07:23	172.0	172.2	0.18	3.72	13.83
41	07:24	08:24	171.0	165.9	-5.08	-1.54	2.36
42	09:30	10:30	179.3	156.8	-22.52	-18.97	359.96
43	10:31	11:31	187.5	205.5	17.96	21.51	462.49
44	11:32	12:32	161.6	177.6	15.93	19.47	379.13
45	12:33	13:33	209.2	204.2	-5.01	-1.47	2.15
46	13:34	14:34	228.0	217.5	-10.48	-6.93	48.07
47	14:35	15:35	231.4	225.8	-5.58	-2.03	4.14
46 Tests		Mean			-3.54		
Sum							4149.27

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

SD=	Root(1-Number).Integral(D1-D) <sup>2</sup>	9.60	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O <sub>0</sub> is therefore calculated as:-			
O <sub>0</sub> =	0.2*440 mg/m3 (s,d,6%O2)/1.96	44.90	mg/m3(s,d),6%O2
For 46 tests, kv =	0.9885		
Therefore variability=	9.6 <= 44.9 * 0.9885		
or	9.60	<=	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 (wet)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMS Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	01-Mar-16	13:00	14:00	78.27	6.27	1.57	79.94	6.15	1.95	79.9
2	01-Mar-16	14:01	15:01	75.80	6.52	1.57	77.83	6.61	1.93	77.8
3	01-Mar-16	15:02	16:02	77.66	6.46	1.57	79.59	6.29	1.94	79.6
4	01-Mar-16	16:03	17:03	77.25	6.53	1.60	79.25	6.28	1.97	79.2
5	01-Mar-16	18:00	19:00	74.83	6.50	1.61	75.92	6.53	2.10	75.9
6	01-Mar-16	19:01	20:01	70.60	6.43	1.59	71.82	6.24	2.04	71.8
7	01-Mar-16	20:02	21:02	67.57	6.50	1.49	68.37	6.07	1.93	68.4
8	01-Mar-16	21:03	22:03	65.39	6.50	1.36	65.83	6.14	1.76	65.8
9	01-Mar-16	22:04	23:04	64.43	6.49	1.51	65.23	6.10	1.94	65.2
10	01-02/03/2016	23:05	0:05	63.42	6.67	1.56	64.75	5.86	1.99	64.8
11	02-Mar-16	0:06	1:06	64.94	6.68	1.51	66.17	7.67	1.93	66.2
12	02-Mar-16	1:07	2:07	66.39	6.54	1.50	67.95	6.19	1.96	68.0
13	02-Mar-16	2:08	3:08	68.01	6.50	1.52	69.37	6.03	1.96	69.4
14	02-Mar-16	3:09	4:09	71.04	6.62	1.50	71.74	6.25	1.93	71.7
15	02-Mar-16	4:10	5:10	75.07	6.61	1.52	75.48	6.38	2.00	75.5
16	02-Mar-16	5:11	6:11	75.81	6.65	1.55	76.50	6.29	1.83	76.5
17	02-Mar-16	6:12	7:12	77.49	6.55	1.30	77.92	6.22	1.74	77.9
18	02-Mar-16	7:13	8:13	74.67	6.73	1.29	74.96	6.31	1.71	75.0
19	02-Mar-16	8:14	9:14	73.62	6.90	1.29	73.13	6.61	1.72	73.1
20	02-Mar-16	10:00	11:00	77.64	6.75	1.25	78.50	6.47	1.72	78.5
21	02-Mar-16	11:01	12:01	78.60	6.77	1.23	79.77	6.36	1.69	79.8
22	02-Mar-16	12:02	13:02	68.26	6.63	1.21	81.13	6.35	1.69	81.1
23	02-Mar-16	13:03	14:03	80.95	6.49	1.42	82.15	6.26	1.68	82.1
24	02-Mar-16	14:04	15:04	80.44	6.43	1.42	81.96	6.21	1.67	82.0
25	02-Mar-16	15:05	16:05	78.67	6.42	1.43	80.03	5.96	1.70	80.0
26	02-Mar-16	17:10	18:10	80.55	6.10	1.49	82.55	5.88	1.79	82.6
27	02-Mar-16	18:11	19:11	80.48	5.94	1.49	82.60	5.81	1.77	82.6
28	02-Mar-16	19:12	20:12	75.11	6.25	1.47	77.13	6.10	1.75	77.1
29	02-Mar-16	20:13	21:13	214.36	6.59	1.44	219.81	5.83	2.46	219.8
30	02-Mar-16	21:14	22:14	87.61	7.40	3.25	82.73	7.32	1.72	82.7
31	02-Mar-16	22:15	23:15	45.62	7.33	1.22	49.33	6.92	1.51	49.3
32	02-03/03/2016	23:16	0:16	44.35	7.25	1.24	48.33	6.98	1.52	48.3
33	03-Mar-16	0:17	1:17	44.01	7.23	1.25	48.03	6.94	1.52	48.0
34	03-Mar-16	1:18	2:18	44.58	7.25	1.25	48.66	6.49	1.50	48.7
35	03-Mar-16	2:19	3:19	45.32	7.33	1.24	49.31	6.88	1.51	49.3
36	03-Mar-16	3:20	4:20	47.08	7.35	1.23	50.35	6.88	1.51	50.4
37	03-Mar-16	4:21	5:21	50.62	7.05	1.28	53.98	6.45	1.57	54.0
38	03-Mar-16	5:22	6:22	55.55	6.33	1.36	58.49	6.01	1.62	58.5
39	03-Mar-16	6:23	7:23	56.15	6.37	1.34	58.93	6.08	1.68	58.9
40	03-Mar-16	7:24	8:24	54.63	6.66	1.39	57.19	5.99	1.60	57.2
41	03-Mar-16	9:30	10:30	55.80	7.06	1.29	50.79	6.93	1.33	50.8
42	03-Mar-16	10:31	11:31	60.55	6.55	1.23	62.53	7.72	1.68	62.5
43	03-Mar-16	11:32	12:32	51.48	6.70	1.45	61.50	5.90	1.70	61.5
44	03-Mar-16	12:33	13:33	64.48	7.21	1.24	65.90	6.93	1.61	65.9
45	03-Mar-16	13:34	14:34	71.71	6.92	1.38	72.82	6.41	1.65	72.8
46	03-Mar-16	14:35	15:35	74.94	6.51	1.43	76.17	6.30	1.68	76.2

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

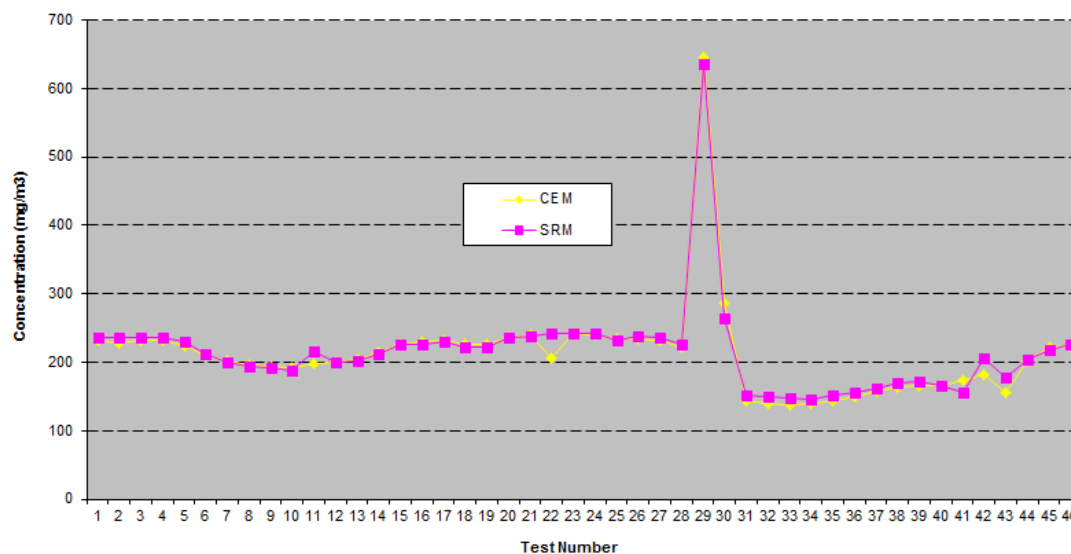
**4A2.2.3 Table 4.2.3 -Standardised monitoring Data – Sulphur Dioxide, High Range**

Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(SO <sub>2</sub> mg/m <sup>3</sup> )	(SO <sub>2</sub> mg/m <sup>3</sup> )	(mg/m <sup>3</sup> )
1	01-Mar-16	13:00	14:00	231.3	235.4	12.0
2	01-Mar-16	14:01	15:01	228.0	236.5	12.0
3	01-Mar-16	15:02	16:02	232.6	236.5	12.0
4	01-Mar-16	16:03	17:03	232.5	235.4	12.0
5	01-Mar-16	18:00	19:00	224.8	229.7	12.0
6	01-Mar-16	19:01	20:01	211.1	212.9	11.0
7	01-Mar-16	20:02	21:02	202.8	200.1	10.0
8	01-Mar-16	21:03	22:03	196.0	193.3	10.0
9	01-Mar-16	22:04	23:04	193.3	191.3	9.9
10	01-02/03/2016	23:05	0:05	192.7	187.1	9.7
11	02-Mar-16	0:06	1:06	197.5	217.1	11.0
12	02-Mar-16	1:07	2:07	199.8	200.6	10.0
13	02-Mar-16	2:08	3:08	204.2	202.5	11.0
14	02-Mar-16	3:09	4:09	215.1	212.5	11.0
15	02-Mar-16	4:10	5:10	227.1	225.9	12.0
16	02-Mar-16	5:11	6:11	230.1	227.1	12.0
17	02-Mar-16	6:12	7:12	232.9	230.0	12.0
18	02-Mar-16	7:13	8:13	227.2	222.5	12.0
19	02-Mar-16	8:14	9:14	226.7	221.7	12.0
20	02-Mar-16	10:00	11:00	236.6	235.7	12.0
21	02-Mar-16	11:01	12:01	239.8	237.5	12.0
22	02-Mar-16	12:02	13:02	206.2	241.5	13.0
23	02-Mar-16	13:03	14:03	242.6	243.0	13.0
24	02-Mar-16	14:04	15:04	240.1	241.6	13.0
25	02-Mar-16	15:05	16:05	234.6	231.9	12.0
26	02-Mar-16	17:10	18:10	235.2	238.2	12.0
27	02-Mar-16	18:11	19:11	232.5	237.2	12.0
28	02-Mar-16	19:12	20:12	221.5	225.8	12.0
29	02-Mar-16	20:13	21:13	646.9	636.8	33.0
30	02-Mar-16	21:14	22:14	285.5	263.9	14.0
31	02-Mar-16	22:15	23:15	144.9	152.5	7.9
32	02-03/03/2016	23:16	0:16	140.1	150.1	7.8
33	03-Mar-16	0:17	1:17	138.8	148.7	7.7
34	03-Mar-16	1:18	2:18	140.8	146.0	7.6
35	03-Mar-16	2:19	3:19	144.0	151.9	7.9
36	03-Mar-16	3:20	4:20	149.7	155.3	8.0
37	03-Mar-16	4:21	5:21	157.6	161.6	8.4
38	03-Mar-16	5:22	6:22	164.5	169.9	8.8
39	03-Mar-16	6:23	7:23	166.7	172.2	8.9
40	03-Mar-16	7:24	8:24	165.7	165.9	8.6
41	03-Mar-16	9:30	10:30	173.9	156.8	8.2
42	03-Mar-16	10:31	11:31	181.9	205.5	11.0
43	03-Mar-16	11:32	12:32	156.6	177.6	9.2
44	03-Mar-16	12:33	13:33	203.1	204.2	11.0
45	03-Mar-16	13:34	14:34	221.4	217.5	11.0
46	03-Mar-16	14:35	15:35	224.9	225.8	12.0

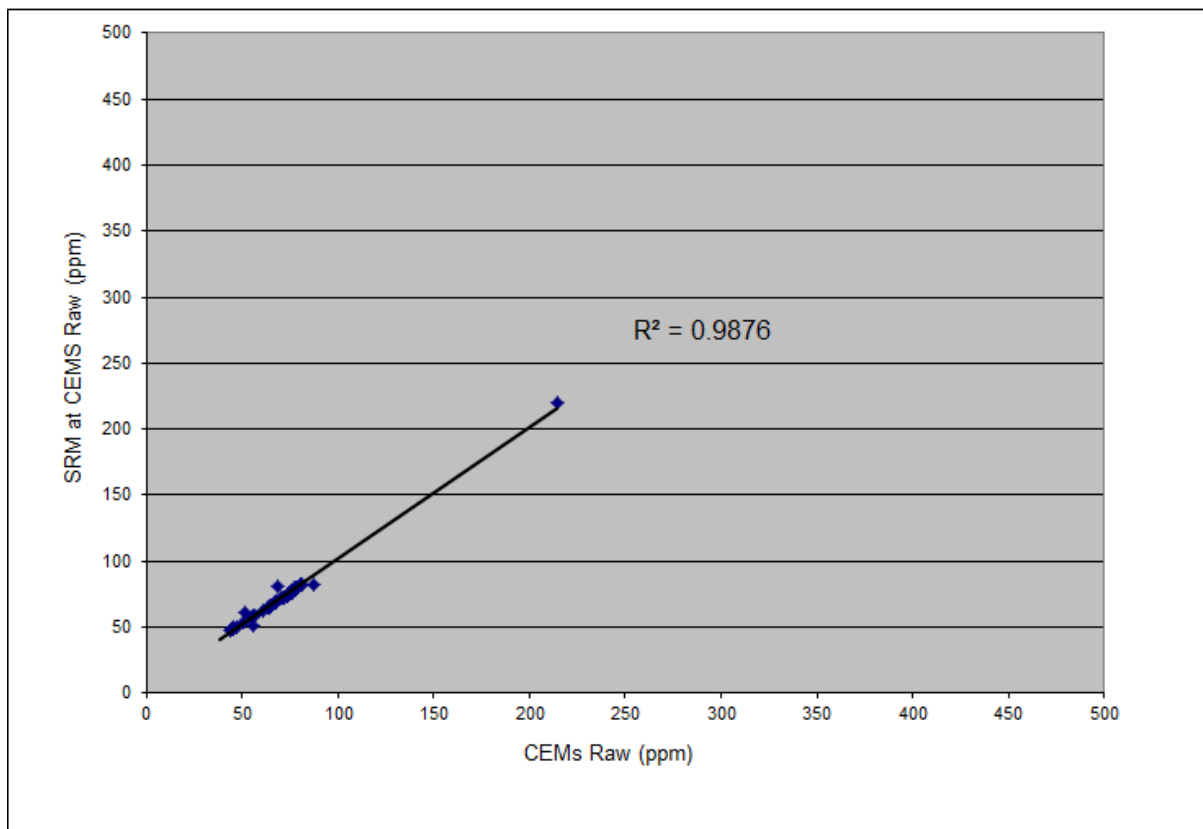
Note:  
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

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



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



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

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

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

As the  $R^2$  value for this determinand was 0.9876, an outlier test has not been undertaken.

#### 4A2.5.3 Determination of Method A or Method B - 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	13:00	14:00	79.9	6.2	235.4
2	14:01	15:01	77.8	6.6	236.5
3	15:02	16:02	79.6	6.3	236.5
4	16:03	17:03	79.2	6.3	235.4
5	18:00	19:00	75.9	6.5	229.7
6	19:01	20:01	71.8	6.2	212.9
7	20:02	21:02	68.4	6.1	200.1
8	21:03	22:03	65.8	6.1	193.3
9	22:04	23:04	65.2	6.1	191.3
10	23:05	0:05	64.8	5.9	187.1
11	0:06	1:06	66.2	7.7	217.1
12	1:07	2:07	68.0	6.2	200.6
13	2:08	3:08	69.4	6.0	202.5
14	3:09	4:09	71.7	6.2	212.5
15	4:10	5:10	75.5	6.4	225.9
16	5:11	6:11	76.5	6.3	227.1
17	6:12	7:12	77.9	6.2	230.0
18	7:13	8:13	75.0	6.3	222.5
19	8:14	9:14	73.1	6.6	221.7
20	10:00	11:00	78.5	6.5	235.7
21	11:01	12:01	79.8	6.4	237.5
22	12:02	13:02	81.1	6.4	241.5
23	13:03	14:03	82.1	6.3	243.0
24	14:04	15:04	82.0	6.2	241.6
25	15:05	16:05	80.0	6.0	231.9
26	17:10	18:10	82.6	5.9	238.2
27	18:11	19:11	82.6	5.8	237.2
28	19:12	20:12	77.1	6.1	225.8
29	20:13	21:13	219.8	5.8	636.8
30	21:14	22:14	82.7	7.3	263.9
31	22:15	23:15	49.3	6.9	152.5
32	23:16	0:16	48.3	7.0	150.1
33	0:17	1:17	48.0	6.9	148.7
34	1:18	2:18	48.7	6.5	146.0
35	2:19	3:19	49.3	6.9	151.9
36	3:20	4:20	50.4	6.9	155.3
37	4:21	5:21	54.0	6.5	161.6
38	5:22	6:22	58.5	6.0	169.9
39	6:23	7:23	58.9	6.1	172.2
40	7:24	8:24	57.2	6.0	165.9
41	9:30	10:30	50.8	6.9	156.8
42	10:31	11:31	62.5	7.7	205.5
43	11:32	12:32	61.5	5.9	177.6
44	12:33	13:33	65.9	6.9	204.2
45	13:34	14:34	72.8	6.4	217.5
46	14:35	15:35	76.2	6.3	225.8
Sum			3322.42		
Emission Limit Value (ELV) =		440	mg/Nm <sup>3</sup>	Y <sub>max</sub>	636.79
Maximum Permissible uncertainty =		20	%	Y <sub>min</sub>	145.95
Maximum Permissible uncertainty (at 15% of the ELV) =		88	mg/Nm <sup>3</sup>		
		66	mg/Nm <sup>3</sup>		
Is Ymax - Ymin > MPU at ELV?		Yes		Y <sub>max</sub> - Y <sub>min</sub>	490.84
Is Ymin > 15% of ELV?		Yes			
Derivation of Calibration Function			Method A		

**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 <sup>2</sup>	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference	23/02/2016	0.0	1.2	-70.69	-67.62	4779.76	4571.94	
2	13:00	14:00	79.9	78.3	9.25	9.48	87.74	89.96	
3	14:01	15:01	77.8	75.8	7.14	7.02	50.10	49.21	
4	15:02	16:02	79.6	77.7	8.90	8.87	78.92	78.69	
5	16:03	17:03	79.2	77.2	8.56	8.46	72.42	71.60	
6	18:00	19:00	75.9	74.8	5.23	6.05	31.64	36.57	
7	19:01	20:01	71.8	70.6	1.13	1.81	2.05	3.29	
8	20:02	21:02	68.4	67.6	-2.32	-1.22	2.83	1.49	
9	21:03	22:03	65.8	65.4	-4.86	-3.39	16.50	11.50	
10	22:04	23:04	65.2	64.4	-5.46	-4.35	23.78	18.96	
11	23:05	0:05	64.8	63.4	-5.94	-5.37	31.86	28.82	
12	0:06	1:06	66.2	64.9	-4.52	-3.84	17.36	14.77	
13	1:07	2:07	68.0	66.4	-2.74	-2.39	6.56	5.73	
14	2:08	3:08	69.4	68.0	-1.32	-0.77	1.02	0.60	
15	3:09	4:09	71.7	71.0	1.05	2.26	2.38	5.09	
16	4:10	5:10	75.5	75.1	4.79	6.28	30.11	39.44	
17	5:11	6:11	76.5	75.8	5.81	7.02	40.82	49.30	
18	6:12	7:12	77.9	77.5	7.23	8.70	62.96	75.76	
19	7:13	8:13	75.0	74.7	4.27	5.88	25.10	34.62	
20	8:14	9:14	73.1	73.6	2.44	4.83	11.79	23.33	
21	10:00	11:00	78.5	77.6	7.81	8.85	69.15	78.31	
22	11:01	12:01	79.8	78.6	9.08	9.81	89.09	96.22	
23	12:02	13:02	81.1	68.3	10.44	-0.52	-5.45	0.27	
24	13:03	14:03	82.1	80.9	11.46	12.16	139.32	147.84	
25	14:04	15:04	82.0	80.4	11.27	11.65	131.24	135.71	
26	15:05	16:05	80.0	78.7	9.34	9.88	92.30	97.63	
27	17:10	18:10	82.6	80.6	11.86	11.77	139.55	138.44	
28	18:11	19:11	82.6	80.5	11.91	11.70	139.26	136.82	
29	19:12	20:12	77.1	75.1	6.44	6.33	40.77	40.05	
30	20:13	21:13	219.8	214.4	149.12	145.57	21708.50	21191.60	
31	21:14	22:14	82.7	87.6	12.04	18.82	226.59	354.16	
32	22:15	23:15	49.3	45.6	-21.36	-23.16	494.88	536.57	
33	23:16	0:16	48.3	44.3	-22.36	-24.44	546.54	597.30	
34	0:17	1:17	48.0	44.0	-22.66	-24.78	561.44	613.81	
35	1:18	2:18	48.7	44.6	-22.03	-24.21	533.39	586.12	
36	2:19	3:19	49.3	45.3	-21.38	-23.47	501.85	550.75	
37	3:20	4:20	50.4	47.1	-20.34	-21.71	441.40	471.15	
38	4:21	5:21	54.0	50.6	-16.71	-18.17	303.67	330.11	
39	5:22	6:22	58.5	55.5	-12.20	-13.24	161.58	175.29	
40	6:23	7:23	58.9	56.1	-11.76	-12.64	148.56	159.70	
41	7:24	8:24	57.2	54.6	-13.50	-14.15	191.09	200.28	
42	9:30	10:30	50.8	55.8	-19.90	-12.99	258.50	168.73	
43	10:31	11:31	62.5	60.5	-8.16	-8.24	67.23	67.87	
44	11:32	12:32	61.5	51.5	-9.19	-17.31	159.05	299.55	
45	12:33	13:33	65.9	64.5	-4.79	-4.31	20.63	18.57	
46	13:34	14:34	72.8	71.7	2.13	2.93	6.24	8.57	
47	14:35	15:35	76.2	74.9	5.48	6.16	33.77	37.91	
Sum			3322.42	3232.95	0.00	0.00	32575.82	32450.02	1.00

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

##### Method A

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

$N$	$N$	$N$	$N$		
$b = \sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})$	$\bar{x} = 1/N \sum_{i=1}^N x_i$	$\bar{y} = 1/N \sum_{i=1}^N y_i$		$\bar{x} =$	68.79
				$\bar{y} =$	70.69
				$b =$	1.004
$a = \bar{y} - b\bar{x}$	$a = 70.69 - 68.79 * 1.003$			$a =$	1.637

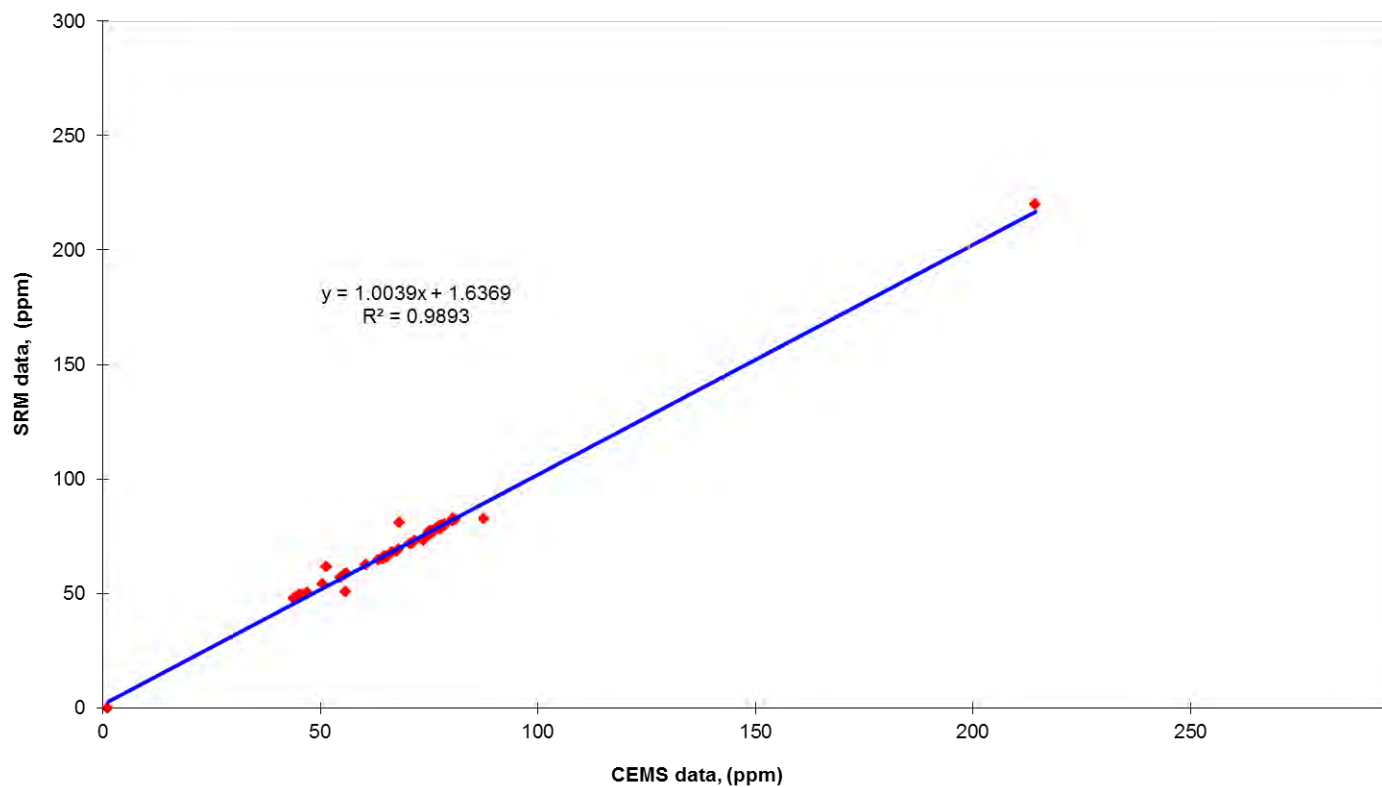
The calibration is function  $y_i = a + b x_i$  or  $y_i = 1.637 + 1.004 * x_i$

### A2.8.3 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 <sup>3</sup> )	(mg/Nm <sup>3</sup> )	(mg/m3)
1	Reference	23/02/2016	1.2	2.8	0.0		1.2	8.0	0.0
2	13:00	14:00	78.3	80.2	6.3	1.6	231.3	237.1	235.4
3	14:01	15:01	75.8	77.7	6.5	1.6	228.0	233.8	236.5
4	15:02	16:02	77.7	79.6	6.5	1.6	232.6	238.4	236.5
5	16:03	17:03	77.2	79.2	6.5	1.6	232.5	238.3	235.4
6	18:00	19:00	74.8	76.8	6.5	1.6	224.8	230.6	229.7
7	19:01	20:01	70.6	72.5	6.4	1.6	211.1	216.8	212.9
8	20:02	21:02	67.6	69.5	6.5	1.5	202.8	208.5	200.1
9	21:03	22:03	65.4	67.3	6.5	1.4	196.0	201.6	193.3
10	22:04	23:04	64.4	66.3	6.5	1.5	193.3	198.9	191.3
11	23:05	00:05	63.4	65.3	6.7	1.6	192.7	198.4	187.1
12	00:06	01:06	64.9	66.8	6.7	1.5	197.5	203.2	217.1
13	01:07	02:07	66.4	68.3	6.5	1.5	199.8	205.5	200.6
14	02:08	03:08	68.0	69.9	6.5	1.5	204.2	209.9	202.5
15	03:09	04:09	71.0	73.0	6.6	1.5	215.1	220.9	212.5
16	04:10	05:10	75.1	77.0	6.6	1.5	227.1	233.0	225.9
17	05:11	06:11	75.8	77.7	6.7	1.5	230.1	235.9	227.1
18	06:12	07:12	77.5	79.4	6.5	1.3	232.9	238.7	230.0
19	07:13	08:13	74.7	76.6	6.7	1.3	227.2	233.1	222.5
20	08:14	09:14	73.6	75.5	6.9	1.3	226.7	232.6	221.7
21	10:00	11:00	77.6	79.6	6.8	1.3	236.6	242.5	235.7
22	11:01	12:01	78.6	80.5	6.8	1.2	239.8	245.7	237.5
23	12:02	13:02	68.3	70.2	6.6	1.2	206.2	212.0	241.5
24	13:03	14:03	80.9	82.9	6.5	1.4	242.6	248.4	243.0
25	14:04	15:04	80.4	82.4	6.4	1.4	240.1	245.9	241.6
26	15:05	16:05	78.7	80.6	6.4	1.4	234.6	240.4	231.9
27	17:10	18:10	80.6	82.5	6.1	1.5	235.2	240.9	238.2
28	18:11	19:11	80.5	82.4	5.9	1.5	232.5	238.2	237.2
29	19:12	20:12	75.1	77.0	6.2	1.5	221.5	227.1	225.8
30	20:13	21:13	214.4	216.8	6.6	1.4	646.9	654.3	636.8
31	21:14	22:14	87.6	89.6	7.4	3.3	285.5	291.9	263.9
32	22:15	23:15	45.6	47.4	7.3	1.2	144.9	150.6	152.5
33	23:16	00:16	44.3	46.2	7.3	1.2	140.1	145.8	150.1
34	00:17	01:17	44.0	45.8	7.2	1.2	138.8	144.5	148.7
35	01:18	02:18	44.6	46.4	7.3	1.2	140.8	146.5	146.0
36	02:19	03:19	45.3	47.1	7.3	1.2	144.0	149.8	151.9
37	03:20	04:20	47.1	48.9	7.3	1.2	149.7	155.5	155.3
38	04:21	05:21	50.6	52.5	7.1	1.3	157.6	163.3	161.6
39	05:22	06:22	55.5	57.4	6.3	1.4	164.5	170.0	169.9
40	06:23	07:23	56.1	58.0	6.4	1.3	166.7	172.2	172.2
41	07:24	08:24	54.6	56.5	6.7	1.4	165.7	171.3	165.9
42	09:30	10:30	55.8	57.6	7.1	1.3	173.9	179.7	156.8
43	10:31	11:31	60.5	62.4	6.6	1.2	181.9	187.5	205.5
44	11:32	12:32	51.5	53.3	6.7	1.4	156.6	162.2	177.6
45	12:33	13:33	64.5	66.4	7.2	1.2	203.1	209.0	204.2
46	13:34	14:34	71.7	73.6	6.9	1.4	221.4	227.4	217.5
47	14:35	15:35	74.9	76.9	6.5	1.4	224.9	230.6	225.8
Sum							9802.67		
Emission Limit Value (ELV) =			440	mg/Nm <sup>3</sup>					

Reference Oxygen 6 %

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



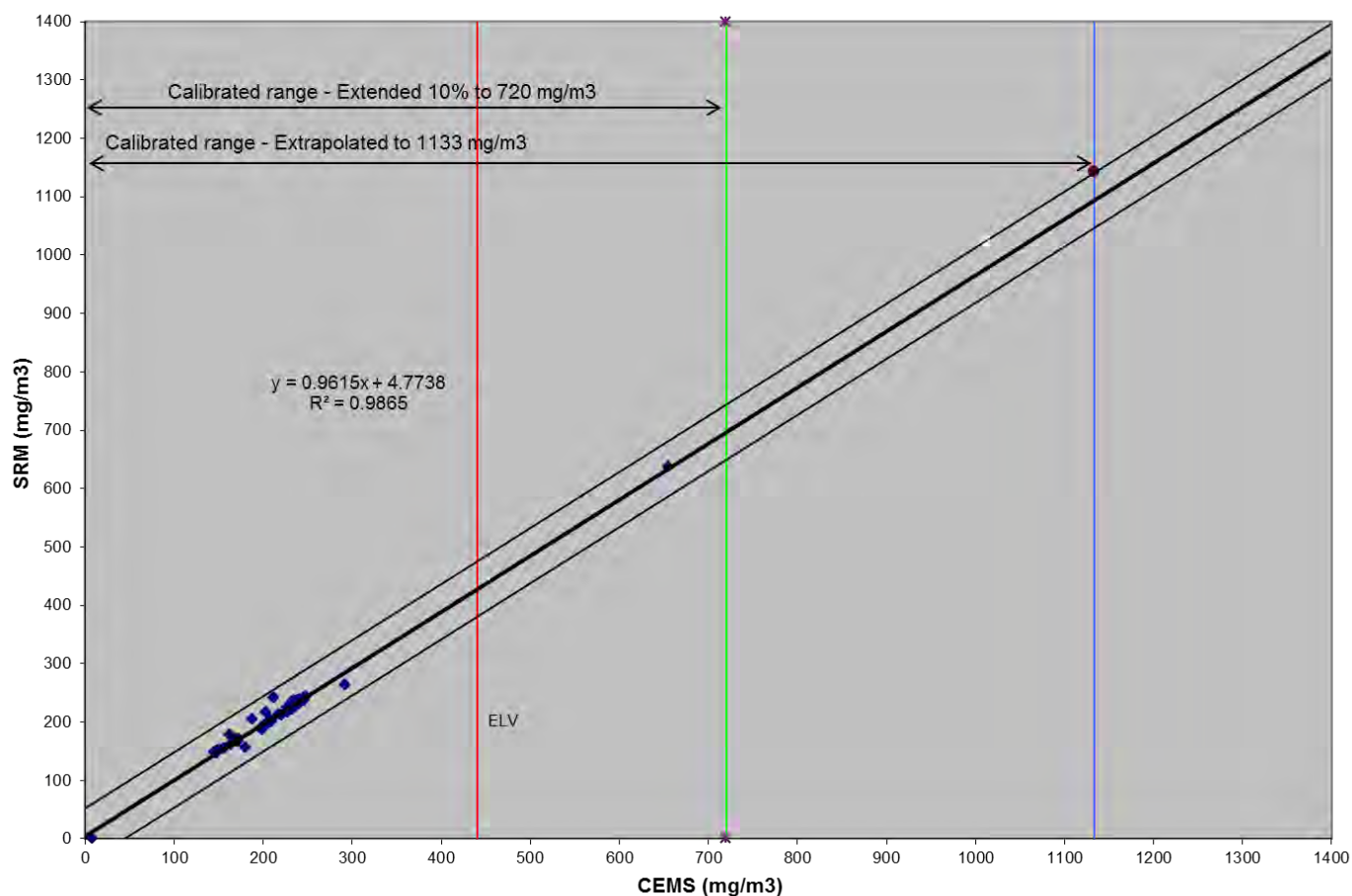
**4A2.10.3 Table 4.5.3 – Data used for the Variability Test – Sulphur Dioxide, High Range.**

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			
2	13:00	14:00	237.1	235.4	-1.72	1.67	2.79
3	14:01	15:01	233.8	236.5	2.65	6.04	36.43
4	15:02	16:02	238.4	236.5	-1.89	1.50	2.24
5	16:03	17:03	238.3	235.4	-2.92	0.47	0.22
6	18:00	19:00	230.6	229.7	-0.91	2.48	6.14
7	19:01	20:01	216.8	212.9	-3.85	-0.46	0.22
8	20:02	21:02	208.5	200.1	-8.41	-5.02	25.18
9	21:03	22:03	201.6	193.3	-8.32	-4.93	24.29
10	22:04	23:04	198.9	191.3	-7.64	-4.25	18.07
11	23:05	00:05	198.4	187.1	-11.34	-7.95	63.23
12	00:06	01:06	203.2	217.1	13.89	17.27	298.37
13	01:07	02:07	205.5	200.6	-4.86	-1.47	2.15
14	02:08	03:08	209.9	202.5	-7.34	-3.95	15.63
15	03:09	04:09	220.9	212.5	-8.35	-4.96	24.64
16	04:10	05:10	233.0	225.9	-7.05	-3.67	13.44
17	05:11	06:11	235.9	227.1	-8.77	-5.39	29.02
18	06:12	07:12	238.7	230.0	-8.70	-5.32	28.25
19	07:13	08:13	233.1	222.5	-10.57	-7.18	51.59
20	08:14	09:14	232.6	221.7	-10.94	-7.55	57.04
21	10:00	11:00	242.5	235.7	-6.78	-3.39	11.52
22	11:01	12:01	245.7	237.5	-8.21	-4.82	23.26
23	12:02	13:02	212.0	241.5	29.51	32.90	1082.28
24	13:03	14:03	248.4	243.0	-5.47	-2.08	4.35
25	14:04	15:04	245.9	241.6	-4.37	-0.98	0.96
26	15:05	16:05	240.4	231.9	-8.44	-5.06	25.58
27	17:10	18:10	240.9	238.2	-2.69	0.70	0.49
28	18:11	19:11	238.2	237.2	-0.97	2.42	5.85
29	19:12	20:12	227.1	225.8	-1.33	2.06	4.25
30	20:13	21:13	654.3	636.8	-17.55	-14.16	200.48
31	21:14	22:14	291.9	263.9	-27.99	-24.60	605.20
32	22:15	23:15	150.6	152.5	1.84	5.22	27.29
33	23:16	00:16	145.8	150.1	4.34	7.73	59.78
34	00:17	01:17	144.5	148.7	4.21	7.60	57.75
35	01:18	02:18	146.5	146.0	-0.59	2.80	7.84
36	02:19	03:19	149.8	151.9	2.19	5.58	31.09
37	03:20	04:20	155.5	155.3	-0.23	3.15	9.94
38	04:21	05:21	163.3	161.6	-1.73	1.66	2.75
39	05:22	06:22	170.0	169.9	-0.06	3.33	11.09
40	06:23	07:23	172.2	172.2	-0.07	3.32	11.02
41	07:24	08:24	171.3	165.9	-5.38	-2.00	3.98
42	09:30	10:30	179.7	156.8	-22.83	-19.45	378.12
43	10:31	11:31	187.5	205.5	17.97	21.36	456.36
44	11:32	12:32	162.2	177.6	15.33	18.72	350.38
45	12:33	13:33	209.0	204.2	-4.82	-1.43	2.05
46	13:34	14:34	227.4	217.5	-9.87	-6.49	42.06
47	14:35	15:35	230.6	225.8	-4.81	-1.42	2.02
46 Tests		Mean			-3.39		
Sum							4116.65

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

SD=	Root(1-Number).Integral(D1-D) <sup>2</sup>	9.56	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O <sub>0</sub> is therefore calculated as:-			
O <sub>0</sub> =	0.2*440 mg/m3 (s,d,6%O2)/1.96	44.90	mg/m3(s,d),6%O2
For 46 tests, kv =	0.9885		
Therefore variability=	9.56 <= 44.9 * 0.9885		
or	9.56 <=	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 4A3: Data & calculations – QAL2 – Unit 9, Procal 2**

## Section 4A3 – Data and calculations – QAL2 Procal 2

### 4A3.1.1 Table 4.1.1 – Raw monitoring Data – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (Wet)	CEMS Oxygen (dry)	CEMS Moisture	SRM Raw Value (dry)	SRM Oxygen (Dry)	SRM Moisture	SRM at CEMS Raw conditions
		hr:min		NO (ppm)	(%)	(%)	NOx (ppm)	(%)	(%)	NOx (ppm)
1	01-Mar-16	13:00	14:00	246.56	6.27	1.57	231.17	6.15	1.95	226.7
2	01-Mar-16	14:01	15:01	235.25	6.52	1.57	198.67	6.61	1.93	194.8
3	01-Mar-16	15:02	16:02	195.58	6.46	1.57	207.83	6.29	1.94	203.8
4	01-Mar-16	16:03	17:03	238.85	6.53	1.60	210.67	6.28	1.97	206.5
5	01-Mar-16	18:00	19:00	235.29	6.50	1.61	216.17	6.53	2.10	211.6
6	01-Mar-16	19:01	20:01	238.55	6.43	1.59	218.17	6.24	2.04	213.7
7	01-Mar-16	20:02	21:02	238.85	6.50	1.49	223.33	6.07	1.93	219.0
8	01-Mar-16	21:03	22:03	242.34	6.50	1.36	223.83	6.14	1.76	219.9
9	01-Mar-16	22:04	23:04	242.54	6.49	1.51	227.67	6.10	1.94	223.2
10	01-02/03/2016	23:05	0:05	233.54	6.67	1.56	233.83	5.86	1.99	229.2
11	02-Mar-16	0:06	1:06	232.95	6.68	1.51	188.50	7.67	1.93	184.9
12	02-Mar-16	1:07	2:07	240.02	6.54	1.50	222.33	6.19	1.96	218.0
13	02-Mar-16	2:08	3:08	234.98	6.50	1.52	228.33	6.03	1.96	223.8
14	02-Mar-16	3:09	4:09	203.37	6.62	1.50	220.67	6.25	1.93	216.4
15	02-Mar-16	4:10	5:10	233.03	6.61	1.52	214.67	6.38	2.00	210.4
16	02-Mar-16	5:11	6:11	229.30	6.65	1.55	216.67	6.29	1.83	212.7
17	02-Mar-16	6:12	7:12	235.21	6.55	1.30	216.17	6.22	1.74	212.4
18	02-Mar-16	7:13	8:13	230.35	6.73	1.29	217.67	6.31	1.71	213.9
19	02-Mar-16	8:14	9:14	223.47	6.90	1.29	205.67	6.61	1.72	202.1
20	02-Mar-16	10:00	11:00	229.63	6.75	1.25	220.67	6.47	1.72	216.9
21	02-Mar-16	11:01	12:01	227.01	6.77	1.23	211.83	6.36	1.69	208.3
22	02-Mar-16	12:02	13:02	231.36	6.63	1.21	210.33	6.35	1.69	206.8
23	02-Mar-16	13:03	14:03	240.65	6.49	1.42	217.67	6.26	1.68	214.0
24	02-Mar-16	14:04	15:04	241.03	6.43	1.42	214.83	6.21	1.67	211.2
25	02-Mar-16	15:05	16:05	200.33	6.42	1.43	223.00	5.96	1.70	219.2
26	02-Mar-16	17:10	18:10	244.86	6.10	1.49	245.17	5.88	1.79	240.8
27	02-Mar-16	18:11	19:11	247.24	5.94	1.49	219.50	5.81	1.77	215.6
28	02-Mar-16	19:12	20:12	236.57	6.25	1.47	213.17	6.10	1.75	209.4
29	02-Mar-16	20:13	21:13	229.12	6.59	1.44	225.33	5.83	2.46	219.8
30	02-Mar-16	21:14	22:14	196.73	7.40	3.25	176.00	7.32	1.72	173.0
31	02-Mar-16	22:15	23:15	206.37	7.33	1.22	187.17	6.92	1.51	184.3
32	02-03/03/2016	23:16	0:16	206.86	7.25	1.24	187.83	6.98	1.52	185.0
33	03-Mar-16	0:17	1:17	209.00	7.23	1.25	190.00	6.94	1.52	187.1
34	03-Mar-16	1:18	2:18	212.25	7.25	1.25	201.00	6.49	1.50	198.0
35	03-Mar-16	2:19	3:19	181.37	7.33	1.24	192.50	6.88	1.51	189.6
36	03-Mar-16	3:20	4:20	197.25	7.35	1.23	190.50	6.88	1.51	187.6
37	03-Mar-16	4:21	5:21	209.26	7.05	1.28	203.33	6.45	1.57	200.1
38	03-Mar-16	5:22	6:22	235.89	6.33	1.36	215.83	6.01	1.62	212.3
39	03-Mar-16	6:23	7:23	236.29	6.37	1.34	215.83	6.08	1.68	212.2
40	03-Mar-16	7:24	8:24	223.32	6.66	1.39	210.50	5.99	1.60	207.1
41	03-Mar-16	9:30	10:30	209.45	7.06	1.29	196.50	6.93	1.33	193.9
42	03-Mar-16	10:31	11:31	231.85	6.55	1.23	174.67	7.72	1.68	171.7
43	03-Mar-16	11:32	12:32	226.55	6.70	1.45	229.33	5.90	1.70	225.4
44	03-Mar-16	12:33	13:33	205.02	7.21	1.24	185.50	6.93	1.61	182.5
45	03-Mar-16	13:34	14:34	206.71	6.92	1.38	203.83	6.41	1.65	200.5
46	03-Mar-16	14:35	15:35	182.20	6.51	1.43	195.33	6.30	1.68	192.0

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

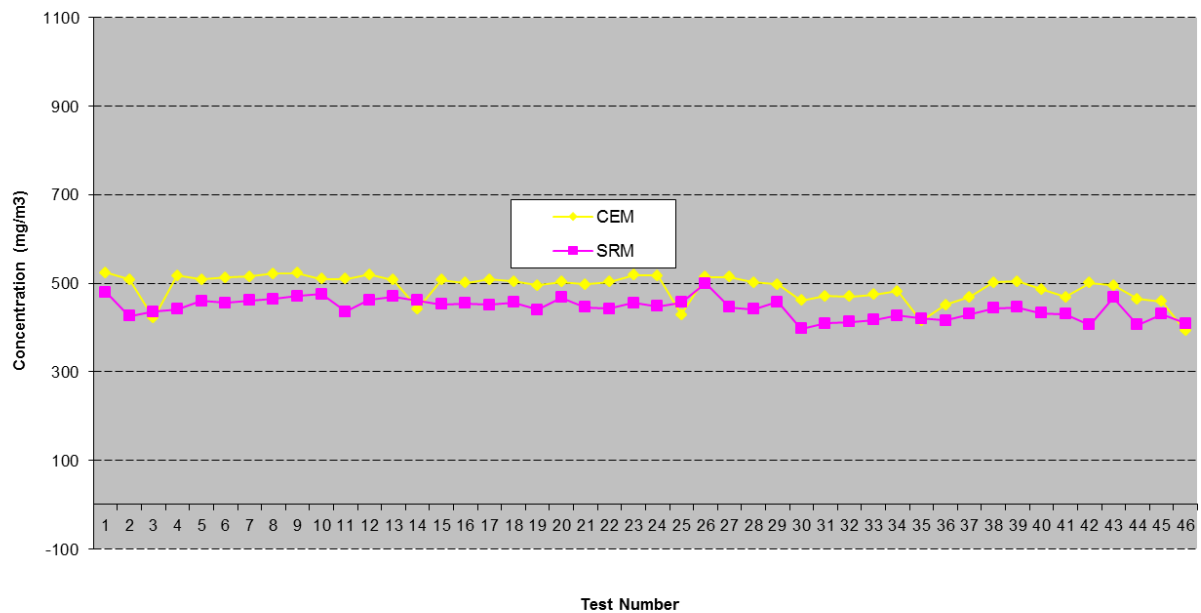
#### 4A3.2.1 Table 4.2.1 - Standardised monitoring Data – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(NOx as NO2 mg/m3)	(NOx as NO2 mg/m3)	(mg/m3)
1	01-Mar-16	13:00	14:00	523.8	479.7	16.0
2	01-Mar-16	14:01	15:01	508.6	425.5	14.0
3	01-Mar-16	15:02	16:02	421.0	435.3	15.0
4	01-Mar-16	16:03	17:03	516.7	441.0	15.0
5	01-Mar-16	18:00	19:00	508.1	460.2	15.0
6	01-Mar-16	19:01	20:01	512.6	455.4	15.0
7	01-Mar-16	20:02	21:02	515.2	460.7	15.0
8	01-Mar-16	21:03	22:03	521.9	464.1	16.0
9	01-Mar-16	22:04	23:04	522.9	470.5	16.0
10	01-02/03/2016	23:05	0:05	510.0	475.8	16.0
11	02-Mar-16	0:06	1:06	509.1	435.9	15.0
12	02-Mar-16	1:07	2:07	519.1	462.6	16.0
13	02-Mar-16	2:08	3:08	507.0	469.7	16.0
14	02-Mar-16	3:09	4:09	442.5	460.7	15.0
15	02-Mar-16	4:10	5:10	506.7	452.5	15.0
16	02-Mar-16	5:11	6:11	500.2	453.9	15.0
17	02-Mar-16	6:12	7:12	508.1	450.7	15.0
18	02-Mar-16	7:13	8:13	503.8	456.4	15.0
19	02-Mar-16	8:14	9:14	494.6	440.4	15.0
20	02-Mar-16	10:00	11:00	502.9	468.0	16.0
21	02-Mar-16	11:01	12:01	497.8	445.6	15.0
22	02-Mar-16	12:02	13:02	502.3	442.3	15.0
23	02-Mar-16	13:03	14:03	518.4	454.9	15.0
24	02-Mar-16	14:04	15:04	517.2	447.5	15.0
25	02-Mar-16	15:05	16:05	429.4	456.6	15.0
26	02-Mar-16	17:10	18:10	513.9	499.4	17.0
27	02-Mar-16	18:11	19:11	513.4	445.1	15.0
28	02-Mar-16	19:12	20:12	501.3	440.7	15.0
29	02-Mar-16	20:13	21:13	497.0	457.6	15.0
30	02-Mar-16	21:14	22:14	460.8	396.6	13.0
31	02-Mar-16	22:15	23:15	471.0	409.6	14.0
32	02-03/03/2016	23:16	0:16	469.6	413.0	14.0
33	03-Mar-16	0:17	1:17	473.9	416.5	14.0
34	03-Mar-16	1:18	2:18	481.9	426.9	14.0
35	03-Mar-16	2:19	3:19	414.2	420.0	14.0
36	03-Mar-16	3:20	4:20	450.9	415.9	14.0
37	03-Mar-16	4:21	5:21	468.3	430.6	15.0
38	03-Mar-16	5:22	6:22	502.1	443.4	15.0
39	03-Mar-16	6:23	7:23	504.3	445.6	15.0
40	03-Mar-16	7:24	8:24	486.8	431.9	15.0
41	03-Mar-16	9:30	10:30	469.1	430.3	15.0
42	03-Mar-16	10:31	11:31	500.6	405.6	14.0
43	03-Mar-16	11:32	12:32	495.5	467.8	16.0
44	03-Mar-16	12:33	13:33	464.1	406.4	14.0
45	03-Mar-16	13:34	14:34	458.8	430.3	15.0
46	03-Mar-16	14:35	15:35	392.9	409.2	14.0

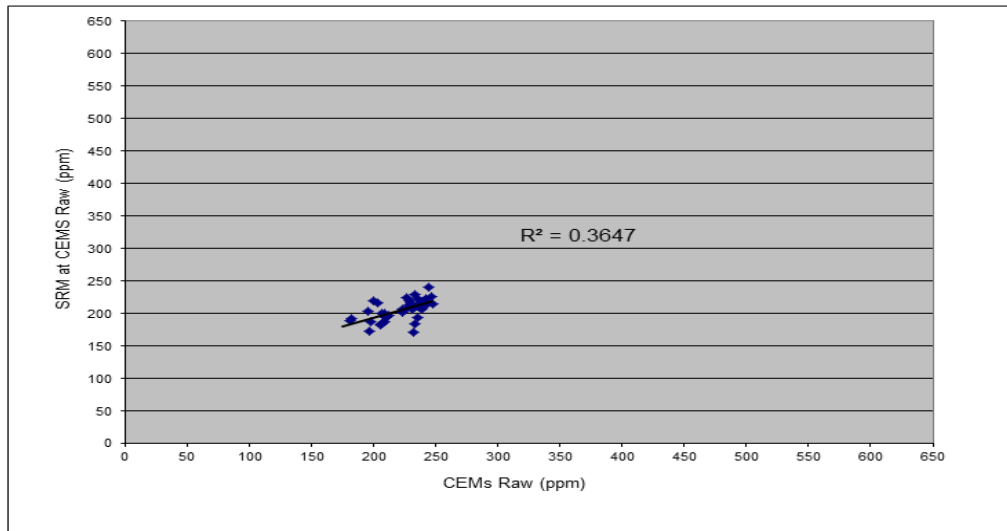
Note:  
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

**4A3.3.1 – 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)**



#### 4A3.4.1 – Elimination of Outliers – Oxides of Nitrogen,



Test No	Test Start Time	Test End Time	CEMS Raw Value	SRM Value at CEMS Raw conditions	Difference Di	Difference Di - Di	Is Result an Outlier - Di - Di > 2SD
	hr:min		(ppm)	(ppm)			
1	13:00	14:00	246.6	226.7	-19.90	-2.36	No
2	14:01	15:01	235.2	194.8	-40.41	-22.88	No
3	15:02	16:02	195.6	203.8	8.22	25.75	No
4	16:03	17:03	238.9	206.5	-32.33	-14.80	No
5	18:00	19:00	235.3	211.6	-23.65	-6.12	No
6	19:01	20:01	238.5	213.7	-24.84	-7.30	No
7	20:02	21:02	238.9	219.0	-19.82	-2.29	No
8	21:03	22:03	242.3	219.9	-22.45	-4.92	No
9	22:04	23:04	242.5	223.2	-19.29	-1.76	No
10	23:05	00:05	233.5	229.2	-4.36	13.17	No
11	00:06	01:06	233.0	184.9	-48.09	-30.56	Yes
12	01:07	02:07	240.0	218.0	-22.03	-4.50	No
13	02:08	03:08	235.0	223.8	-11.13	6.40	No
14	03:09	04:09	203.4	216.4	13.05	30.58	Yes
15	04:10	05:10	233.0	210.4	-22.65	-5.11	No
16	05:11	06:11	229.3	212.7	-16.61	0.92	No
17	06:12	07:12	235.2	212.4	-22.80	-5.27	No
18	07:13	08:13	230.3	213.9	-16.41	1.12	No
19	08:14	09:14	223.5	202.1	-21.33	-3.80	No
20	10:00	11:00	229.6	216.9	-12.75	4.78	No
21	11:01	12:01	227.0	208.3	-18.76	-1.22	No
22	12:02	13:02	231.4	206.8	-24.58	-7.05	No
23	13:03	14:03	240.7	214.0	-26.65	-9.12	No
24	14:04	15:04	241.0	211.2	-29.79	-12.25	No
25	15:05	16:05	200.3	219.2	18.88	36.41	Yes
26	17:10	18:10	244.9	240.8	-4.09	13.44	No
27	18:11	19:11	247.2	215.6	-31.62	-14.09	No
28	19:12	20:12	236.6	209.4	-27.13	-9.59	No
29	20:13	21:13	229.1	219.8	-9.34	8.19	No
30	21:14	22:14	196.7	173.0	-23.76	-6.23	No
31	22:15	23:15	206.4	184.3	-22.02	-4.49	No
32	23:16	00:16	206.9	185.0	-21.88	-4.34	No
33	00:17	01:17	209.0	187.1	-21.89	-4.36	No
34	01:18	02:18	212.3	198.0	-14.26	3.27	No
35	02:19	03:19	181.4	189.6	8.23	25.76	No
36	03:20	04:20	197.3	187.6	-9.62	7.91	No
37	04:21	05:21	209.3	200.1	-9.13	8.40	No
38	05:22	06:22	235.9	212.3	-23.55	-6.02	No
39	06:23	07:23	236.3	212.2	-24.07	-6.54	No
40	07:24	08:24	223.3	207.1	-16.20	1.34	No
41	09:30	10:30	209.5	193.9	-15.56	1.97	No
42	10:31	11:31	231.9	171.7	-60.12	-42.59	Yes
43	11:32	12:32	226.5	225.4	-1.11	16.42	No
44	12:33	13:33	205.0	182.5	-22.51	-4.98	No
45	13:34	14:34	206.7	200.5	-6.24	11.30	No
46	14:35	15:35	182.2	192.0	9.85	27.38	No
				Average Di	-17.53		
				Standard Deviation	14.80		
				Standard Deviation x2	29.60		

#### 4A3.5.1 Determination of Method A or Method B - 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	13:00	14:00	231.2	6.2	479.7
2	14:01	15:01	198.7	6.6	425.5
3	15:02	16:02	207.8	6.3	435.3
4	16:03	17:03	210.7	6.3	441.0
5	18:00	19:00	216.2	6.5	460.2
6	19:01	20:01	218.2	6.2	455.4
7	20:02	21:02	223.3	6.1	460.7
8	21:03	22:03	223.8	6.1	464.1
9	22:04	23:04	227.7	6.1	470.5
10	23:05	0:05	233.8	5.9	475.8
12	1:07	2:07	222.3	6.2	462.6
13	2:08	3:08	228.3	6.0	469.7
15	4:10	5:10	214.7	6.4	452.5
16	5:11	6:11	216.7	6.3	453.9
17	6:12	7:12	216.2	6.2	450.7
18	7:13	8:13	217.7	6.3	456.4
19	8:14	9:14	205.7	6.6	440.4
20	10:00	11:00	220.7	6.5	468.0
21	11:01	12:01	211.8	6.4	445.6
22	12:02	13:02	210.3	6.4	442.3
23	13:03	14:03	217.7	6.3	454.9
24	14:04	15:04	214.8	6.2	447.5
26	17:10	18:10	245.2	5.9	499.4
27	18:11	19:11	219.5	5.8	445.1
28	19:12	20:12	213.2	6.1	440.7
29	20:13	21:13	225.3	5.8	457.6
30	21:14	22:14	176.0	7.3	396.6
31	22:15	23:15	187.2	6.9	409.6
32	23:16	0:16	187.8	7.0	413.0
33	0:17	1:17	190.0	6.9	416.5
34	1:18	2:18	201.0	6.5	426.9
35	2:19	3:19	192.5	6.9	420.0
36	3:20	4:20	190.5	6.9	415.9
37	4:21	5:21	203.3	6.5	430.6
38	5:22	6:22	215.8	6.0	443.4
39	6:23	7:23	215.8	6.1	445.6
40	7:24	8:24	210.5	6.0	431.9
41	9:30	10:30	196.5	6.9	430.3
43	11:32	12:32	229.3	5.9	467.8
44	12:33	13:33	185.5	6.9	406.4
45	13:34	14:34	203.8	6.4	430.3
46	14:35	15:35	195.3	6.3	409.2
Sum			8872.33		
Emission Limit Value (ELV) =		1080	mg/Nm <sup>3</sup>	Y <sub>max</sub>	499.39
Maximum Permissible uncertainty =		20	%	Y <sub>min</sub>	396.61
Maximum Permissible uncertainty (a		216	mg/Nm <sup>3</sup>		
15% of the ELV =		162	mg/Nm <sup>3</sup>		
Is Ymax - Ymin > MPU at ELV?		No		Y <sub>max</sub> - Ymin	102.78
Is Ymin > 15% of ELV?		Yes			
Derivation of Calibration Function		Method B			

**4A3.6.1 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)	Yi	Xi	Xi * Yi	Xi <sup>2</sup>	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference	25/02/2016	0.0	1.7	-202.69	-218.01	44186.68	47526.83	
2	13:00	14:00	226.7	246.6	23.98	26.85	643.82	721.02	
3	14:01	15:01	194.8	235.2	-7.85	15.54	-121.97	241.45	
4	15:02	16:02	203.8	195.6	1.11	-24.13	-26.84	582.21	
5	16:03	17:03	206.5	238.9	3.84	19.14	73.44	366.49	
6	18:00	19:00	211.6	235.3	8.95	15.58	139.48	242.78	
7	19:01	20:01	213.7	238.5	11.03	18.84	207.73	354.97	
8	20:02	21:02	219.0	238.9	16.34	19.15	312.91	366.54	
9	21:03	22:03	219.9	242.3	17.20	22.63	389.33	512.27	
10	22:04	23:04	223.2	242.5	20.56	22.83	469.54	521.35	
11	23:05	0:05	229.2	233.5	26.49	13.84	366.58	191.43	
13	1:07	2:07	218.0	240.0	15.30	20.31	310.75	412.52	
14	2:08	3:08	223.8	235.0	21.16	15.27	323.19	233.21	
16	4:10	5:10	210.4	233.0	7.70	13.32	102.51	177.44	
17	5:11	6:11	212.7	229.3	10.01	9.60	96.04	92.12	
18	6:12	7:12	212.4	235.2	9.72	15.50	150.73	240.33	
19	7:13	8:13	213.9	230.3	11.25	10.64	119.75	113.23	
20	8:14	9:14	202.1	223.5	-0.55	3.76	-2.06	14.15	
21	10:00	11:00	216.9	229.6	14.19	9.92	140.74	98.38	
22	11:01	12:01	208.3	227.0	5.57	7.30	40.69	53.36	
23	12:02	13:02	206.8	231.4	4.09	11.65	47.68	135.78	
24	13:03	14:03	214.0	240.7	11.32	20.95	237.04	438.73	
25	14:04	15:04	211.2	241.0	8.56	21.32	182.50	454.66	
27	17:10	18:10	240.8	244.9	38.09	25.16	958.10	632.86	
28	18:11	19:11	215.6	247.2	12.94	27.53	356.21	758.11	
29	19:12	20:12	209.4	236.6	6.75	16.86	113.89	284.28	
30	20:13	21:13	219.8	229.1	17.09	9.42	160.98	88.68	
31	21:14	22:14	173.0	196.7	-29.72	-22.98	682.86	527.97	
32	22:15	23:15	184.3	206.4	-18.34	-13.34	244.56	177.90	
33	23:16	0:16	185.0	206.9	-17.71	-12.85	227.53	165.13	
34	0:17	1:17	187.1	209.0	-15.57	-10.70	166.69	114.58	
35	1:18	2:18	198.0	212.3	-4.69	-7.45	34.97	55.54	
36	2:19	3:19	189.6	181.4	-13.08	-38.33	501.58	1469.53	
37	3:20	4:20	187.6	197.3	-15.06	-22.46	338.17	504.28	
38	4:21	5:21	200.1	209.3	-2.55	-10.44	26.63	109.05	
39	5:22	6:22	212.3	235.9	9.65	16.18	156.15	261.83	
40	6:23	7:23	212.2	236.3	9.53	16.58	158.06	274.97	
41	7:24	8:24	207.1	223.3	4.44	3.62	16.06	13.08	
42	9:30	10:30	193.9	209.5	-8.80	-10.26	90.23	105.19	
44	11:32	12:32	225.4	226.5	22.75	6.84	155.61	46.77	
45	12:33	13:33	182.5	205.0	-20.18	-14.69	296.45	215.83	
46	13:34	14:34	200.5	206.7	-2.21	-13.00	28.72	168.89	
47	14:35	15:35	192.0	182.2	-10.64	-37.51	398.91	1406.72	
Sum			8715.46	9447.38	0.00	0.00	53502.59	61472.45	0.87

#### 4A3.7.1 Determination of Calibration Function - Oxides of Nitrogen

##### Method B

Formulae:- Number of tests conducted = N 43

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

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

$$x = (1/43) * 9447.3 \quad \text{or -} \quad x = 219.71$$

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

$$y = (1/43) * 8715. \quad \text{or -} \quad y = 202.69$$

The Slope is calculated by :

$$\beta = y/(x-Z) \quad 202.6 / (219.7 - 1.7) \quad \beta = 0.930$$

The offset is calculated by:

$$\alpha = -\beta.Z \quad -0.92 * 1.7 \quad \alpha = -1.58$$

The calibration is function  $y_{im} = \alpha + \beta_{xi,m}$  or  $y_i = -1.58 + 0.92 * X_i$

#### 4A3.8.1 Table 4.4.1 - Calculation of calibrated CEMS values - Oxides of Nitrogen

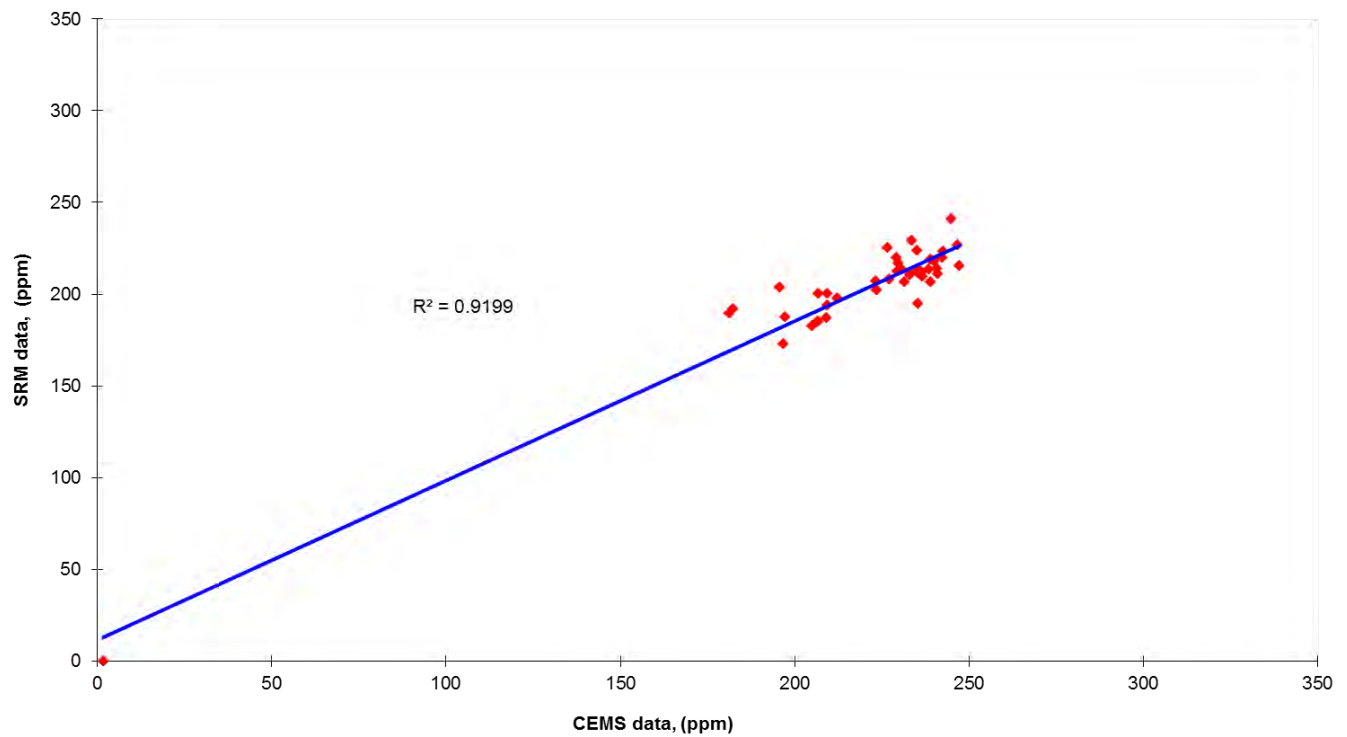
Test No	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
	hr:min		(ppm)	(ppm)	(%)	(%)	(mg/Nm <sup>3</sup> )	(mg/Nm <sup>3</sup> )	(mg/m3)
1	Reference	25/02/2016	1.7	0.0	0.0		1.7	0.0	0.0
2	13:00	14:00	246.6	227.6	6.3	1.6	523.8	483.6	479.7
3	14:01	15:01	235.2	217.1	6.5	1.6	508.6	469.5	425.5
4	15:02	16:02	195.6	180.3	6.5	1.6	421.0	388.0	435.3
5	16:03	17:03	238.9	220.5	6.5	1.6	516.7	477.0	441.0
6	18:00	19:00	235.3	217.2	6.5	1.6	508.1	469.0	460.2
7	19:01	20:01	238.5	220.2	6.4	1.6	512.6	473.2	455.4
8	20:02	21:02	238.9	220.5	6.5	1.5	515.2	475.6	460.7
9	21:03	22:03	242.3	223.7	6.5	1.4	521.9	481.9	464.1
10	22:04	23:04	242.5	223.9	6.5	1.5	522.9	482.7	470.5
11	23:05	00:05	233.5	215.5	6.7	1.6	510.0	470.7	475.8
13	01:07	02:07	240.0	221.6	6.5	1.5	519.1	479.2	462.6
14	02:08	03:08	235.0	216.9	6.5	1.5	507.0	467.8	469.7
16	04:10	05:10	233.0	215.1	6.6	1.5	506.7	467.7	452.5
17	05:11	06:11	229.3	211.6	6.7	1.5	500.2	461.3	453.9
18	06:12	07:12	235.2	217.1	6.5	1.5	508.1	470.0	450.7
19	07:13	08:13	230.3	212.6	6.7	1.5	503.8	466.1	456.4
20	08:14	09:14	223.5	206.2	6.9	1.3	494.6	456.5	440.4
21	10:00	11:00	229.6	211.9	6.8	1.3	502.9	464.3	468.0
22	11:01	12:01	227.0	209.5	6.8	1.3	497.8	459.6	445.6
23	12:02	13:02	231.4	213.5	6.6	1.3	502.3	463.8	442.3
24	13:03	14:03	240.7	222.2	6.5	1.2	518.4	477.6	454.9
25	14:04	15:04	241.0	222.5	6.4	1.2	517.2	476.4	447.5
27	17:10	18:10	244.9	226.1	5.9	1.4	513.9	469.1	499.4
28	18:11	19:11	247.2	228.3	6.2	1.4	513.4	483.5	445.1
29	19:12	20:12	236.6	218.4	6.6	1.4	501.3	473.6	440.7
30	20:13	21:13	229.1	211.4	7.4	1.5	497.0	486.4	457.6
31	21:14	22:14	196.7	181.3	7.3	1.5	460.8	415.0	396.6
32	22:15	23:15	206.4	190.3	7.3	1.5	471.0	433.0	409.6
33	23:16	00:16	206.9	190.7	7.2	1.4	469.6	433.3	413.0
34	00:17	01:17	209.0	192.7	7.3	3.3	473.9	446.7	416.5
35	01:18	02:18	212.3	195.8	7.3	1.2	481.9	447.0	426.9
36	02:19	03:19	181.4	167.0	7.3	1.2	414.2	381.9	420.0
37	03:20	04:20	197.3	181.8	7.1	1.2	450.9	406.8	415.9
38	04:21	05:21	209.3	193.0	6.3	1.2	468.3	410.3	430.6
39	05:22	06:22	235.9	217.7	6.4	1.2	502.1	464.2	443.4
40	06:23	07:23	236.3	218.1	6.7	1.2	504.3	474.6	445.6
41	07:24	08:24	223.3	206.0	7.1	1.3	486.8	461.5	431.9
42	09:30	10:30	209.5	193.1	6.6	1.4	469.1	417.5	430.3
44	11:32	12:32	226.5	209.0	6.7	1.3	495.5	456.7	467.8
45	12:33	13:33	205.0	189.0	7.2	1.4	464.1	428.5	406.4
46	13:34	14:34	206.7	190.6	6.9	1.3	458.8	422.6	430.3
47	14:35	15:35	182.2	167.8	6.5	1.2	392.9	361.2	409.2
Sum							20630.36		
Emission Limit Value (ELV) =			1080	mg/Nm <sup>3</sup>					

Reference Oxygen

6

%

**4A3.9.1 Plot 2.1 CEM versus SRM Parallel Test Data at CEM measurement conditions –NOx  
ppm, wet gas.**



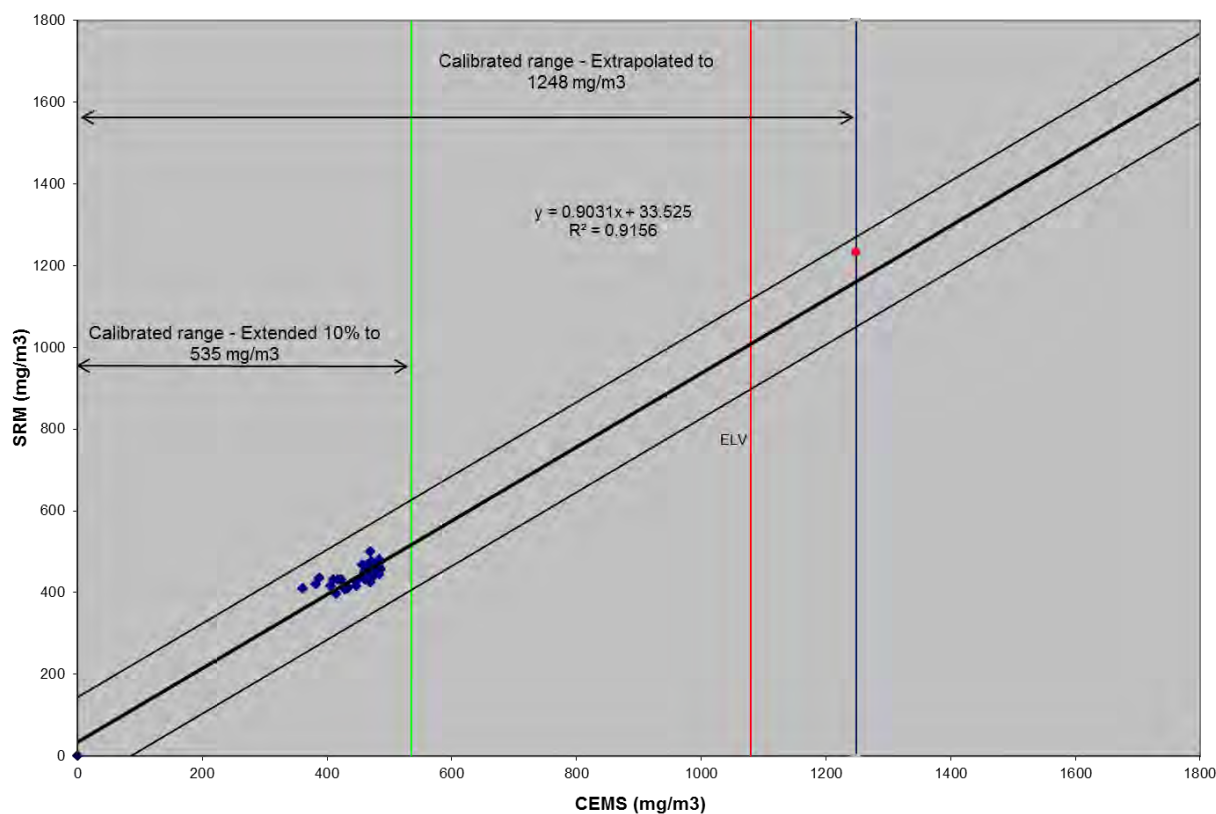
**4A3.10.1 Table 4.5.1 – Data used for the Variability Test – Oxides of Nitrogen**

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	13:00	14:00	483.6	479.7	-3.97	5.68	32.28
3	14:01	15:01	469.5	425.5	-43.98	-34.33	1178.63
4	15:02	16:02	388.0	435.3	47.25	56.90	3237.14
5	16:03	17:03	477.0	441.0	-36.02	-26.38	695.74
6	18:00	19:00	469.0	460.2	-8.72	0.93	0.86
7	19:01	20:01	473.2	455.4	-17.74	-8.10	65.55
8	20:02	21:02	475.6	460.7	-14.91	-5.27	27.73
9	21:03	22:03	481.9	464.1	-17.74	-8.09	65.44
10	22:04	23:04	482.7	470.5	-12.19	-2.54	6.46
11	23:05	00:05	470.7	475.8	5.14	14.79	218.73
13	01:07	02:07	479.2	462.6	-16.66	-7.02	49.25
14	02:08	03:08	467.8	469.7	1.86	11.51	132.43
16	04:10	05:10	467.7	452.5	-15.15	-5.51	30.33
17	05:11	06:11	461.3	453.9	-7.44	2.21	4.87
18	06:12	07:12	470.0	450.7	-19.38	-9.73	94.66
19	07:13	08:13	466.1	456.4	-9.70	-0.05	0.00
20	08:14	09:14	456.5	440.4	-16.03	-6.38	40.74
21	10:00	11:00	464.3	468.0	3.72	13.37	178.73
22	11:01	12:01	459.6	445.6	-13.97	-4.33	18.71
23	12:02	13:02	463.8	442.3	-21.45	-11.80	139.31
24	13:03	14:03	477.6	454.9	-22.71	-13.07	170.73
25	14:04	15:04	476.4	447.5	-28.91	-19.27	371.25
27	17:10	18:10	469.1	499.4	30.26	39.91	1592.50
28	18:11	19:11	483.5	445.1	-38.43	-28.78	828.39
29	19:12	20:12	473.6	440.7	-32.84	-23.20	538.01
30	20:13	21:13	486.4	457.6	-28.76	-19.11	365.35
31	21:14	22:14	415.0	396.6	-18.37	-8.72	76.09
32	22:15	23:15	433.0	409.6	-23.44	-13.79	190.28
33	23:16	00:16	433.3	413.0	-20.26	-10.61	112.58
34	00:17	01:17	446.7	416.5	-30.18	-20.53	421.60
35	01:18	02:18	447.0	426.9	-20.13	-10.48	109.80
36	02:19	03:19	381.9	420.0	38.12	47.76	2281.39
37	03:20	04:20	406.8	415.9	9.11	18.76	351.75
38	04:21	05:21	410.3	430.6	20.36	30.01	900.33
39	05:22	06:22	464.2	443.4	-20.87	-11.22	125.87
40	06:23	07:23	474.6	445.6	-29.00	-19.36	374.67
41	07:24	08:24	461.5	431.9	-29.57	-19.92	397.00
42	09:30	10:30	417.5	430.3	12.75	22.40	501.59
44	11:32	12:32	456.7	467.8	11.11	20.76	430.81
45	12:33	13:33	428.5	406.4	-22.09	-12.44	154.81
46	13:34	14:34	422.6	430.3	7.73	17.37	301.88
47	14:35	15:35	361.2	409.2	48.04	57.69	3327.83
42 Tests		Mean			-9.65		
Sum							20142.09

#### 4A3.11.1 - Variability Test Calculation – Oxides of Nitrogen

SD=	$\text{Root}(1-\text{Number}).\text{Integral}(D1-D)^2$	22.16	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O <sub>0</sub> is therefore calculated as:-			
O <sub>0</sub> =	$0.2 \times 1080 \text{ mg/m3 (s,d,6\%O2)} / 1.96$	110.20	mg/m3(s,d),6%O2
For 42 tests, kv =	0.9885		
Therefore variability=		$22.16 \leq 110.2 \times 0.9885$	
or	22.16	$\leq$	108.94
Which is TRUE therefore the CEMS passes the test			

#### 4A3.12.1 Plot 3.1 –Standardised CEM data versus standardised SRM - Oxides of Nitrogen (as NO<sub>2</sub>) – Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen



#### 4A3.1.2 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 (wet)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMs Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	01-Mar-16	13:00	14:00	81.69	6.27	1.57	79.94	6.15	1.95	79.9
2	01-Mar-16	14:01	15:01	78.65	6.52	1.57	77.83	6.61	1.93	77.8
3	01-Mar-16	15:02	16:02	68.80	6.46	1.57	79.59	6.29	1.94	79.6
4	01-Mar-16	16:03	17:03	81.76	6.53	1.60	79.25	6.28	1.97	79.2
5	01-Mar-16	18:00	19:00	79.73	6.50	1.61	75.92	6.53	2.10	75.9
6	01-Mar-16	19:01	20:01	74.78	6.43	1.59	71.82	6.24	2.04	71.8
7	01-Mar-16	20:02	21:02	70.12	6.50	1.49	68.37	6.07	1.93	68.4
8	01-Mar-16	21:03	22:03	68.58	6.50	1.36	65.83	6.14	1.76	65.8
9	01-Mar-16	22:04	23:04	68.49	6.49	1.51	65.23	6.10	1.94	65.2
10	01-02/03/2016	23:05	0:05	66.78	6.67	1.56	64.75	5.86	1.99	64.8
11	02-Mar-16	0:06	1:06	68.05	6.68	1.51	66.17	7.67	1.93	66.2
12	02-Mar-16	1:07	2:07	69.45	6.54	1.50	67.95	6.19	1.96	68.0
13	02-Mar-16	2:08	3:08	70.27	6.50	1.52	69.37	6.03	1.96	69.4
14	02-Mar-16	3:09	4:09	65.48	6.62	1.50	71.74	6.25	1.93	71.7
15	02-Mar-16	4:10	5:10	77.10	6.61	1.52	75.48	6.38	2.00	75.5
16	02-Mar-16	5:11	6:11	78.29	6.65	1.55	76.50	6.29	1.83	76.5
17	02-Mar-16	6:12	7:12	80.28	6.55	1.30	77.92	6.22	1.74	77.9
18	02-Mar-16	7:13	8:13	77.49	6.73	1.29	74.96	6.31	1.71	75.0
19	02-Mar-16	8:14	9:14	75.42	6.90	1.29	73.13	6.61	1.72	73.1
20	02-Mar-16	10:00	11:00	79.49	6.75	1.25	78.50	6.47	1.72	78.5
21	02-Mar-16	11:01	12:01	80.12	6.77	1.23	79.77	6.36	1.69	79.8
22	02-Mar-16	12:02	13:02	81.98	6.63	1.21	81.13	6.35	1.69	81.1
23	02-Mar-16	13:03	14:03	84.41	6.49	1.42	82.15	6.26	1.68	82.1
24	02-Mar-16	14:04	15:04	83.29	6.43	1.42	81.96	6.21	1.67	82.0
25	02-Mar-16	15:05	16:05	70.08	6.42	1.43	80.03	5.96	1.70	80.0
26	02-Mar-16	17:10	18:10	87.02	6.10	1.49	82.55	5.88	1.79	82.6
27	02-Mar-16	18:11	19:11	87.29	5.94	1.49	82.60	5.81	1.77	82.6
28	02-Mar-16	19:12	20:12	81.47	6.25	1.47	77.13	6.10	1.75	77.1
29	02-Mar-16	20:13	21:13	81.33	6.59	1.44	219.81	5.83	2.46	219.8
30	02-Mar-16	21:14	22:14	73.36	7.40	3.25	82.73	7.32	1.72	82.7
31	02-Mar-16	22:15	23:15	50.96	7.33	1.22	49.33	6.92	1.51	49.3
32	02-03/03/2016	23:16	0:16	50.09	7.25	1.24	48.33	6.98	1.52	48.3
33	03-Mar-16	0:17	1:17	48.64	7.23	1.25	48.03	6.94	1.52	48.0
34	03-Mar-16	1:18	2:18	49.19	7.25	1.25	48.66	6.49	1.50	48.7
35	03-Mar-16	2:19	3:19	42.71	7.33	1.24	49.31	6.88	1.51	49.3
36	03-Mar-16	3:20	4:20	50.98	7.35	1.23	50.35	6.88	1.51	50.4
37	03-Mar-16	4:21	5:21	55.49	7.05	1.28	53.98	6.45	1.57	54.0
38	03-Mar-16	5:22	6:22	59.89	6.33	1.36	58.49	6.01	1.62	58.5
39	03-Mar-16	6:23	7:23	59.51	6.37	1.34	58.93	6.08	1.68	58.9
40	03-Mar-16	7:24	8:24	59.74	6.66	1.39	57.19	5.99	1.60	57.2
41	03-Mar-16	9:30	10:30	60.55	7.06	1.29	50.79	6.93	1.33	50.8
42	03-Mar-16	10:31	11:31	64.33	6.55	1.23	62.53	7.72	1.68	62.5
43	03-Mar-16	11:32	12:32	64.81	6.70	1.45	61.50	5.90	1.70	61.5
44	03-Mar-16	12:33	13:33	69.97	7.21	1.24	65.90	6.93	1.61	65.9
45	03-Mar-16	13:34	14:34	78.00	6.92	1.38	72.82	6.41	1.65	72.8
46	03-Mar-16	14:35	15:35	67.87	6.51	1.43	76.17	6.30	1.68	76.2

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

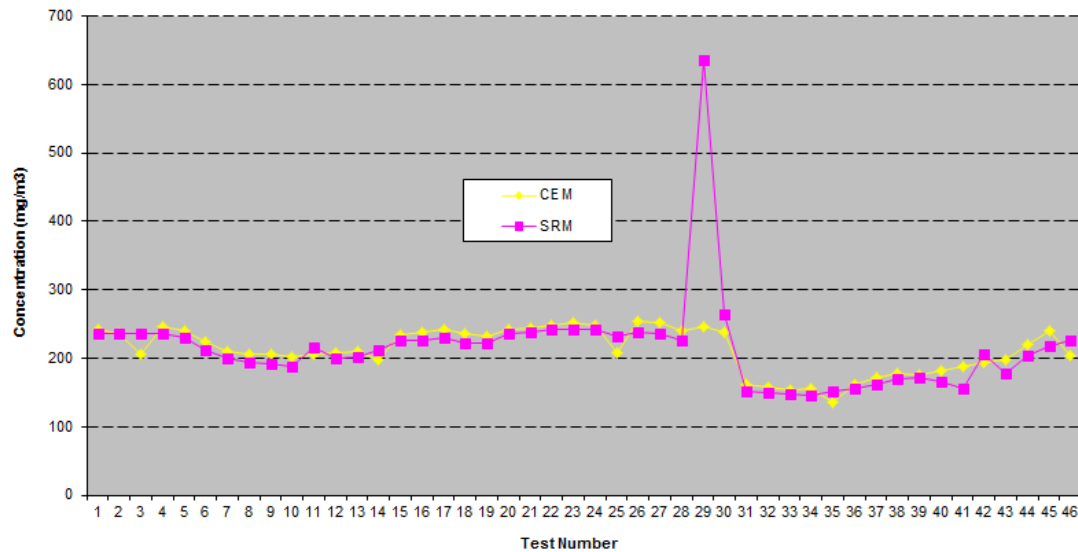
#### 4A3.2.2 Table 4.2.2 -Standardised monitoring Data – Sulphur Dioxide, Low Range

Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(SO <sub>2</sub> mg/m <sup>3</sup> )	(SO <sub>2</sub> mg/m <sup>3</sup> )	(mg/m <sup>3</sup> )
1	01-Mar-16	13:00	14:00	241.5	235.4	12.0
2	01-Mar-16	14:01	15:01	236.6	236.5	12.0
3	01-Mar-16	15:02	16:02	206.0	236.5	12.0
4	01-Mar-16	16:03	17:03	246.1	235.4	12.0
5	01-Mar-16	18:00	19:00	239.5	229.7	12.0
6	01-Mar-16	19:01	20:01	223.6	212.9	11.0
7	01-Mar-16	20:02	21:02	210.4	200.1	10.0
8	01-Mar-16	21:03	22:03	205.5	193.3	10.0
9	01-Mar-16	22:04	23:04	205.4	191.3	9.9
10	01-02/03/2016	23:05	0:05	202.9	187.1	9.7
11	02-Mar-16	0:06	1:06	206.9	217.1	11.0
12	02-Mar-16	1:07	2:07	209.0	200.6	10.0
13	02-Mar-16	2:08	3:08	210.9	202.5	11.0
14	02-Mar-16	3:09	4:09	198.2	212.5	11.0
15	02-Mar-16	4:10	5:10	233.3	225.9	12.0
16	02-Mar-16	5:11	6:11	237.6	227.1	12.0
17	02-Mar-16	6:12	7:12	241.3	230.0	12.0
18	02-Mar-16	7:13	8:13	235.8	222.5	12.0
19	02-Mar-16	8:14	9:14	232.3	221.7	12.0
20	02-Mar-16	10:00	11:00	242.2	235.7	12.0
21	02-Mar-16	11:01	12:01	244.4	237.5	12.0
22	02-Mar-16	12:02	13:02	247.6	241.5	13.0
23	02-Mar-16	13:03	14:03	253.0	243.0	13.0
24	02-Mar-16	14:04	15:04	248.6	241.6	13.0
25	02-Mar-16	15:05	16:05	209.0	231.9	12.0
26	02-Mar-16	17:10	18:10	254.1	238.2	12.0
27	02-Mar-16	18:11	19:11	252.2	237.2	12.0
28	02-Mar-16	19:12	20:12	240.2	225.8	12.0
29	02-Mar-16	20:13	21:13	245.4	636.8	33.0
30	02-Mar-16	21:14	22:14	239.1	263.9	14.0
31	02-Mar-16	22:15	23:15	161.8	152.5	7.9
32	02-03/03/2016	23:16	0:16	158.2	150.1	7.8
33	03-Mar-16	0:17	1:17	153.4	148.7	7.7
34	03-Mar-16	1:18	2:18	155.4	146.0	7.6
35	03-Mar-16	2:19	3:19	135.7	151.9	7.9
36	03-Mar-16	3:20	4:20	162.1	155.3	8.0
37	03-Mar-16	4:21	5:21	172.8	161.6	8.4
38	03-Mar-16	5:22	6:22	177.3	169.9	8.8
39	03-Mar-16	6:23	7:23	176.7	172.2	8.9
40	03-Mar-16	7:24	8:24	181.2	165.9	8.6
41	03-Mar-16	9:30	10:30	188.7	156.8	8.2
42	03-Mar-16	10:31	11:31	193.2	205.5	11.0
43	03-Mar-16	11:32	12:32	197.2	177.6	9.2
44	03-Mar-16	12:33	13:33	220.4	204.2	11.0
45	03-Mar-16	13:34	14:34	240.9	217.5	11.0
46	03-Mar-16	14:35	15:35	203.6	225.8	12.0

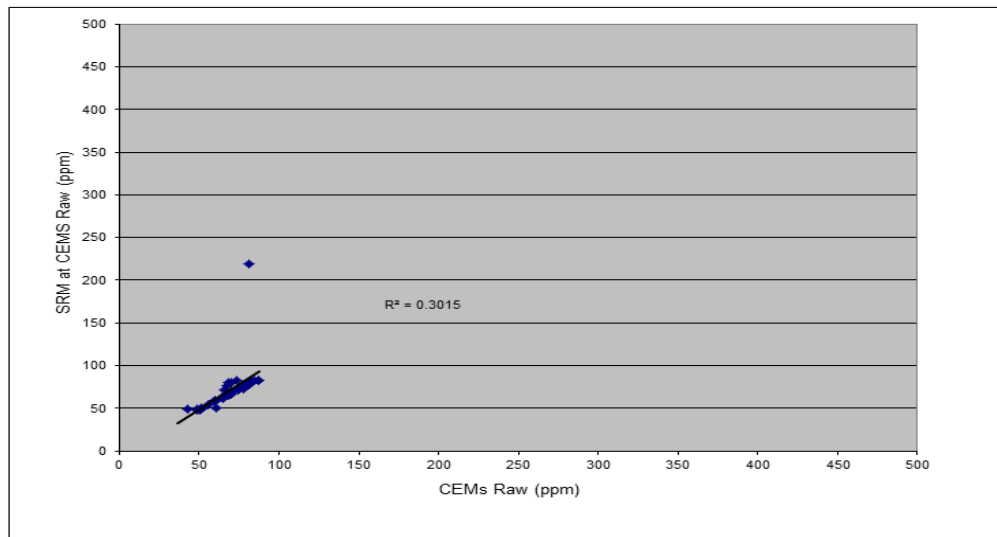
Note:  
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

**4A3.3.2 – 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.



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	13:00	14:00	81.7	79.9	-1.75	-3.90	No
2	14:01	15:01	78.7	77.8	-0.82	-2.96	No
3	15:02	16:02	68.8	79.6	10.79	8.65	No
4	16:03	17:03	81.8	79.2	-2.52	-4.66	No
5	18:00	19:00	79.7	75.9	-3.81	-5.95	No
6	19:01	20:01	74.8	71.8	-2.97	-5.11	No
7	20:02	21:02	70.1	68.4	-1.75	-3.89	No
8	21:03	22:03	68.6	65.8	-2.76	-4.90	No
9	22:04	23:04	68.5	65.2	-3.26	-5.40	No
10	23:05	00:05	66.8	64.8	-2.02	-4.17	No
11	00:06	01:06	68.0	66.2	-1.87	-4.02	No
12	01:07	02:07	69.4	68.0	-1.49	-3.64	No
13	02:08	03:08	70.3	69.4	-0.90	-3.04	No
14	03:09	04:09	65.5	71.7	6.26	4.12	No
15	04:10	05:10	77.1	75.5	-1.62	-3.76	No
16	05:11	06:11	78.3	76.5	-1.79	-3.93	No
17	06:12	07:12	80.3	77.9	-2.35	-4.50	No
18	07:13	08:13	77.5	75.0	-2.53	-4.67	No
19	08:14	09:14	75.4	73.1	-2.29	-4.43	No
20	10:00	11:00	79.5	78.5	-0.99	-3.13	No
21	11:01	12:01	80.1	79.8	-0.35	-2.49	No
22	12:02	13:02	82.0	81.1	-0.85	-2.99	No
23	13:03	14:03	84.4	82.1	-2.26	-4.40	No
24	14:04	15:04	83.3	82.0	-1.33	-3.48	No
25	15:05	16:05	70.1	80.0	9.95	7.80	No
26	17:10	18:10	87.0	82.6	-4.47	-6.62	No
27	18:11	19:11	87.3	82.6	-4.70	-6.84	No
28	19:12	20:12	81.5	77.1	-4.33	-6.48	No
29	20:13	21:13	81.3	219.8	138.48	136.34	Yes
30	21:14	22:14	73.4	82.7	9.37	7.23	No
31	22:15	23:15	51.0	49.3	-1.64	-3.78	No
32	23:16	00:16	50.1	48.3	-1.76	-3.91	No
33	00:17	01:17	48.6	48.0	-0.61	-2.76	No
34	01:18	02:18	49.2	48.7	-0.53	-2.68	No
35	02:19	03:19	42.7	49.3	6.60	4.45	No
36	03:20	04:20	51.0	50.4	-0.62	-2.77	No
37	04:21	05:21	55.5	54.0	-1.51	-3.66	No
38	05:22	06:22	59.9	58.5	-1.41	-3.55	No
39	06:23	07:23	59.5	58.9	-0.58	-2.72	No
40	07:24	08:24	59.7	57.2	-2.55	-4.70	No
41	09:30	10:30	60.5	50.8	-9.76	-11.90	No
42	10:31	11:31	64.3	62.5	-1.80	-3.95	No
43	11:32	12:32	64.8	61.5	-3.31	-5.45	No
44	12:33	13:33	70.0	65.9	-4.07	-6.22	No
45	13:34	14:34	78.0	72.8	-5.18	-7.33	No
46	14:35	15:35	67.9	76.2	8.30	6.16	No
				Average Di	2.14		
				Standard Deviation	20.95		
				Standard Deviation x2	41.90		

#### 4A3.5.2 Determination of Method A or Method B - 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	13:00	14:00	79.9	6.2	235.4
2	14:01	15:01	77.8	6.6	236.5
3	15:02	16:02	79.6	6.3	236.5
4	16:03	17:03	79.2	6.3	235.4
5	18:00	19:00	75.9	6.5	229.7
6	19:01	20:01	71.8	6.2	212.9
7	20:02	21:02	68.4	6.1	200.1
8	21:03	22:03	65.8	6.1	193.3
9	22:04	23:04	65.2	6.1	191.3
10	23:05	0:05	64.8	5.9	187.1
11	0:06	1:06	66.2	7.7	217.1
12	1:07	2:07	68.0	6.2	200.6
13	2:08	3:08	69.4	6.0	202.5
14	3:09	4:09	71.7	6.2	212.5
15	4:10	5:10	75.5	6.4	225.9
16	5:11	6:11	76.5	6.3	227.1
17	6:12	7:12	77.9	6.2	230.0
18	7:13	8:13	75.0	6.3	222.5
19	8:14	9:14	73.1	6.6	221.7
20	10:00	11:00	78.5	6.5	235.7
21	11:01	12:01	79.8	6.4	237.5
22	12:02	13:02	81.1	6.4	241.5
23	13:03	14:03	82.1	6.3	243.0
24	14:04	15:04	82.0	6.2	241.6
25	15:05	16:05	80.0	6.0	231.9
26	17:10	18:10	82.6	5.9	238.2
27	18:11	19:11	82.6	5.8	237.2
28	19:12	20:12	77.1	6.1	225.8
30	21:14	22:14	82.7	7.3	263.9
31	22:15	23:15	49.3	6.9	152.5
32	23:16	0:16	48.3	7.0	150.1
33	0:17	1:17	48.0	6.9	148.7
34	1:18	2:18	48.7	6.5	146.0
35	2:19	3:19	49.3	6.9	151.9
36	3:20	4:20	50.4	6.9	155.3
37	4:21	5:21	54.0	6.5	161.6
38	5:22	6:22	58.5	6.0	169.9
39	6:23	7:23	58.9	6.1	172.2
40	7:24	8:24	57.2	6.0	165.9
41	9:30	10:30	50.8	6.9	156.8
42	10:31	11:31	62.5	7.7	205.5
43	11:32	12:32	61.5	5.9	177.6
44	12:33	13:33	65.9	6.9	204.2
45	13:34	14:34	72.8	6.4	217.5
46	14:35	15:35	76.2	6.3	225.8
Sum			3102.60		
Emission Limit Value (ELV) =		440	mg/Nm <sup>3</sup>	Y <sub>max</sub>	263.93
Maximum Permissible uncertainty =		20	%	Y <sub>min</sub>	145.95
Maximum Permissible uncertainty (at 15% of the ELV) =		88	mg/Nm <sup>3</sup>		
		66	mg/Nm <sup>3</sup>		
Is Y <sub>max</sub> - Y <sub>min</sub> > MPU at ELV?		Yes		Y <sub>max</sub> - Y <sub>min</sub>	117.98
Is Y <sub>min</sub> > 15% of ELV?		Yes			
Derivation of Calibration Function		Method A			

**4A3.6.2 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 <sup>2</sup>	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference		0.0	0.0	-67.45	-68.31	4607.62	4666.77	
2	13:00	14:00	79.9	81.7	12.49	13.38	167.11	178.94	
3	14:01	15:01	77.8	78.7	10.38	10.34	107.32	106.84	
4	15:02	16:02	79.6	68.8	12.14	0.48	5.85	0.23	
5	16:03	17:03	79.2	81.8	11.80	13.45	158.70	180.88	
6	18:00	19:00	75.9	79.7	8.47	11.41	96.70	130.26	
7	19:01	20:01	71.8	74.8	4.37	6.47	28.27	41.86	
8	20:02	21:02	68.4	70.1	0.92	1.80	1.66	3.25	
9	21:03	22:03	65.8	68.6	-1.62	0.27	-0.44	0.07	
10	22:04	23:04	65.2	68.5	-2.22	0.17	-0.38	0.03	
11	23:05	0:05	64.8	66.8	-2.69	-1.54	4.14	2.36	
12	0:06	1:06	66.2	68.0	-1.27	-0.27	0.34	0.07	
13	1:07	2:07	68.0	69.4	0.50	1.13	0.57	1.28	
14	2:08	3:08	69.4	70.3	1.93	1.96	3.77	3.84	
15	3:09	4:09	71.7	65.5	4.29	-2.84	-12.18	8.04	
16	4:10	5:10	75.5	77.1	8.04	8.79	70.61	77.22	
17	5:11	6:11	76.5	78.3	9.06	9.98	90.36	99.58	
18	6:12	7:12	77.9	80.3	10.48	11.96	125.31	143.11	
19	7:13	8:13	75.0	77.5	7.51	9.17	68.87	84.12	
20	8:14	9:14	73.1	75.4	5.68	7.10	40.36	50.46	
21	10:00	11:00	78.5	79.5	11.06	11.18	123.57	124.93	
22	11:01	12:01	79.8	80.1	12.32	11.81	145.53	139.44	
23	12:02	13:02	81.1	82.0	13.68	13.67	187.03	186.80	
24	13:03	14:03	82.1	84.4	14.70	16.09	236.57	258.99	
25	14:04	15:04	82.0	83.3	14.51	14.97	217.22	224.19	
26	15:05	16:05	80.0	70.1	12.58	1.77	22.25	3.13	
27	17:10	18:10	82.6	87.0	15.10	18.71	282.54	349.99	
28	18:11	19:11	82.6	87.3	15.15	18.98	287.44	360.12	
29	19:12	20:12	77.1	81.5	9.68	13.15	127.38	173.00	
31	21:14	22:14	82.7	73.4	15.28	5.04	77.09	25.45	
32	22:15	23:15	49.3	51.0	-18.12	-17.35	314.48	301.13	
33	23:16	0:16	48.3	50.1	-19.12	-18.22	348.47	332.14	
34	0:17	1:17	48.0	48.6	-19.42	-19.67	382.00	386.95	
35	1:18	2:18	48.7	49.2	-18.79	-19.12	359.31	365.67	
36	2:19	3:19	49.3	42.7	-18.14	-25.60	464.53	655.58	
37	3:20	4:20	50.4	51.0	-17.09	-17.34	296.33	300.53	
38	4:21	5:21	54.0	55.5	-13.47	-12.83	172.79	164.50	
39	5:22	6:22	58.5	59.9	-8.96	-8.42	75.49	70.94	
40	6:23	7:23	58.9	59.5	-8.51	-8.80	74.92	77.44	
41	7:24	8:24	57.2	59.7	-10.26	-8.58	88.00	73.55	
42	9:30	10:30	50.8	60.5	-16.66	-7.77	129.41	60.35	
43	10:31	11:31	62.5	64.3	-4.92	-3.98	19.58	15.85	
44	11:32	12:32	61.5	64.8	-5.95	-3.51	20.86	12.31	
45	12:33	13:33	65.9	70.0	-1.55	1.66	-2.57	2.75	
46	13:34	14:34	72.8	78.0	5.37	9.69	52.05	93.88	
47	14:35	15:35	76.2	67.9	8.73	-0.44	-3.84	0.19	
Sum			3102.60	3142.43	0.00	0.00	10063.04	10539.01	0.95

#### 4A3.7.2 Determination of Calibration Function - Sulphur Dioxide, Low Range.

##### Method A

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

$N$	$N$	$N$	$N$		
$b = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2}$	$\bar{x} = \frac{1}{N} \sum x_i$	$\bar{y} = \frac{1}{N} \sum y_i$		$\bar{x} =$	68.31
$i=1$	$i=1$	$i=1$	$i=1$	$\bar{y} =$	67.45
				$b =$	0.955
$a = \bar{y} - b\bar{x}$	$a = 67.45 - 68.32 * 0.954$			$a =$	2.219

The calibration is function  $y_i = a + b x_i$  or  $y_i = 2.219 + 0.955 * x_i$

#### 4A3.8.2 Table A.4.4.2 - Calculation of calibrated CEMS values - Sulphur Dioxide, Low Range

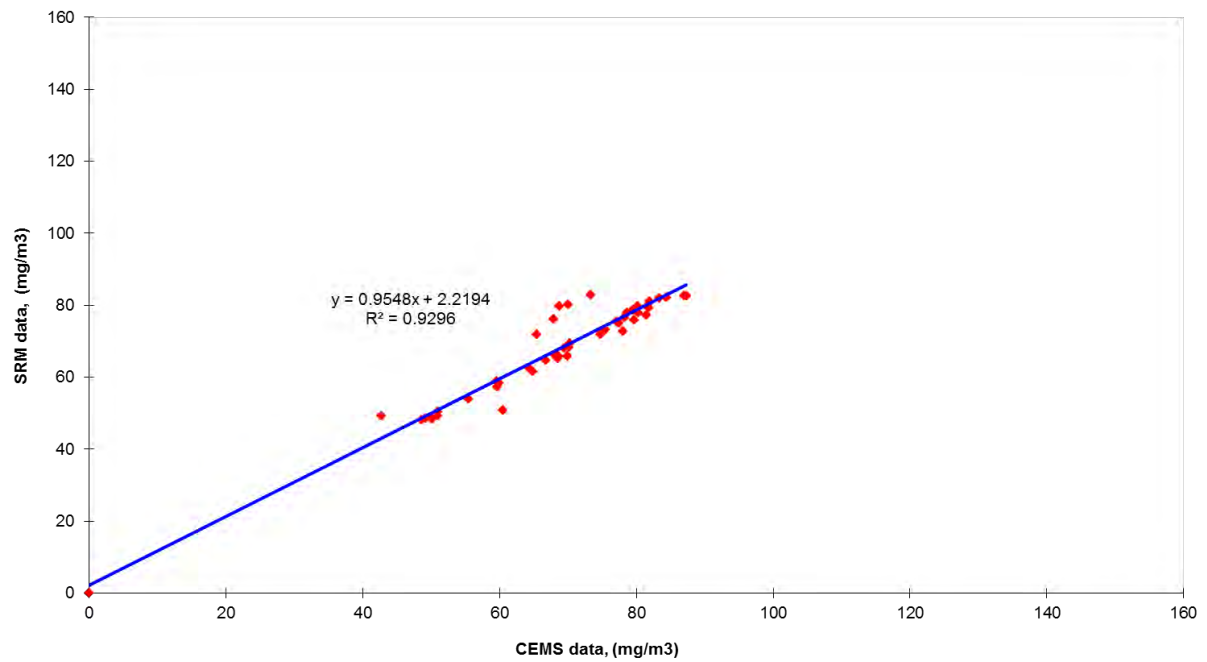
Test No	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
	hr:min		(ppm)	(ppm)	(%)	(%)	(mg/Nm <sup>3</sup> )	(mg/Nm <sup>3</sup> )	(mg/m3)
1	Reference		0.0	2.2	0.0		0.0	6.3	0.0
2	13:00	14:00	81.7	80.2	6.3	1.6	241.5	237.1	235.4
3	14:01	15:01	78.7	77.3	6.5	1.6	236.6	232.6	236.5
4	15:02	16:02	68.8	67.9	6.5	1.6	206.0	203.4	236.5
5	16:03	17:03	81.8	80.3	6.5	1.6	246.1	241.7	235.4
6	18:00	19:00	79.7	78.3	6.5	1.6	239.5	235.4	229.7
7	19:01	20:01	74.8	73.6	6.4	1.6	223.6	220.1	212.9
8	20:02	21:02	70.1	69.2	6.5	1.5	210.4	207.6	200.1
9	21:03	22:03	68.6	67.7	6.5	1.4	205.5	202.9	193.3
10	22:04	23:04	68.5	67.6	6.5	1.5	205.4	202.8	191.3
11	23:05	00:05	66.8	66.0	6.7	1.6	202.9	200.5	187.1
12	00:06	01:06	68.0	67.2	6.7	1.5	206.9	204.3	217.1
13	01:07	02:07	69.4	68.5	6.5	1.5	209.0	206.2	200.6
14	02:08	03:08	70.3	69.3	6.5	1.5	210.9	208.1	202.5
15	03:09	04:09	65.5	64.7	6.6	1.5	198.2	196.0	212.5
16	04:10	05:10	77.1	75.8	6.6	1.5	233.3	229.5	225.9
17	05:11	06:11	78.3	77.0	6.7	1.5	237.6	233.6	227.1
18	06:12	07:12	80.3	78.9	6.5	1.3	241.3	237.1	230.0
19	07:13	08:13	77.5	76.2	6.7	1.3	235.8	231.9	222.5
20	08:14	09:14	75.4	74.2	6.9	1.3	232.3	228.6	221.7
21	10:00	11:00	79.5	78.1	6.8	1.3	242.2	238.1	235.7
22	11:01	12:01	80.1	78.7	6.8	1.2	244.4	240.2	237.5
23	12:02	13:02	82.0	80.5	6.6	1.2	247.6	243.2	241.5
24	13:03	14:03	84.4	82.8	6.5	1.4	253.0	248.2	243.0
25	14:04	15:04	83.3	81.7	6.4	1.4	248.6	244.0	241.6
26	15:05	16:05	70.1	69.1	6.4	1.4	209.0	206.2	231.9
27	17:10	18:10	87.0	85.3	6.1	1.5	254.1	249.1	238.2
28	18:11	19:11	87.3	85.6	5.9	1.5	252.2	247.2	237.2
29	19:12	20:12	81.5	80.0	6.2	1.5	240.2	235.9	225.8
31	21:14	22:14	73.4	72.3	6.6	1.4	239.1	218.1	263.9
32	22:15	23:15	51.0	50.9	7.4	3.3	161.8	165.8	152.5
33	23:16	00:16	50.1	50.0	7.3	1.2	158.2	158.9	150.1
34	00:17	01:17	48.6	48.7	7.3	1.2	153.4	153.7	148.7
35	01:18	02:18	49.2	49.2	7.2	1.2	155.4	155.2	146.0
36	02:19	03:19	42.7	43.0	7.3	1.2	135.7	135.8	151.9
37	03:20	04:20	51.0	50.9	7.3	1.2	162.1	161.7	155.3
38	04:21	05:21	55.5	55.2	7.3	1.2	172.8	175.6	161.6
39	05:22	06:22	59.9	59.4	7.1	1.3	177.3	185.0	169.9
40	06:23	07:23	59.5	59.0	6.3	1.4	176.7	174.8	172.2
41	07:24	08:24	59.7	59.3	6.4	1.3	181.2	176.0	165.9
42	09:30	10:30	60.5	60.0	6.7	1.4	188.7	182.0	156.8
43	10:31	11:31	64.3	63.6	7.1	1.3	193.2	198.3	205.5
44	11:32	12:32	64.8	64.1	6.6	1.2	197.2	192.5	177.6
45	12:33	13:33	70.0	69.0	6.7	1.4	220.4	210.1	204.2
46	13:34	14:34	78.0	76.7	7.2	1.2	240.9	241.6	217.5
47	14:35	15:35	67.9	67.0	6.9	1.4	203.6	207.0	225.8
Sum							9531.91		
Emission Limit Value (ELV) =			440	mg/Nm <sup>3</sup>					

Reference Oxygen

6

%

#### 4A3.9.2 Plot 2.2 CEM versus SRM Parallel Test Data at CEM measurement conditions –Sulphur dioxide, wet gas



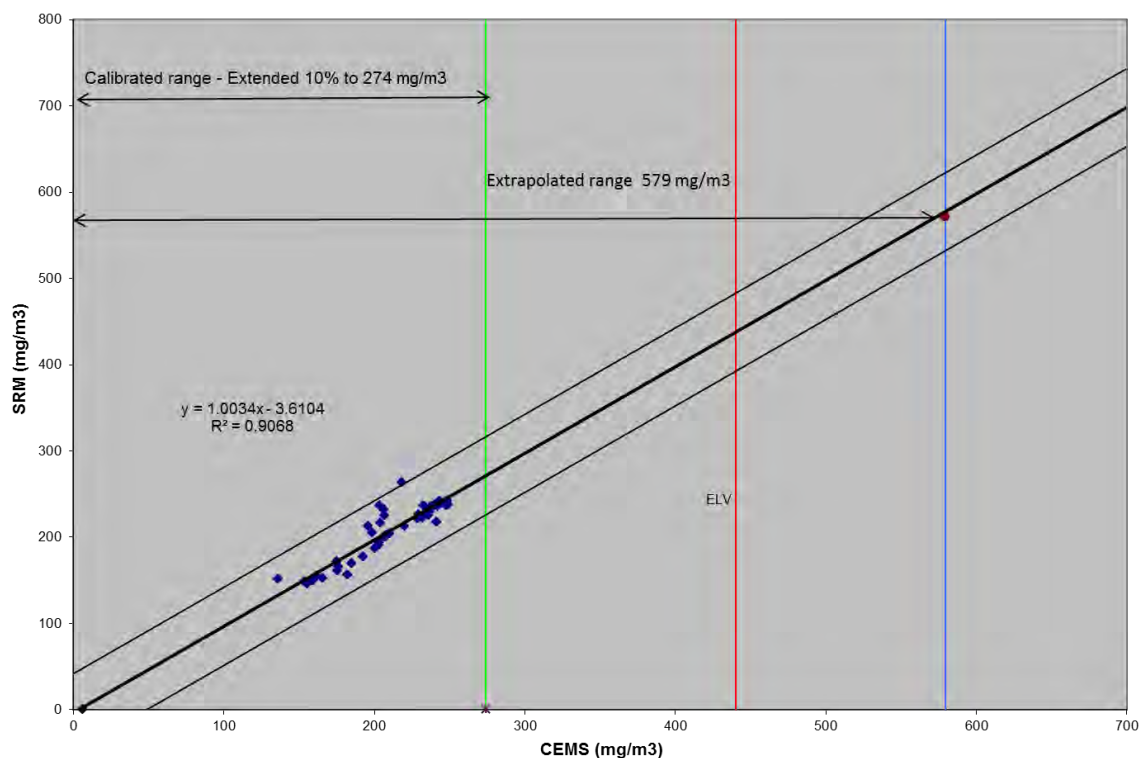
**4A3.10.2 Table 4.5.2 – Data used for the Variability Test – Sulphur Dioxide, Low Range.**

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			
2	13:00	14:00	237.1	235.4	-1.74	1.09	1.18
3	14:01	15:01	232.6	236.5	3.90	6.73	45.24
4	15:02	16:02	203.4	236.5	33.11	35.94	1291.79
5	16:03	17:03	241.7	235.4	-6.24	-3.41	11.64
6	18:00	19:00	235.4	229.7	-5.67	-2.84	8.07
7	19:01	20:01	220.1	212.9	-7.18	-4.35	18.93
8	20:02	21:02	207.6	200.1	-7.52	-4.69	21.97
9	21:03	22:03	202.9	193.3	-9.57	-6.74	45.49
10	22:04	23:04	202.8	191.3	-11.52	-8.69	75.51
11	23:05	00:05	200.5	187.1	-13.41	-10.58	111.91
12	00:06	01:06	204.3	217.1	12.79	15.62	243.93
13	01:07	02:07	206.2	200.6	-5.59	-2.75	7.59
14	02:08	03:08	208.1	202.5	-5.56	-2.73	7.44
15	03:09	04:09	196.0	212.5	16.52	19.35	374.32
16	04:10	05:10	229.5	225.9	-3.56	-0.73	0.53
17	05:11	06:11	233.6	227.1	-6.46	-3.63	13.18
18	06:12	07:12	237.1	230.0	-7.03	-4.20	17.62
19	07:13	08:13	231.9	222.5	-9.38	-6.55	42.91
20	08:14	09:14	228.6	221.7	-6.91	-4.08	16.65
21	10:00	11:00	238.1	235.7	-2.35	0.48	0.23
22	11:01	12:01	240.2	237.5	-2.68	0.15	0.02
23	12:02	13:02	243.2	241.5	-1.70	1.13	1.27
24	13:03	14:03	248.2	243.0	-5.23	-2.40	5.75
25	14:04	15:04	244.0	241.6	-2.46	0.37	0.14
26	15:05	16:05	206.2	231.9	25.77	28.60	817.94
27	17:10	18:10	249.1	238.2	-10.89	-8.06	64.99
28	18:11	19:11	247.2	237.2	-10.03	-7.20	51.81
29	19:12	20:12	235.9	225.8	-10.07	-7.24	52.35
31	21:14	22:14	218.1	263.9	45.85	48.68	2369.89
32	22:15	23:15	165.8	152.5	-13.33	-10.50	110.31
33	23:16	00:16	158.9	150.1	-8.78	-5.95	35.43
34	00:17	01:17	153.7	148.7	-4.98	-2.14	4.60
35	01:18	02:18	155.2	146.0	-9.21	-6.38	40.71
36	02:19	03:19	135.8	151.9	16.11	18.94	358.67
37	03:20	04:20	161.7	155.3	-6.44	-3.61	13.06
38	04:21	05:21	175.6	161.6	-13.97	-11.14	124.19
39	05:22	06:22	185.0	169.9	-15.05	-12.22	149.33
40	06:23	07:23	174.8	172.2	-2.67	0.16	0.03
41	07:24	08:24	176.0	165.9	-10.07	-7.24	52.41
42	09:30	10:30	182.0	156.8	-25.22	-22.39	501.45
43	10:31	11:31	198.3	205.5	7.13	9.96	99.19
44	11:32	12:32	192.5	177.6	-14.98	-12.15	147.57
45	12:33	13:33	210.1	204.2	-5.86	-3.03	9.20
46	13:34	14:34	241.6	217.5	-24.08	-21.25	451.60
47	14:35	15:35	207.0	225.8	18.87	21.70	470.72
45 Tests		Mean			-2.83		
Sum							8288.75

#### 4A3.11.2 - Variability Test Calculation – Sulphur Dioxide, Low Range.

SD=	Root(1-Number).Integral(D1-D) <sup>2</sup>	13.73	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O <sub>0</sub> is therefore calculated as:-			
O <sub>0</sub> =	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=	13.73 <= 44.9 * 0.9885		
or	13.73 <=	44.38	
Which is TRUE therefore the CEMS passes the test			

#### 4A3.12.2 Plot 3.2 –Standardised CEM data versus standardised SRM - Sulphur dioxide, Low Range – Reference conditions 273K, 101.3kPa 6% oxygen, dry gas.



#### 4A3.1.3 Table 4.1.3– Raw monitoring Data – Sulphur Dioxide, High Range

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (wet)	CEMS Oxygen (wet)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMs Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	01-Mar-16	13:00	14:00	85.23	6.27	1.57	79.94	6.15	1.95	79.9
2	01-Mar-16	14:01	15:01	82.06	6.52	1.57	77.83	6.61	1.93	77.8
3	01-Mar-16	15:02	16:02	71.68	6.46	1.57	79.59	6.29	1.94	79.6
4	01-Mar-16	16:03	17:03	85.20	6.53	1.60	79.25	6.28	1.97	79.2
5	01-Mar-16	18:00	19:00	83.15	6.50	1.61	75.92	6.53	2.10	75.9
6	01-Mar-16	19:01	20:01	78.20	6.43	1.59	71.82	6.24	2.04	71.8
7	01-Mar-16	20:02	21:02	73.56	6.50	1.49	68.37	6.07	1.93	68.4
8	01-Mar-16	21:03	22:03	72.00	6.50	1.36	65.83	6.14	1.76	65.8
9	01-Mar-16	22:04	23:04	71.92	6.49	1.51	65.23	6.10	1.94	65.2
10	01-02/03/2016	23:05	0:05	70.18	6.67	1.56	64.75	5.86	1.99	64.8
11	02-Mar-16	0:06	1:06	71.43	6.68	1.51	66.17	7.67	1.93	66.2
12	02-Mar-16	1:07	2:07	72.86	6.54	1.50	67.95	6.19	1.96	68.0
13	02-Mar-16	2:08	3:08	73.64	6.50	1.52	69.37	6.03	1.96	69.4
14	02-Mar-16	3:09	4:09	68.52	6.62	1.50	71.74	6.25	1.93	71.7
15	02-Mar-16	4:10	5:10	80.47	6.61	1.52	75.48	6.38	2.00	75.5
16	02-Mar-16	5:11	6:11	81.64	6.65	1.55	76.50	6.29	1.83	76.5
17	02-Mar-16	6:12	7:12	83.69	6.55	1.30	77.92	6.22	1.74	77.9
18	02-Mar-16	7:13	8:13	80.84	6.73	1.29	74.96	6.31	1.71	75.0
19	02-Mar-16	8:14	9:14	78.67	6.90	1.29	73.13	6.61	1.72	73.1
20	02-Mar-16	10:00	11:00	82.89	6.75	1.25	78.50	6.47	1.72	78.5
21	02-Mar-16	11:01	12:01	83.46	6.77	1.23	79.77	6.36	1.69	79.8
22	02-Mar-16	12:02	13:02	85.38	6.63	1.21	81.13	6.35	1.69	81.1
23	02-Mar-16	13:03	14:03	87.88	6.49	1.42	82.15	6.26	1.68	82.1
24	02-Mar-16	14:04	15:04	86.80	6.43	1.42	81.96	6.21	1.67	82.0
25	02-Mar-16	15:05	16:05	73.21	6.42	1.43	80.03	5.96	1.70	80.0
26	02-Mar-16	17:10	18:10	90.61	6.10	1.49	82.55	5.88	1.79	82.6
27	02-Mar-16	18:11	19:11	90.87	5.94	1.49	82.60	5.81	1.77	82.6
28	02-Mar-16	19:12	20:12	84.92	6.25	1.47	77.13	6.10	1.75	77.1
29	02-Mar-16	20:13	21:13	211.49	6.59	1.44	219.81	5.83	2.46	219.8
30	02-Mar-16	21:14	22:14	96.72	7.40	3.25	82.73	7.32	1.72	82.7
31	02-Mar-16	22:15	23:15	53.91	7.33	1.22	49.33	6.92	1.51	49.3
32	02-03/03/2016	23:16	0:16	53.00	7.25	1.24	48.33	6.98	1.52	48.3
33	03-Mar-16	0:17	1:17	51.59	7.23	1.25	48.03	6.94	1.52	48.0
34	03-Mar-16	1:18	2:18	52.17	7.25	1.25	48.66	6.49	1.50	48.7
35	03-Mar-16	2:19	3:19	45.31	7.33	1.24	49.31	6.88	1.51	49.3
36	03-Mar-16	3:20	4:20	53.82	7.35	1.23	50.35	6.88	1.51	50.4
37	03-Mar-16	4:21	5:21	58.50	7.05	1.28	53.98	6.45	1.57	54.0
38	03-Mar-16	5:22	6:22	63.25	6.33	1.36	58.49	6.01	1.62	58.5
39	03-Mar-16	6:23	7:23	62.86	6.37	1.34	58.93	6.08	1.68	58.9
40	03-Mar-16	7:24	8:24	62.90	6.66	1.39	57.19	5.99	1.60	57.2
41	03-Mar-16	9:30	10:30	63.59	7.06	1.29	50.79	6.93	1.33	50.8
42	03-Mar-16	10:31	11:31	67.66	6.55	1.23	62.53	7.72	1.68	62.5
43	03-Mar-16	11:32	12:32	68.09	6.70	1.45	61.50	5.90	1.70	61.5
44	03-Mar-16	12:33	13:33	73.01	7.21	1.24	65.90	6.93	1.61	65.9
45	03-Mar-16	13:34	14:34	81.11	6.92	1.38	72.82	6.41	1.65	72.8
46	03-Mar-16	14:35	15:35	70.67	6.51	1.43	76.17	6.30	1.68	76.2

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa

**4A3.2.3 Table 4.2.3 -Standardised monitoring Data – Sulphur Dioxide, High Range**

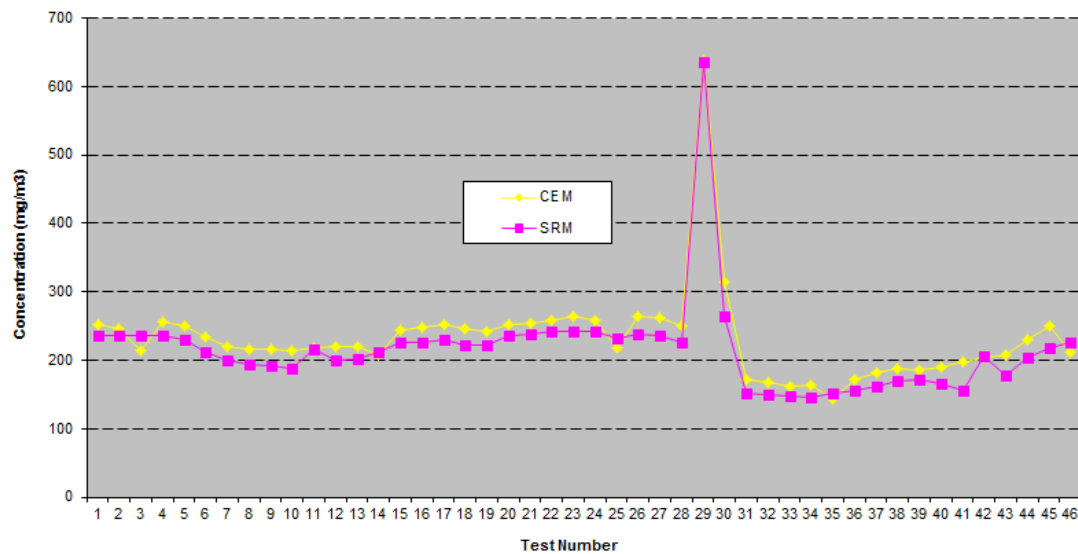
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(SO <sub>2</sub> mg/m <sup>3</sup> )	(SO <sub>2</sub> mg/m <sup>3</sup> )	(mg/m <sup>3</sup> )
1	01-Mar-16	13:00	14:00	251.9	235.4	12.0
2	01-Mar-16	14:01	15:01	246.9	236.5	12.0
3	01-Mar-16	15:02	16:02	214.7	236.5	12.0
4	01-Mar-16	16:03	17:03	256.5	235.4	12.0
5	01-Mar-16	18:00	19:00	249.8	229.7	12.0
6	01-Mar-16	19:01	20:01	233.8	212.9	11.0
7	01-Mar-16	20:02	21:02	220.8	200.1	10.0
8	01-Mar-16	21:03	22:03	215.8	193.3	10.0
9	01-Mar-16	22:04	23:04	215.7	191.3	9.9
10	01-02/03/2016	23:05	0:05	213.2	187.1	9.7
11	02-Mar-16	0:06	1:06	217.2	217.1	11.0
12	02-Mar-16	1:07	2:07	219.2	200.6	10.0
13	02-Mar-16	2:08	3:08	221.0	202.5	11.0
14	02-Mar-16	3:09	4:09	207.4	212.5	11.0
15	02-Mar-16	4:10	5:10	243.5	225.9	12.0
16	02-Mar-16	5:11	6:11	247.8	227.1	12.0
17	02-Mar-16	6:12	7:12	251.5	230.0	12.0
18	02-Mar-16	7:13	8:13	246.0	222.5	12.0
19	02-Mar-16	8:14	9:14	242.3	221.7	12.0
20	02-Mar-16	10:00	11:00	252.6	235.7	12.0
21	02-Mar-16	11:01	12:01	254.6	237.5	12.0
22	02-Mar-16	12:02	13:02	257.9	241.5	13.0
23	02-Mar-16	13:03	14:03	263.4	243.0	13.0
24	02-Mar-16	14:04	15:04	259.1	241.6	13.0
25	02-Mar-16	15:05	16:05	218.3	231.9	12.0
26	02-Mar-16	17:10	18:10	264.6	238.2	12.0
27	02-Mar-16	18:11	19:11	262.5	237.2	12.0
28	02-Mar-16	19:12	20:12	250.4	225.8	12.0
29	02-Mar-16	20:13	21:13	638.2	636.8	33.0
30	02-Mar-16	21:14	22:14	315.2	263.9	14.0
31	02-Mar-16	22:15	23:15	171.2	152.5	7.9
32	02-03/03/2016	23:16	0:16	167.4	150.1	7.8
33	03-Mar-16	0:17	1:17	162.7	148.7	7.7
34	03-Mar-16	1:18	2:18	164.8	146.0	7.6
35	03-Mar-16	2:19	3:19	144.0	151.9	7.9
36	03-Mar-16	3:20	4:20	171.2	155.3	8.0
37	03-Mar-16	4:21	5:21	182.1	161.6	8.4
38	03-Mar-16	5:22	6:22	187.3	169.9	8.8
39	03-Mar-16	6:23	7:23	186.7	172.2	8.9
40	03-Mar-16	7:24	8:24	190.8	165.9	8.6
41	03-Mar-16	9:30	10:30	198.2	156.8	8.2
42	03-Mar-16	10:31	11:31	203.2	205.5	11.0
43	03-Mar-16	11:32	12:32	207.2	177.6	9.2
44	03-Mar-16	12:33	13:33	229.9	204.2	11.0
45	03-Mar-16	13:34	14:34	250.4	217.5	11.0
46	03-Mar-16	14:35	15:35	212.0	225.8	12.0

Note:

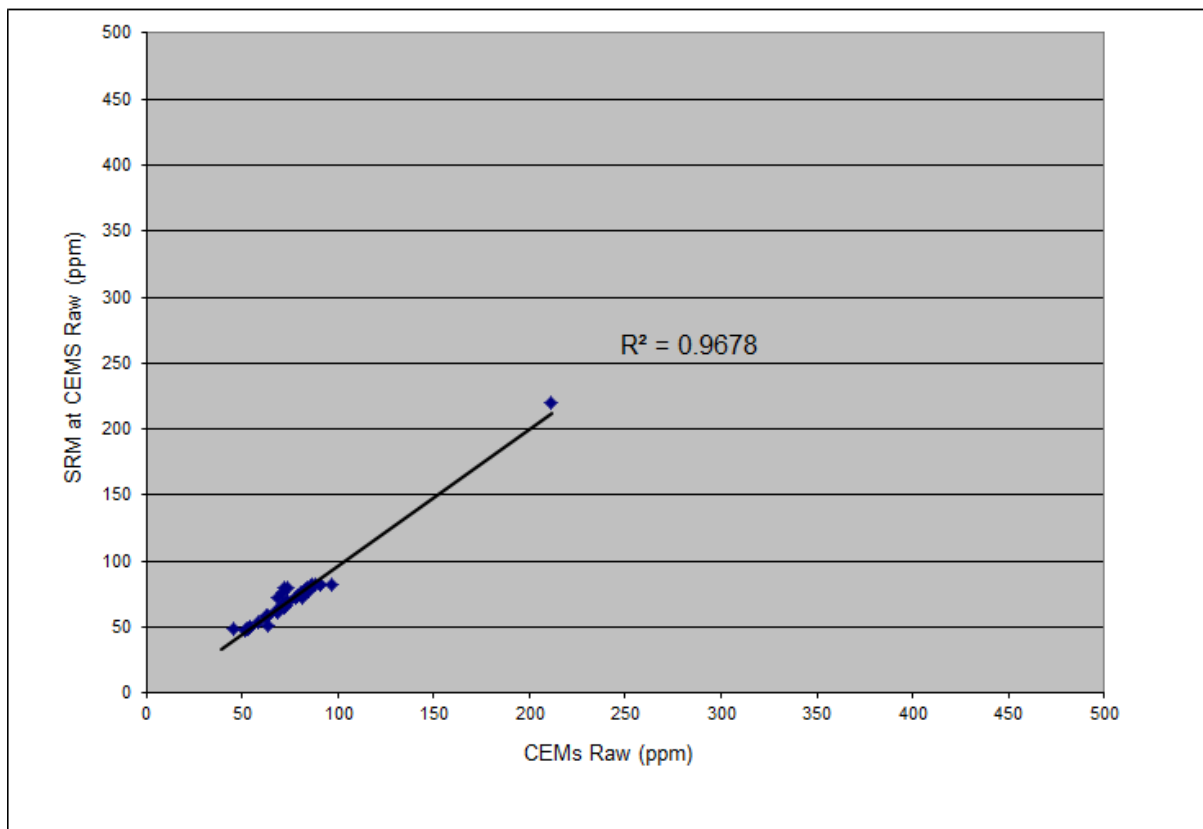
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

**4A3.3.3 – 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)**



#### 4A3.4.3 – Elimination of Outliers – Sulphur Dioxide, High Range.



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

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

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

As the  $R^2$  value for this determinand was 0.9678, an outlier test has not been undertaken.

#### 4A3.5.3 Determination of Method A or Method B - 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	13:00	14:00	79.9	6.2	235.4
2	14:01	15:01	77.8	6.6	236.5
3	15:02	16:02	79.6	6.3	236.5
4	16:03	17:03	79.2	6.3	235.4
5	18:00	19:00	75.9	6.5	229.7
6	19:01	20:01	71.8	6.2	212.9
7	20:02	21:02	68.4	6.1	200.1
8	21:03	22:03	65.8	6.1	193.3
9	22:04	23:04	65.2	6.1	191.3
10	23:05	0:05	64.8	5.9	187.1
11	0:06	1:06	66.2	7.7	217.1
12	1:07	2:07	68.0	6.2	200.6
13	2:08	3:08	69.4	6.0	202.5
14	3:09	4:09	71.7	6.2	212.5
15	4:10	5:10	75.5	6.4	225.9
16	5:11	6:11	76.5	6.3	227.1
17	6:12	7:12	77.9	6.2	230.0
18	7:13	8:13	75.0	6.3	222.5
19	8:14	9:14	73.1	6.6	221.7
20	10:00	11:00	78.5	6.5	235.7
21	11:01	12:01	79.8	6.4	237.5
22	12:02	13:02	81.1	6.4	241.5
23	13:03	14:03	82.1	6.3	243.0
24	14:04	15:04	82.0	6.2	241.6
25	15:05	16:05	80.0	6.0	231.9
26	17:10	18:10	82.6	5.9	238.2
27	18:11	19:11	82.6	5.8	237.2
28	19:12	20:12	77.1	6.1	225.8
29	20:13	21:13	219.8	5.8	636.8
30	21:14	22:14	82.7	7.3	263.9
31	22:15	23:15	49.3	6.9	152.5
32	23:16	0:16	48.3	7.0	150.1
33	0:17	1:17	48.0	6.9	148.7
34	1:18	2:18	48.7	6.5	146.0
35	2:19	3:19	49.3	6.9	151.9
36	3:20	4:20	50.4	6.9	155.3
37	4:21	5:21	54.0	6.5	161.6
38	5:22	6:22	58.5	6.0	169.9
39	6:23	7:23	58.9	6.1	172.2
40	7:24	8:24	57.2	6.0	165.9
41	9:30	10:30	50.8	6.9	156.8
42	10:31	11:31	62.5	7.7	205.5
43	11:32	12:32	61.5	5.9	177.6
44	12:33	13:33	65.9	6.9	204.2
45	13:34	14:34	72.8	6.4	217.5
46	14:35	15:35	76.2	6.3	225.8
Sum			3322.42		
Emission Limit Value (ELV) =		440	mg/Nm <sup>3</sup>	Y <sub>max</sub>	636.79
Maximum Permissible uncertainty =		20	%	Y <sub>min</sub>	145.95
Maximum Permissible uncertainty (at 15% of the ELV) =		88	mg/Nm <sup>3</sup>		
		66	mg/Nm <sup>3</sup>		
Is Ymax - Ymin > MPU at ELV?		Yes		Y <sub>max</sub> - Y <sub>min</sub>	490.84
Is Ymin > 15% of ELV?		Yes			
Derivation of Calibration Function			Method A		

**4A3.6.3 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 <sup>2</sup>	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference		0.0	0.0	-70.69	-74.91	5295.10	5610.95	
2	13:00	14:00	79.9	85.2	9.25	10.32	95.46	106.50	
3	14:01	15:01	77.8	82.1	7.14	7.16	51.11	51.23	
4	15:02	16:02	79.6	71.7	8.90	-3.22	-28.69	10.40	
5	16:03	17:03	79.2	85.2	8.56	10.30	88.13	106.06	
6	18:00	19:00	75.9	83.2	5.23	8.25	43.14	68.02	
7	19:01	20:01	71.8	78.2	1.13	3.30	3.72	10.88	
8	20:02	21:02	68.4	73.6	-2.32	-1.35	3.13	1.82	
9	21:03	22:03	65.8	72.0	-4.86	-2.91	14.14	8.44	
10	22:04	23:04	65.2	71.9	-5.46	-2.99	16.32	8.93	
11	23:05	0:05	64.8	70.2	-5.94	-4.73	28.07	22.36	
12	0:06	1:06	66.2	71.4	-4.52	-3.48	15.72	12.11	
13	1:07	2:07	68.0	72.9	-2.74	-2.05	5.60	4.19	
14	2:08	3:08	69.4	73.6	-1.32	-1.27	1.67	1.61	
15	3:09	4:09	71.7	68.5	1.05	-6.39	-6.73	40.84	
16	4:10	5:10	75.5	80.5	4.79	5.57	26.68	30.97	
17	5:11	6:11	76.5	81.6	5.81	6.73	39.14	45.34	
18	6:12	7:12	77.9	83.7	7.23	8.79	63.55	77.19	
19	7:13	8:13	75.0	80.8	4.27	5.93	25.30	35.15	
20	8:14	9:14	73.1	78.7	2.44	3.76	9.18	14.16	
21	10:00	11:00	78.5	82.9	7.81	7.98	62.39	63.75	
22	11:01	12:01	79.8	83.5	9.08	8.55	77.65	73.09	
23	12:02	13:02	81.1	85.4	10.44	10.47	109.36	109.68	
24	13:03	14:03	82.1	87.9	11.46	12.97	148.67	168.35	
25	14:04	15:04	82.0	86.8	11.27	11.90	134.04	141.55	
26	15:05	16:05	80.0	73.2	9.34	-1.70	-15.86	2.88	
27	17:10	18:10	82.6	90.6	11.86	15.71	186.30	246.71	
28	18:11	19:11	82.6	90.9	11.91	15.96	190.02	254.75	
29	19:12	20:12	77.1	84.9	6.44	10.01	64.52	100.28	
30	20:13	21:13	219.8	211.5	149.12	136.58	20367.81	18654.89	
31	21:14	22:14	82.7	96.7	12.04	21.81	262.66	475.87	
32	22:15	23:15	49.3	53.9	-21.36	-21.00	448.64	440.98	
33	23:16	0:16	48.3	53.0	-22.36	-21.90	489.80	479.71	
34	0:17	1:17	48.0	51.6	-22.66	-23.31	528.35	543.58	
35	1:18	2:18	48.7	52.2	-22.03	-22.74	500.95	517.00	
36	2:19	3:19	49.3	45.3	-21.38	-29.59	632.82	875.71	
37	3:20	4:20	50.4	53.8	-20.34	-21.09	428.81	444.65	
38	4:21	5:21	54.0	58.5	-16.71	-16.41	274.23	269.22	
39	5:22	6:22	58.5	63.2	-12.20	-11.66	142.28	135.92	
40	6:23	7:23	58.9	62.9	-11.76	-12.05	141.62	145.14	
41	7:24	8:24	57.2	62.9	-13.50	-12.00	162.05	144.03	
42	9:30	10:30	50.8	63.6	-19.90	-11.32	225.29	128.16	
43	10:31	11:31	62.5	67.7	-8.16	-7.25	59.17	52.57	
44	11:32	12:32	61.5	68.1	-9.19	-6.82	62.66	46.49	
45	12:33	13:33	65.9	73.0	-4.79	-1.90	9.08	3.59	
46	13:34	14:34	72.8	81.1	2.13	6.20	13.21	38.47	
47	14:35	15:35	76.2	70.7	5.48	-4.24	-23.24	17.96	
Sum			3322.42	3520.59	0.00	0.00	31473.02	30842.14	1.02

#### 4A3.7.3 Determination of Calibration Function - Sulphur Dioxide, High Range.

##### Method A

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

$N$	$N$	$N$	$N$		
$b = \sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})$	$\bar{x} = 1/N \sum_{i=1}^N x_i$	$\bar{y} = 1/N \sum_{i=1}^N y_i$		$\bar{x} =$	74.91
				$\bar{y} =$	70.69
				$b =$	1.020
$a = \bar{y} - b\bar{x}$	$a = 70.69 - 74.91 * 1.02$			$a =$	-5.749

The calibration is function  $y_i = a + b x_i$  or  $y_i = -5.749 + 1.02 * x_i$

### A3.8.3 Table A.4.4.3 - Calculation of calibrated CEMS values - Sulphur Dioxide, High Range.

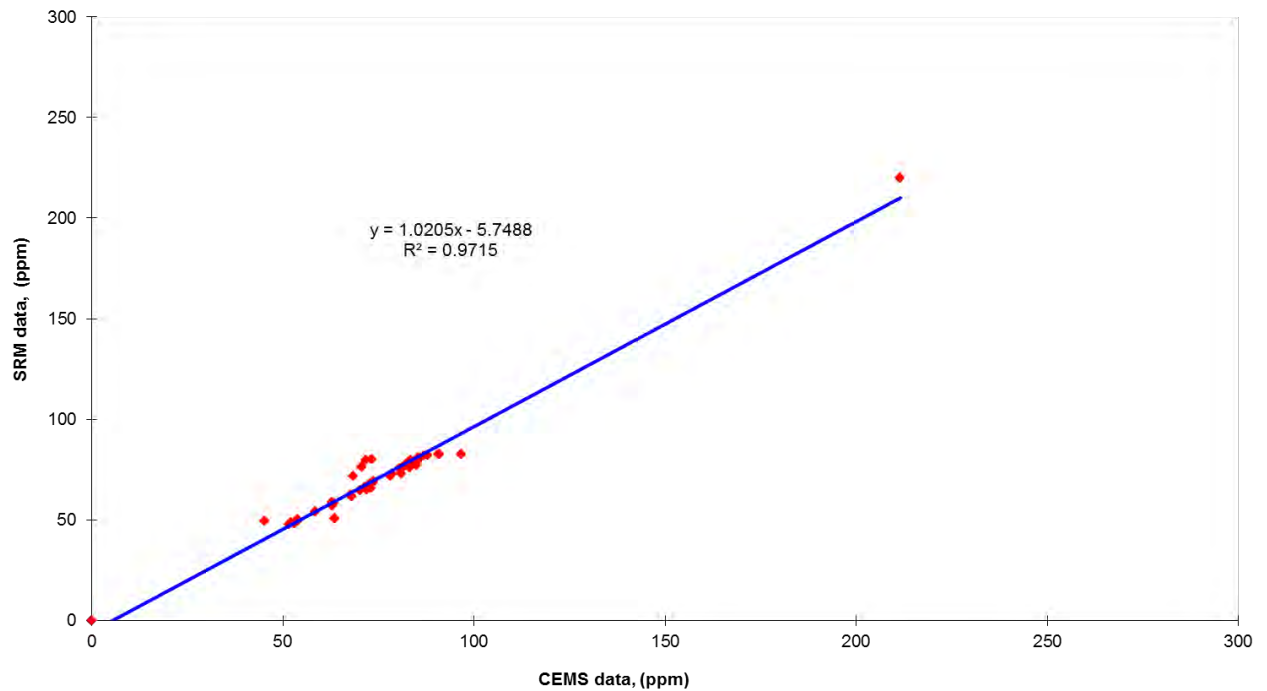
Test No	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
	hr:min		(ppm)	(ppm)	(%)	(%)	(mg/Nm <sup>3</sup> )	(mg/Nm <sup>3</sup> )	(mg/m3)
1	Reference		0.0	-5.7	0.0		0.0	-16.4	0.0
2	13:00	14:00	85.2	81.2	6.3	1.6	251.9	240.1	235.4
3	14:01	15:01	82.1	78.0	6.5	1.6	246.9	234.6	236.5
4	15:02	16:02	71.7	67.4	6.5	1.6	214.7	201.9	236.5
5	16:03	17:03	85.2	81.2	6.5	1.6	256.5	244.4	235.4
6	18:00	19:00	83.2	79.1	6.5	1.6	249.8	237.7	229.7
7	19:01	20:01	78.2	74.1	6.4	1.6	233.8	221.4	212.9
8	20:02	21:02	73.6	69.3	6.5	1.5	220.8	208.0	200.1
9	21:03	22:03	72.0	67.7	6.5	1.4	215.8	202.9	193.3
10	22:04	23:04	71.9	67.6	6.5	1.5	215.7	202.9	191.3
11	23:05	00:05	70.2	65.9	6.7	1.6	213.2	200.1	187.1
12	00:06	01:06	71.4	67.1	6.7	1.5	217.2	204.1	217.1
13	01:07	02:07	72.9	68.6	6.5	1.5	219.2	206.4	200.6
14	02:08	03:08	73.6	69.4	6.5	1.5	221.0	208.3	202.5
15	03:09	04:09	68.5	64.2	6.6	1.5	207.4	194.3	212.5
16	04:10	05:10	80.5	76.4	6.6	1.5	243.5	231.1	225.9
17	05:11	06:11	81.6	77.6	6.7	1.5	247.8	235.4	227.1
18	06:12	07:12	83.7	79.7	6.5	1.3	251.5	239.4	230.0
19	07:13	08:13	80.8	76.7	6.7	1.3	246.0	233.5	222.5
20	08:14	09:14	78.7	74.5	6.9	1.3	242.3	229.5	221.7
21	10:00	11:00	82.9	78.8	6.8	1.3	252.6	240.2	235.7
22	11:01	12:01	83.5	79.4	6.8	1.2	254.6	242.3	237.5
23	12:02	13:02	85.4	81.4	6.6	1.2	257.9	245.8	241.5
24	13:03	14:03	87.9	83.9	6.5	1.4	263.4	251.5	243.0
25	14:04	15:04	86.8	82.8	6.4	1.4	259.1	247.3	241.6
26	15:05	16:05	73.2	69.0	6.4	1.4	218.3	205.6	231.9
27	17:10	18:10	90.6	86.7	6.1	1.5	264.6	253.2	238.2
28	18:11	19:11	90.9	87.0	5.9	1.5	262.5	251.3	237.2
29	19:12	20:12	84.9	80.9	6.2	1.5	250.4	238.5	225.8
30	20:13	21:13	211.5	210.1	6.6	1.4	638.2	633.9	636.8
31	21:14	22:14	96.7	93.0	7.4	3.3	315.2	302.9	263.9
32	22:15	23:15	53.9	49.3	7.3	1.2	171.2	156.4	152.5
33	23:16	00:16	53.0	48.3	7.3	1.2	167.4	152.7	150.1
34	00:17	01:17	51.6	46.9	7.2	1.2	162.7	147.9	148.7
35	01:18	02:18	52.2	47.5	7.3	1.2	164.8	150.0	146.0
36	02:19	03:19	45.3	40.5	7.3	1.2	144.0	128.7	151.9
37	03:20	04:20	53.8	49.2	7.3	1.2	171.2	156.4	155.3
38	04:21	05:21	58.5	53.9	7.1	1.3	182.1	168.0	161.6
39	05:22	06:22	63.2	58.8	6.3	1.4	187.3	174.1	169.9
40	06:23	07:23	62.9	58.4	6.4	1.3	186.7	173.4	172.2
41	07:24	08:24	62.9	58.4	6.7	1.4	190.8	177.2	165.9
42	09:30	10:30	63.6	59.1	7.1	1.3	198.2	184.3	156.8
43	10:31	11:31	67.7	63.3	6.6	1.2	203.2	190.1	205.5
44	11:32	12:32	68.1	63.7	6.7	1.4	207.2	193.9	177.6
45	12:33	13:33	73.0	68.8	7.2	1.2	229.9	216.5	204.2
46	13:34	14:34	81.1	77.0	6.9	1.4	250.4	237.8	217.5
47	14:35	15:35	70.7	66.4	6.5	1.4	212.0	199.1	225.8
Sum							10680.81		
Emission Limit Value (ELV) =			440	mg/Nm <sup>3</sup>					

Reference Oxygen

6

%

**4A3.9.3 Plot 2.3 CEM versus SRM Parallel Test Data at CEM measurement conditions –Sulphur dioxide, wet gas.**



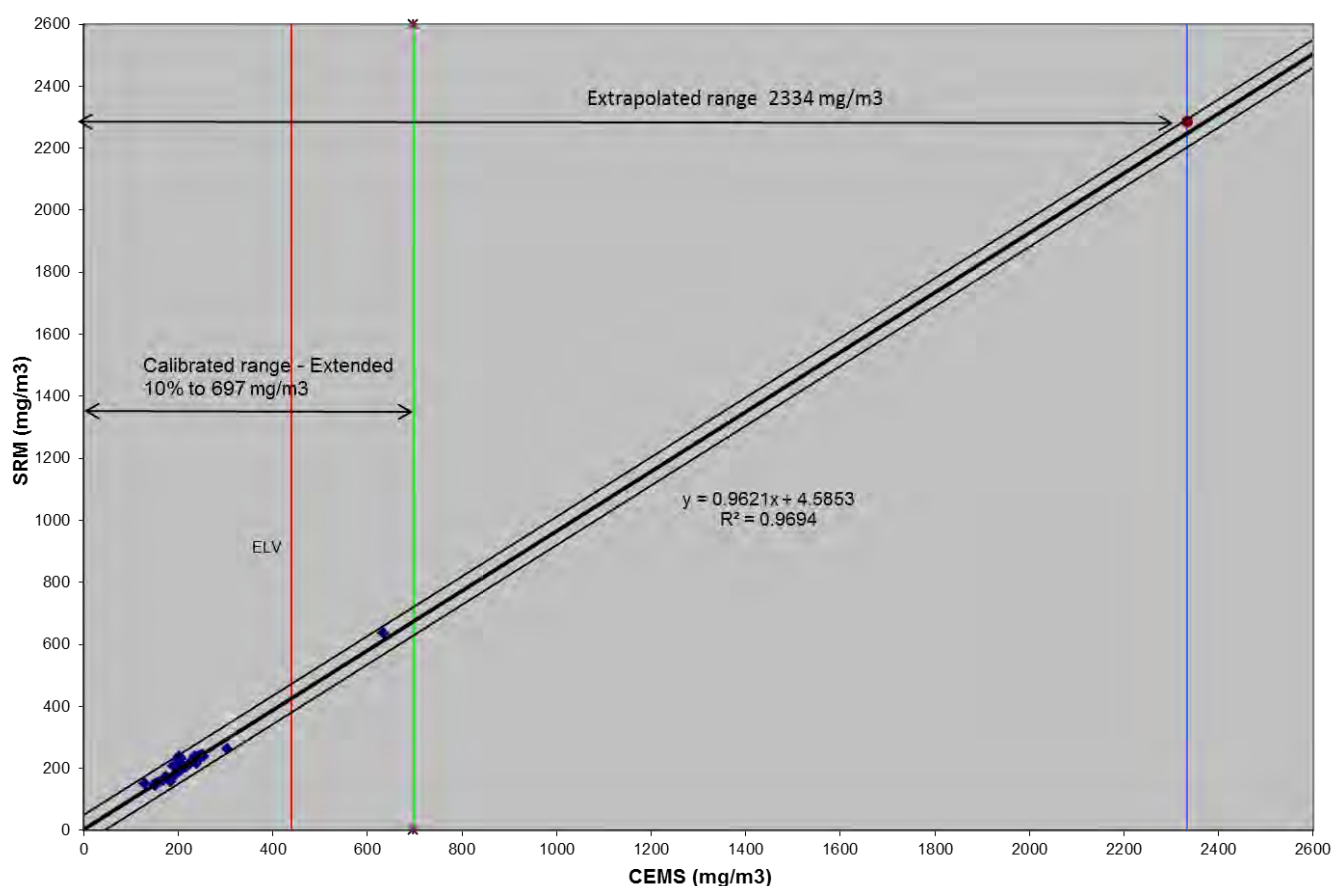
**4A3.10.3 Table 4.5.3 – Data used for the Variability Test – Sulphur Dioxide, High Range.**

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			
2	13:00	14:00	240.1	235.4	-4.70	-0.73	0.53
3	14:01	15:01	234.6	236.5	1.86	5.83	33.99
4	15:02	16:02	201.9	236.5	34.64	38.60	1490.33
5	16:03	17:03	244.4	235.4	-8.98	-5.01	25.09
6	18:00	19:00	237.7	229.7	-7.95	-3.98	15.88
7	19:01	20:01	221.4	212.9	-8.47	-4.50	20.23
8	20:02	21:02	208.0	200.1	-7.95	-3.98	15.83
9	21:03	22:03	202.9	193.3	-9.63	-5.66	32.07
10	22:04	23:04	202.9	191.3	-11.60	-7.63	58.29
11	23:05	00:05	200.1	187.1	-13.05	-9.08	82.48
12	00:06	01:06	204.1	217.1	12.96	16.93	286.46
13	01:07	02:07	206.4	200.6	-5.80	-1.83	3.37
14	02:08	03:08	208.3	202.5	-5.79	-1.82	3.31
15	03:09	04:09	194.3	212.5	18.25	22.22	493.62
16	04:10	05:10	231.1	225.9	-5.16	-1.19	1.42
17	05:11	06:11	235.4	227.1	-8.24	-4.27	18.20
18	06:12	07:12	239.4	230.0	-9.39	-5.42	29.34
19	07:13	08:13	233.5	222.5	-11.01	-7.04	49.54
20	08:14	09:14	229.5	221.7	-7.83	-3.86	14.91
21	10:00	11:00	240.2	235.7	-4.54	-0.57	0.32
22	11:01	12:01	242.3	237.5	-4.78	-0.82	0.66
23	12:02	13:02	245.8	241.5	-4.36	-0.39	0.15
24	13:03	14:03	251.5	243.0	-8.57	-4.60	21.18
25	14:04	15:04	247.3	241.6	-5.70	-1.73	3.00
26	15:05	16:05	205.6	231.9	26.30	30.27	916.50
27	17:10	18:10	253.2	238.2	-15.00	-11.03	121.68
28	18:11	19:11	251.3	237.2	-14.10	-10.13	102.65
29	19:12	20:12	238.5	225.8	-12.72	-8.75	76.63
30	20:13	21:13	633.9	636.8	2.86	6.83	46.60
31	21:14	22:14	302.9	263.9	-38.97	-35.00	1224.69
32	22:15	23:15	156.4	152.5	-3.96	0.01	0.00
33	23:16	00:16	152.7	150.1	-2.55	1.42	2.00
34	00:17	01:17	147.9	148.7	0.81	4.78	22.82
35	01:18	02:18	150.0	146.0	-4.07	-0.10	0.01
36	02:19	03:19	128.7	151.9	23.28	27.25	742.70
37	03:20	04:20	156.4	155.3	-1.10	2.87	8.24
38	04:21	05:21	168.0	161.6	-6.39	-2.42	5.84
39	05:22	06:22	174.1	169.9	-4.18	-0.21	0.05
40	06:23	07:23	173.4	172.2	-1.23	2.74	7.48
41	07:24	08:24	177.2	165.9	-11.33	-7.36	54.12
42	09:30	10:30	184.3	156.8	-27.47	-23.50	552.17
43	10:31	11:31	190.1	205.5	15.36	19.33	373.52
44	11:32	12:32	193.9	177.6	-16.37	-12.40	153.69
45	12:33	13:33	216.5	204.2	-12.35	-8.38	70.21
46	13:34	14:34	237.8	217.5	-20.34	-16.37	267.95
47	14:35	15:35	199.1	225.8	26.71	30.68	941.43
46 Tests		Mean			-3.97		
Sum							8391.16

#### 4A3.11.3 - Variability Test Calculation – Sulphur Dioxide, High Range.

SD=	$\text{Root}(1-\text{Number}).\text{Integral}(D1-D)^2$	13.66	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. $O_0$ is therefore calculated as:-			
$O_0$ =	$0.2 \times 440 \text{ mg/m3 (s,d,6\%O2)}/1.96$	44.90	mg/m3(s,d),6%O2
For 46 tests, kv =	0.9885		
Therefore variability=	$13.66 \leq 44.9 \times 0.9885$		
or	13.66	$\leq$	44.38
Which is TRUE therefore the CEMS passes the test			

#### 4A3.12.3 Plot 3.3 –Standardised CEM data versus standardised SRM - Sulphur dioxide, High Range – Reference conditions 273K, 101.3kPa., 6% oxygen, dry gas.



## **Section 4A4: Data & calculations – QAL2 – Unit 9, SICK Dusthunter**

## Section 4A4 – Data and calculations – QAL2 SICK Dusthunter

### 4A4.1.1 Table 4.1.1 – Raw monitoring Data – Total Particulate Matter

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (Extinction)	CEMS Oxygen (dry)	CEMS Moisture (Wet)	CEM Stack Temp	CEM Stack Press	SRM Raw value (wet)	SRM Moisture (Wet FT)	SRM Oxygen (Dry)	SRM Stack Temp	SRM Stack Press	SRM at CEMs Raw conditions
		hr:min		%	(%)	(%)	C	kpa	(mg/m3)	(%)	(%)	C	kpa	(mg/m3)
1	01-Mar-16	10:45	11:45	4.7	6.1	1.8	60.5	100.4	9.2	2.0	6.0	60.0	100.2	7.4
2	01-Mar-16	11:53	12:53	4.5	6.1	1.2	60.9	100.4	1.9	2.0	6.0	60.6	100.2	1.5
3	01-Mar-16	13:03	14:03	4.7	6.3	1.6	61.2	100.3	11.1	2.0	6.1	61.0	100.2	9.0
4	01-Mar-16	14:11	15:11	4.3	6.5	1.6	61.0	100.2	8.3	2.0	6.3	60.0	100.2	6.7
5	01-Mar-16	15:20	16:20	4.5	6.5	1.6	60.9	100.2	7.7	2.0	6.2	60.0	100.2	6.3
6	01-Mar-16	16:28	17:28	4.5	6.6	1.6	61.3	100.2	8.0	2.0	6.2	61.0	100.2	6.5
7	02-Mar-16	9:56	10:56	5.1	6.8	1.3	59.7	99.3	9.9	2.0	6.4	60.0	99.5	8.0
8	02-Mar-16	11:03	12:03	4.8	6.8	1.2	57.8	99.5	8.9	2.0	6.4	56.8	99.5	7.2
9	02-Mar-16	12:11	13:11	4.7	6.6	1.3	57.5	99.6	11.7	2.0	6.2	57.9	99.5	9.5
10	02-Mar-16	13:20	14:20	4.6	6.5	1.4	57.7	99.6	12.5	2.0	6.1	57.9	99.5	10.2
11	02-Mar-16	14:27	15:27	4.4	6.4	1.4	58.1	99.7	10.9	2.0	6.0	57.9	99.5	8.8
12	02-Mar-16	15:35	16:35	4.0	6.5	1.4	58.2	99.7	7.1	2.0	6.1	57.9	99.5	5.7
13	03-Mar-16	9:35	10:36	6.1	7.1	1.3	56.3	100.4	5.9	2.0	6.7	56.0	99.8	4.8
14	03-Mar-16	10:42	11:42	4.3	6.3	1.3	57.4	100.4	6.9	2.0	6.0	56.8	99.8	5.7
15	03-Mar-16	11:51	12:51	4.2	7.0	1.5	57.1	100.3	8.3	2.0	6.6	56.1	99.8	6.8
16	03-Mar-16	12:59	13:59	4.0	7.2	1.3	57.3	100.2	6.0	2.0	6.8	56.3	99.8	4.9
17	03-Mar-16	14:06	15:06	4.6	6.8	1.4	58.1	100.1	6.9	2.0	6.1	57.7	99.8	5.6
18	03-Mar-16	15:13	16:13	4.6	6.5	1.4	59.1	99.9	4.6	2.0	6.2	57.9	99.8	3.7

Note:

Emission concentrations expressed at reference conditions 273K, 101.3kPa.

#### 4A4.2.1 Table 4.2.1 - Standardised monitoring Data – Total Particulate Matter

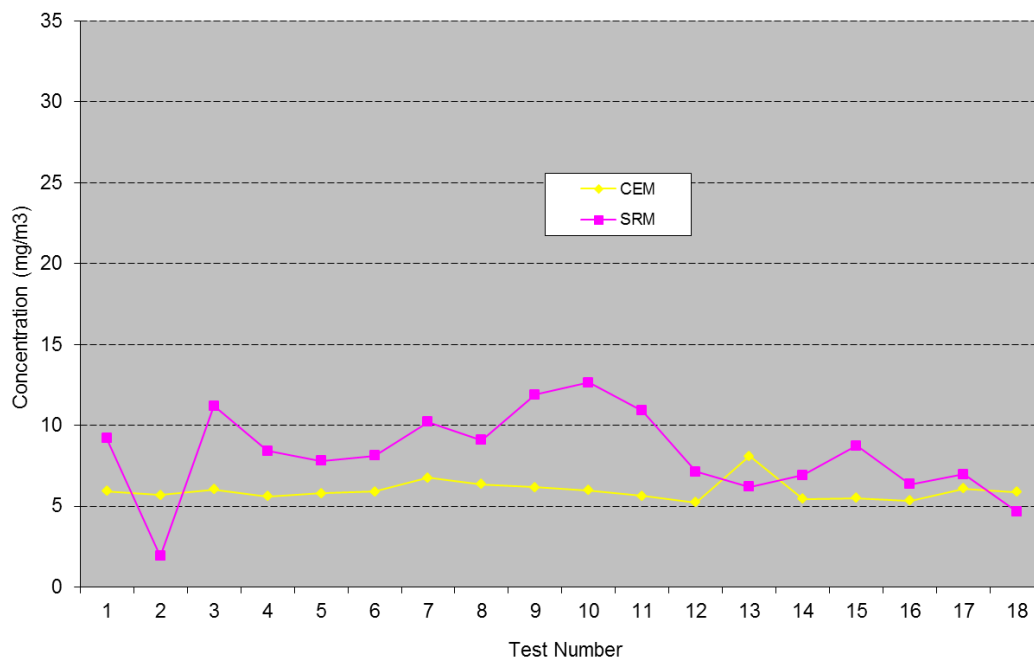
Test No	Date	Test Start Time	Test End Time	CEMS Standardised Value	SRM Standardised Value	SRM Uncertainty
		hr:min		(mg/m3)	mg/m3)	(mg/m3)
1	01-Mar-16	10:45	11:45	5.9	9.2	0.37
2	01-Mar-16	11:53	12:53	5.7	1.9	0.08
3	01-Mar-16	13:03	14:03	6.0	11.2	0.45
4	01-Mar-16	14:11	15:11	5.6	8.4	0.34
5	01-Mar-16	15:20	16:20	5.8	7.8	0.31
6	01-Mar-16	16:28	17:28	5.9	8.1	0.32
7	02-Mar-16	9:56	10:56	6.8	10.2	0.41
8	02-Mar-16	11:03	12:03	6.4	9.1	0.36
9	02-Mar-16	12:11	13:11	6.2	11.9	0.48
10	02-Mar-16	13:20	14:20	6.0	12.6	0.51
11	02-Mar-16	14:27	15:27	5.6	10.9	0.44
12	02-Mar-16	15:35	16:35	5.2	7.1	0.29
13	03-Mar-16	9:35	10:36	8.1	6.2	0.25
14	03-Mar-16	10:42	11:42	5.5	6.9	0.28
15	03-Mar-16	11:51	12:51	5.5	8.7	0.35
16	03-Mar-16	12:59	13:59	5.3	6.4	0.26
17	03-Mar-16	14:06	15:06	6.1	7.0	0.28
18	03-Mar-16	15:13	16:13	5.9	4.7	0.19

**Note:**

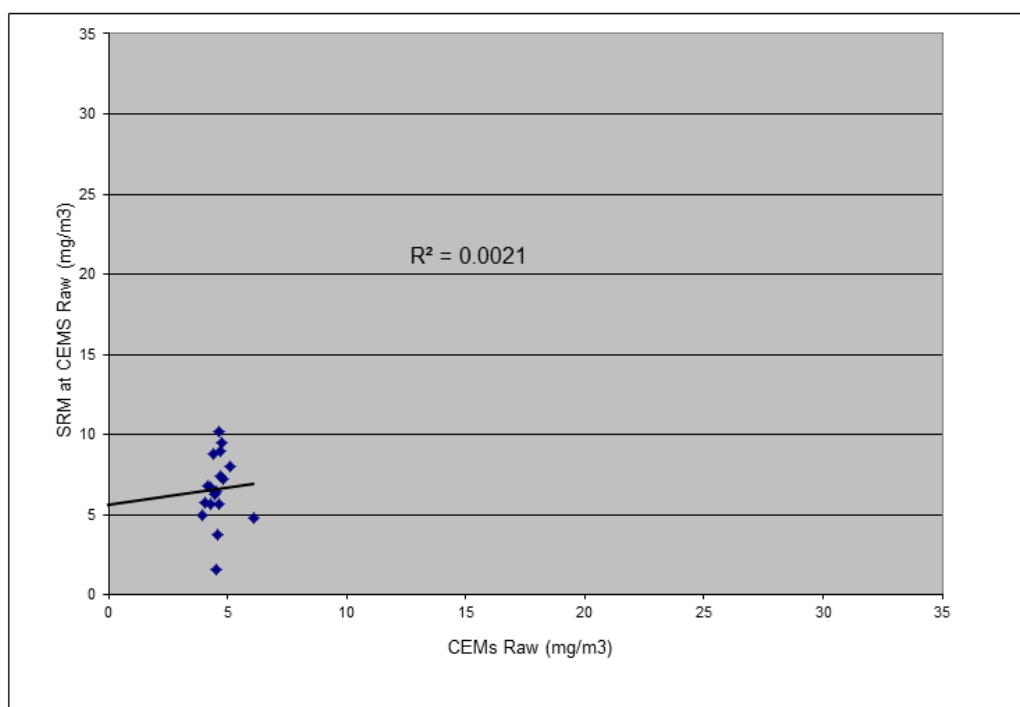
Emission concentrations expressed at reference conditions 273K, 101.3kPa

6 % Oxygen, dry gas

#### 4A4.3.1 – Plot 1.1 - Time Series of Standardised CEM versus Standardised SRM data – Total Particulate Matter, (Expressed at reference conditions 273K, 101.3kPa, dry gas, 6% oxygen)



#### 4A4.4.1 – Elimination of Outliers – Total Particulate Matter,



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		(mg/m3)	(mg/m3)			
1	10:45	11:45	4.7	7.4	2.76	0.78	No
2	11:53	12:53	4.5	1.5	-2.99	-4.97	Yes
3	13:03	14:03	4.7	9.0	4.27	2.29	No
4	14:11	15:11	4.3	6.7	2.38	0.40	No
5	15:20	16:20	4.5	6.3	1.79	-0.20	No
6	16:28	17:28	4.5	6.5	1.96	-0.02	No
7	09:56	10:56	5.1	8.0	2.91	0.92	No
8	11:03	12:03	4.8	7.2	2.38	0.40	No
9	12:11	13:11	4.7	9.5	4.73	2.74	No
10	13:20	14:20	4.6	10.2	5.51	3.53	No
11	14:27	15:27	4.4	8.8	4.44	2.45	No
12	15:35	16:35	4.0	5.7	1.69	-0.29	No
13	09:35	10:36	6.1	4.8	-1.28	-3.27	No
14	10:42	11:42	4.3	5.7	1.34	-0.64	No
15	11:51	12:51	4.2	6.8	2.67	0.69	No
16	12:59	13:59	4.0	4.9	0.96	-1.02	No
17	14:06	15:06	4.6	5.6	1.01	-0.98	No
18	15:13	16:13	4.6	3.7	-0.82	-2.81	No
				Average $\bar{D}_i$	1.98		
				Standard Deviation	2.16		
				Standard Deviation x2	4.32		

#### 4A4.5.1 Determination of Method A or Method B - Total Particulate Matter

Test No	Test Start Time	Test End Time	SRM measured value (y)	SRM Moisture	SRM O2	SRM Standardised
	hr:min		(mg/m3)	(%)	(%)	(mg/m3)
1	10:45	11:45	9.2	1.6	6.0	9.3
4	13:03	14:03	8.3	1.6	6.1	11.9
5	14:11	15:11	7.7	1.6	6.3	11.2
6	15:20	16:20	8.0	1.6	6.2	11.5
7	16:28	17:28	9.9	1.6	6.2	14.4
8	9:56	10:56	8.9	1.3	6.4	12.9
9	11:03	12:03	11.7	1.2	6.4	17.0
10	12:11	13:11	12.5	1.2	6.2	18.1
11	13:20	14:20	10.9	1.4	6.1	15.7
12	14:27	15:27	7.1	1.4	6.0	10.1
13	15:35	16:35	5.9	1.4	6.1	8.4
14	9:35	10:36	6.9	1.3	6.7	10.4
15	10:42	11:42	8.3	1.2	6.0	11.8
16	11:51	12:51	6.0	1.4	6.6	9.0
17	12:59	13:59	6.9	1.2	6.8	10.4
18	14:06	15:06	4.6	1.4	6.1	6.6
Sum			132.94			
Emission Limit Value (ELV) =		35	mg/Nm <sup>3</sup>	Y <sub>max</sub>	18.09	18.09
Maximum Permissible uncertainty =		20	%	Y <sub>min</sub>	6.56	6.56
Maximum Permissible uncertainty (at 15% of the ELV =		7	mg/Nm <sup>3</sup>			11.52
Is Y <sub>max</sub> - Y <sub>min</sub> > MPU at ELV?		Yes		Y <sub>max</sub> - Y <sub>min</sub>	11.52	
Is Y <sub>min</sub> > 15% of ELV?		Yes				

Derivation of Calibration Function	Method A
------------------------------------	----------

#### 4A4.6.1 Table 4.3.1 - Data used to derive calibration function - Total Particulate Matter,

Test No	Test Start Time	Test End Time	SRM measured value (y) (mg/m3)	CEMS measured signal (x) (mg/m3)	Yi	Xi	Xi * Yi	Xi <sup>2</sup>	b
	hr:min				1	2	3	4	
1	Reference		0.0	0.0	-6.40	-4.34	27.81	18.87	
2	10:45	11:45	7.3	4.7	0.92	0.33	0.31	0.11	
4	13:03	14:03	8.9	4.7	2.45	0.38	0.93	0.14	
5	14:11	15:11	6.6	4.3	0.20	-0.02	0.00	0.00	
6	15:20	16:20	6.2	4.5	-0.24	0.13	-0.03	0.02	
7	16:28	17:28	6.4	4.5	-0.04	0.16	-0.01	0.03	
8	9:56	10:56	7.9	5.1	1.50	0.75	1.13	0.56	
9	11:03	12:03	7.1	4.8	0.72	0.48	0.35	0.23	
10	12:11	13:11	9.4	4.7	2.96	0.40	1.20	0.16	
11	13:20	14:20	10.0	4.6	3.60	0.30	1.07	0.09	
12	14:27	15:27	8.7	4.4	2.31	0.06	0.13	0.00	
13	15:35	16:35	5.7	4.0	-0.74	-0.30	0.22	0.09	
14	9:35	10:36	4.7	6.1	-1.65	1.75	-2.89	3.06	
15	10:42	11:42	5.6	4.3	-0.82	-0.03	0.03	0.00	
16	11:51	12:51	6.7	4.2	0.32	-0.19	-0.06	0.04	
17	12:59	13:59	4.9	4.0	-1.53	-0.38	0.58	0.14	
18	14:06	15:06	5.6	4.6	-0.83	0.30	-0.25	0.09	
19	15:13	16:13	3.7	4.6	-2.72	0.22	-0.59	0.05	
Sum			115.24	78.18	0.00	0.00	29.90	23.68	1.26

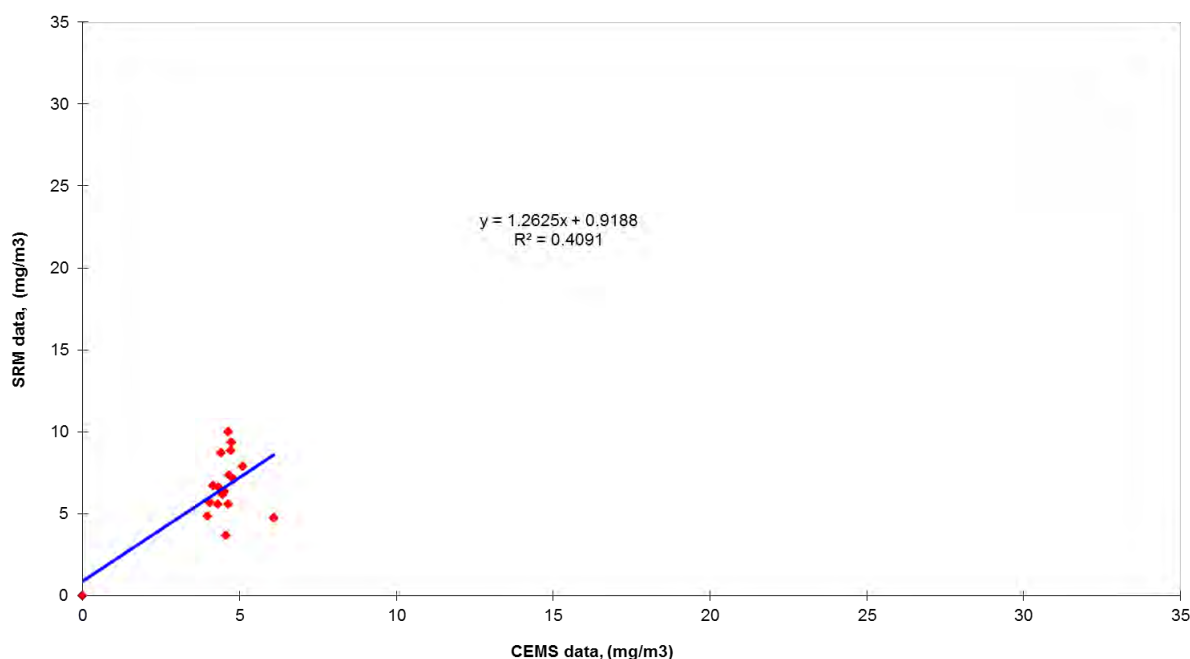
#### 4A4.7.1 Determination of Calibration Function - Total Particulate Matter

<b>Method A</b>					
If Ymax-Ymin >15% of the ELV, the following formulae are used:					
N	N	N	N		
$b = \sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})$ where		$\bar{x} = 1/N \sum_{i=1}^N x_i$	$\bar{y} = 1/N \sum_{i=1}^N y_i$	x=	4.34
i=1	i=1	i=1	i=1	y=	6.40
				b=	1.262
$a = \bar{y} - b\bar{x}$	$a = 6.41 - 4.35 * 1.262$			a=	0.919
The calibration is function $y_i = a + b x_i$ or			$y_i =$	$0.919 + 1.262 * x_i$	

#### 4A4.8.1 Table 4.4.1 - Calculation of calibrated CEMS values - Total Particulate Matter

Test No	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Moisture	CEMS Temp	CEMS Pressure	CEMS Dry Oxygen	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
	hr:min		(mg/m3)	(mg/m3)	(%)	(°C)	(kPa)	(%)	(mg/Nm³)	(mg/Nm³)	(mg/m3)
1	Reference		0.0	0.9	0.0			0.0	0.0	0.7	0.0
2	10:45	11:45	4.7	6.8	1.8	60.5	100.4	6.1	5.9	8.7	9.2
4	13:03	14:03	4.7	6.9	1.6	61.2	100.3	6.3	6.0	8.8	11.2
5	14:11	15:11	4.3	6.4	1.6	61.0	100.2	6.5	5.6	8.3	8.4
6	15:20	16:20	4.5	6.6	1.6	60.9	100.2	6.5	5.8	8.5	7.8
7	16:28	17:28	4.5	6.6	1.6	61.3	100.2	6.6	5.9	8.6	8.1
8	09:56	10:56	5.1	7.3	1.3	59.7	99.3	6.8	6.8	9.7	10.2
9	11:03	12:03	4.8	7.0	1.2	57.8	99.5	6.8	6.4	9.2	9.1
10	12:11	13:11	4.7	6.9	1.3	57.5	99.6	6.6	6.2	9.0	11.9
11	13:20	14:20	4.6	6.8	1.4	57.7	99.6	6.5	6.0	8.8	12.6
12	14:27	15:27	4.4	6.5	1.4	58.1	99.7	6.4	5.6	8.3	10.9
13	15:35	16:35	4.0	6.0	1.4	58.2	99.7	6.5	5.2	7.8	7.1
14	09:35	10:36	6.1	8.6	1.3	56.3	100.4	7.1	8.1	11.5	6.2
15	10:42	11:42	4.3	6.4	1.3	57.4	100.4	6.3	5.5	8.1	6.9
16	11:51	12:51	4.2	6.2	1.5	57.1	100.3	7.0	5.5	8.2	8.7
17	12:59	13:59	4.0	5.9	1.3	57.3	100.2	7.2	5.3	8.0	6.4
18	14:06	15:06	4.6	6.8	1.4	58.1	100.1	6.8	6.1	8.9	7.0
19	15:13	16:13	4.6	6.7	1.4	59.1	99.9	6.5	5.9	8.6	4.7
Sum									101.87		
Emission Limit Value (ELV) =			35	mg/Nm³							
Reference Oxygen			6 %								

#### 4A4.9.1 Plot 2.1 CEM versus SRM Parallel Test Data at CEM measurement conditions –NOx ppm, wet gas.



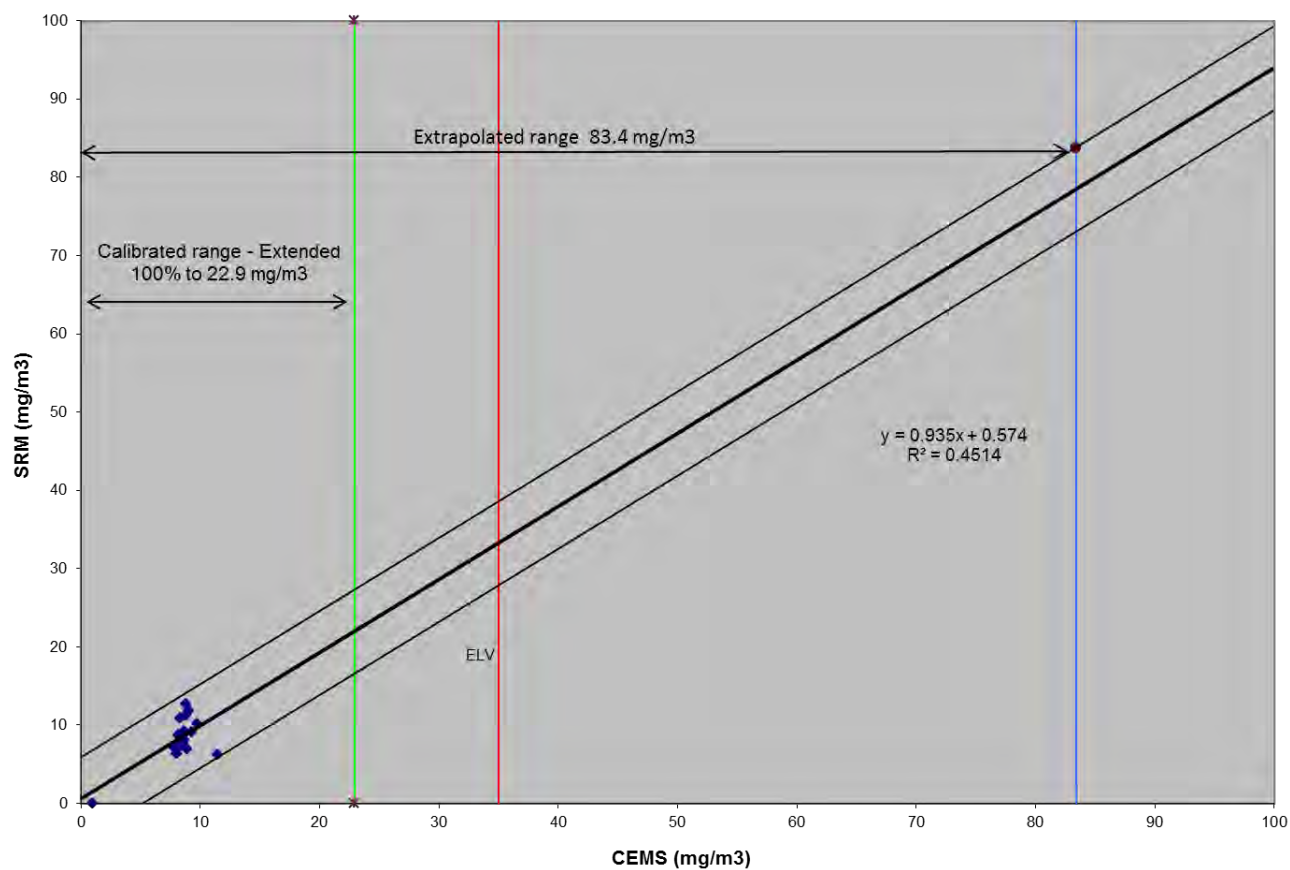
**4A4.10.1 Table 4.5.1 – Data used for the Variability Test – Total Particulate Matter**

Test No	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
	hr:min		mg/m3	mg/m3			
2	10:45	11:45	8.7	9.2	0.55	0.46	0.21
4	13:03	14:03	8.8	11.2	2.39	2.30	5.28
5	14:11	15:11	8.3	8.4	0.13	0.04	0.00
6	15:20	16:20	8.5	7.8	-0.72	-0.81	0.66
7	16:28	17:28	8.6	8.1	-0.51	-0.61	0.37
8	09:56	10:56	9.7	10.2	0.46	0.36	0.13
9	11:03	12:03	9.2	9.1	-0.14	-0.24	0.06
10	12:11	13:11	9.0	11.9	2.90	2.81	7.88
11	13:20	14:20	8.8	12.6	3.88	3.78	14.32
12	14:27	15:27	8.3	10.9	2.59	2.50	6.26
13	15:35	16:35	7.8	7.1	-0.65	-0.74	0.55
14	09:35	10:36	11.5	6.2	-5.26	-5.36	28.71
15	10:42	11:42	8.1	6.9	-1.13	-1.22	1.50
16	11:51	12:51	8.2	8.7	0.55	0.46	0.21
17	12:59	13:59	8.0	6.4	-1.61	-1.71	2.91
18	14:06	15:06	8.9	7.0	-1.92	-2.02	4.07
16 Tests		Mean			0.09		
Sum							73.11

**4A4.11.1 - Variability Test Calculation – Total Particulate Matter**

SD=	Root(1-Number).Integral(D1-D) <sup>2</sup>	2.21	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 30% ELV as a 95% confidence interval. O <sub>0</sub> is therefore calculated as:-			
O <sub>0</sub> =	0.3*35 mg/m3 (s,d,6%O2)/1.96	5.36	mg/m3(s,d),6%O2
For 16 tests, t <sub>0.95(N-1)</sub> =	0.9777		
Therefore variability=	2.21 <= 5.36 * 0.9777		
or	2.21 <=	5.24	
Which is TRUE therefore the CEMS passes the test			

**4A4.12.1 Plot 3.1 –Standardised CEM data versus standardised SRM - Total Particulate Matter  
– Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen**



## Section 5 – Results of Functional tests

**Table 5.1 - Audit of functional tests**

<b>Operator</b>	RWE Generation UK plc.	
<b>Site</b>	Aberthaw Power Plant	
<b>Stack</b>	Unit 9	
<b>Process Sector</b>	LCPD	
<b>Analyser A - Make Model MCERTs Certificate Number</b>	Procal 1 - Pulsi 2000, In Situ IR MC990006/07	
<b>Analyser B - Make Model MCERTs Certificate Number</b>	Procal 2 - Pulsi 2000, In Situ IR MC990006/07	
<b>Analyser C - Make Model MCERTs Certificate Number</b>	Erwin SICK OMD41, Cross Duct Forward Scatter MC040042/01	
<b>Analyser D - Make Model MCERTs Certificate Number</b>	SICK Maihak GmbH GM32 – In-situ MC100163/01	
<b>Parameters Tested</b>	<b>Daily ELV</b>	<b>Certified range</b>
<b>NO &amp; NO<sub>2</sub></b>	1210 mg/m <sup>3</sup> (NO <sub>x</sub> as NO <sub>2</sub> )	PROCAL: NO = 0 – 1000 ppm  GM 32: Measuring path length 1.25m: NO 0 to 70 mg/m <sup>3</sup> & 0 to 700 mg/m <sup>3</sup>  GM 32: Measuring path length 1.00m NO 0 to 87.5 mg/m <sup>3</sup> & 0 to 875 mg/m <sup>3</sup>
<b>Total Particulate Matter</b>	55 mg/m <sup>3</sup>	Erwin SICK: TPM = 0 – 200 mg/m <sup>3</sup>
<b>SO<sub>2</sub></b>	440 mg/m <sup>3</sup>	PROCAL = SO <sub>2</sub> low = 0 – 250 ppm SO <sub>2</sub> high = 0 – 1000 ppm  GM 32: Measuring path length 1.25m: SO <sub>2</sub> 0 to 75mg/m <sup>3</sup> & 0 to 1000mg/m <sup>3</sup>  GM 32: Measuring path length 1.00m SO <sub>2</sub> 0 to 93.8 mg/m <sup>3</sup> and 0 to 1250 mg/m <sup>3</sup>

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	16 <sup>th</sup> to 25 <sup>th</sup> February 2016
Analyser C & D	
Organisation carrying out tests -	SICK
Status of organisation – CEMS manufacturer/operator/service contractor	CEMS OEM
Test engineer	P. Burgess & Rhodri Jones
Date of tests	16 <sup>th</sup> to 25 <sup>th</sup> February 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"> <li>- sampling probe;</li> <li>- gas conditioning systems;</li> <li>- pumps;</li> <li>- all connections;</li> <li>- sample lines;</li> <li>- power lines;</li> <li>- filters.</li> </ul> <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><b>Procal</b> – Yes <b>SICK (OMD)</b> – Yes – Optics cleaned <b>SICK (GM32)</b> – 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>	N/A	<p><b>Procal</b> – N/A although differential pressure noted as OK <b>SICK (OMD &amp; GM32)</b> – N/A</p>
<p>Results of leak check compliant with requirements of relevant standards</p>	N/A	
<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>	Yes	<p><b>Procal</b> – Yes <b>SICK (OMD 41)</b> – Yes – although based on the use of filters <b>SICK (GM32)</b> – Yes, although based on the use of filters</p>
<p>Results compliant with requirements of relevant standards</p> <p>Parameter:</p>		
<p>NO</p> <p>SO<sub>2</sub></p> <p>TPM</p>	<p>Yes (Procal)</p> <p>Yes (Procal)</p> <p>Yes</p>	<p><b>SICK (GM32)</b> – Span value of filters not stated, though analyser response recorded <b>SICK (OMD41)</b> - Span values recorded as mA signals</p>

Requirement	Compliance Y/N	Notes
4 - Zero and Span Check Full System  Reference zero and span materials shall be used to verify the corresponding readings of the AMS.	N/A	Procal, & SICK GM 32 analysers are in situ type and therefore there is as such, no 'full system'.
5 – NOx converter efficiency check	N/A	
6 - Linearity  The linearity of the analysers shall be checked using five different reference materials, including zero concentration.	Yes – Procal, SICK OMD 41 No – SICK GM32	<b>Procal</b> – Yes <b>SICK (OMD)</b> – Yes – although based on the use of filters
The reference material with zero concentration, as well as the reference materials with four different concentrations, shall have a verifiable quantity and quality.	Yes	<b>Procal</b> – Yes <b>SICK</b> – Yes – although based on the use of filters <b>SICK (GM32)</b> - N/A
The reference material concentrations shall be selected such that the measured values are approximately 20%, 40%, 60% and 80% of two times the emission limit.	See note	<b>Procal</b> – Yes <b>SICK</b> – Used 8 points using filters <b>SICK (GM32)</b> - N/A
The dry test reference material shall be applied to the inlet of the AMS.  Reference materials can be introduced directly into the analyser as long as the integrity of the sample system has been proved	N/A	N/A

Requirement	Compliance Y/N	Notes
<p>6 – Linearity (continued) 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><b>Procal</b> – No times stated in report</p> <p><b>SICK (OMD &amp; GM32)</b> – No times stated in report</p>
Linearity Test Pass Parameter		<p><b>Procal</b> – Yes</p> <p><b>SICK (OMD)</b> – Yes</p>
NO, SO <sub>2</sub> & TPM	Yes	
6 – Interferences (only required in the event of a failure of the QAL 2/AST)	N/A	
7 – Zero and Span Drift (Audit)	Yes	
<p>8- Response time</p> <p>The response of the AMS shall be checked. This can be performed, if appropriate, by feeding the reference material at the end of the sampling probe. The response time shall not exceed the measured value as identified during QAL 1.</p>	See Note	<p><b>Procal</b> – Yes</p> <p><b>SICK (OMD 41)</b> – Yes</p> <p><b>SICK (GM 32)</b> – No</p>

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

Requirement	Compliance Y/N	Notes
9c – Service Report – <b>SICK OMD</b>		
• Document reference	Yes	
• Instrument manufacturer	Yes	
• Instrument Type	Yes	
• Instrument model	Yes	
• Instrument Serial No's	Yes	
• Operating principal	Yes	
• Operating range	Yes	
• Certification details	Yes	
• Compliance with MCERTS	Yes	
• Location	Yes	
• Date and time of work	Yes	Date Only
• Equipment used - Type serial no's etc	Yes	On Linearity Sheet
• Gases used – certificate numbers, expiry dates, type	N/A	Linearity carried out using filters. Filter numbers stated (F1 to F8)
• NOx converter efficiency check	N/A	
• Calibration and linearity data	Yes	
• Logged data for period of calibration/linearity	Yes	Data supplied separately by client
• Name & signature of test engineer	Yes	

Requirement	Compliance Y/N	Notes
<b>9c – Service Report – SICK GM32</b>		
• Document reference	Yes	
• Instrument manufacturer	Yes	
• Instrument Type	Yes	
• Instrument model	Yes	
• Instrument Serial No's	Yes	
• Operating principal	Yes	
• Operating range	Yes	
• Certification details	Yes	
• Compliance with MCERTS	Yes	
• Location	Yes	
• Date and time of work	Yes	
• Equipment used - Type serial no's etc	No	
• Gases used – certificate numbers, expiry dates, type	N/A	No gases used
• NOx converter efficiency check	N/A	
• Calibration and linearity data	Yes	Calibration data only – linearities not carried out
• Logged data for period of calibration/linearity	Yes	Analyser readout checked against DCS values
• Name & signature of test engineer	Yes	

<b>SICK (UK) LTD</b> Waldkirch House, 39 Hedley Rd St Albans, Herts, AL1 5BN	<b>SICK</b>	Tel : 0044 (0)1727 831121 Fax : 0044 (0)1727 855332 E – Mail : info@sick.co.uk
<b>GM32 – Probe</b>		
BS EN 14181 – Functional Test & Maintenance Report		

Customer	RWE NPower
Site	Aberthaw
Contact	Dan Peters
Service Ref No.	SVON 018532
Survey Dates	16-2-16
Device Type	GM32 Probe version
Serial Number	13038025
Device Location	Unit 9
MCERTS Cert No	MC100163/01
Certification Details	See Certificate
Measurement Principle	UV Spectroscopy
SICK Engineer	P. Burgess
Signature	P. Burgess

Actual installation data			Remarks
Location	Outside <input type="checkbox"/>	Under cover <input type="checkbox"/>	Inside <input type="checkbox"/>
Ambient temperature	8	°C	
Gas temperature	63	°C	
Length of the probe / Flange – Flange (CD)	1500	mm	
Active measurement distance	500	mm	
Zero path	500	mm	

Plant operating status:	ON LINE
-------------------------	---------

Measurement values before check					
	Unit	Range	Reading	Zero point	Span point
SO <sub>2</sub>	PPM	1200	72	0	837.1
NO	PPM	1000	241	0	697.6
NO <sub>2</sub>	PPM	100	6.3	-0.1	69.8
SO <sub>2</sub> L	PPM	250	70.4	0	174.4
Temp.	DEGREES C		57	- X -	- X -
Press.	MBAR		1031	- X -	- X -

Lamp data		
Max. lamp intensity	19500	Exposure: 500 ms
		Lamp pulse: 20 mA

1. Alignment & Cleanliness		
1.1 Visual Inspection of the analyser	<input checked="" type="checkbox"/>	OK
1.2 Internal check of the analyser	<input checked="" type="checkbox"/>	OK
1.3 Cleanliness of optical components	<input checked="" type="checkbox"/>	OK
1.4 Flushing of air supply	<input checked="" type="checkbox"/>	OK
1.5 Obstructions in the optical path	<input checked="" type="checkbox"/>	NONE
1.6 Check optical alignment of the Analyser	<input checked="" type="checkbox"/>	OK

<b>2. Sampling System</b>		
2.1	System in good condition and free from faults	<input checked="" type="checkbox"/> YES
2.2	Visual Inspection of sampling probe	<input checked="" type="checkbox"/> OK
2.3	Check of the Gas Conditioning System	<input checked="" type="checkbox"/> NA
2.4	Check of the sample pump	<input checked="" type="checkbox"/> NA
2.5	Check of all hoses, gas lines and connections	<input checked="" type="checkbox"/> ALL OK
2.6	Check of power supplies	<input checked="" type="checkbox"/> OK
2.7	Check of all filters	<input checked="" type="checkbox"/> CUSTOMERS OWN SCHEDULE
2.8	Check of heated lines are operating correctly	<input checked="" type="checkbox"/> NA
2.9	Efficiency of NOx converter > 95% (if applicable)	<input checked="" type="checkbox"/> NA
2.10	Has the response time been checked by applying gas to probe	<input checked="" type="checkbox"/> NA

<b>3. Serviceability</b>		
3.1	Safe & Clean working environment for servicing	<input checked="" type="checkbox"/> GOOD
3.2	Adequate supply of reference gases	<input checked="" type="checkbox"/> YES
3.3	Adequate supply of spare parts	<input checked="" type="checkbox"/> YES
3.4	Ability to apply gas at probe	<input checked="" type="checkbox"/> NO
3.5	Output signals checked	<input checked="" type="checkbox"/> YES

<b>4. Zero Span &amp; Leak Checks</b>		
4.1	Leak check of whole system carried out	<input checked="" type="checkbox"/> NA
4.2	Have span checks been carried out at suitable levels	<input checked="" type="checkbox"/> 70% RANGE
4.3	Have zero checks been carried out at suitable levels	<input checked="" type="checkbox"/> YES @ ZERO

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

<b>6. Visual inspection</b>	
6.1 Check measured values are plausible in control room	<input type="checkbox"/> YES
6.2 Check if control cycle is (zero/span) valid	<input type="checkbox"/> YES
6.3 Check if messages are active	<input type="checkbox"/> NONE
Failure:	
Maintenance Req:	
Uncertain:	
6.4 Check for mechanical damages	<input type="checkbox"/> NONE
6.5 Check attachments and connections	<input type="checkbox"/> ALL OK

<b>7. Purge air unit (only GMP and Cross-Duct)</b>	
7.3 Check the hoses and clamps for hose	<input type="checkbox"/> OK
7.4 Exchange purge air filter (order no 5306091)	<input type="checkbox"/> CUSTOMERS OWN SCHEDULE
7.5 Clean pre-filter housing	<input type="checkbox"/> OK
7.6 Check noise of blower	<input type="checkbox"/> QUIET
7.7 Check function of purge air heating and setting (option)	<input type="checkbox"/> 70 DEGREES
7.8 Check function of differential pressure monitor (option)	<input type="checkbox"/> OK

<b>8. Probe (GMP or GPP)</b>	
8.3 Clean probe	<input type="checkbox"/> OK
8.4 Check Probe for corrosion	<input type="checkbox"/> NONE
8.5 Check probe for damage and functionality	<input type="checkbox"/> ALL OK

<b>9. Connection unit</b>	
9.3 Clean housing	<input type="checkbox"/> OK
9.4 Check power supply	<input type="checkbox"/> OK
26V±0,3V: 26.3      115V±1V: 114.4	
9.5 Check analogue input / output (option)	<input type="checkbox"/>
9.6 Check digital input / output (option)	<input type="checkbox"/>
9.7 Check parameterization of the I/O-Module	<input type="checkbox"/>

<b>10. Sender / receiver unit (reflector)</b>		
10.3	Check drying agent cartridges, exchange if req.	<input type="checkbox"/> NOT REQD
10.4	Clean all optical surfaces of the and the reflector	<input type="checkbox"/> OK
10.5	Check stepper motor for proper function	<input type="checkbox"/> OK
10.6	Check fans	<input type="checkbox"/> GOOD
10.7	Check spectrometer signals	<input type="checkbox"/> ALL OK
10.8	Check lamp	<input type="checkbox"/> CHANGED
10.9	Check emission free zero point	<input type="checkbox"/> OK
10.10	Check the alignment adjust	<input type="checkbox"/> DONE
10.11	Check signal strength	<input type="checkbox"/> OK
	A: 788                      B: 802	OK
	C: 783                      D: 840	OK
10.12	Check mirror steps	<input type="checkbox"/> OK
	Dx: 0.026                      Dy: 0.031	OK
10.13	Check parameterization	<input type="checkbox"/> OK

<b>11. Final check</b>		
11.3	Check function of complete measurement system	<input type="checkbox"/> OK
11.4	Check the availability of the system	<input type="checkbox"/> NA
11.5	Save device data external	<input type="checkbox"/> DONE
11.6	Complete service report	<input type="checkbox"/> DONE

<b>12. Additional comments</b>	
Quality of maintenance work by plant personnel: OK	
Cleanliness of measuring station and devices: OK	
Maintenance work done (in addition to Annex 1): LAMP CHANGED	
Problems found, solution applied: NONE	
Recommendation for repair, changes NONE	
Availability of the unit: NA	
Proposal how to reach higher availability and better emission data quality: NONE	
Training provided to plant personnel, proposal for settlement:NO	
Training requirements detected: NONE	

13. Measurement values after check					
	Unit	Range	Reading	Zero point	Span point
SO <sub>2</sub>	PPM	1200	72	0	844.4
NO	PPM	1000	242	0	703.6
NO <sub>2</sub>	PPM	100	8.4	0	70.4
SO <sub>2</sub> LOW	PPM	250	72.3	0	175.9
Temp.	DEGREES C		66	- X -	- X -
Press.	MBAR		1030	- X -	- X -

<b>Remarks</b>
Approved by customer Name: _____
Position: _____



## CALIBRATION CERTIFICATE

Site	Aberthaw	
Date	16/02/2016	
Instrument	Unit 9 Primary	
Instrument Ref	8800736	8500443
Engineer	Michael Findley	

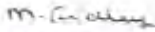
### Results:

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	321	103588	316	316	-1.0
NO	PPM	1000	634		633	633	-0.1
SO2-H	PPM	1000	663	184198	663	665	0.2
SO2-L	PPM	250	204.9	9414329003	199	205	0.0

### Cross sensitivity tests:

Test/	Response			% Error FSD		
	CO	NO	SO2-H	CO	NO	SO2-H
CO2 15%	-1	11	4	-0.2	1.1	0.4
H2O 3%	3	-16	3	0.6	-1.6	0.3
CO2 15% + H2O 3%	6	-11	-1	1.2	-1.1	-0.1

Test/	Response			% Error FSD		
	SO2-L			SO2-L		
CO2 15%	4			1.6		
H2O 3%	3			1.2		
CO2 15% + H2O 3%	-1			-0.4		

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

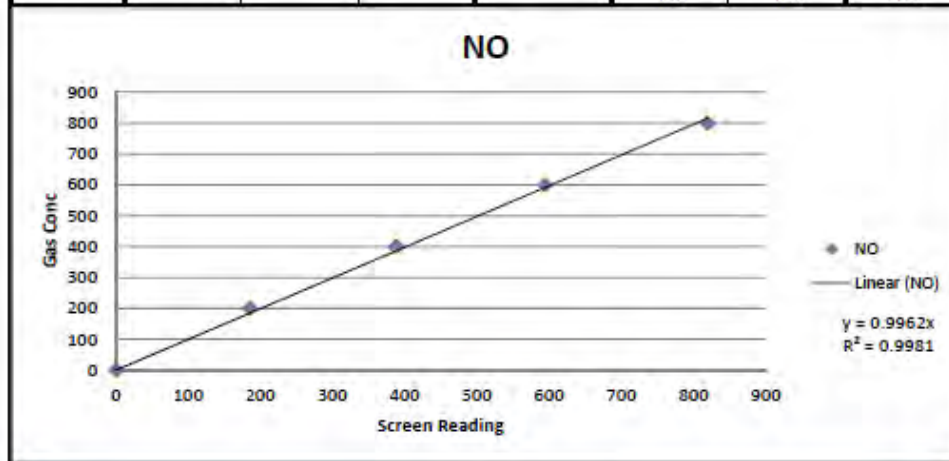


## LINEARISATION RESULTS

Site	Aberthaw	
Date	23/02/2016	
Instrument	Unit 9 Primary	
Instrument Ref	8800736	8500443
Engineer	Michael Findley	

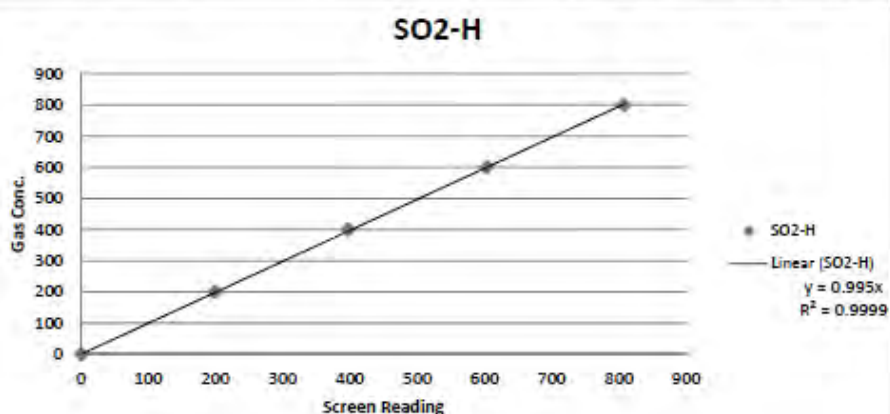
The above analyser has undergone a linearisation check and calibration, if required, in accordance with the company's quality system. The following results were obtained.

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
NO	PPM	1000	800	40005501914	819	819	1.9
					820	820	2.0
					820	820	2.0
NO	PPM	1000	600	40006064936	594	594	-0.6
					597	597	-0.3
					592	592	-0.8
NO	PPM	1000	400	40006064936	388	388	-1.2
					387	387	-1.3
					384	384	-1.6
NO	PPM	1000	200	40006064936	185	185	-1.5
					185	185	-1.5
					182	182	-1.8



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Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
SO2-H	PPM	1000	800	40006094212	807	807	0.7
					809	809	0.9
					808	808	0.8
SO2-H	PPM	1000	600	40008094212	603	603	0.3
					599	599	-0.1
					599	599	-0.1
SO2-H	PPM	1000	400	40008094212	397	397	-0.3
					396	396	-0.4
					396	396	-0.4
SO2-H	PPM	1000	200	40006094212	199	199	-0.1
					200	200	0.0
					199	199	-0.1



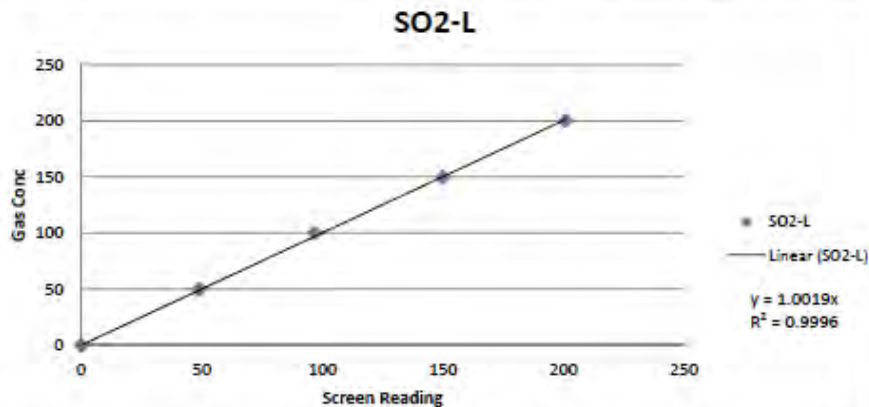
Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK TEL:+44(0)1733 23495 FAX:+44(0)1733 235255  
E-mail: [asampson@procal.com](mailto:asampson@procal.com) Website: [www.procal.com](http://www.procal.com)

7-7862-04 Linearisation Certificate

Change note: 7009251

Date: 30/07/12

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
SO2-L	PPM	250	200	40005732643	201	201	0.4
					201	201	0.4
					201	201	0.4
SO2-L	PPM	250	150	40005732643	150	150	0.0
					145	145	-2.0
					147	147	-1.2
SO2-L	PPM	250	100	40005732643	97	97	-1.2
					97	97	-1.2
					97	97	-1.2
SO2-L	PPM	250	50	40005732643	49	49	-0.4
					47	47	-1.2
					46	46	-1.6



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

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

We,

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Woodston  
Peterborough  
Cambridgeshire  
PE2 7HU  
United Kingdom

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Fax: (+44) (0) 1733 235255

e-mail: [post@procal.com](mailto:post@procal.com)

Web site: [www.procal.com](http://www.procal.com)

declare that the product: Type PULSI 200 Analyser installed at

Customer	Aberthaw Power Station
Control Unit Serial Number	8800736
P200 Serial Number	8500443M
Site Identification	Unit 9 Primary

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

#### MCERTS Product Conformance Certificates:

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

#### MCERTs Certification Body:

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

#### Quality System:

ISO 9001:2008	Certificate Nr: 062043	Dated: 11/06/09
---------------	------------------------	-----------------

#### 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: 16/02/2016 .....

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F:/Drawings & Forms/Forms & procedures/Forms/Current/7-7880-01 Functionality Test Results inc App1  
Change Note: 7008144 Date: 24/09/10 Page 1 of 6



## 1.0 Alignment and Cleanliness.

### 1.1 Internal Check of Analyser

Analyser under test	Status	Notes
Optical path clear	Yes	
Optics clean	Yes	
Internal wiring ok	Yes	
Air supply on	Yes	
Purge flow >300 ltrs/hr	Yes	
Pressure differential <80mBar	Yes	39mbar

## 2.0 Zero and Span Checks.

### 2.1 Zero Check

Component:	H2O	CO2	CO	NO	SO2-L	SO2-H	Ta	Ts	Ps
Units:	%	mAU	ppm	ppm	ppm	ppm			
Process conc	1.5	149	279	253	67	71	18.7	130	1030
Zero conc	0	0	3	3	-1	-1	18.7	128	1069
% 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-L	SO2-H	Ta	Ts	Ps
Units:	%	mAU	ppm	ppm	ppm	ppm			
Full range	10	-	500	1000	250	1000			
Zero Conc	0	0	1	1	0	0	15.8	128	1056
Test Gas Conc		663	321	634	204.9	663			
Cert number			103588		941432 9003	329003			
Response Conc			316	633	202	665	15.9	128	1061
% Error			<2	<2	<2	<2			
Pass/Fail			Pass	Pass	Pass	Pass			
T90 time				105	90	120			

### 2.3 Filter Level Checks

All on zero air	F6	F2	F7	F5G	F3	F1G	F4	F8	
Factory	2654	4200	3831	2222	3333	2070	859	4994	
Last visit	2628	4276	4099	2430	3477	2417	854	4657	
This visit	2761	4390	4187	2482	3572	2497	901	4942	



## 2.4 Interference Checks

Component:	H2O	CO2	CO	NO	SO2-L	SO2-H
Units:	%	mAU	ppm	ppm	ppm	ppm
ZERO	0	0	2	2	2	2
CO2 15%	0	156	-1	11	4	4
H2O 3%	2.1	1	3	-16	3	3
H2O 3% & CO2 15%	2.3	157	6	-11	-1	-1

## 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-L	SO2-H
	Linear	1.530E-02	1	7.530E0	1.240E01	4.850E00	5.140E00
Last test	Squared	5.670E-05	0	1.180E-01	6.750E-02	9.000E-04	-4.790E-4
	Cubed						
	Linear	1.530E-02	1	7.680E+00	1.200E+01	4.990E+00	4.990E+00
This test	Squared	5.670E-05	0	1.200E-01	6.560E-02	-4.650E-4	9.250E-04
	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	
<b>1. Alignment and Cleanliness</b>		
A visual inspection, with reference to the CEMs manuals, shall be carried out on the following when applicable:		
• Internal check of the CEM	√	
• Cleanliness of the optical components	√	
• Flushing air supply	√	
• 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)	√	
<b>2. Sampling Systems</b>		
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
<b>3. Leak testing</b>		
• Leak testing shall be performed according to the CEMs manuals. The tests shall cover the entire sampling system.	n/a	
<b>4. Zero and Span check</b>		
• 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
<b>5. Linearity</b>		
• 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



Requirement		Notes
DCS logged values should be included in the instrument service report.	✓	Data collected on ACU MK3 & customer DCS during testing
• The linearity of the CEM's response shall be checked using five different reference materials, including a zero concentration.	✓	See linearity Cert
• 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
• 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
• 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:		
• Reference material with zero concentration;	✓	See linearity cert
• Reference material concentration approximately 20 % of 2 times the emission limit;	✓	See linearity cert
• Reference material concentration approximately 40 % of 2 times the emission limit;	✓	See linearity cert
• Reference material concentration approximately 60 % of 2 times the emission limit;	✓	See linearity cert
• Reference material concentration approximately 80 % of 2 times the emission limit;	✓	See linearity cert
• Reference material with zero concentration;	✓	See linearity cert
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.		
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.		



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.	
<b>6. Interferences</b>	
* A test shall be undertaken if the process gases to be monitored contain components that are known interferences, as identified during QAL1 and there is a failure of the QAL2 or AST which could be due to interferences.	√ Interference checks made with Water vapour, CO2 and each gas species
<b>7. Zero and Span drift (Audit)</b>	
* 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.	√ Customer has procedure in place and has documented evidence
<b>Response Time</b>	
* The response time of the CEM shall be checked. This can be performed, if appropriate, by feeding of the reference material at the end of the sampling probe. The response time shall not exceed the performance requirement applied during the QAL1 tests.	√ Response time recorded on test sheet and this test sheet
<b>9. Service Report</b>	
As a minimum requirement the service report should include the following:	
* Document reference for work instruction for the type of work being undertaken	√ Procal Method Statement
* Instrument manufacturer	√ Procal
* Instrument type	√ Pulsi 2000
* Instrument model	√ P2000
* Instrument Serial No	√ 8500443M
* Operating principle	√ GFCIR & NIR
* Operating range	√ Recorded on this report
* Certification details	√ Mcerted
* Compliance with MCERTS (including certificate no.)	√ SIRA MC 990006/08
* Location	√ Unit 9 Back Up
* Date and time work was undertaken	√ 16/02/2016
* Equipment used - type, serial no's, calibration dates	√ Procal Water Generator/Gas divider Pcal #6
* Gases used - certificate numbers, expiry dates, binary / mix	√ Copy of Gas Certs at customer request can be emailed
* NOx converter efficiency test, if applicable	n/a
* Calibration and linearity data as required by EN14181	√ See Linearity & (Calcert Data)
* Logged data for period of calibration and linearity. Note there may be gaps in the data, in such cases, the test laboratory shall state why there are gaps in the data	√ See Linearity & (Calcert Data)



## CALIBRATION CERTIFICATE

Site	Aberthaw	
Date	16/02/2016	
Instrument	Unit 9 Back Up	
Instrument Ref	8800624	8500707
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	321	103588	321	322	0.2
NO	PPM	1000	834		885	834	0.0
SO2-H	PPM	1000	863	184198	881	861	-0.2
SO2-L	PPM	250	204.9	9414329003	197	206	0.4

### Cross sensitivity tests:

Test/	Response			% Error FSD		
	CO	NO	SO2-H	CO	NO	SO2-H
CO2 15%	-7	-1	-1	-1.4	-0.1	-0.1
H2O 3%	4	-3	0	0.8	-0.3	0.0
CO2 15% + H2O 3%	-2	-5	7	-0.4	-0.5	0.7

Test/	Response			% Error FSD		
	SO2-L			SO2-L		
CO2 15%	-1			-0.4		
H2O 3%	0			0.0		
CO2 15% + H2O 3%	5			2.0		

Signature: *M. Findley*

M. Findley  
Procal Customer Support Engineer

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7-7853-02 cal cert site visit general use

Change note: 7007110

Date: 17/03/09

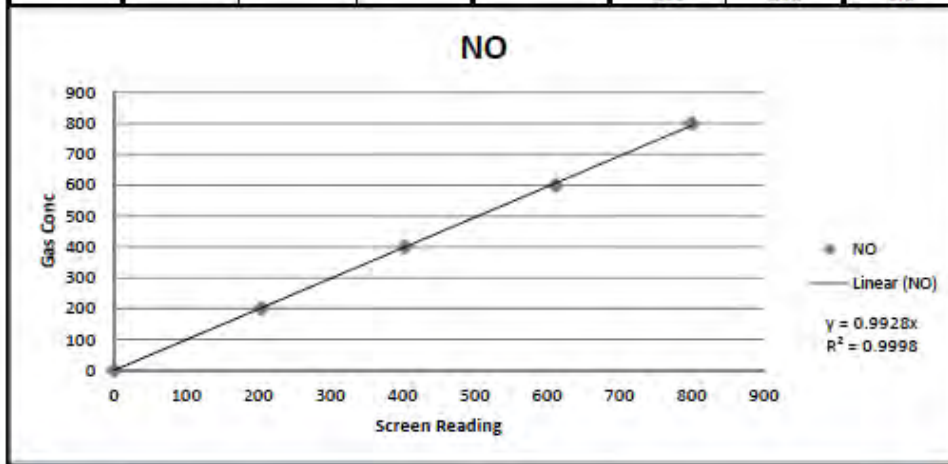


## LINEARISATION RESULTS

Site	Aberthaw	
Date	25/02/2016	
Instrument	Unit 9 Back Up	
Instrument Ref	8800624	8500707
Engineer	Michael Findley	

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

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
NO	PPM	1000	800	49397074001	800	800	0.0
					800	800	0.0
					800	800	0.0
NO	PPM	1000	600	40006064936	611	611	1.1
					606	606	0.6
					607	607	0.7
NO	PPM	1000	400	40006064936	403	403	0.3
					407	407	0.7
					405	405	0.5
NO	PPM	1000	200	40006064936	204	204	0.4
					202	202	0.2
					200	200	0.0

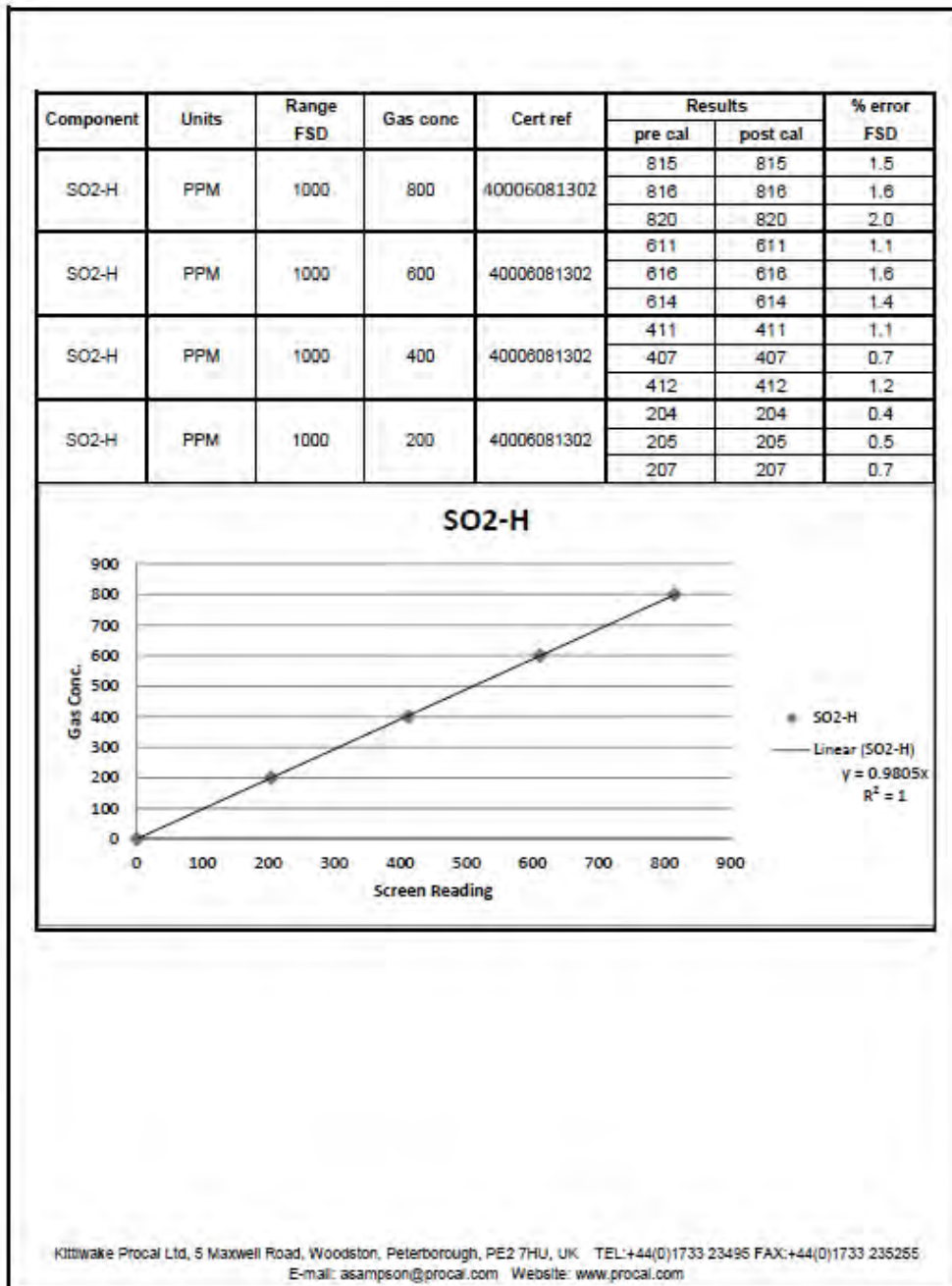


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7-7862-04 Linearisation Certificate

Change note: 7009251

Date: 30/07/12

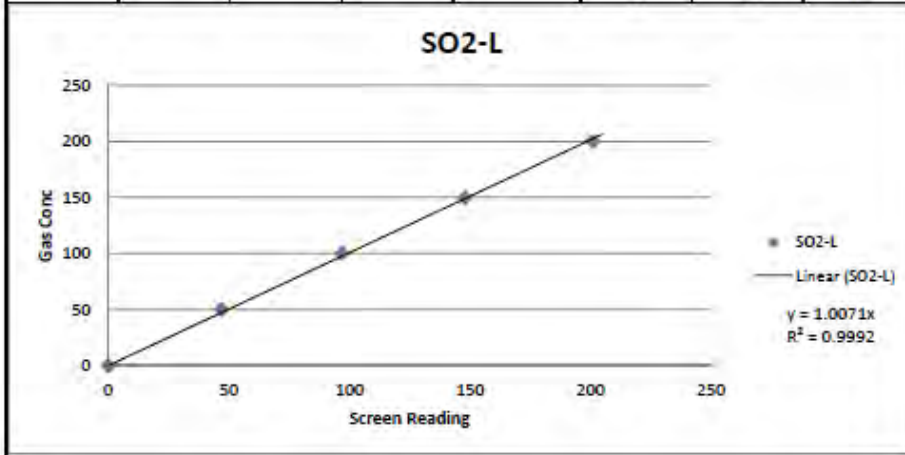


7-7862-04 Linearisation Certificate

Change note: 7009251

Date: 30/07/12

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
SO2-L	PPM	250	200	40005732643	201	201	0.4
					202	202	0.8
					205	205	2.0
SO2-L	PPM	250	150	40005732643	148	148	-0.8
					155	155	2.0
					154	154	1.6
SO2-L	PPM	250	100	40005732643	97	97	-1.2
					101	101	0.4
					101	101	0.4
SO2-L	PPM	250	50	40005732643	47	47	-1.2
					53	53	1.2
					53	53	1.2



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

Signature: *M. Findley*

M. Findley

Procal Customer Support Engineer

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

E-mail: [asampson@procal.com](mailto:asampson@procal.com) Website: [www.procal.com](http://www.procal.com)

7-7862-04 Linearisation Certificate

Change note: 7009251

Date: 30/07/12



## Functionality Test Results

### DECLARATION OF CONFORMITY

We,

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

Tel: (+44) (0) 1733 232495

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e-mail: [post@procal.com](mailto:post@procal.com)

Web site: [www.procal.com](http://www.procal.com)

declare that the product: Type PULSI 200 Analyser installed at

Customer	Aberthaw Power Station
Control Unit Serial Number	8800624
P200 Serial Number	8500707
Site Identification	Unit 9 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	
12 Acorn Industrial Park	Tel: (+44) (0) 1322 520500
Crayford Road	
Crayford	Fax: (+44) (0) 1322 520501
Dartford	
Kent	
DA1 4AL	e-mail: <a href="mailto:info@siraenvironmental.com">info@siraenvironmental.com</a>
United Kingdom	Web site: <a href="http://www.siracertification.com">www.siracertification.com</a>

#### Quality System:

ISO 9001:2008	Certificate Nr: 062043	Dated: 11/06/09
---------------	------------------------	-----------------

#### 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: 16/02/2016.....

Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, United Kingdom  
Tel: +44 (0) 1733 232495 E-mail: [procal@parker.com](mailto:procal@parker.com) Web: [www.procal.com](http://www.procal.com)  
F:/Drawings & Forms/Forms & procedures/Forms/Current/7-7880-01 Functionality Test Results inc App1  
Change Note: 7008144 Date: 24/09/10 Page 1 of 6



## 1.0 Alignment and Cleanliness.

### 1.1 Internal Check of Analyser

Analyser under test	Status	Notes
Optical path clear	Yes	
Optics clean	Yes	
Internal wiring ok	Yes	
Air supply on	Yes	
Purge flow >300 ltrs/hr	Yes	
Pressure differential <80mBar	Yes	51mbar

## 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	1.6	148	130	232	80	56	21.1	129.6	1019
Zero conc	0	0	-1	3	0	0	21.1	127.4	1070
% error	<2	<2	<2	<2	<2	<2			
Pass/Fail	Pass	Pass	Pass	Pass	Pass	Pass			
T90 recovery									

### 2.2 Span Check

Component:	H2O	CO2	CO	NO	SO2-H	SO2-L	Ta	Ts	Ps
Units:	%	mAU	ppm	Ppm	ppm	ppm			
Full range	10	-	500	1000	1000	250			
Zero Conc	0	0	-1	4	1	1	21.2	127.4	1071
Test Gas Conc			321	634	663	204.9			
Cert number			103588		184198	941432 9003			
Response Conc			322	634	661	206	21.2	128	1082
% Error			<2	<2	<2	<2			
Pass/Fail			Pass	Pass	Pass	Pass			
T90 time				80	95	70			

### 2.3 Filter Level Checks

All on zero air	F2	F4	F6	F1G	F7	F5G	F8	F3	
Factory	2316	3751	4570	2975	3045	1901	490	2442	
Last visit	1738	3103	3649	2419	2441	1686	492	2451	
This visit	1747	3014	3567	2364	2423	1686	468	2322	



## 2.4 Interference Checks

Component:	H2O	CO2	CO	NO	SO2-H	SO2-L
Units:	%	mAU	ppm	ppm	ppm	ppm
ZERO	0	0	0	-3	-3	-3
CO2 15%	-0.1	160	-7	-1	-1	-1
H2O 3%	1.9	1	4	-3	0	0
H2O 3% & CO2 15%	2.3	158	-2	-5	7	5

## 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
	Linear	1.570E-02	1	6.527E0	1.081E1	6.373E0	5.923E0
Last test	Squared	4.210E-05	0	9.250E-02	2.728E-02	-2.549E-3	6.462E-04
	Cubed						
	Linear	1.570E-02	1	6.527E+00	1.094E+01	6.302E+00	6.189E+00
This test	Squared	4.210E-05	0	9.250E-02	2.760E-02	-2.521E-3	6.752E-04
	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	
<b>1. Alignment and Cleanliness</b>		
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-alignment required
• Alignment of the measuring system	✓	No alignment required
• Contamination control (internal check of optical surfaces)	✓	
<b>2. Sampling Systems</b>		
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
<b>3. Leak testing</b>		
• Leak testing shall be performed according to the CEMs manuals. The tests shall cover the entire sampling system.	n/a	
<b>4. Zero and Span check</b>		
• 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
<b>5. Linearity</b>		
• 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
• The linearity of the CEM's response shall be checked using five different reference materials, including a zero concentration.	✓	See linearity Cert
• 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
• 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
• 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:		
• Reference material with zero concentration;	✓	See linearity cert
• Reference material concentration approximately 20 % of 2 times the emission limit;	✓	See linearity cert
• Reference material concentration approximately 40 % of 2 times the emission limit;	✓	See linearity cert
• Reference material concentration approximately 60 % of 2 times the emission limit;	✓	See linearity cert
• Reference material concentration approximately 80 % of 2 times the emission limit;	✓	See linearity cert
• Reference material with zero concentration;	✓	See linearity cert
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.		
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.		



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.	
<b>6. Interferences</b>	
* A test shall be undertaken if the process gases to be monitored contain components that are known interferences, as identified during QAL1 and there is a failure of the QAL2 or AST which could be due to interferences.	√ Interference checks made with Water vapour, CO2 and each gas species
<b>7. Zero and Span drift (Audit)</b>	
* 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.	√ Customer has procedure in place and has documented evidence
<b>Response Time</b>	
* The response time of the CEM shall be checked. This can be performed, if appropriate, by feeding of the reference material at the end of the sampling probe. The response time shall not exceed the performance requirement applied during the QAL1 tests.	√ Response time recorded on test sheet and this test sheet
<b>9. Service Report</b>	
As a minimum requirement the service report should include the following:	
* Document reference for work instruction for the type of work being undertaken	√ Procal Method Statement
* Instrument manufacturer	√ Procal
* Instrument type	√ Pulsi 2000
* Instrument model	√ P2000
* Instrument Serial No	√ 8500707
* Operating principle	√ GFCIR & NIR
* Operating range	√ Recorded on this report
* Certification details	√ Mcerted
* Compliance with MCERTS (including certificate no.)	√ SIRA MC 990006/08
* Location	√ Unit 9 Back Up
* Date and time work was undertaken	√ 16/02/2016
* Equipment used - type, serial no's, calibration dates	√ Procal Water Generator/Gas divider Pcal #6
* Gases used - certificate numbers, expiry dates, binary / mix	√ Copy of Gas Certs at customer request can be emailed
* NOx converter efficiency test, if applicable	n/a
* Calibration and linearity data as required by EN14181	√ See Linearity & (Calcert Data)
* Logged data for period of calibration and linearity. Note there may be gaps in the data, in such cases, the test laboratory shall state why there are gaps in the data	√ See Linearity & (Calcert Data)



**Dust Hunter C200 - Linearity Report**

Customer	RWE nPower
Site	Aberthaw Power Station
CEM Location	UNIT 9
Permit Ref	A1234
Contact	Dan Peters
Service Ref No.	SVON018532
Survey Date	16.02.2016
Device Type	Dusthunter C200
Serial Number	1127 8547
MCERTS Cert No	MC090150/00
Certification Details	See Certificate
Measurement Principle	Opacity & Back Scattered Light
Filter Set Serial Number	1123 8411/1123 8413
SICK Engineer	Rhodri Jones
Signature	

Sick (UK) Ltd  
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Hertfordshire  
AL1 5BN



Tel: +44 (0) 1727 831121  
Fax: +44 (0) 1727 855332  
E-Mail: info@sick.co.uk

### High Range Particulate Linearity (Opacity/Extinction)

Customer	RWE nPower
Plant	Aberthaw Power Station
Site Contact	Dan Peters
Product	DH C200
MCERTS Certificate Number	MC090160/00
Location	UNIT 9

Site Permit Ref	A1234
SVON No	SVON018532
Order Number	NA
QAL2/AST/Routine	AST
Date	18.02.2018
Engineer	Rhodri Jones

Filter Set S/N	1123 8411/1123 8413
Calibration Date	12.04.2015
Results Visible on DCS?	Device disconnected from network
Corrections Applied?	NA

Response time ( $T_{90}$ ) seconds	3
Permit Daily ELV for Dust $\text{mg.m}^{-3}$	100
Plant ELV x 2, $\text{mg.m}^{-3}$ ( $c_u$ )	200
Analysers Range (Ex)	1.6

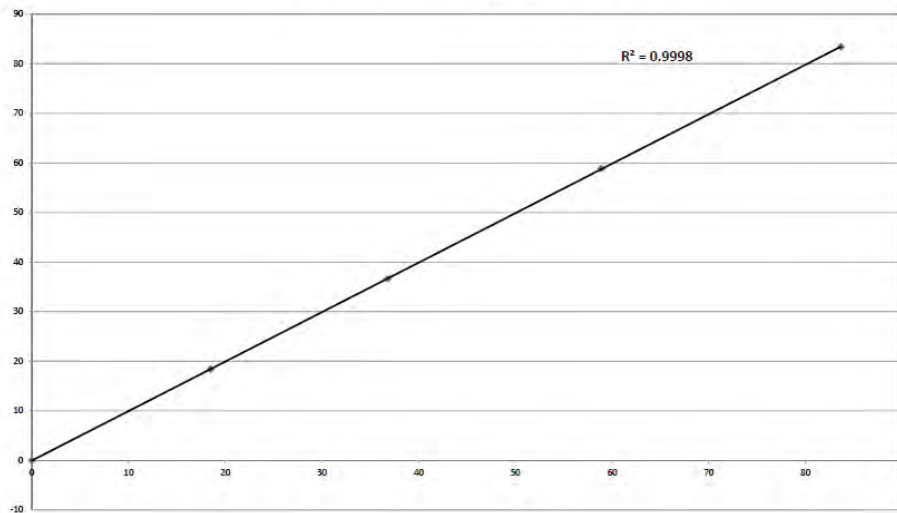
Component 1	Particulate
Set pt time ( $4 \times T_{90}$ ) sec	12
Log time ( $3 \times T_{90}$ ) sec	9

Linearity Results						
Expected Transmission (%)	Reading 1	Reading 2	Reading 3	Average Reading	DCS	Time
18.5	18.40	18.40	18.40	18.40	NA	11:10
36.8	36.60	36.60	36.70	36.63	NA	11:12
55.9	55.90	56.80	56.90	56.87	NA	11:14
83.7	83.40	83.40	83.40	83.40	NA	11:16

Zero Results				
ZERO	Expected Transmission	Analysers Reading	DCS	Time
Zero Reading 1	0.00	0.00	NA	11:00
Zero Reading 2	0.00	0.00	NA	11:03
Zero Reading 3	0.00	0.00	NA	11:06
Zero Reading 4	0.00	0.00	NA	11:18
Zero Reading 5	0.00	0.00	NA	11:20
Zero Reading 6	0.00	0.00	NA	11:20
AVERAGE		0.00		

Actual Transmission (%)	Average CEM Reading $\text{mg.m}^{-3}$	$d_{c,rel}$	$d_{c,rel} < 5\%$ (EN 14181)
0.00	0.00	0.01%	PASS
18.50	18.40	-0.02%	PASS
36.80	36.63	-0.03%	PASS
55.90	56.87	0.07%	PASS
83.70	83.40	-0.03%	PASS

Actual Transmission (%) v CEM Reading ( $\text{mg.m}^{-3}$ )



Engineer	Rhodri Jones
Signature	
Comments	

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E-Mail: info@sick.co.uk

### Low Range Particulate Linearity (Scattered Light)

Customer	RWE nPower
Plant	Aberthaw Power Station
Site Contact	Dan Peters
Product	DH C200
MCERTS Certificate Number	MC090150/00
Location	UNIT 9

Site Permit Ref	A1234
SVON No	SVON018532
Order Number	NA
QAL2/AST/Routine	QAL2
Date	18.02.2015
Engineer	Rhodri Jones

Filter Set S/N	1123 8413
Calibration Date	12.04.2015
Results Visible on DCS?	Not connected to network
Corrections Applied?	NA

Response time ( $T_{90}$ ) seconds	3
Permit Daily ELV for Dust $\text{mg.m}^{-3}$	100
Plant ELV x 2, $\text{mg.m}^{-3}$ ( $c_{pl}$ )	200
Analyser Range $\text{mg.m}^{-3}$	60

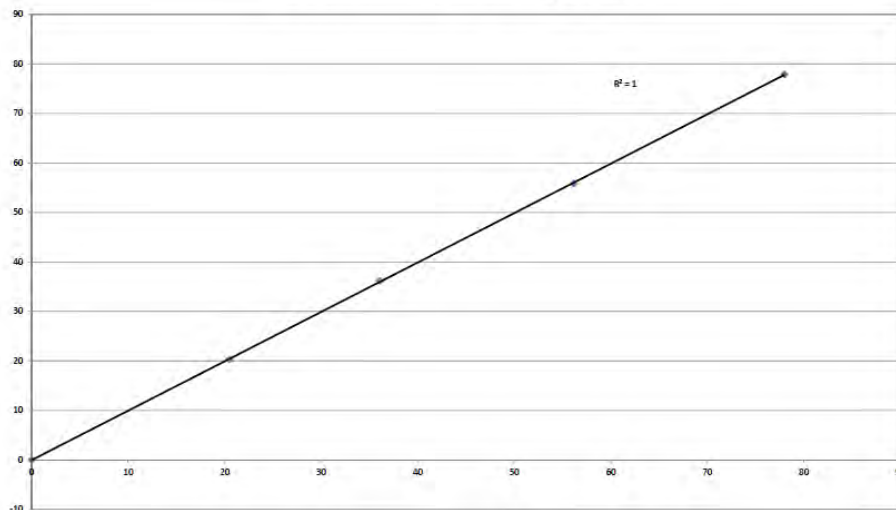
Component 1	Particulate
Set pt time ( $4 \times T_{90}$ ) sec	12
Log time ( $3 \times T_{90}$ ) sec	9

Linearity Results						
Expected Transmission (%)	Reading 1	Reading 2	Reading 3	Average Reading	DCS	Time
20.5	20.30	20.30	20.30	20.30	NA	11:33
78.0	77.90	77.80	77.90	77.87	NA	11:34
36.1	36.20	36.20	36.20	36.20	NA	11:35
56.2	55.80	55.80	55.90	55.83	NA	11:36

Zero Results				
ZERO	Expected Transmission	Analyser Reading	DCS	Time
Zero Reading 1	0.00	0.00	NA	11:30
Zero Reading 2	0.00	0.00	NA	11:31
Zero Reading 3	0.00	0.00	NA	11:32
Zero Reading 4	0.00	0.00	NA	11:37
Zero Reading 5	0.00	0.00	NA	11:38
Zero Reading 6	0.00	0.00	NA	11:39
AVERAGE	0.00			

Actual Transmission (%)	Average CEM Reading $\text{mg.m}^{-3}$	$d_{\text{rel}}$	$d_{\text{rel}} < 5\%$ (EN 14181)
0.00	0.00	0.01%	PASS
20.50	20.30	-0.02%	PASS
78.00	77.87	-0.03%	PASS
36.10	36.20	0.07%	PASS
56.20	55.83	-0.03%	PASS

Actual Transmission (%) v CEM Reading ( $\text{mg.m}^{-3}$ )



Engineer	Rhodri Jones
Signature	
Comments	

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## Unit 9 – Dusthunter C200

<b>Customer data</b>	
Customer: RWE nPower	Customer no:
Country: UK	City: Cardiff
Plant: Aberthaw Power Station	Location: Unit 9 - Stack

<b>1. Device data</b>	
Device type: DHC200	Device no: 1044863
Seral no: 1127 8547	
Purge air version: integrated MCU <input type="checkbox"/>	External blower <input checked="" type="checkbox"/>

<b>2. Plant data</b>			
Location:	Outside <input type="checkbox"/>	Under cover <input type="checkbox"/>	Inside <input checked="" type="checkbox"/>
Orientation of the stack/duct	Horizontal <input type="checkbox"/>	Vertical <input checked="" type="checkbox"/>	Angle of _____ °
Orientation of the DUSTHUNTER	Horizontal <input type="checkbox"/>	Vertical <input checked="" type="checkbox"/>	Angle of _____ °
Flange-Flange distance	7494 mm	Active measurement distance	7494 mm
Zero point distance	7494 mm	Differential pressure	_____ hpa
Ambient temperature	8 °C	Gas temperature	60 °C
MCU on site	<input checked="" type="checkbox"/>	MCU relocated	<input type="checkbox"/>
Plant operating status	Online	Dew point	_____ °C

<b>3. Prerequisite</b>			
	Y	N	Remarks
3.1. Documentation + Delivery complete	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Yes
3.2. Platform at measurement spot has suitable dimension?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Yes
3.3. Has an official institute acknowledged this measurement spot, if it is under a legal regulation?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	EA
3.4. Customer specific data for parameterization available?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Yes
3.5. External purge air unit installed and electrically connected? (option)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Instrument Air used as purge
3.6. MCU unit installed and electrically connected?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Yes
3.7. Zero point stands / tube available and distance corresponding to F1/F1 at measuring point ?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Yes

4. Preliminary work			
	Y	N	Remarks
4.1. Mounting of flanges as described in the Operating Instruction?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Correctly Installed
4.2. Check for damage	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No damage
4.3. Check ambient conditions (ref. ch. 2)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Good
4.4. Check mounting conditions (ref. ch. 2)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Good
4.5. Check mounting	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Aligned and secure
4.6. Check cables / wires for correct installation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Good
4.7. Check main power supply voltage	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

5. Purge Air Unit (integrated or external version)			
	Y	N	Remarks
5.1. Purge air unit type			Instrument Air
5.2. Check the rotation direction	<input type="checkbox"/>	<input type="checkbox"/>	NA
5.3. Check hoses for correct installation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Leak free
5.4. Purge air heating installed? (Option)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No
5.5. Differential pressure monitor installed? (Option)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NA

6. Sender/receiver, reflector/scattered light receiver unit and MCU			
	Y	N	Remarks
6.1. Clean all optical surfaces	<input checked="" type="checkbox"/>	<input type="checkbox"/>	All optical surfaces cleaned
6.2. Check power supply voltages	<input checked="" type="checkbox"/>	<input type="checkbox"/>	118V
6.3. Check emission free zero point	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Checked on test stands
6.4. Adjust DUSTHUNTER at zero point stands or tube (focussing, alignment and adjustment of the DUSTHUNTER according operating instruction - transmission and scattered light beam)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Reading Zero, no adjustments made
6.5. Connect purge air to the DUSTHUNTER	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NA
6.6. Check and adjust differential pressure monitor (option)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NA
6.7. Install the DUSTHUNTER at the measuring point.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Device re-installed
6.8. Check self alignment	<input checked="" type="checkbox"/>	<input type="checkbox"/>	High Range well aligned Low Range (laser) required alignment
6.9. Standard parameterization with SOPAS ET	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Was incorrect – now as required
6.10. DUST calibration values available	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Refer to linearity report
6.11. Interface modul parameterization (option)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	AO2 & AO3 now used
6.12. Check parameterization and start measuring	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Parameterisation correct
6.13. Check signals and function control	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Signals checked to DCS
6.14. Check if measured values are plausible (ref. Ch. 8)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	As expected
6.15. Note software revision DUSTHUNTER	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Version 1.1
6.16. Note Software revision MCU	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Version 1.8
6.17. Save device data	<input checked="" type="checkbox"/>	<input type="checkbox"/>	SOPAS project saved
6.18. Instruct the operator personnel	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Well informed engineers
6.19. Instruct reading of the measured values	<input checked="" type="checkbox"/>	<input type="checkbox"/>	As above
6.20. Instruct maintenance (hand over the maintenance manual)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	As above
6.21. Instruct reading warnings and error messages and steps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	As above

#### 7. Input / Output / Ranges MCU

##### 7.1. Analog output / Display

Live zero: mA		Output of control values: Y <input checked="" type="checkbox"/> / N <input type="checkbox"/>						
Analog output	Source	Range		Unit	Reading (actual)	Control value	Zero point	Span point
		Start	End					
1	NOT USED					<input type="checkbox"/>	mA	mA
2	Extinction	0.0	1.6	Ex		<input checked="" type="checkbox"/>	4.0 mA	15.2 mA
3	Scattered Light	0.0	60	mg/m <sup>3</sup>		<input checked="" type="checkbox"/>	4.0 mA	15.2 mA


##### 7.2. Analog input

Analog input	Source	Unit	Live zero	Start	End
1					
2					

7.3. Digital output		
Digital output	Signal	Inv.
1		<input type="checkbox"/>
2		<input type="checkbox"/>
3		<input type="checkbox"/>
4		<input type="checkbox"/>
5		<input type="checkbox"/>


7.4. Digital input		
Digital input	Source	Inv.
1		<input type="checkbox"/>
2		<input type="checkbox"/>
3		<input type="checkbox"/>
4		<input type="checkbox"/>

8. Dust measurement values after commissioning					
	Unit	Range	Reading	Zero point	Span point
Opacity	%		13.9%		
Dust (Trans.)	mg/m <sup>3</sup>		0.1		
Transm.	%		85.9%		
Extinction	-	0 – 1.6	0.0581	0.0033%	70.0263%
Rel.Opacity	%		7.0%		
Dust (SL)	mg/m <sup>3</sup>	0 – 60	26.6	0.0439	70.0096
Scattered Light	-		21.99		

<b>Remarks</b> Refer to linearity report for Linearity data	
Date : 16.02.2016	Name Plant Ian Jauncey personnel: Rhodri Jones  Engineer:

# SICK

## Unit 9 - GM32 Linearity Report

Customer	RWE Npower
Site	Aberthaw Power Station
Permit Ref	A1234
Contact	James Beveridge
Service Ref No.	SVON018532
Survey Date	25.02.2016
Device Type	GM32
Device Location	Unit 9
Serial Number	1303 8025
MCERTS Cert No	MC100163/01
Certification Details	See Certificate
Measurement Principle	U.V DOAS
Gas Box Serial Number	0816 8035
SICK Engineer	Rhodri Jones
Signature	

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St Albans  
Hertfordshire  
AL1 5BN

# SICK

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

## GM32 SO<sub>2</sub> Linearity

Customer	RWE Npower
Site	Aberthaw Power Station
Product	GM32
Analysers Serial Number	1303 8025
MCERTS Certificate Number	MC100163/01
Location	Unit 9
Active Path Length (mm)	500
Gas Box Serial Number	0816 8035
Calibration Date	01.01.2016
Calibration Gas Cylinder Ref:	VC3713C
Test Gas Conc. (ppm)	3572
Test Gas Conc. (mg.m <sup>-3</sup> )	10180
Gas Expiry Date	19.01.2018
Tolerance	2%

Site Permit Ref	A1234
SVON No	SVON018532
Order Number	AXC1235784133
QAL2/AST/Routine	AST
Date	16.02.2015
Engineer	Rhodri Jones
Response Time (T <sub>90</sub> ) Seconds	30
Permit Daily ELV for SO <sub>2</sub> (mg.m <sup>-3</sup> )	440
Permit Daily ELV x 2 (mg.m <sup>-3</sup> ) (c <sub>μ</sub> )	880
Analysers Range	1200
Ambient Pressure (hPa)	1005
Results Visible on DCS?	Yes, when not in maintenance mode
Corrections Applied?	None - As measured (ppm)

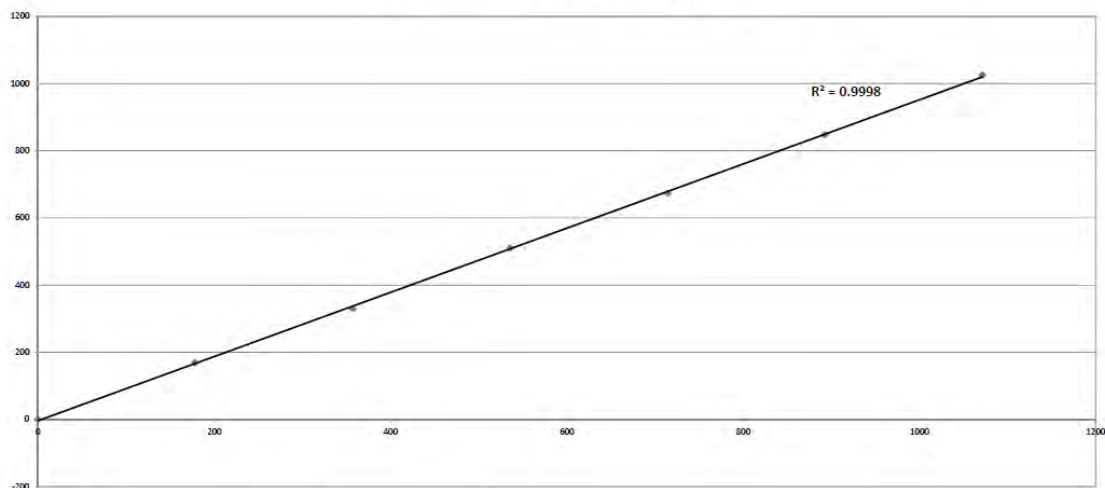
Component 1	SO <sub>2</sub>
Set Pt Time (4xT <sub>90</sub> ) sec	120
Log Time (3xT <sub>90</sub> ) sec	90
Gasbox Temperature (°C)	80
Reference Temperature (K)	273
ppm to mg.m <sup>-3</sup> for SO <sub>2</sub>	2.85

Linearity Results									
% 2 x ELV	Test Cell Length (mm)	Expected (ppm)	Reading 1 (ppm)	Reading 2 (ppm)	Reading 3 (ppm)	Average Reading	DCS	Time	
232%	100	714.40	677.00	671.00	671.00	673.00	673.0	15:04-15:08	
174%	75	535.80	510.00	511.00	509.40	510.13	510.0	15:08-15:10	
290%	125	893.00	850.00	844.00	849.50	847.83	848.0	15:12-15:14	
58%	25	178.60	168.00	168.70	168.87	168.52	169.0	15:16-15:18	
116%	50	357.20	331.00	329.00	328.00	329.33	329.0	15:20-15:22	
348%	150	1071.60	1026.00	1026.00	1024.00	1025.33	1025.0	14:58-15:01	

Zero Results			
ZERO	Analysers Reading (ppm)	DCS (ppm)	Time
Zero Reading 1	0.00	0.00	14:52
Zero Reading 2	0.00	0.00	14:54
Zero Reading 3	0.00	0.00	14:56
Zero Reading 4	0.00	0.00	15:24
Zero Reading 5	0.00	0.00	15:26
Zero Reading 6	0.00	0.00	15:28
AVERAGE	0.00		

Test Cell Length (mm)	Actual Value (ppm)	% Range	% 2 x ELV	Average CEM Reading (ppm)	d <sub>c,rel</sub>	d <sub>c,rel</sub> < 5% (EN 14181)
NA	0.00	0.0%	0%	0.00	0.33%	PASS
25mm	178.60	14.9%	58%	168.52	0.12%	PASS
50mm	357.20	29.8%	116%	329.33	-0.96%	PASS
75mm	535.80	44.7%	174%	510.13	0.23%	PASS
100mm	714.40	59.5%	232%	673.00	-0.62%	PASS
125mm	893.00	74.4%	290%	847.83	-0.11%	PASS
150mm	1071.60	89.3%	348%	1025.33	0.70%	PASS

Applied Concentration (ppm) v CEM Reading (ppm)



Engineer	Rhodri Jones
Signature	
Comments	Analysers exhibiting a linear response

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E-Mail: info@sick.co.uk

### GM32 NO Linearity

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

Site Permit Ref	A1234
SVON No	SVON018532
Order Number	AXC123784133
QAL2/AST/Routine	AST
Date	25.02.2016
Engineer	Rhodri Jones

Gas Box Serial Number	0616 8035
Calibration Date	01.01.2016
Calibration Gas Cylinder Ref:	VCSMG3285
Test Gas Conc. (ppm)	8817
Test Gas Conc. (mg.m <sup>-3</sup> )	9135
Gas Expiry Date	30.01.2018
Tolerance	2%

Response Time (T <sub>90</sub> ) Seconds	30
Permit Daily ELV for NO (mg.m <sup>-3</sup> )	1210
Permit Daily ELV x 2 (mg.m <sup>-3</sup> ) (c <sub>μ</sub> )	2420
Analysers Range	1000
Ambient Pressure (hPa)	1005
Results Visible on DCS?	Yes, when not in maintenance mode
Corrections Applied?	None - As measured (ppm)

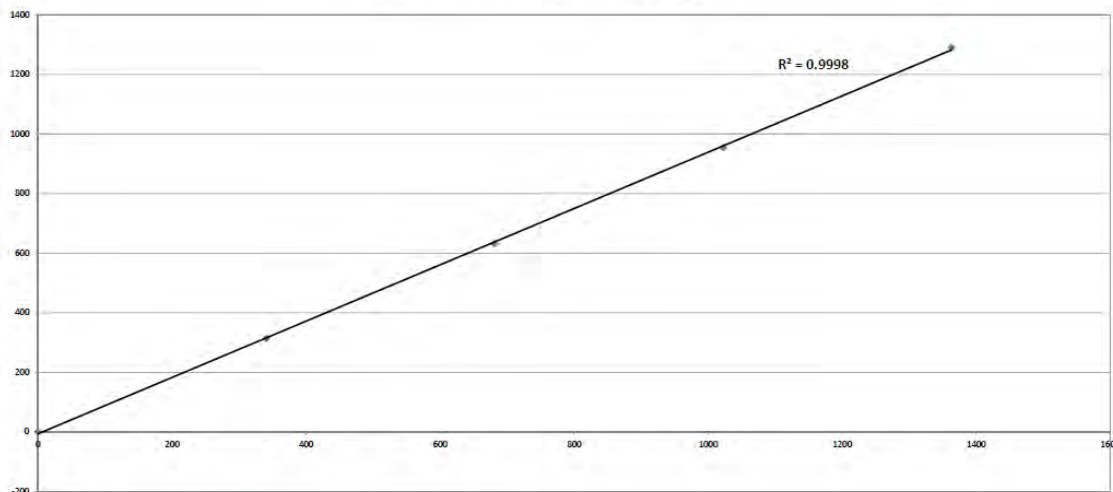
Component 1	NO
Set Pt Time (4xT <sub>90</sub> ) sec	120
Log Time (3xT <sub>90</sub> ) sec	90
Gasbox Temperature (°C)	80
Reference Temperature (K)	273
ppm to mg.m <sup>-3</sup> for NO	1.34

Linearity Results									
% 2 x ELV	Test Cell Length (mm)	Expected (ppm)	Reading 1 (ppm)	Reading 2 (ppm)	Reading 3 (ppm)	Average Reading	DCS	DCS Time	
75%	100	1363.40	1294.00	1289.00	1287.00	1290.00	1290.0	14:24-14:28	
57%	75	1022.55	956.00	954.00	953.00	954.33	954.0	14:30-14:34	
19%	25	340.85	314.00	313.00	314.00	313.67	314.0	14:46-14:50	
38%	50	681.70	633.00	632.00	631.00	632.00	632.0	14:38-14:42	

Zero Results			
ZERO	Analysers Reading (ppm)	DCS (ppm)	Time
Zero Reading 1	0.00	0.00	14:16
Zero Reading 2	0.00	0.00	14:18
Zero Reading 3	0.00	0.00	14:20
Zero Reading 4	0.00	0.00	14:52
Zero Reading 5	0.00	0.00	14:54
Zero Reading 6	0.00	0.00	14:56
AVERAGE	0.00		

Test Cell Length (mm)	Actual Value (ppm)	% Range	% 2 x ELV	Average CEM Reading (ppm)	d <sub>0,rel</sub>	d <sub>0,rel</sub> < 5% (EN 14181)
NA	0.00	0.0%	0%	0.00	0.16%	PASS
25mm	340.85	34.1%	14%	313.67	-0.16%	PASS
50mm	681.70	68.2%	28%	632.00	-0.28%	PASS
75mm	1022.55	102.3%	42%	954.33	-0.24%	PASS
100mm	1363.40	136.3%	56%	1290.00	0.36%	PASS

Applied Concentration (ppm) v CEM Reading (ppm)



Engineer	Rhodri Jones
Signature	
Comments	Analysers exhibiting a linear response

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### GM32 NO<sub>2</sub> Linearity

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

Site Permit Ref	A1234
SVON No	SVON019532
Order Number	AXC1235784133
QAL2/AST/Routine	AST
Date	25.02.2016
Engineer	Rhodri Jones

Gas Box Serial Number	0816 8035
Calibration Date	01.01.2016
Calibration Gas Cylinder Ref:	VCD116712
Test Gas Conc. (ppm)	980
Test Gas Conc. (mg.m <sup>-3</sup> )	2021
Gas Expiry Date	30.01.2018
Tolerance	2%

Response Time (T <sub>90</sub> ) Seconds	50
Permit Daily ELV for NO <sub>2</sub> (mg.m <sup>-3</sup> )	121.0
Permit Daily ELV x 2 (mg.m <sup>-3</sup> ) (c <sub>pl</sub> )	242
Analysers Range	100
Ambient Pressure (hPa)	1005
Results Visible on DCS?	Yes, when not in maintenance mode
Corrections Applied?	None - As measured (ppm)

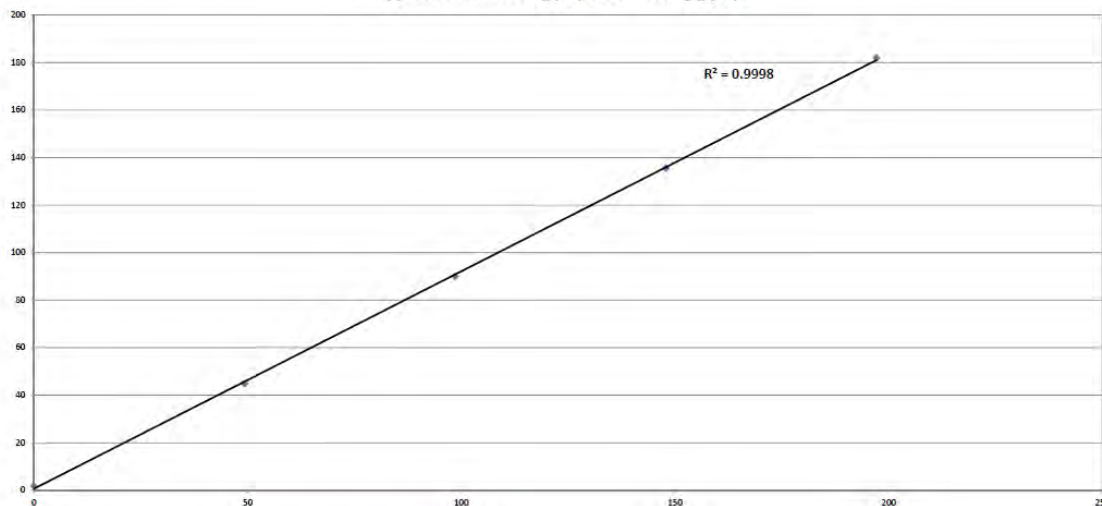
Component 1	NO <sub>2</sub>
Set Pt Time (4xT <sub>90</sub> ) sec	200
Log Time (3xT <sub>90</sub> ) sec	150
Gasbox Temperature (°C)	80
Reference Temperature (K)	273
ppm to mg.m <sup>-3</sup> for NO <sub>2</sub>	2.05

Linearity Results									
% 2 x ELV	Test Cell Length (mm)	Expected (ppm)	Reading 1 (ppm)	Reading 2 (ppm)	Reading 3 (ppm)	Average Reading	DCS	Time	
167%	100	197.20	182.45	181.50	181.90	181.95	182.0	13:47-13:51	
125%	75	147.90	136.70	135.80	134.20	135.57	136.0	14:10-14:14	
42%	25	49.30	44.70	45.10	44.90	44.90	45.0	14:02-14:06	
84%	50	98.60	90.60	89.80	89.70	90.03	90.0	13:54-13:58	

Zero Results			
ZERO	Analysers Reading (ppm)	DCS (ppm)	Time
Zero Reading 1	3.50	2.00	13:40
Zero Reading 2	3.00	3.00	13:42
Zero Reading 3	2.40	2.00	13:44
Zero Reading 4	0.30	0.00	14:16
Zero Reading 5	0.90	0.00	14:18
Zero Reading 6	0.50	0.00	14:20
AVERAGE	1.77		

Test Cell Length (mm)	Actual Value (ppm)	% Range	% 2 x ELV	Average CEM Reading (ppm)	d <sub>c,ref</sub>	d <sub>c,ref</sub> < 5% (EN 14181)
NA	0.00	0.0%	0%	1.77	0.26%	PASS
25mm	49.30	49.3%	20%	44.90	-0.46%	PASS
50mm	98.60	98.6%	41%	90.03	-0.36%	PASS
75mm	147.90	147.9%	61%	135.57	-0.16%	PASS
100mm	197.20	197.2%	81%	181.95	0.43%	PASS

Applied Concentration (ppm) v CEM Reading (ppm)



Engineer	Rhodri Jones
Signature	
Comments	

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# ***CERTIFICATE OF CALIBRATION***

Unit No	U 9
Application	Stack Flue Gas Oxygen Analyser
Probe Serial No	3k220000139812
WOC No	3-16-513046-00

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	7.168 mA
8 % Oxygen	Certified Input Valve	8.04 %
	Cylinder No	S1144548
	Expiry Date	19/06/2019
	Theoretical Output	16.864 mA

## **Results**

		Local Display	Current	Procal ACU Display
1.98 % Oxygen (7.168 mA)	Before	2.06%	7.22mA	2.2%
	After	1.99%	7.17mA	2.1%
8.04 % Oxygen (16.864 mA)	Before	8.19%	17.116mA	8.4%
	After	8.02%	16.85mA	8.2%

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"> <li>- a plan of the CEMS;</li> </ul>	<p>Yes</p>	<p>A plan of the AMS resides in the Electrical Control &amp; Instrumentation section offices and at the analyser.</p>
<ul style="list-style-type: none"> <li>- all manuals (maintenance, users, etc.);</li> </ul>	<p>Yes</p>	<p>.</p>
<ul style="list-style-type: none"> <li>- log books to document possible malfunctions and action taken;</li> </ul>	<p>Yes</p>	
<ul style="list-style-type: none"> <li>- service reports;</li> </ul>	<p>Yes</p>	<p>All service reports are filed.</p>
<ul style="list-style-type: none"> <li>- QAL 3 documentation including actions taken as a result of out of control situations</li> </ul>	<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&amp;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
01/03/16	Horiba PG 250	FYS 403	NO (17025)	83649	911 ppm	0 ppm	900 ppm	3 ppm	900 ppm
			O <sub>2</sub> (17025 validated)	216463	14.63 %	0.10 %	14.60 %	0.09 %	14.42 %
	Gasmet DX4000	01610	SO <sub>2</sub> (17025 validated)	-	178 ppm	0.0 ppm	176 ppm	0.78 ppm	175.4 ppm
02/03/16	Horiba PG 250	FYS 403	NO (17025)	83649	911 ppm	4 ppm	900 ppm	3 ppm	906 ppm
			O <sub>2</sub> (17025 validated)	216463	14.63 %	0.08 %	14.55 %	0.07 %	14.60 %
	Gasmet DX4000	01610	SO <sub>2</sub> (17025 validated)	-	178 ppm	0.39 ppm	174.3 ppm	-0.12 ppm	175.3 ppm
03/03/16	Horiba PG 250	FYS 403	NO (17025)	83649	911 ppm	3 ppm	911 ppm	3 ppm	908 ppm
			O <sub>2</sub> (17025 validated)	216463	14.63 %	0.07 %	14.55 %	0.04 %	14.55 %
	Gasmet DX4000	01610	SO <sub>2</sub> (17025 validated)	-	178 ppm	-0.14 ppm	176.5 ppm	-0.01 ppm	175.4 ppm

**Notes**

- \*- Calibration values are those for the entire sample system.
- - Zero gas 99.999% N<sub>2</sub>

## **APPENDIX 2 – Accreditation Schedule**

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

 Accredited to ISO/IEC 17025:2005	<b>The Environmental Consultancy Ltd</b> <b>trading as RPS Consultants</b> Issue No: 064    Issue date: 17 December 2015	
	14 Cornhill London EC3V 3ND	Contact: Mr S Hurst Tel: +44 (0) 20 7280 3200 Fax: +44 (0) 20 7283 9248 E-Mail: hursts@rpsgroup.com Website: www.rpsgroup.com

Testing performed by the Organisation at the locations specified below

Locations covered by the organisation and their relevant activities

Laboratory locations:

Location details	Activity	Location code
<b>Address</b> Tern Place Denmore Road Bridge of Don Aberdeen AB23 8JX  <b>Local contact</b> Mr I Edmans Tel: +44 (0)845 60 123 88 Fax: +44 (0)1224 708 998 Email: rpsasb@rpsgroup.com	Health and Hygiene	B
<b>Address</b> 14 Cornhill London EC3V 3ND  <b>Local contact</b> 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
<b>Address</b> Noble House Capital Drive Linford Wood Milton Keynes MK14 6QP  <b>Local contact</b> Mr B Durden Tel: +44 (0)1235 437 100 Fax: +44 (0)1908 689899 Email: rpsmk@rpsgroup.com	Health and Hygiene	E
<b>Address</b> Suite 4C Rhodes Business Park Silburn Way Middleton Manchester M24 4NE  <b>Local contact</b> Mr B Durden Tel: +44 (0) 161 6549069 Fax: +44 (0)161 6438495 Email: rpswn@rpsgroup.com	Health and Hygiene	F


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	<b>The Environmental Consultancy Ltd</b> trading as RPS Consultants Issue No: 064 Issue date: 17 December 2015
Testing performed by the Organisation at the locations specified	


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


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### DETAIL OF ACCREDITATION


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	<b>The Environmental Consultancy Ltd</b> trading as RPS Consultants Issue No: 064 Issue date: 17 December 2015		
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 <sup>3</sup> )	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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	<b>The Environmental Consultancy Ltd</b> trading as RPS Consultants Issue No: 064 Issue date: 17 December 2015		
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	
	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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	<b>The Environmental Consultancy Ltd</b> trading as RPS Consultants Issue No: 064    Issue date: 17 December 2015		
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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	<b>The Environmental Consultancy Ltd</b> trading as RPS Consultants Issue No: 064 Issue date: 17 December 2015		
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 <sub>10</sub> /PM <sub>2.5</sub> at low concentrations (0-40 mg/m <sup>3</sup> )	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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	<b>The Environmental Consultancy Ltd</b> trading as RPS Consultants Issue No: 064 Issue date: 17 December 2015		
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 <sub>2</sub> )*	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 (NO <sub>x</sub> )*	BS EN 14792:2005 (RPSCE/1/21f - Chemiluminescence analyser) EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	L
	Nitrous Oxide (N <sub>2</sub> 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/OC) (0 to 1000 mg/m <sup>3</sup> )	BS EN 12619:2013 (RPSCE/1/4b - FID 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
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.