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EN 14181 AST Report Commissioned by
Lafarge Tarmac Cement and Lime Limited

Installation Name & Address
Lafarge Tarmac Cement and Lime Limited
Aberthaw Cement Plant
East Aberthaw
Barry
Vale of Glamorgan
CF62 3ZR

Primary Site Contact: Robert Fairless

EPR Permit: EPR/BL3986ID/V007

Stack Reference
ABB2 - A1 - Main Stack on Preheater Tower

Dates of the Monitoring Campaign
8th - 11th December 2014

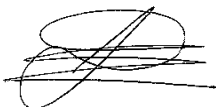
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CSW-1657

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Report Version
Version 1

Signature of Report Approver


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Opinions and interpretations expressed herein are outside the scope of Exova Catalyst's UKAS accreditation.

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This test report has been written to fully comply with the requirements in the Environment Agency's Method Implementation Document (MID) Version 3 which was published in April 2014.

Executive Summary (Page 1 of 2)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
 ABB2 - A1 - Main Stack on Preheater Tower
 8th - 11th December 2014

Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by Lafarge Tarmac Cement and Lime Limited to carry out stack emissions testing on the ABB2 - A1 - Main Stack on Preheater Tower Stack at Aberthaw Works.

The aim of the monitoring campaign was to perform an AST Calibration Check Exercise on the Continuous Emissions Monitoring System (CEMS), which is installed on the Plant, following the requirements of EN 14181.

Special Requirements

There were no special requirements.

AST CALIBRATION CHECK SUMMARY

Parameter	Source of the Calibration Function Derived from Previous QAL2	Calibration Function as Derived from the Previous QAL2	Calibration Range from Previous QAL2 @ REF Conditions	Calibration Function that the AST was performed against (See Conclusion)	Result of Variability Test	Result of Calibration Test	Range after AST Extension @ REF Conditions
Total VOCs	Parallel Test	$y = 1.2893x + 0.06$	0 to 57	$y = 1.2893x + 0.06$	Pass	Pass	Existing Range Still Valid
Oxides of Nitrogen (as NO ₂)	Parallel Test	$y = 0.9806x - 0.29$	0 to 931	$y = 0.9806x - 0.29$	Pass	Pass	Existing Range Still Valid
Sulphur Dioxide	Parallel Test	$y = 1.81x + 0.7839$	0 to 691	$y = 1.81x + 0.7839$	Pass	Fail	N/A - Fail
Carbon Monoxide	Parallel Test	$y = 1.1061x - 1.67$	0 to 1397	$y = 1.1061x - 1.67$	Pass	Fail	N/A - Fail
Hydrogen Chloride	Parallel Test	$y = 0.8515x + 0.53$	0 to 20	$y = 0.8515x + 0.53$	Pass	Pass	Existing Range Still Valid
Ammonia	Parallel Test	$y = 1.1582x + 0.04$	0 to 60	$y = 1.1582x + 0.04$	Pass	Pass	Existing Range Still Valid
Water Vapour (% v/v)	Parallel Test	$y = 1.0236x - 0.39$	0 to 14	$y = 1.0236x - 0.39$	Pass	Pass	0 to 14.7 % v/v
Oxygen (% v/v)	Parallel Test	$y = 0.924x - 0.19$	0 to 12	$y = 0.924x - 0.19$	Pass	Pass	Existing Range Still Valid

The calibration functions, once applied, only remain valid as long as the QAL3 data remains within control limits, and that there are no manual adjustments made to the CEMs other than those allowed to bring the settings back within the QAL3 control limit.

All calibration functions relate to mg/m³, unless otherwise stated.

LINEARITY SUMMARY

Parameter	Linearity Performed?	Linearity Calibration Function	R ² Value	Maximum ABS %, d _{c,rel}	Allowable ABS %, d _{c,rel}	Result of Residuals Test	Range Linearity Performed Over
Total VOCs	Yes	$y = 1.0077x + 0.0307$	1.00	1.89	5	Pass	0 to 15 mg/m ³
Nitrogen Monoxide (as NO ₂)	Yes	$y = 0.9833x - 2.5289$	1.00	0.52	5	Pass	0 to 1021 mg/m ³
Nitrogen Dioxide	Yes	$y = 0.9909x - 0.232$	1.00	0.49	5	Pass	0 to 62 mg/m ³
Sulphur Dioxide	Yes	$y = 0.9928x + 1.0685$	1.00	0.51	5	Pass	0 to 283 mg/m ³
Carbon Monoxide	Yes	$y = 1.0013x - 2.7119$	1.00	1.02	5	Pass	0 to 907 mg/m ³
Hydrogen Chloride	Yes	$y = 0.9904x - 0.0395$	1.00	0.62	5	Pass	0 to 20 mg/m ³
Ammonia	Yes	$y = 0.9984x - 0.1189$	1.00	1.06	5	Pass	0 to 31 mg/m ³
Water Vapour (% v/v)	Yes	$y = 0.9945x + 0.0379$	1.00	0.25	5	Pass	0 to 12 % v/v
Oxygen (% v/v)	Yes	$y = 1.0007x + 0.0452$	1.00	1.27	5	Pass	0 to 12 % v/v

All calibration functions relate to mg/m³, unless otherwise stated.

Executive Summary (Page 2 of 2)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
 ABB2 - A1 - Main Stack on Preheater Tower
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SUMMARY OF STANDARD REFERENCE METHOD & EN 14181 DEVIATIONS

Parameter	Run	Deviation
All	All	There are no deviations associated with the sampling employed.

CONCLUSIONS, DISCUSSIONS & ACTIONS FROM THE SAMPLING EXERCISE

Total VOCs, Oxides of Nitrogen, Hydrogen Chloride, Water Vapour

The CEMS data was corrected using the calibration function derived during the most recent QAL2 campaign. The corrected values passed both the variability and calibration tests as required by EN 14181 and therefore the calibration function is deemed to be valid within the given tolerances. The calibration range derived in the previous QAL2 is still valid.

Water Vapour

The CEMS data was corrected using the calibration function derived during the most recent QAL2 campaign. The corrected values passed both the variability and calibration tests as required by EN 14181 and therefore the calibration function is deemed to be valid within the given tolerances. The calibration range derived in the previous QAL2 has been extended as a larger spread of data was collected during this AST exercise.

Sulphur Dioxide

The CEMS data was corrected using the calibration function derived during the most recent QAL2 campaign. The corrected values did not pass both of the variability and calibration tests as required by EN 14181 and therefore the calibration function is deemed to be invalid. The correct functionality of the CEMS system had been checked during the pre-AST functional checks. It should be noted that if a function of $y = x$ had been used, both the variability and calibration tests would have passed. This points to the original calibration function being unreliable. It is suggested that a function of $y = x$ be input into the DCS until a repeat QAL2 exercise is performed in December 2015. Permission from the EA should be sought before applying this recommendation.

Carbon Monoxide

The CEMS data was corrected using the calibration function derived during the most recent QAL2 campaign. The corrected values did not pass both of the variability and calibration tests as required by EN 14181 and therefore the calibration function is deemed to be invalid. The correct functionality of the CEMS system had been checked during the pre-AST functional checks. It should be noted that if a function of $y = x$ had been used, both the variability and calibration tests would have passed. This points to the original calibration function being unreliable. It is suggested that a function of $y = x$ be input into the DCS until a repeat QAL2 exercise is performed in December 2015. Permission from the EA should be sought before applying this recommendation.

Ammonia

The CEMS data was corrected using the calibration function derived during the most recent QAL2 campaign. The corrected values passed both the variability and calibration tests as required by EN 14181 and therefore the calibration function is deemed to be valid within the given tolerances. The calibration range derived in the previous QAL2 is still valid. Please note, that an ERF (Emissions Range Factor) of 50 mg/m³ has been taken as using a value of 10 mg/m³ sees the test of calibration fail. The EA should be consulted over this approach, however Catalyst deem this to be a sensible approach to take as the emission of Ammonia are far in excess of 10 mg/m³, and therefore an ERF of 10 mg/m³ would be prohibitively and unfairly tight to achieve.

All components - Linearity

The CEMS was found to give a linear response to the test gases supplied to the analyser, passing the EN 14181 test of residuals requirement.

REGULATORY INFORMATION

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
 ABB2 - A1 - Main Stack on Preheater Tower
 8th - 11th December 2014

Parameter	Value
Name of the Installation	Aberthaw Works
Address of the Installation	See Title Page
Sector of the Installation	Cement & Lime
Permit Number	EPR/BL3986ID/V007
Date of the Last QAL2 / AST Campaign	4th - 6th December 2012
Date CEMS Data Obtained by Exova Catalyst	12/12/2014

Regulated Determinands and Emission Limit Values (ELVs)

Determinand	Short-Term ELV (mg/m ³)	Daily or 48hr Average ELV (mg/m ³)	Uncertainty Requirement (%)
Total VOCs	-	50	30
Oxides of Nitrogen (as NO ₂)	-	800	20
Nitrogen Monoxide	-	-	20
Nitrogen Dioxide	-	-	20
Sulphur Dioxide	-	800	20
Carbon Monoxide	-	1000	20 ¹
Hydrogen Chloride	-	10	40
Ammonia	-	50 ²	40

¹ Taken from MID 14181 v3

² Normally in lieu of an ELV, an ERF (Emissions Range Factor) would be used as per guidance, EN 14181 EA Communication 1, Nov 2011. However using a value of 10 mg/m³, as suggested in the EA guidance, sees the test of calibration fail. As the emissions are much greater than 10 mg/m³ an alternative ERF of 50 mg/m³ has been taken, against which the test of calibration passes.

OPERATIONAL INFORMATION AND SITE MONITORING PROVISIONS

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
 ABB2 - A1 - Main Stack on Preheater Tower
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Process Type and Variations in Emissions

Parameter	Value
Continuous or batch process	Continuous
Were there any variations in emissions during the EN 14181 test (e.g. Load changes)	Coal & Raw mill will come on and off
Will these variations affect the representative nature of the collected data?	No
Are there any factors that may affect the collected data (e.g. auto-calibrations, plant start up and shut down)	Autocalibration 7:00am & 7:00pm
Reviewing historical Plant data, were low emissions expected for any determinands?	No
Was the CEMS reading zero for any determinands, if so, was this investigated to ensure it was working?	No
What product was being processed during the tests?	Cement Manufacture

Type of Fuel

Parameter	Value
Fuel type used during the EN 14181 test (include proportions for co-incineration)	Normal operation of the plant mixture of coal, tyres, SPF
Are multiple calibration functions required if the emissions vary due to different fuel types being used?	No

Abatement

Parameter	Value
Type of Abatement System	
Running Status	Operational

MONITORING PROVISIONS AT THE INSTALLATION - PERIODIC MONITORING

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Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower
8th - 11th December 2014

Duct Characteristics

Parameter	Units	Value
Type	-	Rectangular
Depth	m	1.96
Width	m	1.96
Area	m ²	3.84
Port Depth	cm	9
Orientation of Duct	-	Horizontal
Sample Port Size	-	4" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	Permanent
Inside / Outside	Outside

Platform Details

EA Technical Guidance Note M1 / EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	Yes
Platform has vertical base boards (approx. 0.25m high)	Yes
Platform has chains / self closing gates at top of ladders	Yes
Access to sample ports unhindered by obstructions	No
Safe access available	Yes
Easy access available	Yes

Sampling Location / Platform Improvement Recommendations

The Height of the top port is too high to access due to manual handling constraints.

EN 15259 Homogeneity Test Requirements

According to EN 15259, a Homogeneity Test is required on this stack, however, as far as we are aware, it has not yet been undertaken. Unless agreed otherwise with the respective regulator, we would recommend that the Homogeneity Test be undertaken prior to the next set of emissions testing on this stack, and would be happy to carry out the work. Please contact Exova Catalyst for further details.

Sampling Plane Validation Criteria (from EA Technical Guidance Document (Monitoring) TGN M1 / EN 15259)

Criteria in M1	Units	Traverse 1		Required	Compliant
Lowest Differential Pressure	Pa	120.0		> 5 Pa	Yes
Mean Velocity	m/s	18.40		-	-
Lowest Gas Velocity	m/s	14.14		-	-
Highest Gas Velocity	m/s	23.83		-	-
Ratio of Above	: 1	1.7		< 3 : 1	Yes
Maximum Angle of Swirl	°	10		< 15°	Yes
No Local Negative Flow	-	Yes		-	Yes

MONITORING PROVISIONS AT THE INSTALLATION - PERIODIC MONITORING

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Lafarge Tarmac Cement and Lime Limited, Aberthaw Works

ABB2 - A1 - Main Stack on Preheater Tower

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Pro-forma for Site Provisions for Monitoring

Requirement	Compliant	Notes
A safe and clean working environment with sufficient space and weather protection.	Yes	Clean secure building
Easy and safe access to the CEMS.	Yes	Locked, permit required to access CEMS
Adequate supplies of reference materials, tools and spare parts.	Yes	Small items only, ABB supply all major parts and components. A service contract is currently in place with ABB.
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 CEMS.	Yes	
Compliance with MID 15259	Yes	See the Sampling Plane Validation Criteria table on the previous page.

Plant Photos

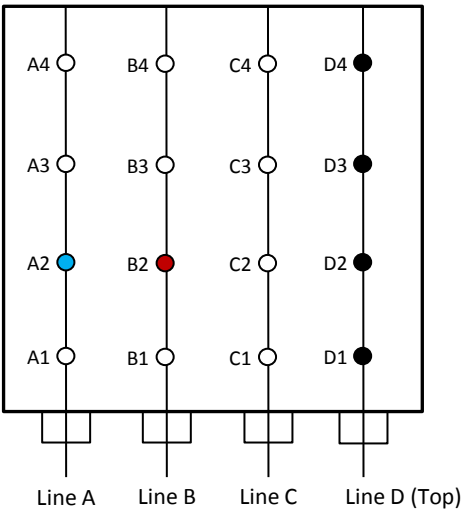
Photo 1



Photo 2



Sample Points



where

○ = isokinetic point sampled at

● = isokinetic point not sampled at

● = combustion gases sample point

● = non-isokinetic sample point

CONTINUOUS EMISSION MONITORING SYSTEMS (CEMS) AT THE INSTALLATION

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
 ABB2 - A1 - Main Stack on Preheater Tower
 8th - 11th December 2014

Main Determinand	Type	Instrument Name	Instrument Serial Number	Measurement Principle	Certified Range (mg/m³)	QAL1 Compliant	MCERTS Number
Total VOCs	Extractive	AO 2000 Multi FID14	F3.351051.7	FID	0 - 15	Yes	MC030015/07
Oxides of Nitrogen (as NO ₂)	Extractive	CEMAS FTIR-NT	1288025-001	FTIR	0 - 400	Yes	MC030016/09
Nitrogen Monoxide	Extractive	CEMAS FTIR-NT	1288025-001	FTIR	0 - 400	Yes	MC030016/09
Nitrogen Dioxide	Extractive	CEMAS FTIR-NT	1288025-001	FTIR	-	Yes	MC030016/09
Sulphur Dioxide	Extractive	CEMAS FTIR-NT	1288025-001	FTIR	0 - 300	Yes	MC030016/09
Carbon Monoxide	Extractive	CEMAS FTIR-NT	1288025-001	FTIR	0 - 300	Yes	MC030016/09
Hydrogen Chloride	Extractive	CEMAS FTIR-NT	1288025-001	FTIR	0 - 15	Yes	MC030016/09
Ammonia	Extractive	CEMAS FTIR-NT	1288025-001	FTIR	0 - 15	Yes	MC030016/09
Water Vapour	Extractive	CEMAS FTIR-NT	1288025-001	FTIR	0 - 40	Yes	MC030016/09
Oxygen (Wet)	Extractive	CEMAS FTIR-NT	1288025-001	Zirconia Cell	0 - 25	Yes	MC030016/09

TEST LABORATORY STAFF

Position	Name	MCERTS Accreditation	MCERTS Number & Expiry Date	Technical Endorsements
Team Leader	Martin Futter	MCERTS Level 2	MM 03 216	TE1 TE2 TE3 TE4
Technician	William Trueman	MCERTS Level 1	MM 06 753	TE1 TE2 TE3 TE4

STANDARD REFERENCE METHODS (SRMs)

Exova Catalyst hold UKAS and MCERTS Accreditation for performing QAL2 and ASTs, to EN 14181.

Determinand	Instrument Name	Measurement Principle	Instrumental Ranges		MCERTS Number	Reference Method	MU (%)
			Certified (mg/m ³)	Operational (mg/m ³)			
Total VOCs	Sick Maihak 3006	FID	0 - 15	0 - 100	MC 040036	EN 12619	8.0
Oxides of Nitrogen (as NO ₂)	Gasmet DX4000	FTIR	0 - 200	0 - 800	MC 030014	TGN M22	5.5
Nitrogen Monoxide	Gasmet DX4000	FTIR	0 - 200	0 - 800	MC 030014	TGN M22	5.0
Nitrogen Dioxide	Gasmet DX4000	FTIR	0 - 200	0 - 30	MC 030014	TGN M22	5.0
Sulphur Dioxide	Gasmet DX4000	FTIR	0 - 75	0 - 500	MC 030014	TGN M22	5.6
Carbon Monoxide	Gasmet DX4000	FTIR	0 - 75	0 - 800	MC 030014	TGN M22	4.2
Hydrogen Chloride	Gasmet DX4000	FTIR	0 - 15	0 - 10	MC 030014	TGN M22	10.0
Ammonia	Gasmet DX4000	FTIR	N/A	0 - 60	MC 030014	TGN M22	6.0
Water Vapour	Gasmet DX4000	FTIR	0 - 30%	0 - 30%	MC 030014	TGN M22	6.0
Oxygen (Dry)	Horiba PG-250 SRM	Paramagnetic Cell	0 - 25%	0 - 25%	MC 110186	EN 14789	3.1

NOTE 1: Exova Catalyst hold UKAS and MCERTS Accreditation for all Standard Reference Method Tests performed.

where: MST stands for Manual Sampling Train

LIST OF EQUIPMENT

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM (1)	CAT 7.18	Horiba PG-250 SRM	CAT 9.14	Digital Manometer (1)	CAT 3.56
Control Box DGM (2)	-	Horiba PG-250 SRM	-	Digital Manometer (2)	-
Box Thermocouples (1)	CAT 3.38	Servomex 4900	CAT 24.2	Digital Temperature Meter	CAT 3.56
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	CAT 26.1	Stopwatch	CAT 14.62 (MST)
Umbilical (1)	CAT 3.38	ABB AO2020-URAS26	CAT	Barometer	CAT 13.17
Umbilical (2)	-	Servomex 5200MP	CAT 24.8	Stack Thermocouple (1)	CAT 4.427
Oven Box (1)	CAT 12.41	JCT JCC P1 Cooler	CAT 4.204	Stack Thermocouple (2)	CAT 4.261
Oven Box (2)	-	Gasmet DX4000	CAT 19.4	Stack Thermocouple (3)	CAT 4.329
Heated Probe (1)	CAT 5.45	Gasmet Sampling System	CAT 19.4	1m Heated Line (1)	-
Heated Probe (2)	CAT 5.61	Bernath 3006 FID	CAT 8.13	1m Heated Line (2)	-
Heated Probe (3)	CAT 5.46	M&C PSS	CAT 12.46	1m Heated Line (3)	-
S-Pitot (1)	CAT 21P.65	Mass Flow Controller (1)	CAT 6.34	5m Heated Line (1)	CAT 20.36
S-Pitot (2)	CAT 21P.38	Mass Flow Controller (2)	CAT 6.35	15m Heated Line (1)	CAT
L-Pitot	CAT 21L.16	Mass View (1)	CAT 25.27	20m Heated Line (1)	CAT
500g Check Weight	CAT 17.14	Mass View (2)	CAT 2528	20m Heated Line (2)	CAT
1Kg Check Weight	CAT 17.14	Easylogger EN-EL-12 Bit	CAT 11.32	Dual Channel Heater Controller	CAT
Last Impinger Arm	CAT 4.210 / 4.211	Easylogger EN-EL-12 Bit	CAT 11,33	Single Channel Heater Controller	CAT
Callipers	CAT 23.18			Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	CAT			Tape Measure	CAT 16.22

VOLATILE ORGANIC COMPOUNDS: AST CALCULATIONS

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Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower

Calibration Data

Pair	Date	Time (60-minute Average)	x, CEMS (STP, WET) mg/m ³	y, SRM (STP, WET) mg/m ³	SRM (STP, DRY, 10% O ₂) mg/m ³	x - x _{av} (A)	y - y _{av} (B)	(A) x (B)	(x - x _{av}) ²	CAL CEMS (STP, WET) mg/m ³
1	08/12/2014	14:32 - 15:32	21.50	27.13	31.82	-2.03	-3.51	7.14	4.13	27.79
2	08/12/2014	15:32 - 16:32	23.54	29.47	32.34	0.00	-1.17	0.00	0.00	30.41
3	08/12/2014	16:32 - 17:32	25.49	32.51	33.96	1.95	1.87	3.65	3.81	32.92
4	08/12/2014	17:32 - 18:32	25.52	32.08	32.71	1.98	1.44	2.85	3.91	32.96
5	08/12/2014	19:32 - 20:32	27.36	35.12	34.52	3.82	4.48	17.11	14.61	35.33
6	08/12/2014	20:32 - 21:32	27.16	34.75	34.97	3.62	4.11	14.85	13.09	35.07
7	08/12/2014	21:32 - 22:32	25.66	33.18	32.84	2.12	2.54	5.38	4.50	33.14
8	08/12/2014	22:32 - 23:32	25.41	32.95	33.05	1.87	2.30	4.31	3.51	32.82
9	09/12/2014	23:32 - 00:32	25.46	33.08	33.14	1.92	2.44	4.68	3.68	32.88
10	09/12/2014	00:32 - 01:32	25.46	33.02	32.81	1.92	2.38	4.57	3.68	32.88
11	09/12/2014	01:32 - 02:32	25.13	32.53	32.89	1.59	1.89	3.01	2.54	32.46
12	09/12/2014	02:32 - 03:32	22.94	30.55	33.42	-0.60	-0.09	0.06	0.35	29.64
13	09/12/2014	03:32 - 04:32	20.48	26.90	31.90	-3.06	-3.74	11.44	9.35	26.46
14	09/12/2014	04:32 - 05:32	21.06	27.66	32.73	-2.48	-2.98	7.40	6.16	27.21
15	09/12/2014	05:32 - 06:32	21.40	28.26	33.24	-2.13	-2.38	5.09	4.56	27.66
16	09/12/2014	07:32 - 08:32	21.31	28.64	34.00	-2.23	-2.00	4.46	4.98	27.53
17	09/12/2014	08:32 - 09:32	21.52	28.71	34.09	-2.01	-1.94	3.90	4.06	27.81
18	09/12/2014	09:32 - 10:32	23.46	31.22	36.19	-0.07	0.57	-0.04	0.01	30.31
19	09/12/2014	10:32 - 11:32	21.34	28.26	33.03	-2.20	-2.38	5.23	4.82	27.58
20	09/12/2014	11:32 - 12:32	21.50	28.62	33.26	-2.03	-2.02	4.11	4.14	27.78
21	09/12/2014	12:32 - 13:32	21.60	28.85	33.44	-1.94	-1.79	3.48	3.76	27.91
SPREAD OF DATA					4.37	SUM		112.67	99.64	
DAILY ELV (mg/m ³)					50					
MU (%)					30					
15% of ELV					7.50					

Outliers Data

Pair	Date	Time (60-minute Average)	x, CEMS (WET) mg/m ³	y, SRM (WET) mg/m ³
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Any values sitting outside 2 x Standard Deviations have been removed as Outliers, as per EA's Quick Guide, RM-QG14.

Existing Calibration Function
$y = 1.2893x + 0.06$

Source of Existing Calibration Function
QAL 2 Report - ESG - report no. 121107-2012/QAL2

Existing Calibration Range (@ REF Conditions)
0 to 57 mg/m ³

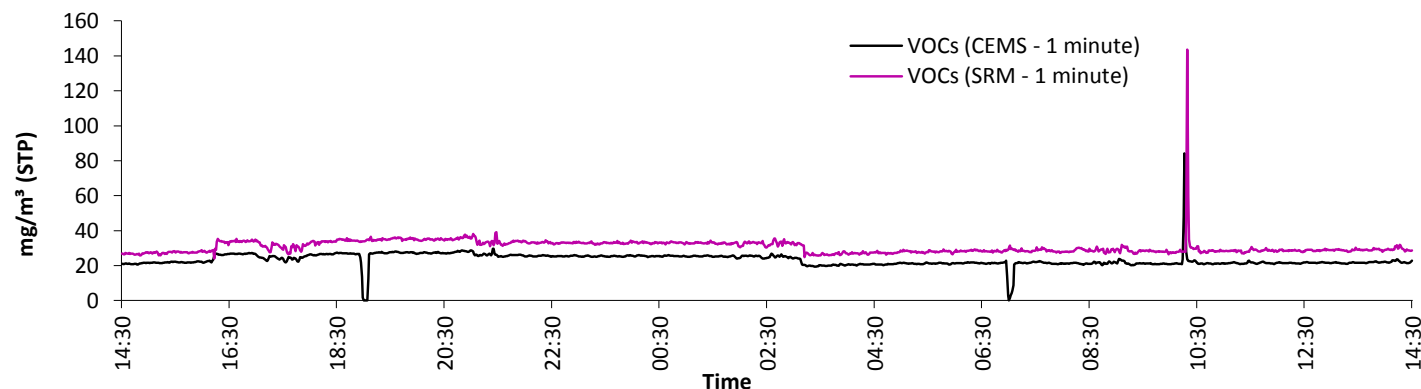
VOLATILE ORGANIC COMPOUNDS: AST CALCULATIONS

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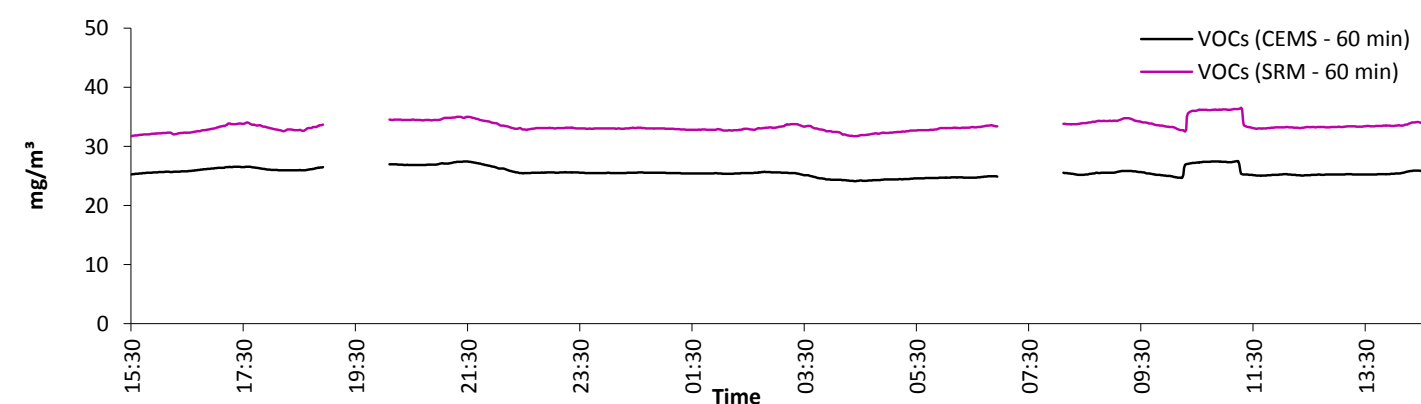
Lafarge Tarmac Cement and Lime Limited, Aberthaw Works

ABB2 - A1 - Main Stack on Preheater Tower

PLOT 1a: GRAPH FOR STP SRM vs STP CEMS (NON-STANDARDISED) (1 minute readings)



PLOT 1: GRAPH FOR REFERENCE SRM vs REFERENCE CEMS (STANDARDISED) (60 minute rolling averages)



Variability Test Data

Pair	Date	Time (60-minute Average)	CAL CEMS (STP, WET) mg/m³	CEMS Water Vapour % v/v	SRM Water Vapour % v/v	CEMS Oxygen (DRY) % v/v	SRM Oxygen (DRY) % v/v	CAL CEMS (STP, DRY, 10% O ₂) mg/m³	SRM (STP, DRY, 10% O ₂) mg/m³	ys, SRM - CAL CEMS
1	08/12/2014	14:32 - 15:32	27.79	11.18	10.06	10.48	10.57	32.71	31.82	-0.89
2	08/12/2014	15:32 - 16:32	30.41	11.93	10.64	9.62	9.78	33.37	32.34	-1.04
3	08/12/2014	16:32 - 17:32	32.92	12.67	11.70	8.90	9.07	34.28	33.96	-0.32
4	08/12/2014	17:32 - 18:32	32.96	13.80	12.33	8.47	8.69	33.55	32.71	-0.85
5	08/12/2014	19:32 - 20:32	35.33	14.73	13.31	7.87	8.09	34.71	34.52	-0.19
6	08/12/2014	20:32 - 21:32	35.07	14.79	13.38	8.20	8.38	35.38	34.97	-0.41
7	08/12/2014	21:32 - 22:32	33.14	14.47	12.98	8.04	8.23	32.89	32.84	-0.05
8	08/12/2014	22:32 - 23:32	32.82	14.36	12.91	8.22	8.41	32.99	33.05	0.06
9	09/12/2014	23:32 - 00:32	32.88	14.29	12.80	8.23	8.41	33.04	33.14	0.10
10	09/12/2014	00:32 - 01:32	32.88	14.51	12.99	8.11	8.27	32.81	32.81	0.00
11	09/12/2014	01:32 - 02:32	32.46	14.47	12.93	8.32	8.50	32.92	32.89	-0.03
12	09/12/2014	02:32 - 03:32	29.64	12.91	11.74	9.48	9.61	32.50	33.42	0.92
13	09/12/2014	03:32 - 04:32	26.46	10.59	9.48	10.59	10.75	31.28	31.90	0.62
14	09/12/2014	04:32 - 05:32	27.21	10.40	9.33	10.49	10.75	31.79	32.73	0.94
15	09/12/2014	05:32 - 06:32	27.66	10.51	9.48	10.36	10.67	31.95	33.24	1.30
16	09/12/2014	07:32 - 08:32	27.53	10.24	9.21	10.66	10.79	32.62	34.00	1.38
17	09/12/2014	08:32 - 09:32	27.81	10.06	9.13	10.72	10.81	33.08	34.09	1.00
18	09/12/2014	09:32 - 10:32	30.31	10.30	9.33	10.46	10.54	35.27	36.19	0.92
19	09/12/2014	10:32 - 11:32	27.58	10.33	9.37	10.58	10.61	32.46	33.03	0.57
20	09/12/2014	11:32 - 12:32	27.78	10.41	9.40	10.51	10.55	32.53	33.26	0.74
21	09/12/2014	12:32 - 13:32	27.91	10.95	10.03	10.44	10.45	32.65	33.44	0.80
MAX								35.38	Sd	0.72

VOLATILE ORGANIC COMPOUNDS: AST CALCULATIONS

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Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower

Test of Variability

$Q_0 = ELV \times (MU / 100) / 1.96$	7.65
Kv for 21 Pairs of Data	0.9824

The variability is accepted if $Sd \leq 1.5 \times Q_0 \times Kv$

Parameter	Value
Standard Deviation (Sd)	0.72
$1.5 \times Q_0 \times Kv$	11.28
Outcome of Variability Test	Pass

Test of Calibration (Acceptance of Calibration Function)

$t^{0.95} (N-1)$	1.711
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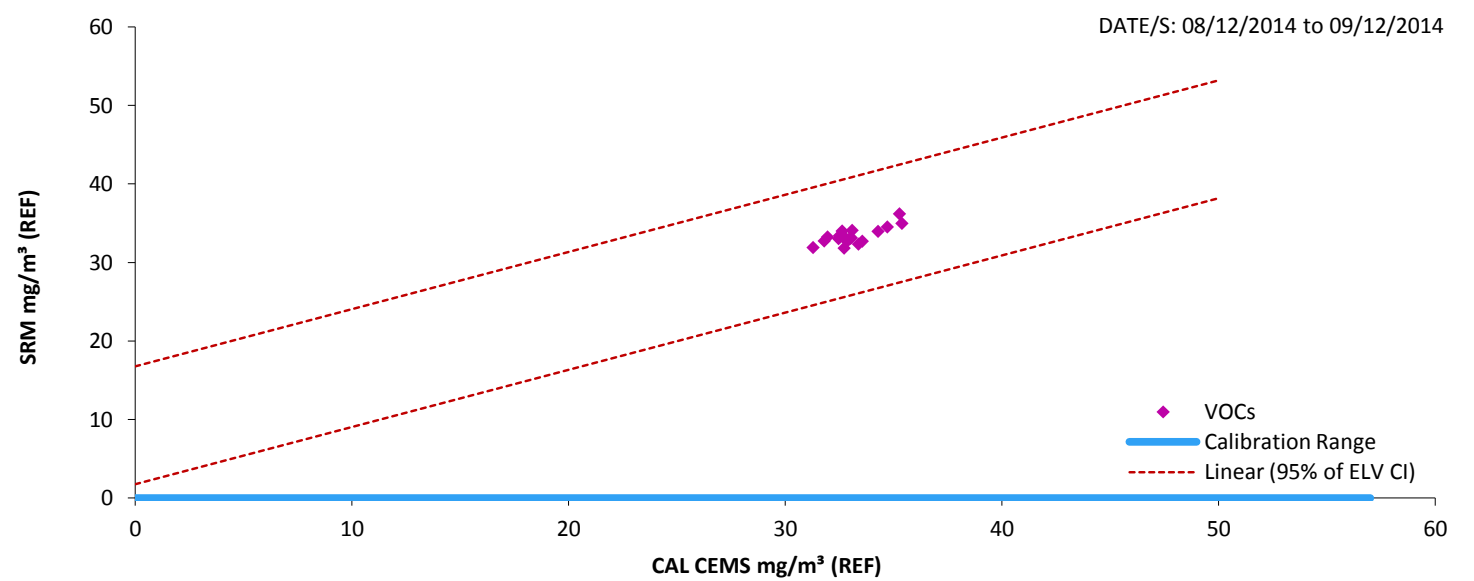
where N (number of samples) = 21

The calibration is accepted if $D \leq t^{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_0$

Parameter	Value
Mean Difference (D)	0.27
$t^{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_0$	7.92
Outcome of Calibration Test	Pass

New Calibration Range (REF)	Existing Range Still Valid
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PLOT 2: X-Y Plot - REF CAL CEMS vs REF SRM Values



Section 4B - Data and Calculations - AST

OXIDES OF NITROGEN (as NO₂): AST CALCULATIONS
(Page 1 of 3)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower

Calibration Data

Pair	Date	Time (60-minute Average)	x, CEMS (STP, WET) mg/m ³	y, SRM (STP, WET) mg/m ³	SRM (STP, DRY, 10% O ₂) mg/m ³	x - x _{av} (A)	y - y _{av} (B)	(A) x (B)	(x - x _{av}) ²	CAL CEMS (STP, WET) mg/m ³
1	08/12/2014	14:32 - 15:32	567.97	548.72	643.52	-51.14	-56.63	2895.83	2614.91	556.66
2	08/12/2014	15:32 - 16:32	597.66	587.32	644.37	-21.44	-18.03	386.73	459.87	585.77
3	08/12/2014	16:32 - 17:32	664.66	655.34	684.50	45.55	49.99	2276.97	2075.00	651.47
4	08/12/2014	17:32 - 18:32	680.41	678.23	691.35	61.30	72.88	4467.41	3757.89	666.92
5	08/12/2014	19:32 - 20:32	685.74	695.25	683.35	66.64	89.90	5990.63	4440.71	672.15
6	08/12/2014	20:32 - 21:32	672.90	677.25	681.62	53.79	71.90	3867.80	2893.61	659.55
7	08/12/2014	21:32 - 22:32	678.18	688.72	681.72	59.08	83.37	4925.37	3490.56	664.74
8	08/12/2014	22:32 - 23:32	687.69	694.94	697.19	68.59	89.59	6145.10	4704.63	674.06
9	09/12/2014	23:32 - 00:32	686.45	687.14	688.41	67.35	81.79	5508.39	4535.41	672.84
10	09/12/2014	00:32 - 01:32	691.07	697.35	692.74	71.96	91.99	6620.26	5178.78	677.37
11	09/12/2014	01:32 - 02:32	682.09	693.52	701.17	62.99	88.17	5553.52	3967.40	668.57
12	09/12/2014	02:32 - 03:32	636.50	621.61	680.01	17.39	16.25	282.71	302.48	623.86
13	09/12/2014	03:32 - 04:32	539.73	522.80	619.90	-79.37	-82.55	6551.64	6299.43	528.97
14	09/12/2014	04:32 - 05:32	569.17	535.89	634.14	-49.94	-69.46	3468.49	2493.62	557.84
15	09/12/2014	05:32 - 06:32	572.63	536.82	631.49	-46.47	-68.53	3184.71	2159.41	561.24
16	09/12/2014	07:32 - 08:32	543.38	502.52	596.57	-75.72	-102.83	7786.37	5733.66	532.55
17	09/12/2014	08:32 - 09:32	553.79	521.28	618.96	-65.31	-84.07	5490.57	4265.59	542.76
18	09/12/2014	09:32 - 10:32	646.10	605.20	701.64	27.00	-0.15	-4.12	728.79	633.28
19	09/12/2014	10:32 - 11:32	546.44	511.49	597.74	-72.66	-93.86	6820.50	5279.92	535.55
20	09/12/2014	11:32 - 12:32	547.44	525.32	610.52	-71.66	-80.03	5734.95	5134.99	536.53
21	09/12/2014	12:32 - 13:32	551.17	525.67	609.36	-67.93	-79.68	5412.88	4614.61	540.19
SPREAD OF DATA					105.07	SUM		93366.69	75131.28	
DAILY ELV (mg/m ³)					800					
MU (%)					20					
15% of ELV					120.00					

Outliers Data

Pair	Date	Time (60-minute Average)	x, CEMS (WET) mg/m ³	y, SRM (WET) mg/m ³
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Any values sitting outside 2 x Standard Deviations have been removed as Outliers, as per EA's Quick Guide, RM-QG14.

Existing Calibration Function
$y = 0.9806x - 0.29$

Source of Existing Calibration Function
QAL 2 Report - ESG - report no. 121107-2012/QAL2

Existing Calibration Range (@ REF Conditions)
0 to 931 mg/m ³

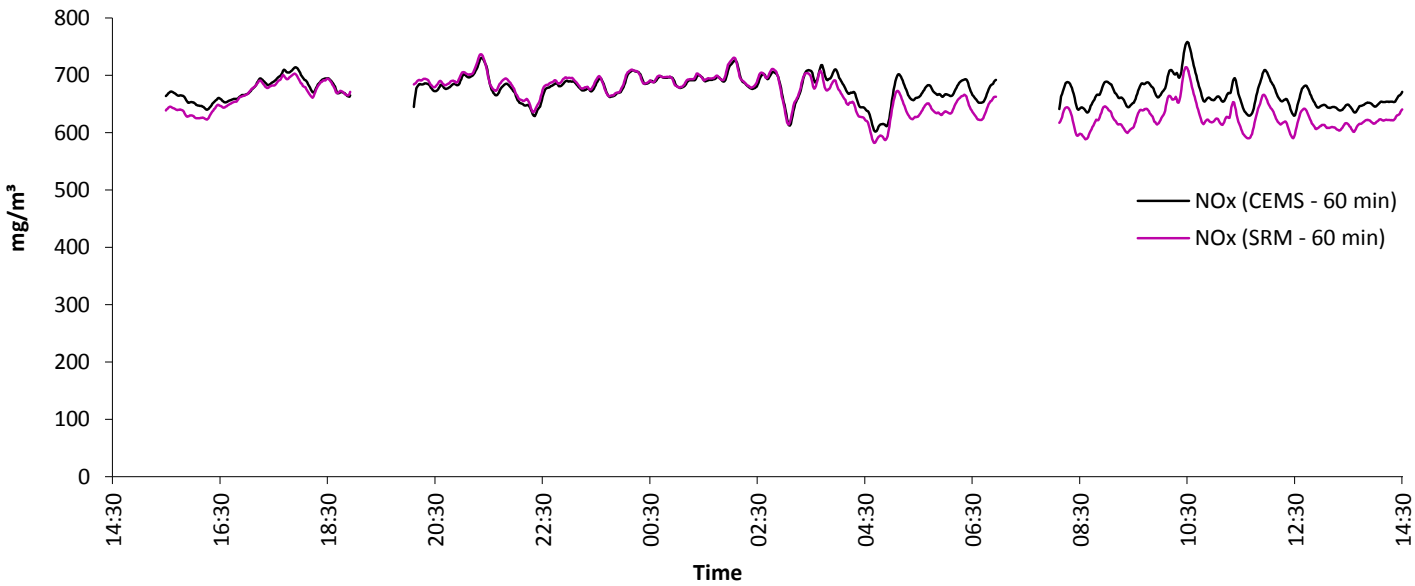
OXIDES OF NITROGEN (as NO₂): AST CALCULATIONS

(Page 2 of 3)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works

ABB2 - A1 - Main Stack on Preheater Tower

PLOT 1: GRAPH FOR REFERENCE SRM vs REFERENCE CEMS (STANDARDISED) (60 minute rolling averages)



Variability Test Data

Pair	Date	Time (60-minute Average)	CAL CEMS (STP, WET) mg/m³	CEMS Water Vapour % v/v	SRM Water Vapour % v/v	CEMS Oxygen (DRY) % v/v	SRM Oxygen (DRY) % v/v	CAL CEMS (STP, DRY, 10% O ₂) mg/m³	SRM (STP, DRY, 10% O ₂) mg/m³	ys, SRM - CAL CEMS
1	08/12/2014	14:32 - 15:32	556.66	11.18	10.06	10.48	10.57	655.35	643.52	-11.84
2	08/12/2014	15:32 - 16:32	585.77	11.93	10.64	9.62	9.78	642.93	644.37	1.45
3	08/12/2014	16:32 - 17:32	651.47	12.67	11.70	8.90	9.07	678.30	684.50	6.20
4	08/12/2014	17:32 - 18:32	666.92	13.80	12.33	8.47	8.69	678.94	691.35	12.40
5	08/12/2014	19:32 - 20:32	672.15	14.73	13.31	7.87	8.09	660.21	683.35	23.14
6	08/12/2014	20:32 - 21:32	659.55	14.79	13.38	8.20	8.38	665.37	681.62	16.25
7	08/12/2014	21:32 - 22:32	664.74	14.47	12.98	8.04	8.23	659.66	681.72	22.06
8	08/12/2014	22:32 - 23:32	674.06	14.36	12.91	8.22	8.41	677.56	697.19	19.62
9	09/12/2014	23:32 - 00:32	672.84	14.29	12.80	8.23	8.41	676.12	688.41	12.29
10	09/12/2014	00:32 - 01:32	677.37	14.51	12.99	8.11	8.27	675.93	692.74	16.81
11	09/12/2014	01:32 - 02:32	668.57	14.47	12.93	8.32	8.50	677.97	701.17	23.19
12	09/12/2014	02:32 - 03:32	623.86	12.91	11.74	9.48	9.61	684.13	680.01	-4.12
13	09/12/2014	03:32 - 04:32	528.97	10.59	9.48	10.59	10.75	625.23	619.90	-5.33
14	09/12/2014	04:32 - 05:32	557.84	10.40	9.33	10.49	10.75	651.84	634.14	-17.70
15	09/12/2014	05:32 - 06:32	561.24	10.51	9.48	10.36	10.67	648.37	631.49	-16.89
16	09/12/2014	07:32 - 08:32	532.55	10.24	9.21	10.66	10.79	631.03	596.57	-34.47
17	09/12/2014	08:32 - 09:32	542.76	10.06	9.13	10.72	10.81	645.67	618.96	-26.71
18	09/12/2014	09:32 - 10:32	633.28	10.30	9.33	10.46	10.54	736.80	701.64	-35.16
19	09/12/2014	10:32 - 11:32	535.55	10.33	9.37	10.58	10.61	630.33	597.74	-32.60
20	09/12/2014	11:32 - 12:32	536.53	10.41	9.40	10.51	10.55	628.14	610.52	-17.62
21	09/12/2014	12:32 - 13:32	540.19	10.95	10.03	10.44	10.45	631.97	609.36	-22.60
MAX								736.80	Sd	20.49

OXIDES OF NITROGEN (as NO₂): AST CALCULATIONS

(Page 3 of 3)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works

ABB2 - A1 - Main Stack on Preheater Tower

Test of Variability

$Q_0 = \text{ELV} \times (\text{MU} / 100) / 1.96$	81.63
Kv for 21 Pairs of Data	0.9824

The variability is accepted if $Sd \leq 1.5 \times Q_0 \times Kv$

Parameter	Value
Standard Deviation (Sd)	20.49
$1.5 \times Q_0 \times Kv$	120.29
Outcome of Variability Test	Pass

Test of Calibration (Acceptance of Calibration Function)

$t_{0.95} (N-1)$	1.711
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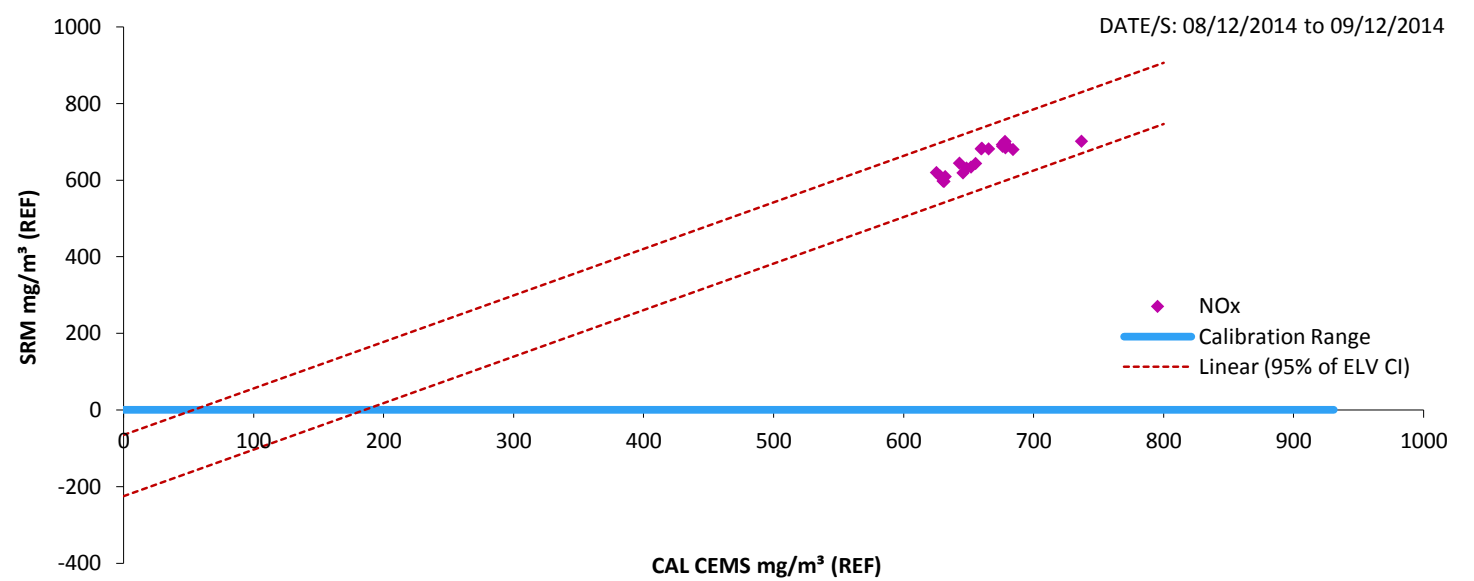
where N (number of samples) = 21

The calibration is accepted if $D \leq t_{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_0$

Parameter	Value
Mean Difference (D)	3.41
$t_{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_0$	89.28
Outcome of Calibration Test	Pass

New Calibration Range (REF)	Existing Range Still Valid
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PLOT 2: X-Y Plot - REF CAL CEMS vs REF SRM Values



SULPHUR DIOXIDE: AST CALCULATIONS

(Page 1 of 3)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower

Calibration Data

Pair	Date	Time (60-minute Average)	x, CEMS (STP, WET) mg/m ³	y, SRM (STP, WET) mg/m ³	SRM (STP, DRY, 10% O ₂) mg/m ³	x - x _{av} (A)	y - y _{av} (B)	(A) x (B)	(x - x _{av}) ²	CAL CEMS (STP, WET) mg/m ³
1	08/12/2014	14:32 - 15:32	167.03	183.45	215.14	-98.80	-98.92	9773.36	9761.17	303.11
2	08/12/2014	16:32 - 17:32	483.18	493.80	515.77	217.35	211.43	45953.59	47241.16	875.34
3	08/12/2014	17:32 - 18:32	450.68	457.59	466.44	184.86	175.22	32390.13	34171.59	816.52
4	08/12/2014	19:32 - 20:32	460.44	471.86	463.79	194.61	189.49	36876.85	37873.43	834.18
5	08/12/2014	20:32 - 21:32	448.26	458.21	461.16	182.43	175.83	32077.46	33281.42	812.13
6	08/12/2014	21:32 - 22:32	424.61	440.08	435.61	158.78	157.71	25041.85	25211.81	769.33
7	08/12/2014	22:32 - 23:32	391.84	404.64	405.95	126.01	122.27	15407.54	15879.57	710.02
8	09/12/2014	23:32 - 00:32	374.54	385.74	386.44	108.72	103.36	11237.08	11819.01	678.71
9	09/12/2014	00:32 - 01:32	355.50	373.28	370.81	89.68	90.91	8152.27	8041.89	644.25
10	09/12/2014	01:32 - 02:32	331.49	347.83	351.67	65.66	65.46	4298.46	4311.77	600.78
11	09/12/2014	02:32 - 03:32	266.32	289.70	316.92	0.49	7.33	3.57	0.24	482.81
12	09/12/2014	03:32 - 04:32	132.85	153.19	181.64	-132.97	-129.18	17177.73	17681.81	241.25
13	09/12/2014	04:32 - 05:32	125.49	144.37	170.83	-140.33	-138.01	19367.05	19693.81	227.93
14	09/12/2014	05:32 - 06:32	131.15	151.91	178.70	-134.68	-130.46	17570.44	18137.98	238.17
15	09/12/2014	07:32 - 08:32	120.86	143.58	170.45	-144.97	-138.79	20120.64	21015.97	219.54
16	09/12/2014	08:32 - 09:32	124.48	142.68	169.42	-141.35	-139.69	19744.81	19979.38	226.09
17	09/12/2014	09:32 - 10:32	124.94	144.83	167.91	-140.88	-137.54	19377.33	19848.38	226.93
18	09/12/2014	10:32 - 11:32	131.53	149.79	175.04	-134.30	-132.59	17806.18	18035.93	238.85
19	09/12/2014	11:32 - 12:32	132.82	150.31	174.69	-133.01	-132.06	17565.20	17690.97	241.19
20	09/12/2014	12:32 - 13:32	138.53	160.61	186.18	-127.30	-121.76	15499.90	16204.93	251.52
SPREAD OF DATA					347.86	SUM		385441.43	395882.21	
DAILY ELV (mg/m ³)					800					
MU (%)					20					
15% of ELV					120.00					

Outliers Data

Pair	Date	Time (60-minute Average)	x, CEMS (WET) mg/m ³	y, SRM (WET) mg/m ³
1	08/12/2014	15:32 - 16:32	293.20	296.03
2				
3				
4				
5				
6				
7				
8				
9				
10				

Any values sitting outside 2 x Standard Deviations have been removed as Outliers, as per EA's Quick Guide, RM-QG14.

Existing Calibration Function
$y = 1.81x + 0.7839$

Source of Existing Calibration Function
QAL 2 Report - ESG - report no. 121107-2012/QAL2

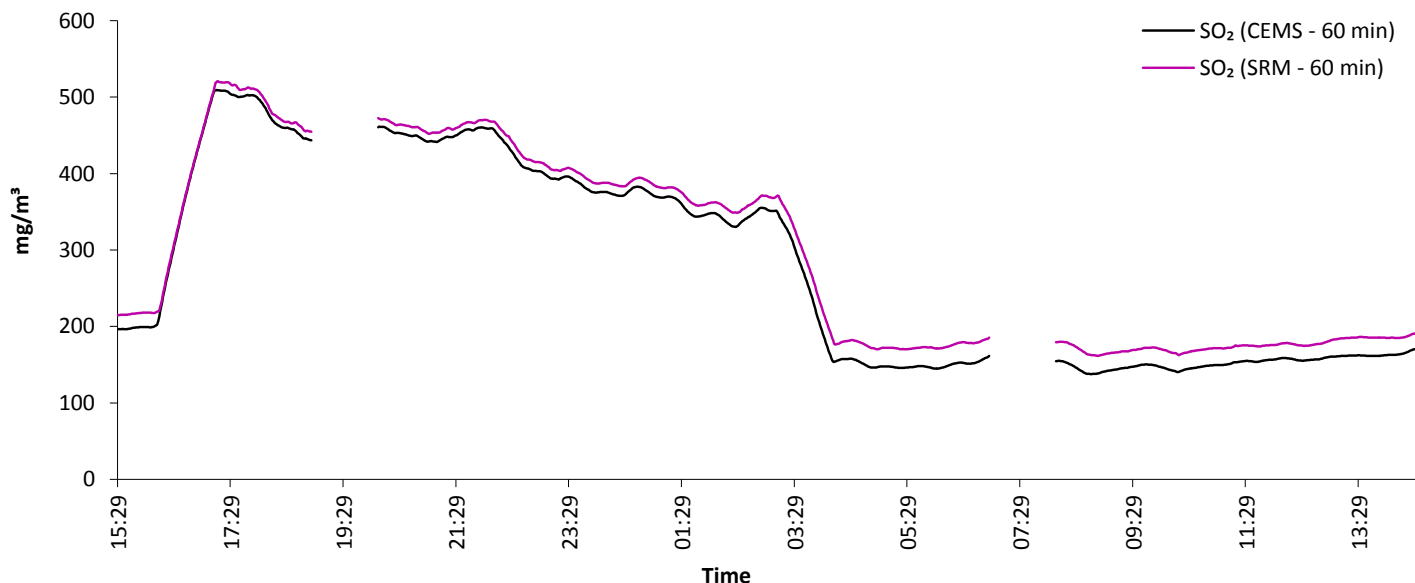
Existing Calibration Range (@ REF Conditions)
0 to 691 mg/m ³

SULPHUR DIOXIDE: AST CALCULATIONS

(Page 2 of 3)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower

PLOT 1: GRAPH FOR REFERENCE SRM vs REFERENCE CEMS (STANDARDISED) (60 minute rolling averages)



Variability Test Data

Pair	Date	Time (60-minute Average)	CAL CEMS (STP, WET) mg/m³	CEMS Water Vapour % v/v	SRM Water Vapour % v/v	CEMS Oxygen (DRY) % v/v	SRM Oxygen (DRY) % v/v	CAL CEMS (STP, DRY, 10% O ₂) mg/m³	SRM (STP, DRY, 10% O ₂) mg/m³	ys, SRM - CAL CEMS
1	08/12/2014	14:32 - 15:32	303.11	11.18	10.06	10.48	10.57	356.85	215.14	-141.70
2	08/12/2014	16:32 - 17:32	875.34	12.67	11.70	8.90	9.07	911.38	515.77	-395.61
3	08/12/2014	17:32 - 18:32	816.52	13.80	12.33	8.47	8.69	831.25	466.44	-364.80
4	08/12/2014	19:32 - 20:32	834.18	14.73	13.31	7.87	8.09	819.36	463.79	-355.57
5	08/12/2014	20:32 - 21:32	812.13	14.79	13.38	8.20	8.38	819.30	461.16	-358.14
6	08/12/2014	21:32 - 22:32	769.33	14.47	12.98	8.04	8.23	763.45	435.61	-327.84
7	08/12/2014	22:32 - 23:32	710.02	14.36	12.91	8.22	8.41	713.70	405.95	-307.76
8	09/12/2014	23:32 - 00:32	678.71	14.29	12.80	8.23	8.41	682.01	386.44	-295.57
9	09/12/2014	00:32 - 01:32	644.25	14.51	12.99	8.11	8.27	642.88	370.81	-272.06
10	09/12/2014	01:32 - 02:32	600.78	14.47	12.93	8.32	8.50	609.24	351.67	-257.57
11	09/12/2014	02:32 - 03:32	482.81	12.91	11.74	9.48	9.61	529.46	316.92	-212.54
12	09/12/2014	03:32 - 04:32	241.25	10.59	9.48	10.59	10.75	285.15	181.64	-103.51
13	09/12/2014	04:32 - 05:32	227.93	10.40	9.33	10.49	10.75	266.33	170.83	-95.50
14	09/12/2014	05:32 - 06:32	238.17	10.51	9.48	10.36	10.67	275.14	178.70	-96.44
15	09/12/2014	07:32 - 08:32	219.54	10.24	9.21	10.66	10.79	260.14	170.45	-89.69
16	09/12/2014	08:32 - 09:32	226.09	10.06	9.13	10.72	10.81	268.96	169.42	-99.54
17	09/12/2014	09:32 - 10:32	226.93	10.30	9.33	10.46	10.54	264.03	167.91	-96.12
18	09/12/2014	10:32 - 11:32	238.85	10.33	9.37	10.58	10.61	281.12	175.04	-106.08
19	09/12/2014	11:32 - 12:32	241.19	10.41	9.40	10.51	10.55	282.37	174.69	-107.68
20	09/12/2014	12:32 - 13:32	251.52	10.95	10.03	10.44	10.45	294.25	186.18	-108.07
MAX								911.38	Sd	115.11

SULPHUR DIOXIDE: AST CALCULATIONS

(Page 3 of 3)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works

ABB2 - A1 - Main Stack on Preheater Tower

Test of Variability

$Q_0 = ELV \times (MU / 100) / 1.96$	81.63
Kv for 20 Pairs of Data	0.9824

The variability is accepted if $Sd \leq 1.5 \times Q_0 \times Kv$

Parameter	Value
Standard Deviation (Sd)	115.11
$1.5 \times Q_0 \times Kv$	120.29
Outcome of Variability Test	Pass

Test of Calibration (Acceptance of Calibration Function)

$t_{0.95} (N-1)$	1.711
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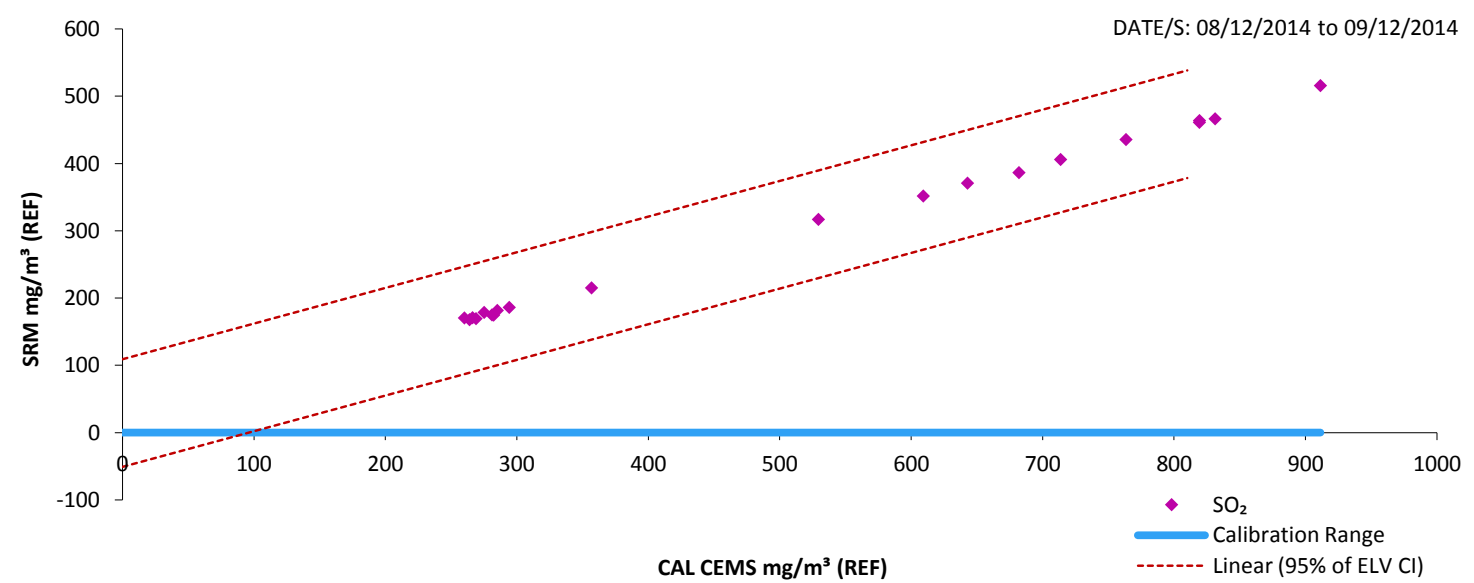
where N (number of samples) = 20

The calibration is accepted if $D \leq t_{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_0$

Parameter	Value
Mean Difference (D)	209.59
$t_{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_0$	125.67
Outcome of Calibration Test	Fail

New Calibration Range (REF)	N/A - Fail
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PLOT 2: X-Y Plot - REF CAL CEMS vs REF SRM Values



Section 4B - Data and Calculations - AST

CARBON MONOXIDE: AST CALCULATIONS

(Page 1 of 3)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower

Calibration Data

Pair	Date	Time (60-minute Average)	x, CEMS (STP, WET) mg/m ³	y, SRM (STP, WET) mg/m ³	SRM (STP, DRY, 10% O ₂) mg/m ³	x - x _{av} (A)	y - y _{av} (B)	(A) x (B)	(x - x _{av}) ²	CAL CEMS (STP, WET) mg/m ³
1	08/12/2014	14:32 - 15:32	434.69	398.08	466.85	-325.69	-279.11	90901.54	106071.16	479.14
2	08/12/2014	15:32 - 16:32	498.81	442.48	485.47	-261.56	-234.71	61390.52	68415.62	550.07
3	08/12/2014	16:32 - 17:32	592.88	534.48	558.26	-167.49	-142.70	23902.18	28054.34	654.12
4	08/12/2014	17:32 - 18:32	850.05	745.20	759.62	89.68	68.02	6099.37	8041.67	938.57
5	08/12/2014	19:32 - 20:32	830.42	744.95	732.20	70.04	67.76	4746.36	4906.19	916.86
6	08/12/2014	20:32 - 21:32	883.80	788.21	793.29	123.42	111.02	13702.67	15233.43	975.90
7	08/12/2014	21:32 - 22:32	840.60	726.59	719.21	80.23	49.40	3963.53	6436.19	928.12
8	08/12/2014	22:32 - 23:32	876.85	771.65	774.14	116.48	94.47	11003.02	13566.70	968.22
9	09/12/2014	23:32 - 00:32	832.33	726.91	728.24	71.95	49.72	3577.66	5177.10	918.97
10	09/12/2014	00:32 - 01:32	811.93	704.23	699.58	51.55	27.05	1394.23	2657.61	896.40
11	09/12/2014	01:32 - 02:32	763.85	661.99	669.29	3.47	-15.19	-52.74	12.05	843.22
12	09/12/2014	02:32 - 03:32	819.99	735.83	804.96	59.61	58.64	3495.98	3553.67	905.32
13	09/12/2014	03:32 - 04:32	787.69	702.62	833.11	27.31	25.44	694.75	745.95	869.59
14	09/12/2014	04:32 - 05:32	876.67	774.27	916.21	116.30	97.08	11290.21	13525.28	968.02
15	09/12/2014	05:32 - 06:32	971.91	872.86	1026.78	211.54	195.67	41391.53	44747.96	1073.36
16	09/12/2014	07:32 - 08:32	1052.36	945.54	1122.49	291.98	268.36	78355.41	85254.18	1162.34
17	09/12/2014	10:32 - 11:32	687.46	642.83	751.23	-72.91	-34.35	2504.71	5316.19	758.73
18	09/12/2014	11:32 - 12:32	513.18	471.79	548.30	-247.19	-205.40	50773.51	61104.50	565.96
19	09/12/2014	12:32 - 13:32	521.66	476.02	551.81	-238.71	-201.16	48020.55	56984.71	575.34
SPREAD OF DATA					656.49	SUM		457154.99	529804.51	
DAILY ELV (mg/m ³)					1000					
MU (%)					20					
15% of ELV					150.00					

Outliers Data

Pair	Date	Time (60-minute Average)	x, CEMS (WET) mg/m ³	y, SRM (WET) mg/m ³
1	09/12/2014	08:32 - 09:32	1093.02	1073.78
2				
3				
4				
5				
6				
7				
8				
9				
10				

Any values sitting outside 2 x Standard Deviations have been removed as Outliers, as per EA's Quick Guide, RM-QG14.

Existing Calibration Function
$y = 1.1061x - 1.67$

Source of Existing Calibration Function
QAL 2 Report - ESG - report no. 121107-2012/QAL2

Existing Calibration Range (@ REF Conditions)
0 to 1397 mg/m ³

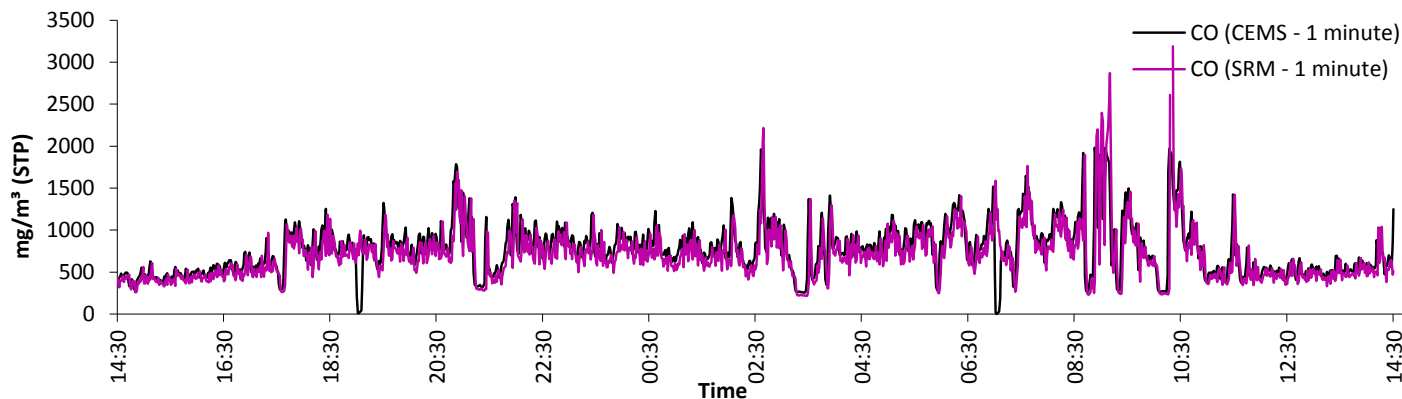
CARBON MONOXIDE: AST CALCULATIONS

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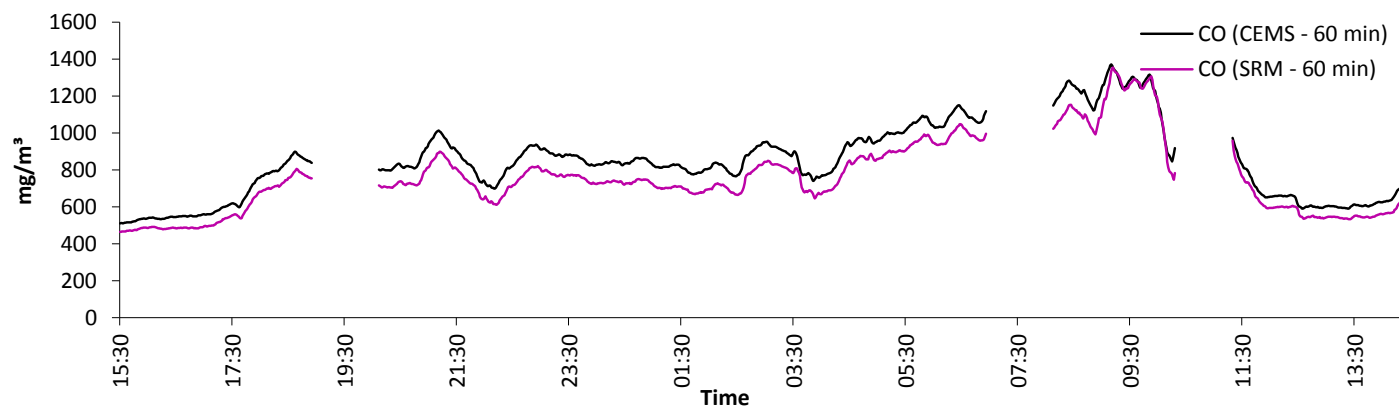
Lafarge Tarmac Cement and Lime Limited, Aberthaw Works

ABB2 - A1 - Main Stack on Preheater Tower

PLOT 1a: GRAPH FOR STP SRM vs STP CEMS (NON-STANDARDISED) (1 minute readings)



PLOT 1: GRAPH FOR REFERENCE SRM vs REFERENCE CEMS (STANDARDISED) (60 minute rolling averages)



Variability Test Data

Pair	Date	Time (60-minute Average)	CAL CEMS (STP, WET) mg/m³	CEMS Water Vapour % v/v	SRM Water Vapour % v/v	CEMS Oxygen (DRY) % v/v	SRM Oxygen (DRY) % v/v	CAL CEMS (STP, DRY, 10% O ₂) mg/m³	SRM (STP, DRY, 10% O ₂) mg/m³	ys, SRM - CAL CEMS
1	08/12/2014	14:32 - 15:32	479.14	11.18	10.06	10.48	10.57	564.09	466.85	-97.24
2	08/12/2014	15:32 - 16:32	550.07	11.93	10.64	9.62	9.78	603.74	485.47	-118.27
3	08/12/2014	16:32 - 17:32	654.12	12.67	11.70	8.90	9.07	681.05	558.26	-122.79
4	08/12/2014	17:32 - 18:32	938.57	13.80	12.33	8.47	8.69	955.50	759.62	-195.88
5	08/12/2014	19:32 - 20:32	916.86	14.73	13.31	7.87	8.09	900.57	732.20	-168.37
6	08/12/2014	20:32 - 21:32	975.90	14.79	13.38	8.20	8.38	984.51	793.29	-191.22
7	08/12/2014	21:32 - 22:32	928.12	14.47	12.98	8.04	8.23	921.03	719.21	-201.82
8	08/12/2014	22:32 - 23:32	968.22	14.36	12.91	8.22	8.41	973.24	774.14	-199.10
9	09/12/2014	23:32 - 00:32	918.97	14.29	12.80	8.23	8.41	923.45	728.24	-195.20
10	09/12/2014	00:32 - 01:32	896.40	14.51	12.99	8.11	8.27	894.50	699.58	-194.92
11	09/12/2014	01:32 - 02:32	843.22	14.47	12.93	8.32	8.50	855.08	669.29	-185.79
12	09/12/2014	02:32 - 03:32	905.32	12.91	11.74	9.48	9.61	992.78	804.96	-187.82
13	09/12/2014	03:32 - 04:32	869.59	10.59	9.48	10.59	10.75	1027.82	833.11	-194.71
14	09/12/2014	04:32 - 05:32	968.02	10.40	9.33	10.49	10.75	1131.14	916.21	-214.93
15	09/12/2014	05:32 - 06:32	1073.36	10.51	9.48	10.36	10.67	1240.01	1026.78	-213.23
16	09/12/2014	07:32 - 08:32	1162.34	10.24	9.21	10.66	10.79	1377.29	1122.49	-254.80
17	09/12/2014	10:32 - 11:32	758.73	10.33	9.37	10.58	10.61	893.01	751.23	-141.78
18	09/12/2014	11:32 - 12:32	565.96	10.41	9.40	10.51	10.55	662.59	548.30	-114.29
19	09/12/2014	12:32 - 13:32	575.34	10.95	10.03	10.44	10.45	673.09	551.81	-121.27
MAX								1377.29	Sd	42.56

CARBON MONOXIDE: AST CALCULATIONS

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Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower

Test of Variability

$Q_0 = ELV \times (MU / 100) / 1.96$	102.04
Kv for 19 Pairs of Data	0.9814

The variability is accepted if $Sd \leq 1.5 \times Q_0 \times Kv$

Parameter	Value
Standard Deviation (Sd)	42.56
$1.5 \times Q_0 \times Kv$	150.21
Outcome of Variability Test	Pass

Test of Calibration (Acceptance of Calibration Function)

$t_{0.95} (N-1)$	1.729
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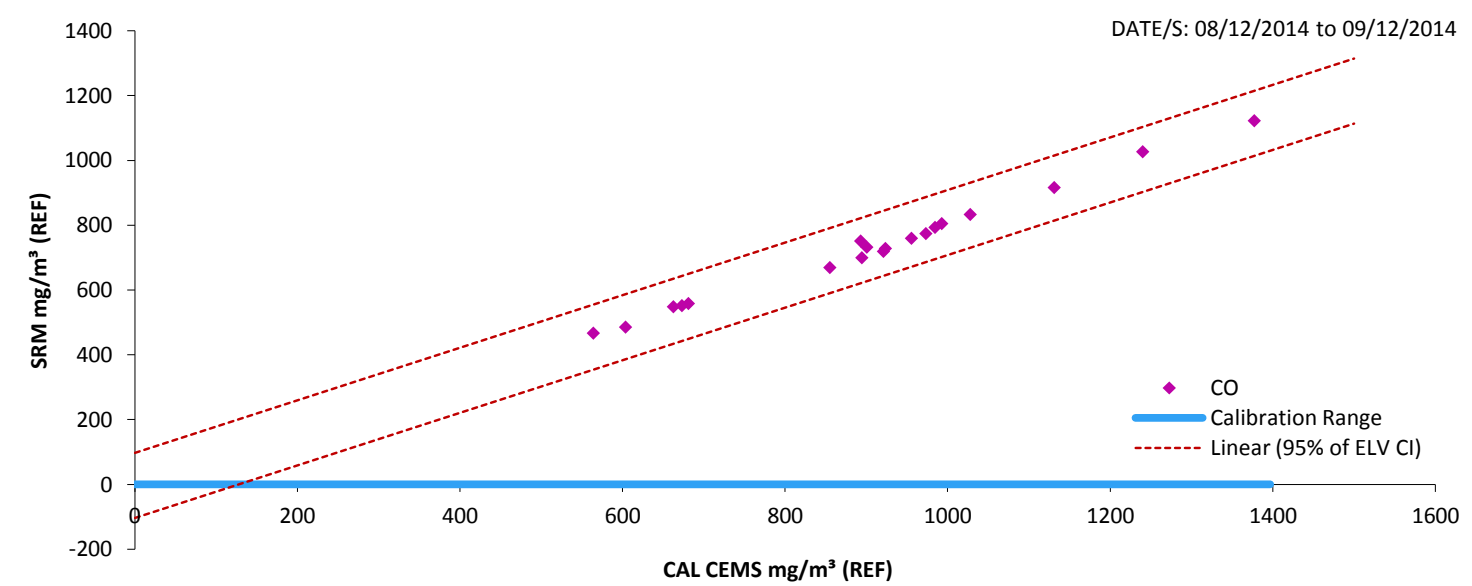
where N (number of samples) = 19

The calibration is accepted if $D \leq t_{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_0$

Parameter	Value
Mean Difference (D)	164.41
$t_{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_0$	118.92
Outcome of Calibration Test	Fail

New Calibration Range (REF)	N/A - Fail
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PLOT 2: X-Y Plot - REF CAL CEMS vs REF SRM Values



HYDROGEN CHLORIDE: AST CALCULATIONS

(Page 1 of 3)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower

Calibration Data

Pair	Date	Time (60-minute Average)	x, CEMS (STP, WET) mg/m ³	y, SRM (STP, WET) mg/m ³	SRM (STP, DRY, 10% O ₂) mg/m ³	x - x _{av} (A)	y - y _{av} (B)	(A) x (B)	(x - x _{av}) ²	CAL CEMS (STP, WET) mg/m ³
1	08/12/2014	14:32 - 15:32	1.38	1.77	2.08	-2.43	-0.45	1.08	5.88	1.70
2	08/12/2014	15:32 - 16:32	2.90	1.41	1.55	-0.90	-0.81	0.73	0.82	3.00
3	08/12/2014	16:32 - 17:32	7.86	3.34	3.49	4.06	1.12	4.53	16.51	7.23
4	08/12/2014	17:32 - 18:32	6.51	3.17	3.23	2.71	0.95	2.57	7.34	6.07
5	08/12/2014	19:32 - 20:32	6.70	3.53	3.47	2.90	1.31	3.79	8.38	6.23
6	08/12/2014	20:32 - 21:32	8.58	3.75	3.77	4.78	1.53	7.30	22.81	7.83
7	08/12/2014	21:32 - 22:32	8.48	4.74	4.69	4.68	2.52	11.78	21.86	7.75
8	08/12/2014	22:32 - 23:32	3.74	2.39	2.40	-0.06	0.17	-0.01	0.00	3.72
9	09/12/2014	23:32 - 00:32	4.97	2.53	2.53	1.17	0.31	0.36	1.36	4.76
10	09/12/2014	00:32 - 01:32	5.41	3.09	3.07	1.61	0.87	1.40	2.60	5.14
11	09/12/2014	01:32 - 02:32	4.68	2.61	2.64	0.88	0.39	0.34	0.77	4.51
12	09/12/2014	02:32 - 03:32	3.91	2.76	3.02	0.11	0.54	0.06	0.01	3.86
13	09/12/2014	04:32 - 05:32	1.38	2.80	3.31	-2.42	0.58	-1.40	5.87	1.70
14	09/12/2014	05:32 - 06:32	1.40	1.95	2.30	-2.40	-0.27	0.64	5.77	1.72
15	09/12/2014	07:32 - 08:32	1.33	1.15	1.36	-2.47	-1.07	2.65	6.11	1.66
16	09/12/2014	08:32 - 09:32	1.31	0.62	0.74	-2.49	-1.60	3.97	6.18	1.65
17	09/12/2014	09:32 - 10:32	1.41	0.68	0.79	-2.39	-1.54	3.68	5.71	1.73
18	09/12/2014	10:32 - 11:32	1.25	0.73	0.86	-2.55	-1.49	3.79	6.49	1.60
19	09/12/2014	11:32 - 12:32	1.47	0.63	0.73	-2.34	-1.59	3.73	5.46	1.78
20	09/12/2014	12:32 - 13:32	1.37	0.75	0.87	-2.44	-1.47	3.58	5.93	1.69
SPREAD OF DATA					3.96	SUM		54.58	135.89	
DAILY ELV (mg/m ³)					10					
MU (%)					40					
15% of ELV					1.50					

Existing Calibration Function
$y = 0.8515x + 0.53$

Source of Existing Calibration Function
QAL 2 Report - ESG - report no. 121107-2012/QAL2

Existing Calibration Range (@ REF Conditions)
0 to 20 mg/m ³

Outliers Data

Pair	Date	Time (60-minute Average)	x, CEMS (WET) mg/m ³	y, SRM (WET) mg/m ³
1	09/12/2014	03:32 - 04:32	1.14	4.74
2				
3				
4				
5				
6				
7				
8				
9				
10				

Any values sitting outside 2 x Standard Deviations have been removed as Outliers, as per EA's Quick Guide, RM-QG14.

Section 4B - Data and Calculations - AST

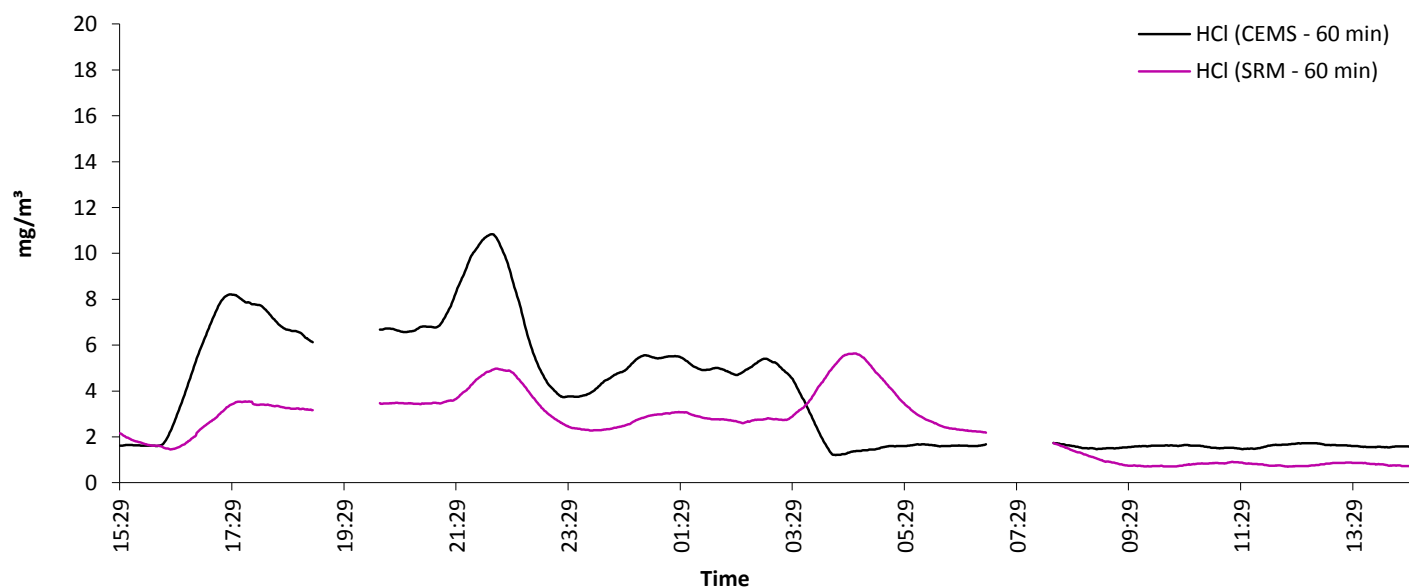
HYDROGEN CHLORIDE: AST CALCULATIONS

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Lafarge Tarmac Cement and Lime Limited, Aberthaw Works

ABB2 - A1 - Main Stack on Preheater Tower

PLOT 1: GRAPH FOR REFERENCE SRM vs REFERENCE CEMS (STANDARDISED) (60 minute rolling averages)



Variability Test Data

Pair	Date	Time (60-minute Average)	CAL CEMS (STP, WET) mg/m³	CEMS Water Vapour % v/v	SRM Water Vapour % v/v	CEMS Oxygen (DRY) % v/v	SRM Oxygen (DRY) % v/v	CAL CEMS (STP, DRY, 10% O ₂) mg/m³	SRM (STP, DRY, 10% O ₂) mg/m³	ys, SRM - CAL CEMS
1	08/12/2014	14:32 - 15:32	1.70	11.18	10.06	10.48	10.57	2.00	2.08	0.08
2	08/12/2014	15:32 - 16:32	3.00	11.93	10.64	9.62	9.78	3.29	1.55	-1.74
3	08/12/2014	16:32 - 17:32	7.23	12.67	11.70	8.90	9.07	7.52	3.49	-4.04
4	08/12/2014	17:32 - 18:32	6.07	13.80	12.33	8.47	8.69	6.18	3.23	-2.95
5	08/12/2014	19:32 - 20:32	6.23	14.73	13.31	7.87	8.09	6.12	3.47	-2.65
6	08/12/2014	20:32 - 21:32	7.83	14.79	13.38	8.20	8.38	7.90	3.77	-4.13
7	08/12/2014	21:32 - 22:32	7.75	14.47	12.98	8.04	8.23	7.69	4.69	-3.00
8	08/12/2014	22:32 - 23:32	3.72	14.36	12.91	8.22	8.41	3.73	2.40	-1.34
9	09/12/2014	23:32 - 00:32	4.76	14.29	12.80	8.23	8.41	4.78	2.53	-2.25
10	09/12/2014	00:32 - 01:32	5.14	14.51	12.99	8.11	8.27	5.13	3.07	-2.06
11	09/12/2014	01:32 - 02:32	4.51	14.47	12.93	8.32	8.50	4.58	2.64	-1.93
12	09/12/2014	02:32 - 03:32	3.86	12.91	11.74	9.48	9.61	4.23	3.02	-1.21
13	09/12/2014	04:32 - 05:32	1.70	10.40	9.33	10.49	10.75	1.99	3.31	1.32
14	09/12/2014	05:32 - 06:32	1.72	10.51	9.48	10.36	10.67	1.99	2.30	0.31
15	09/12/2014	07:32 - 08:32	1.66	10.24	9.21	10.66	10.79	1.97	1.36	-0.61
16	09/12/2014	08:32 - 09:32	1.65	10.06	9.13	10.72	10.81	1.96	0.74	-1.22
17	09/12/2014	09:32 - 10:32	1.73	10.30	9.33	10.46	10.54	2.01	0.79	-1.22
18	09/12/2014	10:32 - 11:32	1.60	10.33	9.37	10.58	10.61	1.88	0.86	-1.02
19	09/12/2014	11:32 - 12:32	1.78	10.41	9.40	10.51	10.55	2.08	0.73	-1.35
20	09/12/2014	12:32 - 13:32	1.69	10.95	10.03	10.44	10.45	1.98	0.87	-1.11
MAX								7.90	Sd	1.36

HYDROGEN CHLORIDE: AST CALCULATIONS

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Lafarge Tarmac Cement and Lime Limited, Aberthaw Works

ABB2 - A1 - Main Stack on Preheater Tower

Test of Variability

$Q_0 = ELV \times (MU / 100) / 1.96$	2.04
Kv for 20 Pairs of Data	0.9824

The variability is accepted if $Sd \leq 1.5 \times Q_0 \times Kv$

Parameter	Value
Standard Deviation (Sd)	1.36
$1.5 \times Q_0 \times Kv$	3.01
Outcome of Variability Test	Pass

Test of Calibration (Acceptance of Calibration Function)

$t^{0.95} (N-1)$	1.711
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where N (number of samples) = 20

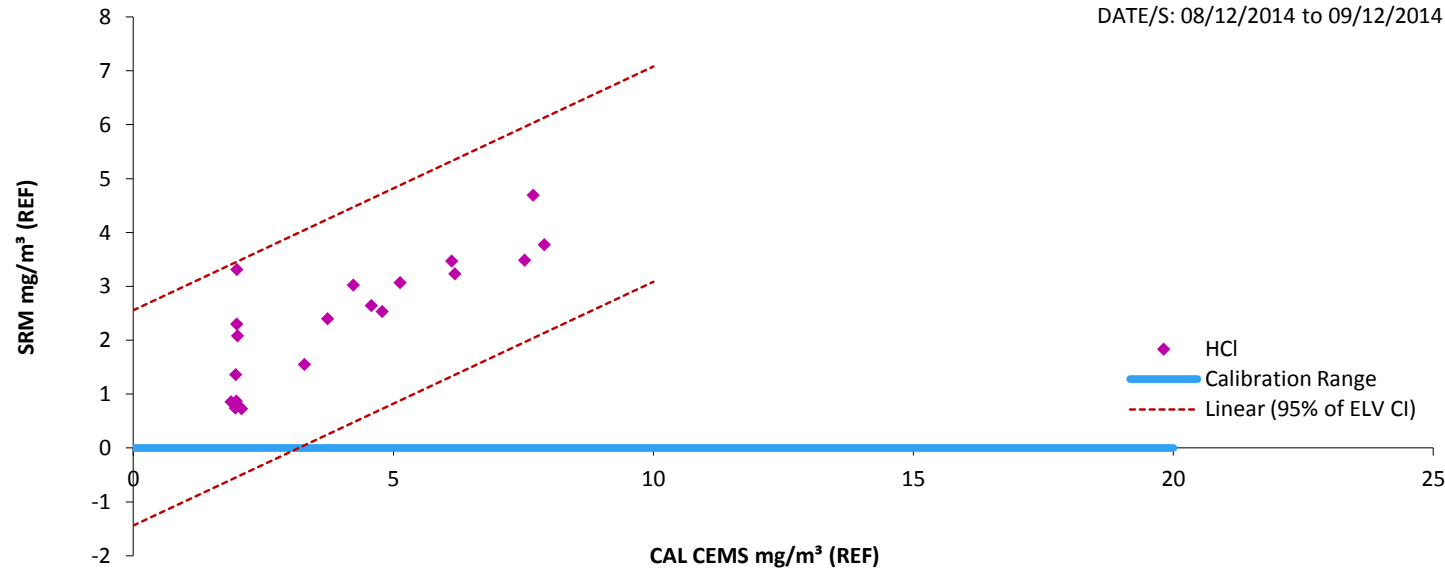
The calibration is accepted if $D \leq t^{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_0$

Parameter	Value
Mean Difference (D)	1.61
$t^{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_0$	2.56
Outcome of Calibration Test	Pass

New Calibration Range (REF)	Existing Range Still Valid
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PLOT 2: X-Y Plot - REF CAL CEMS vs REF SRM Values

DATE/S: 08/12/2014 to 09/12/2014



Section 4B - Data and Calculations - AST

AMMONIA: AST CALCULATIONS

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Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower

Calibration Data

Pair	Date	Time (60-minute Average)	x, CEMS (STP, WET) mg/m ³	y, SRM (STP, WET) mg/m ³	SRM (STP, DRY, 10% O ₂) mg/m ³	x - x _{av} (A)	y - y _{av} (B)	(A) x (B)	(x - x _{av}) ²	CAL CEMS (STP, WET) mg/m ³
1	08/12/2014	14:32 - 15:32	12.46	10.50	12.31	-13.26	-12.31	163.26	175.81	14.47
2	08/12/2014	15:32 - 16:32	19.79	16.74	18.36	-5.93	-6.07	35.99	35.11	22.96
3	08/12/2014	16:32 - 17:32	35.85	30.96	32.33	10.13	8.15	82.50	102.59	41.56
4	08/12/2014	17:32 - 18:32	33.77	29.64	30.21	8.05	6.82	54.93	64.78	39.15
5	08/12/2014	19:32 - 20:32	37.35	33.31	32.74	11.63	10.50	122.15	135.29	43.30
6	08/12/2014	20:32 - 21:32	47.50	46.77	47.07	21.78	23.96	521.79	474.30	55.05
7	08/12/2014	21:32 - 22:32	38.62	33.82	33.48	12.90	11.01	142.06	166.40	44.77
8	08/12/2014	22:32 - 23:32	35.76	32.49	32.59	10.04	9.68	97.18	100.83	41.46
9	09/12/2014	23:32 - 00:32	35.22	31.98	32.04	9.50	9.17	87.05	90.20	40.83
10	09/12/2014	00:32 - 01:32	35.30	31.85	31.64	9.58	9.04	86.61	91.73	40.92
11	09/12/2014	01:32 - 02:32	34.87	31.46	31.80	9.15	8.64	79.12	83.79	40.43
12	09/12/2014	02:32 - 03:32	27.60	25.34	27.72	1.88	2.53	4.75	3.52	32.00
13	09/12/2014	04:32 - 05:32	15.84	14.65	17.34	-9.88	-8.16	80.62	97.59	18.39
14	09/12/2014	05:32 - 06:32	16.08	14.56	17.13	-9.64	-8.25	79.48	92.89	18.67
15	09/12/2014	07:32 - 08:32	14.57	12.62	14.98	-11.14	-10.20	113.62	124.19	16.92
16	09/12/2014	08:32 - 09:32	14.54	11.89	14.12	-11.18	-10.92	122.06	124.91	16.88
17	09/12/2014	09:32 - 10:32	16.24	13.59	15.76	-9.48	-9.22	87.36	89.82	18.85
18	09/12/2014	10:32 - 11:32	14.61	11.73	13.71	-11.11	-11.08	123.11	123.41	16.96
19	09/12/2014	11:32 - 12:32	14.91	11.28	13.11	-10.81	-11.53	124.60	116.83	17.31
20	09/12/2014	12:32 - 13:32	13.50	11.04	12.80	-12.22	-11.77	143.76	149.28	15.68
			SPREAD OF DATA		34.76			SUM	2352.02	2443.29
ERF = Emissions Range Factor			ERF (mg/m ³)		50					
			MU (%)		40					
			15% of ERF		7.50					

Existing Calibration Function
$y = 1.1582x + 0.04$

Source of Existing Calibration Function
QAL 2 Report - ESG - report no. 121107-2012/QAL2

Existing Calibration Range (@ REF Conditions)
0 to 60 mg/m ³

Outliers Data

Pair	Date	Time (60-minute Average)	x, CEMS (WET) mg/m ³	y, SRM (WET) mg/m ³
1	09/12/2014	03:32 - 04:32	15.47	15.80
2				
3				
4				
5				
6				
7				
8				
9				
10				

Any values sitting outside 2 x Standard Deviations have been removed as Outliers, as per EA's Quick Guide, RM-QG14.

Section 4B - Data and Calculations - AST

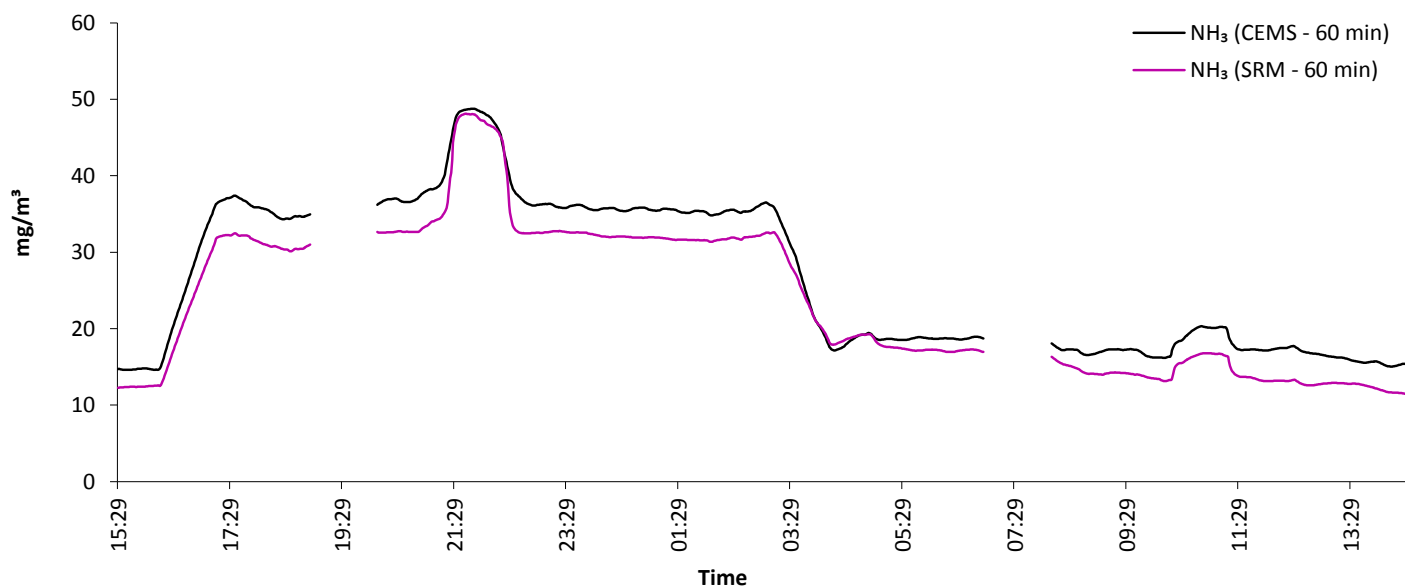
AMMONIA: AST CALCULATIONS

(Page 2 of 3)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works

ABB2 - A1 - Main Stack on Preheater Tower

PLOT 1: GRAPH FOR REFERENCE SRM vs REFERENCE CEMS (STANDARDISED) (60 minute rolling averages)



Variability Test Data

Pair	Date	Time (60-minute Average)	CAL CEMS (STP, WET) mg/m ³	CEMS Water Vapour % v/v	SRM Water Vapour % v/v	CEMS Oxygen (DRY) % v/v	SRM Oxygen (DRY) % v/v	CAL CEMS (STP, DRY, 10% O ₂) mg/m ³	SRM (STP, DRY, 10% O ₂) mg/m ³	ys, SRM - CAL CEMS
1	08/12/2014	14:32 - 15:32	14.47	11.18	10.06	10.48	10.57	17.04	12.31	-4.72
2	08/12/2014	15:32 - 16:32	22.96	11.93	10.64	9.62	9.78	25.21	18.36	-6.84
3	08/12/2014	16:32 - 17:32	41.56	12.67	11.70	8.90	9.07	43.27	32.33	-10.94
4	08/12/2014	17:32 - 18:32	39.15	13.80	12.33	8.47	8.69	39.86	30.21	-9.65
5	08/12/2014	19:32 - 20:32	43.30	14.73	13.31	7.87	8.09	42.53	32.74	-9.79
6	08/12/2014	20:32 - 21:32	55.05	14.79	13.38	8.20	8.38	55.54	47.07	-8.47
7	08/12/2014	21:32 - 22:32	44.77	14.47	12.98	8.04	8.23	44.43	33.48	-10.95
8	08/12/2014	22:32 - 23:32	41.46	14.36	12.91	8.22	8.41	41.67	32.59	-9.08
9	09/12/2014	23:32 - 00:32	40.83	14.29	12.80	8.23	8.41	41.03	32.04	-8.99
10	09/12/2014	00:32 - 01:32	40.92	14.51	12.99	8.11	8.27	40.83	31.64	-9.19
11	09/12/2014	01:32 - 02:32	40.43	14.47	12.93	8.32	8.50	41.00	31.80	-9.20
12	09/12/2014	02:32 - 03:32	32.00	12.91	11.74	9.48	9.61	35.09	27.72	-7.37
13	09/12/2014	04:32 - 05:32	18.39	10.40	9.33	10.49	10.75	21.48	17.34	-4.15
14	09/12/2014	05:32 - 06:32	18.67	10.51	9.48	10.36	10.67	21.56	17.13	-4.43
15	09/12/2014	07:32 - 08:32	16.92	10.24	9.21	10.66	10.79	20.05	14.98	-5.07
16	09/12/2014	08:32 - 09:32	16.88	10.06	9.13	10.72	10.81	20.08	14.12	-5.97
17	09/12/2014	09:32 - 10:32	18.85	10.30	9.33	10.46	10.54	21.93	15.76	-6.17
18	09/12/2014	10:32 - 11:32	16.96	10.33	9.37	10.58	10.61	19.96	13.71	-6.26
19	09/12/2014	11:32 - 12:32	17.31	10.41	9.40	10.51	10.55	20.26	13.11	-7.15
20	09/12/2014	12:32 - 13:32	15.68	10.95	10.03	10.44	10.45	18.34	12.80	-5.54
MAX								55.54	Sd	2.17

Section 4B - Data and Calculations - AST

AMMONIA: AST CALCULATIONS

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Lafarge Tarmac Cement and Lime Limited, Aberthaw Works

ABB2 - A1 - Main Stack on Preheater Tower

Test of Variability

$Q_0 = ELV \times (MU / 100) / 1.96$	10.20
Kv for 20 Pairs of Data	0.9824

The variability is accepted if $Sd \leq 1.5 \times Q_0 \times Kv$

Parameter	Value
Standard Deviation (Sd)	2.17
$1.5 \times Q_0 \times Kv$	15.04
Outcome of Variability Test	Pass

Test of Calibration (Acceptance of Calibration Function)

$t_{0.95} (N-1)$	1.711
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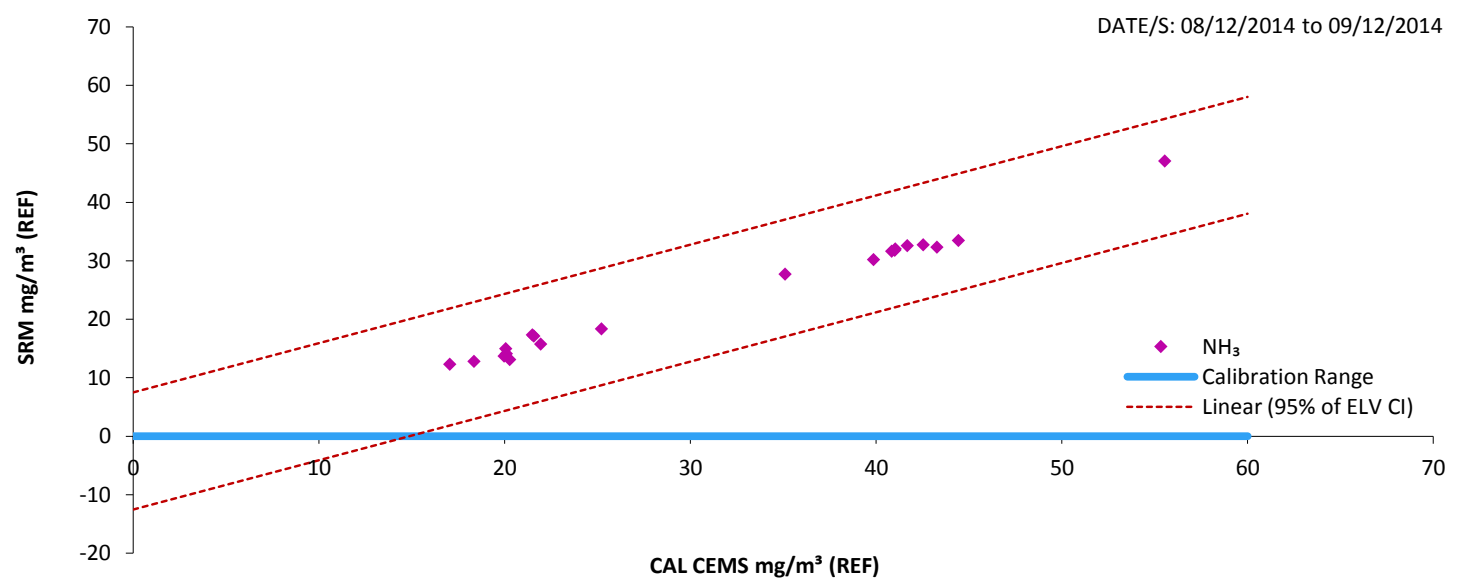
where N (number of samples) = 20

The calibration is accepted if $D \leq t_{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_0$

Parameter	Value
Mean Difference (D)	7.50
$t_{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_0$	11.03
Outcome of Calibration Test	Pass

New Calibration Range (REF)	Existing Range Still Valid
-----------------------------	----------------------------

PLOT 2: X-Y Plot - REF CAL CEMS vs REF SRM Values



Section 4B - Data and Calculations - AST

WATER VAPOUR: AST CALCULATIONS

(Page 1 of 3)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower

Calibration Data

Pair	Date	Time (60-minute Average)	x, CEMS (ACTUAL) % v/v	y, SRM (ACTUAL) % v/v	x - x _{av} (A)	y - y _{av} (B)	(A) x (B)	(x - x _{av}) ²	CAL CEMS (ACTUAL) % v/v
1	08/12/2014	14:32 - 15:32	11.18	10.06	-1.10	-1.01	1.11	1.21	11.06
2	08/12/2014	15:32 - 16:32	11.93	10.64	-0.35	-0.43	0.15	0.12	11.82
3	08/12/2014	16:32 - 17:32	12.67	11.70	0.39	0.63	0.24	0.15	12.58
4	08/12/2014	17:32 - 18:32	13.80	12.33	1.52	1.26	1.91	2.31	13.73
5	08/12/2014	19:32 - 20:32	14.73	13.31	2.45	2.23	5.47	6.00	14.69
6	08/12/2014	20:32 - 21:32	14.79	13.38	2.51	2.30	5.77	6.29	14.75
7	08/12/2014	21:32 - 22:32	14.47	12.98	2.19	1.90	4.17	4.81	14.43
8	08/12/2014	22:32 - 23:32	14.36	12.91	2.08	1.84	3.82	4.33	14.31
9	09/12/2014	23:32 - 00:32	14.29	12.80	2.01	1.73	3.47	4.02	14.23
10	09/12/2014	00:32 - 01:32	14.51	12.99	2.23	1.91	4.26	4.97	14.46
11	09/12/2014	01:32 - 02:32	14.47	12.93	2.19	1.86	4.07	4.78	14.42
12	09/12/2014	02:32 - 03:32	12.91	11.74	0.63	0.67	0.42	0.40	12.83
13	09/12/2014	03:32 - 04:32	10.59	9.48	-1.69	-1.59	2.69	2.87	10.45
14	09/12/2014	04:32 - 05:32	10.40	9.33	-1.88	-1.75	3.28	3.52	10.26
15	09/12/2014	05:32 - 06:32	10.51	9.48	-1.77	-1.60	2.83	3.14	10.37
16	09/12/2014	07:32 - 08:32	10.24	9.21	-2.04	-1.86	3.79	4.15	10.09
17	09/12/2014	08:32 - 09:32	10.06	9.13	-2.22	-1.94	4.31	4.92	9.91
18	09/12/2014	09:32 - 10:32	10.30	9.33	-1.98	-1.74	3.46	3.93	10.15
19	09/12/2014	10:32 - 11:32	10.33	9.37	-1.96	-1.70	3.32	3.82	10.18
20	09/12/2014	11:32 - 12:32	10.41	9.40	-1.87	-1.67	3.12	3.50	10.26
21	09/12/2014	12:32 - 13:32	10.95	10.03	-1.33	-1.04	1.39	1.77	10.82
SPREAD OF DATA				4.25	SUM		63.06	71.02	
EFFECTIVE ELV (% v/v)				30					
MU (%)				30					
15% of ELV				4.50					

Existing Calibration Function
$y = 1.0236x - 0.39$

Source of Existing Calibration Function
QAL 2 Report - ESG - report no. 121107-2012/QAL2

Existing Calibration Range
0 to 14 % v/v

Outliers Data

Pair	Date	Time (60-minute Average)	x, CEMS (ACTUAL) % v/v	y, SRM (ACTUAL) % v/v
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Any values sitting outside 2 x Standard Deviations have been removed as Outliers, as per EA's Quick Guide, RM-QG14.

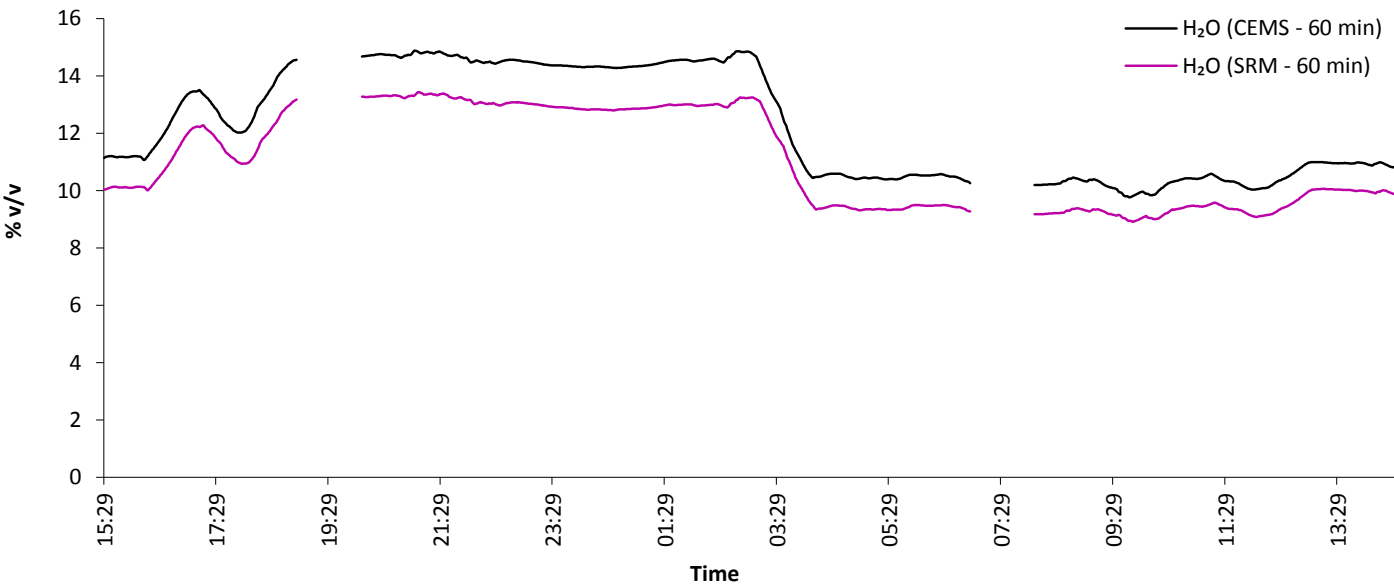
WATER VAPOUR: AST CALCULATIONS

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Lafarge Tarmac Cement and Lime Limited, Aberthaw Works

ABB2 - A1 - Main Stack on Preheater Tower

PLOT 1: GRAPH FOR STP SRM vs STP CEMS (60 minute rolling averages)



Variability Test Data

Pair	Date	Time (60-minute Average)	CAL CEMS (ACTUAL) % v/v	ys, SRM (ACTUAL) % v/v	ys, SRM - CAL CEMS
1	08/12/2014	14:32 - 15:32	11.06	10.06	-1.00
2	08/12/2014	15:32 - 16:32	11.82	10.64	-1.18
3	08/12/2014	16:32 - 17:32	12.58	11.70	-0.88
4	08/12/2014	17:32 - 18:32	13.73	12.33	-1.41
5	08/12/2014	19:32 - 20:32	14.69	13.31	-1.38
6	08/12/2014	20:32 - 21:32	14.75	13.38	-1.37
7	08/12/2014	21:32 - 22:32	14.43	12.98	-1.45
8	08/12/2014	22:32 - 23:32	14.31	12.91	-1.40
9	09/12/2014	23:32 - 00:32	14.23	12.80	-1.43
10	09/12/2014	00:32 - 01:32	14.46	12.99	-1.48
11	09/12/2014	01:32 - 02:32	14.42	12.93	-1.49
12	09/12/2014	02:32 - 03:32	12.83	11.74	-1.08
13	09/12/2014	03:32 - 04:32	10.45	9.48	-0.97
14	09/12/2014	04:32 - 05:32	10.26	9.33	-0.93
15	09/12/2014	05:32 - 06:32	10.37	9.48	-0.89
16	09/12/2014	07:32 - 08:32	10.09	9.21	-0.88
17	09/12/2014	08:32 - 09:32	9.91	9.13	-0.78
18	09/12/2014	09:32 - 10:32	10.15	9.33	-0.82
19	09/12/2014	10:32 - 11:32	10.18	9.37	-0.80
20	09/12/2014	11:32 - 12:32	10.26	9.40	-0.86
21	09/12/2014	12:32 - 13:32	10.82	10.03	-0.79
MAX			14.75	Sd	0.27

WATER VAPOUR: AST CALCULATIONS

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Lafarge Tarmac Cement and Lime Limited, Aberthaw Works

ABB2 - A1 - Main Stack on Preheater Tower

Test of Variability

$Q_0 = \text{ELV} \times (\text{MU} / 100) / 1.96$	4.59
Kv for 21 Pairs of Data	0.9824

The variability is accepted if $Sd \leq 1.5 \times Q_0 \times Kv$

Parameter	Value
Standard Deviation (Sd)	0.27
$1.5 \times Q_0 \times Kv$	6.77
Outcome of Variability Test	Pass

Test of Calibration (Acceptance of Calibration Function)

$t^{0.95} (N-1)$	1.711
------------------	-------

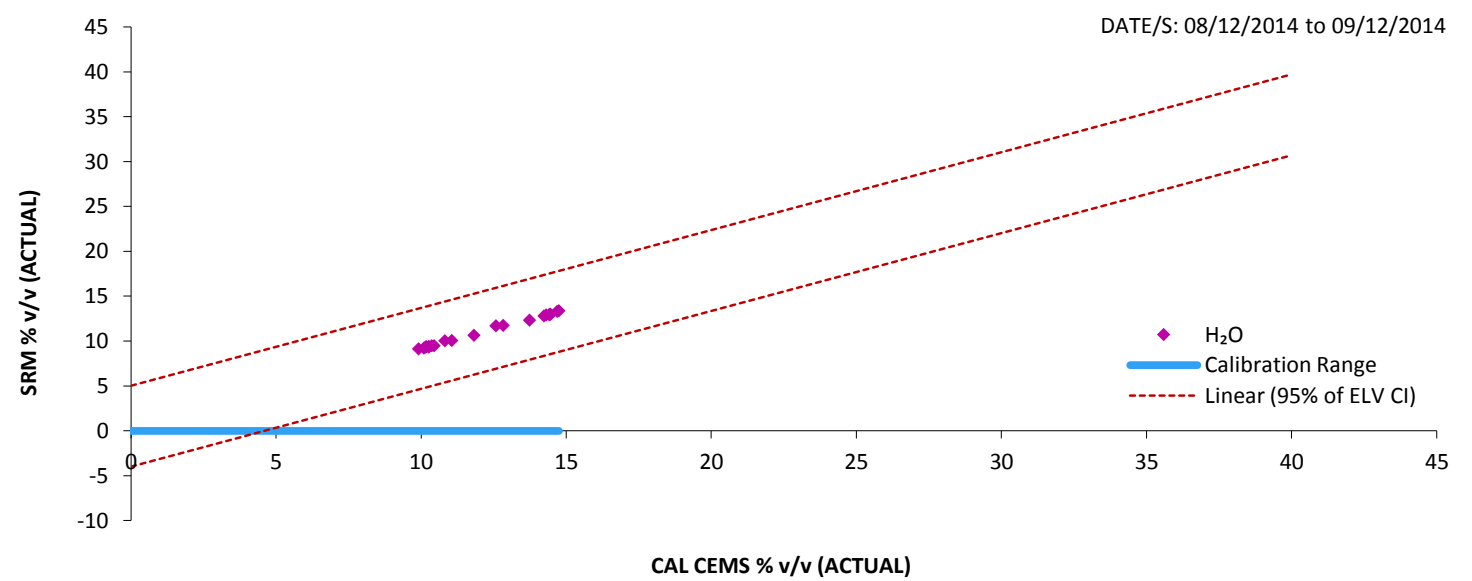
where N (number of samples) = 21

The calibration is accepted if $D \leq t^{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_0$

Parameter	Value
Mean Difference (D)	1.11
$t^{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_0$	4.69
Outcome of Calibration Test	Pass

New Calibration Range	0 to 14.7 % v/v
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PLOT 2: X-Y Plot - REF CAL CEMS vs REF SRM Values



OXYGEN: AST CALCULATIONS

(Page 1 of 3)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower

Calibration Data

Pair	Date	Time (60-minute Average)	x, CEMS (WET) % v/v	y, SRM (WET) % v/v	x - x _{av} (A)	y - y _{av} (B)	(A) x (B)	(x - x _{av}) ²	CAL CEMS (WET) % v/v
1	08/12/2014	14:32 - 15:32	10.48	10.57	1.02	0.95	0.97	1.03	9.49
2	08/12/2014	15:32 - 16:32	9.62	9.78	0.16	0.16	0.03	0.02	8.70
3	08/12/2014	16:32 - 17:32	8.90	9.07	-0.56	-0.54	0.31	0.32	8.04
4	08/12/2014	17:32 - 18:32	8.47	8.69	-1.00	-0.93	0.92	1.00	7.63
5	08/12/2014	19:32 - 20:32	7.87	8.09	-1.60	-1.53	2.44	2.55	7.08
6	08/12/2014	20:32 - 21:32	8.20	8.38	-1.26	-1.23	1.55	1.59	7.39
7	08/12/2014	21:32 - 22:32	8.04	8.23	-1.42	-1.39	1.98	2.03	7.24
8	08/12/2014	22:32 - 23:32	8.22	8.41	-1.24	-1.21	1.50	1.54	7.41
9	09/12/2014	23:32 - 00:32	8.23	8.41	-1.24	-1.21	1.49	1.53	7.41
10	09/12/2014	00:32 - 01:32	8.11	8.27	-1.36	-1.34	1.82	1.85	7.30
11	09/12/2014	01:32 - 02:32	8.32	8.50	-1.15	-1.11	1.28	1.31	7.50
12	09/12/2014	02:32 - 03:32	9.48	9.61	0.02	-0.01	0.00	0.00	8.57
13	09/12/2014	03:32 - 04:32	10.59	10.75	1.13	1.13	1.28	1.27	9.60
14	09/12/2014	04:32 - 05:32	10.49	10.75	1.03	1.13	1.16	1.06	9.51
15	09/12/2014	05:32 - 06:32	10.36	10.67	0.90	1.05	0.94	0.80	9.38
16	09/12/2014	07:32 - 08:32	10.66	10.79	1.19	1.18	1.40	1.42	9.66
17	09/12/2014	08:32 - 09:32	10.72	10.81	1.25	1.19	1.49	1.57	9.71
18	09/12/2014	09:32 - 10:32	10.46	10.54	1.00	0.92	0.92	0.99	9.48
19	09/12/2014	10:32 - 11:32	10.58	10.61	1.11	1.00	1.11	1.24	9.58
20	09/12/2014	11:32 - 12:32	10.51	10.55	1.05	0.94	0.98	1.10	9.52
21	09/12/2014	12:32 - 13:32	10.44	10.45	0.98	0.84	0.82	0.95	9.46
SPREAD OF DATA				2.72	SUM		24.39	25.19	
EFFECTIVE ELV (% v/v)				21					
MU (%)				10					
15% of ELV				3.15					

Existing Calibration Function
$y = 0.924x - 0.19$

Source of Existing Calibration Function
QAL 2 Report - ESG - report no. 121107-2012/QAL2

Existing Calibration Range
0 to 12 % v/v

Outliers Data

Pair	Date	Time (60-minute Average)	x, CEMS (WET) % v/v	y, SRM (WET) % v/v
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Any values sitting outside 2 x Standard Deviations have been removed as Outliers, as per EA's Quick Guide, RM-QG14.

Section 4B - Data and Calculations - AST

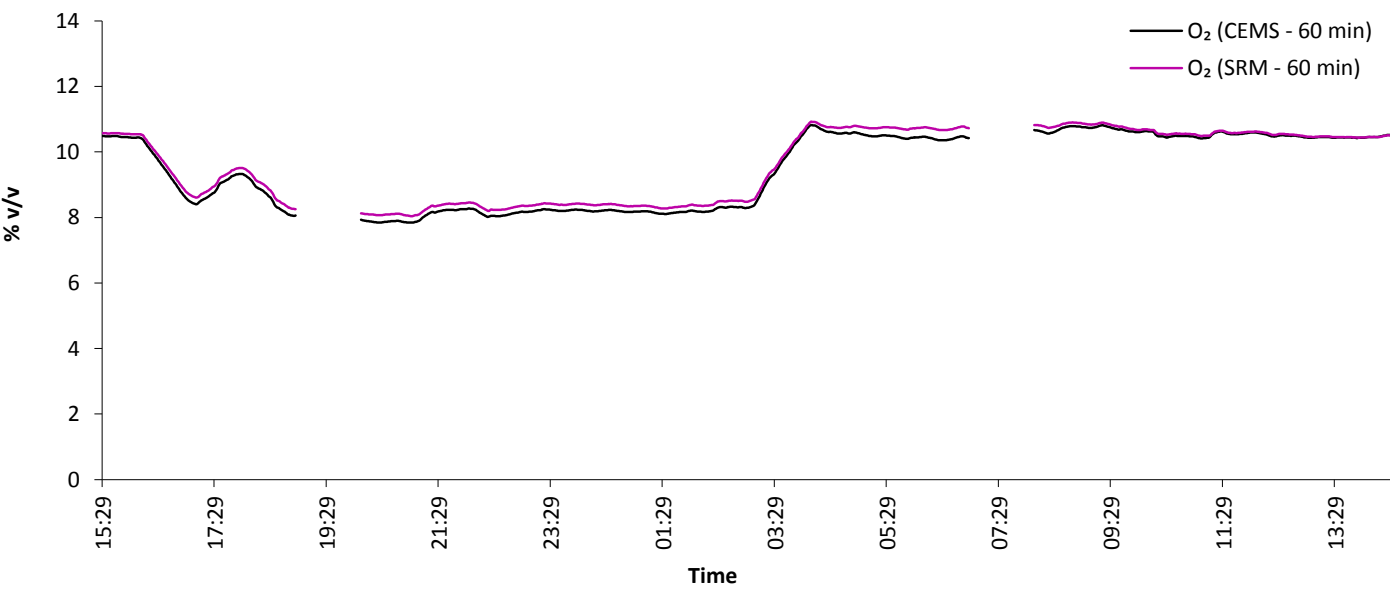
OXYGEN: AST CALCULATIONS

(Page 2 of 3)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works

ABB2 - A1 - Main Stack on Preheater Tower

PLOT 1: GRAPH FOR STP SRM vs STP CEMS (60 minute rolling averages)



Variability Test Data

Pair	Date	Time (60-minute Average)	CAL CEMS (WET) % v/v	ys, SRM (WET) % v/v	ys, SRM - CAL CEMS
1	08/12/2014	14:32 - 15:32	9.49	10.57	1.08
2	08/12/2014	15:32 - 16:32	8.70	9.78	1.08
3	08/12/2014	16:32 - 17:32	8.04	9.07	1.04
4	08/12/2014	17:32 - 18:32	7.63	8.69	1.06
5	08/12/2014	19:32 - 20:32	7.08	8.09	1.01
6	08/12/2014	20:32 - 21:32	7.39	8.38	0.99
7	08/12/2014	21:32 - 22:32	7.24	8.23	0.99
8	08/12/2014	22:32 - 23:32	7.41	8.41	1.00
9	09/12/2014	23:32 - 00:32	7.41	8.41	0.99
10	09/12/2014	00:32 - 01:32	7.30	8.27	0.97
11	09/12/2014	01:32 - 02:32	7.50	8.50	1.01
12	09/12/2014	02:32 - 03:32	8.57	9.61	1.04
13	09/12/2014	03:32 - 04:32	9.60	10.75	1.15
14	09/12/2014	04:32 - 05:32	9.51	10.75	1.24
15	09/12/2014	05:32 - 06:32	9.38	10.67	1.29
16	09/12/2014	07:32 - 08:32	9.66	10.79	1.14
17	09/12/2014	08:32 - 09:32	9.71	10.81	1.09
18	09/12/2014	09:32 - 10:32	9.48	10.54	1.06
19	09/12/2014	10:32 - 11:32	9.58	10.61	1.03
20	09/12/2014	11:32 - 12:32	9.52	10.55	1.03
21	09/12/2014	12:32 - 13:32	9.46	10.45	0.99
MAX			9.71	Sd	0.08

Section 4B - Data and Calculations - AST

OXYGEN: AST CALCULATIONS

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Lafarge Tarmac Cement and Lime Limited, Aberthaw Works

ABB2 - A1 - Main Stack on Preheater Tower

Test of Variability

$Q_o = ELV \times (MU / 100) / 1.96$	1.07
Kv for 21 Pairs of Data	0.9824

The variability is accepted if $Sd \leq 1.5 \times Q_o \times Kv$

Parameter	Value
Standard Deviation (Sd)	0.08
$1.5 \times Q_o \times Kv$	1.58
Outcome of Variability Test	Pass

Test of Calibration (Acceptance of Calibration Function)

$t_{0.95} (N-1)$	1.711
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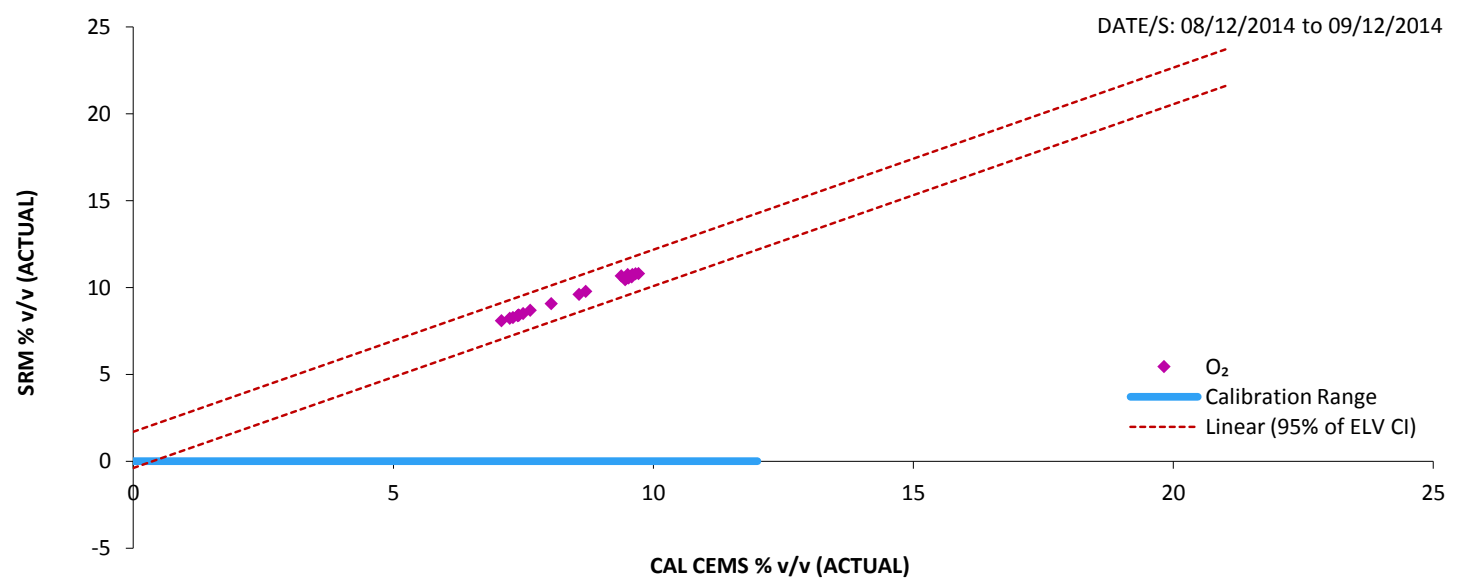
where N (number of samples) = 21

The calibration is accepted if $D \leq t_{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_o$

Parameter	Value
Mean Difference (D)	1.06
$t_{0.95} (N-1) \times Sd / \text{SQRT} (N) + Q_o$	1.10
Outcome of Calibration Test	Pass

New Calibration Range	Existing Range Still Valid
-----------------------	----------------------------

PLOT 2: X-Y Plot - REF CAL CEMS vs REF SRM Values



Section 5 - Results of the Functional Checks

FUNCTIONAL CHECKS OF CEMS

(Page 1 of 2)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower

Reference Materials Used for CEMS Linearity Checks

Parameter	Linearity Check Gas	Concentration (mg/m ³ / %)	Linearity Check Gas Supplier	Cylinder Number	Cylinder Expiry Date	Certified Accuracy
Total VOCs	C ₃ H ₈	16.36 ppm	Air Liquid	6854486	26/06/2017	-
Nitrogen Monoxide	NO	810 ppm	Air Liquid	L50000154	07/11/2013	-
Nitrogen Dioxide	NO ₂	49.9 ppm	Air Liquid	VCD119244	04/10/2014	-
Sulphur Dioxide	SO ₂	165 ppm	Air Liquid	L50000154	07/11/2013	-
Carbon Monoxide	CO	1207 ppm	Air Liquid	L50000154	07/11/2013	-
Hydrogen Chloride	HCl	-	IAS	-	-	-
Ammonia	NH ₃	65.5 ppm	Air Liquid	VC113282	19/03/2015	-
Water Vapour	H ₂ O	-	-	N/A	N/A	N/A
Oxygen	O ₂	21%	Air Liquid	N50000609	12/11/2016	-
Zero Gas	N ₂ / Inst. Air (FID)	N/A	N/A	N/A	N/A	N/A

PRO-FORMA FOR ASSESSING AND REPORTING THE RESULTS OF THE FUNCTIONAL TESTS

(Page 1 of 4)

Functional Checks Performed By	ABB
Date/s Functional Checks Performed	7th - 12th November 2014

1. Alignment and Cleanliness (Non-Extractive CEMS Only)

Requirement	Performed	Notes
A visual inspection, with reference to the CEMS manuals, shall be carried out on the following when applicable:		
Internal check of the CEMS.	Yes	ABB Service Report
Cleanliness of the optical components.	Yes	ABB Service Report
Flushing air supply.	Yes	ABB Service Report
Optical path free from obstructions.	Yes	ABB Service Report
After re-assembly at the measurement location, at least the following shall be checked:		
Alignment of the measuring system.	Yes	ABB Service Report
Contamination control (internal check of optical surfaces).	Yes	ABB Service Report

2. Sampling System (Extractive CEMS Only)

Requirement	Performed	Notes
A visual inspection of the sampling system shall be performed, noting the condition of the following components, when fitted:		
Sampling probe.	Yes	ABB Service Report
Gas conditioning systems.	N/A	
Pumps.	Yes	ABB Service Report
All connections.	Yes	ABB Service Report
Sample lines.	Yes	ABB Service Report
Power supplies.	Yes	ABB Service Report
Filters.	Yes	ABB Service Report
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 the data.	Yes	ABB Service Report

3. Leak testing

Requirement	Performed	Notes
Leak Testing shall be performed according to the CEMS manuals. The test shall cover the entire sampling system.	Yes	

4. Zero and Span Check

Requirement	Performed	Notes
Reference zero and span materials shall be used to verify the corresponding readings of the CEMS. Ensure the reading on the DCS Computer reflects the reading on the screen of the CEMS Analyser/s.	Yes	See Section 5 of the Test Report - "CEMS Checks" for the results of the zero and span checks. The reading on the DCS was cross-referenced with the CEMS' screen to ensure the logged reading was correct.

PRO-FORMA FOR ASSESSING AND REPORTING THE RESULTS OF THE FUNCTIONAL TESTS

(Page 2 of 4)

4. Zero and Span Check (continued)

Requirement	Performed	Notes
In case of non-extractive CEMS, 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 CEMS at the measurement location.	Yes	See Section 5 of the Test Report - "CEMS Checks" for the results of the zero and span checks. The reading on the DCS was cross-referenced with the CEMS' screen to ensure the logged reading was correct.

5. Linearity

Requirement	Performed	Notes
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. DCS logged values should be included in the instrument service report.	Yes	ABB Service Report
The linearity of the CEMS response shall be checked using five different reference materials, including a zero concentration.	Yes	ABB Service Report
The reference material with zero concentration, as well as the reference materials with four different concentrations, shall have a verifiable quantity and quality.	Yes	See Section 5 of the Test Report - "Reference Materials Used for CEMS Linearity Checks".
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.	Yes	
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 (either Daily or Short Term ELV). 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 CEMS. (i.e. not down the line)	No	ABB Service Report for linearity data
The individual CEMS are tested using the following concentrations applied in a randomised sequence:		
Reference material with zero concentration	No	See ABB Service Report
Reference material concentration approximately 20% of 2 x the ELV	No	See ABB Service Report
Reference material concentration approximately 40% of 2 x the ELV	No	See ABB Service Report
Reference material concentration approximately 60% of 2 x the ELV	No	See ABB Service Report
Reference material concentration approximately 80% of 2 x the ELV	No	See ABB Service Report
Reference material with zero concentration	No	See ABB Service Report

6. Interferences

Requirement	Performed	Notes
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.	Yes	

PRO-FORMA FOR ASSESSING AND REPORTING THE RESULTS OF THE FUNCTIONAL TESTS

(Page 3 of 4)

7. Zero and Span Drift Audit		
Requirement	Performed	Notes
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.	Yes	Carried out by ABB

8. Response Time		
Requirement	Performed	Notes
The response time of the CEMS 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. (i.e. 200 seconds)	Yes	Parameter specific response times can be found in the Zero and Span Gas Functional Test Table (above).

9. Service Report (THIS IS AN AUDIT OF THE SERVICE REPORT, STATE IF THE REQUIRED INFO IS PRESENT OR NOT IN THE SERVICE REPORT)		
Requirement	Performed	Notes
As a minimum requirement the service report should include the following:		
Document reference for work instruction for the type of work being undertaken.	No	ABB Service Report
Instrument manufacturer.	Yes	ABB Service Report
Instrument type.	Yes	ABB Service Report
Instrument model.	Yes	ABB Service Report
Instrument serial no.	Yes	ABB Service Report
Operating principle.	Yes	ABB Service Report
Operating range.	Yes	ABB Service Report
Certification details.	No	ABB Service Report
Compliance with MCERTS. (including certificate no.)	No	ABB Service Report
Location.	Yes	ABB Service Report
Date and time work was undertaken.	Yes	ABB Service Report
Equipment used - type, serial no's, calibration dates.	Yes	ABB Service Report
Gases used - certificate no's, expiry dates, binary or mixture.	Yes	ABB Service Report
Calibration and linearity data as required by EN14181.	No	ABB Service Report
Logged data for the period of calibration and linearity. NOTE: There may be gaps in the data, for example, if the CEMS are removed from the stack for the linearity test. In such cases, the test laboratory shall state why there are gaps in the data.	Yes	ABB Service Report
Name and signature of the service engineer present on the service report?	Yes	ABB Service Report

PRO-FORMA FOR ASSESSING AND REPORTING THE RESULTS OF THE FUNCTIONAL TESTS

(Page 4 of 4)

10. Documentation and Records		
Requirement	Available	Notes
A plan of the CEM.	Yes	In Manual
All manuals (maintenance, users, etc).	Yes	manuals available
Log books to document possible malfunctions and action taken.	Yes	Maximo system
Service reports.	Yes	Available
QAL3 documentation including actions taken as a result of out of control situations.	Yes	Carried out by ABB, 6 monthly
Management system procedures for maintenance, calibration and training.	Yes	
Training records.	Yes	Basic training from ABB
Maintenance schedules.	Yes	Service contract with ABB
Auditing plans and records - evidence that the operator includes the procedures for the management of the CEMS within the auditing cycle of the management system.	N/A	
Existing instrument calibration functions / gain factors.	Yes	
Documentation and records audit completed and validated prior to commencing SRM testing.	Yes	

VOLATILE ORGANIC COMPOUNDS: LINEARITY CHECK CALCULATIONS

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower
7th - 12th November 2014

Linearity Tests performed by	David Gartland ABB
100% value taken for Linearity Tests	

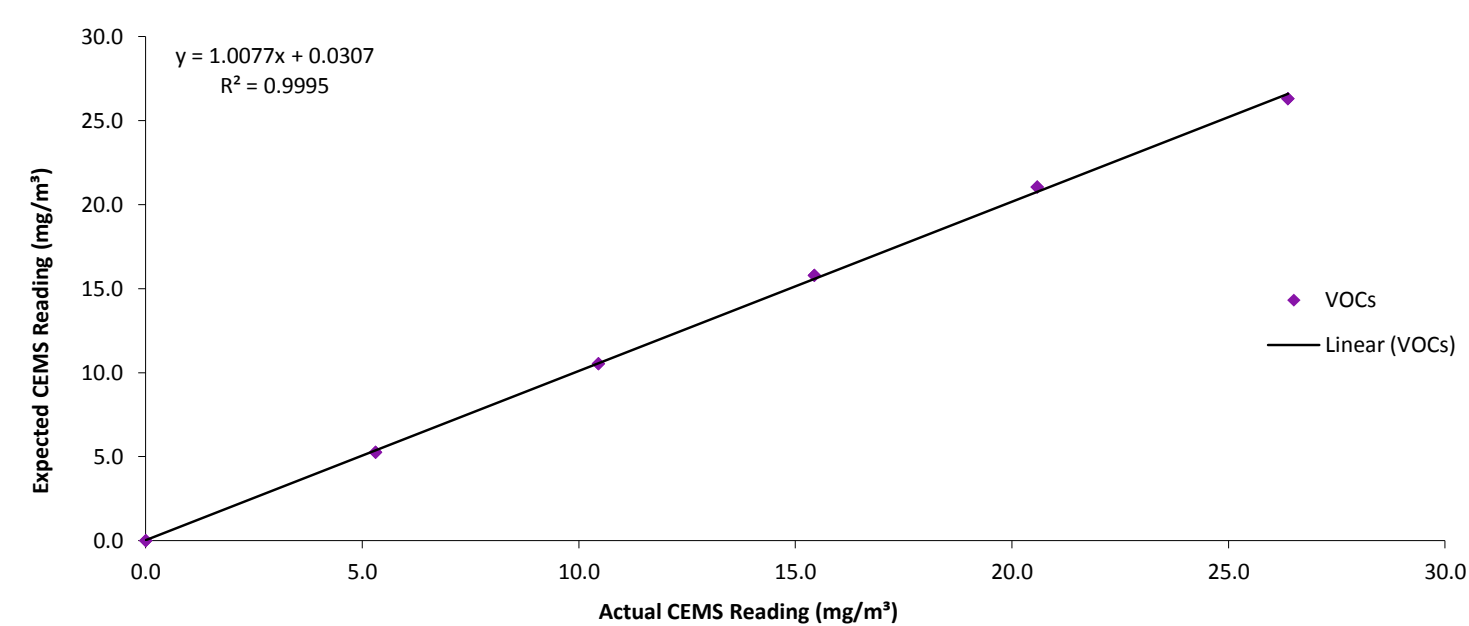
Linearity Readings on CEMS

Linearity Point	Time of Readings	Linearity % Point	Expected Reading (mg/m³)	Reading 1 4 x Response (mg/m³)	Reading 2 1 x Response (mg/m³)	Reading 3 1 x Response (mg/m³)	Average CEMS Reading (mg/m³)
1			0.00	0.00	0.00	0.00	0.00
2			5.26	5.31	5.31	5.31	5.31
3			10.53	10.45	10.45	10.45	10.45
4			15.79	15.44	15.44	15.44	15.44
5			21.05	20.58	20.58	20.58	20.58
6			26.31	26.37	26.37	26.37	26.37

Test of Residuals

Linearity Point	Average x_c	d_c	$\%, d_{c,rel}$	ABS $\%, d_{c,rel}$	MAX ABS $\%, d_{c,rel}$	Limit	Outcome
1	0.00	-0.03	-0.19	0.19	1.89	5	Pass
2	5.31	-0.12	-0.76	0.76			
3	10.45	-0.03	-0.20	0.20			
4	15.44	0.20	1.29	1.29			
5	20.58	0.28	1.75	1.75			
6	26.37	-0.30	-1.89	1.89			

Graphical Representation of Linearity Data



Recommendation of the application of $y = x$ (from Environment Agency Document MID 14181, Version 3.0)
(Applicable where linearity data is being used for the calibration function (See Page 3, and the column "Source of Calibration Function Derived")

Average of SRM Results (mg/m³)	13.16	Daily ELV (mg/m³)	50
Average of Uncalibrated CEMS Results (mg/m³)	13.02	Half the 95% Confidence Interval (%) MU	15
Difference between SRM and CEMS Results (mg/m³)	0.13 (i)	Allowable Tolerance (mg/m³)	7.5 (ii)

$y = x$ may be recommended if (i) $\leq$ (ii)

Should the derived calibration function be ignored and a function of $y = x$ be recommended?	Yes
Which calibration function is it recommended to apply to the Data Collection Software?	$y = x$

NITROGEN MONOXIDE: LINEARITY CHECK CALCULATIONS (Page 1 of 2)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower
7th - 12th November 2014

Linearity Tests performed by	David Gartland ABB
100% value taken for Linearity Tests	

Linearity Readings on CEMS [As Read on Analyser] (as NO)

Linearity Point	Time of Readings	Linearity % Point	Expected Reading (mg/m³)	Reading 1 4 x Response (mg/m³)	Reading 2 1 x Response (mg/m³)	Reading 3 1 x Response (mg/m³)	Average CEMS Reading (mg/m³)
1			0.00	0.54	0.00	1.34	0.62
2			216.92	220.27	220.67	220.94	220.62
3			433.84	444.01	445.89	444.15	444.68
4			650.75	668.16	663.61	665.48	665.75
5			867.67	885.08	884.81	888.43	886.11
6			1084.59	1101.19	1101.60	1100.93	1101.24

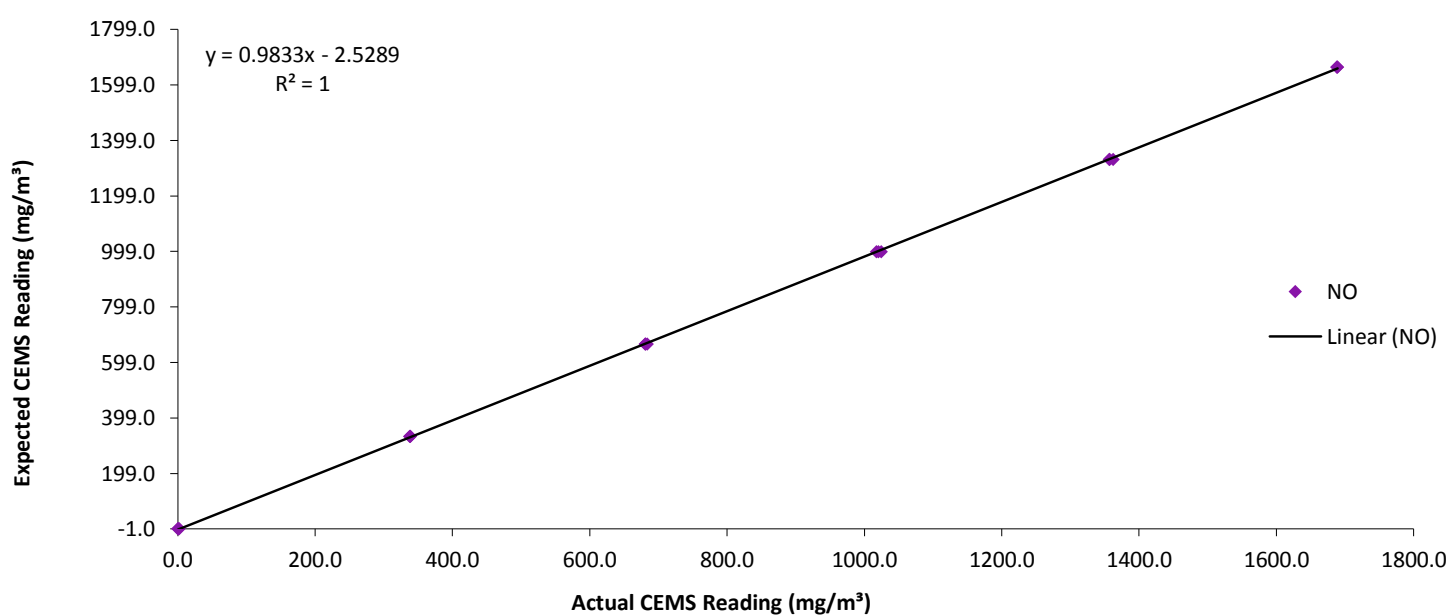
Linearity Readings on CEMS (as NO₂)

Linearity Point	Time of Readings	Linearity % Point	Expected Reading (mg/m³)	Reading 1 4 x Response (mg/m³)	Reading 2 1 x Response (mg/m³)	Reading 3 1 x Response (mg/m³)	Average CEMS Reading (mg/m³)
1	00:00	0.00	0.00	0.82	0.00	2.05	0.96
2	00:00	0.00	332.61	337.74	338.36	338.77	338.29
3	00:00	0.00	665.22	680.82	683.69	681.02	681.85
4	00:00	0.00	997.82	1024.51	1017.53	1020.41	1020.82
5	00:00	0.00	1330.43	1357.12	1356.71	1362.25	1358.70
6	00:00	0.00	1663.04	1688.50	1689.11	1688.09	1688.57

Test of Residuals (as NO₂)

Linearity Point	Average x _c	d _c	%, d _{c,rel}	ABS %, d _{c,rel}	MAX ABS %, d _{c,rel}	Limit	Outcome
1	0.96	1.59	0.16	0.16	0.52	5	Pass
2	338.29	2.49	0.25	0.25			
3	681.85	-2.73	-0.27	0.27			
4	1020.82	-3.44	-0.34	0.34			
5	1358.70	-3.07	-0.31	0.31			
6	1688.57	5.17	0.52	0.52			

Graphical Representation of Linearity Data (as NO₂)



NITROGEN MONOXIDE: LINEARITY CHECK CALCULATIONS (Page 2 of 2)

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
 ABB2 - A1 - Main Stack on Preheater Tower
 7th - 12th November 2014

Recommendation of the application of $y = x$ (from Environment Agency Document MID 14181, Version 3.0)
(Applicable where linearity data is being used for the calibration function (See Page 3, and the column "Source of Calibration Function Derived"))

Average of SRM Results (mg/m³)	831.52		Daily ELV (mg/m³)	800	
Average of Uncalibrated CEMS Results (mg/m³)	848.20		Half the 95% Confidence Interval (%) MU	10	
Difference between SRM and CEMS Results (mg/m³)	16.68	(i)	Allowable Tolerance (mg/m³)	80.0	(ii)

$y = x$ may be recommended if (i) $\leq$ (ii)

Should the derived calibration function be ignored and a function of $y = x$ be recommended?	Yes
Which calibration function is it recommended to apply to the Data Collection Software?	$y = x$

NITROGEN DIOXIDE: LINEARITY CHECK CALCULATIONS

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower
7th - 12th November 2014

Linearity Tests performed by	David Gartland ABB
100% value taken for Linearity Tests	

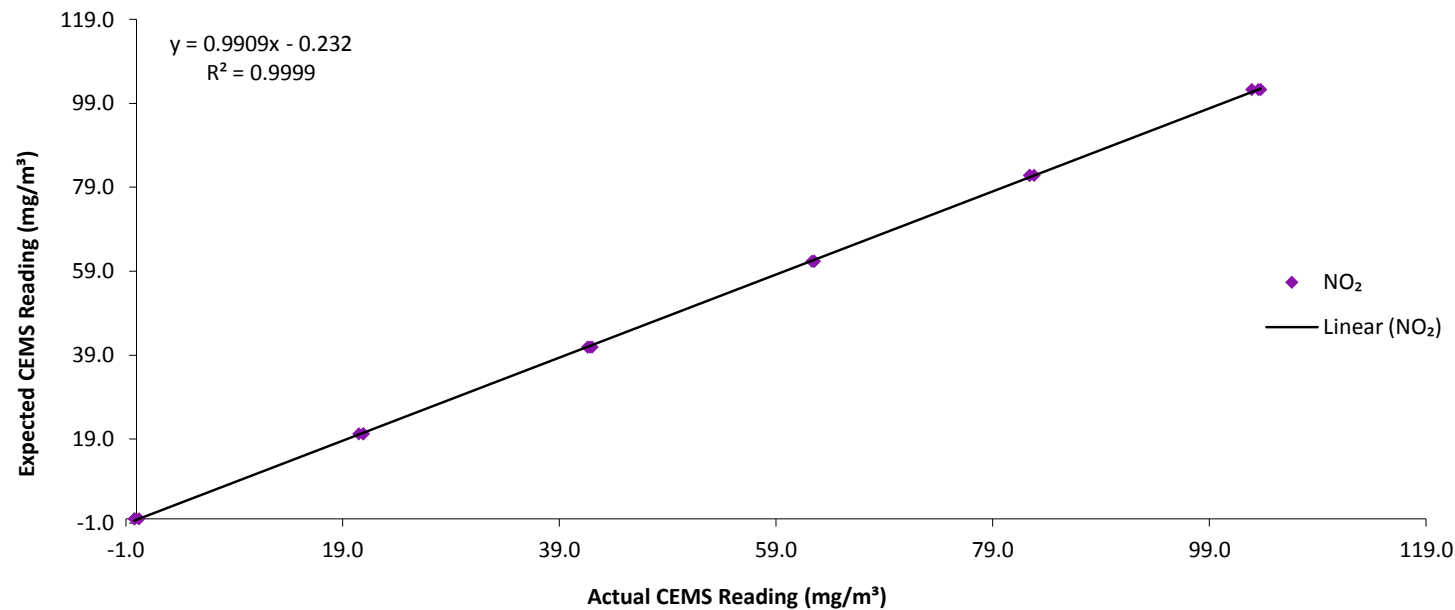
Linearity Readings on CEMS

Linearity Point	Time of Readings	Linearity % Point	Expected Reading (mg/m³)	Reading 1 4 x Response (mg/m³)	Reading 2 1 x Response (mg/m³)	Reading 3 1 x Response (mg/m³)	Average CEMS Reading (mg/m³)
1			0.00	-0.21	0.21	-0.21	-0.07
2			20.25	20.91	20.50	20.91	20.77
3			40.92	41.82	42.03	41.62	41.82
4			61.38	62.32	62.53	62.53	62.46
5			81.84	82.82	82.41	82.41	82.55
6			102.30	102.91	103.53	103.73	103.39

Test of Residuals

Linearity Point	Average x_c	d_c	$\%, d_{c,rel}$	ABS $\%, d_{c,rel}$	MAX ABS $\%, d_{c,rel}$	Limit	Outcome
1	-0.07	0.30	0.49	0.49	0.49	5	Pass
2	20.77	-0.10	-0.16	0.16			
3	41.82	-0.29	-0.47	0.47			
4	62.46	-0.28	-0.45	0.45			
5	82.55	0.28	0.45	0.45			
6	103.39	0.08	0.14	0.14			

Graphical Representation of Linearity Data



Recommendation of the application of $y = x$ (from Environment Agency Document MID 14181, Version 3.0)
(Applicable where linearity data is being used for the calibration function (See Page 3, and the column "Source of Calibration Function Derived"))

Average of SRM Results (mg/m³)	51.11	Daily ELV (mg/m³)	800
Average of Uncalibrated CEMS Results (mg/m³)	51.82	Half the 95% Confidence Interval (%) MU	10
Difference between SRM and CEMS Results (mg/m³)	0.71 (i)	Allowable Tolerance (mg/m³)	80.0 (ii)

$y = x$ may be recommended if (i) ≤ (ii)

Should the derived calibration function be ignored and a function of $y = x$ be recommended?	Yes
Which calibration function is it recommended to apply to the Data Collection Software?	$y = x$

SULPHUR DIOXIDE: LINEARITY CHECK CALCULATIONS

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower
7th - 12th November 2014

Linearity Tests performed by	David Gartland ABB
100% value taken for Linearity Tests	

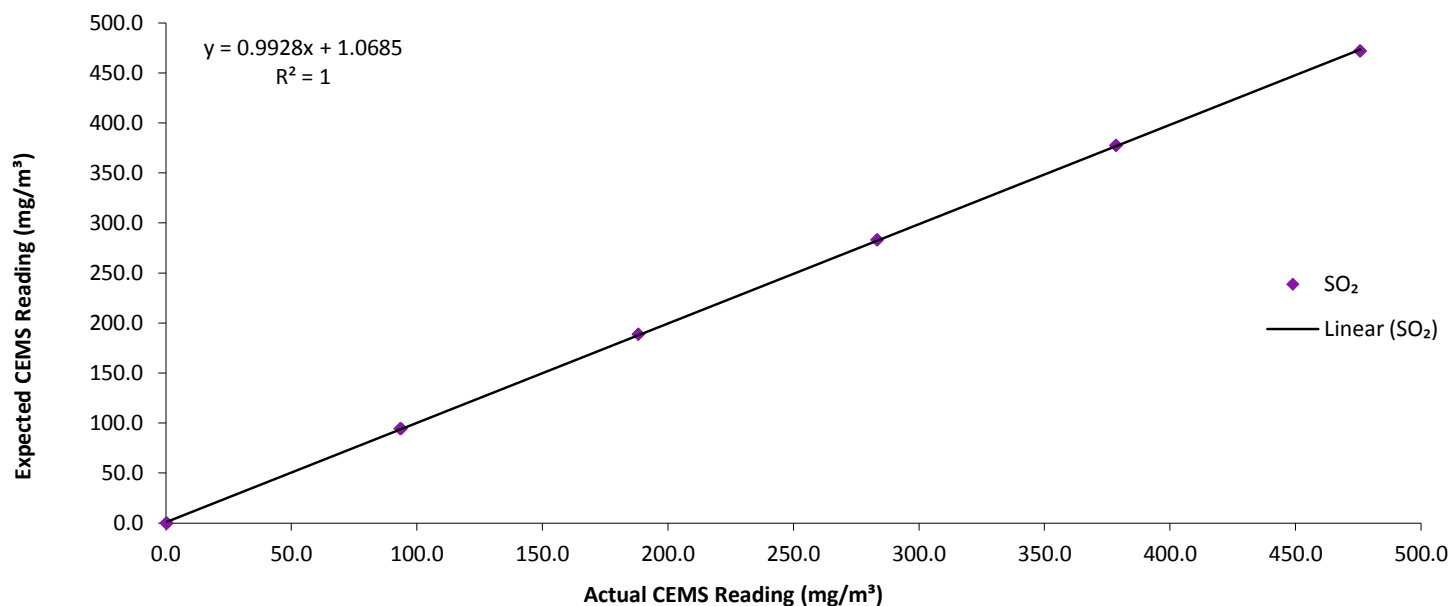
Linearity Readings on CEMS

Linearity Point	Time of Readings	Linearity % Point	Expected Reading (mg/m ³)	Reading 1 4 x Response (mg/m ³)	Reading 2 1 x Response (mg/m ³)	Reading 3 1 x Response (mg/m ³)	Average CEMS Reading (mg/m ³)
1			0.00	0.00	0.57	0.29	0.29
2			94.38	93.24	93.81	93.52	93.52
3			188.76	188.19	188.19	188.19	188.19
4			283.14	283.43	283.43	283.14	283.33
5			377.52	378.66	378.38	378.38	378.47
6			471.90	475.62	475.62	475.90	475.71

Test of Residuals

Linearity Point	Average x_c	d_c	%, $d_{c,rel}$	ABS %, $d_{c,rel}$	MAX ABS %, $d_{c,rel}$	Limit	Outcome
1	0.29	-1.35	-0.48	0.48	0.51	5	Pass
2	93.52	0.46	0.16	0.16			
3	188.19	0.86	0.30	0.30			
4	283.33	0.78	0.28	0.28			
5	378.47	0.70	0.25	0.25			
6	475.71	-1.46	-0.51	0.51			

Graphical Representation of Linearity Data



Recommendation of the application of $y = x$ (from Environment Agency Document MID 14181, Version 3.0)

(Applicable where linearity data is being used for the calibration function (See Page 3, and the column "Source of Calibration Function Derived"))

Average of SRM Results (mg/m ³)	235.95
Average of Uncalibrated CEMS Results (mg/m ³)	236.59
Difference between SRM and CEMS Results (mg/m ³)	0.64 (i)

Daily ELV (mg/m ³)	800
Half the 95% Confidence Interval (%) MU	10
Allowable Tolerance (mg/m ³)	80.0 (ii)

$y = x$ may be recommended if (i) ≤ (ii)

Should the derived calibration function be ignored and a function of $y = x$ be recommended?	Yes
Which calibration function is it recommended to apply to the Data Collection Software?	$y = x$

CARBON MONOXIDE: LINEARITY CHECK CALCULATIONS

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower
7th - 12th November 2014

Linearity Tests performed by	David Gartland ABB
100% value taken for Linearity Tests	

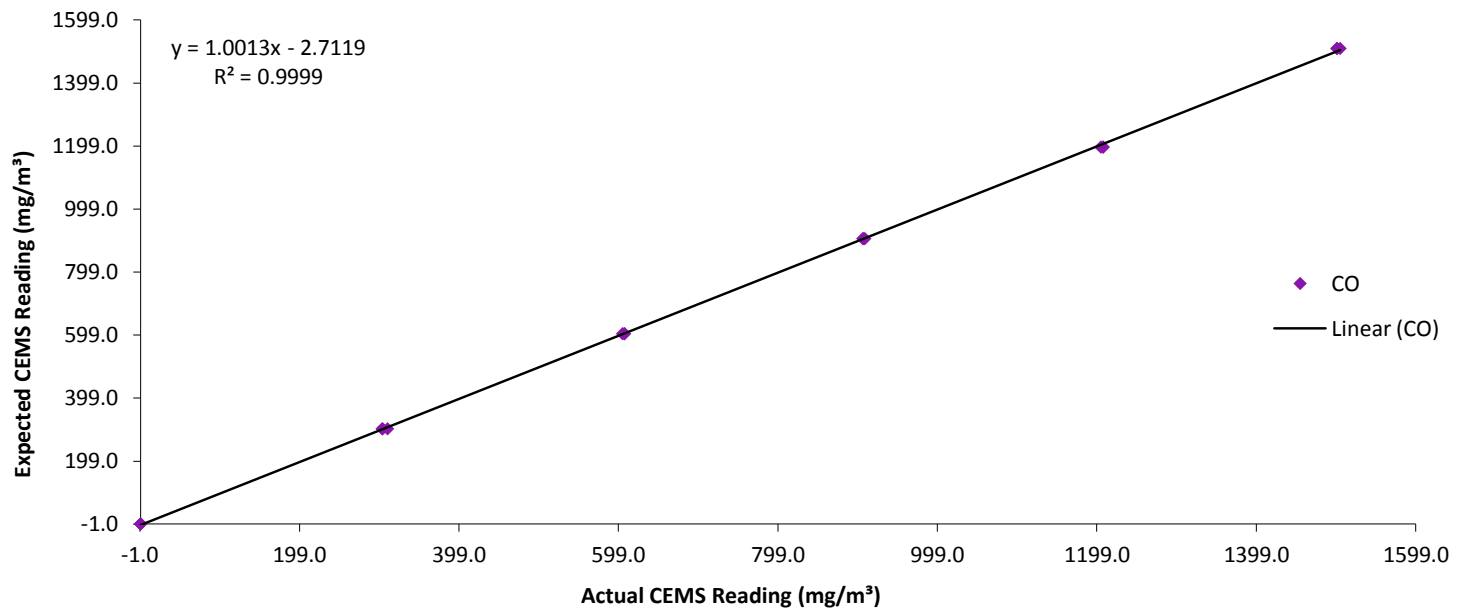
Linearity Readings on CEMS

Linearity Point	Time of Readings	Linearity % Point	Expected Reading (mg/m ³)	Reading 1 4 x Response (mg/m ³)	Reading 2 1 x Response (mg/m ³)	Reading 3 1 x Response (mg/m ³)	Average CEMS Reading (mg/m ³)
1			0.00	-0.13	-0.25	-0.38	-0.25
2			301.75	309.50	302.75	303.25	305.17
3			603.50	606.38	606.88	604.25	605.83
4			905.25	906.75	908.13	905.50	906.79
5			1195.75	1204.13	1207.13	1206.88	1206.04
6			1508.75	1500.25	1500.38	1504.25	1501.63

Test of Residuals

Linearity Point	Average x_c	d_c	%, $d_{c,rel}$	ABS %, $d_{c,rel}$	MAX ABS %, $d_{c,rel}$	Limit	Outcome
1	-0.25	2.96	0.33	0.33	1.02	5	Pass
2	305.17	-1.11	-0.12	0.12			
3	605.83	-0.43	-0.05	0.05			
4	906.79	-0.04	0.00	0.00			
5	1206.04	-9.20	-1.02	1.02			
6	1501.63	7.83	0.86	0.86			

Graphical Representation of Linearity Data



Recommendation of the application of $y = x$ (from Environment Agency Document MID 14181, Version 3.0)

(Applicable where linearity data is being used for the calibration function (See Page 3, and the column "Source of Calibration Function Derived"))

Average of SRM Results (mg/m ³)	752.50
Average of Uncalibrated CEMS Results (mg/m ³)	754.20
Difference between SRM and CEMS Results (mg/m ³)	1.70 (i)

Daily ELV (mg/m ³)	1000
Half the 95% Confidence Interval (%) MU	10
Allowable Tolerance (mg/m ³)	100.0 (ii)

$y = x$ may be recommended if (i) $\leq$ (ii)

Should the derived calibration function be ignored and a function of $y = x$ be recommended?	Yes
Which calibration function is it recommended to apply to the Data Collection Software?	$y = x$

HYDROGEN CHLORIDE: LINEARITY CHECK CALCULATIONS

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower
7th - 12th November 2014

Linearity Tests performed by	David Gartland ABB
100% value taken for Linearity Tests	

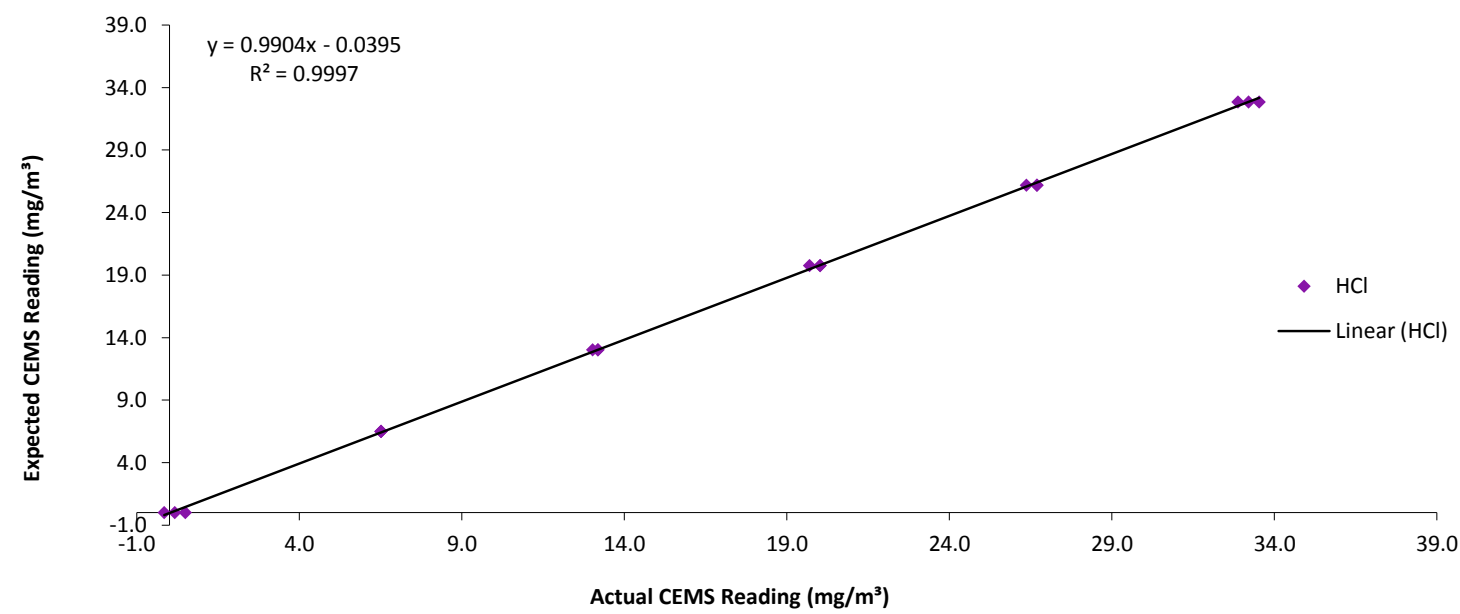
Linearity Readings on CEMS

Linearity Point	Time of Readings	Linearity % Point	Expected Reading (mg/m³)	Reading 1 4 x Response (mg/m³)	Reading 2 1 x Response (mg/m³)	Reading 3 1 x Response (mg/m³)	Average CEMS Reading (mg/m³)
1			0.00	0.16	0.49	-0.16	0.16
2			6.49	6.51	6.51	6.51	6.51
3			13.02	13.02	13.18	13.18	13.13
4			19.76	20.02	20.02	19.69	19.91
5			26.19	26.37	26.69	26.69	26.58
6			32.84	32.88	33.53	33.20	33.20

Test of Residuals

Linearity Point	Average x_c	d_c	$\%, d_{c,rel}$	ABS $\%, d_{c,rel}$	MAX ABS $\%, d_{c,rel}$	Limit	Outcome
1	0.16	-0.12	-0.62	0.62	0.62	5	Pass
2	6.51	0.09	0.44	0.44			
3	13.13	0.06	0.29	0.29			
4	19.91	0.08	0.40	0.40			
5	26.58	-0.10	-0.51	0.51			
6	33.20	0.00	0.00	0.00			

Graphical Representation of Linearity Data



Recommendation of the application of $y = x$ (from Environment Agency Document MID 14181, Version 3.0)
(Applicable where linearity data is being used for the calibration function (See Page 3, and the column "Source of Calibration Function Derived"))

Average of SRM Results (mg/m³)	16.38	Daily ELV (mg/m³)	10
Average of Uncalibrated CEMS Results (mg/m³)	16.58	Half the 95% Confidence Interval (%) MU	20
Difference between SRM and CEMS Results (mg/m³)	0.20 (i)	Allowable Tolerance (mg/m³)	2.0 (ii)

$y = x$ may be recommended if (i) $\leq$ (ii)

Should the derived calibration function be ignored and a function of $y = x$ be recommended?	Yes
Which calibration function is it recommended to apply to the Data Collection Software?	$y = x$

AMMONIA: LINEARITY CHECK CALCULATIONS

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower
7th - 12th November 2014

Linearity Tests performed by	David Gartland ABB
100% value taken for Linearity Tests	

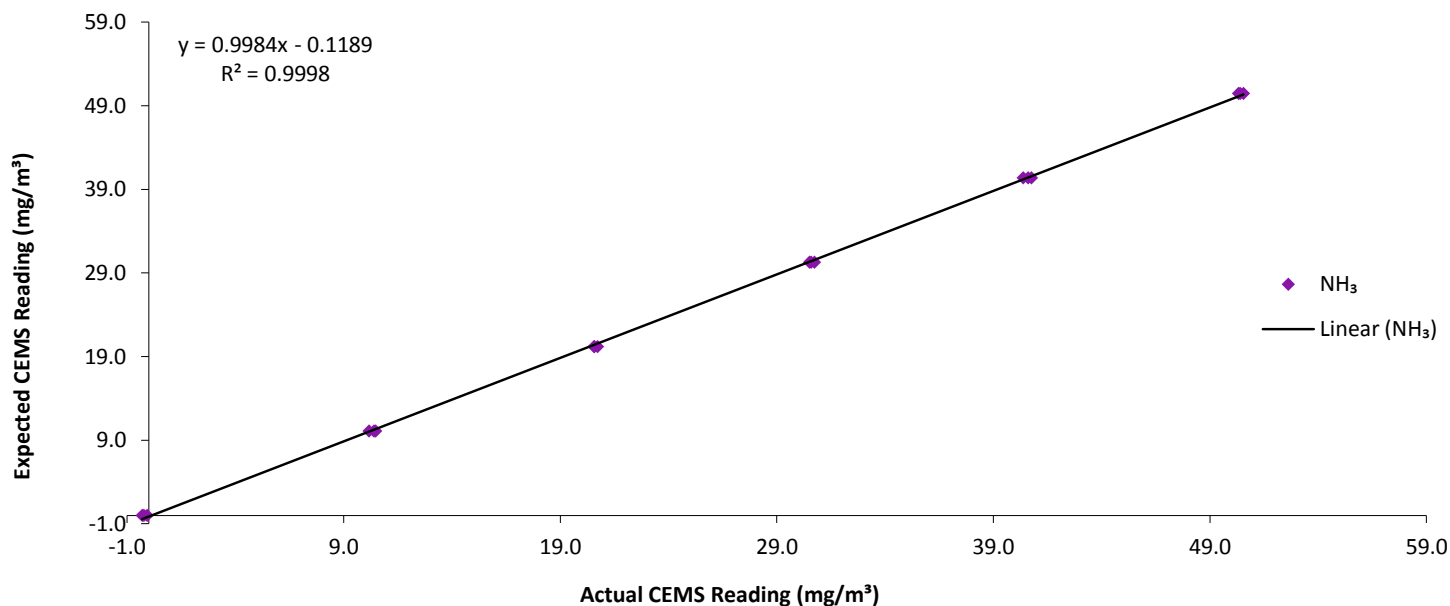
Linearity Readings on CEMS

Linearity Point	Time of Readings	Linearity % Point	Expected Reading (mg/m ³)	Reading 1 4 x Response (mg/m ³)	Reading 2 1 x Response (mg/m ³)	Reading 3 1 x Response (mg/m ³)	Average CEMS Reading (mg/m ³)
1			0.00	-0.08	-0.30	-0.23	-0.20
2			10.09	10.40	10.17	10.47	10.35
3			20.19	20.72	20.57	20.57	20.62
4			30.28	30.74	30.51	30.59	30.61
5			40.38	40.76	40.38	40.61	40.58
6			50.47	50.32	50.40	50.55	50.42

Test of Residuals

Linearity Point	Average x_c	d_c	%, $d_{c,rel}$	ABS %, $d_{c,rel}$	MAX ABS %, $d_{c,rel}$	Limit	Outcome
1	-0.20	0.32	1.06	1.06	1.06	5	Pass
2	10.35	-0.12	-0.39	0.39			
3	20.62	-0.28	-0.92	0.92			
4	30.61	-0.16	-0.53	0.53			
5	40.58	-0.02	-0.06	0.06			
6	50.42	0.25	0.83	0.83			

Graphical Representation of Linearity Data



Recommendation of the application of $y = x$ (from Environment Agency Document MID 14181, Version 3.0)

(Applicable where linearity data is being used for the calibration function (See Page 3, and the column "Source of Calibration Function Derived"))

Average of SRM Results (mg/m ³)	25.24
Average of Uncalibrated CEMS Results (mg/m ³)	25.40
Difference between SRM and CEMS Results (mg/m ³)	0.16 (i)

Daily ELV (mg/m ³)	10
Half the 95% Confidence Interval (%) MU	20
Allowable Tolerance (mg/m ³)	2.0 (ii)

$y = x$ may be recommended if (i) $\leq$ (ii)

Should the derived calibration function be ignored and a function of $y = x$ be recommended?	Yes
Which calibration function is it recommended to apply to the Data Collection Software?	$y = x$

WATER VAPOUR: LINEARITY CHECK CALCULATIONS

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower
7th - 12th November 2014

Linearity Tests performed by	David Gartland ABB
100% value taken for Linearity Tests	

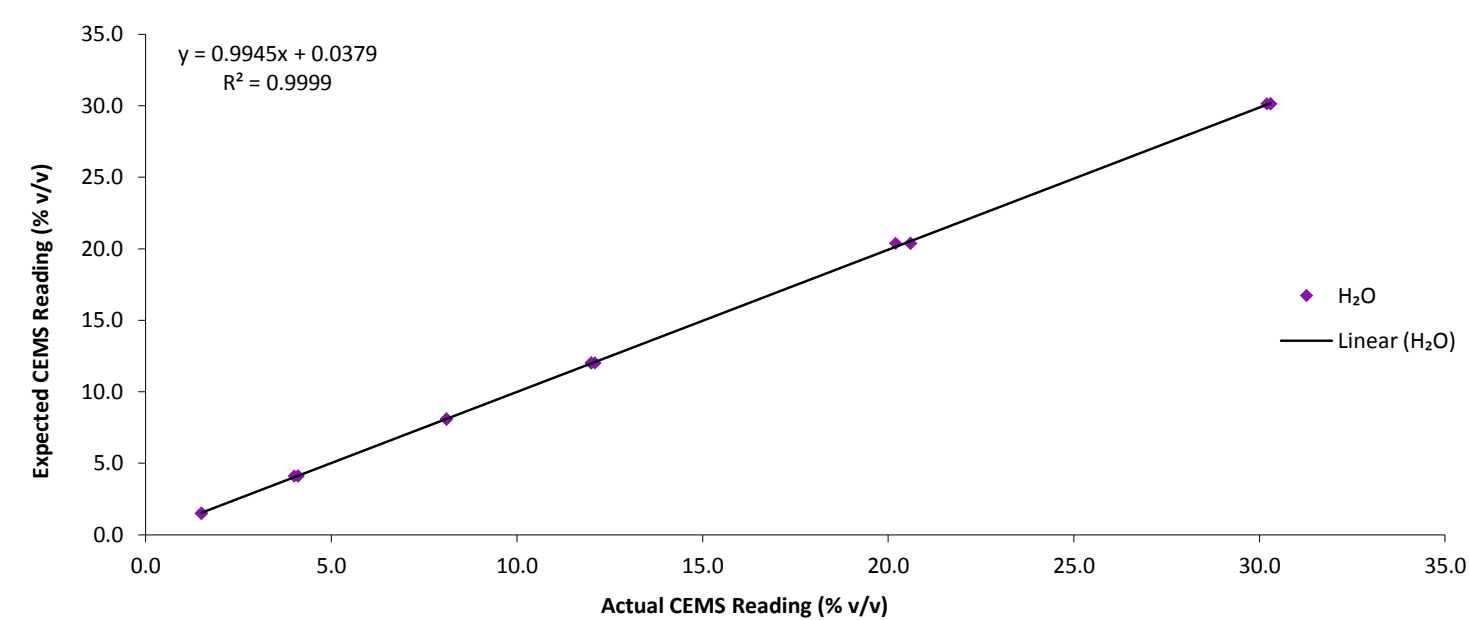
Linearity Readings on CEMS

Linearity Point	Time of Readings	Linearity % Point	Expected Reading (% v/v)	Reading 1 4 x Response (% v/v)	Reading 2 1 x Response (% v/v)	Reading 3 1 x Response (% v/v)	Average CEMS Reading (% v/v)
1			1.50	1.50	1.50	1.50	1.50
2			4.11	4.10	4.00	4.10	4.07
3			8.09	8.10	8.10	8.10	8.10
4			12.02	12.00	12.10	12.00	12.03
5			20.38	20.60	20.60	20.20	20.47
6			30.14	30.20	30.30	30.30	30.27

Test of Residuals

Linearity Point	Average x _c	d _c	%, d _{c,rel}	ABS %, d _{c,rel}	MAX ABS %, d _{c,rel}	Limit	Outcome
1	1.50	-0.03	-0.25	0.25	0.25	5	Pass
2	4.07	0.03	0.23	0.23			
3	8.10	0.00	-0.03	0.03			
4	12.03	0.02	0.12	0.12			
5	20.47	-0.01	-0.10	0.10			
6	30.27	0.00	0.02	0.02			

Graphical Representation of Linearity Data



Recommendation of the application of y = x (from Environment Agency Document MID 14181, Version 3.0)
(Applicable where linearity data is being used for the calibration function (See Page 3, and the column "Source of Calibration Function Derived"))

Average of SRM Results (% v/v)	12.71	(i)	Daily ELV (% v/v)	30	(ii)
Average of Uncalibrated CEMS Results (% v/v)	12.74		Half the 95% Confidence Interval (%) MU	15	
Difference between SRM and CEMS Results (% v/v)	0.03		Allowable Tolerance (% v/v)	4.5	

y = x may be recommended if (i) ≤ (ii)

Should the derived calibration function be ignored and a function of y = x be recommended?	Yes
Which calibration function is it recommended to apply to the Data Collection Software?	y = x

OXYGEN: LINEARITY CHECK CALCULATIONS

Lafarge Tarmac Cement and Lime Limited, Aberthaw Works
ABB2 - A1 - Main Stack on Preheater Tower
7th - 12th November 2014

Linearity Tests performed by	David Gartland ABB
100% value taken for Linearity Tests	26.2

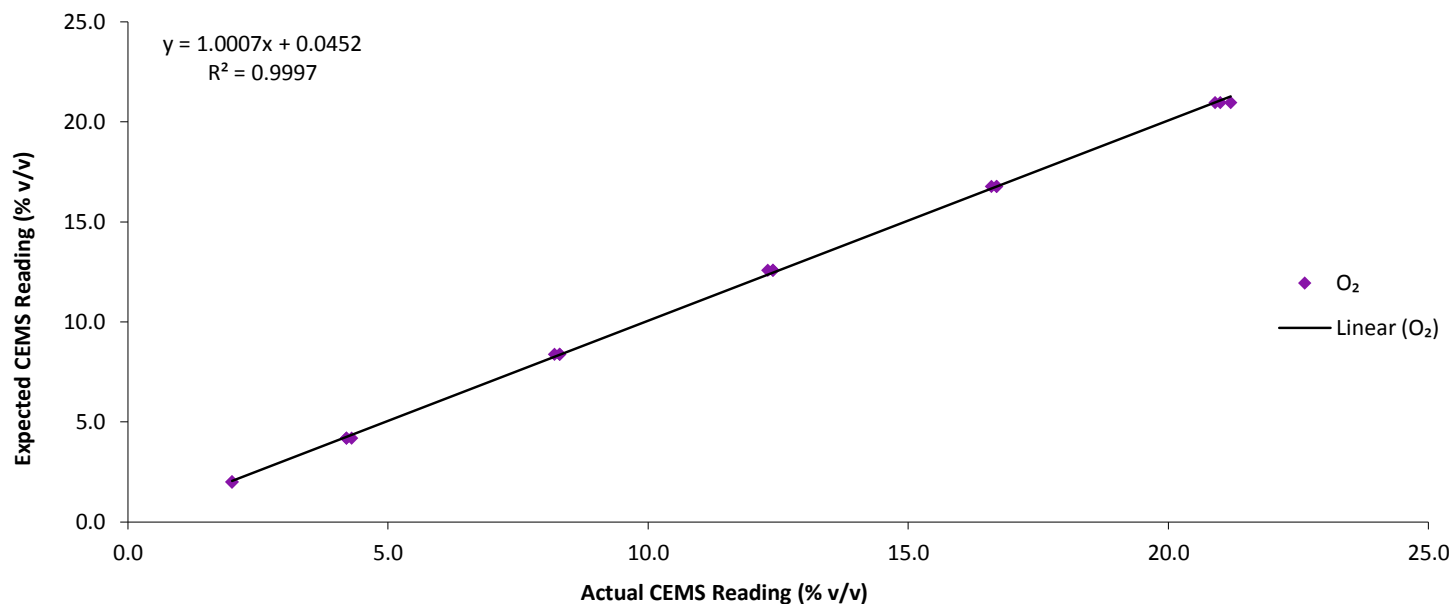
Linearity Readings on CEMS

Linearity Point	Time of Readings	Linearity % Point	Expected Reading (% v/v)	Reading 1 4 x Response (% v/v)	Reading 2 1 x Response (% v/v)	Reading 3 1 x Response (% v/v)	Average CEMS Reading (% v/v)
1			2.00	2.00	2.00	2.00	2.00
2			4.19	4.30	4.20	4.20	4.23
3			8.38	8.30	8.30	8.20	8.27
4			12.58	12.40	12.30	12.40	12.37
5			16.77	16.70	16.60	16.70	16.67
6			20.96	21.20	21.00	20.90	21.03

Test of Residuals

Linearity Point	Average x_c	d_c	$\%, d_{c,rel}$	ABS $\%, d_{c,rel}$	MAX ABS $\%, d_{c,rel}$	Limit	Outcome
1	2.00	-0.05	-0.37	0.37	1.27	5	Pass
2	4.23	-0.09	-0.73	0.73			
3	8.27	0.06	0.50	0.50			
4	12.37	0.16	1.27	1.27			
5	16.67	0.05	0.38	0.38			
6	21.03	-0.13	-1.05	1.05			

Graphical Representation of Linearity Data



Recommendation of the application of $y = x$ (from Environment Agency Document MID 14181, Version 3.0)

(Applicable where linearity data is being used for the calibration function (See Page 3, and the column "Source of Calibration Function Derived"))

Average of SRM Results (% v/v)	10.81
Average of Uncalibrated CEMS Results (% v/v)	10.76
Difference between SRM and CEMS Results (% v/v)	0.05 (i)

Daily ELV (% v/v)	21
Half the 95% Confidence Interval (%) MU	5
Allowable Tolerance (% v/v)	1.05 (ii)

$y = x$ may be recommended if (i) $\leq$ (ii)

Should the derived calibration function be ignored and a function of $y = x$ be recommended?	Yes
Which calibration function is it recommended to apply to the Data Collection Software?	$y = x$