

RECEIVED

AUG 01 2018

AIR QUALITY DIVISION

Report of a...

**Linearity Error Check &
Cylinder Gas Audit**

Performed for...

Cadillac Renewable Energy

Cadillac, Michigan

On the

Wood Fired Boiler Exhaust

I. INTRODUCTION

Cadillac Renewable Energy Performed the Linearity check and Cylinder Gas Audit (CGA), for the second quarter 2018, on the CEMS servicing our wood fired boiler. The CEMS is comprised of a carbon monoxide (CO) monitor, oxides of nitrogen (NO_x) monitor, wet basis oxygen (O₂) monitor and dry basis oxygen (O₂) monitor.

A linearity check was conducted on the NO_x monitor and the two (2) O₂ monitors. A CGA was conducted on the CO monitor.

The linearity check and CGA were performed on May 29, 2018 by Justin Lockhart, an employee of Cadillac Renewable Energy.

RECEIVED

AUG 01 2018

AIR QUALITY DIVISION

II. Presentation of Results

II.1 Table 1

Oxides of Nitrogen (Nox) Linearity Error Results

Cadillac Renewable Energy, Cadillac Michigan

05/29/18

Reference Gas	Run	Time	CEMS Response
(LOW) 64.700	1	10:03 AM	66.157
	2	10:12 AM	66.676
	3	10:21 AM	66.888
	Average (Mean) PPM Response		66.574
	Absolute Value Of The Difference		1.874
	Linearity Error		2.90%
(MID) 140.000	1	10:06 AM	143.453
	2	10:15 AM	143.127
	3	10:24 AM	143.804
	Average (Mean) PPM Response		143.461
	Absolute Value Of The Difference		3.461
	Linearity Error		2.50%
(HIGH) 246.000	1	10:09 AM	246.692
	2	10:18 AM	246.51
	3	10:27 AM	246.179
	Average (Mean) PPM Response		246.46
	Absolute Value Of The Difference		0.46
	Linearity Error		0.20%
** Linearity Errors need to be less than or equal to 5.0% or difference needs to be less than or equal to 5 PPM			

II.2 Table 2

Wet Oxygen (O₂) Linearity Error Results

Cadillac Renewable Energy, Cadillac Michigan

05/29/18

Reference Gas	Run	Time	CEMS Response
(LOW) 4.010	1	9:22 AM	3.901
	2	9:31 AM	3.963
	3	9:40 AM	3.964
	Average (Mean) PPM Response		3.943
	Absolute Value Of The Difference		0.067
	Linearity Error		1.70%
(MID) 9.050	1	9:25 AM	8.976
	2	9:34 AM	9.018
	3	9:43 AM	9.038
	Average (Mean) PPM Response		9.011
	Absolute Value Of The Difference		0.039
	Linearity Error		0.40%
(HIGH) 15.100	1	9:28 AM	15.241
	2	9:37 AM	15.28
	3	9:46 AM	15.272
	Average (Mean) PPM Response		15.264
	Absolute Value Of The Difference		0.164
	Linearity Error		1.10%
** Linearity Errors need to be less than or equal to 5.0% or difference needs to be less than or equal to 5 PPM			

II.3 Table 3
 Dry Oxygen (O2) Linearity Error Results
 Cadillac Renewable Energy, Cadillac Michigan
 05/29/18

Reference Gas	Run	Time	CEMS Response
(LOW) 4.010	1	9:22 AM	3.982
	2	9:31 AM	4.007
	3	9:40 AM	4.008
	Average (Mean) PPM Response		3.999
	Absolute Value Of The Difference		0.011
	Linearity Error		0.30%
(MID) 9.050	1	9:25 AM	8.985
	2	9:34 AM	8.987
	3	9:43 AM	8.991
	Average (Mean) PPM Response		8.988
	Absolute Value Of The Difference		0.052
	Linearity Error		0.70%
(HIGH) 15.100	1	9:28 AM	14.872
	2	9:37 AM	14.874
	3	9:46 AM	14.855
	Average (Mean) PPM Response		14.867
	Absolute Value Of The Difference		0.233
	Linearity Error		1.50%
** Linearity Errors need to be less than or equal to 5.0% or difference needs to be less than or equal to 5 PPM			

II.4 Table 4
Carbon Monoxide (CO) Linearity Error Results
Cadillac Renewable Energy, Cadillac Michigan
05/29/18

Reference Gas	Run	Time	CEMS Response
(LOW) 242.000	1	10:43 AM	239.121
	2	10:49 AM	239.187
	3	10:55 AM	239.499
	Average (Mean) PPM Response		239.269
	Absolute Value Of The Difference		2.731
	CGA Accuracy		1.10%
(HIGH) 535.000	1	10:46 AM	534.879
	2	10:52 AM	535.343
	3	10:58 AM	535.524
	Average (Mean) PPM Response		535.249
	Absolute Value Of The Difference		0.249
	CGA Accuracy		0.00%
** CGA Accuracy need to be less than or equal to 15.0% or difference needs to be less than or equal to 5 PPM			

III.1 DISCUSSION OF RESULTS

III.1 Linearity Error

The results of the linearity error can be found in tables 1 – 3 (Section II.1 through II.3). The control limits for linearity error are as follows:

III.1.1 NO_x – Linearity error needs to be less than or equal to 5.0% or the Difference needs to be less than or equal to .5 PPM, whichever is less restrictive.

III.1.2 O₂ – Linearity Error needs to be less than or equal to 5.0% or the Difference needs to be less than or equal to 0.5% O₂, whichever is less restrictive.

All the monitors pass the linearity requirements as outlined above.

III.2 CGA Accuracy

The results of the CO CGA can be found in Table 4 (Section II.4). The control limit for CGA accuracy is plus or minus 15% of the average audit value or plus or minus 5 PPM, whichever is greater. The CO monitor meets the CGA accuracy control limit.

IV. AUDIT PROTOCOL

IV.1 Linearity Error – The linearity error was performed in accordance with 40 CFR Part 75, Appendix A. Each monitor was challenged three times each with a high, mid and low protocol gas. Once a stable reading was obtained, it was recorded. The readings for each gas range were averaged and compared to the protocol gas concentrations. The calculations were performed using Equation A-4 from Appendix A. The calibration gas certification sheets can be found in Appendix A.

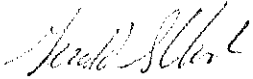
IV.2 CGA – The CGA was performed in accordance with 40 CFR Part 60, Appendix F. Each monitor was challenged three times each with a mid and low protocol gas.

Once a stable reading was obtained, it was recorded. The three mid and the three low readings for each monitor were averaged and compared to the protocol gas concentrations.

The calibrations were performed using Equation 1-1 from Appendix F. The calibration gas certification sheet can be found in Appendix A.

This report was prepared by:

Gerald Clark



Maintenance Manager

This report was reviewed by:

Jeffrey Strong



Plant Manager

7/10/10

RECEIVED

AUG 01 2010

AIR QUALITY DIVISION