



**Relative Accuracy Test Audit
Test Report**

**Lansing Board of Water and Light
REO Town Facility
Auxiliary Boiler
Lansing, Michigan 48901
October 26, 2017**

**Report Submittal Date
November 21, 2017**

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Mostardi Platt

Project No. M174302C

1.0 EXECUTIVE SUMMARY

MOSTARDI PLATT conducted a Continuous Emissions Monitoring System (CEMS) Relative Accuracy Test Audit (RATA) test program for Lansing Board of Water and Light at the REO Town Facility in Lansing, Michigan, on the Auxiliary Boiler on October 26, 2017. This report summarizes the results of the test program and test methods used.

The test location, test date, and test parameter are summarized below.

TEST INFORMATION		
Test Location	Test Date	Test Parameter
Auxiliary Boiler	October 26, 2017	Oxygen (O ₂) and Nitrogen Oxides (NO _x)

The purpose of the test program was to demonstrate the relative accuracies of the Auxiliary Boiler O₂ and NO_x analyzers during the specified operating conditions. The test results from this test program indicate that each CEMS component meets the United States Environmental Protection Agency (USEPA) annual performance specification for relative accuracy as published in 40 Code of Federal Regulations Part 60 (40CFR60).

RATA RESULTS					
Test Location	Date	Parameter	Units	Relative Accuracy Acceptance Criteria	Relative Accuracy (RA)
Auxiliary Boiler	10/26/17	NO _x	lb/mmBtu	≤ 20.0% of the mean reference value	2.60%
		NO _x	ppmvd @ 3% O ₂	≤ 20.0% of the mean reference value	3.76%
		O ₂	% dry	≤ 20.0% of the mean reference value	3.42%

The gas cylinders used to perform the RATA are summarized below.

GAS CYLINDER INFORMATION				
Parameter	Gas Vendor	Cylinder Serial Number	Cylinder Value	Expiration Date
NO _x	Airgas	XC03254B	0.0 ppm	5/25/2025
NO _x	Airgas	CC179027	24.83 ppm	9/01/2020
NO _x	Airgas	CC274893	44.65 ppm	5/15/2020
O ₂	Airgas	CC179027	0.0%	9/01/2020
O ₂	Airgas	XC03254B	12.43%	5/25/2025
O ₂	Airgas	CC283878	21.04%	1/26/2023

The identifications of the individuals associated with the test program are summarized below.

TEST PERSONNEL INFORMATION		
Location	Address	Contact
Test Coordinator	Lansing Board of Water and Light 1232 Haco Drive P.O. Box 13007 Lansing, Michigan 48912	Ms. Trista Gregorski Engineer, Environmental Services (517) 702-6865 (phone) trista.gregorski@lbwl.com
Test Facility	Lansing Board of Water and Light REO Town Facility 1201 S. Washington Ave. Lansing, Michigan 48917	
Testing Company Supervisor	Mostardi Platt 888 Industrial Drive Elmhurst, Illinois 60126	Mr. Chris Eldridge Project Supervisor 630-993-2100 (phone) celdridge@mp-mail.com QI Group V (certified on 3/4/16)
Testing Company Personnel		Mr. Christopher Buglio Test Technician

2.0 TEST METHODOLOGY

Emission testing was conducted following the United States Environmental Protection Agency (USEPA) methods specified in 40CFR60, Appendix A in addition to the Mostardi Platt Quality Manual. Schematics of the test section diagram and sampling train used are included in Appendix A and B respectively. Calculation and nomenclature are included in Appendix C. Copies of analyzer print-outs for each test run are included in Appendix D. CEM data and process data as provided by Lansing Board of Water and Light are included in Appendix E.

The following methodologies were used during the test program:

Method 3A Oxygen (O₂) Determination

Stack gas O₂ concentrations and emission rates were determined in accordance with USEPA Method 3A, 40CFR60, Appendix A. A Servomex analyzer was used to determine the O₂ concentrations in the manner specified in the Method. The instrument has a paramagnetic detector 21.04%. High-range calibrations were performed using USEPA Protocol gas. Zero nitrogen (a low ppm pollutant in balance nitrogen calibration gases) was introduced during other instrument calibrations to check instrument zero. High- and a mid-range % O₂ levels in balance nitrogen were also introduced. Zero and mid-range calibrations were performed using USEPA Protocol gas after each test run. Copies of the gas cylinder certifications are found in Appendix G. This testing met the performance specifications as outlined in the Method.

Method 7E Nitrogen Oxides (NO_x) Determination

Stack gas NO_x concentrations and emission rates were determined in accordance with USEPA Method 7E, 40CFR60, Appendix A. A Thermo Scientific Model 42C Chemiluminescence Nitrogen Oxides Analyzer was used to determine nitrogen oxides concentrations, in the manner specified in the Method. The instrument operated in the nominal range of 0 ppm to 50 ppm with the specific range determined by the high-level span calibration gas of 44.65 ppm.

The Model 42C High Level is based on the principle that nitric oxide (NO) and ozone (O₃) react to produce a characteristic luminescence with an intensity linearly proportional to the NO concentration. Infrared light emission results when electronically excited nitrogen dioxide (NO₂) molecules decay to lower energy states. Specifically,



NO₂ must first be transformed into NO before it can be measured using the chemiluminescent reaction. NO₂ is converted to NO by a molybdenum NO₂-to-NO converter heated to about 326°C. The flue gas air sample is drawn into the Model 42C High Level through the sample bulkhead. The sample flows through a particulate filter, a capillary, and then to the mode solenoid valve. The solenoid valve routes the sample either straight to the reaction chamber (NO mode) or through the NO₂-to-NO converter and then to the reaction chamber (NO_x mode).

Dry air enters the Model 42C High Level through the dry air bulkhead, through a flow sensor, and then through a silent discharge ozonator. The ozonator generates the necessary ozone concentration needed for the chemiluminescent reaction. The ozone reacts with the NO in the ambient air sample to produce electronically excited NO₂ molecules. A photomultiplier tube (PMT) housed in a thermoelectric cooler detects the NO₂ luminescence.

The NO and NO_x concentrations calculated in the NO and NO_x modes are stored in memory. The difference between the concentrations are used to calculate the NO₂ concentration. The Model 42C High Level outputs NO, NO₂, and NO_x concentrations to both the front panel display and the analog outputs.

Stack gas was delivered to the analyzer via a Teflon® sampling line, heated to a minimum temperature of 250°F. Excess moisture in the stack gas was removed using a refrigerated condenser. The entire system was calibrated in accordance with the Method, using USEPA Protocol gases introduced at the probe, before and after each test run. This testing met the performance specifications as outlined in the Method.

A list of calibration gases used and the results of all calibration and other required quality assurance checks are found in Appendix F. Copies of the gas cylinder certifications are found in Appendix G. The NO₂ to NO converter test can be found in Appendix H. This testing met the performance specifications as outlined in the Method.

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3.0 TEST RESULT SUMMARIES

Client: Lansing Board of Water and Light				Location: Auxiliary Boiler Stack				
Facility: REO Town Facility				Date: 10/26/17				
Project #: M174302				Test Method: 7E, 3A				
Fuel Type: Natural Gas				Fuel Factor: 8710				
O2 based NOx lb/mmBtu RATA								
CEM Monitor Information								
NO_x Monitor/Model:			Thermo Fisher Scientific		NO_x Serial # :		1207552010	
O2 Monitor/Model:			Thermo Fisher Scientific		O2 Serial # :		1207552010	
1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM NO_x lb/MMBtu	CEM NO_x lb/MMBtu	(RM-CEM) Difference (di)	(RM-CEM) Difference² (di²)
0	1	10/26/17	07:15	07:35	0.014	0.015	-0.001	0.000
1	2	10/26/17	07:48	08:08	0.015	0.015	0.000	0.000
1	3	10/26/17	08:20	08:40	0.014	0.015	-0.001	0.000
1	4	10/26/17	08:52	09:12	0.014	0.014	0.000	0.000
1	5	10/26/17	09:24	09:44	0.014	0.014	0.000	0.000
1	6	10/26/17	09:56	10:16	0.014	0.014	0.000	0.000
1	7	10/26/17	10:28	10:48	0.014	0.014	0.000	0.000
1	8	10/26/17	11:00	11:20	0.014	0.014	0.000	0.000
1	9	10/26/17	11:32	11:52	0.014	0.014	0.000	0.000
1	10	10/26/17	12:04	12:24	0.014	0.014	0.000	0.000
n					9			
t(0.975)					2.306			
Mean Reference Method Value					0.014		RM avg	
Mean CEM Value					0.014		CEM avg	
Sum of Differences					-0.001		di	
Mean Difference					0.000		d	
Sum of Differences Squared					0.000		di²	
Standard Deviation					0.000		sd	
Confidence Coefficient 2.5% Error (1-tail)					0.000		cc	
Relative Accuracy					2.60		RA	

Client: Lansing Board of Water and Light					Location: Auxiliary Boiler Stack			
Facility: REO Town Facility					Date: 10/26/17			
Project #: M174302					Test Method: 7E, 3A			
NOx ppmvd @ 3% O2 RATA								
CEM Monitor Information								
NO_x Monitor/Model:			Thermo Fisher Scientific		NO_x Serial # :		1207552010	
O₂ Monitor/Model:			Thermo Fisher Scientific		O₂ Serial # :		1207552010	
1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM NOx ppmvd @ 3 %O2	CEM NOx ppmvd @ 3 %O2	(RM-CEM) Difference (di)	(RM-CEM) Difference² (di²)
1	1	10/26/17	07:15	07:35	11.6	12.0	-0.4	0.2
1	2	10/26/17	07:48	08:08	12.3	12.0	0.3	0.1
1	3	10/26/17	08:20	08:40	11.8	12.0	-0.2	0.0
1	4	10/26/17	08:52	09:12	11.7	12.0	-0.3	0.1
1	5	10/26/17	09:24	09:44	11.5	12.0	-0.5	0.3
0	6	10/26/17	09:56	10:16	11.3	12.0	-0.7	0.5
1	7	10/26/17	10:28	10:48	11.6	12.0	-0.4	0.2
1	8	10/26/17	11:00	11:20	11.7	12.0	-0.3	0.1
1	9	10/26/17	11:32	11:52	11.2	11.0	0.2	0.0
1	10	10/26/17	12:04	12:24	11.6	12.0	-0.4	0.2
n					9			
t(0.975)					2.306			
Mean Reference Method Value					11.667		RM avg	
Mean CEM Value					11.889		CEM avg	
Sum of Differences					-2.000		di	
Mean Difference					-0.222		d	
Sum of Differences Squared					1.080		di²	
Standard Deviation					0.282		sd	
Confidence Coefficient 2.5% Error (1-tail)					0.217		cc	
Relative Accuracy					3.76		RA	

Client: Lansing Board of Water and Light					Location: Auxiliary Boiler Stack			
Facility: REO Town Facility					Date: 10/26/17			
Project #: M174302					Test Method: 3A			
O₂ % (dry) RATA								
CEM Monitor Information								
O₂ Monitor/Model:			Thermo Fisher Scientific		O₂ Serial # :		1207552010	
1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM O₂ % (dry)	CEM O₂ % (dry)	(RM-CEM) Difference (di)	(RM-CEM) Difference² (di²)
1	1	10/26/17	07:15	07:35	6.1	5.9	0.2	0.04
1	2	10/26/17	07:48	08:08	6.0	5.8	0.2	0.04
1	3	10/26/17	08:20	08:40	5.9	5.7	0.2	0.04
1	4	10/26/17	08:52	09:12	5.8	5.6	0.2	0.04
1	5	10/26/17	09:24	09:44	5.8	5.6	0.2	0.04
0	6	10/26/17	09:56	10:16	5.7	5.6	0.1	0.01
1	7	10/26/17	10:28	10:48	5.8	5.6	0.2	0.04
1	8	10/26/17	11:00	11:20	5.8	5.6	0.2	0.04
1	9	10/26/17	11:32	11:52	5.7	5.5	0.2	0.04
1	10	10/26/17	12:04	12:24	5.8	5.6	0.2	0.04
n					9			
t(0.975)					2.306			
Mean Reference Method Value					5.856		RM avg	
Mean CEM Value					5.656		CEM avg	
Sum of Differences					1.800		di	
Mean Difference					0.200		d	
Sum of Differences Squared					0.360		di²	
Standard Deviation					0.000		sd	
Confidence Coefficient 2.5% Error (1-tail)					0.000		cc	
Relative Accuracy					3.42		RA	