PROCESS POLLUTANT DETERMINATION FOR COMPLIANCE EMISSION TESTING

BANBURY MIXER NO. 7
TEST DATE OCTOBER 24, 2013

Prepared For:

THE GOODYEAR TIRE AND RUBBER COMPANY
1901 GOODYEAR BOULEVARD
DANVILLE, VIRGINIA 24541

Prepared By:

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CHARLOTTE, NORTH CAROLINA

CEC Project 132-066

November 22, 2013

REPORT CERTIFICATION

This report, testing details, and approach have been developed under the supervision (including review) of the persons named below. Results contained in this report relate only to the sources tested and the parameters included in the test program. CEC operates in conformance with the requirements of ASTM D7036-04 (Reapproved 2011).

Date 11/22/13 Signature W. Quentin Best

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Senior Project Manager
Civil & Environmental Consultants, Inc.

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1.0 INTRODUCTION

Civil & Environmental Consultants, Inc. (CEC) of Charlotte, North Carolina was contracted by The Goodyear Tire and Rubber Company (Goodyear) to conduct a compliance test on Banbury Mixer No. 7 (ID. No. EU-007) located in Danville, Virginia. The results of the total particulate matter (PM) and particulate matter less than 10 microns (PM10) sampling and the documentation provided in this report will be used to determine compliance with Title V Permit No. SCRO30106 issued by the Commonwealth of Virginia Department of Environmental Quality (VDEQ).

The emission testing on the fabric filter exhaust of Banbury Mixer No. 7 was performed on October 24, 2013. Three 2-hour sampling runs were conducted for total particulate matter and PM10. United States Environmental Protection Agency (US EPA) Methods 1 through 5 and 202 were used for the determination of total particulate matter concentrations and emission rates. US EPA Method 201A and 202 were used for the determination of PM10. The test runs were conducted concurrently during normal plant operations. The sampling and analytical procedures used in this test program were those established by the US EPA and VDEQ in standard reference test methods and appropriate sampling and analytical procedures.

Table 1 – List of Project Participants The Goodyear Tire & Rubber Company Danville, Virginia Facility			
Participant	**Title**	**Affiliation**	**Contact**
W. Quentin Best	Senior Professional	CEC, Inc.	Telephone: 980.237.0373 Facsimile: 980.237.0372 qbest@cecinc.com
Bryan L. Starnes	Project Manager	CEC, Inc.	
Joshua A. Jones, QSTI	Assistant Project Manager	CEC, Inc.	
Graham R. Guse	Technician	CEC, Inc.	
Kevin M. Dunham	Technician	CEC, Inc.	
Carlton Williams	Regional Environmental Manager North America - Commercial Plts	The Goodyear Tire & Rubber Company	Telephone: 330.796.0811 Mobile: 864.978.3170 carlton_williams@goodyear.com

Mr. Carlton Williams of Goodyear was responsible for coordinating the referenced process and for the collection of process operations data. This data is presented in Appendix F.

This report contains the results of the emission tests conducted during the test program. Copies of reference method field data sheets, sample analysis data, example calculations and equipment calibration records are included as appendices to this report.

2.0 SUMMARY OF TEST RESULTS

This section presents a summary of the particulate matter sampling. Detailed sampling results and example calculations for the test program can be found in Appendix A. Field data sheets and sample recovery documentation are presented in Appendix B. Appendix C contains the laboratory report. Appendix D presents copies of the current reference method equipment calibration records. Appendix E contains copies of the Qualified Stack Test Individual (QSTI) certifications for CEC testing personnel. Appendix F contains documentation of the production during the compliance test.

2.1 SAMPLING RESULTS

The summary of the results for the tests performed at the Banbury Mixer No. 7 is presented in Table 2 below. The emission rates presented in the following tables were calculated based upon emission stream conditions measured during the test period. The calculations were conducted in accordance with the appropriate test methods.

Table 2 – Particulate Matter and PM10 Sampling Results

Fabric Filter Exhaust from Banbury Mixer No. 7

Total Particulate Matter	Average Emission Rate				
	Run 1	Run 2	Run 3	Average	Limit
gr/dscf*	0.00082	0.00065	0.00077	0.00075	0.01
lb/hr**	0.068	0.057	0.066	0.064	
PM10					
gr/dscf*	0.00096	0.00045	0.00016	0.00031***	0.01
lb/hr**	0.079	0.034	0.013	0.024***	

* gr/dscf = grains per dry standard cubic foot

** lb/hr = pound per hour

*** Average based on Runs 2 and 3

Goodyear has been issued Title V Permit No. SCO30106 by VDEQ. The applicable emission limit for particulate matter at the Banbury Mixer is 0.01 grains per dry standard cubic foot (gr/dscf). The results of the Banbury Mixer No. 7 test program demonstrate that the tested unit was in compliance with the applicable air emission limit for total particulate matter and PM10.

2.2 SAMPLING DATES AND TIMES

Table 3 presents the sampling dates and times for the process tested at the Goodyear, Danville, Virginia facility.

Table 3 – Sampling Dates and Times
The Goodyear Tire & Rubber Company
Danville, Virginia Facility

Sample Location	Run 1	Run 2	Run 3
Banbury Mixer No. 7	10/24/13	10/24/13	10/24/13
	0955-1210	1343-1554	1630-1844

3.0 PROCESS DESCRIPTION

The Goodyear facility operates nine Banbury mixers. Banbury No. 7 was chosen as a representative of the nine Banbury mixers.

Figure 1 details the air-flow schematic for the referenced system. Production data and control device parameters during the sampling were recorded by Goodyear personnel and are presented in Appendix F. The sampling was performed during material processing.

Banbury Mixer No. 7

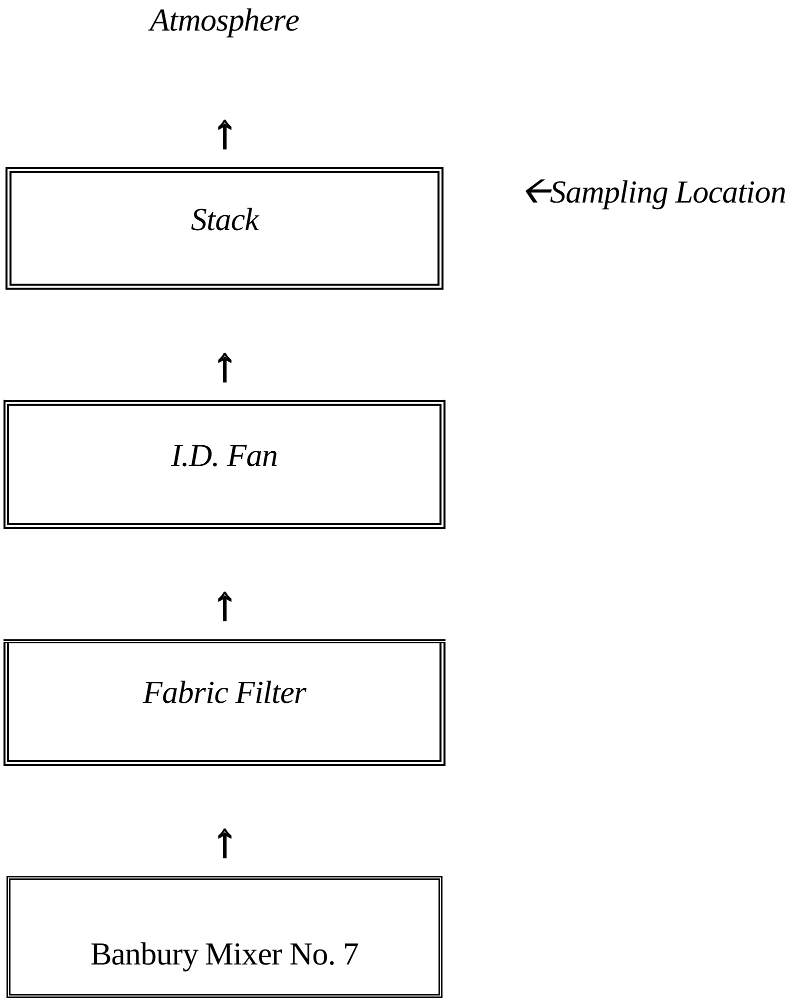


Figure 1 - Process Air Flow Schematic

4.0 SUMMARY OF THE REFERENCE TEST METHODS

This section describes the sampling strategy, sampling and analytical methods, and quality assurance/quality control procedures implemented during this project.

4.1 SAMPLING STRATEGY

The US EPA methods that were utilized in this sampling program were:

- Method 1 for the location of sampling ports and points, and determination of cyclonic flow;
- Method 2 for velocity / volumetric flow rate determination, and assignment of dry molecular weight of the stack gas;
- Method 4 for the determination of moisture in the stack gas;
- Method 5 for the determination of particulate matter;
- Method 201A for the determination of PM10, and
- Method 202 for the determination of condensable particulate matter.

These test methods are available in the Code of Federal Regulations Volume 40, Part 60, US EPA's web site www.epa.gov/ttn/emc/, and/or by request from CEC.

4.2 SAMPLING AND ANALYTICAL PROCEDURES

A sampling and analysis synopsis for these methods is discussed briefly in the following subsections.

4.2.1 US EPA Method 1-Sampling Point Determination

For this test program, the US EPA Method 1 was used to determine the appropriateness of the existing ports as the sampling location at the Banbury Mixer No. 7 stack. The duct diameters upstream and downstream from the sampling ports were determined prior to sampling. The number of traverse points was chosen with respect to sampling port location. For particulate traverses, Method 1 specifies a minimum of 8 traverse points for sampling ports located >8/>2 downstream/upstream stack diameters from flow disturbances and a maximum of 24 traverse points when located >2/>0.5 downstream/ upstream stack diameters from flow disturbances.

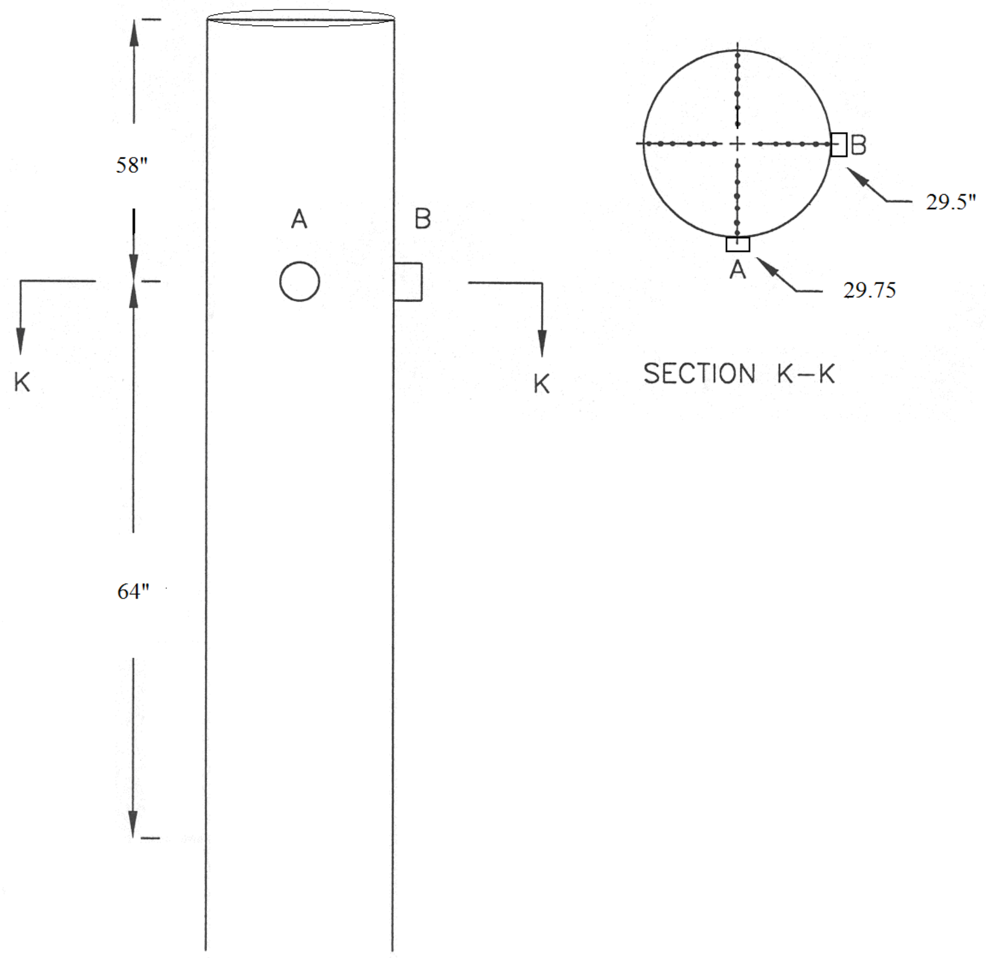
The dimensions of the stack and the location of the sampling ports and points are detailed in Figure 2. Method 1 sampling criteria was maintained. The Banbury Mixer No. 7 Exhaust Stack was a circular duct divided into 24 equal traverse areas with ports labeled A and B (twelve sample points per port). During the Method 5/202 and 201A/202 sampling runs, the individual points were sampled for a period of five (5) minutes, which yielded a total test of 120 minutes.

The Banbury Mixer No. 7 sampling location was determined to be less than 20° and in compliance with US EPA Method 1, Section 11.4.2 for cyclonic flow. A copy of this data can be found in Appendix B.

Banbury Mixer No. 7 Exhaust Stack

Table 4 – Stack Diameter and Upstream/Downstream Measurements for Banbury Mixer No.7 Exhaust Stack
The Goodyear Tire & Rubber Company
Danville, Virginia Facility- Method 1

System	Stack Diameter (inches)	Upstream (inches)	Downstream (inches)	Total number of sampling points per run
Banbury Mixer No. 7 Stack	29.75/29.5	58	64	24



Not to Scale

Figure 2 - Location of Sampling Ports and Points

4.2.2 US EPA Method 2 Velocity and Volumetric Flow Rate Determination

Method 2 was used for determining the average gas velocity from measurements of gas density and the average velocity head with a Type S (Stausscheibe or reverse type) pitot tube (0.84 coefficient). This method is applicable for quantifying gas flows for stacks that are 12 inches and over in diameter which meet the criteria of Method 1.

During this project, the sampling locations met the criteria detailed in Method 1. Gas stream density was assigned a value per Method 2 Section 8.6. Moisture determination was performed by Method 4. The velocity traverses were performed using Method 2 where the principal components of the gas velocity measurement system were sequentially:

- A calibrated stainless steel Type S pitot tube and Type K thermocouple;
- Leak-free interface tubing between pitot tube and differential pressure gauge;
- A 0 to 10 inch inclined manometer; and
- An NIST traceable pyrometer.

The apparatus was set-up according to manufacturer and reference method recommendations. Pre-test and post-test leak checks were conducted using procedures outlined in Method 2, Section 8.0. Velocity head and temperature measurements were performed during each sampling run at the traverse points specified by Method 1. The effluent gas temperature was measured with chromel-alumel thermocouples equipped with a digital temperature indicator. The atmospheric and static pressure of each stack was also determined during each sample run. The volumetric flow rate calculations used were those specified in Method 2, Section 12. Figure No. 3 show a typical S-type Pitot tube velocity measurement system.

CEC conducted measurements of the face opening alignments, external tubing diameter, and base-to-opening plane distances of the pitot tubes. These measurements meet the design criteria in US EPA Method 2 for a Type “S” pitot tube, and therefore a baseline coefficient value of 0.84 inches was assigned to the Pitot tube. Verification of these measurements were recorded onto a pitot tube calibration worksheet and presented in Appendix D of the final report.

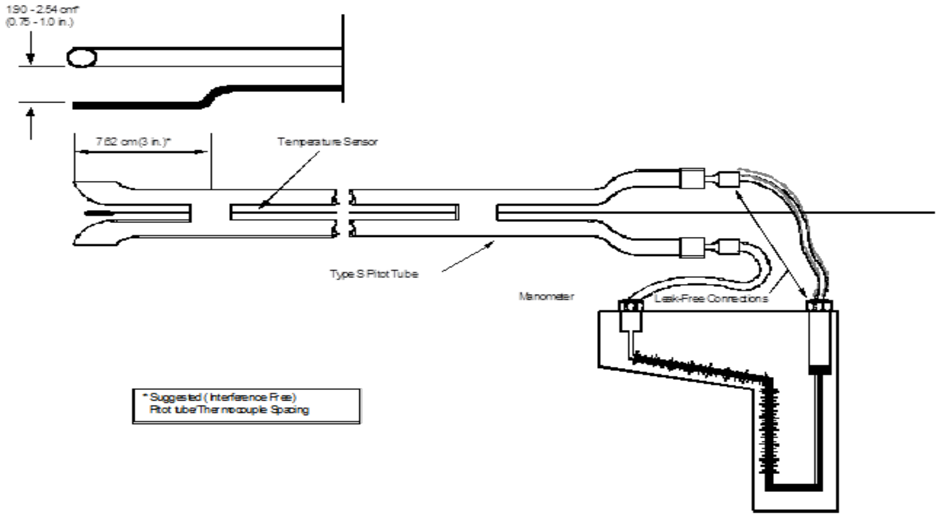


Figure 3 - S-Type Pitot Velocity Measurements System

4.2.3 US EPA Method 3 Molecular Weight Rate Determination

Method 3 is applicable for determining carbon dioxide and oxygen concentrations and dry molecular weight of a sample from a gas stream of a fossil-fuel combustion process. This method may also be applicable to other processes where it has been determined that compounds other than carbon dioxide, oxygen, carbon monoxide, and nitrogen are not present in concentrations sufficient to affect the results. However, US EPA Method 2, Section 8.6 states that “For processes emitting essentially air, an analysis needs not be conducted; use a dry molecular weight of 29.0.” The Banbury mixer was emitting essentially air, therefore the emission rate calculations were based on a dry molecular weight of 29.0.

4.2.4 US EPA Method 4 Moisture Determination

Method 4 involves the determination of stack gas moisture. The moisture content is used to correct the emission concentration or mass emission rate to a dry basis. EPA Method 4 and *Field Procedure 4* of the QA Handbook were used to measure stack gas moisture content. *Field Procedure 4* provides detailed information on the application of Method 4.

Preliminary flue gas moisture content (for purposes of setting the isokinetic flow rate) was determined using wet bulb/dry bulb thermometers and partial pressure, vapor and saturated vapor pressure equations. This technique is described in Method 4 and is summarized below:

- Moisten the wet bulb thermometer wick with deionized water;
- Insert both thermometers into the flue gas stream and monitor the wet bulb temperature;
- When the wet bulb temperature has stabilized, record both the wet bulb and dry bulb thermometer temperatures; and
- Calculate the flue gas moisture content (PMV) using the appropriate equations.

The moisture content for emission rate calculations was determined in conjunction with the Method 5 isokinetic sampling train. The reference method involves the withdrawal of gaseous and particulate pollutants from the emission source at an isokinetic rate using a Method 5 sampling system. The sampling and analytical procedure for reference Method 4 will be discussed in detail in Section 4.2.5 with the isokinetic sampling procedures.

4.2.5 US EPA Method 5 Particulate Matter Sampling and Analysis

Testing for total particulate matter was performed according to US EPA Methods 5 and 202. Gaseous and particulate pollutants were withdrawn isokinetically from the emission source and collected in a multi-component sampling train. In principle, filterable particulate matter includes any material that was condensed at or above the filtration temperature of approximately 250 degrees Fahrenheit and was collected on a tared glass fiber filter. The condensable particulate matter (CPM) is collected in the dry impinger system after the filterable particulate matter has been collected on the filter. The CPM is collected in the condenser system/ water drop out impinger and CPM filter. The gaseous components are bubbled through a measured volume of chilled deionized water to determine the moisture content of the emission source. The principal components of the sampling system were sequentially:

- A stainless steel sample nozzle and borosilicate probe liner;
- A heated (248°F ±25°F) probe and filter assembly with tared glass fiber filter;

- An impinger train consisting of a dry and wet impinger system. The dry impinger system consisted of a condenser and a dropout impinger; followed by an empty modified Greenburg Smith impinger and a CPM filter. Following the CPM filter, the wet impinger system consisted of two impingers. The first containing 100 ml of deionized water followed by a final impinger containing 200 grams of silica gel; and
- A metering system capable of maintaining an isokinetic sampling rate and accurately determining the sample volume according to specifications in APTD-0581.

After the test run, the impingers were weighed to determine moisture. The collected condensate measurements were recorded on the Method 4 moisture determination data analysis form. An impinger stem was added to the dropout impinger so that the stem extended below the water level. Nitrogen purged deionized water was added to the impinger to ensure the water level was over the stem for the duration of the purge. The sampling train was reassembled and connected to an ultra-high purity nitrogen gas cylinder for a one hour purge with nitrogen at 14 liters per minute.

The tared filter, which collected the filterable particulate matter sample, was carefully removed from the glass filter support and sealed in a Petri dish. The nozzle, probe liner, and front filter-half of the filter assembly were brushed and rinsed with acetone into a glass storage container which was sealed and the liquid level was marked.

After the purge, liquid in the dropout impinger and backup impinger was collected into a clean sampling container (CPM container No. 1). The back filter-half, condenser, dropout impinger, backup impinger, the front half of the CPM filter assembly and connecting glassware were twice rinsed with deionized water into CPM container No.1. Following the water rinses, the glassware was rinsed once with acetone and rinsed twice with hexane and was recovered into CPM Container No.2. The CPM filter was removed from the filter holder and sealed in a labeled Petri dish. The sample containers were transported to Enthalpy Analytical, Inc. in Durham, North Carolina for gravimetrical analysis. Documentation of the laboratory analysis and chain-of-custody can be found in Appendix C. The condensable fractions of the sample runs were train blank corrected.

4.2.6 US EPA Method 201A Particulate Matter Less Than 10 Microns (PM10) Sampling and Analysis

Testing for PM10 was performed according to US EPA Methods 201A and 202. Gaseous and particulate pollutants were withdrawn at a predetermined constant flow rate through an in-stack sizing device. In principle, particulate matter is extracted at a constant flow rate through an in-stack sizing device with well-defined limits to minimize variations with isokinetic sampling. The in-stack sizing device separates particles with nominal aerodynamic diameters of 10 micrometers and the final fraction was collected on a tared quartz fiber filter housed in a stainless steel impactor. The condensable particulate matter (CPM) is collected in the dry impinger system after the PM10 has been collected on the filter. The CPM is collected in the condenser system/ water drop out impinger and CPM filter. The gaseous components are bubbled through a measured volume of chilled deionized water to determine the moisture content of the emission source. The principal components of the sampling system were sequentially:

- A stainless steel sample nozzle and PM10 sizing heads with tared quartz fiber filter;
- A heated (248°F ±25°F) stainless steel probe liner;
- An impinger train consisting of a dry and wet impinger system. The dry impinger system consisted of a condenser and a dropout impinger; followed by an empty modified Greenburg Smith impinger and a CPM filter. Following the CPM filter, the wet impinger system consisted of two impingers. The first containing 100 ml of deionized water followed by a final impinger containing 200 grams of silica gel; and
- A metering system capable of maintaining an isokinetic sampling rate and accurately determining the sample volume according to specifications in APTD-0581.

After the test run, the impingers were weighed to determine moisture. The collected condensate measurements were recorded on the Method 4 moisture determination data analysis form. An impinger stem was added to the dropout impinger so that the stem extended below the water level. Nitrogen purged deionized water was added to the impinger to ensure the water level was over the stem for the duration of the purge. The sampling train was reassembled and connected to an ultra-high purity nitrogen gas cylinder for a one hour purge with nitrogen at 14 liters per minute.

The tared PM10 filter was carefully removed from the stainless steel filter support and sealed in a petri dish. The sizing head and front filter-half of the filter assembly were brushed and rinsed with acetone into a separate glass storage container (PM10 fraction) which was sealed and the liquid level was marked. The fraction greater than 10 microns was discarded.

After the purge, liquid in the dropout impinger and backup impinger was collected into a clean sampling container (CPM container No. 1). The back filter-half, condenser, dropout impinger, backup impinger, the front half of the CPM filter assembly and connecting glassware were twice rinsed with deionized water into CPM container No.1. Following the water rinses, the glassware was rinsed once with acetone and rinsed twice with hexane and was recovered into CPM Container No. 2. The CPM filter was removed from the filter holder and sealed in a labeled Petri dish. The sample containers were transported to Enthalpy Analytical, Inc. in Durham, North Carolina for gravimetrical analysis. Documentation of the laboratory analysis and chain-of-custody can be found in Appendix C. The condensable fractions of the sample runs were train blank corrected.

5.0 QUALITY ASSURANCE / QUALITY CONTROL RESULTS

CEC has established quality assurance and quality control (QA/QC) guidelines for providing quality sampling and analytical data from source tests. These QA/QC procedures were implemented to ensure the acceptability and reliability of the data generated.

In summary, an appropriate degree of data quality was maintained throughout this project. Leak checks and isokinetic QA criteria were met for the full sampling run. The sampling trains were leak checked prior to and immediately after sampling. Leak rates for the isokinetic sampling trains were less than the maximum criterion of 0.02 cubic feet per minute. The sampling rates were also within the 100% ±10% criterion established for isokinetic sampling. Quality control procedures for the particulate matter determinations have included the analysis of acetone rinse blanks. The result of the method blank is reported in Appendix C with the laboratory data.

Method 201A is typically paired with Method 202 for the determination of condensable particulate matter which is considered to be PM2.5. However, per Method 201A, the Method 202 sampling is only required for evaluating sources when the emission source operates at a temperature over 85 degrees F. The backhalf sampling trains were analyzed and included in the data even though the stack temperature did not exceed 85 degrees. Please note due to the cold day and high wind on the day of testing the backhalf requirement for the 202 portion of the sampling train was not maintained above 65 degrees F.

Method 201A has a requirement that point for point isokinetic sampling is required. Sampling run number 1 failed to meet the point per point isokinetic requirement. Due to the variability in the flow and nozzle selection, there were six out of the 24 points that were not isokinetic. The method allows up to five data point to be outside of 100 ± 20 %. The run data is presented, but not included in the average for the PM10 data.

Table 5 – Quality Assurance and Quality Control Data – Method 5

Banbury Mixer No. 7		Run 1	Run 2	Run 3	Criteria
Leak Checks	Method 5	0.002	0.005	0.001	< 0.020 cu. ft.
Isokinetics		101.3	102.6	100.6	100 ± 10%
Post Meter Calibration – Alternative Method 4 Post-Test Calibration (ALT-009) Post Meter Calibration				Meter Box 300.390 Avg. Y = 0.975	0.986 ± 0.05
Leak Checks	Method 201A	0.002	0.001	0.001	< 0.020 cu. ft.
Isokinetics		97.4	109.4	101.2	100 ± 20%
Post Meter Calibration – Alternative Method 4 Post-Test Calibration (ALT-009) Post Meter Calibration				Meter Box 300.392 Avg. Y = 0.957	0.990 + 0.05

Field data and final laboratory results were entered into CEC's air quality data system by a staff professional, and reviewed by a project manager for verification of data. After QC review by the project manager, a senior professional verified the final report for completeness and reasonableness of data. The report was returned to the staff professional for review and preparation of the final draft. The report requires the signature of the staff professional and a project manager before release to the client. Data and final reports are archived in a secured area for a minimum period of seven years.

CEC's field and laboratory test equipment has been maintained and calibrated in accordance with quality assurance procedures established by the US EPA in the QA handbook. Equipment calibrations including pre-test and post-test calibration data are presented in Appendix D

APPENDIX A

SUMMARY OF RESULTS AND EXAMPLE CALCULATIONS

SUMMARY OF RESULTS
EPA METHOD 5 and 202
Determination of Total Particulate Concentrations and Emission Rates

	Run Number	1	2	3	Average
	Sample Identification	132066-01	132066-02	132066-03	----
	Date:	10/24/2013	10/24/2013	10/24/2013	----
θ	Net Time of Test, minutes	120.0	120.0	120.0	----
	Sample Time, 24-hour clock	0955-1210	1343-1554	1630-1844	----
P_{bar}	Barometric Pressure, in. Hg	29.62	29.62	29.56	29.60
P_g	Static Pressure, in. H_2O	-0.250	-0.250	-0.250	-0.250
P_S	Stack Pressure, Absolute, in. Hg	29.602	29.602	29.542	29.582
V_M	Actual Meter Volume Sampled, cu. ft.	84.709	88.336	86.523	86.523
ΔH	Avg. Delta H, in. H_20	1.61	1.74	1.73	1.69
T_M	Avg. Gas Meter Temp., Deg. F	71.7	76.1	67.7	71.8
$V_{m(STD}$	Volume Sampled at Stand. Cond., cu. ft.	82.436	85.292	84.695	84.141
V_C	Volume of Water Collected, ml	-2.1	-8.0	-2.4	-4.2
$V_{wc(std)}$	Volume of Water Vapor at Std. Cond.,SCF	-0.10	-0.38	-0.11	-0.20
W_C	Volume of Water Collected in Silica Gel, g	13.90	22.20	20.50	18.87
$V_{wsg(st}$	Vol. of Water Vapor in Silica Gel at Std. Cond., SCF	0.66	1.05	0.97	0.89
B_{WS1}	Moisture Content of Gas Stream	0.007	0.008	0.010	0.008
P_{MV1}	Calculated Percent Moisture in Stack	0.7	0.8	1.0	0.8
P_{MV1S}	Saturated Percent Moisture in Stack	2.3	2.7	2.5	2.5
P_{MV1R}	Reported Percent Moisture in Stack	0.7	0.8	1.0	0.8
M_{FD1}	Mole Fraction of Dry Gas	0.993	0.992	0.990	0.992
M_d	Mole. Wt. Stack Gas, Dry Basis, lb/lb mole	29.0	29.0	29.0	29.0
M_S	Mole. Wt. Stack Gas, Wet Basis, lb/lb mole	28.926	28.914	28.890	28.910
Cp	Pitot Tube Coefficient	0.84	0.84	0.84	0.84
ΔPS	Avg. Sqrt. Delta P, in. H20	0.608	0.645	0.633	0.629
T_S	Avg. Stack Temp., Deg. F	67.0	72.0	70.4	69.8
V_S	Avg. Stack Velocity, ft/sec	34.2	36.5	35.8	35.5
A	Area Stack, ft^2	4.787	4.787	4.787	4.787

SUMMARY OF RESULTS
EPA METHOD 5 and 202
Determination of Total Particulate Concentrations and Emission Rates

Run Number		1	2	3	Average
Q_{SD}	Gas Volume Flow, Dry Std. Cond. CFM	9685	10215	10018	9972
Q_A	Actual Gas Volume Flow, CFM	9836	10484	10294	10205
Q_{SW}	Gas Volume Flow, Wet Std. Cond., CFM	9750	10295	10119	10055
D_n	Sample Nozzle Diameter, inches	0.248	0.244	0.248	0.247
A_n	Area of Nozzle, ft^2	0.00034	0.00032	0.00034	0.00033
I	Percent Isokinetic	101.3	102.6	100.6	101.5
Mb #	Meter Box Number	300.390	300.390	300.390	---
ΔH@	ΔH@ of Meter Box @ 0.75 SCFM	1.956	1.956	1.956	---
Y_{qa}	Alt. Mthd 5 Posttest Calibration (ALT-009)	0.970	0.971	0.983	0.975
Y	Meter Calibration Factor	0.986	0.986	0.986	---

Summary of Results
EPA Methods 5 and 202
Determination of Total Particulate Concentrations and Emission Rates

Run Number		1	2	3	Average
	Sample Identification	132066-01	132066-02	132066-03	
Filterable Particulate Matter (PM) Concentration and Emission Rates					
m_n	Particulate Catch, mg	2.8	2.0	2.4	2.4
C_s	PM Concentration, gr/dscf	0.00052	0.00036	0.00044	0.00044
C_{sm}	PM Concentration, mg/dscm	1.20	0.83	1.00	1.01
C_{AW}	PM Emission Rate, lbs/hr	0.044	0.032	0.038	0.038
Condensable Particulate Matter (CPM) Concentration and Emission Rates					
m_{cpm}	CPM Catch, mg	1.6	1.6	1.8	1.7
C_{sc}	CPM Concentration, gr/dscf	0.00030	0.00029	0.00033	0.00031
C_{sm}	CPM Concentration, mg/dscm	0.69	0.66	0.75	0.70
C_{AWc}	CPM Emission Rate, lbs/hr	0.025	0.025	0.028	0.026
Total Particulate Matter (TPM) Concentration and Emission Rates					
C_{sT}	TPM Concentration, gr/dscf	0.00082	0.00065	0.00077	0.00075
C_{sm}	TPM Concentration, mg/dscm	1.88	1.49	1.75	1.71
C_{AWT}	TPM Emission Rate, lbs/hr	0.068	0.057	0.066	0.064

Summary of Results
EPA Methods 5 and 202
Determination of Total Particulate Concentrations and Emission Rates

Example Calculations Run 1

Stack Pressure, Absolute, in. Hg
$P_S = P_{bar} + (P_g / 13.6) =$ 29.602

Volume Sampled at Stand. Cond., cu. ft.
$Vm(std) = (Vm * Y *(Pbar + DH / 13.6) * Tstd) / (Pstd * (Tm + 460) =$ 82.436

Method 4 Calculations:
Volume of Water Vapor at Std. Cond., SCF
$V_{WC(std)} = 0.04706 * V_C =$ -0.10

Vol. of Water Vapor in Silica Gel at Std. Cond., SCF
$V_{wsg(std)} = 0.04715 * W_C =$ 0.66

Moisture Content of Gas Stream
$B_{WS1} = (V_{WC(std)} + V_{wsg(std)}) / (V_{m(std)} + V_{WC(std)} + V_{wsg(std)}) =$ 0.007

Percent Moisture in Stack
$P_{MV1} = 100 * (V_{WC(std)} + V_{wsg(std)}) / (V_{m(std)} + V_{WC(std)} + V_{wsg(std)}) =$ 0.7

Saturated Stack Moisture using Stack Temperature (°F): Note if $\%S_{VP} > 100\% = 100\%$
$P_{MV1S} = \%S_{VP} = (100/Ps) * 10^{(6.6921-(3144/(T+390.86)))}$ 2.3

Reported Stack Moisture according to Method 4 Section 12.1.7
In saturated or moisture laden gas streams, the lower Bws (PMV1 or PMV1S) is considered correct 0.7

Mole Fraction of Dry Gas
$M_{FD1} = (100 - P_{MV}) / 100 =$ 0.993

Mole. Wt. Stack Gas, Dry Basis, lb/lb mole
Md is assigned a value per EPA Method 2, Section 8.6 = 29.0

Mole. Wt. Stack Gas, Wet Basis, lb/lb mole
$M_S = M_d * (1 - B_{ws}) + 18.0 * B_{ws} =$ 28.926

Avg. Stack Velocity, ft/sec
$VS = 85.49 * CP * \sqrt{DPavg} * \sqrt{(TS + 460) / (PS * MS)} =$ 34.2

Gas Volume Flow, Dry Std. Cond. CFM
$Q_{SD} = (60 \text{ sec/min} * (1-B_{ws}) * V_s * A * ((T_{std} * P_s) / (T_{s(abs)} * P_{std}))$ 9685

Actual Gas Volume Flow, CFM
$Q_A = V_S * A * 60 \text{ sec/min} =$ 9836

Gas Volume Flow, Wet Std. Cond., CFM
$Q_{SW} = Q_{SD} * [1/(1-B_{WS})] =$ 9750

Area of Nozzle, ft^2

Summary of Results
EPA Methods 5 and 202
Determination of Total Particulate Concentrations and Emission Rates

Example Calculations Run 1

$A_n = ((D_n / 2)^{\wedge 2} * 3.14159)/144 =$ 0.00034

Percent Isokinetic
I = (0.0945 * (TS + 460) * Vm (STD)) / (q * VS * PS * (1 - Bws) * An) = 101.3

Alternative Method 5 Posttest Calibration (ALT-009) Criteria: (Y± 0.05)
$Yqa = (\theta/Vm) * ((0.319*Tm)/(\Delta H@*(Pb+(\Delta H_{avg}/13.6)))*(29/Md))^{\wedge 1/2} * (\Delta H_{avg})^{\wedge 1/2} =$ 0.970

Filterable Particulate Matter (PM) Concentration and Emission Rates

Filterable Particulate Concentration, gr/dscf (At Standard Conditions)
$C_S = 0.015432358$ grain/ 1 mg * $m_n / V_{STD} =$ 0.00052

Filterable Particulate Matter Concentration, mg/dscm
Csm = mass (mg) / (Vmstd (dscf) * 0.028316847) 1.20

Filterable Particulate Emission Rate, lbs/hr (At Standard Conditions)
$C_{AW} = 60$ min/hr / 7000 grain/lb * $C_s * Q_{Sd} =$ 0.044

Standard Conditions 68 Deg. F, 29.92 in. Hg
Pstd = 29.92 in. Hg
Tstd = 528 °R

TEST RESULTS and DATA ANALYSIS SHEET

Location: Banbury Mixer # 7
Date: 24-Oct-2013
Start Time: 9:55
End Time: 12:10
RUN No. 1
JOB No. 132-066

STACK DATA			Molecular Weight			EQUIPMENT			AVERAGE TEST DATA		
% Moisture:	2	% est.	%CO2:	0.00	%	METER BOX:	300.392		Average ΔP:	0.45	in H_2O
Barometric:	29.65	in Hg	%O2:	20.90	%	Y:	0.990		Average T_m:	525.5	°R
Static Press:	-0.25	in H_2O	%N2/CO:	79.10	%	ΔH@:	1.912	in H_2O	Average T_s:	526.8	°R
Stack Press:	29.63	in Hg	Md:	28.84	lb/lb-mole	Cp':	0.765	S/N -	Average ΔH:	0.51	in H_2O
Stack Area:	4.8	ft^2	Actual Mw:	28.77	lb/lb-mole	Cp:	0.765	S/N -	T_{std}:	528.00	°R
# of Points:	24	points	Run Time:	115.00	min	Nozzle Dia:	0.193	inches	P_{std}:	29.92	in Hg

<PM$_{2.5}$ Filter Analysis		
Container 1:	0	mg
C1 + Filter Tare:		mg
Acetone V_{aw1}:		ml
Acetone W_{a1}:	-	mg
(Filter) M_1:	0.00	mg

>PM$_{10}$ Recovery Analysis		
Container 2:		mg
Cont. 2 Tare:		mg
Acetone V_{aw2}:		ml
Acetone W_{a2}:	-	mg
(PM$_{2.5}$) M_2:	-	mg

<PM$_{2.5}$ Recovery Analysis		
Container 4:	2.2	mg
Cont. 4 Tare:		mg
Acetone V_{aw4}:		ml
Acetone W_{a4}:	-	mg
(PM$_{2.5}$) M_4:	2.200	mg

PM$_{2.5\text{-}10}$ Recovery Analysis		
Container 3:	0.62	mg
Cont. 3 Tare:		mg
Acetone V_{aw3}:		ml
Acetone W_{a3}:	-	mg
(PM$_{10}$-$_{2.5}$) M_3:	0.620	mg

Moisture Analysis		
Container 6:	207.3	g
Silica Gel Tare:	200	g
M_{sg}:	7.3	g
$V_{wsg(std)}$:	0.344	scf
Container 5:	-1.7	ml
$V_{wc(std)}$:	-0.080	scf
V_{ws}:	0.264	scf
B_{ws}:	0.006	H_20
Actual % H_2O:	0.6	%

Acetone Blank Analysis		
Container 7:	2300.1	mg
Container 7 Tare:	2299.9	mg
Acetone Density ρ_a:	0.000791	mg/ml
Blank Volume V_{aw}:	200	ml
Blank Conc.C_a:	1.264222503	mg_r/mg_v

CALCULATIONS AND DATA ANALYSIS

V_m:	46.150	acf - [Actual Sample Volume]
V_{ms}:	45.545	dscf - [Corrected Sample Volume (std)]
V_{ws}:	0.264	scf - [Volume of Water Vapor]
Q_{Sst}:	0.396	dscfm - [Corrected Dry Sampling Rate (std)]
Q_s:	0.401	acfm - [Actual Final Sampling Rate]
I:	97.405	% - [Percent Isokinetic Sampling]
N_{re}:	3044	[Actual Reynolds Number]
$V_{s(avg)}$:	33.80	fps - [Avgerage Stack Velocity]
μ:	184.362	mpoise - [Actual Gas Viscosity]
C:	1.0651	[Cunningham Correction Factor]
D_{50}:	10.911	μmeter - D50 for Cyclone 1
D_{50IV}:	2.339	μmeter - D50 for Cyclone IV
$Q_{sd(stack)}$:	574,797	dscf/hr - [Dry Stack Flow Rate (std)]
$Q_{sw(stack)}$:	578,123	scf/hr - [Wet Stack Flow Rate (std)]

Concentrations

PM$_{10}$: **0.00096** gr/dscf

Emission Rates

PM$_{10}$: **0.0785** lb/hr

Spreadsheet for U.S. EPA Method 201A - Determination of Filterable PM10 and PM2.5 Emissions

TEST RESULTS and DATA ANALYSIS SHEET

Location:	Banbury Mixer # 7	Start Time:	13:43:00	RUN No.	2
Date:	24-Oct-2013	End Time:	15:50:00	JOB No.	132-066

STACK DATA			Molecular Weight			EQUIPMENT			AVERAGE TEST DATA		
% Moisture:	2	% est.	%CO2:	0.00	%	METER BOX:	300.392				
Barometric:	29.62	in Hg	%O2:	20.90	%	Y:	0.990		Average ΔP:	0.39	in H_2O
Static Press:	-0.25	in H_2O	%N2/CO:	79.10	%	ΔH@:	1.912	in H_2O	Average T_m:	530.9	°R
Stack Press:	29.60	in Hg	Md:	28.84	lb/lb-mole	Cp':	0.765	S/N -	Average T_s:	531.9	°R
Stack Area:	4.8	ft^2	Actual Mw:	28.75	lb/lb-mole	Cp:	0.765	S/N -	Average ΔH:	0.55	in H_2O
# of Points:	24	points	Run Time:	108.00	min	Nozzle Dia:	0.1940	inches	T_{std}:	528.00	°R
									P_{std}:	29.92	in Hg

<$PM_{2.5}$ Filter Analysis			<$PM_{2.5}$ Recovery Analysis			Moisture Analysis		
Container 1:	0	mg	Container 4:	1	mg	Container 6:	208.4	g
C1 + Filter Tare:		mg	Cont. 4 Tare:		mg	Silica Gel Tare:	200	g
Acetone V_{aw1}:		ml	Acetone V_{aw4}:		ml	M_{sg}:	8.4	g
Acetone W_{a1}:	-	mg	Acetone W_{a4}:	-	mg	$V_{wsg(std)}$:	0.395	scf
(Filter) M_1:	0.000	mg	($PM_{2.5}$) M_4:	1.000	mg	Container 5:	-0.4	ml
>PM_{10} Recovery Analysis			$PM_{2.5\text{-}10}$ Recovery Analysis			$V_{wc(std)}$:	-0.019	scf
Container 2:		mg	Container 3:	0.31	mg			
Cont. 2 Tare:		mg	Cont. 3 Tare:		mg	V_{ws}:	0.377	scf
Acetone V_{aw2}:		ml	Acetone V_{aw3}:		ml	B_{ws}:	0.008	H_20
Acetone W_{a2}:	-	mg	Acetone W_{a3}:	-	mg	Actual % H_2O:	0.8	%
($PM_{2.5}$) M_2:	-	mg	($PM_{10\text{-}2.5}$) M_3:	0.310	mg			

Acetone Blank Analysis		
Container 7:		mg
Container 7 Tare:		mg
Acetone Density ρ_a:		mg/ml
Blank Volume V_{aw}:		ml
Blank Conc.C_a:	-	mg_r/mg_v

CALCULATIONS AND DATA ANALYSIS

V_m:	45.949	acf - [Actual Sample Volume]			
V_{ms}:	44.847	dscf - [Corrected Sample Volume (std)]			
V_{ws}:	0.377	scf - [Volume of Water Vapor]	μ:	185.33	mpoise - [Actual Gas Viscosity]
Q_{Sst}:	0.415	dscfm - [Corrected Dry Sampling Rate (std)]	C:	1.070	[Cunningham Correction Factor]
Q_s:	0.426	acfm - [Actual Final Sampling Rate]	D_{50}:	10.52	μmeter - D50 for Cyclone 1
I:	109.4	% - [Percent Isokinetic Sampling]	D_{50IV}:	2.207	μmeter - D50 for Cyclone IV
N_{re}:	3180	[Actual Reynolds Number]	$Q_{sd(stack)}$:	531,069	dscf/hr - [Dry Stack Flow Rate (std)]
$V_{s(avg)}$:	31.64	fps - [Avgerage Stack Velocity]	$Q_{sw(stack)}$:	535,528	scf/hr - [Wet Stack Flow Rate (std)]

Concentrations			Emission Rates		
PM_{10}:	0.00045	gr/dscf	PM_{10}:	0.0342	lb/hr

TEST RESULTS and DATA ANALYSIS SHEET

Location:	Banbury Mixer # 7	**Start Time:**	16:30:00	**RUN No.**	3
Date:	24-Oct-2013	**End Time:**	18:48:00	**JOB No.**	132-066

STACK DATA			Molecular Weight			EQUIPMENT			
% Moisture:	2	% est.	%CO2:	0.00	%	METER BOX:	300.392		
Barometric:	29.56	in Hg	%O2:	20.90	%	Y:	0.990		
Static Press:	-0.25	in H_2O	%N2/CO:	79.10	%	ΔH@:	1.912	in H_2O	
Stack Press:	29.54	in Hg	Md:	28.84	lb/lb-mole	Cp': 0.765	S/N	-	
Stack Area:	4.8	ft^2	Actual Mw:	28.73	lb/lb-mole	Cp: 0.765	S/N	-	
# of Points:	24	points	Run Time:	128.00	min	Nozzle Dia:	0.1930	inches	

AVERAGE TEST DATA		
Average ΔP:	0.46	in H_2O
Average T_m:	525.8	°R
Average T_s:	530.2	°R
Average ΔH:	0.54	in H_2O
T_{std}:	528.00	°R
P_{std}:	29.92	in Hg

<$PM_{2.5}$ Filter Analysis			<$PM_{2.5}$ Recovery Analysis		
Container 1:	0	mg	Container 4:	0	mg
C1 + Filter Tare:		mg	Cont. 4 Tare:		mg
Acetone V_{aw1}:		ml	Acetone V_{aw4}:		ml
Acetone W_{a1}:	-	mg	Acetone W_{a4}:	-	mg
(Filter) M_1:	0.000	mg	($PM_{2.5}$) M_4:	0.000	mg
>PM_{10} Recovery Analysis			**$PM_{2.5-10}$ Recovery Analysis**		
Container 2:		mg	Container 3:	0.55	mg
Cont. 2 Tare:		mg	Cont. 3 Tare:		mg
Acetone V_{aw2}:		ml	Acetone V_{aw3}:		ml
Acetone W_{a2}:	-	mg	Acetone W_{a3}:	-	mg
($PM_{2.5}$) M_2:	-	mg	(PM_{10}-2.5) M_3:	0.550	mg

Moisture Analysis		
Container 6:	214.9	g
Silica Gel Tare:	200	g
M_{sg}:	14.9	g
$V_{wsg(std)}$:	0.701	scf
Container 5:	-3.7	ml
$V_{wc(std)}$:	-0.174	scf
V_{ws}:	0.527	scf
B_{ws}:	0.010	H_20
Actual % H_2O:	1.0	%
Acetone Blank Analysis		
Container 7:		mg
Container 7 Tare:		mg
Acetone Density ρ_a:		mg/ml
Blank Volume V_{aw}:		ml
Blank Conc.C_a:	-	mg_r/mg_v

CALCULATIONS AND DATA ANALYSIS

V_m:	54.206	acf - [Actual Sample Volume]
V_{ms}:	53.31	dscf - [Corrected Sample Volume (std)]
V_{ws}:	0.527	scf - [Volume of Water Vapor]
Q_{Sst}:	0.417	dscfm - [Corrected Dry Sampling Rate (std)]
Q_s:	0.428	acfm - [Actual Final Sampling Rate]
I:	101.2	% - [Percent Isokinetic Sampling]
N_{re}:	3202	[Actual Reynolds Number]
$V_{s(avg)}$:	34.69	fps - [Avgerage Stack Velocity]

μ:	184.769	mpoise - [Actual Gas Viscosity]
C:	1.070	[Cunningham Correction Factor]
D_{50}:	10.47	μmeter - D50 for Cyclone 1
D_{50IV}:	2.19	μmeter - D50 for Cyclone IV
$Q_{sd(stack)}$:	582,079	dscf/hr - [Dry Stack Flow Rate (std)]
$Q_{sw(stack)}$:	587,835	scf/hr - [Wet Stack Flow Rate (std)]

Concentrations			Emission Rates		
PM_{10}:	0.00016	gr/dscf	PM_{10}:	0.0132	lb/hr

APPENDIX B

FIELD DATA SHEETS

EPA Method 1
Determination of Sampling Ports and Points

Client Goodyear Tire & Rubber Company City/State Danville, VA
Sampling Location Banbury Mixer #7 Stack Date 10/23/13

Sampling Location Dimensions, in inches: Port A Port B
From Far Wall to Outside of Port 35.75/35.50
Nipple Length 6.0 6.0
Depth of Duct 29.75 29.50
Width (Rectangular Duct) —

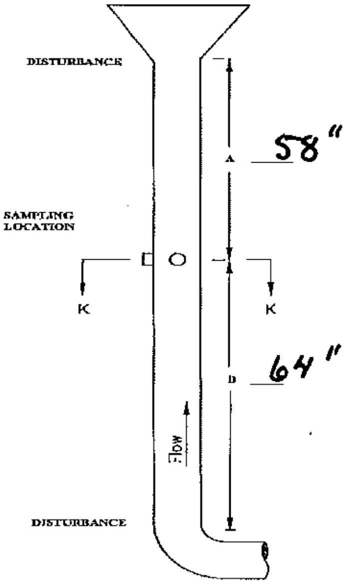
Equivalent Diameter Calculation (DE):

$$DE = \frac{2 \times Length \times Width}{Length + Width} = \frac{2(\text{—})(\text{—})}{(\text{—} + \text{—})} = \text{—}$$

Distance to Ports From Nearest Flow Disturbance:

	Upstream - A	Downstream - B
Dimensions in Inches	58"	64"
Duct Diameters	1.97	2.17

Stack Area, in Square Feet 4787
Calculations By WGS



Schematic of Sampling Location

Location of Traverse Points in Circular Stacks					
	4	6	8	10	12
1	6.7	4.4	3.2	2.6	2.1
2	25.0	14.6	10.5	8.2	6.7
3	75.0	29.6	19.4	14.6	11.8
4	93.3	70.4	32.3	22.6	17.7
5		85.4	67.7	34.2	25.0
6		95.6	80.6	65.8	35.6
7			89.5	77.4	64.4
8			96.8	85.4	75.0
9				91.8	82.3
10				97.4	88.2
11					93.3
12					97.9

Location of Traverse Points in Rectangular Stacks							
	2	3	4	5	6	7	8
1	25.0	16.7	12.5	10.0	8.3	7.1	6.3
2	75.0	50.0	37.5	30.0	25.0	21.4	18.8
3		83.3	62.5	50.0	41.7	35.7	31.3
4			87.5	70.0	58.3	50.0	43.8
5				90.0	75.0	64.3	56.3
6					91.7	78.6	68.8
7						92.9	81.3
8							93.8
9							
10							
11							
12							

Point	% of Stack ID	Stack ID, in.	Distance From Inside Wall, in.	Nipple Length, in.	Distance From Outside of Port, in.
1	2.1	29.50	0.62	6.0	6.62→7.0
2	6.7		1.98		7.98
3	11.8		3.48		9.48
4	17.7		5.22		11.22
5	25.0		7.38		13.38
6	35.6		10.5		16.5
7	64.4		19.0		25.0
8	75.0		22.13		28.13
9	82.3		24.28		30.28
10	88.2		26.02		32.02
11	93.3		27.52		33.52
12	97.9		28.88		34.88→
					34.5

Stack Diameter = 12 - 24 inches Relocate to 0.50 inches from stack wall
Stack Diameter > 24 inches Relocate to 1.00 inches from stack wall

Audited by: MB **(Personnel)** **Date:** 11/18/13 **Completeness** ✓ **Legibility** ✓ **Accuracy** ✓
Audited by: WGS **(Team Leader) Date:** 11/11/13 **Specifications** ✓ **Reasonableness** ✓

EPA Method 1
Determination of Sampling Ports and Points

Client Goodyear Tire & Rubber Company City/State Danville, VA
Sampling Location Banbury Mixer #7 Stack Date 10/23/13

Sampling Location Dimensions, in inches:
From Far Wall to Outside of Port ~~35.75~~ / 35.50
Nipple Length 6.0 / 6.0
Depth of Duct ~~29.75~~ / 29.50 = 29.625
Width (Rectangular Duct) —

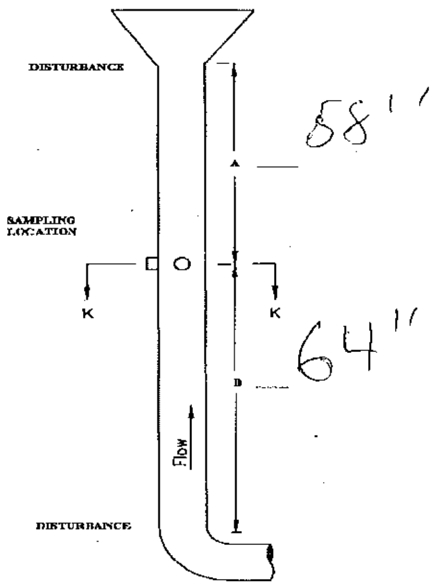
Equivalent Diameter Calculation (DE):

$$DE = \frac{2 \times \text{Length} \times \text{Width}}{\text{Length} + \text{Width}} = \frac{2(\;-\;)(\;-\;)}{(\;-\;+\;-\;)} = -$$

Distance to Ports From Nearest Flow Disturbance:

	Upstream - A	Downstream - B
Dimensions in Inches	58"	64"
Duct Diameters	1.95"	2.15 ✓

Stack Area, in Square Feet 4.787 ✓ (29.625)
Calculations By JAJ



Schematic of Sampling Location

Location of Traverse Points in Circular Stacks

	4	6	8	10	12
1	6.7	4.4	3.2	2.6	2.1
2	25.0	14.6	10.5	8.2	6.7
3	75.0	29.6	19.4	14.6	11.8
4	93.3	70.4	32.3	22.6	17.7
5		85.4	67.7	34.2	25.0
6		95.6	80.6	65.8	35.6
7			89.5	77.4	64.4
8			96.8	85.4	75.0
9				91.8	82.3
10				97.4	88.2
11					93.3
12					97.9

Location of Traverse Points in Rectangular Stacks

	2	3	4	5	6	7	8
1	25.0	16.7	12.5	10.0	8.3	7.1	6.3
2	75.0	50.0	37.5	30.0	25.0	21.4	18.8
3		83.3	62.5	50.0	41.7	35.7	31.3
4			87.5	70.0	58.3	50.0	43.8
5				90.0	75.0	64.3	56.3
6					91.7	78.6	68.8
7						92.9	81.3
8							93.8
9							
10							
11							
12							

Point	% of Stack ID	Stack ID, in.	Distance From Inside Wall, in.	Nipple Length, in.	Distance From Outside of Port, in.
1	2.1	29.50	0.62	6.0	6.62 → 7.00
2	6.7		1.98		7.98
3	11.8		3.50		10.50
4	17.7		5.24		11.24
5	25.0		7.41		13.41
6	35.6		10.55		16.55
7	64.4		19.08		25.08
8	75.0		22.22		28.22
9	82.3		24.38		30.38
10	88.2		26.13		32.13
11	93.3		27.64		33.64
12	97.9		29.00		35.00 → 34.5
1					

Stack Diameter = 12 - 24 inches Relocate to 0.50 inches from stack wall
Stack Diameter > 24 inches Relocate to 1.00 inches from stack wall

Audited by: M (Personnel) **Date:** 11/11/13 **Completeness** ✓ **Legibility** ✓ **Accuracy** ✓
Audited by: WGS (Team Leader) **Date:** 11/18/13 **Specifications** ✓ **Reasonableness** ✓

EPA Method 2
Determination of Stack Gas Velocity, Volumetric Flow Rate and Cyclonic Flow

Client Goodyear
Sampling Location Banbury Mixer #7 Stack
Run Date 10/23/13
Barometric Pressure, in. Hg 29.55
Static Pressure, in. H_2O -0.40
Pitot Tube Coefficient 0.84

City, State Danville, VA
Operators
Time 1500
Pitot Tube I.D. No. 2007 11
Date Calibrated 1511
Leak Check, in. H_2O <0.1 @ 3.5 / -3.0

Field Data

Traverse Point Number	Velocity Head Δp Inches H_2O		Stack Temperature °F		Cyclonic Flow Determination			
	L	R			A	B	A	B
	A	B	A	B	Δp, at 0° Reference		Angle Which Yields a Null Δp	
1	0.59	0.57	73	73	0.11	0.08	8°	8°
2	0.55	0.59	74	73	0.11	0.09	8°	9°
3	0.50	0.55	74	74	0.14	0.09	10°	10°
4	0.53	0.50	75	74	0.12	0.10	14°	10°
5	0.52	0.38	75	74	0.13	0.11	18°	14°
6	0.45	0.30	75	74 -	0.11	0.14	13°	15°
7	0.30	0.44	75	74 -	0.05	0.09	10°	12°
8	0.26	0.45	75	74	0	0.06	0	10°
9	0.25	0.43	75	74	0	0.06	0	9°
10	0.20	0.40	75	74	0	0.07	0	9°
11	0.15	0.38	75	74	0	0.06	0	11°
12	0.13	0.36	75	74	0	0.08	0	30°
Averages		0.408		74.25				~~11.68~~ WOB 9.3✓

Stack Temperature, Dry, °F (A) —
Stack Temperature, Wet °F (B) —
Difference (A - B) —
Preliminary Percent Moisture 2

Comments

Audited by: M **(Personnel)** **Date:** 11/18/13 **Completeness** ✓ **Legibility** ✓ **Accuracy** ✓
Audited by: WOB **(Team Leader)** **Date:** 11/18/13 **Specifications** ✓ **Reasonableness** ✓

CEC
Civil & Environmental
Consultants, Inc.

Isokinetic Field Data Sheet - EPA Method 5/202

Client The Goodyear Tire and Rubber Company
Run Number 1
City/State Danville, VA
Date 10/24/13
Sampling Location Unit No. 7 - Banbury Mixer
Operators WQB/BLS JAJ

Bar. Press., In. Hg 29.62
Static Press., In. H_2O -0.25
Meter Box No. 300.390
Sample Box No. D
Probe/Pitot No. 200.077
Probe Temp. Setting 250
Sample ID No. 132066-01
Filter No. 5622

NOMOGRAPH SET-UP: K Factor 4.24
ΔH @ 1.956 Y = 0.986
Meter Temp. ~~45~~ 63°
Stack Temp. ~~45~~ 65°
Pitot Coeff. 0.84
% Moisture 2
C Factor ——
Start Time 0955

Avg. Δ P 0.41
Ref. Δ P ——
Desired Nozzle 0.26
Nozzle No. 300.192
Nozzle Calibration .248, .248, .247
Nozzle Diameter .248
End Time 1210

LEAK CHECKS
Pre-Test 0.002 @ 14 In. Hg.
Post-Test 0.002 @ 5.0 In. Hg.
Pre-Test Pitot <0.1 @ 9.2/4.6 In. H_2O
Post-Test Pitot <0.1 @ +6.0/-3.0 In. H_2O
Observer ——
Agency VADEQ

Sample Point	Clock Time	Dry Gas Meter Cubic Feet	Pitot Reading Δ P In. H_2O	Orifice Setting ΔH Inches H_2O Ideal	Actual	Dry Gas Meter Temp. °F	Pump Vacuum Inches Hg	Stack Temp °F	Probe Temp °F	Filter Exhaust °F	~~Impinger~~ CPM Filter Exhaust °F	Impinger Temp °F
A1	0	975.900	0.15	0.64	0.65	58	1	61	253	264	52	52
2	5	978.10	0.18	0.76	0.75	62	1	62	244	270	52	44
3	10	980.61	0.24	1.02	1.00	62	1	63	255	265	52	43
4	15	983.22	0.24	1.02	1.00	63	1	65	253	261	52	44
5	20	986.24	0.30	1.27	1.25	65	1	65	248	265	53	45
6	25	989.31	0.30	1.27	1.25	65	1	65	246	265	54	45
7	30	992.40	0.41	1.74	1.75	67	1	66	249	264	54	46
8	35	996.10	0.41	1.74	1.75	68	1	66	250	258	57	46
9	40	999.71	0.55	2.33	2.35	70	1	66	250	264	57	48
10	45	3.94	0.55	2.33	2.35	71	1	67	245	262	58	49
11	50	8.42	0.55	2.33	2.35	72	1	67	250	261	58	50
12	55	12.65	0.55	2.33	2.35	72	1	68	250	258	58	50
B1	60	17.015	0.40	1.70	1.70	72	1	68	245	244	58	55
2	65	20.75	0.40	1.70	1.70	75	1	66	250	240	60	51
3	70	24.38	0.40	1.70	1.70	75	1	68	249	248	61	52
4	75	27.91	0.40	1.70	1.70	75	1	69	250	251	61	52
5	80	31.83	0.40	1.70	1.70	74	1	69	249	249	61	52
6	85	35.69	0.40	1.70	1.70	76	1	69	245	250	61	58
7	90	39.31	0.29	1.23	1.25	79	1	69	248	253	60	51
8	95	42.47	0.29	1.23	1.25	79	1	69	246	250	59	51
9	100	45.70	0.37	1.57	1.55	80	1	70	238	244	59	51
10	105	49.24	0.42	1.78	1.80	80	1	70	251	251	60	50
11	110	52.97	0.44	1.87	1.85	80	1	70	246	245	60	50
12	115	56.90	0.44	1.87	1.85	80	1	70	250	246	60	50
	120	60.609										
		84.709	0.378		1.606	71.7		67.0				

Comments:

Isokinetic Check:

Audited by: [illegible] (Personnel) Date: 11/18/13 Completeness ✓ Legibility ✓ Accuracy ✓

Audited by: WBB (Team Leader) Date: 11/11/13 Specifications ✓ Reasonableness ✓

Civil & Environmental Consultants, Inc.

Isokinetic Field Data Sheet - EPA Method 5/202

Client The Goodyear Tire and Rubber Company
Run Number 2
City/State Danville, VA
Date 10/24/13
Sampling Location Unit No. 7 - Banbury Mixer
Operators WQB/~~BLS~~ JAJ

Bar. Press., In. Hg 29.62
NOMOGRAPH SET-UP: *K Factor* 4.100/4.062
LEAK CHECKS
Static Press., In. H_2O -0.25
ΔH @ 1.956 Y = 0.986
Avg. Δ P 0.378
Pre-Test 0.003 @ 14.0 In. Hg.
Meter Box No. 300.370
Meter Temp. 85
Ref. Δ P —
Post-Test 0.005 @ 6.5 In. Hg.
Sample Box No. D
Stack Temp. 70
Desired Nozzle 0.256
Pre-Test Pitot <0.1 @ +9.0/-4.1 In. H_2O
Probe/Pitot No. 200.080
Pitot Coeff. 0.84
Nozzle No. 300.488
Post-Test Pitot <0.1 @ 17.0/3.2 In. H_2O
Probe Temp. Setting 250
% Moisture 2
Nozzle Calibration 0.243, 0.244, 0.245
Sample ID No. 132066-02
C Factor —
Nozzle Diameter 0.244
Observer —
Filter No. 5623
Start Time 1343
End Time 1554
Agency VADEQ

Sample Point	Clock Time	Dry Gas Meter Cubic Feet	Pitot Reading Δ P In. H_2O	Orifice Setting ΔH Inches H_2O Ideal	Actual	Dry Gas Meter Temp. °F	Pump Vacuum Inches Hg	Stack Temp °F	Probe Temp °F	Filter Exhaust °F	Impinger Filter Exhaust °F	Impinger Temp °F
A1	0	64.468	0.52	2.13	2.15	69	1	68	245	248	57	55
2	5	68.60	0.49	2.00	2.00	72	1	71	253	249	58	59
3	10	72.50	0.49	2.00	2.00	72	1	71	254	250	59	59
4	15	76.45	0.45	1.85	1.85	72	1	70	249	250	60	64
5	20	80.44	0.45	1.85	1.85	72	1	71	247	250	62	65
6	25	84.30	0.45	1.85	1.85	72	1	72	243	245	65	65
7	30	88.21	0.45	1.85	1.85	72	1	73	247	250	64	64
8	35	92.70	0.49	2.00	2.00	74	1	72	245	254	65	63
9	40	95.69	0.45	1.85	1.85	76	1	72	245	251	65	63
10	45	99.58	0.42	1.72	1.70	78	1	70	248	250	65	62
11	50	103.41	0.42	1.72	1.70	80	1	72	245	255	65	62
12	55	107.31	0.15	0.62	0.62	80	1	70	243	255	65	61
B1	60	109.483	0.325	1.340	1.340	77	1	73	241	250	60	57
2	65 1129	112.90	0.24	0.98	0.98	78	1	73	243	249	61	56
3	70	115.62	0.21	0.85	0.85	78	1	74	247	257	61	55
4	75	118.22	0.24	0.98	0.98	78	1	73	249	262	60	56
5	80	121.02	0.28	1.14	1.10	77	1	73	242	255	60	56
6	85	124.44	0.34	1.38	1.40	78	1	72	246	260	60	57
7	90	127.41	0.47	1.91	1.90	77	3	73	252	257	60	57
8	95	131.834	0.57	2.32	2.30	77	4	74	247	249	61	58
9	100	135.69	0.58	2.36	2.35	78	4	74	245	261	62	59
10	105	139.94	0.56	2.28	2.30	80	3.5	73	243	257	62	61
11	110	144.27	0.57	2.32	2.30	80	3.5	72	240	262	63	61
12	115	148.46	0.59	2.40	2.40	79	3.5	72	249	258	64	62
	120	152.804	0.426	✓		✓						
		88.336 ✓	0.43		1.74	76.08	✓	72.0	✓			

Comments:

Isokinetic Check: 102.1

Audited by: M (Personnel) Date: 11/8/13 Completeness ✓ Legibility ✓ Accuracy ✓
Audited by: WBG (Team Leader) Date: 11/11/13 Specifications ✓ Reasonableness ✓

Civil & Environmental Consultants, Inc.

Isokinetic Field Data Sheet - EPA Method 5/202

Client The Goodyear Tire and Rubber Company
Run Number 3
City/State Danville, VA
Date 10/24/13
Sampling Location Unit No. 7 - Banbury Mixer
Operators WQB/~~BLS~~ JAJ

Bar. Press., In. Hg 29.56
NOMOGRAPH SET-UP: K Factor 4.239
LEAK CHECKS
Static Press., In. H_2O -.25
ΔH @ 1.956 Y = 0.986
Avg. Δ P 0.426
Pre-Test 0.005 @ 13.0 In. Hg.
Meter Box No. 360.390
Meter Temp. 70
Ref. Δ P —
Post-Test 0.001 @ 5 In. Hg.
Sample Box No. D
Stack Temp. 72
Desired Nozzle 0.252
Pre-Test Pitot <0.1 @ +6.5/-4.6 In. H_2O
Probe/Pitot No. 200.077
Pitot Coeff. 0.84
Nozzle No. 360.192
Post-Test Pitot <0.1 @ 8.3/3.7 In. H_2O
Probe Temp. Setting 250
% Moisture 2
Nozzle Calibration .248 .248 .247
Sample ID No. 132066-03
C Factor —
Nozzle Diameter .248
Observer —
Filter No. 5624
Start Time 1630
End Time 1844
Agency VADEQ

Sample Point	Clock Time	Dry Gas Meter Cubic Feet	Pitot Reading Δ P In. H_2O	Orifice Setting ΔH Inches H_2O Ideal	Orifice Setting ΔH Inches H_2O Actual	Dry Gas Meter Temp. °F	Pump Vacuum Inches Hg	Stack Temp °F	Probe Temp °F	Filter Exhaust °F	Impinger Filter Exhaust °F	Impinger Temp °F
A1	0	153.224 ~~153.095~~	0.20	0.85	0.85	67	1	70	252	248	55	54
2	5	155.80	0.20	0.85	0.85	67	1	70	255	251	55	54
3	10	158.35	0.28	1.19	1.20	68	1	70	254	250	55	52
4	15	161.41	0.28	1.19	1.20	69	1	71	252	251	55	51
5	20	164.39	0.32	1.36	1.35	69	1	71	254	256	55	52
6	25	167.60	0.34	1.44	1.45	69	1	71	252	254	55	52
7	30	170.81	0.39	1.65	1.65	69	1	71	250	260	56	53
8	35	174.35	0.57	2.42	2.40	69	2	71	246	254	57	53
9	40	178.68	0.58	2.46	2.45	69	2	71	248	252	57	53
10	45	183.14	0.56	2.37	2.35	69	2	71	249	240	58	55
11	50	187.34	0.56	2.37	2.35	70	2	~~70~~ 71	245	250	58	56
12	55	191.65	0.55	2.33	2.35	70	2	71	249	257	59	56
B1	60	195.939	0.38 31	1.35 31	1.35 30	66	1	71	252	256	55	54
2	65	199.06	0.31	1.31	1.30	67	1	71	255	252	55	54
3	70	202.19	0.42	1.78	1.80	67	1	71	246	246	56	55
4	75	206.17	0.44	1.87	1.85	67	1	71	247	258	56	58
5	80	209.93	0.46	1.95	1.95	67	1.5	71	251	256	57	60
6	85	213.64	0.45	1.91	1.90	67	1.5	70	246	251	56	60
7	90	217.35	0.46	1.95	1.95	67	1.5	70	245	255	56	60
8	95	221.24	0.32	1.36	1.35	67	1	69	244	253	56	60
9	100	224.38	0.40	1.70	1.70	67	1	70	251	250	56	60
10	105	227.96	0.45	1.91	1.90	66	1	69	251	248	55	60
11	110	231.82	0.48	2.04	2.05	64	1.5	69	251	246	56	60
12	115	235.78	0.49	2.08	2.10	64	1.5	68	248	246	56	60
	120	239.747										
		86.523 ✓	0.409 ✓		1.733 ✓	67.708 ✓		70.838 ✓				

Comments:

Isokinetic Check: 100.141

Audited by: JB (Personnel) Date: 11/8/13 Completeness ✓ Legibility ✓ Accuracy ✓
Audited by: WQB (Team Leader) Date: 11/11/13 Specifications ✓ Reasonableness ✓

Civil & Environmental Consultants, Inc.

Methods 5 & 202 and Sample Recovery – Data Analysis

Client Name Goodyear
City/State Danville, VA
Sampling Location Banbury Mixer No. 7
Clean-Up Box Number M5/202
Chain of Custody: Date Received 10/25/13

Project Number 132-066
Sample Date 10/24/13
Samples Recovered BY
Recovery Date BY 10/24/13
Received By W PRJ Locked? ✓

Equipment Documentation

Run Number	1	2	3	
Sample ID Number	132-066-01	132-066-02	132-066-03	
Sample Box Number	D	D	D	
Probe Number	200.077	200.080	200.077	

300.192 300.488 300.192

Sample Recovery – Fraction 1

Filter Container #	BV ~~[illegible]~~ 5622	5623	5624	
Particulate Description	None visible	None visible	None visible	
Filter Container Sealed?	✓	✓	✓	

Sample Recovery – Fraction 2

Probe Rinse Container #	132066-01	132066-02	132066-03	
Rinsing Solution	Acetone	Acetone	Acetone	Acetone
Sample Container Sealed?	✓	✓	✓	
Liquid Level Marked?	✓	✓	✓	

Analysis of Moisture and Sample Recovery – Fraction 3

Reagent Recovery Container	132066-01	132066-02	132066-03	
Imp. Absorbing Solution	DI H_2O	DI H_2O	DI H_2O	DI H_2O
Description of Reagent	clear	clear	clear	
Reagent Level Marked?	✓	✓	✓	
Final Volume, ml	97.9	92.0	97.6	
Initial Volume, ml	100	100	100	
Net Condensed Volume, ml	-2.1	-8.0	-2.4	
N_2 Purge	1 hour-14 LPM	1 hour-14 LPM	1 hour-14 LPM	
Rinse twice with DI H_2O	✓	✓	✓	
Rinse twice with Acetone	✓	✓	✓	
Rinse twice with hexane	✓	✓	✓	

Analysis of Moisture and Sample Recovery – Silica Gel

Silica Gel Recovery Container #	1	2	3	
Percent Silica Gel Spent	25%	30%	30%	
Final Weight, g	213.9	222.2	220.5	
Initial Weight, g	200	200	200	
Net Absorbed Water, g	13.9	22.2	20.5	
Total Moisture Collected, g	11.8	14.2	18.1	

Reagent Blanks

200mL BV

Absorbing Reagent Blank (~~500~~mL)	DI H_2O	Absorbing Blank ID#	132066-09
Rinsing Reagent Blank (200 mL)	Acetone	Rinsing Blank ID #	132066-08
Rinsing Reagent Blank (200 mL)	Hexane	Rinsing Blank ID #	132066-10
Analyst Initials	BLS	Reviewer Initials	

Balance ID	Wt.(200 mg)	Wt. (500 mg)	Wt. (1,000 mg)	
10/23/13	200.0	500.0	1000.0	
10/24/13	200.0	499.9	999.9	

Audited by: Mr **(Personnel)** **Date:** 11/18/13 **Completeness** ✓ **Legibility** ✓ **Accuracy** ✓
Audited by: LOOB **(Team Leader)** **Date:** 11/11/13 **Specifications** ✓ **Reasonableness** ✓

Civil & Environmental Consultants, Inc.

Method 5 & 202 – Moisture Determination and Sample Recovery

Client Name Goodyear
City/State Danville, VA
Sampling Location Banbury Mixer No. 7

Project Number: 132-066
Sample Date: 10/24/13
Samples Recovered by: BV
Recovery Date 10/24/13

Moisture Recovery by weight

Run No.: 1				
Impinger Bottle Weight	Initial wt. (mg)	Final Wt (mg)	Difference (gain) wt.	
1st Imp. Bottle	479.8	BV ~~481.5~~ 479.1	-0.7	
2nd Imp. Bottle	608.7	609.4	0.7	-2.1
3rd Imp. Bottle	700.2	698.1	-2.1	
4th Imp. Bottle	796.7	810.6	13.9	
5th Imp. Bottle				
6th Imp. Bottle			TC =	11.80 grams

Run No.: 2				
Impinger Bottle Weight	Initial wt. (mg)	Final Wt (mg)	Difference (gain) wt.	
1st Imp. Bottle	485.1	484.1	-1.0	
2nd Imp. Bottle	596.8	597.4	0.6	-8.0
3rd Imp. Bottle	709.4	701.8	-7.6	
4th Imp. Bottle	806.4	828.6	22.2	
5th Imp. Bottle				
6th Imp. Bottle			TC =	14.2 grams

Run No.: 3				
Impinger Bottle Weight	Initial wt. (mg)	Final Wt (mg)	Difference (gain) wt.	
1st Imp. Bottle	479.3	479.4	0.1	
2nd Imp. Bottle	606.8	607.2	0.4	-2.4
3rd Imp. Bottle	691.0	688.1	-2.9	
4th Imp. Bottle	794.1	814.6	20.5	
5th Imp. Bottle				
6th Imp. Bottle			TC =	18.1 grams

Run No.:				
Impinger Bottle Weight	Initial wt. (mg)	Final Wt (mg)	Difference (gain) wt.	
1st Imp. Bottle				
2nd Imp. Bottle				
3rd Imp. Bottle				
4th Imp. Bottle				
5th Imp. Bottle				
6th Imp. Bottle				

Audited by: ____ **(Personnel)** **Date:** 11/18/13 **Completeness** ✓ **Legibility** ✓ **Accuracy** ✓

Audited by: ____ **(Team Leader)** **Date:** 11/11/13 **Specifications** ✓ **Reasonableness** ✓

Civil & Environmental Consultants, Inc.

EPA Method 2
Determination of Stack Gas Velocity, Volumetric Flow Rate and Cyclonic Flow

Client Goodyear Tire & Rubber Company
Sampling Location Banbury #7
Run Date 10/24/13
Barometric Pressure, in. Hg -0.25 29.65
Static Pressure, in. H_2O ~ ↓
Pitot Tube Coefficient 0.765

City, State Danville VA
Operators WDB, JAM
Time 0900
Pitot Tube I.D. No. 200,302 / 0799
Date Calibrated 6/22/13
Leak Check, in. H_2O <0.1 @ 3.8 / -3.9

Field Data

Traverse Point Number	Velocity Head Δp Inches H_2O		Stack Temperature °F		Cyclonic Flow Determination			
					Δp, at 0° Reference		Angle Which Yields a Null Δp	
	A	B	A	B				
1 1	0.63	0.62	57	62				
2 1	0.64	0.62	59	62				
3 2	0.60	0.50	60	62				
4 2	0.60	0.50	61	62				
5 3	0.58	0.36	61	62				
6 3	0.57	0.35	61	62				
7 4	0.33	0.49	61	62				
8 4	0.33	0.48	61	62				
9 5	0.26	0.44	60	60				
10 5	0.26	0.45	60	60				
11 6	0.20	0.42	—	—				
12 6	0.19	0.41	—	—				
		✓		✓				
Averages		0.451		60.87				

Stack Temperature, Dry, °F (A) —
Stack Temperature, Wet °F (B) —
Difference (A - B) —
Preliminary Percent Moisture 2

Comments

Audited by: MR (Personnel) Date: 11/18/13 Completeness Legibility ✓ Accuracy ✓
Audited by: WB (Team Leader) Date: 11/12/13 Specifications ✓ Reasonableness ✓

Civil & Environmental Consultants, Inc.

PRELIMINARY TEST DATA SHEET

Location: Banbury Mixer # 7
Date: 24-Oct-2013
Start Time: 9:00:00
End Time: 9:20:00
RUN No. 1
JOB No. 132-066

STACK DATA

Head Config.
PM_{10} & $PM_{2.5}$ (1), PM_{10} Only (2), $PM_{2.5}$ Only (3): 2

% Moisture:	2	% est.	**%CO_2:**	0.00	%
Barometric:	29.65	in Hg	**%O_2:**	20.90	%
Static Press:	-0.25	in H_2O	**%N_2/CO:**	79.10	%
Stack Press:	29.63	in Hg	**M_d:**	28.84	lb/lb-mole
Stack Area:	4.79	ft^2	**Est. M_w:**	28.62	lb/lb-mole
Stack Area:	689.3	in^2			

STANDARD CONDITIONS
T_{std}: 68 °F
P_{std}: 29.92 inches Hg

PRE-TEST CALCULATIONS

Viscocity μ_s:	181.47	mpoise
Cunningham:	1.0664	
D_{50LL}:	10.68	μm
[N_{re}>3162] D_{50LL}:	-	μm
D_{50T}:	10.84	μm
Estimated Q_s:	0.3979	acfm
Estimated N_{re}:	3085	
Estimated ΔH:	0.508	in H_2O

EQUIPMENT

METER BOX:	300.392	
Y:	0.990	
ΔH@:	1.912	in H_2O
Estimated T_m:	52	°F
Cp':	0.765	S/N
Cp:	0.765	S/N
Nozzle Dia:	0.193	inches
Nozzle Area:	0.00020	ft^2

PRELIMINARY TRAVERSE

Sample Point	Cyclonic Flow Check Null Angle °	Preliminary ΔP (in. H_2O) ΔP_m	 ΔP_s	 ΔP_{s2}	Stack Temperature (°F)
1	8.0	0.630	0.630	0.672	57.0
2	8.0	0.640	0.640	0.683	59.0
3	10.0	0.600	0.600	0.640	60.0
4	14.0	0.600	0.600	0.640	61.0
5	12.0	0.580	0.580	0.619	61.0
6	13.0	0.570	0.570	0.608	61.0
7	10.0	0.330	0.330	0.352	61.0
8	0.0	0.330	0.330	0.352	61.0
9	0.0	0.260	0.260	0.277	60.0
10	0.0	0.260	0.260	0.277	60.0
11	0.0	0.200	0.200	0.213	60.0
12	0.0	0.190	0.190	0.203	60.0
13	8.0	0.620	0.620	0.662	62.0
14	9.0	0.620	0.620	0.662	62.0
15	10.0	0.500	0.500	0.534	62.0
16	10.0	0.500	0.500	0.534	62.0
17	14.0	0.360	0.360	0.384	62.0
18	15.0	0.350	0.350	0.373	62.0
19	12.0	0.490	0.490	0.523	62.0
20	10.0	0.480	0.480	0.512	62.0
21	9.0	0.440	0.440	0.469	60.0
22	9.0	0.450	0.450	0.480	60.0
23	11.0	0.420	0.420	0.448	60.0
24	30.0	0.410	0.410	0.437	60.0
	9.3 (absolute °)	0.451	0.451	0.481	60.708

NOZZLE SELECTION

Nozzle S/N	Diam. Dn (in)	Vn (fps)	V_{min} (fps)	V_{max} (fps)	ΔP_{min} (inches H_2O)	ΔP_{max}
	0.125	77.82	59.09	95.58	1.33	3.48
	0.138	63.85	47.53	79.03	0.86	2.38
	0.154	51.27	36.97	64.19	0.52	1.57
	0.178	38.38	25.79	49.08	0.25	0.92
	0.193	32.64	20.55	42.41	***0.16***	***0.69***
	0.200	30.40	18.40	39.82	0.13	0.60
	0.220	25.12	12.85	33.75	0.06	0.43
	0.250	19.45	9.73	27.29	0.04	0.28
	0.253	19.00	9.50	26.77	0.03	0.27
	0.274	16.20	8.10	23.62	0.02	0.21
	0.296	13.88	6.94	20.82	0.02	0.17
	0.320	11.87	5.94	17.81	0.01	0.12

NOTE: This spreadsheet contains circular references, therefore, iterative calculation must be turned on in Excel. In the 2010 version of Excel, the iterative calculation selection is located in File/Options/Formulas.

10/24/13
Test Personnel (signature/date)

11/21/13 Review
Project Leader (signature/date)

Spreadsheet for U.S. EPA Method 201A - Determination of Filterable PM10 and PM2.5 Emissions
TEST DATA SHEET

Location: Banbury Mixer # 7
Start Time: 9:55
RUN No. 1
Date: 24-Oct-2013
End Time: 12:10
JOB No. 132-066

STACK DATA			EQUIPMENT			ESTIMATES			+/- 50°F ΔH			
% Moisture:	2	% est.	METER BOX:	300.392		Ts (°F): 60.71	Tm (°F):	52	Ts-50°	10.7083333	Ts+50°	110.708
Barometric:	29.65	in Hg	Y:	0.990		Est. Qs:	0.3979	cfm	Est. Qs:	0.4328	Est. Qs:	0.458
Static Press:	-0.25	in H_2O	ΔH@:	1.912	in H_2O	Est. μ_s:	181.47	mpoise	Est. μ_s:	157.534386	Est. μ_s:	181.53
Stack Press:	29.63	in Hg	Cp': 0.765	S/N	-	Est. ΔH:	0.508	in H_2O	Est. ΔH:	0.621	Est. ΔH:	0.423
$\%CO_2$:	0.00	%	Cp: 0.765	S/N	-	LEAK CHECKS						
$\%O_2$:	20.90	%	Nozzle Dia:	0.1930	inches	DGM initial	292.88		339.04	cf		
$\%N_2/CO$:	79.10	%	Stack Area:	4.8	ft^2	DGM final	292.886		339.042	cf		
M_d:	28.84	lb/lb-mole	# of Points:	24	points	Time	1		1	min.		
Est. M_w:	28.62	lb/lb-mole	Run Time:	120.00	min	Leak Rate	0.0060		0.0020	cfm		
T_{std}:	528	°R	P_{std}:	29.92	in Hg	Vacuum	15		5	in. Hg		

Sample Point	Clock Time (min)	Dry Gas Meter Reading (ft^3)	Pitot ΔP ("H_2O)	Gas Temperatures (°F) DGM Inlet	Gas Temperatures (°F) DGM Outlet	Gas Temperatures (°F) Stack	Orifice Press. ΔH (in H_2O) Ideal	Orifice Press. ΔH (in H_2O) Actual	Pump Vac. (in Hg)	Gas Temps (°F) Probe	Gas Temps (°F) Filter	Gas Temps Imp. Exit	Qs (acfm)	D_{50} [10 µm]	D_{50} [2.5 µm]	Pt. Iso
1	5.75	292.9000	0.640	58.0	58.0	65	0.505	0.500	1	175	58	41	0.4174	10.54	2.21	83.24%
2	11.50	295.2400	0.620	59.0	59.0	65	0.506	0.510	1	218	54	46	0.4113	10.65	2.25	83.33%
3	16.75	297.5500	0.520	59.0	59.0	65	0.506	0.510	1	225	54	46	0.4115	10.65	2.24	91.02%
4	22.00	299.6600	0.520	60.0	60.0	65	0.507	0.510	1	230	55	47	0.4165	10.55	2.22	92.14%
5	26.25	301.8000	0.330	61.0	61.0	65	0.508	0.510	1	230	55	48	0.4128	10.62	2.24	114.62%
6	30.50	303.5200	0.340	61.0	61.0	65	0.508	0.510	1	230	56	48	0.4032	10.80	2.30	110.29%
7	35.75	305.2000	0.520	62.0	62.0	65	0.509	0.510	1	234	58	48	0.4072	10.73	2.27	90.07%
8	41.00	307.3000	0.520	63.0	63.0	66	0.508	0.510	1	236	59	49	0.4130	10.63	2.24	91.27%
9	45.75	309.4300	0.420	63.0	63.0	66	0.508	0.510	1	246	60	49	0.4157	10.58	2.22	102.23%
10	50.50	311.3700	0.430	65.0	65.0	66	0.510	0.520	1	242	61	49	0.4163	10.57	2.22	101.17%
11	54.75	313.3200	0.340	65.0	65.0	66	0.510	0.510	1	245	61	50	0.4199	10.51	2.20	114.77%
12	59.00	315.0800	0.350	67.0	67.0	65	0.514	0.520	1	245	60	49	0.4050	10.77	2.29	109.20%
13	64.75	316.7870	0.640	67.0	67.0	67	0.510	0.510	1	243	58	53	0.4019	10.86	2.32	79.98%
14	70.50	319.0700	0.620	67.0	67.0	67	0.510	0.510	1	245	58	50	0.3714	11.48	2.56	75.10%
15	76.25	321.1800	0.610	68.0	68.0	68	0.509	0.510	1	245	58	50	0.4330	10.31	2.16	88.19%
16	82.00	323.6400	0.610	68.0	68.0	68	0.509	0.500	1	249	60	49	0.2394	15.70	4.35	48.75%
17	87.50	325.0000	0.590	69.0	69.0	69	0.508	0.500	1	244	63	51	0.4876	9.49	1.96	100.89%
18	93.00	327.6500	0.590	70.0	70.0	70	0.507	0.500	1	244	63	53	0.3956	11.02	2.39	81.78%
19	97.25	329.8000	0.340	70.0	70.0	69	0.509	0.500	1	245	65	52	0.5253	9.00	1.84	143.16%
20	101.75	332.0100	0.360	71.0	71.0	69	0.510	0.510	1	245	66	52	0.4212	10.53	2.21	111.57%
21	105.25	333.8900	0.240	72.0	72.0	70	0.509	0.520	1	250	67	53	0.4610	9.89	2.05	149.38%
22	109.00	335.4900	0.250	72.0	72.0	70	0.509	0.510	1	250	67	54	0.2958	13.54	3.40	93.92%
23	112.00	336.5900	0.160	72.0	72.0	70	0.509	0.500	1	245	65	56	0.4033	10.87	2.33	160.08%
24	115.00	337.7900	0.170	72.0	72.0	70	0.509	0.500	1	245	68	55	0.4235	10.50	2.20	163.06%
		339.0500														

Actual Run Time	V_m	ΔP (avg)	$T_{m\,(avg)}$ 525.5 °R	$T_{s\,(avg)}$ 526.8 °R	Max Vac.	ΔH (avg)	$V_{s\,(avg)}$	Run ISO
115.00 min	46.150 cf	0.447 in H_2O	65.9 °F	67.1 °F	1	0.508 in H_2O	33.889 fps	98.63%

10/24/13
Test Personnel (signature/date)

11/21/13 Review
Project Leader (signature/date)

EPA Method OTM 27 Sampling Calculations

Client:	The Goodyear Tire and Rubber Company	CEC Project No.:	132-066	Date:	~~10/3/2013~~ 10/24/13 BV
City/State:	Danville, VA	Run No.:	1	Operators:	WQB
Sampling Location:	Unit	Operational Condition:	Normal		

Initialization Parameters:						Leak Check, <0.020 Cf						
Meter Box No.:	300, 392		Probe/PitotNo.:	200302		Pre-Test	0.004	15	in. Hg			
Sample Box No.:			Probe Temp. Settin	250		Post-Test	0.002	5	in. Hg			
Sample ID No.:	132066-04		Filter No.:	3288		Start Volume:	292.955		cu. Ft.			
DGM Coefficient?	0.99	Y	Number Of Points:	24		Start Time:	1210					
Orifice Coefficient?	1.912		Nozzle Diameter:	.193	in.	End Time:						
Pitot Coefficient?	0.765		Actual Meter Temp.:	52	°F	Pitot Lk: >3.0 in. H2O	Positive	Negative				
Barometric Press.?	29.65	in. Hg	Est. Moisture:	2	%	Pre-Test Pitot <0.1	6.2	3.1	in. H_2O			
Static Pressure?	-.25	in. H_2O	O_2 Content:	21	%	Post-Test Pitot <0.1	6.8	3.1	in. H_2O			
Run Duration?	120	min.	CO_2 Content:	0	%	Intermediate Lk Chck	1	2	3	4	5	6
						Vac., in. Hg						
T_s Avg. stack temp.	60.1	°F	DH	.505	in. H_2O	DGM init, Cf						
T_{s+50} Avg. stack temp.+50	110.1	°F	DH_{+50}	0.423	in. H_2O	DGM finl, Cf						
T_{s-50} Avg. stack temp.-50	10.1	°F	DH_{-50}	0.621	in. H_2O	Leak Rate, cfm						

Intermediate Lk Chck column 7

Pt. No.	MC %	ΔP	'DP bf	Run Time	Run Time Actual	Stack Temp.	Rate ΔH	Actual ΔH	Pt Beg Vol.	Incr. Vol.	Run Vol.	Meter Temp.	Probe Temp.	Imp. Filter Temp.	Imp. ~~Filter~~ Temp.	Imp. Temp.	Pt. 1
1	2	0.64		5.15	5.45	65		0.51	292.900			58	192	55	41		
2	2	0.62		11.50	11.30	65		0.51	295.27			59	218	54	46		
3	2	0.52		16.75	16.45	65		0.51	297.55			59	275	54	46		
4	2	0.52		22.00	22.00	65		0.51	299.66			60	230	55	47		
5	2	0.33		26.25	26.15	65		0.51	301.50			61	230	55	48		
6	2	0.34		30.5	30.30	65		0.51	303.52			61	230	56	48		
7	2	0.52		35.75	35.45	65		0.51	305.20			62	234	58	48		
8	2	0.52		41.0	41.00	66		0.51	307.30			63	236	59	49		
9	2	0.42		45.75	45.45	66		0.52	309.43			63	246	60	49		
10	2	0.43		50.50	50.30	66	0.08	0.51	311.37			65	242	61	48		
11	2	0.34		54.25	54.45	66	0.51	0.51	313.32			65	245	61	50		
12	2	0.35		5400	59.00	~~66~~ 67 68		0.52	315.08			65	245	60	49		
13	2	0.64		64.75	64.45	67		0.51	316.787			67	243	~~60~~ 58	53		
14	2	0.62		70.50	70.30	67		0.51	319.07			67	245	58	50		
15	2	0.61		76.25	116.15	68		0.51	321.14	322.1		68	245	58	50		
16	2	0.61		78.50	118.30	68		0.46	323.64			68	249	60	49		
17	2	0.59		82	122.00	68		0.50	325.00			69	244	63	51		
18	2	0.54		87.5	127.5	70		0.56	327.65			70	244	63	53		
19	2	0.34		93	133.00	69		0.50	329.80			70	245	65	52		
20	2	0.36		97.25	137.15	69		0.51	332.01			71	245	66	52		
21	2	0.24		101.25	141.45	70		0.51	333.57			72	250	67	53		
22	2	0.25		105.25	45.15	70		0.51	335.49			72	250	67	54		
23	2	0.46		109.0		70		0.51	336.59			72	245	65	56		
24	2	0.17		112	52	70			337.79			72	245	68	55		
End				115	55				339.05								

Spreadsheet for U.S. EPA Method 201A - Determination of Filterable PM_{10} and $PM_{2.5}$ Emissions

PRELIMINARY TEST DATA SHEET

Location: Banbury Mixer # 7 **Start Time:** 9:55 **RUN No.** 2
Date: 24-Oct-2013 **End Time:** 12:10 **JOB No.** 132-066

STACK DATA

Head Config.
PM_{10} & $PM_{2.5}$ (1), PM_{10} Only (2), $PM_{2.5}$ Only (3) 2

% Moisture:	2	% est.	**%CO_2:**	0.00	%
Barometric:	29.62	in Hg	**%O_2:**	20.90	%
Static Press:	-0.25	in H_2O	**%N_2/CO:**	79.10	%
Stack Press:	29.60	in Hg	**M_d:**	28.84	lb/lb-mole
Stack Area:	4.79	ft^2	**Est. M_w:**	28.62	lb/lb-mole
Stack Area:	689.3	in^2			

STANDARD CONDITIONS	**T_{std}:**	68	°F
	P_{std}:	29.92	inches Hg

528

PRE-TEST CALCULATIONS

Viscocity μ_s:	183.71	mpoise
Cunningham:	1.0679	
D_{50LL}:	10.65	µm
[N_{re}>3162] D_{50LL}:	-	µm
D_{50T}:	10.82	µm
Estimated Q_s:	0.4060	acfm
Estimated N_{re}:	3052	
Estimated ΔH:	0.532	in H_2O

EQUIPMENT

METER BOX:	300.392	
Y:	0.990	
ΔH@:	1.912	in H_2O
Estimated T_m:	75	°F
Cp':	0.765	S/N
Cp:	0.765	S/N
Nozzle Dia:	0.194	inches
Nozzle Area:	0.00021	ft^2

PRELIMINARY TRAVERSE

Sample Point	Cyclonic Flow Check Null Angle °	Preliminary ΔP (in. H_2O) ΔP_m	 ΔP_s	 ΔP_{s2}	Stack Temperature (°F)
1	8.0	0.640	0.640	0.683	70.0
2	8.0	0.620	0.620	0.662	70.0
3	10.0	0.520	0.520	0.555	70.0
4	14.0	0.520	0.520	0.555	70.0
5	12.0	0.330	0.330	0.352	70.0
6	13.0	0.340	0.340	0.363	70.0
7	10.0	0.520	0.520	0.555	70.0
8	0.0	0.520	0.520	0.555	70.0
9	0.0	0.420	0.420	0.448	70.0
10	0.0	0.430	0.430	0.459	70.0
11	0.0	0.340	0.340	0.363	70.0
12	0.0	0.350	0.350	0.373	70.0
13	8.0	0.640	0.640	0.683	70.0
14	9.0	0.620	0.620	0.662	70.0
15	10.0	0.610	0.610	0.651	70.0
16	10.0	0.610	0.610	0.651	70.0
17	14.0	0.590	0.590	0.630	70.0
18	15.0	0.590	0.590	0.630	70.0
19	12.0	0.340	0.340	0.363	70.0
20	10.0	0.360	0.360	0.384	70.0
21	9.0	0.240	0.240	0.256	70.0
22	9.0	0.250	0.250	0.267	70.0
23	11.0	0.160	0.160	0.171	70.0
24	30.0	0.170	0.170	0.181	70.0
	9.3 (absolute °)	0.447	0.447	0.477	70.000

NOZZLE SELECTION

Nozzle S/N	Diam. Dn (in)	Vn (fps)	V_{min} (fps)	V_{max} (fps)	ΔP_{min} (inches H_2O)	ΔP_{max}
	0.125	79.39	60.31	97.50	1.36	3.55
	0.138	65.14	48.53	80.61	0.88	2.43
	0.154	52.31	37.75	65.47	0.53	1.60
	0.172	41.93	28.82	53.30	0.31	1.06
	0.194	32.96	20.70	42.85	***0.16***	***0.69***
	0.200	31.01	18.84	40.60	0.13	0.62
	0.220	25.63	13.19	34.40	0.07	0.44
	0.250	19.85	9.92	27.82	0.04	0.29
	0.253	19.38	9.69	27.29	0.04	0.28
	0.274	16.52	8.26	24.07	0.03	0.22
	0.296	14.16	7.08	21.24	0.02	0.17
	0.320	12.11	6.06	18.17	0.01	0.12

NOTE: This spreadsheet contains circular references, therefore, iterative calculation must be turned on in Excel. In the 2010 version of Excel, the iterative calculation selection is located in File/Options/Formulas.

10/24/13
Test Personnel (signature/date)

Paul 11/21/13 Review
Project Leader (signature/date)

Spreadsheet for U.S. EPA Method 201A - Determination of Filterable PM10 and PM2.5 Emissions

TEST DATA SHEET

Location: Banbury Mixer # 7
Date: 24-Oct-2013
Start Time: 13:43
End Time: 15:50
RUN No. 2
JOB No. 132-066

STACK DATA			**EQUIPMENT**		
% Moisture:	2	% est.	METER BOX:	300.392	
Barometric:	29.62	in Hg	Y:	0.990	
Static Press:	-0.25	in H_2O	ΔH@:	1.912	in H_2O
Stack Press:	29.60	in Hg	Cp': 0.765	S/N	-
$\%CO_2$:	0.00	%	Cp: 0.765	S/N	-
$\%O_2$:	20.90	%	Nozzle Dia:	0.1940	inches
$\%N_2/CO$:	79.10	%	Stack Area:	4.8	ft^2
M_d:	28.84	lb/lb-mole	# of Points:	24	points
Est. M_w:	28.62	lb/lb-mole	Run Time:	120.00	min
T_{std}:	528	°R	P_{std}:	29.92	in Hg

ESTIMATES				**+/- 50°F ΔH**			
Ts (°F): 70		Tm (°F):	75	Ts-50°	20	Ts+50°	120
Est. Qs:	0.4060	cfm		Est. Qs:	0.4408	Est. Qs:	0.4661
Est. μ_s:	183.71	mpoise		Est. μ_s:	159.737497	Est. μ_s:	183.759225
Est. ΔH:	0.532	in H_2O		Est. ΔH:	0.649	Est. ΔH:	0.445

LEAK CHECKS			
DGM initial	0	0	cf
DGM final	0.002	0.001	cf
Time	1	1	min.
Leak Rate	0.0020	0.0010	cfm
Vacuum	14	6	in. Hg

Sample Point	Clock Time (min)	Dry Gas Meter Reading (ft^3)	Pitot ΔP ("H_2O)	Gas Temperatures (°F) DGM Inlet	DGM Outlet	Stack	Orifice Press. ΔH (in $H_2$0) Ideal	Actual	Pump Vac. (in Hg)	Gas Temps (°F) Probe	Filter	Imp. Exit	Qs (acfm)	D_{50} [10 μm]	D_{50} [2.5 μm]	Pt. Iso
1	3.25	339.5010	0.200	65.0	65.0	68	0.527	0.530	1	240	58	55	0.4069	10.78	2.30	143.15%
2	6.50	340.8000	0.190	67.0	67.0	70	0.525	0.520	1	240	59	55	0.3852	**11.23**	2.47	138.80%
3	9.75	342.0300	0.190	68.0	68.0	70	0.526	0.500	1	232	61	54	0.3751	**11.45**	2.55	135.15%
4	12.75	343.2300	0.180	70.0	70.0	70	0.528	0.500	1	240	63	54	0.3306	**12.52**	**2.97**	122.39%
5	16.75	344.2100	0.290	70.0	70.0	70	0.528	0.500	1	241	64	54	0.3087	**13.14**	**3.23**	90.03%
6	20.75	345.4300	0.290	71.0	71.0	70	0.529	0.510	1	239	65	55	0.3460	**12.12**	**2.81**	100.91%
7	25.50	346.8000	0.420	72.0	72.0	72	0.526	0.510	1	239	65	55	0.4048	10.87	2.34	97.92%
8	30.50	348.7000	0.450	73.0	73.0	73	0.525	0.510	1	239	65	54	0.4575	9.98	**2.08**	106.80%
9	35.75	350.9600	0.490	74.0	74.0	73	0.526	0.510	1	236	65	54	0.4791	9.66	**2.00**	107.20%
10	41.00	353.4500	0.500	74.0	74.0	74	0.524	0.520	1	237	64	54	0.4935	9.47	**1.95**	109.21%
11	46.50	356.0100	0.580	74.0	74.0	73	0.526	0.520	1	235	63	54	0.4941	9.45	**1.95**	101.61%
12	52.00	358.7000	0.570	75.0	75.0	74	0.525	0.520	1	236	63	54	0.5180	9.15	**1.87**	107.35%
13	57.50	361.5200	0.560	72.0	72.0	74	0.522	0.750	1	230	63	55	0.4343	10.37	**2.17**	90.81%
14	63.00	363.8700	0.550	73.0	73.0	74	0.523	0.750	1	230	62	57	0.4907	9.51	**1.96**	103.53%
15	68.00	366.5300	0.460	72.0	72.0	74	0.522	0.650	1	230	61	57	0.4614	9.94	**2.07**	106.44%
16	73.00	368.8000	0.460	72.0	72.0	74	0.522	0.600	1	229	60	55	0.4369	10.33	**2.16**	100.80%
17	77.00	370.9500	0.300	71.0	71.0	73	0.523	0.500	1	228	63	52	0.4064	10.86	2.33	116.19%
18	81.00	372.5500	0.300	71.0	71.0	73	0.523	0.500	1	228	63	52	0.4064	10.86	2.33	116.19%
19	85.75	374.1500	0.420	71.0	71.0	73	0.523	0.500	1	229	62	51	0.4384	10.29	**2.15**	105.95%
20	90.50	376.2000	0.430	71.0	71.0	73	0.523	0.600	1	229	62	51	0.4706	9.78	**2.03**	112.40%
21	95.25	378.4000	0.400	71.0	71.0	72	0.525	0.600	1	230	61	54	0.4057	10.86	2.33	100.55%
22	100.00	380.3000	0.400	71.0	71.0	72	0.525	0.500	1	230	61	55	0.4056	10.86	2.33	100.53%
23	104.00	382.2000	0.310	71.0	71.0	72	0.525	0.550	1	231	61	56	0.4056	10.86	2.33	114.21%
24	108.00	383.8000	0.310	71.0	71.0	72	0.525	0.550	1	231	61	56	0.4183	10.62	**2.25**	117.78%
		385.4500														

Actual Run Time	V_m	ΔP (avg)	$T_{m\,(avg)}$ 530.9 °R	$T_{s\,(avg)}$ 531.9 °R	Max Vac.	ΔH (avg)	$V_{s\,(avg)}$	Run ISO
108.00 min	45.949 cf	0.385 in H_2O	71.3 °F	72.2 °F	1	0.550 in H_2O	31.712 fps	110.36%

10/24/13
Test Personnel (signature/date)

Paul 11/21/13 Review
Project Leader (signature/date)

EPA Method OTM 27 Sampling Calculations

Client:	The Goodyear Tire and Rubber Company		CEC Project No.:	132-066	Date:	~~10/3/2013~~ 10/29/13 BV	
City/State:	Danville, VA		Run No.:	2	Operators:	WQB / JAJ	
Sampling Location:	Unit		Operational Condition:	Normal			

Initialization Parameters:						Leak Check, <0.020 Cf							
Meter Box No.:	300342		Probe/PitotNo.:	200.303		Pre-Test	0.002	14	in. Hg				
Sample Box No.:			Probe Temp. Settin	250		Post-Test	0.001	6	in. Hg				
Sample ID No.:	132066-05		Filter No.:	3289		Start Volume:	~~339.30~~		cu. Ft.	339.501			
DGM Coefficient?	0.99 Y		Number Of Points:	24		Start Time:	143						
Orifice Coefficient?	1.912		Nozzle Diameter:	.194	in.	End Time:	350 pm						
Pitot Coefficient?	0.765		Actual Meter Temp.:		°F	Pitot Lk: >3.0 in. H2O	Positive	Negative					
Barometric Press.?	29.62	in. Hg	Est. Moisture:	2	%	Pre-Test Pitot <0.1	+3.2	-3.3	in. H_2O				
Static Pressure?	-0.25	in. H_2O	O_2 Content:	21	%	Post-Test Pitot <0.1	+7.5	-3.5	in. H_2O				
Run Duration?	120	min.	CO_2 Content:	0	%	Intermediate Lk Chck	1	2	3	4	5	6	7
						Vac., in. Hg							
T_s Avg. stack temp.	70	°F	DH	0.532	in. H_2O	DGM init, Cf							
T_{s+50} Avg. stack temp.+50	120	°F	DH_{+50}	0.445	in. H_2O	DGM finl, Cf							
T_{s-50} Avg. stack temp.-50	20	°F	DH_{-50}	0.49	in. H_2O	Leak Rate, cfm							

Pt. No.	MC %	ΔP	'DP bf	Run Time	Run Time Actual	Stack Temp.	Rate ΔH	Actual ΔH	Pt Beg Vol.	Incr. Vol.	Run Vol.	Meter Temp.	Probe Temp.	~~Imp.~~ Filter Temp.	Imp. ~~Filter~~ Temp.	Imp. Temp.	Pt. VAC
1	2	0.20		3.25	3.15	68	.3	0.53	340.50			65	240	58	55		
2	2	0.19		6.50	6:30	70	.3	0.52	342.03			67	240	59	55		
3	2	~~0.18~~ .19		9.75	9:45	68	.3	0.50	343.23			68	232	61	54		
4	2	~~0.29~~ .18		12.75	12:45	70	.3	0.50	344.21			70	230	59	55		
5	2	.29		16.75	16:45	70	.6	0.50	345.43			70	230	59	54		
6	2	.29		20.75	20.45	70	.6	0.51	346.8			71	229	61	54		
7	2	.28		25.50	25.30	70	.73	0.51	348.7			72	230	62	54		
8	2	.45		30.50	30:30	70	.73	0.51	350.96			74	231	63	55		
9	2	.49		35.75	35:45	72	.73	0.51	353.95			74	231	63	55		
10	2	0.50		41	41	74	.73	0.51	356.01			74	232	64	54		
11	2	0.58		46.5	46.30	73	.73	0.51	358.70			74	240	63	54		
12	2	0.57		52	52	74	.72	0.51	361.43 52.06			75	236	63	54		
13	2	0.56		57.50	57.50	74	.75	0.	363.87			73	230	62	57		
14	2	0.56		63.00	63:00	74	.65		366.53			72	230	62	57		
15	2	0.40		68.00	68.00	74	.60		368.80			72	230	61	55		
16	2	0.46		73.00	73.00	74	.50		370.95			72	229	60	55		
17	2	0.30		77.00	77:00	73	.50		372.55			71	228	62	52		
18	2	0.30		81.00	81:00	73	.50		374.15			70	228	63	52		
19	2	0.42		85.75	85:45	73	.60		376.20			71	229	63	51		
20	2	0.43		90.50	90:30	73	.60		378.40			71	229	62	51		
21	2	0.40		95.25	95.15	72	.50		380.30			71	230	61	54		
22	2	0.40		100.00	100:00	72	.55		382.20			71	230	61	55		
23	2	0.31		104.00	104:00	72	.55		383.80			71	231	61	56		
24	2	0.31		108:00	108:00	72	.55		385.45			71	231	61	50		
End																	

1
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Spreadsheet for U.S. EPA Method 201A - Determination of Filterable PM10 and PM2.5 Emissions

PRELIMINARY TEST DATA SHEET

Location: Banbury Mixer # 7
Start Time: 13:43
RUN No. 3
Date: 24-Oct-2013
End Time: 15:30
JOB No. 132-066

STACK DATA

Head Config.
PM_{10} & $PM_{2.5}$ (1), PM_{10} Only (2), $PM_{2.5}$ Only (3): 2

% Moisture:	2	% est.	**$\%CO_2$:**	0.00	%
Barometric:	29.56	in Hg	**$\%O_2$:**	20.90	%
Static Press:	-0.25	in H_2O	**$\%N_2/CO$:**	79.10	%
Stack Press:	29.54	in Hg	**M_d:**	28.84	lb/lb-mole
Stack Area:	4.79	ft^2	**Est. M_w:**	28.62	lb/lb-mole
Stack Area:	689.3	in^2			

STANDARD CONDITIONS	T_{std}:	68	°F
	P_{std}:	29.92	inches Hg

528

PRE-TEST CALCULATIONS

Viscocity μ_s:	184.19	mpoise
Cunningham:	1.0683	
D_{50LL}:	10.64	μm
$[N_{re}>3162]$ D_{50LL}:	-	μm
D_{50T}:	10.82	μm
Estimated Q_s:	0.4080	acfm
Estimated N_{re}:	3042	
Estimated ΔH:	0.526	in H_2O

EQUIPMENT

METER BOX:	300.392	
Y:	0.990	
ΔH@:	1.912	in H_2O
Estimated T_m:	68	°F
Cp': 0.765	S/N	
Cp: 0.765	S/N	
Nozzle Dia:	0.193	inches
Nozzle Area:	0.00020	ft^2

PRELIMINARY TRAVERSE

Sample Point	Cyclonic Flow Check	Preliminary ΔP (in. H_2O)			Stack Temperature
	Null Angle °	ΔP_m	ΔP_s	ΔP_{s2}	(°F)
1	8.0	0.200	0.200	0.213	72.0
2	8.0	0.190	0.190	0.203	72.0
3	10.0	0.190	0.190	0.203	72.0
4	14.0	0.180	0.180	0.192	72.0
5	12.0	0.290	0.290	0.309	72.0
6	13.0	0.290	0.290	0.309	72.0
7	10.0	0.420	0.420	0.448	72.0
8	0.0	0.450	0.450	0.480	72.0
9	0.0	0.490	0.490	0.523	72.0
10	0.0	0.500	0.500	0.534	72.0
11	0.0	0.580	0.580	0.619	72.0
12	0.0	0.570	0.570	0.608	72.0
13	8.0	0.560	0.560	0.598	72.0
14	9.0	0.550	0.550	0.587	72.0
15	10.0	0.460	0.460	0.491	72.0
16	10.0	0.460	0.460	0.491	72.0
17	14.0	0.300	0.300	0.320	72.0
18	15.0	0.300	0.300	0.320	72.0
19	12.0	0.420	0.420	0.448	72.0
20	10.0	0.430	0.430	0.459	72.0
21	9.0	0.400	0.400	0.427	72.0
22	9.0	0.400	0.400	0.427	72.0
23	11.0	0.310	0.310	0.331	72.0
24	30.0	0.310	0.310	0.331	72.0
	9.3	0.385	0.385	0.411	72.000

(absolute °)

NOZZLE SELECTION

Nozzle S/N	Diam. Dn (in)	Vn (fps)	V_{min} (fps)	V_{max} (fps)	ΔP_{min} (inches H_2O)	ΔP_{max}
	0.125	79.79	60.62	97.99	1.37	3.57
	0.138	65.47	48.78	81.01	0.88	2.44
	0.154	52.57	37.96	65.79	0.54	1.61
	0.172	42.14	28.98	53.56	0.31	1.07
	0.188	35.28	22.82	45.55	0.19	0.77
	0.193	33.47	21.15	43.46	***0.17***	***0.70***
	0.220	25.76	13.29	34.57	0.07	0.44
	0.250	19.95	9.97	27.95	0.04	0.29
	0.253	19.48	9.74	27.42	0.04	0.28
	0.274	16.61	8.30	24.19	0.03	0.22
	0.296	14.23	7.12	21.35	0.02	0.17
	0.320	12.18	6.09	18.26	0.01	0.12

NOTE: This spreadsheet contains circular references, therefore, iterative calculation must be turned on in Excel. In the 2010 version of Excel, the iterative calculation selection is located in File/Options/Formulas.

[illegible] Best 10/24/13
Test Personnel (signature/date)

Paul [illegible] 11/21/13 Review
Project Leader (signature/date)

Spreadsheet for U.S. EPA Method 201A - Determination of Filterable PM10 and PM2.5 Emissions

TEST DATA SHEET

Location: Banbury Mixer # 7
Date: 24-Oct-2013
Start Time: 16:30
End Time: 18:48
RUN No. 3
JOB No. 132-066

STACK DATA			EQUIPMENT			ESTIMATES				+/- 50°F ΔH			
% Moisture:	2	% est.	METER BOX:	300.392		Ts (°F):	72	Tm (°F):	68	Ts-50°	22	Ts+50°	122
Barometric:	29.56	in Hg	Y:	0.990		Est. Qs:	0.4080	cfm		Est. Qs:	0.4427	Est. Qs:	0.4681
Static Press:	-0.25	in H_2O	ΔH@:	1.912	in H_2O	Est. μ_s:	184.19	mpoise		Est. μ_s:	160.213105	Est. μ_s:	184.239679
Stack Press:	29.54	in Hg	Cp': 0.765	S/N	-	Est. ΔH:	0.526	in H_2O		Est. ΔH:	0.641	Est. ΔH:	0.439
$\%CO_2$:	0.00	%	Cp: 0.765	S/N	-	LEAK CHECKS							
$\%O_2$:	20.90	%	Nozzle Dia:	0.1930	inches	DGM initial	0			0	cf		
$\%N_2/CO$:	79.10	%	Stack Area:	4.8	ft^2	DGM final	0.015			0.001	cf		
M_d:	28.84	lb/lb-mole	# of Points:	24	points	Time	1			1	min.		
Est. M_w:	28.62	lb/lb-mole	Run Time:	120.00	min	Leak Rate	0.0150			0.0010	cfm		
T_{std}:	528	°R	P_{std}:	29.92	in Hg	Vacuum	13			5	in. Hg		

Sample Point	Clock Time (min)	Dry Gas Meter Reading (ft^3)	Pitot ΔP ("H_2O)	Gas Temperatures (°F) DGM Inlet	Gas Temperatures (°F) DGM Outlet	Gas Temperatures (°F) Stack	Orifice Press. ΔH (in H_2O) Ideal	Orifice Press. ΔH (in H_2O) Actual	Pump Vac. (in Hg)	Gas Temps (°F) Probe	Gas Temps (°F) Filter	Gas Temps Imp. Exit	Qs (acfm)	D_{50} [10 μm]	D_{50} [2.5 μm]	Pt. Iso
1	6.25	387.0000	0.640	68.0	68.0	70	0.530	0.730	1	235	62	60	0.4229	10.52	**2.21**	83.79%
2	12.50	389.6000	0.620	67.0	67.0	70	0.529	0.650	1	236	59	59	0.4676	9.80	**2.03**	94.13%
3	18.25	392.4700	0.510	67.0	67.0	71	0.527	0.510	1	242	60	57	0.4487	10.10	**2.11**	99.51%
4	24.00	395.0000	0.510	67.0	67.0	71	0.527	0.500	1	240	61	56	0.4203	10.58	**2.23**	93.21%
5	28.75	397.3700	0.350	67.0	67.0	71	0.527	0.500	1	241	62	57	0.4143	10.69	2.27	110.92%
6	33.50	399.3000	0.350	67.0	67.0	71	0.527	0.550	1	241	62	57	0.4187	10.61	**2.24**	112.09%
7	39.25	401.2500	0.510	68.0	68.0	72	0.526	0.600	1	240	62	57	0.4346	10.34	**2.17**	96.29%
8	45.00	403.7000	0.510	68.0	68.0	72	0.526	0.600	1	240	62	57	0.4612	9.92	**2.06**	102.19%
9	50.25	406.3000	0.460	67.0	67.0	71	0.527	0.500	1	240	61	56	0.4273	10.45	**2.19**	99.79%
10	55.75	408.5000	0.470	67.0	67.0	71	0.527	0.500	1	240	61	56	0.4265	10.47	**2.20**	98.52%
11	60.75	410.8000	0.400	67.0	67.0	71	0.527	0.550	1	241	62	57	0.4386	10.26	**2.15**	109.82%
12	65.75	412.9500	0.410	67.0	67.0	71	0.527	0.550	1	241	62	58	0.4488	10.10	**2.10**	110.99%
13	72.00	415.1500	0.630	65.0	65.0	71	0.525	0.700	1	242	64	59	0.4179	10.62	**2.25**	83.38%
14	78.25	417.7000	0.630	65.0	65.0	71	0.525	0.550	1	242	65	60	0.4587	9.94	**2.07**	91.52%
15	84.50	420.5000	0.630	66.0	66.0	71	0.526	0.600	1	242	65	61	0.4578	9.96	**2.07**	91.35%
16	90.75	423.3000	0.610	66.0	66.0	71	0.526	0.600	1	242	65	61	0.4742	9.71	**2.01**	96.16%
17	96.50	426.2000	0.550	66.0	66.0	71	0.526	0.600	1	231	64	61	0.4799	9.63	**1.99**	102.48%
18	102.50	428.9000	0.560	66.0	66.0	71	0.526	0.600	1	234	64	61	0.4939	9.43	**1.94**	104.54%
19	107.25	431.8000	0.350	65.0	65.0	69	0.529	0.500	1	235	60	59	0.4079	10.78	2.30	109.41%
20	112.00	433.7000	0.360	65.0	65.0	69	0.529	0.500	1	235	60	59	0.4079	10.78	2.30	107.88%
21	116.00	435.6000	0.250	64.0	64.0	69	0.528	0.400	1	235	60	58	0.3575	**11.83**	2.70	113.46%
22	120.00	437.0000	0.250	64.0	64.0	69	0.528	0.400	1	236	60	58	0.3703	**11.54**	2.59	117.51%
23	124.00	438.4500	0.250	64.0	64.0	69	0.528	0.400		238	60	57	0.3448	**12.14**	**2.82**	109.41%
24	128.00	439.8000	0.250	64.0	64.0	69	0.528	0.400		238	60	57	0.3591	**11.80**	2.68	113.94%
		441.2060														

Actual Run Time	V_m	ΔP (avg)	$T_{m\,(avg)}$ 525.8 °R	$T_{s\,(avg)}$ 530.2 °R	Max Vac.	ΔH (avg)	$V_{s\,(avg)}$	Run ISO
128.00 min	54.206 cf	0.461 in H_2O	66.1 °F	70.5 °F	1	0.541 in H_2O	34.758 fps	101.98%

10/24/13

Test Personnel (signature/date)

Paul 11/21/13 Review

Project Leader (signature/date)

EPA Method OTM 27 Sampling Calculations

10/29/13

Client:	The Goodyear Tire and Rubber Company	CEC Project No.:	132-066	Date:	~~10/3/2013~~ BU
City/State:	Danville, VA	Run No.:	3	Operators:	WQB / JAJ
Sampling Location:	Unit	Operational Condition:	Normal		

Initialization Parameters:

						Leak Check, <0.020 Cf				
Meter Box No.:	300, 392		Probe/PitotNo.:	200.302		Pre-Test	0.015	13	in. Hg	
Sample Box No.:			Probe Temp. Setting	250		Post-Test	0.001	5	in. Hg	
Sample ID No.:	132066-06		Filter No.:	3290		Start Volume:			cu. Ft.	
DGM Coefficient?	0.990	Y	Number Of Points:	24		Start Time:	1630	387,000		
Orifice Coefficient?	1.912		Nozzle Diameter:		in.	End Time:	1848			
Pitot Coefficient?	0.765		Actual Meter Temp.:		°F	Pitot Lk: >3.0 in. H2O	Positive	Negative		
Barometric Press.?	29.56	in. Hg	Est. Moisture:	2	%	Pre-Test Pitot <0.1	6.5	3.0	in. H_2O	
Static Pressure?	-.25	in. H_2O	O_2 Content:	21	%	Post-Test Pitot <0.1	8.1	4.6	in. H_2O	
Run Duration?	120	min.	CO_2 Content:	0	%	Intermediate Lk Chck	1	2	3	4

						Intermediate Lk Chck	5, 6, 7
						Vac., in. Hg	
T_s	Avg. stack temp.	72	°F	DH	0.526 in. H_2O	DGM init, Cf	
T_{s+50}	Avg. stack temp.+50	122	°F	DH_{+50}	~~[illegible]~~ in. H_2O 0.439	DGM finl, Cf	
T_{s-50}	Avg. stack temp.-50	22	°F	DH_{-50}	0.641 in. H_2O	Leak Rate, cfm	

	Pt. No.	MC %	ΔP	'DP bf	Run Time	Run Time Actual	Stack Temp.	Rate ΔH	Actual ΔH	Pt Beg Vol.	Incr. Vol.	Run Vol.	Meter Temp.	Probe Temp.	cpm Imp. Filter Temp.	#4 Imp. ~~Filter~~ Temp.	Imp. Temp.	Pt. 1
1	1	2	0.64		6.25	6:15	70		0.73	389.60			68	235	62	60		
	2	2	0.62		12.50	12:30	70		0.65	392.47			67	236	59	59		
2	3	2	0.51		18.25	18:15	71		0.51	395.00			67	242	60	57		
	4	2	0.51		24.00	24:00	71		0.50	397.37			67	240	61	56		
3	5	2	0.35		28.75	28.45	71		0.50	399.30			67	241	63	57		
	6	2	0.35		33.5	33:30	71		0.55	401.25			67	241	62	57		
4	7	2	0.51		39.25	39:15	72		0.60	403.70			68	240	62	57		
	8	2	0.51		45.00	45:00	72		0.60	406.30			68	240	62	57		
5	9	2	0.46		50.25	50.15	71		0.50	408.50			67	240	61	56		
	10	2	0.47		55.75	55:45	71		0.50	410.80			67	240	61	56		
6	11	2	0.40		60.75	1:00:45	71		0.55	412.95			67	241	62	57		
	12	2	0.41		65.75	1:05:45	71		0.55	415.15			67	241	62	58		
1	13	2	0.63		72.00	1:12:00	71		0.70	417.70			65	242	64	59		
	14	2	0.63		78.25	1:18:15	71		0.55	420.50			65	242	65	60		
2	15	2	0.63		84.50	1:24:30	71		0.60	423.30			66	242	65	61		
	16	2	0.61		90.75	1:30:45	71		0.60	426.20			66	242	65	61		
3	17	2	0.55		96.50	1:36:30	71		0.60	428.90			66	231	64	61		
	18	2	0.56		102.50	1:42:30	71		0.60	431.80			66	234	64	61		
4	19	2	0.35		107.25	1:47:15	69		0.50	433.70			65	235	60	59		
	20	2	0.36		112.00	1:52:00	69		0.90	435.60			65	235	60	59		
5	21	2	0.25		116.00	1:56:00	69		0.40	437.00			64	235	60	58		
	22	2	0.25		120.00	2:00:00	69		0.40	438.45			64	236	60	58		
6	23	2	0.25		124.00	2:04:00	67		0.40	439.50			64	235	60	57		
	24	2	0.25		128.00	2:08:00	69		0.40	441.206			64	238	60	57		
	End																	

Methods ~~5~~ 201A & 202 and Sample Recovery – Data Analysis

BV

Client Name Goodyear
City/State Danville, VA
Sampling Location Banbury Mixer No. 7
Clean-Up Box Number M201A /202
Chain of Custody: Date Received 10/24/13

Project Number 132066
Sample Date 10/24/13
Samples Recovered BV
Recovery Date 10/24/13
Received By ____ Locked? ✓

Equipment Documentation

Run Number	1	2	3	Field Blank
Sample ID Number	132066-04	132066-05	132066-06	132066-07
Sample Box Number	H	H	H	—
Probe Number	200.302	200.303	200.302	200.303

CCT-

Sample Recovery – Fraction 1

Filter Container #	3288	3289	3290	NA
Particulate Description	None visible	None visible	None visible	—
Filter Container Sealed?	✓	✓	✓	—

Sample Recovery – Fraction 2

Probe Rinse Container #	132066-04	132066-05	132066-06	132066-07
Rinsing Solution	Acetone	Acetone	Acetone	Acetone
Sample Container Sealed?	✓	✓	✓	NA ~~✓~~ BV
Liquid Level Marked?	✓	✓	✓	NA ~~✓~~ BV

Analysis of Moisture and Sample Recovery – Fraction 3

Reagent Recovery Container	132066-04	132066-05	132066-06	132066-07
Imp. Absorbing Solution	DI H_2O	DI H_2O	DI H_2O	DI H_2O
Description of Reagent	clear	clear	clear	clear
Reagent Level Marked?	✓	✓	✓	✓
Final Volume, ml	98.3	99.6	96.3	100
Initial Volume, ml	100	100	100	100
Net Condensed Volume, ml	-1.7	-0.4	-3.7	0
N_2 Purge	1 hour - 14 LPM	1 hour - 14 LPM	1 hour - 14 LPM	1 hour - 14 LPM
Rinse twice with DI H_2O	✓	✓	✓	✓
Rinse twice with Acetone	✓	✓	✓	✓
Rinse twice with hexane	✓	✓	✓	✓

Analysis of Moisture and Sample Recovery – Silica Gel

Silica Gel Recovery Container #	4	5	6	4
Percent Silica Gel Spent	20%	20%	25%	0%
Final Weight, g	207.3	208.4	214.9	200
Initial Weight, g	200	200	200	200
Net Absorbed Water, g	7.3	8.4	14.9	0
Total Moisture Collected, g	5.6	8.0	11.2	0

Reagent Blanks

Absorbing Reagent Blank (~~500~~mL) 200 mL BV	DI H_2O	Absorbing Blank ID#	132066-09
Rinsing Reagent Blank (200 mL)	Acetone	Rinsing Blank ID #	132066-08
Rinsing Reagent Blank (200 mL)	Hexane	Rinsing Blank ID #	132066-10
Analyst Initials	BV	Reviewer Initials	

Balance ID	Wt.(200 mg)	Wt. (500 mg)	Wt. (1,000 mg)	
10/23/13	200.0	500.0	1000.0	
10/24/13	200.0	499.9	999.9	

Audited by: ____ **(Personnel)** **Date:** 11/18/13 **Completeness** ✓ **Legibility** ✓ **Accuracy** ✓
Audited by: LQB **(Team Leader)** **Date:** 11/12/13 **Specifications** ✓ **Reasonableness** ✓

Civil & Environmental
Consultants, Inc.

Method ~~5~~ 201A & 202 – Moisture Determination and Sample Recovery

Client Name Goodyear
City/State Danville VA
Sampling Location Banbury Mixer No. 7

Project Number: 132-066
Sample Date: 10/24/13
Samples Recovered by: BY
Recovery Date 10/24/13

Moisture Recovery by weight

DI H_2O 80 ml added before purge → 1348 - 1448 N_2 purge

Run No.: 1				
Impinger Bottle Weight	Initial wt. (mg)	Final Wt (mg)	Difference (gain) wt.	
1st Imp. Bottle	481.5	481.4	-0.1	
2nd Imp. Bottle	592.8	592.1	-0.7	-1.70
3rd Imp. Bottle	660.4	659.5	-0.9	
4th Imp. Bottle	794.8	802.1	7.3	
5th Imp. Bottle				
6th Imp. Bottle			TC =	5.60 grams

DI H_2O 80 ml added → before purge

Run No.: 2				
Impinger Bottle Weight	Initial wt. (mg)	Final Wt (mg)	Difference (gain) wt.	
1st Imp. Bottle	480.8	480.1	-0.7	
2nd Imp. Bottle	593.6	594.0	0.4	-0.40
3rd Imp. Bottle	701.8	701.7	-0.1	
4th Imp. Bottle	802.0	810.4	8.4	
5th Imp. Bottle				
6th Imp. Bottle			TC =	8.00 grams

DI H_2O 80 ml → added before purge

Run No.: 3				
Impinger Bottle Weight	Initial wt. (mg)	Final Wt (mg)	Difference (gain) wt.	
1st Imp. Bottle	361.8	361.8	0.0	
2nd Imp. Bottle	594.1	595.0	0.9	-3.70
3rd Imp. Bottle	707.1	702.5	-4.6	
4th Imp. Bottle	796.8	811.7	14.9	
5th Imp. Bottle				
6th Imp. Bottle			TC =	11.20 grams

DI H_2O 80 ml → added before purge

Run No.: Field Blank				
Impinger Bottle Weight	Initial wt. (mg)	Final Wt (mg)	Difference (gain) wt.	
1st Imp. Bottle	482.3	481.5	—	
2nd Imp. Bottle	591.6 → 670.2	659.0	—	
3rd Imp. Bottle	660.4	660.4	0	
4th Imp. Bottle	794.8	794.8	0	
5th Imp. Bottle				
6th Imp. Bottle		"After purge"		

Audited by: ND (Personnel) Date: 11/18/13 Completeness ✓ Legibility ✓ Accuracy ✓
Audited by: WDB (Team Leader) Date: 11/12/13 Specifications ✓ Reasonableness ✓

Civil & Environmental
Consultants, Inc.

APPENDIX C

LABORATORY DATA

Civil & Environmental Consultants, Inc. - Charlotte

2030 S. Tryon Street, Suite 3E
Charlotte, NC 28203

Goodyear

Danville, VA
Client # 132-066

Analytical Report
(1013-06)

EPA Method 5

Particulate Matter

EPA Method 202

Condensable Particulate Matter

EPA Modified Method 201A

Particulate Matter

NELAP accredited in the state of Virginia under Laboratory ID # 460155, Certificate # 2453.

Enthalpy Analytical, Inc.
Phone: (919) 850 - 4392 / Fax: (919) 850 - 9012 / www.enthalpy.com
800-1 Capitola Drive Durham, NC 27713-4385

I certify that to the best of my knowledge all analytical data presented in this report:

- Have been checked for completeness
- Are accurate, error-free, and legible
- Have been conducted in accordance with approved protocol, and that all deviations and analytical problems are summarized in the appropriate narrative(s)

This analytical report was prepared in Portable Document Format (.PDF) and contains 20 pages.

Michael Steven Schapira

QA Review Performed by: Michael Steven Schapira

Report Issued: 11/11/13

Summary of Results

Company	Civil & Env. Consultants
Analyst	KTH / JMD
Parameters	EPA Method 5

Client #	132-066
Job #	1013-06
# Samples	3 Samples + Blanks

Compound	Sample ID / Particulate Matter (PM) Weight (mg)		
	132066-01 ***M5/202-R1***	***13206-02*** ***M5/202-R2***	***132066-03*** ***M5/202-R3***
Net Filter Catch	0.0	0.7	0.6
Net Front Rinse	2.8	1.3	1.8
Total Particulate	2.8	2.0	2.4

Company	Civil & Env. Consultants
Analyst	KTH / JMD
Parameters	EPA Method 202

Client #	132-066
Job #	1013-06
# Samples	6 Runs + blanks

Compound	Sample ID / Condensible Particulate Matter (CPM) Weight (mg)		
	132066-01 M5/202-R1	***132066-02 M5/202-R2***	***132066-03 M5/202-R3***
Net Organic Catch	2.2	1.8	1.6
Corrected Inorganic	1.4	1.8	2.2
TB Corrected CPM	1.6	1.6	1.8
	132066-04 M201A/202-R1	***132066-05 M201A/202-R2***	***132066-06 M201A/202-R3***
Net Organic Catch	3.2	1.1	0.9
Corrected Inorganic	1.0	1.8	0.8
TB Corrected CPM	2.2	1.0	0.0
	132066-07 M202-FTB		
Organic Catch	0.8	If Train Blank CPM is >2.0 mg,	
Inorganic Catch	1.2	then sample correction is 2.0 mg.	
CPM	2.0		

Company	Civil & Env. Consultants
Analyst	JMD/KTH
Parameters	Modified EPA Method 201A

Client #	132-066
Job #	1013-06
# Samples	3 runs

Sample Fraction	Sample ID / Catch Weight (mg)		
	132066-04 M201A/202-R1	***132066-05 M201A/202-R2***	***132066-06 M201A/202-R3***
Filter Catch	-0.18	-0.12	-0.25
Acetone Rinses	0.62	0.31	0.55
Total particulate (mg)	0.62	0.31	0.55

Results

EPA Method 5 - Particulate Determination - Data Analysis

Company	Civil & Env. Consultants
Analyst	KTH / JMD
Parameters	EPA Method 5

Client #	132-066
Job #	1013-06
# Samples	3 Samples + Blanks

Analysis of Particulate Recovery

Sample ID	*M5/202-R1*		*M5/202-R2*		*M5/202-R3*	
Filter ID	*5622*	Dates	*5623*	Dates	*5624*	Dates
Final wt. (g) 1st	0.3592	11/6/13 8P	0.3566	11/6/13 8P	0.3569	11/6/13 8P
Final wt. (g) 2nd	0.3591	11/7/13 2P	0.3572	11/7/13 2P	0.3570	11/7/13 2P
Filter tare (g)	0.3591	10/21/13	0.3565	10/21/13	0.3564	10/21/13
Net filter catch (mg)	0.0		0.7		0.6	
Beaker number	*7457*	Dates	*7458*	Dates	*7459*	Dates
Final wt (g) 1st	2.28684	11/7/13 9A	2.27812	11/7/13 9A	2.29131	11/7/13 9A
Final wt (g) 2nd	2.28686	11/7/13 4P	2.27812	11/7/13 4P	2.29128	11/7/13 4P
Beaker tare (g)	2.28394	10/30/13	2.27668	10/30/13	2.28930	10/30/13
Acetone vol (mL)	149		155		172	
Acetone blank (g)	0.0001		0.0001		0.0002	
Net front rinse (mg)	2.8		1.3		1.8	
Total particulate (mg)	2.8		2.0		2.4	

Blank Acetone Analysis

Blank beaker number	*7472*	
Blank volume (mL)	214	Date
Beaker tare (g)	2.29990	10/30/13
Max acetone residue (g)	0.0017	

		Dates
Final wt (g) 1st	2.30008	11/7/13 9A
Final wt (g) 2nd	2.30011	11/7/13 4P
Acetone residue (g)	0.0002	

In-House Blank Acetone Analysis

Blank beaker number	*7473*	
Blank volume (mL)	200	Date
Beaker tare (g)	2.28666	10/30/13
Max acetone residue (g)	0.0016	

		Dates
Final wt (g) 1st	2.28681	11/7/13 9A
Final wt (g) 2nd	2.28682	11/7/13 4P
Acetone residue (g)	0.0002	

Company	Civil & Environmental Consultants
Analyst	KTH / JMD
Parameters	EPA Method 202

Client #	132-066
Job #	1013-06
# Samples	6 Runs + blanks

Analysis of Condensible Particulate Recovery

Sample ID Number	M202-FTB		M5/202-R1		M5/202-R2		M5/202-R3	
Organic								
Beaker Number	*7469*		*7463*		*7464*		*7465*	
Initial Hexane/Acetone Volume, mL	184		216		245		282	
Lab Hexane Volume, mL	165	Dates	165	Dates	165	Dates	165	Dates
Final Weight, g	2.2797	11/7/13 9A	2.3012	11/7/13 9A	2.3027	11/7/13 9A	2.2768	11/7/13 9A
Reweigh, Final, g	2.2797	11/7/13 4P	2.3011	11/7/13 4P	2.3027	11/7/13 4P	2.2767	11/7/13 4P
Beaker Tare, g	2.2789	10/30/13	2.2989	10/30/13	2.3009	10/30/13	2.2751	10/30/13
Net Organic Catch, mg	0.8		2.2		1.8		1.6	
Inorganic								
Beaker Number	*7606*	Dates	*7600*	Dates	*7601*	Dates	*7602*	Dates
Final Weight, g	2.2853	11/7/13 9A	2.2872	11/7/13 9A	2.2925	11/7/13 9A	2.2884	11/7/13 9A
Reweigh, Final, g	2.2851	11/7/13 4P	2.2871	11/7/13 4P	2.2924	11/7/13 4P	2.2882	11/7/13 4P
Beaker Tare, g	2.2839	11/5/13	2.2857	11/5/13	2.2905	11/5/13	2.2860	11/5/13
Sample H2O volume, mL	222		252		314		279	
Added H2O, Filter Extraction, mL	75		75		75		75	
Removed Pre-aliquot, mL	0.5		0.5		0.5		0.5	
Pre-aliquot CF	1.002		1.002		1.001		1.001	
Resuspended Volume, mL	100.0		100.0		100.0		100.0	
Removed Post-aliquot, mL	0.5		0.5		0.5		0.5	
Post-aliquot CF	1.01		1.01		1.01		1.01	
Net Inorganic, mg	1.2		1.4		1.8		2.2	
Ammonium Correction, mg	0.0		0.0		0.0		0.0	
Corrected Inorganic, mg	1.2		1.4		1.8		2.2	
Condensible Particulate Matter, mg	2.0		3.6		3.6		3.8	
TB Corrected CPM, mg			1.6		1.6		1.8	

Client Blank Analyses

Type Blank	Hexane	
Beaker Number	*7470*	Dates
Dry Residue Weight, g	2.2782	11/7/13 9A
Reweigh, Final, g	2.2782	11/7/13 4P
Tare weight, g	2.2780	10/30/13
Hexane Residue, g	0.0002	
Hexane Volume, mL	218	
Max. Hexane Residue, g	0.0001	

Type Blank	H2O Blank	
Beaker Number	*7607*	Dates
Dry Residue Weight, g	2.2870	11/7/13 9A
Reweigh, Final, g	2.2869	11/7/13 4P
Tare weight, g	2.2863	11/5/13
Water Residue, g	0.0006	
Water Volume, mL	200	
Max. Water Residue, g	0.0002	

Type Blank	Acetone	
Beaker Number	*7472*	Dates
Dry Residue Weight, g	2.3001	11/7/13 9A
Reweigh, Final, g	2.3001	11/7/13 4P
Tare weight, g	2.2999	10/30/13
Acetone Residue, g	0.0002	
Acetone Volume, mL	214	
Max. Acetone Residue, g	0.0002	

In-House Blank Analyses

Type Blank	Hexane	
Beaker Number	*7471*	Dates
Dry Residue Weight, g	2.2947	11/7/13 9A
Reweigh, Final, g	2.2942	11/7/13 4P
Tare weight, g	2.2936	10/30/13
Hexane Residue, g	0.0006	
Hexane Volume, mL	225	
Max. Hexane Residue, g	0.0001	

Type Blank	H2O Blank	
Beaker Number	*7608*	Dates
Dry Residue Weight, g	2.2724	11/7/13 9A
Reweigh, Final, g	2.2724	11/7/13 4P
Tare weight, g	2.2721	11/5/13
Water Residue, g	0.0002	
Water Volume, mL	250	
Max. Water Residue, g	0.0003	

Type Blank	Acetone	
Beaker Number	*7473*	Dates
Dry Residue Weight, g	2.2868	11/7/13 9A
Reweigh, Final, g	2.2868	11/7/13 4P
Tare weight, g	2.2867	10/30/13
Acetone Residue, g	0.0002	
Acetone Volume, mL	200	
Max. Acetone Residue, g	0.0002	

Company	Civil & Environmental Consultants
Analyst	KTH / JMD
Parameters	EPA Method 202

Client #	132-066
Job #	1013-06
# Samples	6 Runs + blanks

Analysis of Condensible Particulate Recovery

Sample ID Number	M202-FTB		M201A/202-R1		M201A/202-R2		M201A/202-R3	
Organic								
Beaker Number	*7469*		*7466*		*7467*		*7468*	
Initial Hexane/Acetone Volume, mL	184		261		311		356	
Lab Hexane Volume, mL	165	Dates	165	Dates	165	Dates	165	Dates
Final Weight, g	2.2797	11/7/13 9A	2.2840	11/7/13 9A	2.3052	11/7/13 9A	2.2766	11/7/13 9A
Reweigh, Final, g	2.2797	11/7/13 4P	2.2840	11/7/13 4P	2.3052	11/7/13 4P	2.2766	11/7/13 4P
Beaker Tare, g	2.2789	10/30/13	2.2809	10/30/13	2.3040	10/30/13	2.2757	10/30/13
Net Organic Catch, mg	0.8		3.2		1.1		0.9	
Inorganic								
Beaker Number	*7606*	Dates	*7603*	Dates	*7604*	Dates	*7605*	Dates
Final Weight, g	2.2853	11/7/13 9A	2.2648	11/7/13 9A	2.2986	11/7/13 9A	2.2919	11/7/13 9A
Reweigh, Final, g	2.2851	11/7/13 4P	2.2647	11/7/13 4P	2.2983	11/7/13 4P	2.2918	11/7/13 4P
Beaker Tare, g	2.2839	11/5/13	2.2637	11/5/13	2.2966	11/5/13	2.2910	11/5/13
Sample H2O volume, mL	222		247		302		297	
Added H2O, Filter Extraction, mL	75		75		75		75	
Removed Pre-aliquot, mL	0.5		0.5		0.5		0.5	
Pre-aliquot CF	1.002		1.002		1.001		1.001	
Resuspended Volume, mL	100.0		100.0		100.0		100.0	
Removed Post-aliquot, mL	0.5		0.5		0.5		0.5	
Post-aliquot CF	1.01		1.01		1.01		1.01	
Net Inorganic, mg	1.2		1.0		1.8		0.8	
Ammonium Correction, mg	0.0		0.0		0.0		0.0	
Corrected Inorganic, mg	1.2		1.0		1.8		0.8	
Condensible Particulate Matter, mg	2.0		4.2		2.9		1.7	
TB Corrected CPM, mg			2.2		1.0		0.0	

Client Blank Analyses

Type Blank	Hexane		Type Blank	H2O Blank		Type Blank	Acetone	
Beaker Number	*7470*	Dates	Beaker Number	*7607*	Dates	Beaker Number	*7472*	Dates
Dry Residue Weight, g	2.2782	11/7/13 9A	Dry Residue Weight, g	2.2870	11/7/13 9A	Dry Residue Weight, g	2.3001	11/7/13 9A
Reweigh, Final, g	2.2782	11/7/13 4P	Reweigh, Final, g	2.2869	11/7/13 4P	Reweigh, Final, g	2.3001	11/7/13 4P
Tare weight, g	2.2780	10/30/13	Tare weight, g	2.2863	11/5/13	Tare weight, g	2.2999	10/30/13
Hexane Residue, g	0.0002		Water Residue, g	0.0006		Acetone Residue, g	0.0002	
Hexane Volume, mL	218		Water Volume, mL	200		Acetone Volume, mL	214	
Max. Hexane Residue, g	0.0001		Max. Water Residue, g	0.0002		Max. Acetone Residue, g	0.0002	

In-House Blank Analyses

Type Blank	Hexane		Type Blank	H2O Blank		Type Blank	Acetone	
Beaker Number	*7471*	Dates	Beaker Number	*7608*	Dates	Beaker Number	*7473*	Dates
Dry Residue Weight, g	2.2947	11/7/13 9A	Dry Residue Weight, g	2.2724	11/7/13 9A	Dry Residue Weight, g	2.2868	11/7/13 9A
Reweigh, Final, g	2.2942	11/7/13 4P	Reweigh, Final, g	2.2724	11/7/13 4P	Reweigh, Final, g	2.2868	11/7/13 4P
Tare weight, g	2.2936	10/30/13	Tare weight, g	2.2721	11/5/13	Tare weight, g	2.2867	10/30/13
Hexane Residue, g	0.0006		Water Residue, g	0.0002		Acetone Residue, g	0.0002	
Hexane Volume, mL	225		Water Volume, mL	250		Acetone Volume, mL	200	
Max. Hexane Residue, g	0.0001		Max. Water Residue, g	0.0003		Max. Acetone Residue, g	0.0002	

Company	Civil & Environmental Consultants
Analyst	KTH / JMD
Parameters	EPA Method 202

Client #	132-066
Job #	1013-06
# Samples	6 Runs + blanks

MDL 0.09 (mg Ammonium)
MDL 0.26 (mg Sulfate)
Blank titrant amount (Vtb) 0.03
NH4OH normality 0.1 Lot # Sigma Aldrich 318620

Sample ID	Volume Resuspended (mL)	Titration Aliquot Vol (mL)	NH_4OH Titration Vol (mL)	Aliquot Factor (mL rec'd/aliq mL)	SO4 Catch (mg)	Ammonium equivalent (mg)
M202-FTB	100	99.5	0.00	1.01	0.26 ND	0.09 ND
M5/202-R1	100	99.5	0.05	1.01	0.26 ND	0.09 ND
M5/202-R2	100	99.5	0.00	1.01	0.26 ND	0.09 ND
M5/202-R3	100	99.5	0.04	1.01	0.26 ND	0.09 ND
M201A/202-R1	100	99.5	0.05	1.01	0.26 ND	0.09 ND
M201A/202-R2	100	99.5	0.00	1.01	0.26 ND	0.09 ND
M201A/202-R3	100	99.5	0.03	1.01	0.26 ND	0.09 ND

Company	Civil & Env. Consultants
Analyst	JMD/KTH
Parameters	Modified EPA Method 201A

Client #	132-066
Job #	1013-06
# Samples	3 runs

Sample ID	M201A/202-R1		M201A/202-R2		M201A/202-R3	
Filter ID	3288	Dates	3289	Dates	3290	Dates
Final wt. (g) 1st	0.11072	11/6/13 8P	0.11047	11/6/13 8P	0.11139	11/6/13 8P
Final wt. (g) 2nd	0.11073	11/7/13 2P	0.11048	11/7/13 2P	0.11139	11/7/13 2P
Final Tare Weight (g)	0.11091	5/20/13	0.11060	5/20/13	0.11164	5/20/13
Net filter catch (mg)	-0.18		-0.12		-0.25	
Acetone Rinses						
Beaker number	7460	Dates	7461	Dates	7462	Dates
Final wt (g) 1st	2.28768	11/7/13 9A	2.27855	11/7/13 9A	2.28928	11/7/13 9A
Final wt (g) 2nd	2.28768	11/7/13 4P	2.27852	11/7/13 4P	2.28925	11/7/13 4P
Beaker tare (g)	2.28700	10/30/13	2.27808	10/30/13	2.28860	10/30/13
Acetone vol (mL)	67		136		104	
Blank Correction (g)	0.00006		0.00013		0.00010	
PM Catch (mg)	0.62		0.31		0.55	
Total particulate (mg)	0.62		0.31		0.55	

Client Blank Acetone Analysis

Blank beaker number	7472	Dates
Final wt (g) 1st	2.30008	11/7/13 9A
Final wt (g) 2nd	2.30011	11/7/13 4P
Beaker tare (g)	2.29990	10/30/13
Acetone residue (g)	0.00021	
Blank volume (mL)	214	
Max acetone residue (g)	0.00169	

Laboratory Blank Acetone Analysis

Blank beaker number	7473	Dates
Final wt (g) 1st	2.28681	11/7/13 9A
Final wt (g) 2nd	2.28682	11/7/13 4P
Beaker tare (g)	2.28666	10/30/13
Acetone residue (g)	0.00015	
Blank volume (mL)	200	
Max acetone residue (g)	0.00158	

Narrative Summary

Enthalpy Analytical Narrative Summary

Company	Civil & Env. Consultants, Inc.
Analyst	KTH / JMD
Parameters	EPA Method 5

Client #	132-066
Job #	1013-06
# Samples	3 and Blanks

Custody

Jim Beach received the samples on 10/28/13 after being relinquished by Civil & Environmental Consultants, Inc. of Charlotte, NC. The samples were received at ambient temperature and were in good condition. Prior to, during, and after analysis, the samples were kept under lock with access only to authorized personnel by Enthalpy Analytical, Inc.

Analysis

The samples were analyzed for particulate matter using the analytical procedures in EPA Method 5, Determination of Particulate Matter Emissions from Stationary Sources (40 CFR Part 60, Appendix A).

The filter fractions were weighed on Balance 2 (Mettler Model AB265-S, Serial # 1125163272) and the rinse fractions were weighed on Balance 8 (Sartorius Model ME 5-F, Serial # 23104965). Each balance is certified by Mettler Toledo through July 31, 2014.

QC Notes

The catch weights were adjusted by a corresponding reagent blank correction value. A mathematically determined (theoretical) maximum value was calculated and compared with the actual value measured for the blank. The lower of the two values was used as the blank correction value, which was then factored by the sample volume divided by the blank volume, and subtracted from the sample catch weight.

Reporting Notes

Gravimetric analyses are considered to be accurate to ±0.5 mg. Therefore, negative catch weights between 0 and –0.5 mg are set to zero and no investigation is undertaken. Negative catch weights less than -0.5 mg are investigated. The only fraction with a negative catch weight was the filter for ***Run 1***, which was in the hundredths of a milligram negative. Not further action was taken, beyond treating it as a zero when determining the final catch weight.

These analyses met the requirements of the TNI Standard. Any deviations from the requirements of the reference method or TNI Standard have been stated above.

The results presented in this report are representative of the samples as provided to the laboratory.

Enthalpy Analytical Narrative Summary

Company	Civil & Env. Consultants, Inc.
Analyst	KTH / JMD
Parameters	EPA Method 202

Client #	132-066
Job #	1013-06
# Samples	6 and Blanks

Custody

Jim Beach received the samples on 10/28/13 after being relinquished by Civil & Environmental Consultants, Inc. of Charlotte, NC. The samples were received at ambient temperature and were in good condition. Prior to, during, and after analysis, the samples were kept under lock with access only to authorized personnel by Enthalpy Analytical, Inc.

Analysis

The samples were analyzed for Condensable Particulate Matter using the analytical procedures in EPA Method 202, Determination of Condensible Particulate Emissions from Stationary Sources (40 CFR Part 51, Appendix M).

All samples were weighed on Balance 8 (Sartorius Model ME 5-F, Serial # 23104965), certified by Mettler Toledo through July 31, 2014.

QC Notes

A field blank (train blank) was received from each source and analyzed with these samples. The method specifies that blank corrections are accomplished by subtracting the particulate mass determined for the 'Field Train Blank' or 2 mg (whichever is less) from the sample weight.

Acetone, water, and hexane reagent blanks were received and analyzed with these samples. Results are reported for each of these blanks, but none are used to blank correct the associated sample results.

The inorganic results for the samples were corrected for the ammonium ions used to precipitate the sulfate, per the formula in the Method (Section 12.2.1).

Reporting Notes

Gravimetric analyses are considered to be accurate to ±0.5 mg. Therefore, negative catch weights between 0 and –0.5 mg are set to zero and no investigation is undertaken. Negative catch weights less than -0.5 mg are investigated. There were no fractions with negative catch weights for this set of Method 202 samples with the exception of the client hexane blank.

These analyses met the requirements of the TNI Standard. Any deviations from the requirements of the reference method or TNI Standard have been stated above.

The results presented in this report are representative of the samples as provided to the laboratory.

Enthalpy Analytical Narrative Summary

Company	Civil & Env. Consultants
Analyst	KTH / JMD
Parameters	Modified EPA Method 201A

Client #	132-066
Job #	1013-06
# Samples	3 Runs

Custody

Jim Beach received the samples on 10/28/13 after being relinquished by Civil & Environmental Consultants, Inc. The samples were received in good condition at ambient temperature. Prior to, during, and after analysis, the samples were kept under lock with access only to authorized personnel by Enthalpy Analytical, Inc.

Analysis

The samples were analyzed for particulate matter using EPA Method 201A, Determination of PM_{10} and $PM_{2.5}$ Emissions (Constant Sampling Rate Procedures).

Each sample consisted of just one filter and one acetone rinse fraction.

Filter ***3288*** (part of the ***Run 1*** sample) appeared very slightly damaged, but the other two filters did not appear to be damaged.

All samples were weighed on Balance 2 (Mettler Model AB265-S, Serial #1125163272) or on Balance 8 (Sartorius Model ME 5-F, Serial #23104965), both certified by Mettler Toledo through July 31, 2014.

QC Notes

Gravimetric analyses are considered to be accurate to ±0.5 mg. Therefore, negative catch weights between 0 and –0.5 mg are displayed as measured, but treated as zero for determination of the total catch weight. No investigation is undertaken for negative masses less than half a milligram.

All three filter samples showed negative catch weights less than 0.5 mg. No filter pieces were obvious as present in the rinse fractions.

Negative catch greated than 0.5 mg magnitude would have been investigated were there any.

Reporting Notes

These analyses met the requirements of the TNI Standard. Any deviations from the requirements of the reference method and/or the TNI Standard have been stated above.

The results presented in this report are representative of the samples as provided to the laboratory.

General Reporting Notes

(continued)

- The Sample ID ***LCS*** represents a Laboratory Control Sample. Clean matrix, similar to the client sample matrix, prepared and analyzed by the laboratory using the same reagents, spiking standards and procedures used for the client samples. The LCS is used to assess the control of the laboratory's analytical system. Whenever spikes are prepared for our client projects, two spikes are retained as LCSs. The LCSs are labeled with the associated project number and kept in-house at the appropriate temperature conditions. When the project samples are received for analysis, the LCSs are analyzed to confirm that the analyte could be recovered from the media, separate from the samples which were used on the project and which may have been affected by source matrix, sample collection and/or sample transport.
- **Significant Figures**: Where the reported value is much greater than unity (1.00) in the units expressed, the number is rounded to a whole number of units, rather than to 3 significant figures. For example, a value of 10,456.45 ug catch is rounded to 10,456 ug. There are five significant digits displayed, but no confidence should be placed on more than two significant digits.
- **Manual Integration**: The data systems used for processing will flag manually integrated peaks with an "M". There are several reasons a peak may be manually integrated. These reasons will be identified by the following two letter designations on sample chromatograms, if provided in the report. The peak was ***not integrated*** by the software **"NI"**, the peak was ***integrated incorrectly*** by the software **"II"** or the ***wrong peak*** was integrated by the software **"WP"**. These codes will accompany the analyst's manual integration stamp placed next to the compound name on the chromatogram.

Sample Custody

2030 S. Tryon Street Suite 3E, Charlotte, NC 28203 **Civil & Environmental Consultants, Inc.** Toll-Free: 855-859-9932 Direct: 980-224-8104

Company: Goodyear
City, State: Danville, Virginia
Contact: Bryan Starnes

Laboratory: Enthalpy Analytical
Project No. 132-066
Purchase Order: NC13-108

Number of Containers: 36

Sampling Methods: EPA Methods 5/202 and 201A/202

Sample Description	Sample ID	Date	Sample Disposition and Remarks
Total particulate matter sampling train (M5/202)- Run 1	132066-01	10/24/13	Filter 5622, Front Acetone Rinse, DI H20 Back Rinse (W), Acetone/Hexane Solvent Rinse (S), CPM Filter
Total particulate matter sampling train (M5/202)- Run 2	132066-02	10/24/13	Filter 5623, Front Acetone Rinse, DI H20 Back Rinse (W), Acetone/Hexane Solvent Rinse (S), CPM Filter
Total particulate matter sampling train (M5/202)- Run 3	132066-03	10/24/13	Filter 5624, Front Acetone Rinse, DI H20 Back Rinse (W), Acetone/Hexane Solvent Rinse (S), CPM Filter
Particulate matter < 10 microns/condensables- Run 1	132066-04	10/24/13	Filter 3288, Front Acetone Rinse, DI H20 Back Rinse (W), Acetone/Hexane Solvent Rinse (S), CPM Filter
Particulate matter < 10 microns/condensables- Run 2	132066-05	10/24/13	Filter 3289, Front Acetone Rinse, DI H20 Back Rinse (W), Acetone/Hexane Solvent Rinse (S), CPM Filter
Particulate matter < 10 microns/condensables- Run 3	132066-06	10/24/13	Filter 3290, Front Acetone Rinse, DI H20 Back Rinse (W), Acetone/Hexane Solvent Rinse (S), CPM Filter
Particulate matter < 10 microns/condensables-Field Blank	132066-07	10/23/13	DI H20 Back Rinse (W), Acetone/Hexane Solvent Rinse (S), CPM Filter
Acetone Reagent Blank	132066-08	10/24/13	Acetone Reagent Blank
DI Water Reagent Blank	132066-09	10/24/13	DI H2O Reagent Blank
Hexane Reagent Blank	132066-10	10/24/13	Hexane Reagent Blank

Bryan J. Starnes Relinquished By: Date/Time 10/28/13 @1150

Relinquished By: Date/Time 10-28-13

Received for Laboratory By: L. Burr 10-28-13

Special Instructions: five PM fractions per sample run- Method 5/202 and Method 201A/202 samples
Questions- please contact Bryan Starnes (cell-704.309.7346)

This Is The Last Page Of This Report.

APPENDIX D

2013 EQUIPMENT CALIBRATIONS

QUALITY ASSURANCE AND EQUIPMENT CALIBRATION PROCEDURES

General. Field or laboratory test equipment purchased or fabricated by Civil and Environmental Consultants, Inc. (CEC) is assigned a unique, permanent identification number. New items for which calibration is required are calibrated before initial field use. Equipment whose calibration status may change with use or with time is inspected in the field before testing begins, and again upon return from field use. When an item of equipment is found to be out of calibration, it is adjusted and recalibrated or retired from service. CEC's equipment is periodically recalibrated, regardless of the outcome of these regular inspections.

Calibrations are conducted in accordance with United States Environmental Protection Agency (US EPA) specifications. CEC follows the calibration procedures outlined in EPA Reference Methods found in the Code of Federal Regulations (Volume 40, Part 60) and those recommended in the Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III (EPA/600/R-94/038c). When the Reference Methods do not detail procedures, CEC uses methods such as those prescribed by the American Society for Testing and Materials (ASTM).

Data obtained during calibrations are recorded on standardized forms, which are verified for completeness and accuracy by the Quality Assurance Manager. Data reduction and subsequent calculations are performed using CEC's Air Quality Data System. Calibration calculations are performed by an environmental scientist, independently audited by the Project Manager, and reviewed by the Quality Assurance Manger for verification of data. Copies of calibration data are included in the test or project report.

Inspection and Maintenance. An effective preventative program is necessary to ensure equipment performance quality prior to, during, and following the source test. Equipment returning from the field is inspected before it is returned to storage. During the course of these inspections, items are cleaned, repaired, reconditioned, and recalibrated when necessary.

Equipment that is transported to the field for a test project is inspected again prior to being packed. CEC performs these quality assurance checks prior to departure for the project site to detect equipment problems, which may occur during periods of storage. CEC transports adequate back-up equipment to the project site so as to minimize delays in the test schedule.

Calibration. Source sampling equipment that requires calibration includes nozzles, pitot tubes, thermometers, flow meters, dry gas meters, and barometers. The following sections briefly describe the calibration procedures followed by CEC.

Nozzles. Probe nozzles are uniquely and permanently identified at the time of purchase or fabrication; with the exception for glass nozzles. (Glass nozzles are not uniquely identified due to their fragile status.) Nozzles are calibrated before initial field use and prior to the source test. The inside diameter of the nozzle is measured to the nearest 0.001 inch precision micrometer. Three measurements are made using different diameters. If the difference between the high and the low measurements do not exceed 0.004 inch, the average of the three measurements is used. If the difference exceeds this amount, or when the nozzle becomes nicked, dented, or corroded, the nozzle is reshaped, sharpened, and recalibrated. Regardless of usage, nozzles are inspected on a yearly basis.

Pitot Tubes. CEC Type S Pitot tubes have been constructed and calibrated using those recommendations in accordance with EPA Reference Method 2, Section 10.1. CEC Type S Pitot tubes C_p coefficients have been determined according to Method 2, Section 10.1. CEC standard Pitot tubes have been assigned a C_p coefficient of 0.99 according to Calibration Procedure 2. Pitot tubes are visually inspected prior to field use. If the inspection indicates damage, the calibration is rechecked. Regardless of usage, CEC Pitot tubes are inspected and recalibrated on a yearly basis.

Dry Gas Meter and Orifice. Console metering systems receive a full calibration at the time of purchase and annually, thereafter. Post-test calibrations are performed after the source test. Approved Alternative Method 5 Post-Test Calibration (ALT-009) may be used to determine a post-test calibration on the console metering systems instead of reference post-test method. If the calibration factor, γ (gamma), deviates by more than five percent per the reference post-test method, the meter is recalibrated and the meter coefficient (initial or recalibrated) that yields the lowest sample volume for the test runs is used. Standard practice at CEC is to recalibrate the dry gas meter when the γ is found to be outside the range of $\gamma \pm 3\%$.

Barometer. Field barometers are compared to a reference mercury barometer and are deemed acceptable when they agree to within ± 0.1 inches Hg. This barometric pressure is corrected for pressure and temperature. Prior to and following the sampling program, the field barometer is verified against the referenced barometer.

Thermometers. New thermometers, pyrometers and thermocouples purchased or fabricated by CEC are calibrated using the procedures described by US EPA Test Protocol. Calibration tolerance limits are as follow:

Impinger Temperature Gauge	± 1°C or 2°F
Dry Gas Meter Temperature Gauge	± 3°C or 5.4°F
Stack Thermocouples	± 1.5% of absolute temperature

Thermometers and thermocouples are inspected and calibrated prior to and following the field test. Regardless of usage, CEC thermometers and thermocouples are inspected and recalibrated on a yearly basis.

Laboratory Equipment. CEC, Inc. has a written quality assurance document that covers calibration and maintenance of laboratory equipment. This includes calibration of the analytical balance against Class S weights. Calibration of thermometers, barometers, and wet test meters are traceable to NIST. A copy of our quality assurance document may be obtained by written request.

PRE-TEST / POST-TEST CALIBRATION DATA FORM

Client Goodyear
City/State Danville, NC
Pre-test Date 10/15/ Calibrator GRG
Post-test Date 10/30 Calibrator
Reference Thermometer NIST
Reference Barometer 25540

	Pre-test			Post-test		
	Temp., ° F	Ref. Temp., ° F	Inspection	Temp., ° F	Ref. Temp., ° F	Inspection
Omega DB/WB #						
Omega DB/WB #						
Omega DB/WB #						
Omega DB/WB #						
			Positive Leak Check			Poistive Leak Check
Dry Gas Meter #300.392 [A]	65	65	☑ Yes ☐ No @ 7.4	69	69	☑ Yes ☐ No @ 2.8
Dry Gas Meter #300.321 [B]			☐ Yes ☐ No @			☐ Yes ☐ No @
Dry Gas Meter #300.035 [C]			☐ Yes ☐ No @			☐ Yes ☐ No @
Dry Gas Meter #300.388 [D]			☐ Yes ☐ No @			☐ Yes ☐ No @
Dry Gas Meter #300.310 [E]	65	64	☑ Yes ☐ No @ 8.1			☐ Yes ☐ No @
Dry Gas Meter #300.045 [F]			☐ Yes ☐ No @			☐ Yes ☐ No @
Dry Gas Meter #300-390 [G]	65	65	☑ Yes ☐ No @ 7.9	62	62	☑ Yes ☐ No @ 7.5
Dry Gas Meter #300.241 [H]			☐ Yes ☐ No @			☐ Yes ☐ No @
Dry Gas Meter #300.214 [I]			☐ Yes ☐ No @			☐ Yes ☐ No @
Dry Gas Meter #300.067 [J]			☐ Yes ☐ No @			☐ Yes ☐ No @
Dry Gas Meter #300.200 [K]			☐ Yes ☐ No @			☐ Yes ☐ No @
Umbilical Adaptor # D #300.	65	64		61	61	
Umbilical Adaptor # G #300.	65	64		60	61	
Umbilical Adaptor # F #300.	65	65		61	61	
Umbilical Adaptor # H #300.	65	65		61	61	
Umbilical Adaptor # #300.						
Umbilical Adaptor # #300.						
			Visual Inspection			Visual Inspection
Probe #200. 076	64	64	☑ Yes ☐ No @			☐ Yes ☐ No @
Probe #200. 079	64	64	☑ Yes ☐ No @			☐ Yes ☐ No @
Probe #200. 080	64	63	☑ Yes ☐ No @	61	60	☑ Yes ☐ No @
Probe #200. 077	64	63	☑ Yes ☐ No @	61	61	☑ Yes ☐ No @
Probe #200. 302	65	64	☑ Yes ☐ No @	61	61	☑ Yes ☐ No @
Probe #200. 303	65	65	☑ Yes ☐ No @	61	61	☑ Yes ☐ No @
Probe #200. 301	65	65	☑ Yes ☐ No @			☐ Yes ☐ No @
Probe #200.			☐ Yes ☐ No @			☐ Yes ☐ No @
Pitot #200. 708	62	61	☑ Yes ☐ No @			☐ Yes ☐ No @
Pitot #200. 711	62	61	☑ Yes ☐ No @			☐ Yes ☐ No @
Pitot #200.			☐ Yes ☐ No @			☐ Yes ☐ No @

	Field Baro., in. Hg	Ref. Baro.,in Hg	Field Baro., in. Hg	Ref. Baro.,in. Hg
Barometer # 600040	29.17	29.16	2923	2920
Barometer #				
Barometer #				

Were safety checks performed during the pre-site reviews? ☑ Yes ☐ No
Were post-test calibrations withi the EPA Quality Assurance criteria? ☑ Yes ☐ No

Civil & Environmental Consultants, Inc.

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

Quality - Service - Reliability

ENVIRONMENTAL SUPPLY COMPANY

1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
2) Record barometric pressure before and after calibration procedure.
3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum total volume of 5 cubic feet.
4) Record readings in outlined boxes below, other columns are automatically calculated.

DATE: 1/30/2013

METER PART #: 300.321

METER SERIAL #: 1523437

CRITICAL ORIFICE SET SERIAL #: 1374

	INITIAL	FINAL	AVG (P_{bar})
BAROMETRIC PRESSURE (in Hg):	29.21	29.19	29.20

IF Y VARIATION EXCEEDS 2.00%, ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT^3)			TEMPERATURES °F						ELAPSED TIME (MIN) θ	DGM ΔH (in H_2O)	(1)	(2)	(3)	Y	$\Delta H_@$
				INITIAL	FINAL	NET (V_m)	AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG			V_m (STD)	V_{cr} (STD)	Y	VARIATION (%)	
# 56	1	0.2882	23	470.90	474.95	4.05	74.0	74	74	74	74	74.0	11.00	0.40	3.913	4.007	1.024		1.638
SS	2	0.2882	23	474.95	479.00	4.05	74.0	73	74	73	74	73.5	11.00	0.40	3.916	4.007	1.023		1.640
	3	0.2882	23	479.00	483.06	4.06	74.0	73	74	73	74	73.5	11.00	0.40	3.926	4.007	1.021		1.640
																AVG =	1.023	0.42	
# 54	1	0.4269	21	445.70	453.97	8.27	75	76	76	76	76	76.0	15.00	0.9	7.970	8.086	1.015		1.679
SS	2	0.4269	21	453.97	462.23	8.26	75	76	75	76	75	75.5	15.00	0.90	7.968	8.086	1.015		1.680
	3	0.4269	21	462.23	470.51	8.28	75	76	75	76	75	75.5	15.00	0.90	7.987	8.086	1.012		1.680
																AVG =	1.014	-0.43	
# 52	1	0.6069	20	359.50	368.80	9.30	68.0	68	69	68	69	68.5	12.00	1.95	9.114	9.257	1.016		1.806
SS	2	0.6069	20	368.80	374.98	6.18	68.0	69	70	69	70	69.5	8.00	1.95	6.045	6.172	1.021		1.803
	3	0.6069	20	374.98	381.18	6.20	68.0	70	71	70	71	70.5	8.00	1.95	6.053	5.172	1.020		1.799
																AVG =	1.019	0.05	
# 51	1	0.6704	19	388.00	399.12	11.12	71	72	73	72	73	72.5	13.00	2.30	10.825	11.047	1.020		1.744
SS	2	0.6704	19	399.12	410.23	11.11	71	72	73	72	73	72.5	13.00	2.30	10.815	11.047	1.021		1.744
	3	0.6704	19	410.23	421.35	11.12	71	72	73	72	73	72.5	13.00	2.30	10.825	11.047	1.020		1.744
																AVG =	1.021	0.25	
# 48	1	0.8138	17	423.10	429.34	6.24	74.0	76	76	76	76	76.0	6.00	3.45	6.052	6.172	1.020		1.779
SS	2	0.8138	17	429.34	435.62	6.28	74	76	77	76	77	76.5	6.00	3.45	6.085	6.172	1.014		1.777
	3	0.8138	17	435.62	441.92	6.30	74	77	77	77	77	77.0	6.00	3.45	6.099	6.172	1.012		1.776
																AVG =	1.015	-0.29	

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 1.018

AVERAGE $\Delta H_@$ = 1.729

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:
The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

(1) $V_m\text{ (std)} = K_1 V_m \dfrac{P_{bar} + (\Delta H/13.6)}{T_m}$ = Net volume of gas sample passed through DGM, corrected to standard conditions

K_1 = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)

T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

(2) $V_{cr}\text{ (std)} = K' \sqrt{\dfrac{P_{bar}\,\theta}{T_{amb}}}$ = Volume of gas sample passed through the critical orifice, corrected to standard conditions

T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)

K' = Average K' factor from Critical Orifice Calibration

(3) $Y = \dfrac{V_{cr}\text{ (std)}}{V_m\text{ (std)}}$ = DGM calibration factor

$$\Delta H_@ = \left(\frac{0.75\,\theta}{V_{cr}(std)}\right)^2 \Delta H \left(\frac{V_m(std)}{V_m}\right)$$

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

Quality - Service - Reliability
ENVIRONMENTAL SUPPLY COMPANY

1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
2) Record barometric pressure before and after calibration procedure.
3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum total volume of 5 cubic feet.
4) Record readings in outlined boxes below, other columns are automatically calculated.

DATE: 1/10/2013
METER PART #: S-200/300.045
METER SERIAL #: 12454596
CRITICAL ORIFICE SET SERIAL #: 1374

	INITIAL	FINAL	AVG (P_{bar})
BAROMETRIC PRESSURE (in Hg):	29.64	29.61	29.63

IF Y VARIATION EXCEEDS 2.00%, ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT³) INITIAL	DGM READINGS (FT³) FINAL	DGM READINGS (FT³) NET (V_m)	TEMPERATURES °F AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG	ELAPSED TIME (MIN) θ	DGM ΔH (in H_2O)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	Y VARIATION (%)	$\Delta H_@$
# 56	1	0.2882	16	485.80	491.28	5.48	71.4	79	79	80	80	79.5	15.00	0.40	5.317	5.557	1.045		1.590
SS	2	0.2882	16	491.28	496.76	5.48	71.6	80	80	81	81	80.5	15.00	0.40	5.307	5.556	1.047		1.588
	3	0.2882	16	496.76	502.25	5.49	72.7	81	81	83	83	82.0	15.00	0.40	5.302	5.550	1.047		1.587
																AVG =	1.046	0.49	
# 54	1	0.4269	16	504.70	512.88	8.18	73.8	83	83	86	86	84.5	15.00	0.96	7.874	8.213	1.043		1.734
SS	2	0.4269	16	512.88	521.09	8.21	74.4	86	86	87	87	86.5	15.00	0.96	7.874	8.209	1.043		1.729
	3	0.4269	16	521.09	529.31	8.22	74.8	87	87	88	88	87.5	15.00	0.96	7.869	8.206	1.043		1.727
																AVG =	1.043	0.14	
# 52	1	0.6069	16	535.30	547.04	11.74	75.2	89	89	90	90	89.5	15.00	2.00	11.227	11.661	1.039		1.780
SS	2	0.6069	16	547.04	558.81	11.77	75.1	90	90	90	90	90.0	15.00	2.00	11.245	11.662	1.037		1.778
	3	0.6069	16	558.81	570.58	11.77	74.9	90	90	90	90	90.0	15.00	2.00	11.245	11.664	1.037		1.778
																AVG =	1.038	-0.35	
# 51	1	0.6704	16	584.70	597.66	12.96	74.4	89	89	90	90	89.5	15.00	2.50	12.409	12.891	1.039		1.823
SS	2	0.6704	16	597.66	610.59	12.93	74.3	90	90	89	89	89.5	15.00	2.50	12.380	12.892	1.041		1.823
	3	0.6704	16	610.59	623.55	12.96	73.7	89	89	89	89	89.0	15.00	2.50	12.420	12.899	1.039		1.822
																AVG =	1.040	-0.16	
# 48	1	0.8138	15	632.90	648.59	15.69	73.0	89	89	89	89	89.0	15.00	3.60	15.077	15.669	1.039		1.783
SS	2	0.8138	15	648.59	664.25	15.66	72.6	89	89	89	89	89.0	15.00	3.60	15.048	15.674	1.042		1.782
	3	0.8138	15	664.25	679.95	15.70	72.4	89	89	89	89	89.0	15.00	3.60	15.027	15.677	1.039		1.781
																AVG =	1.040	-0.12	

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:
The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 1.041

AVERAGE $\Delta H_@$ = 1.740

(1) $V_m\ (std) = K_1\ V_m\ \frac{P_{bar} + (\Delta H/13.6)}{T_m}$ = Net volume of gas sample passed through DGM, corrected to standard conditions

K_1 = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)

T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

$$\Delta H_@ = \left(\frac{0.75\ \theta}{V_{cr}(std)}\right)^2 \Delta H \left(\frac{V_m(std)}{V_m}\right)$$

(2) $V_{cr}\ (std) = K' \sqrt{\frac{P_{bar}\ \theta}{T_{amb}}}$ = Volume of gas sample passed through the critical orifice, corrected to standard conditions

T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)

K' = Average K' factor from Critical Orifice Calibration

(3) $Y = \frac{V_{cr}\ (std)}{V_m\ (std)}$ = DGM calibration factor

Meter Console Information

Console Number:	300.392 A
Dry Gas Meter Number:	978295
Calibration Date:	1/2/2013
Expiration Date:	12/28/2013

Calibration Condition

Time:	1330
Barometric Pressure (P_b):	29.20
Calibration Technician:	JJ
Wet Test Meter ID:	11088
Wet Test Meter Verification Date:	4/1/2012

Pass Positive Leak Check?	8.5	Yes
Pass Negative Leak Check?	0.000	Yes

		Console Meter						Wet Test Meter						Run Time			
DGM Orifice Setting	Vacuum Setting	Meter Initial Volume	Meter Final Volume	Sample Volume	Outlet Temp. Initial	Outlet Temp. Final	Outlet Temp. Average	Wet Test Initial Volume	Wet Test Final Volume	Wet Test Volume	Wet Test Temp. Initial	Wet Test Temp. Final	Wet Test Temp. Average	Minutes	Seconds	hundreds	Elapsed
(P_m)	(2-4 in Hg)	(V_{di})	(V_{df})	(V_m)	(T_{di})	(T_{df})	(T_d)	(V_{wi})	(V_{wf})	(V_w)	(T_{wi})	(T_{wf})	(T_w)				Θ
in. H_2O	in Hg	cubic feet	cubic feet	cubic feet	°F	°F	°F	cubic feet	cubic feet	cubic feet	°F	°F	°F				minutes
0.5	3.0	908.18	913.25	5.070	75	75	75.0	0	5	5.000	65	65	65.0	13.0	7.0	50.0	13.122
1.0	3.0	902	907.15	5.150	77	77	77.0	1	6	5.000	65	65	65.0	9.0	12.0	50.0	9.205
1.5	3.0	854.83	865	10.170	70	71	70.5	0	10	10.000	65	65	65.0	15.0	24.0	50.0	15.405
2.0	3.0	866.14	877.421	11.281	71	73	72.0	1	12	11.000	65	65	65.0	14.0	25.0	50.0	14.422
3.0	3.0	878.44	888.69	10.250	73	75	74.0	0	10	10.000	65	65	65.0	10.0	32.0	50.0	10.538
4.0	3.0	890.74	900.975	10.235	76	77	76.5	0	10	10.000	65	65	65.0	8.0	55.0	50.0	8.9217

Themocouple Simulator: __________

DGM Orifice Setting	DGM Factor	DGM Factor	Orifice Meter	Orifice Meter
(P_m)	γ_i	$\Delta\gamma$	$\Delta H_@$	$\Delta\Delta H_@$
in. H_2O			in. H_2O	in. H_2O
0.5	1.004	0.014	1.938	0.026
1	0.991	0.000	1.900	-0.011
1.5	0.990	0.000	2.020	0.109
2	0.983	-0.007	1.946	0.034
3	0.985	-0.005	1.879	-0.033
4	0.988	-0.002	1.787	-0.125

0.990 γ Average 1.912 ΔH@ Average

Thermocouple Simulator Setting	Meter Box Thermocouple Calibration:				
F°	Probe	Stack	Filter	Exit	Auxiliary
0	1	1	0	0	0
50	48	48	48	48	49
75	74	73	73	74	73
100	98	99	98	98	98
200	202	199	201		201
300	299	301	299		299
500		502	0.2%		
1000		1003	0.1%		
1500		1499	0.2%		
1900					

$\gamma = V_w * P_b * (T_d + 460) / V_d * (P_b + \Delta H/13.6) * (T_w + 460)$

$\Delta H_@ = ((0.0319 * \Delta H) / (P_b * (T_d + 460))) * (((T_w + 460) * \theta) / V_w)^2$

Tolerance Range	
Stack	1.5 % ± Absolute (°R or °K)
Filter	± 5.4° F
Meter	± 5.4° F
Exit	± 2.0° F
Auxiliary	± 5.4° F

Note: For Calibration Factor γ, the ratio of the calibration meter to dry gas meter, acceptable tolerance of individual values from the average is ±0.02.

Note: For $\Delta H_@$, orifice pressure differential that equates to 0.75 cfm (0.0212 m3/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm) H2O.

Meter Console Information
Console Number: 300.388 D
Dry Gas Meter Number: 977111
Calibration Date: 1/3/2013
Expiration Date: 12/29/2013

Calibration Condition
Time: 1200
Barometric Pressure (P_b): 29.38
Calibration Technician: JJ
Wet Test Meter ID: 11088
Wet Test Meter Verification Date: 4/1/2012

Pass Positive Leak Check? 8.1
Pass Negative Leak Check? 0

		Console Meter						Wet Test Meter						Run Time			
DGM Orifice Setting	Vacuum Setting	Meter Initial Volume	Meter Final Volume	Sample Volume	Outlet Temp. Initial	Outlet Temp. Final	Outlet Temp. Average	Wet Test Initial Volume	Wet Test Final Volume	Wet Test Volume	Wet Test Temp. Initial	Wet Test Temp. Final	Wet Test Temp. Average	Minutes	Seconds	hundreds	Elapsed
(P_m)	(2-4 in Hg)	(V_{di})	(V_{df})	(V_m)	(T_{di})	(T_{df})	(T_d)	(V_{wi})	(V_{wf})	(V_w)	(T_{wi})	(T_{wf})	(T_w)				Θ
in. H_2O	in Hg	cubic feet	cubic feet	cubic feet	°F	°F	°F	cubic feet	cubic feet	cubic feet	°F	°F	°F				minutes
0.5	3.0	823.5	828.75	5.250	71	70	70.5	0	5	5.000	63	63	63.0	13.0	10.0	0.0	13.167
1.0	3.3	816.255	822.47	6.215	74	73	73.5	0	6	6.000	63	63	63.0	11.0	5.0	0.0	11.083
1.5	3.0	751.645	761.835	10.190	65	67	66.0	0	10	10.000	63	63	63.0	14.0	55.0	0.0	14.917
2.0	3.0	762.86	784.38	21.520	67	70	68.5	0	21	21.000	63	63	63.0	27.0	16.0	0.0	27.267
3.0	3.0	787.48	797.74	10.260	72	74	73.0	0	10	10.000	63	63	63.0	10.0	30.0	0.0	10.5
4.0	3.0	798.78	815.23	16.450	74	75	74.5	0	16	16.000	63	63	63.0	14.0	36.0	0.0	14.6

Thermocouple Simulator: ____________________

DGM Orifice Setting	DGM Factor	DGM Factor	Orifice Meter	Orifice Meter
(P_m)	γ_i	$\Delta\gamma$	$\Delta H_@$	$\Delta\Delta H_@$
in. H_2O			in. H_2O	in. H_2O
0.5	0.965	-0.015	1.941	0.055
1	0.982	0.002	1.900	0.014
1.5	0.983	0.003	1.884	-0.001
2	0.981	0.001	1.895	0.009
3	0.986	0.006	1.843	-0.043
4	0.984	0.004	1.851	-0.035

0.980 **γ Average** **1.886** **ΔH@ Average**

Thermocouple Simulator Setting	Meter Box Thermocouple Calibration:				
F°	Probe	Stack	Filter	Exit	Auxiliary
0	1	2	1	1	2
50	49	50	50	49	49
75	73	74	74	74	75
100	99	99	99	99	99
200	200	200	200		199
300	302	302	301		301
500		505	-0.5%		
1000		1006	-0.4%		
1500		1503	-0.2%		
1900					

$\gamma = V_w * P_b * (T_d + 460) / V_d * (P_b + \Delta H/13.6) * (T_w + 460)$

$\Delta H_@ = ((0.0319 * \Delta H) / (P_b * (T_d + 460))) * (((T_w + 460) * \theta) / V_w)^2$

Tolerance Range	
Stack	1.5 % ± Absolute (°R or °K)
Filter	± 5.4° F
Meter	± 5.4° F
Exit	± 2.0° F
Auciliary	± 5.4° F

Note: For Calibration Factor γ, the ratio of the calibration meter to dry gas meter, acceptable tolerance of individual values from the average is ±0.02.
Note: For $\Delta H_@$, orifice pressure differential that equates to 0.75 cfm (0.0212 m3/min) at standard temperaure and pressure,
acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm) H2O.

Meter Console Information	
Console Number:	300.390 G
Dry Gas Meter Number:	978295
Calibration Date:	1/4/2013
Expiration Date:	12/30/2013

Calibration Condition	
Time:	1230
Barometric Pressure (P_b):	29.47
Calibration Technician:	JJ
Wet Test Meter ID:	11088
Wet Test Meter Verification Date:	4/1/2012

Pass Positive Leak Check?	7.7	Yes
Pass Negative Leak Check?	0.000	Yes

		Console Meter						Wet Test Meter						Run Time			
DGM Orifice Setting	Vacuum Setting	Meter Initial Volume	Meter Final Volume	Sample Volume	Outlet Temp. Initial	Outlet Temp. Final	Outlet Temp. Average	Wet Test Initial Volume	Wet Test Final Volume	Wet Test Volume	Wet Test Temp. Initial	Wet Test Temp. Final	Wet Test Temp. Average	Minutes	Seconds	hundreds	Elapsed
(P_m)	(2-4 in Hg)	(V_{di})	(V_{df})	(V_m)	(T_{di})	(T_{df})	(T_d)	(V_{wi})	(V_{wf})	(V_w)	(T_{wi})	(T_{wf})	(T_w)				Θ
in. H_2O	in Hg	cubic feet	cubic feet	cubic feet	°F	°F	°F	cubic feet	cubic feet	cubic feet	°F	°F	°F				minutes
0.5	3.0	96	106.35	10.350	72	72	72.0	0	10	10.000	61	61	61.0	26.0	14.0	50.0	26.238
1.0	3.0	84.88	95.22	10.340	74	73	73.5	0	10	10.000	61	61	61.0	18.0	37.0	50.0	18.622
1.5	3.0	34.66	45.01	10.350	72	74	73.0	0	10	10.000	61	61	61.0	15.0	32.0	50.0	15.538
2.0	3.0	46.09	59.305	13.215	64	66	65.0	0	13	13.000	61	61	61.0	17.0	20.0	50.0	17.338
3.0	3.0	60.33	72.59	12.260	67	71	69.0	0	12	12.000	61	61	61.0	13.0	29.0	50.0	13.488
4.0	3.0	73.6	83.84	10.240	71	73	72.0	0	10	10.000	61	61	61.0	9.0	6.0	50.0	9.105

Themocouple Simulator: ____________

DGM Orifice Setting	DGM Factor	DGM Factor	Orifice Meter	Orifice Meter
(P_m)	γ_i	$\Delta\gamma$	$\Delta H_@$	$\Delta\Delta H_@$
in. H_2O			in. H_2O	in. H_2O
0.5	0.985	-0.001	1.901	-0.055
1	0.988	0.002	1.910	-0.046
1.5	0.985	-0.002	1.996	0.041
2	0.986	0.000	1.991	0.035
3	0.986	0.000	2.105	0.149
4	0.987	0.001	1.831	-0.124

0.986 γ Average 1.956 ΔH@ Average

Thermocouple Simulator Setting	Meter Box Thermocouple Calibration:				
F°	Probe	Stack	Filter	Exit	Auxiliary
0	0	0	0	0	1
50	49	50	50	50	50
75	74	73	73	74	73
100	99	100	99	99	99
200	202	200	201		201
300	299	303	299		299
500		501	0.2%		
1000		1004	0.1%		
1500		1502	0.2%		
1900					

$\gamma = V_w * P_b * (T_d + 460) / V_d * (P_b + \Delta H/13.6) * (T_w + 460)$

$\Delta H_@ = ((0.0319 * \Delta H) / (P_b * (T_d + 460))) * (((T_w + 460) * \theta) / V_w)^2$

Tolerance Range	
Stack	1.5 % ± Absolute (°R or °K)
Filter	± 5.4° F
Meter	± 5.4° F
Exit	± 2.0° F
Auciliary	± 5.4° F

Note: For Calibration Factor γ, the ratio of the calibration meter to dry gas meter, acceptable tolerance of individual values from the average is ±0.02.
Note: For $\Delta H_@$, orifice pressure differential that equates to 0.75 cfm (0.0212 m3/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm) H2O.

Meter Console Information

Console Number:	300.241 H
Dry Gas Meter Number:	12834597
Calibration Date:	1/3/2013
Expiration Date:	12/29/2013

Calibration Condition

Time:	900
Barometric Pressure (P_b):	29.41
Calibration Technician:	JJ
Wet Test Meter ID:	11088
Wet Test Meter Verification Date:	4/1/2012

Pass Positive Leak Check?	9.4	Yes
Pass Negative Leak Check?	0.000	Yes

		Console Meter						Wet Test Meter						Run Time			
DGM Orifice Setting	Vacuum Setting	Meter Initial Volume	Meter Final Volume	Sample Volume	Outlet Temp. Initial	Outlet Temp. Final	Outlet Temp. Average	Wet Test Initial Volume	Wet Test Final Volume	Wet Test Volume	Wet Test Temp. Initial	Wet Test Temp. Final	Wet Test Temp. Average	Minutes	Seconds	hundreds	Elapsed
(P_m)	(2-4 in Hg)	(V_{di})	(V_{df})	(V_m)	(T_{di})	(T_{df})	(T_d)	(V_{wi})	(V_{wf})	(V_w)	(T_{wi})	(T_{wf})	(T_w)				Θ
in. H_2O	in Hg	cubic feet	cubic feet	cubic feet	°F	°F	°F	cubic feet	cubic feet	cubic feet	°F	°F	°F				minutes
0.5	3.0	966.1	971.16	5.060	70	70	70.0	0	5	5.000	63	63	63.0	12.0	24.0	50.0	12.405
1.0	3.0	957.995	965.09	7.095	70	70	70.0	0	7	7.000	63	63	63.0	12.0	21.0	50.0	12.355
1.5	3.0	908.73	919.74	11.010	65	66	65.5	0	11	11.000	63	63	63.0	15.0	45.0	50.0	15.755
2.0	3.0	920.745	930.8	10.055	67	68	67.5	0	10	10.000	63	63	63.0	12.0	36.0	50.0	12.605
3.0	3.0	932.835	942.88	10.045	68	69	68.5	0	10	10.000	63	63	63.0	10.0	21.0	50.0	10.355
4.0	3.0	944.91	955.975	11.065	69	70	69.5	0	11	11.000	63	63	63.0	9.0	50.0	50.0	9.8383

DGM Orifice Setting	DGM Factor	DGM Factor	Orifice Meter	Orifice Meter
(P_m)	γ_i	$\Delta\gamma$	$\Delta H_@$	$\Delta\Delta H_@$
in. H_2O			in. H_2O	in. H_2O
0.5	1.000	0.002	1.723	-0.042
1	0.997	-0.001	1.744	-0.021
1.5	1.000	0.002	1.737	-0.028
2	0.998	0.000	1.787	0.022
3	0.999	0.000	1.806	0.041
4	0.997	-0.002	1.793	0.028

0.998 **γ Average** **1.765** **$\Delta H@$ Average**

$\gamma = V_w * P_b * (T_d + 460) / V_d * (P_b + \Delta H/13.6) * (T_w + 460)$

$\Delta H_@ = ((0.0319 * \Delta H) / (P_b * (T_d + 460))) * (((T_w + 460) * \theta) / V_w)^2$

Note: For Calibration Factor γ, the ratio of the calibration meter to dry gas meter, acceptable tolerance of individual values from the average is ±0.02.

Note: For $\Delta H_@$, orifice pressure differential that equates to 0.75 cfm (0.0212 m3/min) at standard temperanre and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm) H2O.

Themocouple Simulator: t-207319

Thermocouple Simulator Setting	Meter Box Thermocouple Calibration:				
F°	Probe	Stack	Filter	Exit	Auxiliary
0	0	0	0	0	0
50	49	49	49	49	49
75	73	73	73	73	73
100	98	98	98	98	98
200	199	199	199		199
300	300	300	300		300
500		500	0.0%		
1000		1002	-0.1%		
1500		1500	0.0%		
1900		1901	0.0%		

Tolerance Range	
Stack	1.5 % ± Absolute (°R or °K)
Filter	± 5.4° F
Meter	± 5.4° F
Exit	± 2.0° F
Auciliary	± 5.4° F

ENVIRONMENTAL SUPPLY COMPANY

Quality - Service - Reliability

METHOD 5 CRITICAL ORIFICE CALIBRATION

CRITICAL ORIFICE SET S/N: 1374

DATE: 7/25/2000

GAS METER P/N: S-200

REFERENCE DRY GAS METER

SERIAL NUMBER: 6334449

LEAK CHECK: Passed

ORIFICE #	RUN #	CRITICAL VACUUM (in Hg)	TESTED VACUUM (in Hg)	Barometric Pressure per Orifice AVG (P_{bar})	DGM READINGS (FT^3)			TEMPERATURES °F						ELAPSED TIME (MIN) Θ	DGM ΔH (in H_2O)	K' FACTOR *	K' FACTOR VARIATION (%)	AVG VOLUME FLOWRATE (FT^3/MIN)	AVG VOLUME FLOWRATE (LITERS/MIN)
					INITIAL	FINAL	NET (V_m)	AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG						
#46 SS	1	14	18		553.448	559.783	6.335	69.0	68.7	69.3	68.7	68.6	68.88	6.00	3.71	0.8153	0.19	1.05	29.80
	2	14	18		559.783	566.105	6.322	68.6	69.2	70.5	68.8	69.0	69.38	6.00	3.71	0.8125	-0.15		
	3	14	18	29.79	566.105	572.441	6.336	69.0	70.4	72.5	69.0	69.3	70.23	6.00	3.71	0.8134	-0.05		
															AVG K' FACTOR =	0.8138			
#51 SS	1	14	18.5		572.441	578.562	6.121	69.0	70.4	73.0	69.3	69.7	70.60	7.00	2.46	0.6710	0.10	0.87	24.71
	2	14	18.5		578.562	584.687	6.125	69.1	72.1	74.0	69.7	70.2	71.50	7.00	2.46	0.6704	0.00		
	3	14	18.5	29.79	584.687	590.814	6.127	69.1	73.1	74.9	70.2	70.7	72.23	7.00	2.46	0.6697	-0.10		
															AVG K' FACTOR =	0.6704			
#52 SS	1	16	19		590.814	597.174	6.360	69.4	73.0	75.1	70.7	71.2	72.50	8.00	2.16	0.6075	0.10	0.79	22.45
	2	16	19		597.174	603.531	6.357	69.1	74.4	75.6	71.2	71.6	73.20	8.00	2.16	0.6064	-0.08		
	3	16	19	29.79	603.531	609.897	6.366	69.1	74.8	76.1	71.6	72.1	73.65	8.00	2.16	0.6067	-0.02		
															AVG K' FACTOR =	0.6069			
#54 SS	1	15	21		609.897	615.457	5.560	67.6	68.1	68.5	68.1	68.1	68.20	10.00	0.96	0.4264	-0.10	0.56	15.73
	2	15	21		615.457	621.036	5.579	67.6	68.3	68.9	68.1	68.3	68.40	10.00	0.96	0.4277	0.21		
	3	15	21	29.83	621.036	626.602	5.565	67.6	68.9	69.5	68.3	68.6	68.83	10.00	0.96	0.4264	-0.11		
															AVG K' FACTOR =	0.4268			
#56 SS	1	16	22		626.602	631.128	4.525	67.2	69.4	69.8	69.3	69.4	69.48	12.00	0.42	0.2881	-0.02	0.38	10.66
	2	16	22		631.128	635.654	4.525	68.0	69.5	70.1	69.4	69.6	69.65	12.00	0.42	0.2882	0.01		
	3	16	22	29.83	635.654	640.179	4.525	68.9	70.0	70.6	69.6	70.0	70.05	12.00	0.42	0.2882	0.01		
															AVG K' FACTOR =	0.2882			

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:
Calculate the standard volumes of air passed through the DGM and the critical orifices, and calculate the DGM calibration factor, Y, using the equations in US EPA Method 5, Section 7.2.3.3 (these equations are programmed on the spreadsheet included with each orifice set).

* Critical Orifice Coefficient = $K' = \frac{K_1 V_m Y (P_{bar} + \Delta H/13.6) \sqrt{T_{amb}}}{P_{bar} T_m \theta}$

K_1 = 17.64 °R/in. Hg (English)
= 0.3858 °K/mm Hg (Metric)
T_{amb} = Absolute ambient temperature, °R (English), °K (Metric)
T_m = Absolute DGM avg. temperature, °R (English), °K (Metric)

Critical Orifice Set number 1374 was calibrated in accordance with the Code of Federal Regulations, Title 40, Part 60, Appendix A, Method 5, Section 7.2

Signature

7/25/00
Date

Co-1374.XLS

CERTIFICATE OF CALIBRATION

This certifies that your American AL-20 Wet Test Meter
Serial No. 11088
Has been calibrated with a American Bell Prover
Serial No. 277
It is traceable to the N.I.S.T., Reference No. 11200311

Rate of Flow	% of Proof
60 CFH	100.0 %

Calibrated by Carl Poe Co., Inc.
4600 Allen Street Houston, Texas 77007
(713) 861-3816 * Fax: (713) 861-8299

January 26, 2012
Date

Charles Cook
Signature

Date:	01/07/13
Barometric Pressure, In. Hg:	29.44

Reference Thermometer:	3075
Tegam NIST Calibrator Serial No.:	100.122

Reference Thermometer:	3075
Tegam NIST Calibrator Serial No.:	100.122

Reference Thermometer:	3075
Tegam NIST Calibrator Serial No.:	100.122

Asset Number		Cal. By	Temp. One	Reference Temp. One	Percent Difference	Passed	Temp. Two	Reference Temp. Two	Percent Difference	Passed	Temp. Three	Reference Temp. Three	Percent Difference	Passed
PROBES														
200.021	2	JJ	65.0	64.0	-0.2%	Yes	150.0	155.0	0.8%	Yes	326.0	328.0	0.3%	Yes
200.063	2	JJ	65.0	64.0	-0.2%	Yes	149.0	155.0	1.0%	Yes	310.0	308.0	-0.3%	Yes
200.064	2	JJ	65.0	64.0	-0.2%	Yes	148.0	151.0	0.5%	Yes	324.0	326.0	0.3%	Yes
200.005	3	JJ	65.0	64.0	-0.2%	Yes	157.0	161.0	0.8%	Yes	254.0	255.0	0.1%	Yes
200.015	3	JJ	64.0	64.0	0.0%	Yes	154.0	160.0	1.0%	Yes	249.0	246.0	-0.4%	Yes
200.016	3	JJ	64.0	64.0	0.0%	Yes	145.0	148.0	0.5%	Yes	250.0	253.0	0.4%	Yes
200.017	3	JJ	64.0	64.0	0.0%	Yes	142.0	145.0	0.5%	Yes	290.0	287.0	-0.4%	Yes
200.076	3	JJ	64.0	64.0	0.0%	Yes	147.0	151.0	0.7%	Yes	249.0	247.0	-0.3%	Yes
200.077	3	JJ	64.0	64.0	0.0%	Yes	149.0	156.0	1.1%	Yes	310.0	308.0	-0.3%	Yes
200.079	3	JJ	64.0	64.0	0.0%	Yes	150.0	154.0	0.7%	Yes	338.0	340.0	0.3%	Yes
200.080	3	JJ	64.0	64.0	0.0%	Yes	158.0	160.0	0.3%	Yes	294.0	303.0	1.2%	Yes
200.300	3	JJ	64.0	64.0	0.0%	Yes	155.0	154.0	-0.2%	Yes	301.0	310.0	1.2%	Yes
200.301	3	JJ	64.0	64.0	0.0%	Yes	155.0	162.0	1.1%	Yes	311.0	315.0	0.5%	Yes
200.302	3	JJ	64.0	64.0	0.0%	Yes	151.0	148.0	-0.5%	Yes	333.0	327.0	-0.8%	Yes
200.303	3	JJ	64.0	64.0	0.0%	Yes	156.0	154.0	-0.3%	Yes	305.0	303.0	-0.3%	Yes
200.008	5	JJ	64.0	64.0	0.0%	Yes	135.0	140.0	0.8%	Yes	277.0	274.0	-0.4%	Yes
200.105	5	JJ	64.0	64.0	0.0%	Yes	141.0	140.0	-0.2%	Yes	260.0	265.0	0.7%	Yes
200.118	5	JJ	64.0	64.0	0.0%	Yes	151.0	155.0	0.7%	Yes	318.0	321.0	0.4%	Yes
200.119	5	JJ	65.0	64.0	-0.2%	Yes	139.0	140.0	0.2%	Yes	302.0	307.0	0.7%	Yes
200.120	5	JJ	64.0	64.0	0.0%	Yes	160.0	159.0	-0.2%	Yes	296.0	302.0	0.8%	Yes
200.121	5	JJ	64.0	64.0	0.0%	Yes	148.0	155.0	1.1%	Yes	295.0	303.0	1.0%	Yes
200.093 7'		JJ	66.0	67.0	0.2%	Yes	148.0	155.0	1.1%	Yes	302.0	305.0	0.4%	Yes
200.094 7'		JJ	66.0	67.0	0.2%	Yes	144.0	140.0	-0.7%	Yes	278.0	285.0	0.9%	Yes
200.310 7'		JJ	66.0	67.0	0.2%	Yes	167.0	170.0	0.5%	Yes	296.0	305.0	1.2%	Yes
200.112 7'		JJ	66.0	67.0	0.2%	Yes	151.0	155.0	0.7%	Yes	300.0	305.0	0.7%	Yes
200.709 8'		JJ	65.0	67.0	0.4%	Yes	147.0	150.0	0.5%	Yes	291.0	285.0	-0.8%	Yes
200.705 8'		JJ	65.0	67.0	0.4%	Yes	145.0	140.0	-0.8%	Yes	283.0	285.0	0.3%	Yes
200.041 8'		JJ	65.0	67.0	0.4%	Yes	186.0	184.0	-0.3%	Yes	300.0	305.0	0.7%	Yes
200.108 8'		JJ	65.0	67.0	0.4%	Yes	178.0	180.0	0.3%	Yes	301.0	305.0	0.5%	Yes
200.109 8'		JJ	65.0	67.0	0.4%	Yes	155.0	155.0	0.0%	Yes	298.0	305.0	0.9%	Yes
200.045 8'		JJ	65.0	67.0	0.4%	Yes	167.0	170.0	0.5%	Yes	279.0	285.0	0.8%	Yes
200.013 10'		JJ	65.0	67.0	0.4%	Yes	145.0	150.0	0.8%	Yes	281.0	285.0	0.5%	Yes
200.014 10'		JJ	66.0	67.0	0.2%	Yes	155.0	155.0	0.0%	Yes	290.0	285.0	-0.7%	Yes
200.050 11'		JJ	66.0	67.0	0.2%	Yes	160.0	159.0	-0.2%	Yes	278.0	285.0	0.9%	Yes
200.051 11'		JJ	66.0	67.0	0.2%	Yes	138.0	140.0	0.3%	Yes	287.0	285.0	-0.3%	Yes
200.052 11'		JJ	66.0	67.0	0.2%	Yes	143.0	148.0	0.8%	Yes	290.0	285.0	-0.7%	Yes
200.053 11'		JJ	66.0	67.0	0.2%	Yes	144.0	148.0	0.7%	Yes	278.0	285.0	0.9%	Yes
200.098 14'		JJ	66.0	67.0	0.2%	Yes	153.0	155.0	0.3%	Yes	300.0	305.0	0.7%	Yes
200.099 14'		JJ	65.0	67.0	0.4%	Yes	161.0	159.0	-0.3%	Yes	287.0	285.0	-0.3%	Yes
200.111 15'		JJ	65.0	67.0	0.4%	Yes	148.0	155.0	1.1%	Yes	298.0	305.0	0.9%	Yes
200.110 15'		JJ	65.0	67.0	0.4%	Yes	151.0	155.0	0.7%	Yes	305.0	305.0	0.0%	Yes
200.091 16'		JJ	65.0	67.0	0.4%	Yes	138.0	140.0	0.3%	Yes	302.0	305.0	0.4%	Yes

Date:	01/07/13
Barometric Pressure, In. Hg:	29.44

Reference Thermometer:	3075
Tegam NIST Calibrator Serial No.:	100.122

Reference Thermometer:	3075
Tegam NIST Calibrator Serial No.:	100.122

Reference Thermometer:	3075
Tegam NIST Calibrator Serial No.:	100.122

Asset Number	Cal. By	Temp. One	Reference Temp. One	Percent Difference	Passed	Temp. Two	Reference Temp. Two	Percent Difference	Passed	Temp. Three	Reference Temp. Three	Percent Difference	Passed
pitots													
200.304	JJ	67.0	66.0	-0.2%	Yes	140.0	143.0	0.5%	Yes	237.0	242.0	0.7%	Yes
200.305	JJ	67.0	66.0	-0.2%	Yes	144.0	143.0	-0.2%	Yes	241.0	242.0	0.1%	Yes
200.706	JJ	67.0	66.0	-0.2%	Yes	143.0	143.0	0.0%	Yes	254.0	256.0	0.3%	Yes
200.708	JJ	67.0	66.0	-0.2%	Yes	125.0	130.0	0.8%	Yes	265.0	267.0	0.3%	Yes
200.711	JJ	67.0	66.0	-0.2%	Yes	127.0	130.0	0.5%	Yes	257.0	260.0	0.4%	Yes
200.704	JJ	67.0	66.0	-0.2%	Yes	130.0	132.0	0.3%	Yes	270.0	265.0	-0.7%	Yes
200.707	JJ	65.0	66.0	0.2%	Yes	135.0	138.0	0.5%	Yes	263.0	266.0	0.4%	Yes
255i	JJ	66.0	66.0	0.0%	Yes	141.0	143.0	0.3%	Yes	256.0	261.0	0.8%	Yes
200.712	JJ	66.0	66.0	0.0%	Yes	132.0	135.0	0.5%	Yes	251.0	254.0	0.4%	Yes
s/n p789	JJ	66.0	66.0	0.0%	Yes	135.0	140.0	0.8%	Yes	267.0	270.0	0.4%	Yes

Ref. Temp. Deg. F + 460

Umbilical Adaptors Temperature Calibration

Calibrated By:	JJ	Date:	1/7/2013	Reference Thermometer:	3075	Tegam NIST Calibrator Serial No.:	100.122	Barometric Pressure,In. Hg:	29.37

Asset Number	Id Letter	Ambient	Reference Ambient	Percent Difference	Passed	Ice Bath	Reference Ice Bath	Percent Difference	Passed	Heat Bath	Reference Heat Bath	Percent Difference	Passed
300.030	A	62	63	0.2%	Yes	32	32	0.0%	Yes	131	131	0.0%	Yes
300.318	B	63	63	0.0%	Yes	32	32	0.0%	Yes	131	131	0.0%	Yes
300.355	C	63	63	0.0%	Yes	33	32	-0.2%	Yes	131	131	0.0%	Yes
300.032	D	62	63	0.2%	Yes	32	32	0.0%	Yes	130	131	0.2%	Yes
300.043	E	62	63	0.2%	Yes	32	32	0.0%	Yes	129	131	0.3%	Yes
300.319	F	62	63	0.2%	Yes	32	32	0.0%	Yes	131	131	0.0%	Yes
300.317	G	63	63	0.0%	Yes	32	32	0.0%	Yes	131	131	0.0%	Yes
300.042	H	63	63	0.0%	Yes	32	32	0.0%	Yes	130	131	0.2%	Yes
300.345	I	63	63	0.0%	Yes	32	32	0.0%	Yes	131	131	0.0%	Yes
300.044	J	63	63	0.0%	Yes	33	32	-0.2%	Yes	131	131	0.0%	Yes
300.031	K	63	63	0.0%	Yes	32	32	0.0%	Yes	130	131	0.2%	Yes
300.216	L	63	63	0.0%	Yes	32	32	0.0%	Yes	131	131	0.0%	Yes
300.320	M	63	63	0.0%	Yes	32	32	0.0%	Yes	131	131	0.0%	Yes
300.346	N	63	63	0.0%	Yes	32	32	0.0%	Yes	131	131	0.0%	Yes
300.295	O	63	63	0.0%	Yes	33	32	-0.2%	Yes	130	131	0.2%	Yes

Temperature Difference Calculation:

$$\frac{(\text{Ref. Temp. Deg. F} + 460) - (\text{Test Temp. Deg. F} + 460)}{\text{Ref. Temp. Deg. F} + 460} \text{ X } 100 = <1.5\%$$

TYPE "S" PITOT TUBE CALIBRATION FORM

Date: 1/7/13
Calibrator: JJ

Specifications:
A.) Pitot tube assembly must be level.
B.) If pitot tube is damaged explain under comments section.
C.) Z = A Sin g (<0.125) and W = A Sin q (<0.03125)
D.) a <10° and b <5°

Pitot Tubes Attached to Probes

I.D. Length	a1°	a2°	b1°	b2°	g°	q°	A, in.	Z, in.	W, in.	PA, in.	PB, in.	Dt, in.	Pass/Fail	Cal. Date
200.021 2'	1.0	1.0	0.5	0.5	0.5	1.5	0.948	0.008	0.02482	0.474	0.474	0.376	Pass	1/7/13
200.063 2'	1.2	1.5	2.7	1.1	3.8	0.6	0.862	0.057	0.00903	0.431	0.431	0.372	Pass	1/7/13
200.064 2'	0.5	0.0	1.5	1.0	1.0	1.0	0.892	0.016	0.01557	0.446	0.446	0.380	Pass	1/7/13
200.074 2'	0.5	0.5	1.0	0.0	1.5	1.0	0.916	0.024	0.01599	0.458	0.458	0.365	Pass	1/7/13
200.005 3'	0.1	0.4	0.8	0.3	1.1	1.1	0.930	0.018	0.01785	0.465	0.465	0.388	Pass	1/7/13
200.015 3'	1.0	1.0	2.0	1.0	1.0	1.0	0.925	0.016	0.01614	0.463	0.463	0.382	Pass	1/7/13
200.016 3'	1.0	0.0	0.5	0.5	1.0	0.5	0.925	0.016	0.00807	0.463	0.463	0.372	Pass	1/7/13
200.017 3'	1.5	1.2	2.0	2.0	1.2	1.9	0.935	0.020	0.03100	0.468	0.468	0.379	Pass	1/7/13
200.076 3'	1.5	1.1	0.7	1.1	2.0	0.5	0.926	0.032	0.00808	0.463	0.463	0.386	Pass	1/7/13
200.077 3'	0.6	0.6	0.5	0.2	2.2	0.2	0.930	0.036	0.00325	0.465	0.465	0.378	Pass	1/7/13
200.079 3'	0.5	0.9	0.9	0.3	1.2	1.0	0.944	0.020	0.01648	0.472	0.472	0.378	Pass	1/7/13
200.080 3'	0.4	0.7	2.2	1.4	1.6	1.0	0.971	0.027	0.01695	0.486	0.486	0.373	Pass	1/7/13
200.300 3'	0.0	0.0	1.0	1.0	0.5	1.0	0.933	0.008	0.01628	0.467	0.467	0.370	Pass	1/7/13
200.301 3'	0.5	1.0	1.0	1.0	0.5	0.0	0.923	0.008	0.00000	0.462	0.462	0.378	Pass	1/7/13
200.302 3'	1.0	0.0	1.0	0.5	1.5	0.0	0.940	0.025	0.00000	0.470	0.470	0.377	Pass	1/7/13
200.303 3'	0.0	0.0	0.0	0.0	0.5	1.0	0.940	0.008	0.01641	0.470	0.470	0.375	Pass	1/7/13
200.008 5'	0.2	0.8	0.6	0.5	1.5	1.0	0.983	0.026	0.01716	0.492	0.492	0.371	Pass	1/7/13
200.105 5'	1.0	1.0	0.5	0.5	1.0	1.5	0.921	0.016	0.02411	0.461	0.461	0.373	Pass	1/7/13
200.118 5'	0.0	0.5	0.0	0.0	0.5	0.5	0.953	0.008	0.00832	0.477	0.477	0.380	Pass	1/7/13
200.119 5'	0.0	0.0	1.0	1.0	1.5	0.5	0.990	0.026	0.00864	0.495	0.495	0.376	Pass	1/7/13
200.120 5'	0.0	1.0	0.5	0.5	1.0	0.0	0.931	0.016	0.00000	0.466	0.466	0.380	Pass	1/7/13
200.121 5'	0.5	0.0	0.5	0.0	2.0	1.0	0.925	0.032	0.01614	0.463	0.463	0.376	Pass	1/7/13
200.093 7'	0.5	0.5	0.0	0.0	0.5	1.0	0.998	0.009	0.01742	0.499	0.499	0.386	Pass	1/7/13
200.094 7'	0.0	0.5	1.0	0.0	2.0	0.0	0.934	0.033	0.00000	0.467	0.467	0.382	Pass	1/7/13
200.310 7'	1.0	1.0	0.0	0.0	0.5	1.0	0.981	0.009	0.01712	0.491	0.491	0.385	Pass	1/7/13
200.112 7'	1.3	2.0	0.0	1.1	0.0	0.9	0.987	0.000	0.01550	0.494	0.494	0.385	Pass	1/7/13
200.709 8'	0.7	2.0	1.0	2.0	0.5	0.7	0.954	0.008	0.01166	0.477	0.477	0.374	Pass	1/7/13
200.705 8'	2.0	0.0	1.0	0.0	0.6	0.9	0.941	0.010	0.01478	0.471	0.471	0.380	Pass	1/7/13
200.041 8'	1.0	0.0	1.0	1.0	0.4	0.8	0.980	0.007	0.01368	0.490	0.490	0.386	Pass	1/7/13
200.108 8'	1.1	1.3	1.4	1.0	1.1	0.5	0.951	0.018	0.00830	0.476	0.476	0.382	Pass	1/7/13
200.109 8'	1.2	1.4	0.0	2.0	1.3	0.0	0.962	0.022	0.00000	0.481	0.481	0.374	Pass	1/7/13
200.045 8'	1.0	1.0	1.5	1.4	0.9	0.00	0.947	0.015	0.00000	0.474	0.474	0.750	Pass	1/7/13
200.013 10'	0.8	1.1	0.0	0.0	0.7	0.0	0.972	0.012	0.00000	0.486	0.486	0.379	Pass	1/7/13
200.014 10'	0.7	1.0	1.1	0.0	0.6	0.5	0.967	0.010	0.00844	0.484	0.484	0.380	Pass	1/7/13
200.050 11'	1.5	1.3	2.0	1.0	0.0	0.0	0.966	0.000	0.00000	0.483	0.483	0.373	Pass	1/7/13
200.051 11'	2.0	2.5	1.2	1.0	0.0	1.3	0.981	0.000	0.02226	0.491	0.491	0.386	Pass	1/7/13
200.052 11'	2.0	1.0	2.0	1.0	1.2	1.1	0.925	0.019	0.01776	0.463	0.463	0.383	Pass	1/7/13
200.053 11'	2.0	3.0	0.0	1.1	0.0	0.7	0.962	0.000	0.01175	0.481	0.481	0.379	Pass	1/7/13
200.098 14'	2.0	1.0	2.0	0.0	1.4	1.4	0.955	0.023	0.02333	0.478	0.478	0.388	Pass	1/7/13
200.099 14'	1.0	1.2	2.0	0.0	1.1	1.1	0.938	0.018	0.01801	0.469	0.469	0.379	Pass	1/7/13
200.111 15'	2.0	1.2	1.0	1.0	0.0	1.0	0.944	0.000	0.01648	0.472	0.472	0.363	Pass	1/7/13
200.110 15'	1.5	2.0	2.0	1.5	1.0	1.2	0.965	0.017	0.02021	0.483	0.483	0.378	Pass	1/7/13
200.091 16'	1.0	1.7	0.0	0.0	0.0	1.2	0.977	0.000	0.02046	0.489	0.489	0.376	Pass	1/7/13

Comments: Pitot Tubes Required Only Minor Maintenance & Reconditioning

TYPE "S" PITOT TUBE CALIBRATION FORM

Date: 1/7/13

Calibrator: JJ

Specifications:

A.) Pitot tube assembly must be level.

B.) If pitot tube is damaged explain under comments section.

C.) Z = A Sin g (<0.125) and W = A Sin q (<0.03125)

D.) a <10° and b <5°

Pitot Tubes Attached to Probes

I.D. Length	a1°	a2°	b1°	b2°	g°	q°	A, in.	Z, in.	W, in.	PA, in.	PB, in.	Dt, in.	Pass/Fail	Cal. Date

Individual Pitot Tubes

I.D. Length	a1°	a2°	b1°	b2°	y°	o°	A, in.	Z, in.	W, in.	PA, in.	PB, in.	Dt, in.	Pass/Fail	
200.304 3'	1.0	1.0	0.0	1.0	0.0	1.0	0.936	0.000	0.01634	0.468	0.468	0.380	Pass	1/7/13
200.305 3'	1.0	1.0	0.5	0.5	0.9	1.0	0.934	0.015	0.01630	0.467	0.467	0.383	Pass	1/7/13
200.704 7'	0.0	0.0	1.0	0.5	0.6	0.0	0.835	0.009	0.00000	0.418	0.418	0.385	Pass	1/7/13
200.708 3'	0.8	0.5	1.0	0.8	0.0	0.0	0.833	0.000	0.00000	0.417	0.417	0.384	Pass	1/7/13
200.706 3'	0.0	1.0	0.0	1.0	0.0	0.0	0.829	0.000	0.00000	0.415	0.415	0.381	Pass	1/7/13
200.255i	0.0	0.5	0.0	0.0	0.0	1.0	0.850	0.000	0.01483	0.425	0.425	0.382	Pass	1/7/13
200.711 5'	0.8	1.0	1.0	1.0	0.9	0.5	0.920	0.014	0.00803	0.460	0.460	0.384	Pass	1/7/13
200.712	1.0	0.5	0.0	0.0	1.0	1.0	0.931	0.016	0.01625	0.466	0.466	0.390	Pass	1/7/13
200.707	0.5	1.0	1.0	0.0	0.0	0.0	0.839	0.000	0.00000	0.420	0.420	0.381	Pass	1/7/13
s/n p 796	0.0	0.0	0.5	1.0	1.0	0.5	0.926	0.016	0.00808	0.463	0.463	0.388	Pass	1/7/13

Comments: Pitot Tubes Required Only Minor Maintenance & Reconditioning

Hotbox Thermocouple Temperature Calibration

Calibrated By: JJ

Date: 1/7/2013

Reference Thermometer: NIST

Tegam NIST Calibrator Serial No.:

Barometric Pressure,In. Hg: # 29.47

Asset Number	Id Letter	Ambient	Reference Ambient	Percent Difference	Passed	MID. Temp.	Reference Temp.	Percent Difference	Passed	HIGH Temp.	Reference Temp.	Percent Difference	Passed
Hotbox	B	61	62	0.2%	Yes	208	208	0.0%	Yes	330	329	-0.1%	Yes
Hotbox	C	61	62	0.2%	Yes	202	203	0.2%	Yes	301	300	-0.1%	Yes
Hotbox	D	61	62	0.2%	Yes	205	206	0.2%	Yes	300	298	-0.3%	Yes
Hotbox	E	62	62	0.0%	Yes	219	218	-0.1%	Yes	308	309	0.1%	Yes
Hotbox	F	62	62	0.0%	Yes	208	206	-0.3%	Yes	317	316	-0.1%	Yes
Hotbox	G	61	62	0.2%	Yes	229	228	-0.1%	Yes	316	317	0.1%	Yes
Hotbox	I	61	62	0.2%	Yes	206	209	0.4%	Yes	354	353	-0.1%	Yes
Hotbox	J	65	65	0.0%	Yes	250	250	0.0%	Yes	320	325	0.6%	Yes
Hotbox	K	66	66	0.0%	Yes	251	250	-0.1%	Yes	319	325	0.8%	Yes
Hotbox	L	67	67	0.0%	Yes	254	250	-0.6%	Yes	327	325	-0.3%	Yes
Hotbox	M	66	66	0.0%	Yes	249	250	0.1%	Yes	321	325	0.5%	Yes
Hotbox	N	61	62	0.2%	Yes	238	240	0.3%	Yes	325	323	-0.3%	Yes
Hotbox	Q1	60	62	0.4%	Yes	217	218	0.1%	Yes	333	334	0.1%	Yes
Hotbox	Q2	62	62	0.0%	Yes	208	206	-0.3%	Yes	321	322	0.1%	Yes
Hotbox	B2	66	67	0.2%	Yes	249	250	0.1%	Yes	320	325	0.6%	Yes

Temperature Difference Calculation:

$$\frac{(\text{Ref. Temp. Deg. F} + 460) - (\text{Test Temp. Deg. F} + 460)}{\text{Ref. Temp. Deg. F} + 460} \text{ X } 100 = <1.5\%$$

Environmental Supply Company, Inc.

Quality Source Sampling Systems & Accessories

Wind Tunnel Pitot Calibration

S-type Pitot ID:	**P-799**	Date:	**22-Jun-13**
Standard Pitot ID:	**RE2-20**	Personnel:	**BR**
Cp(std):	**0.99**	Cp(actual):	**0.765**
Part Number:	**PPS12-Y-PM10**	P(bar):	**29.77**
Test Velocity (fps):	**50**	T(°F):	**78**
Wind Tunnel Location:	**Wake Forest, NC**	Tunnel Size:	**30" x 36"**

A-SIDE

ΔP_{std} (in. H_2O)	ΔP_s (in. H_2O)	Cp(s)	Deviation*
0.670	**1.090**	**0.776**	0.002
0.657	**1.120**	**0.758**	-0.001
0.650	**1.100**	**0.761**	0.000
	AVERAGE	**0.765**	0.001
		Std deviation	0.002

NOTES:

1. **Pitot calibrated with an Environmental Supply Co. PM10 cyclone.**
2. **C_p is only valid when used with PM10 cyclone.**
3. **C_p is only valid with 1" spacing from PM10 cyclone.**

$$Cp(s) = Cp(std)\sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

*Deviation = {Cp(s) - *AVG* Cp(s)} {must be <0.010}

Standard deviation of the deviations must be less than 0.02 for both sides.

Pitot tube S/N P-799 was calibrated in accordance with the CFR 40, Part 60 Appendix A, Method 2, Section 10.

Signature

6/22/13

Date

Wind Tunnel Pitot Calibration

S-type Pitot ID: **P-753**
Standard Pitot ID: **RE2-20**
Cp(std): **0.99**
Part Number: **PPS12-Y-PM10**
Test Velocity (fps): **50**
Wind Tunnel Location: **Wake Forest, NC**

Date: **26-Jul-12**
Personnel: **BR**
Cp(actual): **0.765**
P(bar): **29.58**
T(°F): **89**
Tunnel Size: **30" x 36"**

A-SIDE

ΔP_{std} (in. H_2O)	ΔP_s (in. H_2O)	Cp(s)	Deviation*
0.563	**0.940**	**0.766**	0.002
0.563	**0.943**	**0.765**	-0.001
0.560	**0.940**	**0.764**	0.000
	AVERAGE	**0.765**	0.001
		Std deviation	0.002

NOTES:

1. **Pitot calibrated with an Environmental Supply Co. PM10 cyclone.**
2. **C_p is only valid when used with PM10 cyclone.**
3. **C_p is only valid with 1" spacing from PM10 cyclone.**

$$Cp(s) = Cp(std)\sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

*Deviation = {Cp(s) - *AVG* Cp(s)} {must be <0.010}

Standard deviation of the deviations must be less than 0.02 for both sides.

Pitot tube S/N P-753 was calibrated in accordance with the CFR 40, Part 60 Appendix A, Method 2, Section 10.

Signature

9/17/12
Date

Precision Weighing
1949 Evans Road
Cary, North Carolina 27513
Phone: (919) 678-0077 * Fax: (919) 678-0078
Email: pweighing@aol.com

Client:	Contact:	Department:
CEC, Inc	**Paul Jenkins**	**Lab**

Description:	Thermomotor	Calibration SOP:	2020 Rev. 1.0
Instrument ID:	1992	Serial Number:	1992
Manufacturer:	Erlco	Operating Range:	30 to 200 °F
Model:	30 to 214°F	Instrument Range:	30 to 214 °F
Calibration Interval:	Annual	Calibration Tolerance:	+/- 2 deg F

Calibration Notes: *Nominal Targets are 32 , 110 , 200 Degrees Fahrenheit*

Calibration Data ("As left" data is identical to "As found" data, if "As left" is blank)

Test Points	Units	Standard	As Found	Error	As Left	Error	Pass/Fail
30	° F	31.754	32.2	-0.446			Pass
110	° F	109.436	109.4	0.036			Pass
200	° F	199.786	199.2	0.586			Pass

Instrument Found in Tolerance? Yes
Instrument Left in Tolerance? Yes

Calibration Date:	16-Jan-13	**Calibration Due Date:**	January 2014

Test Standards:	**Standard ID:**	**Expiration Date:**
Digital Thermometer	111913846	November 13

Technicians Remarks: NA

Calibration Performed By:
STANLEY R. HALL

Approved Signature:

Precision Weighing
1949 Evans Road
Cary, North Carolina 27513
Phone: (919) 678-0077 * Fax: (919) 678-0078
Email: pweighing@aol.com

Client:	Contact:	Department:
CEC, Inc	Paul Jenkins	Lab

Description:	Thermometer	Calibration SOP:	2020 Rev. 1.0
Instrument ID:	2206	Serial Number:	3062
Manufacturer:	Ertco	Operating Range:	0 to 200 °C
Model:	0 to 200 °C	Instrument Range:	0 to 200 °C
Calibration Interval:	Annual	Calibration Tolerance:	+/- 1 deg C

Calibration Notes: *Nominal Targets are 0 , 150 , 200 Degrees Celcius*

Calibration Data ("As left" data is identical to "As found" data, if "As left" is blank)

Test Points	Units	Standard	As Found	Error	As Left	Error	Pass/Fail
0	° C	0.048	0.2	-0.152			Pass
150	° C	149.7	149.4	0.3			Pass
200	° C	199.2	199.0	0.2			Pass

Instrument Found in Tolerance? Yes
Instrument Left in Tolerance? Yes

Calibration Date:	16-Jan-13	**Calibration Due Date:**	January 2014

Test Standards:	**Standard ID:**	**Expiration Date:**
Digital Thermometer	111913846	November 2013
Glass Thermometer	5270241	January 2014

Technicians Remarks: NA

Calibration Performed By:

STANLEY R. HALL

Approved Signature:

Precision Weighing
1949 Evans Road
Cary, North Carolina 27513
Phone: (919) 678-0077 * Fax: (919) 678-0078
Email: pweighing@aol.com

Client:	Contact:	Department:
CEC, Inc	Paul Jenkins	Lab

Description:	Thermometer	Calibration SOP:	2020 Rev. 1.0
Instrument ID:	3062	Serial Number:	3080
Manufacturer:	VWR	Operating Range:	0 to 110 °F
Model:	608-3S	Instrument Range:	-30 to 120 °F
Calibration Interval:	Annual	Calibration Tolerance:	+/- 2 deg F

Calibration Notes: *Nominal Targets are 32 , 50 , 110 Degrees Fahrenheit*

Calibration Data ("As left" data is identical to "As found" data, if "As left" is blank)

Test Points	Units	Standard	As Found	Error	As Left	Error	Pass/Fail
32	° F	31.754	32	-0.246			Pass
50	° F	50.092	50	0.092			Pass
110	° F	109.436	110	-0.664			Pass

Instrument Found in Tolerance? Yes
Instrument Left in Tolerance? Yes

Calibration Date:	16-Jan-13	**Calibration Due Date:**	January 2014

Test Standards:	**Standard ID:**	**Expiration Date:**
Digital Thermometer	111913846	November 13

Technicians Remarks: NA

Calibration Performed By:
Stanley R. Hall

Approved Signature:

Precision Weighing
1949 Evans Road
Cary, North Carolina 27513
Phone: (919) 678-0077 * Fax: (919) 678-0078
Email: pweighing@aol.com

Client:

Contact:

Department:
Lab

Description: Thermometer
Instrument ID: 3080
Manufacturer: VWR
Model: 608-3S
Calibration Interval: Annual

Calibration SOP: 2020 Rev. 1.0
Serial Number: 3080
Operating Range: 0 to 110 °F
Instrument Range: -30 to 120 °F
Calibration Tolerance: +/- 2 deg F

Calibration Notes: *Nominal Targets are 32 , 50 , 110 Degrees Fahrenheit*

Calibration Data ("As left" data is identical to "As found" data, if "As left" is blank)

Test Points	Units	Standard	As Found	Error	As Left	Error	Pass/Fail
32	° F	31.754	32	-0.246			Pass
50	° F	50.092	50	0.092			Pass
110	° F	109.436	109	0.436			Pass

Instrument Found in Tolerance? Yes
Instrument Left in Tolerance? Yes

Calibration Date:	16-Jan-13	**Calibration Due Date:**	January 2014

Test Standards:	**Standard ID:**	**Expiration Date:**
Digital Thermometer	111913846	November 13

Technicians Remarks: NA

Calibration Performed By:
Stanley R. Hall

Approved Signature:

Precision Weighing
1949 Evans Road
Cary, North Carolina 27513
Phone: (919) 678-0077 * Fax: (919) 678-0078
Email: pweighing@aol.com

Client:	Contact:	Department:
CEC, Inc	Paul Jenkins	Lab

Description:	Thermometer	Calibration SOP:	2020 Rev. 1.0
Instrument ID:	U38717	Serial Number:	U38717
Manufacturer:	ERTCO	Operating Range:	0 to 200 °C
Model:	-5 to 400°C	Instrument Range:	-5 to 400 °C
Calibration Interval:	Annual	Calibration Tolerance:	+/- 2 deg C

Calibration Notes: *Nominal Targets are 0 , 50 , 100 and 200 Degrees Celsius*

Calibration Data ("As left" data is identical to "As found" data, if "As left" is blank)

Test Points	Units	Standard	As Found	Error	As Left	Error	Pass/Fail
0	° C	0.048	0	0.048			Pass
50	° C	50.372	50	0.372			Pass
100	° C	100.222	99	1.222			Pass
200	° C	199.2	199	0.2			Pass

Instrument Found in Tolerance? Yes
Instrument Left in Tolerance? Yes

Calibration Date:	16-Jan-13	Calibration Due Date:	January 2014

Test Standards:	Standard ID:	Expiration Date:
Digital Thermometer	111913846	November 2013
Glass Thermometer	6270241	January 2014

Technicians Remarks: NA

Calibration Performed By: Stanley R. Hall

Approved Signature:

ACCREDITED

Calibration
Certificate No. 1750.01

Calibration complies with ISO/IEC 17025, ANSI/NCSL Z540-1, and 9001

Cert. No.: 4000-4006344

Traceable® Certificate of Calibration for Digital Thermometer

Instrument Identification:

Model: 4000 S/N: 111913846 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Temperature Calibration Bath TC-275	A9A237		
Digital Thermometer	B16815	6/09/12	B1606038
PRT Temperature Probe	01641	5/28/12	B1526085
Digital Thermometer	111879346	10/21/12	4000-3972946
Temperature Calibration Bath TC-231	A79341		
Thermistor Module	A17118	1/24/12	1000291329
Temperature Probe	3039	2/01/12	6-BA02G-1-1

Certificate Information:

Technician: 68 Procedure: CAL-06 Cal Date: 11/08/11 **Cal Due: 11/08/13**
Test Conditions: 24.0°C 46.0 %RH 1013 mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
°C		N.A.		0.001	-0.002	Y	-0.049	0.051	0.013	3.8:1
°C		N.A.		25.001	24.998	Y	24.951	25.051	0.014	3.6:1
°C		N.A.		60.001	59.998	Y	59.951	60.051	0.018	2.8:1
°C		N.A.		100.001	100.003	Y	99.951	100.051	0.018	2.8:1

This instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2; Min = Nominal(Rounded) - Tolerance; Max = Nominal(Rounded) + Tolerance; Date=MM/DD/YY

Nicol Rodriguez
Nicol Rodriguez, Quality Manager

Wallace Berry
Wallace Berry, Technical Manager

Maintaining Accuracy:

In our opinion once calibrated your Digital Thermometer should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Digital Thermometers change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

CONTROL COMPANY 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

Control Company is an ISO 17025:2005 Calibration Laboratory Accredited by (A2LA) American Association for Laboratory Accreditation, Certificate No. 1750.01.
Control Company is ISO 9001:2008 Quality Certified by (DNV) Det Norske Veritas, Certificate No. CERT-01805-2006-AQ-HOU-ANAB.
International Laboratory Accreditation Cooperation (ILAC) - Multilateral Recognition Arrangement (MRA).

Traceable® is a registered trademark of Control Company

Applied Technical Services

Certificate of Calibration

Certificate #1050576

ACCREDITED

Customer:
Precision Weighing
111 Meece Bridge Road
Taylors, SC 29687

Calibration Location:
Applied Technical Services
1049 Triad Court
Marietta, GA 30062

Instrument Information:

Manufacturer: Fluke
Model Number: 51
Description: Thermometer, Thermocouple
Asset Number: 5270241
Serial Number: 5270241
PO Number: STAN

Calibration Information/Results:

As Found Condition : In Tolerance
Action Taken / As Left: In Tolerance - No Adjustment
Temperature: 70° F
Humidity: 26% RH
Calibration Date: 01/08/2013
Calibration Due Date: 01/08/2014
Calibration Interval: 12 Months

Calib. Procedure: ATS-1005 Rev 2:Calibration of Thermocouple Thermometer Simulate

This instrument has been calibrated using primary or secondary standards whose calibration is traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or applicable ASTM specification number for hardness testing equipment. Some measurements are traceable to natural, physical constants, consensus standards, or ratio type measurements.
The reported expanded measurement uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a confidence level of approximately 95%. The expanded measurement uncertainty is not considered when determining in-tolerance or out-of-tolerance conditions. No statement of compliance with specifications is made or implied on this certificate. Results are reviewed, if applicable, to establish where any measurement results exceeded the stated calibration tolerance and to communicate results by means of this certificate.
All calibrations are performed in accordance with the ATS Quality Manual QM1, Rev. 11, dated 10/22/12. Applied Technical Services, Inc.'s Quality System complies with the applicable requirements of ANSI/NCSL Z540-1, ISO 9001-2008, 10CFR50 Appendix B, 10CFR Part 21, and ISO/IEC 17025. The reported data is valid only at the time of the test and related only to the item calibrated. *Calibration due dates appearing on this certificate and calibration label are determined by the client and do not imply continued conformance to specifications. This certificate shall not be reproduced except in full, without written permission of Applied Technical Services, Inc.

Technical Remarks:

Calibrated By: Tyler, Mike A — Technician
Name — Title

Calibration Equipment Utilized

Standard I.D.	Mfg.	Model No.	Description	Serial	Cal. Date	Due Date
ATS-04528	Fluke	5522A	Calibrator, Multi-Function	1562901	05/04/2012	05/04/2013

Issue date: 01/08/2013

Batch Number: 939232

Calibration Data

FUNCTION TESTED	Nominal Value	CALIBRATION TOLERANCE	As Found	Out of Tol	As Left
Temperature K Type	-20.0 °C	-20.7 to -19.3 °C [EMU 0.19 °C]	-20.6		Same
|	0.0 °C	-0.7 to 0.7 °C [EMU 0.19 °C]	-0.4		Same
|	50.0 °C	49.3 to 50.7 °C [EMU 0.19 °C]	49.5		Same
|	100.0 °C	99.2 to 100.8 °C [EMU 0.19 °C]	99.8		Same
|	200.0 °C	199.1 to 200.9 °C [EMU 0.31 °C]	199.8		Same
|	400.0 °C	398.9 to 401.1 °C [EMU 0.31 °C]	399.6		Same
Temperature J Type	-20.0 °C	-20.8 to -19.2 °C [EMU 0.17 °C]	-20.8		Same
|	0.0 °C	-0.8 to 0.8 °C [EMU 0.17 °C]	-0.4		Same
|	50.0 °C	49.2 to 50.8 °C [EMU 0.17 °C]	49.4		Same
|	100.0 °C	99.1 to 100.9 °C [EMU 0.17 °C]	99.8		Same
|	200.0 °C	199.0 to 201.0 °C [EMU 0.20 °C]	199.5		Same
|	400.0 °C	398.8 to 401.2 °C [EMU 0.20 °C]	399.9		Same

End Of Report

Precision Weighing
1949 Evans Road
Cary, North Carolina 27513
Phone: (919) 678-0077 * Fax: (919) 678-0075
Email: pweighing@aol.com

BALANCE CERTIFICATE OF CALIBRATION

Calibration Date: 16-Jan-13 Calibration Due Date: January 2014 SOP: 2000 rev. 1.3

Balance ID #: N-A Type/Model: My Weigh I 1200 S/N: 600.044

Dept: Lab Room Number: 1 Tolerance +/- : 0.1%

Weight set ID#	NIST Test Number	Cal Date	Cal Due
P 926	1951044	3-Jan-13	Jan 2014

Weight Standard (g)	Before Cal Readings (g)	Difference (g)	After Cal Readings (g)	Difference (g)	Tolerances +/- (g)
0	0.0	0.0	0.0	0.0	0.0
100	100.5	0.5	100.0	0.0	0.1
200	200.8	0.8	200.0	0.0	0.2
500	502.0	2.0	500.0	0.0	0.5
1000	1004.3	4.3	999.9	-0.1	1.0
1200	EEE	N-A	1199.7	-0.3	1.2

Before Calibration Readings:

In Tolerance: ☐
Out of Tolerance: ☒
N-A: ☐

After Calibration Readings:

In Tolerance: ☒
Out of Tolerance: ☐
N-A: ☐

Comments:

This certifies that the balance listed above has been serviced and calibrated to manufacturer specifications and/or Precision Weighing Standard Operating Procedures with weights traceable to the National Institute of Standards and Technology (NIST).

Stanley R. Hall
Precision Weighing Technician

16-Jan-13
Date of Service

Customer Signature (Review)

Date of Review

Precision Weighing
1949 Evans Road
Cary, North Carolina 27513
Phone: (919) 678-0077 * Fax: (919) 678-0075
Email: pweighing@aol.com

BALANCE CERTIFICATE OF CALIBRATION

Calibration Date: 16-Jan-13 Calibration Due Date: January 2014 SOP: 2000 rev. 1.3

Balance ID #: N-A Type/Model: Sartorius AY 1501 S/N: 27254925

Dept: Lab Room Number: 1 Tolerance +/- : 0.1%

Weight set ID#	NIST Test Number	Cal Date	Cal Due
P 926	1951044	3-Jan-13	Jan 2014

Weight Standard (g)	Before Cal Readings (g)	Difference (g)	After Cal Readings (g)	Difference (g)	Tolerances +/- (g)
0	0.0	0.0	0.0	0.0	0.0
200	200.0	0.0	200.0	0.0	0.2
500	499.9	-0.1	500.0	0.0	0.5
700	699.9	-0.1	700.0	0.0	0.7
1000	999.9	-0.1	1000.0	0.0	1.0
1500	1499.9	-0.1	1500.0	0.0	1.5

Before Calibration Readings:

In Tolerance:	
Out of Tolerance:	X
N-A:	

After Calibration Readings:

In Tolerance:	X
Out of Tolerance:	
N-A:	

Comments:

This certifies that the balance listed above has been serviced and calibrated to manufacturer specifications and/or Precision Weighing Standard Operating Procedures with weights traceable to the National Institute of Standards and Technology (NIST).

Stanley R. Hall
Precision Weighing Technician

16-Jan-13
Date of Service

Customer Signature (Review)

Date of Review

Precision Weighing
1949 Evans Road
Cary, North Carolina 27513
Phone: (919) 678-0077 * Fax: (919) 678-0075
Email: pweighing@aol.com

Weight Set Verification Certificate

Client: CEC, Inc

Contact: Paul Jenkins

Department: Lab

Description: Stainless Steel

Weight ID#: 22931

Verification Data

Serial Number	Nominal Value	Reading on Balance
22931	200 grams	200.002
22931	300 grams	300.004
22931	500 grams	499.997

Verification Date: 17-Jan-13 | **Verification Due Date:** January 2014

Calibration SOP: Metrology 2190

TEST STANDARD(S) INFORMATION:

Standard(s) Used	ID	Expiration Date
P 926	1951044	Janunary 2014
LC 1200 S	30101459	January 2014

Comments:

Readings of weight(s) taken on balance(s) listed after balance(s) calibrated with NIST traceable weight set(s) noted.

Technician: STANLEY R. HALL

Customer:

Precision Weighing
1949 Evans Road
Cary, North Carolina 27513
Phone: (919) 678-0077 * Fax: (919) 678-0075
Email: pweighing@aol.com

Weight Set Verification Certificate

Client: Civil

Contact:

Department: Lab

Description: Stainless Steel

Weight ID#: 22934

Verification Data

Serial Number	Nominal Value	Reading on Balance
22934	200 grams	199.998
22934	300 grams	299.999
22934	500 grams	500.000

Verification Date:	17-Jan-13	Verification Due Date:	January 2014

Calibration SOP: Metrology 2190

TEST STANDARD(S) INFORMATION:

Standard(s) Used	ID	Expiration Date
P 926	1951044	Janunary 2014
LC 1200 S	30101459	January 2014

Comments:

Readings of weight(s) taken on balance(s) listed after balance(s) calibrated with NIST traceable weight set(s) noted.

Technician: Stanley R. Hall

Customer:

APPENDIX E

QSTI CERTIFICATIONS

SOURCE EVALUATION SOCIETY

Qualified Source Testing Individual

LET IT BE KNOWN THAT

JOSHUA A. JONES

HAS SUCCESSFULLY PASSED A COMPREHENSIVE EXAMINATION AND SATISFIED EXPERIENCE REQUIREMENTS IN ACCORDANCE WITH THE GUIDELINES ISSUED BY THE SES QUALIFIED SOURCE TEST INDIVIDUAL REVIEW BOARD FOR

MANUAL GAS VOLUME MEASUREMENTS AND ISOKINETIC PARTICULATE SAMPLING METHODS

ISSUED THIS 22^{ND} DAY OF FEBRUARY 2012 AND EFFECTIVE UNTIL FEBRUARY 21^{ST}, 2017

Peter R. Westlin, QSTI/QSTO Review Board

C. David Bagwell, QSTI/QSTO Review Board

Karen D. Kajiya-Mills

Karen D. Kajiya-Mills , QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

LeRoy Owens, QSTI/QSTO Review Board

Glenn C. England, QSTI/QSTO Review Board

APPLICATION
NO.
2012-621

SOURCE EVALUATION SOCIETY

SES

Qualified Source Testing Individual

LET IT BE KNOWN THAT

JOSHUA A. JONES

HAS SUCCESSFULLY PASSED A COMPREHENSIVE EXAMINATION AND SATISFIED EXPERIENCE REQUIREMENTS IN ACCORDANCE WITH THE GUIDELINES ISSUED BY THE SES QUALIFIED SOURCE TEST INDIVIDUAL REVIEW BOARD FOR

MANUAL GASEOUS POLLUTANTS SOURCE SAMPLING METHODS

ISSUED THIS 22ND DAY OF FEBRUARY 2012 AND EFFECTIVE UNTIL FEBRUARY 21ST, 2017

Peter R. Westlin, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

LeRoy Owens, QSTI/QSTO Review Board

C. David Bagwell, QSTI/QSTO Review Board

Karen D. Kajiya-Mills

Karen D. Kajiya-Mills , QSTI/QSTO Review Board

Glenn C. England, QSTI/QSTO Review Board

APPLICATION
NO.
2012-621

SOURCE EVALUATION SOCIETY

Qualified Source Testing Individual

LET IT BE KNOWN THAT

JOSHUA A. JONES

HAS SUCCESSFULLY PASSED A COMPREHENSIVE EXAMINATION AND SATISFIED EXPERIENCE REQUIREMENTS IN ACCORDANCE WITH THE GUIDELINES ISSUED BY THE SES QUALIFIED SOURCE TEST INDIVIDUAL REVIEW BOARD FOR

HAZARDOUS METALS MEASUREMENT SAMPLING METHODS

ISSUED THIS 22ND DAY OF FEBRUARY 2012 AND EFFECTIVE UNTIL FEBRUARY 21ST, 2017

Peter R. Westlin, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

LeRoy Owens, QSTI/QSTO Review Board

C. David Bagwell, QSTI/QSTO Review Board

Karen D. Kajiya-Mills

Karen D. Kajiya-Mills , QSTI/QSTO Review Board

Glenn C. England, QSTI/QSTO Review Board

APPLICATION
NO.
2012-621

APPENDIX F

PRODUCTION DATA DURING THE COMPLIANCE TEST

	Batch Code	Number of Batches	Pounds per Batch	Pounds Processed
Run #1	T4012WBV	51	719	36669
	AGC	1	700	700
		Total Pounds Processed During the Run		**37369**
Run #2	AGC	1	700	700
	Tread	11	700	7700
	G5036WCF	30	775.89	23276.7
		Total Pounds Processed During the Run		**31676.7**
Run #3	G5036WCF	6	775.89	4655.34
	T101JWAK	39	718.82	28033.98
	REMIL	3	700	2100
		Total Pounds Processed During the Run		**34789.32**

Bag house magnehelic readings

OCTOBER 24th RUN 1

9:55 am	4.0" of Water
10:10 am	4.0" " "
10:25 am	4.0"
10:40 am	4.0"
10:55 am	4.0"
11:10 am	4.0
11:25 am	4.0"
11:40 am	4.0"
11:55 am	4.0"
12:10 pm	4.0"

RUN 2

1:43 pm	4.0"
1:58 pm	4.0"
2:13 pm	4.0"
2:28 pm	4.0"
2:43 pm	4.0"
2:58 pm	4.0"
3:13 pm	4.0"
3:28 pm	4.0"
3:43 pm	4.0"

RUN 3

4:30 pm	4.0"
4:45 pm	/
5:00 pm	4.0"
5:15 pm	4.0"
5:30 pm	4.0"
5:45 pm	\
6:00 pm	4.0"