COMPLIANCE TEST REPORT

MAIN BAGHOUSE STACK

Prepared For:

SUNCOKE ENERGY, INC.
MIDDLETOWN OPERATIONS

Prepared By:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
KNOXVILLE, TN

CEC Project 151-733

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Civil & Environmental Consultants, Inc.

Knoxville

308 Cates Street | Maryville, TN 37801 | p: 865-977-9997 f: 865-977-9919 | www.cecinc.com

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ACRONYMS

CEM	Continuous Emission Monitor
CFR	Code of Federal Regulations
CO_2	Carbon Dioxide
dscf	Dry Standard Cubic Feet
EPA	Environmental Protection Agency
MTO	SunCoke Energy, Inc. Middletown Operations
NO_x	Nitrogen Oxide
O_2	Oxygen
PCM	Pushing and Charging Machine
ppmv	Parts Per Million by Volume
QA	Quality Assurance
QC	Quality Control
SWOAQA	Southwest Ohio Air Quality Agency

1.0 INTRODUCTION

Sun Coke Energy, Inc. constructed a new metallurgical coke manufacturing facility in Middletown, Ohio that commenced production operations on October 29, 2011. The facility is referred to as the Middletown Operations (MTO). Per the May 2012 settlement agreement, MTO must perform stack emissions testing on the main stack to demonstrate compliance with the emission limits contained in air permit #P0117561. MTO contracted Civil & Environmental Consultants, Inc. (CEC) to provide the nitrogen oxides (NO_x) emissions testing services for the main stack. This test report provides a detailed description explaining how CEC performed the compliance testing and the results of the test. This is a retest following the original test which was conducted on April 1, 2015.

Lead personnel on-site during the tests included:

Kris Singleton, Environmental Manager MTO;
Shawn Wiley, SWOAQA; and
Michael Mowery, Principal CEC

This report summarizes the test results for the main stack in Section 2 and lists the test methods in Section 3. Section 4 provides information regarding the project quality assurance (QA)/quality control (QC) procedures. The appendices contain process data (Appendix A), continuous emission monitor (CEM) test data (Appendix B), stack gas flow data (Appendix C) and CEC equipment calibrations and calibration gas certificates (Appendix D).

1.1 Process Description

The MTO facility utilizes Sun Coke Energy's Thompson heat recovery type of oven to manufacture metallurgical coke. During coke production the volatile fraction of the coal is driven off in a, high temperature, reducing atmosphere. Coke is essentially the remaining carbon and ash. The volatile fraction of the coal is oxidized within the coke oven, which is maintained at a negative pressure.

Heat recovery steam generators (HRSGs) recover heat from the oven waste gases. The cooled gases pass through a lime spray dryer/baghouse system prior to being exhausted from the main stack. There are currently 100 ovens at MTO that operate on a 48-hour coking cycle. The operating schedule is arranged such that half the ovens are charged each day.

2.0 TEST RESULTS

Because the production cycles are staggered across the entire battery of ovens, the gases sent to the main baghouse are typically uniform and could be sampled at any given time, with the exception of when pushing and charging production is in process. In order to obtain a reasonable average of the main stack emissions, two test runs were performed during non-production times and one test run was performed during a production cycle. Each test run was performed for a one hour period.

Table 2-1 provides a comparison of the measured compliance test data to the emission limits required for the main baghouse stack.

Table 2-1
Compliance Demonstration
Stack Tests at SunCoke Energy, Inc. Middletown Operations (June 29, 2015)

Stack I.D.	Pollutant	Emission Limit	Measured Value	Comply?
Main Baghouse Stack	NO_x	104.2 lb/hr	100.31 lb/hr	Yes
		1.0 lb/ton wet coal	1.0 lb/ton wet coal	Yes

As shown in Table 2-1, the measured NO_x values were within the emission limits. The detailed test results of the stack tests for the sources are provided below.

2.1 Main Baghouse Stack

The main baghouse stack compliance tests were performed on June 29, 2015. The results are summarized in Table 2-2. Test runs 1 and 2 were performed during the oven coking cycle, while test run 3 was performed during the pushing and charging activities.

Table 2-2
Main Baghouse Stack Compliance NO_x Test Results

	Run 1	Run 2	Run 3	Average
Date	6/29/2015	6/29/2015	6/29/2015	
Test Time	17:00 – 18:00	18:20 – 19:20	19:40 – 20:40	
Duration of Test (min)	60	60	60	60
Average Production Rate (tons wet coal/day)(1)				2,371.4
Stack Gas Temperature (°F)	247	248	252	249
Stack Gas Moisture Content (% Vol.)	16.7	20.3	19.7	18.9
O_2 (%)	7.6	8.2	7.8	7.9
CO_2 (%)	9.2	8.9	9.1	9.1
ACFM	374,608	380,766	386,028	380,467
DSCFM	219,831	213,700	216,964	216,832
NO_x Concentration (ppmvd)	63.44	64.04	66.11	64.53
NO_x Mass Emission Rate (lb/hr)	99.99	98.12	102.83	100.31
NO_x Mass Emission Rate (lb/ton wet coal)	1.012	0.993	1.041	1.015

(1) – Average coal charge based on 6/27/15, 6/28/15 and 6/29/15 production rates.

3.0 TEST METHODS

Each test method used for this compliance test program was based on standard methodology taken from the latest version of 40 Code of Federal Regulations (CFR) 60, Appendix A. These test methods were presented in the Test Protocol submitted to SWOAQA prior to the compliance test. Detailed descriptions of the sampling trains and methods used are provided in the following sections.

3.1 EPA Reference Methods 1 and 2 – Volumetric Flow Rate

Environmental Protection Agency (EPA) Methods 1 and 2 were used to determine the sampling traverse layout and stack gas volumetric flow rate at the sampling location. A velocity traverse was conducted at discrete points during each test run at each designated traverse point. A calibrated S-type Pitot tube and an inclined manometer were used to measure the velocity pressure. A calibrated type "K" thermocouple was used to measure the stack gas temperature at each traverse point. Utilizing the measured stack gas molecular weight and the moisture content, the standard (Q_{std}) and actual volumetric flow rates were calculated in accordance with the formulas found in EPA Reference Method 2.

3.2 EPA Reference Method 3A – Stack Gas Molecular Weight

The stack gas oxygen (O_2) and carbon dioxide (CO_2) concentrations were determined in accordance with EPA Reference Method 3A using a Teledyne T-803 O_2 and CO_2 gas analyzer. The resulting O_2 and CO_2 concentrations were used to calculate the molecular weight of the stack gas. A description of the sampling equipment used for this testing is provided in Section 3.5.

3.3 EPA Reference Method 4 – Stack Gas Moisture Content

The moisture content (%), B_{wo}, was determined for stack gas in accordance with EPA Reference Method 4. The Method 4 sample train consisted of a modified Greenburg-Smith filled with 100 ml of distilled water for the first impinger. The second impinger was a Greenburg-

Smith containing 100 ml of distilled water. The third impinger was a modified Greenburg-Smith and was initially empty. The fourth impinger was modified Greenburg-Smith and contained approximately 200 grams of indicating silica gel. Each impinger was weighed prior to assembling the sample train, and again at the end of the test run to determine the moisture gain from the test. Figure 3-1 is a schematic of the Method 4 sample train.

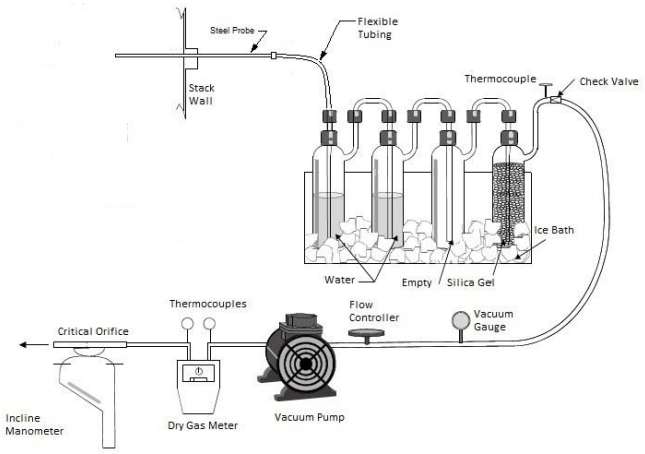


Figure 3-1. Schematic of EPA Method 4 Sample Train

The moisture sample was collected by placing a stainless steel probe three feet into the stack and connecting the end of the probe to the first impinger with a silicone tube. A sample of the stack gas was extracted from the stack into the sample train for a 20 minute period for each of the three compliance test runs. The sample train was leak checked at the beginning and end of each test run.

3.4 EPA Method 7E - NO_x

Gaseous sampling for NO_x was performed on the main stack in accordance with EPA Method 7E. The concentrations of O_2 and CO_2, previously described in Section 3.2, were measured in conjunction with the NO_x measurements.

A single continuous emission monitor (CEM) sampling system was utilized to perform the gaseous sampling on the main stack. The sampling system consisted of a heated metal probe that was used to extract the gas sample from the main stack. The end of the probe was fitted with a sintered stainless steel filter used to remove particulate from the stack gas entering the heated sample probe. A heated Teflon line transported the sample from the point of extraction to the non-contact gas conditioning electronically-controlled chiller system. The chiller was used to remove moisture from the gas stream, while the dry sample gas passed through to the gaseous analyzers. Figure 3-2 is a schematic of the CEM sampling system.

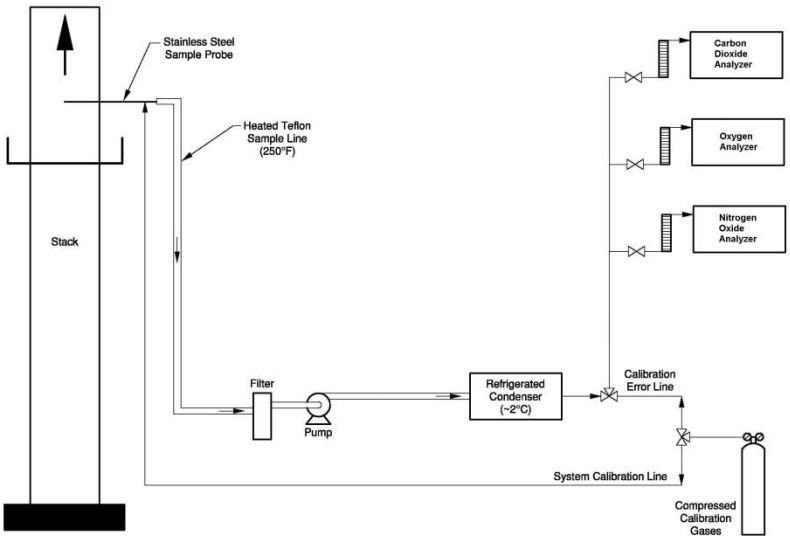


Figure 3-2. Schematic of CEM Sampling System

The CEMs were located in a temperature-controlled sampling trailer to minimize thermal effects on the calibration of the instruments. Each reference method CEM was connected to an electronic datalogger for collection of data. One-minute averages of each reference method CEM was recorded throughout the compliance test period.

The NO_x concentration for the main stack was sampled using a TECO Model 42i-HL chemiluminescent NO-NO_x gas analyzer. The concentration and mass emission rate of NO_x in the stack gas stream was measured and reported in parts per million by volume (ppmv) on a dry

basis, and in pounds per hour, respectively. The emission rate was calculated using the specific run-time average concentration in ppmv, the dry standard volumetric flow rate and the Ideal Gas Law.

Prior to performing the compliance test, the CEMs were calibrated with a zero nitrogen gas along with mid and high-level Relative Accuracy Test Audit (RATA) class calibration gases. Section 4.6 describes the methodology used for CEM calibration. After the initial CEM calibrations were performed a stratification check was performed across the main stack. No significant stratification was found in the stack, which allowed the CEM sampling to be performed at a single point within the stack.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

The objective of CEC's QA Program is to ensure the accuracy and precision, as well as reliability, of the data collected and generated for CEC's clients and to meet the data quality objectives of regulatory or accrediting bodies. Management, administrative, statistical, investigative, preventive, and corrective techniques were employed to maximize the reliability of data.

A strict QA/QC program was adhered to during the performance testing. Before actual sampling on-site, all the sampling equipment was thoroughly checked to ensure that each component was clean and operable. Any damaged or faulty equipment was tagged and removed from service until it could be repaired. If any corrective actions were taken in response to these QC checks or in response to supervisor review of QC procedures, the corrective action taken was documented in a field QA/QC logbook.

Proper equipment calibration is essential in maintaining the desired data quality level. All calibrations of the equipment used in the stack sampling portion of the testing conformed to the guidelines outlined in the EPA QA handbook, *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods* (EPA-600/4-77-027a). The following sections give a synopsis of the calibration procedures for the main components of the stack sampling systems.

4.1 Dry Gas Meters/Orifice Meters

The dry gas meter and critical orifice in the control console used during the testing were calibrated before and after the compliance test to ensure accurate measurements of the sample gas volumes. The dry gas meter and critical orifice are normally housed as a set inside each control console and were calibrated as such. The dry gas meter was calibrated against a primary standard wet test meter.

The dry gas meter was calibrated at predetermined, nominal volume flow settings. For each of these flow rates, an accuracy ratio factor to the calibration standard (Y_i) was computed for the dry gas meter. A successful calibration for a particular dry gas meter would be achieved if each value of Y_i was within 2% of the average value of Y_i ($Y_i = Y \pm 0.02Y$).

In order to establish calibration for the critical orifice, a calibration coefficient ($\Delta H@_I$) was calculated for each flow rate. This coefficient is the orifice pressure differential (in inches H_2O) at a distinct orifice manometer setting that gives a flow of 0.75 ft^3/min of air at standard conditions. The desired tolerance for this coefficient is ±0.2 of the average value of the four values of $\Delta H@_I$ ($\Delta H@ \pm 0.2$). If any of the pre-test calibration coefficients for a particular critical orifice violates the acceptance criteria, the critical orifice in question would be replaced and calibrated.

4.2 Thermocouples and Thermocouple Readouts

All thermocouples used during the stack sampling tests were calibrated to ensure accurate temperature measurements. All the sensors utilized were type "K" thermocouples, which have a working range of approximately -300 °F to approximately 2,500 °F. These sensors were used in the measurement of stack gas temperature, probe temperature, filter box temperature, and impinger train outlet temperature. The thermocouples were calibrated against an NIST traceable, mercury-in-glass thermometer at predetermined temperatures, using a single recently calibrated thermocouple readout.

The thermocouple readout contained in the control console used during the testing was calibrated using a thermocouple temperature simulator. This calibration apparatus generates a voltage signal that mimics the signal an ideal "K" type thermocouple would exhibit at a particular temperature. The signal can be changed via a slide switch. The readout was calibrated at 10 different points from 200 °F through 2,000 °F, at increments of 200 °F.

4.3 Barometer

The field barometer used during the test was an electronic barometer. This barometer was calibrated by comparing it to a NIST traceable electronic barometer and adjusting it if any deviation existed between it and the standard. This exercise was performed both before and after the testing activities.

4.4 Analytical Balance

The field analytical balance that was used to weigh the impingers was checked before building and recovering the sample trains using certified standard weights.

4.5 Pitot Tubes

To ensure accurate measurements of the exhaust gas flow, the S-type Pitot tubes used during the compliance testing were calibrated by the manufacturer using geometric consideration. The basis for the calibration is described in 40 CFR 60, Appendix A, Method 2.

4.6 Continuous Emission Monitors

The reference method CEMs were calibrated with EPA-approved RATA Class calibration gases prior to the beginning of the test series and after each compliance test run. The initial calibration error checks were performed at the beginning of the test run series in accordance with the specific reference method applicable to the analyzer. After the successful completion of the initial calibration error check, a system bias check was performed.

Zero, mid, and high point calibration bias checks were performed prior to the beginning of the compliance test runs. The bias check is a comparison of instrument response to gas introduced into the analyzer with gases routed throughout the entire sampling system. The maximum allowable bias is 5% of the span. After the bias check was performed, the analyzers were not adjusted during the compliance tests, unless an analyzer failed the drift check. No analyzers failed the drift check.

The drift checks were performed on each analyzer by introducing the mid-range calibration gas and the zero nitrogen. The maximum allowable calibration drift is 3% of the span. Calibration drift was determined by comparing the before run and after run values. The test data values were corrected for bias and calibration drift. The following calculation, as cited in the reference method, was used to correct the measured concentrations for bias and instrument calibration drifts:

$$C_{gas} = (C_{anz} - C_o)\frac{C_{ma}}{(C_m - C_o)}$$

Where:

C_{gas} = effluent gas concentration, dry basis, ppmv;
C_{anz} = average gas concentration indicated by the gas analyzer, dry basis, ppmv;
C_o = average of initial and final system calibration bias check responses for the zero gas, ppmv;
C_m = average of initial and final system calibration bias check responses for the upscale calibration gas, ppmv;
C_{ma} = actual concentration of the upscale calibration gas, ppmv.

Response time tests were performed in conjunction with the bias checks. The response time test was performed by measuring the time it took for each analyzer to reach 95% of the concentration of the high range calibration gas. The zero gas was then introduced into the sample system, and the amount of time it took for the analyzer to reach a 95% reduction in scale reading was measured. The greater of these two readings was recorded as the response time for that analyzer.

APPENDIX A

Coal Charging Information for 6/29/15 Stack Testing

Time Period	Production Day	Stack Test(s) Conducted	Coal Charged during Shift (tons)	Coal moisture content	Ovens charged during production period	Specific Ovens charged while Main Stack sampling was occurring	# of Ovens Charged during Testing	Wet Coal Charged during Testing (tons)	Dry Coal Charged during Testing (tons)
6/27 1900 hours to 6/28 1859 hours	6/28/2015	Main Stack	2,388.6	10.12%	Evens	N/A	N/A	N/A	N/A
6/28 1900 hours to 6/29 1859 hours	6/29/2015	Main Stack	2,350.4	9.14%	Odds	N/A	N/A	N/A	N/A
6/29 1900 hours to 6/30 1859 hours	6/30/2015	Main Stack	2,375.1	9.78%	Evens	8, 14, 20, 26, 32, 38, 44	7	334.51	301.8

Average Daily Charging per day during test period	**2,371.4**	**tons/day**
Average Tons Charged per Oven (50 ovens/day)	**47.4**	**tons/oven**

Suncoke Middletown Operations
Main Stack Baghouse Operating Data

Slurry flow	Date	GPM
Test Run #1	6/29/15 17:00	18.3
	6/29/15 17:15	17.3
	6/29/15 17:30	15.9
	6/29/15 17:45	18
Test Run #2	6/29/2015 18:20	16.9
	6/29/2015 18:35	16.8
	6/29/2015 18:50	16.6
	6/29/2015 19:05	16
Test Run #3	6/29/15 19:45	19.8
	6/29/15 20:00	19.7
	6/29/15 20:15	19.5
	6/29/15 20:30	21.2

Baghouse DP	Date	INWC
	6/29/15 17:00	7.9
	6/29/15 17:15	8
	6/29/15 17:30	7.9
	6/29/15 17:45	7.4
	6/29/2015 18:20	7.7
	6/29/2015 18:35	7.8
	6/29/2015 18:50	8
	6/29/2015 19:05	8
	6/29/15 19:45	7.9
	6/29/15 20:00	8
	6/29/15 20:15	7.9
	6/29/15 20:30	7.4

APPENDIX B

CALIBRATION ADJUSTED CEM TEST DATA

for

Plant Name: Suncoke - MTO

Location: Main Stack

Date	Time	Run #	NOx, ppmv (dry)	CO2, Vol% (dry)	O2, Vol % (dry)
			CEC RM	CEC RM	CEC RM
29-Jun-15	1700 - 1800	1	63.44	9.21	7.56
29-Jun-15	1820 - 1920	2	64.04	8.87	8.18
29-Jun-15	1940 - 2040	3	66.11	9.09	7.79
Average:			64.53	9.05	7.84

Civil & Environmental Consultants, Inc.

Gaseous Mass Emission Calculations

Project Name: SunCoke MTO

Project No.: 151-733

Test Date: 6/29/2015

INPUT PARAMETERS

Test I.D.	NOx Conc. (ppm)	Flow Rate (dscfm)	NOx Mass Rate (lb/hr)
1	63.44	219,392	99.785
2	64.04	213,155	97.866
3	66.11	216,544	102.635
Average	64.53	216,364	100.10

Mass Rate (lb/hr)

MR= (ppm)(mw constant)(Qstd(60)

Mn= grams/sample
Qstd= stack gas flow rate (dscfm)
mw constant for NOx - 1.1949×10^{-7}

SunCoke Middletown Operations

Main Stack NO_x Emission Rate Calculations
Based on plant production rates

ovens charged per shift	50			
	6/28/2015	6/29/2015	6/30/2015	Average
wet coal charged per shift (24 hrs)	2388.6	2350.4	2375.1	2371.4
tons wet coal / oven	47.8	47.0	47.5	
tons wet coal / hour per day	2.0	2.0	2.0	
	Run - 1	Run - 2	Run - 3	Average
NOx Emission Rate (lb/hr)	99.99	98.12	102.83	100.31

NOx Emission Rate (lb/ton coal) =

$$\frac{\text{NOx (lb/hr) x 24 hrs/day}}{\text{tons wet coal/day}} = \text{lb/ton coal}$$

Run - 1 =	1.012	lb/ton coal
Run - 2 =	0.993	lb/ton coal
Run - 3 =	1.041	lb/ton coal
Average =	1.015	lb/ton coal

CEM Raw Data

Suncoke - MTO
NOx Compliance Test
Raw Data
Run - 1

	CEC Air Group	CEC Air Group	CEC Air Group
	O2	CO2	NOX
Date	PERCENT	PERCENT	PPM
6/29/2015 17:00	7.44	9.12	68.21
6/29/2015 17:01	7.41	9.13	67.964
6/29/2015 17:02	7.4	9.14	68.103
6/29/2015 17:03	7.4	9.16	67.801
6/29/2015 17:04	7.42	9.16	67.926
6/29/2015 17:05	7.44	9.16	68.29
6/29/2015 17:06	7.43	9.15	68.181
6/29/2015 17:07	7.42	9.14	67.098
6/29/2015 17:08	7.42	9.14	66.535
6/29/2015 17:09	7.43	9.13	66.802
6/29/2015 17:10	7.45	9.12	66.884
6/29/2015 17:11	7.46	9.16	66.673
6/29/2015 17:12	7.47	9.13	66.637
6/29/2015 17:13	7.48	9.1	66.667
6/29/2015 17:14	7.51	9.12	67.043
6/29/2015 17:15	7.54	9.14	67.454
6/29/2015 17:16	7.58	9.04	67.74
6/29/2015 17:17	7.54	9.05	67.357
6/29/2015 17:18	7.5	9.11	66.89
6/29/2015 17:19	7.49	9.15	66.371
6/29/2015 17:20	7.47	9.15	66.022
6/29/2015 17:21	7.49	9.14	65.684
6/29/2015 17:22	7.51	9.1	65.723
6/29/2015 17:23	7.53	9.08	65.58
6/29/2015 17:24	7.53	9.1	65.617
6/29/2015 17:25	7.54	9.14	65.848
6/29/2015 17:26	7.55	9.11	65.607
6/29/2015 17:27	7.56	9.09	65.553
6/29/2015 17:28	7.56	9.1	65.4
6/29/2015 17:29	7.56	9.09	65.275
6/29/2015 17:30	7.55	9.07	65.331
6/29/2015 17:31	7.54	9.08	65.577
6/29/2015 17:32	7.55	9.08	65.476
6/29/2015 17:33	7.56	9.09	65.213
6/29/2015 17:34	7.6	9.07	65.402
6/29/2015 17:35	7.63	9.03	65.469
6/29/2015 17:36	7.63	9.03	66.099
6/29/2015 17:37	7.64	8.99	66.142
6/29/2015 17:38	7.64	8.99	66.814
6/29/2015 17:39	7.64	8.98	67.784
6/29/2015 17:40	7.64	9.02	67.293
6/29/2015 17:41	7.64	9.01	66.646
6/29/2015 17:42	7.67	9.01	66.561
6/29/2015 17:43	7.66	8.98	66.282
6/29/2015 17:44	7.66	9.03	66.26
6/29/2015 17:45	8.11	8.99	66.361
6/29/2015 17:46	7.97	8.68	66.21
6/29/2015 17:47	7.72	8.81	65.34
6/29/2015 17:48	7.72	8.95	69.447
6/29/2015 17:49	7.7	8.99	70.031
6/29/2015 17:50	7.69	8.98	69.289
6/29/2015 17:51	7.69	8.97	69.106
6/29/2015 17:52	7.7	8.96	69.092
6/29/2015 17:53	7.72	8.94	69.315
6/29/2015 17:54	7.73	8.96	69.27
6/29/2015 17:55	7.74	8.93	68.821
6/29/2015 17:56	7.74	8.94	68.683
6/29/2015 17:57	7.74	8.97	68.544
6/29/2015 17:58	7.74	8.95	68.169
6/29/2015 17:59	7.77	8.93	68.199
AVERAGE	**7.59**	**9.05**	**67.02**

Suncoke - MTO
NOx Compliance Test
Raw Data
RUN - 2

	CEC Air Group	CEC Air Group	CEC Air Group
	CO2	NOX	O2
Date	PERCENT	PPM	PERCENT
6/29/2015 18:20	8.83	63.183	7.97
6/29/2015 18:21	8.82	63.525	7.98
6/29/2015 18:22	8.82	63.758	8
6/29/2015 18:23	8.83	63.912	8
6/29/2015 18:24	8.8	63.692	8
6/29/2015 18:25	8.78	63.506	7.99
6/29/2015 18:26	8.8	63.518	8
6/29/2015 18:27	8.83	63.141	7.98
6/29/2015 18:28	8.82	62.952	7.98
6/29/2015 18:29	8.81	62.699	8.03
6/29/2015 18:30	8.76	63.022	8.04
6/29/2015 18:31	8.74	63.307	8.06
6/29/2015 18:32	8.74	63.271	8.08
6/29/2015 18:33	8.75	63.666	8.08
6/29/2015 18:34	8.72	63.847	8.08
6/29/2015 18:35	8.74	63.916	8.07
6/29/2015 18:36	8.74	63.656	8.07
6/29/2015 18:37	8.77	63.925	8.05
6/29/2015 18:38	8.8	64.256	8.07
6/29/2015 18:39	8.74	64.175	8.06
6/29/2015 18:40	8.78	64.078	8.08
6/29/2015 18:41	8.76	63.753	8.09
6/29/2015 18:42	8.74	63.501	8.1
6/29/2015 18:43	8.7	63.333	8.11
6/29/2015 18:44	8.72	63.376	8.13
6/29/2015 18:45	8.72	63.543	8.16
6/29/2015 18:46	8.69	63.97	8.15
6/29/2015 18:47	8.67	64.115	8.14
6/29/2015 18:48	8.71	64.126	8.16
6/29/2015 18:49	8.71	63.732	8.18
6/29/2015 18:50	8.71	63.725	8.2
6/29/2015 18:51	8.65	63.568	8.19
6/29/2015 18:52	8.68	63.695	8.18
6/29/2015 18:53	8.68	63.294	8.2
6/29/2015 18:54	8.65	63.568	8.22
6/29/2015 18:55	8.64	63.727	8.25
6/29/2015 18:56	8.63	63.849	8.26
6/29/2015 18:57	8.62	64.069	8.28
6/29/2015 18:58	8.64	64.102	8.32
6/29/2015 18:59	8.61	64.183	8.32
6/29/2015 19:00	8.58	64.128	8.31
6/29/2015 19:01	8.62	63.798	8.32
6/29/2015 19:02	8.6	64.02	8.34
6/29/2015 19:03	8.6	64.064	8.33
6/29/2015 19:04	8.59	63.855	8.34
6/29/2015 19:05	8.56	63.79	8.37
6/29/2015 19:06	8.57	64.042	8.39
6/29/2015 19:07	8.57	64.174	8.4
6/29/2015 19:08	8.55	64.256	8.39
6/29/2015 19:09	8.54	64.364	8.39
6/29/2015 19:10	8.55	64.249	8.41
6/29/2015 19:11	8.55	64.426	8.4
6/29/2015 19:12	8.56	64.379	8.39
6/29/2015 19:13	8.56	64.171	8.42
6/29/2015 19:14	8.54	64.143	8.42
6/29/2015 19:15	8.51	64.173	8.42
6/29/2015 19:16	8.54	64.293	8.43
6/29/2015 19:17	8.52	64.169	8.45
6/29/2015 19:18	8.55	64.171	8.46
6/29/2015 19:19	8.5	64.538	8.47
6/29/2015 19:20	8.53	65.857	8.46
AVERAGE	**8.67**	**63.86**	**8.21**

Suncoke - MTO
NOx Compliance Test
Raw Data
RUN - 3

	CEC Air Group	CEC Air Group	CEC Air Group
	O2	NOX	CO2
Date	PERCENT	PPM	PERCENT
6/29/2015 19:40	8.34	63.77	8.66
6/29/2015 19:41	8.28	63.966	8.54
6/29/2015 19:42	8.2	64.649	8.61
6/29/2015 19:43	8.1	65.148	8.67
6/29/2015 19:44	7.99	65.054	8.73
6/29/2015 19:45	7.96	65.982	8.79
6/29/2015 19:46	8.04	66.332	8.8
6/29/2015 19:47	8.11	65.552	8.74
6/29/2015 19:48	8.15	64.612	8.73
6/29/2015 19:49	8.13	63.993	8.71
6/29/2015 19:50	8.06	64.565	8.7
6/29/2015 19:51	7.99	65.195	8.74
6/29/2015 19:52	7.87	65.325	8.82
6/29/2015 19:53	7.83	65.37	8.86
6/29/2015 19:54	7.9	65.315	8.89
6/29/2015 19:55	7.93	64.28	8.88
6/29/2015 19:56	7.94	62.768	8.83
6/29/2015 19:57	7.88	62.649	8.84
6/29/2015 19:58	7.75	63.475	8.9
6/29/2015 19:59	7.64	63.85	8.97
6/29/2015 20:00	7.56	64.35	9.02
6/29/2015 20:01	7.6	65.304	9.1
6/29/2015 20:02	7.63	65.471	9.05
6/29/2015 20:03	7.64	65.381	9.02
6/29/2015 20:04	7.66	65.486	8.97
6/29/2015 20:05	7.7	65.31	8.97
6/29/2015 20:06	7.72	65.215	8.95
6/29/2015 20:07	7.75	65.227	8.93
6/29/2015 20:08	7.78	65.032	8.93
6/29/2015 20:09	7.82	65.059	8.91
6/29/2015 20:10	7.84	65.357	8.89
6/29/2015 20:11	7.93	65.474	8.85
6/29/2015 20:12	8	65.385	8.8
6/29/2015 20:13	8.03	64.502	8.74
6/29/2015 20:14	8	64.184	8.72
6/29/2015 20:15	7.93	64.735	8.74
6/29/2015 20:16	7.83	65.552	8.79
6/29/2015 20:17	7.72	65.81	8.86
6/29/2015 20:18	7.66	66.728	8.96
6/29/2015 20:19	7.7	68.072	9
6/29/2015 20:20	7.71	67.14	8.96
6/29/2015 20:21	7.72	65.939	8.95
6/29/2015 20:22	7.75	66.146	8.91
6/29/2015 20:23	7.81	66.132	8.9
6/29/2015 20:24	7.89	66.055	8.85
6/29/2015 20:25	7.93	65.48	8.8
6/29/2015 20:26	7.91	65.192	8.8
6/29/2015 20:27	7.86	65.652	8.82
6/29/2015 20:28	7.79	66.271	8.8
6/29/2015 20:29	7.64	68.161	8.9
6/29/2015 20:30	7.6	69.859	9
6/29/2015 20:31	7.65	70.793	8.99
6/29/2015 20:32	7.7	69.972	8.99
6/29/2015 20:33	7.75	68.639	8.95
6/29/2015 20:34	7.73	67.35	8.94
6/29/2015 20:35	7.68	67.475	8.93
6/29/2015 20:36	7.6	68.355	8.98
6/29/2015 20:37	7.48	68.691	9
6/29/2015 20:38	7.37	68.859	9.09
6/29/2015 20:39	7.37	69.275	9.21
6/29/2015 20:40	7.45	68.731	9.17
AVERAGE	**7.82**	**65.90**	**8.88**

APPENDIX C

Probe/Pitot Tube Traverse Layout Calculation Spreadsheet

Stack/duct inside diameter (inches)	156
Required number of traverse points (stack to	24
Req. traverse points on a diameter	12
Port Length (inches)	6
Number of Ports	4

Project: **SunCoke - Middletown**
Test Location: **Main Stack**
Date: **4/16/2012**

Location of Traverse Point (Measured from Outside Edge of Sample Port)

Traverse Point number on a diameter	2	4	6	8	10	12	14	16	18	20	22	24
1						9.28						
2						16.45						
3						24.41						
4						33.61						
5						45.00						
6						61.54						
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												

Stack Gas Flow
Run - 1

EPA M2/M4 DATA SHEET

Project Name: Suncoke - MTO | Test No.: 1 | Stack Dimensions: 156"

Project No.: 151-733.0002 | Location: Main Stack | Barometric Pressure: 28.26 in. Hg

Date: 6-29-15 | Personnel: MM, JM | Static Pressure: -0.60 in. H_2O

M2 Test Time : Start : 17:35 Stop : 19:00

VELOCITY TRAVERSE

TRAVERSE POINT	VELOCITY PRESSURE (ΔP)	STACK TEMP.
1	0.53	238
2	0.55	239
3	0.57	240
4	0.55	240
5	0.48	242
6	0.40	243
7	0.46	244
8	0.51	247
9	0.54	250
10	0.55	251
11	0.49	252
12	0.35	251
13	0.40	249
14	0.43	251
15	0.50	253
16	0.53	254
17	0.50	254
18	0.35	253
19	0.42	243
20	0.47	245
21	0.50	247
22	0.50	249
23	0.46	251
24	0.43	251
Average		

IMPINGER WEIGHTS

Impinger	Initial Wt.	Final Wt.	Total
1	712.9	760.5	47.6
2	662.7	648.4	-14.3
3	597.6	608.3	10.7
4	773.2	777.7	4.5
Total	2746.4	2794.9	48.5

PITOT LEAK CHECK (> 3")

INITIAL	(+) ✓	(-) ✓
FINAL	(+) ✓	(-) ✓

TRAIN LEAK CHECK (ft^3 @ in, Hg.)

INITIAL	0.0 @ 10
FINAL	0.6 @ 5

MOISTURE TRAIN

SAMPLING TIME Clock	SAMPLING TIME Sample	DRY GAS METER	DGM TEMP.	LAST IMPINGER TEMP.	TRAIN VACUUM
17:35	0	265.845	70	63	2
	5	268.90	71	60	2
	10	272.80	71	58	2
	15	275.40	72	60	2
17:55	20	277.855			
		12.010			

M4 Sample Train I.D. : 1 | O2%: 7.9 | CO2%: 9.0

Control Console I.D.: 4 | ΔH@: 1.7374 | Y: 1.0075

Pitot Tube Type: S | I.D. No.: 6-001 | Coefficient: 0.84

Manometer Type: Oil Incl. | I.D. No.: 4

Thermometer Type: K | I.D. No.: 6.001

NOTES: 16.9% H_2O 374,850 ACFM

219,392 DSCFM

Stack Gas Moisture Test

Project: Suncoke - MTO
Project Number: 151-733
Test Location: Main Stack
Test Number: Run 1
Test Date: 6/29/2015

INPUT PARAMETERS

Volume of water Collected, Vl_o (ml)	48.5	ml
Volume measured by dry gas meter (Vm), ft^3	12.01	ft^3
Delta H, in. H_2O	0.900	in. H_2O
Gamma, γ	1.008	
Barometric Pressure (Pb), in. Hg.	28.26	in. Hg
Temperature of the meter box (Tm), °F	71	°F

Impinger Weights

	Initial	Final	Net Gain
	712.9	760.5	47.6
	662.7	648.4	-14.3
	597.6	608.3	10.7
	773.2	777.7	4.5
Total	2746.4	2794.9	48.5

SAMPLING CALCULATIONS

Volume of Water Collected

Vwstd = (Vl0)(0.04707)
Vwstd = (48.5) * (0.04707)
Vwstd = 2.28 ft^3

Volume of Gas Metered, Standard Conditions

Vmstd = ((17.65) (V_m)(P_b + ΔH/13.6)(Y)/Tm
Vmstd = ((17.65) * (12.01) * (28.26 + (0.9000/13.6)) * (1.0080) / (530.60)
Vmstd = 11.41 ft^3

Moisture Content

Bwo = Vwstd/(Vmstd + Vwstd)
Bwo = 2.28 / (11.40 + 2.28)
Bwo = 0.167

MOISTURE TEST RESULTS

Vol. Sampled at STP (ft^3)	11.40
Moisture Content (% Vol)	16.68%

VELOCITY TRAVERSE CALCULATION SHEET

Client :	Suncoke MTO	**Date :**	6/29/2015
Project Number :	151-733	**Test I.D. :**	CEM Run 1
Source :	Main Stack	**Test Team:**	MM, JM

INPUT PARAMETERS

Barometric Pressure (Pb), in.Hg.	28.26 in, Hg
Avg. Percent CO2	9.0 %
Avg. Percent O2	7.9 %
Avg. Percent CO	0.0 %
Avg. Percent N2	83.1 %
Average Square Root of Delta P	0.6898 in. H_2O
Average Stack Temperature, (T_s)	247 (^oF)
Static Pressure	-0.60 in. H_2O
Stack Diameter	156.00 inches
Pressure in the stack, (P_s)	28.22 in Hg
Stack area, (A_s)	132.73 ft^2
Pitot Tube Coeffiecent , (C_p)	0.840
Average Percent Moisture, (B_{wo})	16.68%

Point No.	Delta P	Sq. Root Delta P	Stack Temp (F)
1	0.53	0.7280	238
2	0.55	0.7416	239
3	0.57	0.7550	240
4	0.55	0.7416	240
5	0.48	0.6928	242
6	0.40	0.6325	243
7	0.46	0.6782	244
8	0.51	0.7141	247
9	0.54	0.7348	250
10	0.55	0.7416	251
11	0.49	0.7000	252
12	0.35	0.5916	251
13	0.40	0.6325	249
14	0.43	0.6557	251
15	0.50	0.7071	253
16	0.53	0.7280	254
17	0.50	0.7071	254
16	0.35	0.5916	253
19	0.42	0.6481	243
20	0.47	0.6856	245
21	0.50	0.7071	247
22	0.50	0.7071	249
23	0.46	0.6782	251
24	0.43	0.6557	251
Average	**0.4779**	**0.6898**	**247.4**

VELOCITY CALCULATIONS

Molecular Weight of the Dry Gas Stream

$Md = (.44)(\%CO_2) + (.32)(\%O_2) + (.28)(\%CO + \%N_2)$

Md = (0.44)*(9.00) + (0.32)*(7.90) + (0.28)*(83.10)

Md = 29.76 lb/lbmol

Molecular Weight of Stack Gas

Ms = (Md)(1-Bwo) + 18(Bwo)

Ms = (29.76) * (1-0.167) + (18) * (0.167)

Ms = 27.80 lb/lbmol

Velocity of Stack Gas

$Vs = 85.49 * 60 * Cp * (\Delta P)^{0.5} * [(Ts+460)/Ps/Ms]^{0.5}$

Vs = 85.49 * 60 *(0.84) * (0.6898) * sqrt {[(707.38)/(28.22)/(27.80)]}

Vs = 2,822.8 ft/min

Total Flow of Stack Gas

Qa = As * Vs

Qa = (132.7322) * (2,822.8)

Qa = 374,675.7 ACFM

Qs = Qa * 528/Ts * Ps/29.92

Qs = (374,675.7) * (528/707.0) * (28.22/29.92)

Qs = 263,886.7 SCFM

Qstd = Qs * (1 - Bwo)

Qstd = (263,886.7) * (1-0.167)

Qstd = 219,870.4 DSCFM

VELOCITY TRAVERSE TEST RESULTS

Stack Gas Temperature (°F)	247	Stack Velocity (ft/min)	2,822.8
Moisture Content (% Vol.)	16.68%	Gas Flow Rate (ACFM)	374,676
CO_2 (% Vol.)	9.0	Gas Flow Rate (SCFM)	263,887
O_2 (% Vol.)	7.9	Gas Flow Rate (DSCFM)	219,870

Stack Gas Flow
Run - 2

EPA M2/M4 DATA SHEET

Project Name: Suncoke - MTO **Test No.:** 2 **Stack Dimensions:** 156"

Project No.: 151-733.0002 **Location:** Main Stack **Barometric Pressure:** 28.26 in. Hg

Date: 6-29-15 **Personnel:** MM, JM **Static Pressure:** -0.60 in. H_2O

M2 Test Time : **Start :** 18:20 **Stop :**

VELOCITY TRAVERSE

TRAVERSE POINT	VELOCITY PRESSURE (ΔP)	STACK TEMP.
1	0.52	236
2	0.51	239
3	0.51	241
4	0.51	244
5	0.47	245
6	0.38	243
7	0.46	242
8	0.48	243
9	0.51	246
10	0.51	248
11	0.48	249
12	0.42	248
13	0.50	248
14	0.52	250
15	0.56	252
16	0.56	253
17	0.50	253
18	0.38	253
19	0.46	249
20	0.49	251
21	0.51	251
22	0.52	252
23	0.49	253
24	0.39	253
Average	0.485	247.6

IMPINGER WEIGHTS

Impinger	Initial Wt.	Final Wt.	Total
1	694.6	757.2	62.6
2	668.8	653.4	-15.4
3	598.2	611.8	13.6
4	748.3	752.1	3.8
Total	2709.9	2774.5	64.6

PITOT LEAK CHECK (> 3")

INITIAL	(+) ✓	(-) ✓
FINAL	(+) ✓	(-) ✓

TRAIN LEAK CHECK (ft^3 @ in, Hg.)

INITIAL	0.0	@ 10
FINAL	0.0	@ 5

MOISTURE TRAIN

SAMPLING TIME Clock	SAMPLING TIME Sample	DRY GAS METER	DGM TEMP.	LAST IMPINGER TEMP.	TRAIN VACUUM
18:25	0	278.000	71	62	2
	5	281.40	71	61	2
	10	285.00	71	61	2
	15	288.00	71	58	2
18:45	20	290.560			
		12.560			

M4 Sample Train I.D. : 2 **O2%:** 8.16 **CO2%:** 8.7

Control Console I.D.: 4 **ΔH@:** 1.7374 **Y:** 1.0077

Pitot Tube Type: S **I.D. No.:** 6-001 **Coefficient:** 0.84

Manometer Type: Oil Incl. **I.D. No.:** 4

Thermometer Type: K **I.D. No.:** 6-001

NOTES: % H_2O - 20.58 381,181 acfm
213,155 dscfm

Stack Gas Moisture Test

Project: Suncoke - MTO
Project Number: 151-733
Test Location: Main Stack
Test Number: Run 2
Test Date: 6/29/2015

INPUT PARAMETERS

Volume of water Collected, Vl_o (ml)	64.6	ml
Volume measured by dry gas meter (Vm), ft^3	12.56	ft^3
Delta H, in. H_2O	0.900	in. H_2O
Gamma	1.008	
Barometric Pressure (Pb), in. Hg.	28.26	in. Hg
Temperature of the meter box (Tm), °F	70	°F

Impinger Weights

	Initial	Final	Net Gain
	694.6	757.2	62.6
	668.8	653.4	-15.4
	598.2	611.8	13.6
	748.3	752.1	3.8
Total	2709.9	2774.5	64.6

SAMPLING CALCULATIONS

Volume of Water Collected

Vwstd = (Vl0)(0.04707)
Vwstd = (64.6) * (0.04707)
Vwstd = 3.04 ft^3

Volume of Gas Metered, Standard Conditions

Vmstd = ((17.65) (V_m)(P_b + ΔH/13.6)(Y)/Tm
Vmstd = ((17.65) * (12.56) * (28.26 + (0.9000/13.6)) * (1.0080) / (529.60)
Vmstd = 11.95 ft^3

Moisture Content

Bwo = Vwstd/(Vmstd + Vwstd)
Bwo = 3.04 / (11.95 + 3.04)
Bwo = 0.203

MOISTURE TEST RESULTS

Vol. Sampled at STP (ft^3)	11.95
Moisture Content (% Vol)	20.29%

VELOCITY TRAVERSE CALCULATION SHEET

Client :	Suncoke MTO	**Date :**	6/29/2015
Project Number :	151-733	**Test I.D. :**	CEM Run 2
Source :	Main Stack	**Test Team:**	MM, JM

INPUT PARAMETERS

Barometric Pressure (Pb), in.Hg.	28.26	in, Hg
Avg. Percent CO2	8.7	%
Avg. Percent O2	8.2	%
Avg. Percent CO	0.0	%
Avg. Percent N2	83.1	%
Average Square Root of Delta P	0.6955	in. H_2O
Average Stack Temperature, (T_s)	248	(^oF)
Static Pressure	-0.60	in. H_2O
Stack Diameter	156.00	inches
Pressure in the stack, (P_s)	28.22	in Hg
Stack area, (A_s)	132.73	ft^2
Pitot Tube Coeffiecent , (C_p)	0.840	
Average Percent Moisture, (B_{wo})	20.29%	

Point No.	Delta P	Sq. Root Delta P	Stack Temp (F)
1	0.52	0.7211	236
2	0.51	0.7141	239
3	0.51	0.7141	241
4	0.51	0.7141	244
5	0.47	0.6856	245
6	0.38	0.6164	243
7	0.46	0.6782	242
8	0.48	0.6928	243
9	0.51	0.7141	246
10	0.51	0.7141	248
11	0.48	0.6928	249
12	0.42	0.6481	248
13	0.50	0.7071	248
14	0.52	0.7211	250
15	0.56	0.7483	252
16	0.56	0.7483	253
17	0.50	0.7071	253
16	0.38	0.6164	253
19	0.46	0.6782	249
20	0.49	0.7000	251
21	0.51	0.7141	251
22	0.52	0.7211	252
23	0.49	0.7000	253
24	0.39	0.6245	253
Average	**0.4850**	**0.6955**	**247.6**

VELOCITY CALCULATIONS

Molecular Weight of the Dry Gas Stream

$Md = (.44)(\%CO_2) + (.32)(\%O_2) + (.28)(\%CO + \%N_2)$

Md = (0.44)*(8.70) + (0.32)*(8.16) + (0.28)*(83.14)

Md = 29.72 lb/lbmol

Molecular Weight of Stack Gas

Ms = (Md)(1-Bwo) + 18(Bwo)

Ms = (29.72) * (1-0.203) + (18) * (0.203)

Ms = 27.34 lb/lbmol

Velocity of Stack Gas

$Vs = 85.49 * 60 * Cp * (\Delta P)^{0.5} * [(Ts+460)/Ps/Ms]^{0.5}$

Vs = 85.49 * 60 *(0.84) * (0.6955) * sqrt {[(707.58)/(28.22)/(27.34)]}

Vs = 2,870.0 ft/min

Total Flow of Stack Gas

Qa = As * Vs

Qa = (132.7322) * (2,870.0)

Qa = 380,944.0 ACFM

Qs = Qa * 528/Ts * Ps/29.92

Qs = (380,944.0) * (528/707.2) * (28.22/29.92)

Qs = 268,222.4 SCFM

Qstd = Qs * (1 - Bwo)

Qstd = (268,222.4) * (1-0.203)

Qstd = 213,800.1 DSCFM

VELOCITY TRAVERSE TEST RESULTS

Stack Gas Temperature (°F)	248	Stack Velocity (ft/min)	2,870.0
Moisture Content (% Vol.)	20.29%	Gas Flow Rate (ACFM)	380,944
CO_2 (% Vol.)	8.7	Gas Flow Rate (SCFM)	268,222
O_2 (% Vol.)	8.2	Gas Flow Rate (DSCFM)	213,800

Stack Gas Flow
Run - 3

EPA M2/M4 DATA SHEET

Project Name: Suncoke - MTO | Test No.: 3 | Stack Dimensions: 156"

Project No.: 151-733.0002 | Location: Main Stack | Barometric Pressure: 28.26 in. Hg

Date: 6-29-15 | Personnel: MM, JM | Static Pressure: -0.60 in. H_2O

M2 Test Time : Start : 19:40 Stop : _____

VELOCITY TRAVERSE

TRAVERSE POINT	VELOCITY PRESSURE (ΔP)	STACK TEMP.
1	0.52	256
2	0.52	256
3	0.53	256
4	0.53	256
5	0.47	256
6	0.43	255
7	0.46	249
8	0.49	251
9	0.52	252
10	0.52	254
11	0.47	254
12	0.38	254
13	0.52	249
14	0.57	253
15	0.59	254
16	0.57	254
17	0.52	255
18	0.34	252
19	0.51	239
20	0.53	242
21	0.55	245
22	0.55	248
23	0.49	250
24	0.37	251
Average	0.4979	251.7

IMPINGER WEIGHTS

Impinger	Initial Wt.	Final Wt.	Total
1	687.8	753.8	66.0
2	663.4	666.1	2.7
3	597.3	598.8	1.5
4	765.6	770.4	4.8
Total	2714.1	2789.1	75.0

PITOT LEAK CHECK (> 3")

INITIAL	(+) ✓	(-) ✓
FINAL	(+) ✓	(-) ✓

TRAIN LEAK CHECK (ft^3 @ in, Hg.)

INITIAL	0.0	@ 10
FINAL	0.0	@ 5

MOISTURE TRAIN

SAMPLING TIME Clock	SAMPLING TIME Sample	DRY GAS METER	DGM TEMP.	LAST IMPINGER TEMP.	TRAIN VACUUM
19:40	0	290.700	70	64	2
	5	293.600	70	60	2
	10	297.70	70	60	2
	15	301.00	70	61	2
20:00	20	305.850			
		15.150			

M4 Sample Train I.D. : 3 | O2%: 7.9 | CO2%: 8.8

Control Console I.D.: 4 | ΔH@: 1.7374 | Y: 1.0077

Pitot Tube Type: S | I.D. No.: G-001 | Coefficient: 0.84

Manometer Type: Oil Incl. | I.D. No.: 4

Thermometer Type: K | I.D. No.: G-001

NOTES: % H_2O - 19.96 386,483 acfm

216,544 dscfm

Stack Gas Moisture Test

Project: Suncoke - MTO
Project Number: 151-733
Test Location: Main Stack
Test Number: Run 3
Test Date: 6/29/2015

INPUT PARAMETERS

Volume of water Collected, Vl_o (ml)	75	ml
Volume measured by dry gas meter (Vm), ft^3	15.15	ft^3
Delta H, in. H_2O	0.900	in. H_2O
Gamma	1.008	
Barometric Pressure (Pb), in. Hg.	28.26	in. Hg
Temperature of the meter box (Tm), °F	71	°F

Impinger Weights

	Initial	Final	Net Gain
	687.8	753.8	66
	663.4	666.1	2.7
	597.3	598.8	1.5
	765.6	770.4	4.8
Total	2714.1	2789.1	75

SAMPLING CALCULATIONS

Volume of Water Collected

Vwstd = (Vl0)(0.04707)
Vwstd = (75.0) * (0.04707)
Vwstd = 3.53 ft^3

Volume of Gas Metered, Standard Conditions

Vmstd = ((17.65) (V_m)(P_b + ΔH/13.6)(Y)/Tm
Vmstd = ((17.65) * (15.15) * (28.26 + (0.9000/13.6)) * (1.0080) / (530.60)
Vmstd = 14.39 ft^3

Moisture Content

Bwo = Vwstd/(Vmstd + Vwstd)
Bwo = 3.53 / (14.38 + 3.53)
Bwo = 0.197

MOISTURE TEST RESULTS

Vol. Sampled at STP (ft^3)	14.38
Moisture Content (% Vol)	19.71%

VELOCITY TRAVERSE CALCULATION SHEET

Client :	Suncoke MTO	**Date :**	6/29/2015
Project Number :	151-733	**Test I.D. :**	CEM Run 3
Source :	Main Stack	**Test Team:**	MM, JM

INPUT PARAMETERS

Barometric Pressure (Pb), in.Hg.	28.26 in, Hg
Avg. Percent CO2	8.8 %
Avg. Percent O2	7.9 %
Avg. Percent CO	0.0 %
Avg. Percent N2	83.3 %
Average Square Root of Delta P	0.7041 in. H_2O
Average Stack Temperature, (T_s)	252 (^oF)
Static Pressure	-0.60 in. H_2O
Stack Diameter	156.00 inches
Pressure in the stack, (P_s)	28.22 in Hg
Stack area, (A_s)	132.73 ft^2
Pitot Tube Coeffiecent , (C_p)	0.840
Average Percent Moisture, (B_{wo})	19.71%

Point No.	Delta P	Sq. Root Delta P	Stack Temp (F)
1	0.52	0.7211	256
2	0.52	0.7211	256
3	0.53	0.7280	256
4	0.53	0.7280	256
5	0.47	0.6856	256
6	0.43	0.6557	255
7	0.46	0.6782	249
8	0.49	0.7000	251
9	0.52	0.7211	252
10	0.52	0.7211	254
11	0.47	0.6856	254
12	0.38	0.6164	254
13	0.52	0.7211	249
14	0.57	0.7550	253
15	0.59	0.7681	254
16	0.57	0.7550	254
17	0.52	0.7211	255
16	0.34	0.5831	252
19	0.51	0.7141	239
20	0.53	0.7280	242
21	0.55	0.7416	245
22	0.55	0.7416	248
23	0.49	0.7000	250
24	0.37	0.6083	251
Average	**0.4979**	**0.7041**	**251.7**

VELOCITY CALCULATIONS

Molecular Weight of the Dry Gas Stream

$Md = (.44)(\%CO_2) + (.32)(\%O_2) + (.28)(\%CO + \%N_2)$

Md = (0.44)*(8.80) + (0.32)*(7.90) + (0.28)*(83.30)

Md = 29.72 lb/lbmol

Molecular Weight of Stack Gas

Ms = (Md)(1-Bwo) + 18(Bwo)

Ms = (29.72) * (1-0.197) + (18) * (0.197)

Ms = 27.41 lb/lbmol

Velocity of Stack Gas

$Vs = 85.49 * 60 * Cp * (\Delta P)^{0.5} * [(Ts+460)/Ps/Ms]^{0.5}$

Vs = 85.49 * 60 *(0.84) * (0.7041) * sqrt {[(711.71)/(28.22)/(27.41)]}

Vs = 2,910.2 ft/min

Total Flow of Stack Gas

Qa = As * Vs

Qa = (132.7322) * (2,910.2)

Qa = 386,276.4 ACFM

Qs = Qa * 528/Ts * Ps/29.92

Qs = (386,276.4) * (528/711.3) * (28.22/29.92)

Qs = 270,399.8 SCFM

Qstd = Qs * (1 - Bwo)

Qstd = (270,399.8) * (1-0.197)

Qstd = 217,104.0 DSCFM

VELOCITY TRAVERSE TEST RESULTS

Stack Gas Temperature (°F)	252	Stack Velocity (ft/min)	2,910.2
Moisture Content (% Vol.)	19.71%	Gas Flow Rate (ACFM)	386,276
CO_2 (% Vol.)	8.8	Gas Flow Rate (SCFM)	270,400
O_2 (% Vol.)	7.9	Gas Flow Rate (DSCFM)	217,104

APPENDIX D

CEM RESPONSE TIME TEST

Location: Suncoke - MTO

Date of Test: June 29, 2015

Analyzer Type: NOx

Span Gas Concentration: 97.48

Analyzer Span Setting: 100 ppm

UPSCALE RESPONSE			
	Start	**95% Response**	**Time (sec)**
1	0.0	92.6	52
2	0.0	92.6	50
3	0.0	92.6	53
Average Upscale Response			**51.67**

DOWNSCALE RESPONSE			
	Start	**95% Response**	**Time (sec)**
1	97.5	4.9	47
2	97.5	4.9	46
3	97.5	4.9	48
Average Downscale Response			**47.00**

UPSCALE RESPONSE = Time required to reach 95% of stable reading shifting from stable zero to stack gas.

DOWNSCALE RESPONSE = Time required to reach 95% of stable reading shifting from stable high-level cal to stack gas.

RESPONSE TIME = The longer of the two mean times.

CEM RESPONSE TIME TEST

Location: Suncoke - MTO

Date of Test: June 29, 2015

Analyzer Type: CO_2

Span Gas Concentration: 20.7

Analyzer Span Setting: 25 %

UPSCALE RESPONSE			
	Start	**95% Response**	**Time (sec)**
1	0.0	19.7	31
2	0.0	19.7	32
3	0.0	19.7	32
Average Upscale Response			**31.67**

DOWNSCALE RESPONSE			
	Start	**95% Response**	**Time (sec)**
1	20.7	1.0	28
2	20.7	1.0	28
3	20.7	1.0	27
Average Downscale Response			**27.67**

UPSCALE RESPONSE = Time required to reach 95% of stable reading shifting from stable zero to stack gas.

DOWNSCALE RESPONSE = Time required to reach 95% of stable reading shifting from stable high-level cal to stack gas.

RESPONSE TIME = The longer of the two mean times.

CEM RESPONSE TIME TEST

Location: Suncoke - MTO

Date of Test: June 29, 2015

Analyzer Type: O_2

Span Gas Concentration: 21.01

Analyzer Span Setting: 25 %

UPSCALE RESPONSE			
	Start	**95% Response**	**Time (sec)**
1	0.0	20.0	31
2	0.0	20.0	32
3	0.0	20.0	32
Average Upscale Response			**31.67**

DOWNSCALE RESPONSE			
	Start	**95% Response**	**Time (sec)**
1	21.0	1.1	28
2	21.0	1.1	28
3	21.0	1.1	27
Average Downscale Response			**27.67**

UPSCALE RESPONSE = Time required to reach 95% of stable reading shifting from stable zero to stack gas.

DOWNSCALE RESPONSE = Time required to reach 95% of stable reading shifting from stable high-level cal to stack gas.

RESPONSE TIME = The longer of the two mean times.

NO_2-NO Converter Efficiency Test (NO_2 Cylinder Method)

Date:	6/29/2015	Location:	Main Stack
Project:	Suncoke - MTO	Operator:	M. Mowery
Analyzer	TECO	CEM Range:	0 - 100
Model:	42i-HL		
S/N:	1431663390		

Cylinder Number	Cal Gas	NO_x Analyzer Response
EB0006070	51.92	48.409

$$\text{Converter Efficiency} = \frac{C_{Dir}}{C_v} \times 100$$

Converter Efficiency = **93.2** % (Must be greater than or equal to 90 percent)

Procedures

1. Calibrate analyzer
2. Introduce a 40 to 60 ppmv NO_2 calibration gas cylinder to the analyzer in direct
3. Calculate efficiency.

	CEC Air Group
	NO2
Date	PPM
6/29/2015 21:17	48.8
6/29/2015 21:18	48.945
6/29/2015 21:19	48.028
6/29/2015 21:20	48.092
6/29/2015 21:21	48.25
6/29/2015 21:22	48.303
6/29/2015 21:23	48.412
6/29/2015 21:24	48.443

Average: 48.409

3-Point Stratification Check
Suncoke - MTO - Main Baghouse Stack

Stack Diameter	(in)	156
Port Length	(in)	6
3 pts.		
Pts.	(in)	(%)
1	32.1	16.7
2	84.0	50.0
3	135.9	83.3

Pts.	NO_x Conc.	CO_2 Conc.	O_2 Conc.
1	65.40	9.08	7.56
2	66.46	9.00	7.64
3	66.61	9.01	7.65
avg.	66.16	9.03	7.62

Pts.	NO_x		CO_2		O_2	
	% Diff	Abs Diff	% Diff	Abs Diff	% Diff	Abs Diff
1	-1.14	0.76	0.52	-0.05	-0.74	0.06
2	0.46	-0.30	-0.30	0.03	0.25	-0.02
3	0.68	-0.45	-0.23	0.02	0.49	-0.04

	CEC Air Group	CEC Air Group	CEC Air Group
	O2	CO2	NOX
Date	PERCENT	PERCENT	PPM
6/30/2019 17:30	7.55	9.07	65.331
6/30/2019 17:31	7.54	9.08	65.577
6/30/2019 17:32	7.55	9.08	65.476
6/30/2019 17:33	7.56	9.09	65.213
6/30/2019 17:34	7.6	9.07	65.402
Average	**7.56**	**9.078**	**65.3998**
6/30/2019 17:35	7.63	9.03	65.469
6/30/2019 17:36	7.63	9.03	66.099
6/30/2019 17:37	7.64	8.99	66.142
6/30/2019 17:38	7.64	8.99	66.814
6/30/2019 17:39	7.64	8.98	67.784
Average	**7.636**	**9.004**	**66.4616**
6/30/2019 17:40	7.64	9.02	67.293
6/30/2019 17:41	7.64	9.01	66.646
6/30/2019 17:42	7.67	9.01	66.561
6/30/2019 17:43	7.66	8.98	66.282
6/30/2019 17:44	7.66	9.03	66.26
Average	**7.654**	**9.01**	**66.6084**

Plant Name	Suncoke - MTO
Sampling Location	Main Stack
Date	29-Jun-15
CEM Operator	Mike Mowery
Project Number	151-733.0002

Run No.	Start Time	Stop Time	Start - Stop Time	Reference Method Obs. Value					
				O_2	CO_2	CO	NO_x	SO_2	Flow Rate
1	1700	1800	1700 - 1800	7.59	9.05		67.02		219,870
2	1820	1920	1820 - 1920	8.21	8.67		63.86		213,800
3	1940	2040	1940 - 2040	7.82	8.88		65.90		217,104

CEM CALIBRATION DATA

Sampling Location	Main Stack
Date	29-Jun-15

Plant Name	Suncoke - MTO
Plant Rep.	Kris Singleton
Team Leader	Mike Mowery
CEM Operator	Mike Mowery
Project Number	151-733.0002

	Analyzer Number	Analyzer Span
O2	80	21.01
CO2	80	20.7
CO		
THC		
NOx	1431663389	97.48
SO2		

Data to be Entered by Operator

(Pre Run n+1) = (Post Run n) unless overridden

	Calibration Gas Specification (% of Span)	CALIBRATION ERROR CHECK			SYSTEM CAL CHECK						
		Calibration Value (% or ppm)	Cylinder Number (1)	Analyzer Calibration Response	Pre Run 1 System Response	Post Run 1 System Response	Pre Run 2 System Response	Post Run 2 System Response	Pre Run 3 System Response	Post Run 3 System Response	Pre Run 4 System Response
O2 Low	< 20	0	NITROGEN	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
O2 Mid	40-60	9.95	SG9115102BAL	10.1	10.0	10.0	10.0	10.0	10.0	10.0	10.0
O2 High	20-100	21.01	SG9153035BAL	21.0							
CO2 Zero	< 20	0	NITROGEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO2 Mid	40-60	10.14	SG9115102BAL	10.1	10.0	9.9	9.9	9.9	9.9	9.9	9.9
CO2 High	20-100	20.7	SG9153035BAL	20.6							
NOx Low	< 20	0	NITROGEN	-0.2	0.4	0.8	0.8	0.7	0.7	0.7	0.7
NOx Mid	40-60	44.24	CC337830	44.9	46.2	47.6	44.4	44.4	44.4	44.3	44.3
NOx High	20-100	97.48	SG9151650	98.0							

CEM Data Correction Data Sheet

Plant Name	Suncoke - MTO
Sampling Location	Main Stack
Date	29-Jun-15
CEM Operator	Mike Mowery
Project Number	151-733.0002
Pollutant	O_2

Run No.	Start Time	Stop Time	Obs. Conc. (% or ppm)	Calibration Data			Calibration Corrected Data (% or ppm)
				Cma	Co	Cm	
1	1700	1800	7.6	10.0	0.1	10.0	7.56
2	1820	1920	8.2	10.0	0.0	10.0	8.18
3	1940	2040	7.8	10.0	0.0	10.0	7.79

Calibration Error Correction

Cgas=(Cobs-Co)*(Cma/(Cm-Co))

CEM Data Correction Data Sheet

Plant Name	Suncoke - MTO
Sampling Location	Main Stack
Date	29-Jun-15
CEM Operator	Mike Mowery
Project Number	151-733.0002
Pollutant	O_2

Run No.	Start Time	Stop Time	Obs. Conc. (% or ppm)	Calibration Data			Calibration Corrected Data (% or ppm)
				Cma	Co	Cm	
1	1700	1800	7.6	10.0	0.1	10.0	7.56
2	1820	1920	8.2	10.0	0.0	10.0	8.18
3	1940	2040	7.8	10.0	0.0	10.0	7.79

Calibration Error Correction

Cgas=(Cobs-Co)*(Cma/(Cm-Co))

CEM Data Correction Data Sheet

Plant Name	Suncoke - MTO
Sampling Location	Main Stack
Date	29-Jun-15
CEM Operator	Mike Mowery
Project Number	151-733.0002
Pollutant	CO_2

Run No.	Start Time	Stop Time	Obs. Conc. (% or ppm)	Calibration Data			Calibration Corrected Data (% or ppm)
				Cma	Co	Cm	
1	1700	1800	9.1	10.1	0.0	10.0	9.21
2	1820	1920	8.7	10.1	0.0	9.9	8.87
3	1940	2040	8.9	10.1	0.0	9.9	9.09

Calibration Error Correction

Cgas=(Cobs-Co)*(Cma/(Cm-Co))

CEM Data Correction Data Sheet

Plant Name	Suncoke - MTO
Sampling Location	Main Stack
Date	29-Jun-15
CEM Operator	Mike Mowery
Project Number	151-733.0002
Pollutant	NO_x

Run No.	Start Time	Stop Time	Obs. Conc. (% or ppm)	Calibration Data			Calibration Corrected Data (% or ppm)
				Cma	Co	Cm	
1	1700	1800	67.0	44.2	0.6	46.9	63.44
2	1820	1920	63.9	44.2	0.8	44.4	64.04
3	1940	2040	65.9	44.2	0.7	44.3	66.11

Calibration Error Correction

Cgas=(Cobs-Co)*(Cma/(Cm-Co))

CEM CALIBRATION DATA

Sampling Location	Main Stack
Date	29-Jun-15
Run Number	1
Start Time	1700
Stop Time	1800

Plant Name	Suncoke - MTO
Plant Rep.	Kris Singleton
Team Leader	Mike Mowery
CEM Operator	Mike Mowery
Project Number	151-733.0002

	Analyzer Number	Analyzer Span
O2	80	21.01
CO2	80	20.7
CO		
THC		
NOx	1431663389	97.48
SO2		

	Calibration Gas Specification (% of Span)	CALIBRATION ERROR CHECK				SYSTEM CAL CHECK					
		Calibration Value (% or ppm)	Cylinder Number (1)	Analyzer Calibration Response	Difference (% of Span)	Pre Run 1 System Response	Pre Run 1 Syst. Bias (% of Span)	Post Run 1 System Response	Post Run 1 Syst. Bias (% of Span)	Drift (% of Span)	Calibration Correction Factors
O2 Low	< 20	0	NITROGEN	0.03	0.14%	0.12	0.43%	0.03	0.00%	-0.43%	Co=0.1
O2 Mid	40-60	9.95	SG9115102BAL	10.13	0.86%	9.95	-0.86%	9.99	-0.67%	0.19%	Cm=10.0
O2 High	20-100	21.01	SG9153035BAL	21.03	0.10%						
CO2 Zero	< 20	0	NITROGEN	0	0.00%	0	0.00%	0	0.00%	0.00%	Co=0.0
CO2 Mid	40-60	10.14	SG9115102BAL	10.11	-0.14%	10.01	-0.48%	9.92	-0.92%	-0.43%	Cm=10.0
CO2 High	20-100	20.7	SG9153035BAL	20.59	-0.53%						
NOx Low	< 20	0	NITROGEN	-0.234	-0.24%	0.398	0.65%	0.769	1.03%	0.38%	Co=0.6
NOx Mid	40-60	44.24	CC337830	44.85	0.63%	46.23	1.42%	47.6	2.82%	1.41%	Cm=46.9
NOx High	20-100	97.48	SG9151650	97.97	0.50%						

$$\textbf{Calibration Error} = \left(\frac{\text{Analyzer Response - Calibration Value}}{\text{Analyzer Span}} \right) \times 100; \quad \text{Allowable error} = \pm 2\%, \pm 5\% \text{ for THC}$$

$$\textbf{System Bias} = \left(\frac{\text{System Response - Analyzer Response}}{\text{Analyzer Span}} \right) \times 100; \quad \text{Allowable error} = \pm 5\%$$

$$\textbf{Drift} = \left(\frac{\text{Post Test Response - Pretest System Response}}{\text{Analyzer Span}} \right) \times 100; \quad \text{Allowable error} = \pm 3\%$$

$$\textbf{Co} = \frac{\text{Pretest System Zero Response + Post Test System Zero Response}}{2}$$

$$\textbf{Cm} = \frac{\text{Pretest System Upscale Response + Post Test System Upscale Response}}{2}$$

(1) Not applicable if using calibration gas dilution system.
(2) Method 20 specifications (% oxygen concentrations) are 0, NR, 11-14, and 20.9.
(3) Not specified by Method 10, use 80-100% of span value.
(4) Method 20 specifications are 0, 20-30, 45-55, and 80-90.
NR = Not Required by EPA Method.
THC Calibration Error is to be conducted through the sampling system per M25A.
THC Calibration Errors are calculated with respect to cylinder concentration, not analyzer span.

CEM CALIBRATION DATA

Sampling Location	Main Stack
Date	29-Jun-15
Run Number	2
Start Time	1820
Stop Time	1920

Plant Name	Suncoke - MTO
Plant Rep.	Kris Singleton
Team Leader	Mike Mowery
CEM Operator	Mike Mowery
Project Number	151-733.0002

	Analyzer Number	Analyzer Span
O2	80	21.01
CO2	80	20.7
CO		
THC		
NOx	1431663389	97.48
SO2		

	Calibration Gas Specification (% of Span)	CALIBRATION ERROR CHECK				SYSTEM CAL CHECK					
						Pre Run 2		Post Run 2			
		Calibration Value (% or ppm)	Cylinder Number (1)	Analyzer Calibration Response	Difference (% of Span)	System Response	Syst. Bias (% of Span)	System Response	Syst. Bias (% of Span)	Drift (% of Span)	Calibration Correction Factors
O2 Low	< 20	0	NITROGEN	0.03	0.14%	0.03	0.00%	0.04	0.05%	0.05%	Co=0.0
O2 Mid	40-60	9.95	SG9115102BAL	10.13	0.86%	9.99	-0.67%	9.98	-0.71%	-0.05%	Cm=10.0
O2 High	20-100	21.01	SG9153035BAL	21.03	0.10%						
CO2 Zero	< 20	0	NITROGEN	0	0.00%	0	0.00%	0.01	0.05%	0.05%	Co=0.0
CO2 Mid	40-60	10.14	SG9115102BAL	10.11	-0.14%	9.92	-0.92%	9.9	-1.01%	-0.10%	Cm=9.9
CO2 High	20-100	20.7	SG9153035BAL	20.59	-0.53%						
NOx Low	< 20	0	NITROGEN	-0.234	-0.24%	0.769	1.03%	0.745	1.00%	-0.02%	Co=0.8
NOx Mid	40-60	44.24	CC337830	44.85	0.63%	44.35	-0.51%	44.35	-0.51%	0.00%	Cm=44.4
NOx High	20-100	97.48	SG9151650	97.97	0.50%						

$$\textbf{Calibration Error} = \left(\frac{\text{Analyzer Response - Calibration Value}}{\text{Analyzer Span}} \right) \times 100; \quad \text{Allowable error} = \pm 2\%, \pm 5\% \text{ for THC}$$

$$\textbf{System Bias} = \left(\frac{\text{System Response - Analyzer Response}}{\text{Analyzer Span}} \right) \times 100; \quad \text{Allowable error} = \pm 5\%$$

$$\textbf{Drift} = \left(\frac{\text{Post Test Response - Pretest System Response}}{\text{Analyzer Span}} \right) \times 100; \quad \text{Allowable error} = \pm 3\%$$

$$\textbf{Co} = \frac{\text{Pretest System Zero Response + Post Test System Zero Response}}{2}$$

(1) Not applicable if using calibration gas dilution system.
(2) Method 20 specifications (% oxygen concentrations) are 0, NR, 11-14, and 20.9.
(3) Not specified by Method 10, use 80-100% of span value.
(4) Method 20 specifications are 0, 20-30, 45-55, and 80-90.
NR = Not Required by EPA Method.
THC Calibration Error is to be conducted through the sampling system per M25A.
THC Calibration Errors are calculated with respect to cylinder concentration, not analyzer span.

CEM CALIBRATION DATA

Sampling Location	Main Stack
Date	29-Jun-15
Run Number	3
Start Time	1940
Stop Time	2040

Plant Name	Suncoke - MTO
Plant Rep.	Kris Singleton
Team Leader	Mike Mowery
CEM Operator	Mike Mowery
Project Number	151-733.0002

	Analyzer Number	Analyzer Span
O2	80	21.01
CO2	80	20.7
CO		
THC		
NOx	1431663389	97.48
SO2		

	Calibration Gas Specification (% of Span)	CALIBRATION ERROR CHECK				SYSTEM CAL CHECK					
		Calibration Value (% or ppm)	Cylinder Number (1)	Analyzer Calibration Response	Difference (% of Span)	Pre Run 3 System Response	Pre Run 3 Syst. Bias (% of Span)	Post Run 3 System Response	Post Run 3 Syst. Bias (% of Span)	Drift (% of Span)	Calibration Correction Factors
O2 Low	< 20	0	NITROGEN	0.03	0.14%	0.04	0.05%	0.03	0.00%	-0.05%	Co=0.0
O2 Mid	40-60	9.95	SG9115102BAL	10.13	0.86%	9.98	-0.71%	9.99	-0.67%	0.05%	Cm=10.0
O2 High	20-100	21.01	SG9153035BAL	21.03	0.10%						
CO2 Zero	< 20	0	NITROGEN	0	0.00%	0.01	0.05%	0.01	0.05%	0.00%	Co=0.0
CO2 Mid	40-60	10.14	SG9115102BAL	10.11	-0.14%	9.9	-1.01%	9.92	-0.92%	0.10%	Cm=9.9
CO2 High	20-100	20.7	SG9153035BAL	20.59	-0.53%						
NOx Low	< 20	0	NITROGEN	-0.234	-0.24%	0.745	1.00%	0.662	0.92%	-0.09%	Co=0.7
NOx Mid	40-60	44.24	CC337830	44.85	0.63%	44.35	-0.51%	44.315	-0.55%	-0.04%	Cm=44.3
NOx High	20-100	97.48	SG9151650	97.97	0.50%						

Calibration Error = $\left(\frac{\text{Analyzer Response - Calibration Value}}{\text{Analyzer Span}} \right)$ x 100; Allowable error = ±2%, ±5% for THC

System Bias = $\left(\frac{\text{System Response - Analyzer Response}}{\text{Analyzer Span}} \right)$ x 100; Allowable error = ±5%

Drift = $\left(\frac{\text{Post Test Response - Pretest System Response}}{\text{Analyzer Span}} \right)$ x 100; Allowable error = ±3%

Co = $\frac{\text{Pretest System Zero Response + Post Test System Zero Response}}{2}$

Cm = $\frac{\text{Pretest System Upscale Response + Post Test System Upscale Response}}{2}$

(1) Not applicable if using calibration gas dilution system.
(2) Method 20 specifications (% oxygen concentrations) are 0, NR, 11-14, and 20.9.
(3) Not specified by Method 10, use 80-100% of span value.
(4) Method 20 specifications are 0, 20-30, 45-55, and 80-90.
NR = Not Required by EPA Method.
THC Calibration Error is to be conducted through the sampling system per M25A.
THC Calibration Errors are calculated with respect to cylinder concentration, not analyzer span.

Airgas

Airgas Specialty Gases
12722 South Wentworth Avenue
Chicago, IL 60628
(773) 785-3000 Fax: (773) 785-1928
www.airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E03NI80E15A0138	Reference Number:	54-124456528-1
Cylinder Number:	SG9115102BAL	Cylinder Volume:	150.9 CF
Laboratory:	ASG - Chicago - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12014	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Sep 30, 2014

Expiration Date: Sep 30, 2022

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	10.00 %	10.14 %	G1	+/- 1.0% NIST Traceable	09/30/2014
OXYGEN	10.00 %	9.957 %	G1	+/- 1.0% NIST Traceable	09/30/2014
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	06120402	CC184369	19.66 % CARBON DIOXIDE/NITROGEN	+/- 0.5%	May 01, 2016
NTRM	09061411	CC268005	22.53 % OXYGEN/NITROGEN	+/- 0.4%	Mar 08, 2019

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
CO2-1 HORIBA VIA-510 V1E3H7P5	NDIR	Sep 29, 2014
O2-1 HORIBA MPA-510 3VUYL9NR	Paramagnetic	Sep 23, 2014

Triad Data Available Upon Request

Approved for Release

Airgas

Airgas Specialty Gases
12722 South Wentworth Avenue
Chicago, IL 60628
(773) 785-3000 Fax: (773) 785-1928
www.airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E03NI58E15A02X7	Reference Number:	54-124430148-2
Cylinder Number:	SG9153035BAL	Cylinder Volume:	160.6 CF
Laboratory:	ASG - Chicago - IL	Cylinder Pressure:	2014 PSIG
PGVP Number:	B12014	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Apr 21, 2014

Expiration Date: Apr 21, 2022

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	21.00 %	20.70 %	G1	+/- 1.0% NIST Traceable	04/21/2014
OXYGEN	21.00 %	21.01 %	G1	+/- 1.0% NIST Traceable	04/21/2014
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	06120405	CC184974	19.66 % CARBON DIOXIDE/NITROGEN	+/- 0.5%	May 01, 2016
NTRM	06120210	CC195743	20.90 % OXYGEN/NITROGEN	+/- 0.4%	Dec 01, 2015

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
CO2-1 HORIBA VIA-510 V1E3H7P5	NDIR	Apr 21, 2014
O2-1 HORIBA MPA-510 3VUYL9NR	Paramagnetic	Apr 15, 2014

Triad Data Available Upon Request

Notes:

Approved for Release

Airgas

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Airgas Specialty Gases
12722 South Wentworth Avenue
Chicago, IL 60628
(773) 785-3000 Fax: (773) 785-1928
Airgas.com

Part Number:	E03NI99E15A0259	Reference Number:	54-124483480-1
Cylinder Number:	CC337830	Cylinder Volume:	144.3 CF
Laboratory:	ASG - Chicago - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12015	Valve Outlet:	660
Gas Code:	CO,NO,NOX,BALN	Certification Date:	Mar 30, 2015

Expiration Date: Mar 30, 2018

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	44.24 PPM	G1	+/- 1.4% NIST Traceable	03/21/2015, 03/30/2015
CARBON MONOXIDE	45.00 PPM	45.18 PPM	G1	+/- 0.7% NIST Traceable	03/21/2015
NITRIC OXIDE	45.00 PPM	44.23 PPM	G1	+/- 1.4% NIST Traceable	03/21/2015, 03/30/2015
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12062252	CC366857	97.56 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	May 25, 2018
PRM	12312	680179	10.01 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Oct 15, 2014
NTRM	13061007	CC422721	99.86 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Nov 19, 2019
GMIS	124206889102	CC320508	4.979 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	May 04, 2015

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nexus 470 AEP0000428	FTIR	Mar 07, 2015
Nexus 470 AEP0000428	FTIR	Mar 07, 2015
Nexus 470 AEP0000428	FTIR	Mar 07, 2015

Triad Data Available Upon Request

Approved for Release

Airgas

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Airgas Specialty Gases
12722 South Wentworth Avenue
Chicago, IL 60628
(773) 785-3000 Fax. (773) 785-1928
Airgas.com

Part Number:	E03NI99E15A7416	Reference Number:	54-124483477-1
Cylinder Number:	SG9151640BAL	Cylinder Volume:	144.3 CF
Laboratory:	ASG - Chicago - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12015	Valve Outlet:	660
Gas Code:	CO,NO,NOX,BALN	Certification Date:	Mar 30, 2015

Expiration Date: Mar 30, 2023

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	95.00 PPM	97.48 PPM	G1	+/- 1.3% NIST Traceable	03/21/2015, 03/30/2015
CARBON MONOXIDE	95.00 PPM	96.10 PPM	G1	+/- 0.8% NIST Traceable	03/21/2015
NITRIC OXIDE	95.00 PPM	97.30 PPM	G1	+/- 1.0% NIST Traceable	03/21/2015, 03/30/2015
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12062252	CC366857	97.56 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	May 25, 2018
PRM	12312	680179	10.01 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Oct 15, 2014
NTRM	13061007	CC422721	99.86 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Nov 19, 2019
GMIS	124206889102	CC320508	4.979 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	May 04, 2015

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nexus 470 AEP0000428	FTIR	Mar 07, 2015
Nexus 470 AEP0000428	FTIR	Mar 07, 2015
Nexus 470 AEP0000428	FTIR	Mar 07, 2015

Triad Data Available Upon Request

Approved for Release

Airgas

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Airgas Specialty Gases
12722 South Wentworth Avenue
Chicago, IL 60628
(773) 785-3000 Fax: (773) 785-1928
Airgas.com

Part Number:	E02AI99E15A1704	Reference Number:	54-124484442-1B
Cylinder Number:	EB0006070	Cylinder Volume:	146.2 CF
Laboratory:	ASG - Chicago - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12015	Valve Outlet:	660
Gas Code:	NO2,BALA	Certification Date:	Apr 20, 2015

Expiration Date: Apr 20, 2018

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NITROGEN DIOXIDE	50.00 PPM	51.92 PPM	G1	+/- 2%	04/13/2015, 04/20/2015
AIR	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
GMIS	124288126119	CC325404	56.18 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Nov 25, 2016
PRM	12325	APEX1099251	50.0 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Jul 26, 2014

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
MKS Multigas 17707558	FTIR	Apr 08, 2015

Triad Data Available Upon Request

Approved for Release

DRY GAS METER CALIBRATION SPREADSHEET

CONTROL BOX ID:	4	CALIBRATED BY:	T Currier
CALIBRATION STANDARD:	Standard	AMBIENT TEMPERATURE (F):	76.1
CALIBRATION STANDARD ID:	543569	AMBIENT PRESSURE (In Hg):	29.94
DATE CALIBRATED:	6/30/2015	Wet Test Meter	1.00

GAS VOLUME

Setting Control Console (delta H)	Gas Volume Metered (liters) Standard Starting Reading	Gas Volume Metered (liters) Standard Ending Reading	Gas Volume Corrected (ft3) Vw	Gas Volume DGM (ft3) Control Console Starting Reading	Gas Volume DGM (ft3) Control Console Ending Reading	Gas Volume DGM (ft3) Control Console Vd
0.5	550	700.05	5.299	309.725	314.976	5.251
1.0	700	850	5.297	314.976	320.256	5.280
2.0	850	1150.05	10.596	320.256	330.854	10.598
3.0	150	450	10.594	330.854	341.514	10.660

TEMPERATURE

Calibrator Starting Temperature (C)	Calibrator Ending Temperature (C)	Calibrator Average Temperature Tw (F)	DGM Starting Temperature (F)	DGM Ending Temperature (F)	DGM Average Temperature Td (F)
23.3	23.5	74.1	75	77	76.0
23.5	23.5	74.3	77	80	78.5
23.5	23.5	74.3	80	85	82.5
23.5	23.5	74.3	84	88	86.0

Time (min)	Gamma (Y)	Delta H@
13.24	1.0114	1.7591
9.22	1.0087	1.7004
13.15	1.0102	1.7162
10.41	1.0082	1.6034
	Avg Y	**Avg Delta H@**
	1.0096	**1.6948**
	0.9896	1.4948
Tolerances	1.0296	1.8948

Y = Ratio of reading of wet test meter to dry test meter. tolerance for individual values +/- 0.02 from average

Delta H @ = Orifice pressure differential that equates to 0.75 cfm of air @ 68 degrees F and 29.92 inches of mercury, in.H2O
tolerance for individual values +/- 0.20 from average

Is Unit Within Calibration Tolerances? **YES**

Calibrator: [signature] Date: 6/30/2015

Approved by: [signature] Date: 6/30/2015

THERMOCOUPLE READOUT CALIBRATION DATA FORM
(FOR K-TYPE THERMOCOUPLES)

Control Box / Thermocouple Readout Number:	Box 4		Calibrated By:	R.Raymond
Ambient Temperature:	70	°F	Date:	5/11/2015
Altek T/C Simulator	Model No.	3307T-K	Serial #'s	9508079

Primary Standards Directly Traceable t National Institute of Standards and Technology (NIST)

Reference[a] Source Temperature, (°F)	Test Thermometer Temperature, (°F)	Temperature Difference, %
0	2	0.43
200	202	0.30
400	397	0.35
800	802	0.16
1000	1000	0.00
1400	1397	0.16

Are all the Thermocouple Readout calibration points within calibration standard of <= to 1.5 %? **Yes**

$$\frac{\text{(Ref. Temp., oF + 460) - (Test Therm. Temp., oF + 460)}}{\text{Ref. Temp., oF + 460}} * 100 <= 1.5\ \%$$

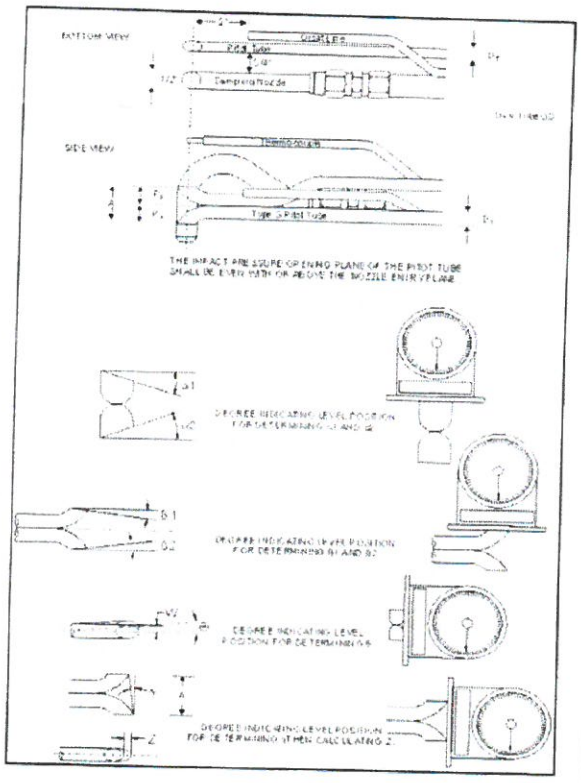
Calibrator Signature: _____ Date: 5/11/2015

Approval Signature: _____ Date: 5/11/15

APEX INSTRUMENTS SOURCE TESTING EQUIPMENT

P6-1

Type S Pitot Tube Inspection Form



PITOT TUBE/PROBE # 5935

Parameter	Value	Allowable Range	Check
Assembly Level?	yes	Yes	OK
Ports Damaged?	no	No	OK
$\alpha 1$	1	$-10° < \alpha 1 < +10°$	OK
$\alpha 2$	1	$-10° < \alpha 2 < +10°$	OK
1	0	$-5° < b1 < +5°$	OK
1	0	$-5° < \beta 2 < +5°$	OK
γ	0		
0	0		
$Z = A \tan \gamma$	0.000	$Z \leq .125"$	OK
$W = A \tan \theta$	0.000	$W \leq .031"$	OK
Dt	0.375	.188" to .375"	OK
A/2Dt	1.116	$1.05 \leq P_A/D_t \leq 1.5$	OK
A	0.837	$2.1D_t \leq A \leq 3D_t$	OK

Certification

I certify that pitot tube/probe number 5935 meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube certification factor of 0.84. See 40 CFR Pt. 60, App. A, EPA Method 2.

Certified by: JP 2-27-15

Personnel (Signature/Date)

App. # 2011-599

Source Evaluation Society
P. O. Box 12124
Research Triangle Park, NC 27709-2124

MICHAEL S. MOWERY

Qualified Source Testing Individual

MANUAL GAS VOLUME MEASUREMENTS AND ISOKINETIC PARTICULATE SAMPLING METHODS - **Effective January 10, 2012 through January 9, 2017** *(date of exam: 6/10/11)*

MANUAL GAS SOURCE SAMPLING METHODS - **Effective January 10, 2012 through January 9, 2017** *(date of exam: 6/1/11)*

GASEOUS POLLUTANTS INSTRUMENTAL SAMPLING METHODS - **Effective January 10, 2012 through January 9, 2017** *(date of exam: 9/9/11)*

HAZARDOUS METALS MEASUREMENT SAMPLING METHODS - **Effective January 10, 2012 through January 9, 2017** *(date of exam: 9/911)*