Emissions Test Report

Particulate and HCN Testing
at the
D-601 and D-602 Scrubber Stacks

ConocoPhillips
Bayway Refinery
Linden, New Jersey

Prepared for:

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TEST SITE:	**ConocoPhillips** **Bayway Refinery** **Linden, New Jersey**
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REPORT CERTIFICATION

TRC Reference Number 178819

I certify under penalty of law that I believe the information provided in this document is true, accurate, and complete. I am aware that there are significant civil and criminal penalties, including the possibility of fine or imprisonment or both, for submitting false, inaccurate or incomplete information.

Signature: _____

Date: _____

Jeff Kunstling
Project Manager

PROFESSIONAL ENGINEER CERTIFICATION

TRC Report Number 178819

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1.0 INTRODUCTION

1.1 Background

TRC Environmental Corporation conducted emissions testing on the U4 Fluid Catalytic Cracking Unit (E263) Wet Gas Scrubber (CD33) D-601 (South) and D-602 (North) Stacks (PT36 and PT35) at the Bayway Refinery located in Linden, New Jersey. The purpose of this testing was to demonstrate compliance with the Fluid Catalytic Cracking Unit/Carbon Monoxide Boilers/Wet Gas Scrubber Unit emissions limits specified in the Title V Air Permit for particulate matter and HCN.

1.2 Outline of Test Program

Compliance sampling runs were conducted for emission rates of particulate matter (TSP) and hydrogen cyanide (HCN). The sampling runs were conducted on September 16, 2010 simultaneously at both of the D-601 and D-602 Scrubber Stacks. All tests were conducted while the unit was operating at the highest achievable load that day.

Tables 1-1 and 1-2 are test logs that present the sampling locations, sampling objectives, sampling methods, test dates, and run numbers for the test program.

1.3 Test Participants

Table 1-3 lists the personnel involved in the test program.

TABLE 1-1
TEST LOG
D-601 SCRUBBER STACK
SEPTEMBER 2010

Sampling Objective	Test Method	Test Date	Run Numbers
Particulate Matter	NJATM1	09/16/10 09/16/10 09/16/10	601-NJ1-1 601-NJ1-2 601-NJ1-3
Hydrogen Cyanide	CTM-033 (mod)	09/16/10 09/16/10 09/16/10	601-CTM033-1 601-CTM033-2 601-CTM033-3

TABLE 1-2
TEST LOG
D-602 SCRUBBER STACK
SEPTEMBER 2010

Sampling Objective	Test Method	Test Date	Run Numbers
Particulate Matter	NJATM1	09/16/10 09/16/10 09/16/10	602-NJ1-1 602-NJ1-2 602-NJ1-3
Hydrogen Cyanide	CTM-033 (mod)	09/16/10 09/16/10 09/16/10	602-CTM033-1 602-CTM033-2 602-CTM033-3

TABLE 1-3
TEST PARTICIPANTS
SEPTEMBER 2010

ConocoPhillips	**Ankush Agarwal** **Test Coordinator**
	Doug LaFayette **Test Coordinator**
New Jersey Department of Environmental Protection	**Neil Nissim** **Test Observer**
	Peter Madan **Test Observer**
TRC Environmental Corporation	**Jeff Kunstling** **Project Manager**
	Derek Brewster **Laboratory Technician**
	Jason Pennington **Sampling Team Leader**
	Mike Worthy **Sampling Team Leader**
	Greg Byrd **Engineering Technician**
	Jay Evans **Engineering Technician**

2.0 SUMMARY OF RESULTS

2.1 Presentation

Table 2-1 presents a summary of the test results. Detailed test results are presented in **Appendix A**, field data are presented in **Appendix B**, and the analytical reports are presented in **Appendix C**. Equipment calibrations are presented in **Appendix D**. Process data collected by ConocoPhillips is presented in **Appendix E**.

2.2 Cyclonic Flow Check

A cyclonic flow check was performed at the D-601 and D-602 sampling locations to determine if any cyclonic flow existed. Average yaw angles of less than 20° were measured, indicating acceptable locations with respect to EPA Method 1 requirements.

TABLE 2-1
TEST RESULTS VERSUS PERMIT LIMITS
D-601 AND D-602 SCRUBBER STACKS
SEPTEMBER 2010

	Rep 1	Rep 2	Rep 3	Average	Permit Limit
PARTICULATE MATTER					
Concentration, gr/dscf [1]					
D-601	0.00609	0.00683	0.00775	0.00689	--
D-602	0.00792	0.00609	0.00604	0.00668	--
Emission Rate, lb/hr					
D-601	9.38	10.3	11.8	10.5	--
D-602	12.0	9.04	8.82	10.0	--
Total (D-601 + D-602)	21.4	19.3	20.6	20.5	50.2
Emission Rate, lb/klb coke burn					
D-601	0.0852	0.0950	0.109	0.0963	--
D-602	0.109	0.0832	0.0815	0.0912	--
Total (D-601 + D-602)	0.194	0.178	0.191	0.188	1.0[2] , 0.5[3]
HYDROGEN CYANIDE					
Concentration, mg/dscm					
D-601	5.28	5.25	5.75	5.43	--
D-602	4.49	5.39	5.44	5.11	--
Emission Rate, lb/hr					
D-601	3.53	3.49	3.84	3.62	--
D-602	2.90	3.47	3.51	3.30	--
Total (D-601 + D-602)	6.43	6.96	7.35	6.92	20

[1] The concentrations presented here are measured in terms of gr/dscf of WGS flue gas as determined by the emissions test.
[2] Permit limit of 1.0 lb PM/1000 lb coke burn from Refinery MACT / NSPS Subpart J
[3] Permit limit of 0.5 lb PM/1000 lb coke burn from Consent Decree agreement with EPA and NJDEP

3.0 PROCESS DESCRIPTION AND OPERATION

3.1 General

The Bayway Refinery refines petroleum using a Class 3 catalytic cracking plant. The U4 Fluid Catalytic Cracking Unit (E263) uses a fluidized catalyst that is continuously being contaminated by coke. The catalyst is regenerated by incinerating the catalyst at approximately 1,325° F, which burns off the coke and carbon. Flue gases from the regeneration unit (containing catalyst dust, hydrocarbons, and possibly other impurities) flow to two carbon monoxide (CO) boilers (CD1 and CD2) that burn the CO and hydrocarbons. The gases leaving the combustion zone of each boiler are treated by an enhanced Selective non-Catalytic Reduction Unit (SNCR) to convert NO_X emissions back to nitrogen and water via reaction of NO_X with ammonia in the temperature range of 1400 ^oF to 1900 ^oF. From there, the flue gases pass through a mixing tee, a series of venturies, and two drum scrubbers (Wet Gas Scrubber - CD33) before being exhausted through the D-601 and D-602 stacks (PT36 and PT35). The testing covered in this report was conducted at the D-601 and D-602 scrubber stacks.

3.2 Source Air Flow

Figure 3-1 is an air flow schematic that shows the passage of the flue gases exhausted from the catalytic regenerator.

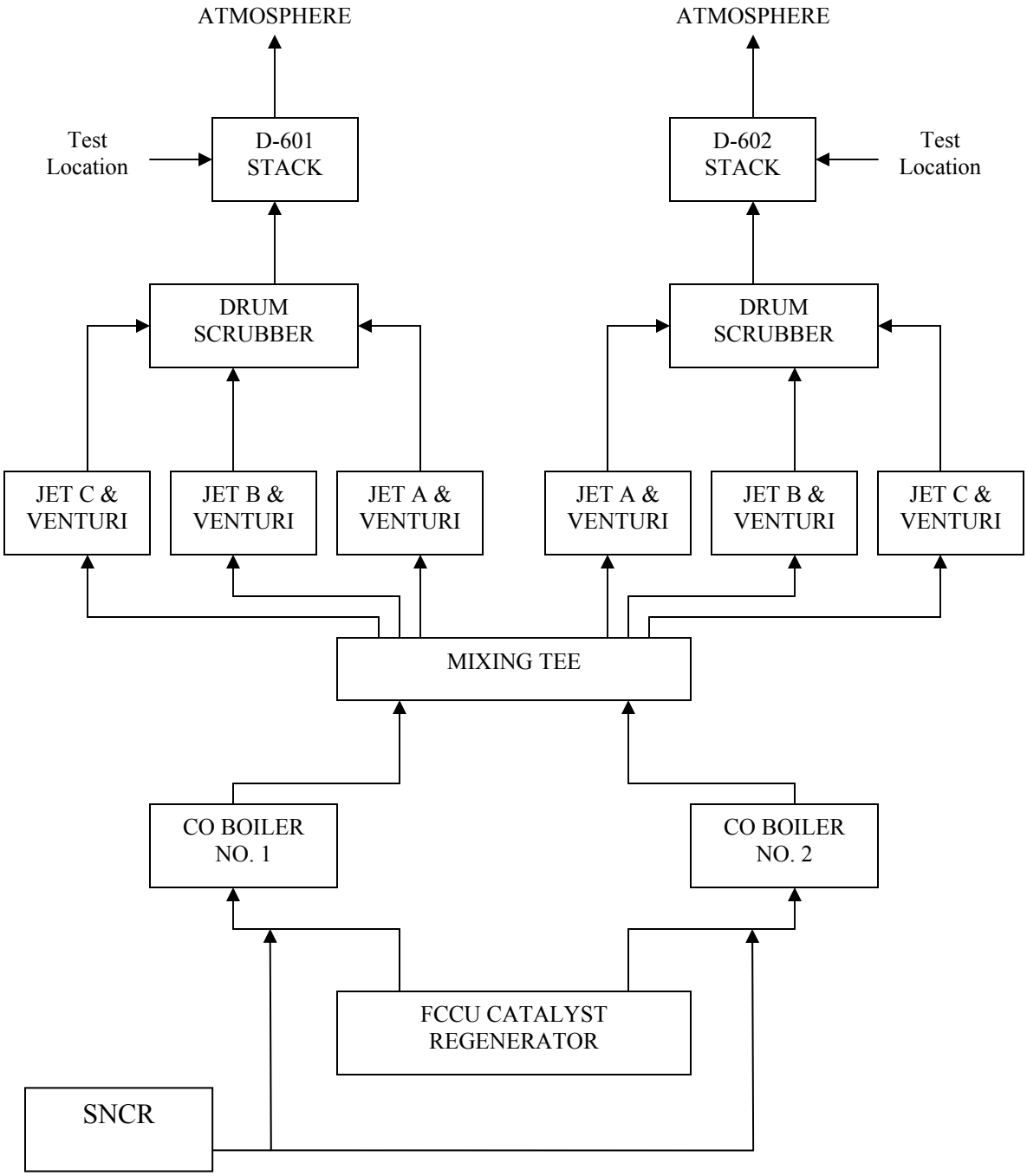

Figure 3-1. Catalytic Regenerator Air Flow Schematic

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 General

All sampling and analytical procedures were those recommended by the United States Environmental Protection Agency and the New Jersey Department of Environmental Protection. This section provides brief descriptions of the sampling and analytical procedures.

4.2 Sampling Points

The number and location of the sampling points were determined according to the procedures outlined in EPA Method 1. As shown in **Figure 4-1**, the D-601 and D-602 Scrubber Stack cross sections were divided into 12 equal areas, with three sampling points on each of four half-axes.

4.3 Cyclonic Flow Check

A Type S Pitot tube assembly, inclined oil manometer, and a universal protractor (angle finder) were used to determine the flow angles at each of the sampling or velocity traverse points. At each point, the Pitot tube was positioned at a right angle to the air flow. The angles were determined by rotating the Pitot tube until a null reading was obtained on the manometer. When the null reading was obtained, the angle of the Pitot tube was recorded.

4.4 Volumetric Air Flow Rates

4.4.1 Flue Gas Velocity

The flue gas velocity and volumetric flow rate were determined according to the procedures outlined in EPA Method 2. Velocity head measurements (delta P) were made using Type S Pitot tubes conforming to the geometric specifications outlined in EPA Method 2. Accordingly, each has been assigned a coefficient of 0.84. Differential pressures were measured with inclined/oil manometers of appropriate range. Flue gas temperatures were measured with chromel-alumel thermocouples equipped with digital readouts.

4.4.2 Flue Gas Composition

Flue gas samples were collected using the multipoint, integrated sampling technique outlined in EPA Method 3. A stainless steel probe and a pump delivering 500 – 750 ml/min of flue gas were used to fill a Tedlar bag. Moisture was removed by means of a knockout jar located prior to the pump. Sampling was for the same duration as the isokinetic sampling runs. Analysis for carbon dioxide and oxygen was performed using an Orsat apparatus. The analytical results were used to determine the flue gas composition and molecular weight.

4.4.3 Flue Gas Moisture Content

The moisture content was determined in conjunction with the various isokinetic sampling methods discussed in the following sections.

4.5 Particulate Matter Emissions Determinations

Samples were withdrawn isokinetically from the source using an NJATM1 sampling train. As outlined in New Jersey Air Test Method 1 (NJATM1), the probe exit and filter exit temperatures were monitored during testing. The sampling train consisted of a glass nozzle, a heated glass probe with a Type S Pitot tube attached, a filter, four chilled impingers, a metering console, and pump. The particulate sample was collected on a Whatman EPM2000 glass fiber filter maintained at a temperature that did not exceed 225°F. The first two impingers each contained 100 ml of deionized, distilled (DI) water, the third remained empty, and the fourth contained pre-weighed silica gel. Each of the 12 traverse points was sampled for 5 minutes, resulting in a net run time of 60 minutes.

The filter was removed from the filter holder and placed in a petri dish. The impingers were weighed and the DI water reagent was returned to a 1000 ml glass jar. The silica gel was returned to the original container. The volume of water vapor condensed in the impingers and the volume of water vapor collected in the silica gel were summed and entered into moisture content calculations. The nozzle, probe, and front-half of the filter holder were rinsed with acetone into a 500 ml glass jar.

NJATM1 analytical procedures were used to analyze the filter and front-half acetone rinse for filterable particulate. During the analysis, the particulate filter was not subjected to temperatures exceeding the temperatures that were measured across the filter during the sample run. The front-half filterable particulate as determined by the NJATM1 procedures was presented as the particulate matter emissions.

4.6 Hydrogen Cyanide Emissions Determinations

Cyanide compounds in the form of hydrogen cyanide were collected from the source using a modified version of the EPA CTM-033 sampling train. The sampling train consisted of a glass nozzle, a heated glass probe with a Type S Pitot tube attached, a filter, at least five chilled impingers, and a metering console. The first three impingers were of 2-liters in volume and each contained 500 mL of 6.0N sodium hydroxide (NaOH), and the fourth contained silica gel. During the run, the pH of the impingers was monitored with color indicator to verify that the pH remained 12 or higher.

As the 6.0N NaOH reagent was expected to remove a significant portion of the CO_2 present in the sample, the volume metered was adjusted to account for the reduced volume of gas reaching the dry gas meter. A Tedlar bag sample will be collected from the dry gas meter outlet in addition to the sample collected from the stack. The difference in the CO_2 readings was considered the amount of CO_2 collected in the reagent. The sample volume metered was adjusted for the amount of CO_2 removed in the reagent.

At the conclusion of each test run, the filter was removed from the filter holder and placed in a petri dish. The impingers were weighed, had the pH checked, and the NaOH reagent was placed in a polyethylene sample jar, and the liquid level marked. The first two impingers were recovered and analyzed together, and the third impinger was recovered and analyzed separately for breakthrough. The silica gel was returned to the original container. Due to the collection of a sodium carbonate precipitate in the impingers, the moisture content from the simultaneous NJATM1 sampling runs was used for each CTM-033 sampling run.

The first impinger through the third impinger along with connecting glassware were rinsed with 6.0N NaOH into the reagent jar. The 6.0N NaOH reagent from each run along with a field spike were analyzed for HCN using ion chromatography.

4.7 Equipment Calibration

Pertinent calibration data are provided in **Appendix D**.

5.0 QA/QC PROCEDURES AND RESULTS

5.1 General

The objective of a QA/QC program is to assure that the precision and accuracy of all data generated is scientifically sound and documented to be "in control". To accomplish this, standardized methods or procedures were used. They must be validated for their intended use, rigorously followed, and data reported with quality indicators (precision, accuracy, completeness, representativeness, etc.).

As a guide, TRC uses the EPA document *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume III (EPA-600/4-77-027b). TRC's QA/QC plan has incorporated certain considerations to the production of quality data in all of its sampling work regardless of the scope and purpose of the testing. These considerations include:

- Planning the testing program;
- Use of reliable and well-maintained equipment;
- Use of appropriate forms for recording sampling data;
- Establishing a sample coding system to ensure proper chain of custody (i.e., sample identification, laboratory tracing and storage, analysis and reporting);
- Use of calibration and audit gases traceable to the National Institute of Standards and Technology (NIST);
- Control errors by checking data inputs and performing redundant calculations;
- Adherence to established protocol.

5.2 Barometer

The barometric pressure for the testing period was recorded from a calibrated barometer on-site. The accuracy of this calibrated barometer was verified by comparison to a mercurial barometer located in the TRC Field Office in Raleigh, NC.

5.3 Probe Nozzle

The probe nozzle used in this test was calibrated initially by the manufacturer and thereafter by the field sampling crew by checking for dimension roundness. This was done by making three separate measurements using alternative inside diameters and calculating the average. A micrometer with a minimum tolerance of 0.001 inch was used for measuring. If a deviation of more than 0.004 inch is found between any measurements, the nozzle is either discarded or repaired and re-measured.

5.4 Pitot Tubes

Each Pitot tube used in this sampling protocol meets the design specifications for Type S Pitot tubes in EPA Method 2. Therefore in accordance with Method 2 procedures, a baseline coefficient (C_p) of 0.84 was assigned to each Pitot tube. Calibration at the manufacturer for Pitot face-opening alignment included measuring the external tubing diameter (dimension D_t), the base-to-opening misalignment angles, with all terms as described in Figures 2-2 and 2-3 of EPA Method 2. Pitot tubes were visually inspected at the completion of the test to insure structural integrity.

5.5 Calibration Meter And Metering System

The meter box calibration was done in accordance with EPA Method 5 section 16, using critical orifices. The meter is allowed to warm up and is then leak checked using the specifications in Method 5 of no detectable leak for a period of one minute. The dry gas meter is then calibrated at five points using an individual orifice for each point. Each point is run two times and averaged to determine the meter coefficient (γ or gamma) and the orifice pressure differential (Delta H@). The criterion for the gamma is the difference for each point is not to exceed ± 0.02 of the average of all the points. The orifice pressure differential that equates to 0.75 cfm at standard conditions (Delta H@) was then calculated for each point and then averaged. A copy of the metering system calibration is included in Appendix D.

5.6 Post-Test Meter Calibration

Post-test meter calibrations to determine the γ (or Yqa) were conducted on the dry gas meter after the test to check their accuracy against the original pretest calibration. This post-test calibration was made using the alternative procedure defined by EPA as ALT-009. This procedure is performed on-site using the data collected for each of the test runs. It is preferred by EPA over the post test procedure identified in Method 5 Section 10.3.2 because it 1) eliminates the question of

possible meter damage during transport *after* the emission test; and, 2) because the calibration data are available in the field immediately following the test, it eliminates the costly travel, remobilization, and scheduling of a retest should the meter fail the post-test calibration. A copy of the post-test calibration is included in Appendix D of this Test Report. A complete copy of EPA ALT-009 is available from EPA from the EMC website at http://www.epa.gov/ttn/emc/.

5.7 Thermocouples And Digital Indicators

Thermocouples were calibrated by comparing them against an ASTM-3F mercury-in-glass thermometer at approximately 32°F (ice water), ambient temperature and approximately 212°F (boiling water). Each thermocouple was calibrated against temperature ranges to which it was to be typically exposed during test conditions, and they must agree within 1.5 percent (expressed in ^{o}R) of the reference thermometer throughout the entire calibration range. A post calibration was performed in accordance with EPA ALT-011 using a single point calibration against an ASTM mercury-in-glass thermometer in addition to a continuity check of the thermocouple. The continuity check involved verifying that the thermocouple read-out trended in the appropriate direction when exposed to a temperature change. Digital indicators were checked by introducing a series of millivolt signal strengths to the input and comparing the indicator reading with the actual signal strength. Calibration is considered acceptable when the calibration error does not exceed 0.5 percent when temperatures are expressed in ^{o}R.

5.8 Reagent Blanks

Samples of each reagent used for collecting samples and rinsing the sample trains were collected and analyzed along with the actual field samples. These data are reported in the lab results.

APPENDIX A

CALCULATIONS AND DATA REDUCTION

APPENDIX A

CALCULATIONS AND DATA REDUCTION

1. Particulate Matter Emissions
a. D-601 Stack

APPENDIX A

CALCULATIONS AND DATA REDUCTION

1. Particulate Matter Emissions
b. D-602 Stack

APPENDIX A

CALCULATIONS AND DATA REDUCTION

2. Hydrogen Cyanide Emissions
a. D-601 Stack

APPENDIX A

CALCULATIONS AND DATA REDUCTION

2. Hydrogen Cyanide Emissions
b. D-602 Stack

APPENDIX B

FIELD DATA SHEETS

APPENDIX B

FIELD DATA SHEETS

1. Particulate Matter Emissions
a. D-601 Stack

APPENDIX B

FIELD DATA SHEETS

1. Particulate Matter Emissions
b. D-602 Stack

APPENDIX B

FIELD DATA SHEETS

2. Hydrogen Cyanide Emissions
a. D-601 Stack

APPENDIX B

FIELD DATA SHEETS

2. Hydrogen Cyanide Emissions
b. D-602 Stack

APPENDIX C

ANALYTICAL DATA

APPENDIX C

ANALYTICAL DATA

1. Particulate Matter

APPENDIX C

ANALYTICAL DATA

2. Hydrogen Cyanide

APPENDIX D

EQUIPMENT CALIBRATION RECORDS

APPENDIX E

PROCESS DATA

APPENDIX A

CALCULATIONS AND DATA REDUCTION

APPENDIX A

CALCULATIONS AND DATA REDUCTION

1. Particulate Matter Emissions

a. D-601 Stack

PARTICULATE MATTER
ConocoPhillips
D-601 Scrubber Stack
Linden, New Jersey

	RUN NUMBER	601-NJ1-1	601-NJ1-2	601-NJ1-3	
	RUN DATE	9/16/2010	9/16/2010	9/16/2010	AVERAGE
	RUN TIME	930-1044	1214-1326	1415-1528	
	MEASURED DATA				
(Y)	Meter Box Y	0.9961	0.9961	0.9961	0.9961
(DeltaH)	Avg Delta H, inches H_2O	1.47	1.44	1.44	1.45
(Pbar)	Barometric Pressure, inches Hg	29.94	29.94	29.94	29.94
(Vm)	Meter Volume, ft^3	38.793	38.757	38.877	38.809
(Tm)	Avg Meter Temp, deg F	74	75	77	75
(Pg)	Static Pressure, inches H_2O	-0.17	-0.19	-0.21	-0.19
(Ts)	Avg Stack Temp, deg F	150	151	151	151
(Vlc)	Water Collected, mL	295.8	297.1	302.3	298.4
(%CO_2)	Carbon Dioxide, %	16.3	15.6	16.2	16.0
(%O_2)	Oxygen, %	1.4	2.3	1.6	1.8
(%N_2)	Nitrogen, %	82.3	82.1	82.2	82.2
(Cp)	Pitot Tube Coefficient	0.84	0.84	0.84	0.84
(DeltaP)	Avg Sqrt Delta P, (inches H2O)½	1.034	1.022	1.024	1.026
(Theta)	Sample Time, min	60	60	60	60
(Dn)	Nozzle Diameter, inches	0.215	0.215	0.215	0.215
	CALCULATED DATA				
(An)	Nozzle Area, square feet	2.52E-04	2.52E-04	2.52E-04	2.52E-04
(Vmstd)	Standard Meter Volume, ft^3	38.520	38.422	38.403	38.448
(Ps)	Stack Pressure, inches Hg	29.93	29.93	29.92	29.93
(%H_2O)	Moisture (gravimetrically), %	26.7	26.8	27.1	26.9
(%H_2Osat)	Moisture (at saturation), %	25.2	25.9	25.7	25.6
(Bws)	Moisture (actual)	25.2	25.9	25.7	25.6
(Vwstd)	Standard Water Vapor Volume, ft^3	14.000	14.062	14.308	14.123
(Mfd)	Dry Mole Fraction	0.748	0.741	0.743	0.744
(Md)	Molecular Weight-dry, lb/lb-mole	30.66	30.59	30.66	30.64
(Ms)	Molecular Weight-wet, lb/lb-mole	27.47	27.33	27.40	27.40
(Vs)	Velocity, ft/s	63.9	63.4	63.4	63.6
(A)	Stack Area, ft^2	72.13	72.13	72.13	72.13
(Qa)	Volumetric flow, acfm	276,694	274,583	274,560	275,279
(Qs)	Volumetric flow, dscfm	179,750	176,572	176,997	177,773
(I)	Isokinetic Rate, %	102.2	103.8	103.5	103.1
	PROCESS DATA				
(Coke Rt)	Measured Coke Burn, klb/hr	110.095	108.753	108.203	109.017
	FILTERABLE PARTICULATE EMISSIONS DATA				
(grams)	Filter Catch, g	0.0131	0.0138	0.0149	0.0139
(grams)	Probe Wash Catch, g	0.0021	0.0032	0.0044	0.0032
(grams)	Total Filterable Particulate Catch, g	0.0152	0.0170	0.0193	0.0172
(gr/dscf)	Concen., gr/dscf	0.00609	0.00683	0.00775	0.00689
(lb/hr)	Emission Rate, lb/hr	9.38	10.3	11.8	10.5
(lb/klb coke)	Emission Rate, lb/klb coke burn	0.0852	0.0950	0.109	0.0963

Example Calculation Page

ConocoPhillips
Linden, New Jersey

SAMPLE CALCULATIONS FOR
NJATM1

D-601 Scrubber Stack

Test Date: 9/16/10 Test Number: 601-NJ1-1

1. Volume of dry gas sampled at standard conditions (70 deg F, 29.92 in. Hg), dscf.

$$Vm(std) = \frac{17.71 \times Y \times Vm \times \left(Pb + \frac{delta\ H}{13.6} \right)}{(Tm + 460)}$$

$$Vm(std) = \frac{17.71 \times 0.9961 \times 38.793 \times \left(29.94 + \frac{1.469}{13.6} \right)}{73.8 + 460}$$

$$= 38.520$$

Where:

Vm(std)	=	Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscf.
Vm	=	Volume of gas sample measured by the dry gas meter at meter conditions, dcf.
Pb	=	Barometric Pressure, in Hg.
delt H	=	Average pressure drop across the orifice meter, in H_20.
Tm	=	Average dry gas meter temperature , deg F.
Y	=	Dry gas meter calibration factor.

17.71	=	Factor that includes ratio of standard temperature (530 deg R) to standard pressure (29.92 in. Hg), deg R/in. Hg.
13.6	=	Specific gravity of mercury.

2. Volume of water vapor in the gas sample corrected to standard conditions, scf.

Vw(std) = 0.04733 x Vwc

Vw(std) = (0.04733 x 295.8)

= 14.000

Where:

Vw(std)	=	Volume of water vapor in the gas sample corrected to standard conditions, scf.
Vwc	=	Volume of liquid condensed in impingers, ml.
Wwsg	=	Weight of water vapor collected in silica gel, g.
0.04733	=	Factor which includes the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant 21.85 (in. Hg) (ft^3)/lb-mole)(deg R); absolute temperature at standard conditions (530 deg R), absolute pressure at standard conditions (29.92 in. Hg), and 453.6 g/lb, ft^3/g.

3. Moisture content

$$Bws = \frac{Vw(std)}{Vw(std) + Vm(std)}$$

$$Bws = \frac{14.000}{14.000 + 38.520}$$

= 0.267 or 26.7 %

Where:

Bws	=	Proportion of water vapor, by volume, in the gas stream, dimensionless.

4. Mole fraction of dry gas.

$$Md = 1 - Bws$$

$$Md = 1 - 0.252$$

$$= 0.733$$

Where:

Md	=	Mole fraction of dry gas, dimensionless.

5. Dry molecular weight of gas stream, lb/lb-mole.

$$MWd = (0.440 \times \% CO_2) + (0.320 \times \% O_2) + (0.280 \times (\% N_2 + \% CO))$$

$$MWd = (0.440 \times 16.30) + (0.320 \times 1.40) + (0.280 \times (82.30))$$

$$= 30.66$$

Where:

MWd	=	Dry molecular weight , lb/lb-mole.
% CO_2	=	Percent carbon dioxide by volume, dry basis.
% O_2	=	Percent oxygen by volume, dry basis.
% N_2	=	Percent nitrogen by volume, dry basis.
% CO	=	Percent carbon monoxide by volume, dry basis.
0.440	=	Molecular weight of carbon dioxide, divided by 100.
0.320	=	Molecular weight of oxygen, divided by 100.
0.280	=	Molecular weight of nitrogen or carbon monoxide, divided by 100.

6. Actual molecular weight of gas stream (wet basis), lb/lb-mole.

$$MWs = (MWd \times Md) + (18 \times (1 - Md))$$

$$MWs = (0.733 \times 30.664) + (18 (1 - 0.733))$$

$$= 27.29$$

Where:

MWs = Molecular weight of wet gas, lb/lb-mole.

18 = Molecular weight of water, lb/lb-mole.

7. Average velocity of gas stream at actual conditions, ft/sec.

$$Vs = 85.49 \times Cp \times ((delt\ p)^{1/2})avg \times \left(\frac{Ts\ (avg)}{Ps \times MWs} \right)^{1/2}$$

$$Vs = 85.49 \times 0.84 \times 1.03352 \times \left(\frac{610}{29.93 \times 27.47} \right)^{1/2}$$

$$= 64.14$$

Where:

Vs = Average gas stream velocity, ft/sec.

85.49 = Pitot tube constant, ft/sec x $\frac{(lb/lb\text{-}mole)(in.\ Hg)^{1/2}}{(deg\ R)(in\ H2O)}$

Cp = Pitot tube coefficient, dimensionless.

Ts = Absolute gas stream temperature, deg R = Ts, deg F + 460.

Ps = Absolute gas stack pressure, in. Hg. = Pb + $\frac{P(static)}{13.6}$

delt p = Velocity head of stack, in. H_2O.

8. Average gas stream volumetric flowrate at actual conditions, wacf/min.

$$Qa(act) = 60 \times Vs \times As$$

$$Qa(act) = 60 \times 63.93 \times 72.13$$

$$= 277{,}607$$

Where:

Qa(act) = Volumetric flowrate of wet stack gas at actual conditions, wacf/min.

As = Cross-sectional area of stack, ft^2.

60 = Conversion, sec/min

9. Average gas stream dry volumetric flowrate at standard conditions, dscf/min.

$$Qs(std) = 17.71 \times Mfd \times \frac{Ps}{Ts} \times Qa(act)$$

$$Qs(std) = 17.71 \times 0.748 \times \frac{29.93}{610} \times 276694$$

$$= 176{,}908$$

Where:

Qs(std) = Volumetric flowrate of dry stack gas at standard conditions, dscf/min.

10. Isokinetic variation calculated from intermediate values, percent.

$$I = \frac{17.262 \times Ts \times Vm(std)}{Vs \times \Theta \times Ps \times Mfd \times (Dn)^2}$$

$$I = \frac{17.262 \times 610 \times 38.520}{63.93 \times 60 \times 29.93 \times 0.748 \times (0.215)^2} = 102.2$$

Where:

I	=	Percent of isokinetic sampling.
Θ	=	Total sampling time, minutes.
Dn	=	Diameter of nozzle, inches.
17.262	=	Factor which includes standard temperature (530 deg R), standard pressure (29.92 in. Hg), the formula for calculating area of circle $D^{2/4}$, conversion of square feet to square inches (144), conversion of seconds to minutes (60), and conversion to percent (100), $\frac{(\text{in. Hg})(\text{in}^2)(\text{min})}{(\text{deg R})(\text{ft}^2)(\text{sec})}$

11. Total Filterable Particulate Concentration, lb/dscf.

$$C\ (\text{lb/dscf}) = \frac{Mt}{Vm(std) \times 453.59}$$

$$C\ (\text{lb/dscf}) = \frac{1.52E\text{-}02}{38.520 \times 453.59}$$

$$C\ (\text{lb/dscf}) = 8.70E\text{-}07$$

Where:

C (lb/dscf)	=	Total Filterable Particulate concentration, lb/dscf.
Mt	=	Mass of Particulate (filterable) caught by train, g
453.59	=	Conversion factor from grams to pounds.

12. Total Filterable Particulate Concentration, gr/dscf.

$$C\ (gr/dscf) = \frac{Mt \times 15.432}{Vm(std)}$$

$$C\ (gr/dscf) = \frac{0.0152 \times 15.432}{38.520}$$

C (gr/dscf) = 0.0061

Where:

C (gr/dscf)	=	Total Filterable Particulate concentration, grains/dscf.
Mt	=	Total mass of Particulate (filterable) caught by train, g
15.432	=	Conversion factor from grams to grains.

13. Total Filterable Particulate mass emission rate, lbs/hr.

PMRt = C(lb/dscf) x Qs(std) x 60

PMRt = 0.00000087 x 176908 x 60

= 9.2

Where:

PMRt	=	Total Particulate (filterable) mass emission rate, lbs/hr.

14. Total Filterable Particulate mass emission rate, lbs/klb coke burn

$PMRt_{(CB)}$	=	PMRt / Coke Rt
PMRt	=	9.2 / 0.000
	=	0.084

Where:

$PMRt_{(CB)}$	=	Total Particulate (filterable) mass emission rate, lbs/klb coke burn
Coke Rt	=	Measured coke burn, klb/hr

APPENDIX A

CALCULATIONS AND DATA REDUCTION

1. Particulate Matter Emissions
b. D-602 Stack

PARTICULATE MATTER
ConocoPhillips
D-602 Scrubber Stack
Linden, New Jersey

	RUN NUMBER	602-NJ1-1	602-NJ1-2	602-NJ1-3	
	RUN DATE	9/16/2010	9/16/2010	9/16/2010	AVERAGE
	RUN TIME	930-1044	1214-1326	1415-1528	
	MEASURED DATA				
(Y)	Meter Box Y	0.9998	0.9998	0.9998	0.9998
(DeltaH)	Avg Delta H, inches H_2O	1.50	1.44	1.41	1.45
(Pbar)	Barometric Pressure, inches Hg	29.94	29.94	29.94	29.94
(Vm)	Meter Volume, ft^3	38.219	37.269	37.767	37.752
(Tm)	Avg Meter Temp, deg F	70	69	71	70
(Pg)	Static Pressure, inches H_2O	-0.26	-0.26	-0.26	-0.26
(Ts)	Avg Stack Temp, deg F	164	162	165	163
(Vlc)	Water Collected, mL	283.8	280.6	286.4	283.6
(%CO_2)	Carbon Dioxide, %	15.3	15.3	15.5	15.4
(%O_2)	Oxygen, %	2.4	2.5	2.4	2.4
(%N_2)	Nitrogen, %	82.3	82.2	82.1	82.2
(Cp)	Pitot Tube Coefficient	0.84	0.84	0.84	0.84
(DeltaP)	Avg Sqrt Delta P, (inches H2O)½	1.035	1.014	1.003	1.017
(Theta)	Sample Time, min	60	60	60	60
(Dn)	Nozzle Diameter, inches	0.217	0.217	0.217	0.217
	CALCULATED DATA				
(An)	Nozzle Area, square feet	2.57E-04	2.57E-04	2.57E-04	2.57E-04
(Vmstd)	Standard Meter Volume, ft^3	38.388	37.480	37.830	37.899
(Ps)	Stack Pressure, inches Hg	29.92	29.92	29.92	29.92
(%H_2O)	Moisture (gravimetrically), %	25.9	26.2	26.4	26.2
(%H_2Osat)	Moisture (at saturation), %	35.0	33.7	36.0	34.9
(Bws)	Moisture (actual)	25.9	26.2	26.4	26.2
(Vwstd)	Standard Water Vapor Volume, ft^3	13.432	13.281	13.555	13.423
(Mfd)	Dry Mole Fraction	0.741	0.738	0.736	0.738
(Md)	Molecular Weight-dry, lb/lb-mole	30.54	30.55	30.58	30.56
(Ms)	Molecular Weight-wet, lb/lb-mole	27.29	27.27	27.26	27.27
(Vs)	Velocity, ft/s	64.9	63.6	63.0	63.9
(A)	Stack Area, ft^2	72.13	72.13	72.13	72.13
(Qa)	Volumetric flow, acfm	280,968	275,230	272,813	276,337
(Qs)	Volumetric flow, dscfm	176,892	173,129	170,353	173,458
(I)	Isokinetic Rate, %	101.6	101.3	103.9	102.3
	PROCESS DATA				
(Coke Rt)	Measured Coke Burn, klb/hr	110.095	108.753	108.203	109.017
	FILTERABLE PARTICULATE EMISSIONS DATA				
(grams)	Filter Catch, g	0.0147	0.0136	0.0130	0.0138
(grams)	Probe Wash Catch, g	0.0050	0.0012	0.0018	0.0027
(grams)	Total Filterable Particulate Catch, g	0.0197	0.0148	0.0148	0.0164
(gr/dscf)	Concen., gr/dscf	0.00792	0.00609	0.00604	0.00668
(lb/hr)	Emission Rate, lb/hr	12.0	9.04	8.82	10.0
(lb/klb coke)	Emission Rate, lb/klb coke burn	0.109	0.0832	0.0815	0.0912

Example Calculation Page

ConocoPhillips
Linden, New Jersey

SAMPLE CALCULATIONS FOR
NJATM1

D-602 Scrubber Stack

Test Date: 9/16/10 Test Number: 602-NJ1-1

1. Volume of dry gas sampled at standard conditions (70 deg F, 29.92 in. Hg), dscf.

$$Vm(std) = \frac{17.71 \times Y \times Vm \times \left(Pb + \frac{\text{delta H}}{13.6} \right)}{(Tm + 460)}$$

$$Vm(std) = \frac{17.71 \times 0.9998 \times 38.219 \times \left(29.94 + \frac{1.50}{13.6} \right)}{69.8 + 460}$$

$$= 38.388$$

Where:

Vm(std)	=	Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscf.
Vm	=	Volume of gas sample measured by the dry gas meter at meter conditions, dcf.
Pb	=	Barometric Pressure, in Hg.
delt H	=	Average pressure drop across the orifice meter, in H_20.
Tm	=	Average dry gas meter temperature , deg F.
Y	=	Dry gas meter calibration factor.

17.71	=	Factor that includes ratio of standard temperature (530 deg R) to standard pressure (29.92 in. Hg), deg R/in. Hg.
13.6	=	Specific gravity of mercury.

2. Volume of water vapor in the gas sample corrected to standard conditions, scf.

Vw(std) = 0.04733 x Vwc

Vw(std) = (0.04733 x 283.8)

= 13.432

Where:

Vw(std)	=	Volume of water vapor in the gas sample corrected to standard conditions, scf.
Vwc	=	Volume of liquid condensed in impingers, ml.
Wwsg	=	Weight of water vapor collected in silica gel, g.
0.04733	=	Factor which includes the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant 21.85 (in. Hg) (ft^3)/lb-mole)(deg R); absolute temperature at standard conditions (530 deg R), absolute pressure at standard conditions (29.92 in. Hg), and 453.6 g/lb, ft^3/g.

3. Moisture content

$$Bws = \frac{Vw(std)}{Vw(std) + Vm(std)}$$

$$Bws = \frac{13.432}{13.432 + 38.388}$$

= 0.259 or 25.9 %

Where:

Bws	=	Proportion of water vapor, by volume, in the gas stream, dimensionless.

4. Mole fraction of dry gas.

Md	=	1 - Bws
Md	=	1 - 0.259
	=	0.741

Where:

Md	=	Mole fraction of dry gas, dimensionless.

5. Dry molecular weight of gas stream, lb/lb-mole.

MWd	=	$(0.440 \times \% CO_2) + (0.320 \times \% O_2) + (0.280 \times (\% N_2 + \% CO))$
MWd	=	$(0.440 \times 15.30) + (0.320 \times 2.40) + (0.280 \times (82.30))$
	=	30.54

Where:

MWd	=	Dry molecular weight , lb/lb-mole.
$\% CO_2$	=	Percent carbon dioxide by volume, dry basis.
$\% O_2$	=	Percent oxygen by volume, dry basis.
$\% N_2$	=	Percent nitrogen by volume, dry basis.
% CO	=	Percent carbon monoxide by volume, dry basis.
0.440	=	Molecular weight of carbon dioxide, divided by 100.
0.320	=	Molecular weight of oxygen, divided by 100.
0.280	=	Molecular weight of nitrogen or carbon monoxide, divided by 100.

6. Actual molecular weight of gas stream (wet basis), lb/lb-mole.

$$MWs = (MWd \times Md) + (18 \times (1 - Md))$$

$$MWs = (0.741 \times 30.544) + (18 (1 - 0.741))$$

$$= 27.29$$

Where:

MWs = Molecular weight of wet gas, lb/lb-mole.

18 = Molecular weight of water, lb/lb-mole.

7. Average velocity of gas stream at actual conditions, ft/sec.

$$Vs = 85.49 \times Cp \times ((delt\ p)^{1/2})avg \times \left(\frac{Ts\ (avg)}{Ps \times MWs} \right)^{1/2}$$

$$Vs = 85.49 \times 0.84 \times 1.03461 \times \left(\frac{624}{29.92 \times 27.29} \right)^{1/2}$$

$$= 64.92$$

Where:

Vs = Average gas stream velocity, ft/sec.

85.49 = Pitot tube constant, ft/sec x $\frac{(lb/lb\text{-}mole)(in.\ Hg)^{1/2}}{(deg\ R)(in\ H2O)}$

Cp = Pitot tube coefficient, dimensionless.

Ts = Absolute gas stream temperature, deg R = Ts, deg F + 460.

Ps = Absolute gas stack pressure, in. Hg. = Pb + $\frac{P(static)}{13.6}$

delt p = Velocity head of stack, in. H_2O.

8. Average gas stream volumetric flowrate at actual conditions, wacf/min.

$$Qa(act) = 60 \times Vs \times As$$

$$Qa(act) = 60 \times 64.92 \times 72.13$$

$$= 280{,}968$$

Where:

Qa(act) = Volumetric flowrate of wet stack gas at actual conditions, wacf/min.

As = Cross-sectional area of stack, ft^2.

60 = Conversion, sec/min

9. Average gas stream dry volumetric flowrate at standard conditions, dscf/min.

$$Qs(std) = 17.71 \times Mfd \times \frac{Ps}{Ts} \times Qa(act)$$

$$Qs(std) = 17.71 \times 0.741 \times \frac{29.92}{624} \times 280968$$

$$= 176{,}892$$

Where:

Qs(std) = Volumetric flowrate of dry stack gas at standard conditions, dscf/min.

10. Isokinetic variation calculated from intermediate values, percent.

$$I = \frac{17.262 \times Ts \times Vm(std)}{Vs \times \Theta \times Ps \times Mfd \times (Dn)^2}$$

$$I = \frac{17.262 \times 624 \times 38.388}{64.92 \times 60 \times 29.92 \times 0.741 \times (0.217)^2} = 101.6$$

Where:

I	=	Percent of isokinetic sampling.
Θ	=	Total sampling time, minutes.
Dn	=	Diameter of nozzle, inches.
17.262	=	Factor which includes standard temperature (530 deg R), standard pressure (29.92 in. Hg), the formula for calculating area of circle $D^{2/4}$, conversion of square feet to square inches (144), conversion of seconds to minutes (60), and conversion to percent (100), $\frac{(\text{in. Hg})(\text{in}^2)(\text{min})}{(\text{deg R})(\text{ft}^2)(\text{sec})}$

11. Total Filterable Particulate Concentration, lb/dscf.

$$C\ (\text{lb/dscf}) = \frac{Mt}{Vm(std) \times 453.59}$$

$$C\ (\text{lb/dscf}) = \frac{1.97E\text{-}02}{38.388 \times 453.59}$$

$$C\ (\text{lb/dscf}) = 1.1314E\text{-}06$$

Where:

C (lb/dscf)	=	Total Filterable Particulate concentration, lb/dscf.
Mt	=	Mass of Particulate (filterable) caught by train, g
453.59	=	Conversion factor from grams to pounds.

12. Total Filterable Particulate Concentration, gr/dscf.

$$C\ (gr/dscf) = \frac{Mt \times 15.432}{Vm(std)}$$

$$C\ (gr/dscf) = \frac{0.0079 \times 15.432}{38.388}$$

C (gr/dscf) = 0.0079

Where:

C (gr/dscf) = Total Filterable Particulate concentration, grains/dscf.

Mt = Total mass of Particulate (filterable) caught by train, g

15.432 = Conversion factor from grams to grains.

13. Total Filterable Particulate mass emission rate, lbs/hr.

PMRt = C(lb/dscf) x Qs(std) x 60

PMRt = 0.00000113 x 176892 x 60

= 12.0

Where:

PMRt = Total Particulate (filterable) mass emission rate, lbs/hr.

14. Total Filterable Particulate mass emission rate, lbs/klb coke burn

$PMRt_{(CB)}$ = PMRt / Coke Rt

PMRt = 12.0 / 0.000

= #DIV/0!

Where:

$PMRt_{(CB)}$ = Total Particulate (filterable) mass emission rate, lbs/klb coke burn

Coke Rt = Measured coke burn, klb/hr

APPENDIX A

CALCULATIONS AND DATA REDUCTION

2. Hydrogen Cyanide Emissions
a. D-601 Stack

HYDROGEN CYANIDE TEST RESULTS
ConocoPhillips
D-601 Scrubber Stack
Linden, New Jersey

	RUN NUMBER	601-033-1	601-033-2	601-033-3	
	RUN DATE	9/16/2010	9/16/2010	9/16/2010	AVERAGE
	RUN TIME	930-1044	1214-1326	1415-1528	
	MEASURED DATA				
(Y)	Meter Box Y	0.9962	0.9962	0.9962	0.9962
(DeltaH)	Avg Delta H, inches H_2O	1.22	1.22	1.26	1.23
(Pbar)	Barometric Pressure, inches Hg	29.94	29.94	29.94	29.94
(Vm)	Meter Volume, ft^3	37.942	38.891	39.521	38.785
(Tm)	Avg Meter Temp, deg F	74	72	73	73
(Pg)	Static Pressure, inches H_2O	-0.18	-0.22	-0.19	-0.20
(Ts)	Avg Stack Temp, deg F	151	152	152	152
(%CO_2)	Carbon Dioxide, %	16.3	15.6	16.2	16.0
(%O_2)	Oxygen, %	1.4	2.3	1.6	1.8
(%N_2)	Nitrogen, %	82.3	82.1	82.2	82.2
(DGM %CO_2)	Carbon Dioxide, % (@DGGM outlet)	11.6	11.4	11.7	11.6
(Delta %CO_2)	Carbon Dioxide, % (removed in reagent)	4.7	4.2	4.5	4.5
(Cp)	Pitot Tube Coefficient	0.84	0.84	0.84	0.84
(DeltaP)	Avg Sqrt Delta P, (inches H2O)½	1.026	1.028	1.033	1.029
(Theta)	Sample Time, min	60	60.0	60	60
(Dn)	Nozzle Diameter, inches	0.214	0.214	0.215	0.214
	CALCULATED DATA				
(An)	Nozzle Area, square feet	2.50E-04	2.50E-04	2.52E-04	2.51E-04
(Vmstd)	Standard Meter Volume, ft^3	37.632	38.730	39.282	38.548
(Vmstd, adj)	Adj. Standard Meter Volume, ft^3	39.401	40.357	41.049	40.269
(Ps)	Stack Pressure, inches Hg	29.93	29.92	29.93	29.93
(%H_2O)	Moisture (gravimetrically), %	25.6	26.0	25.8	25.8
(%H_2Osat)	Moisture (at saturation), %	26.0	26.3	26.6	26.3
(Bws)	Moisture (actual from NJ1)	25.2	25.9	25.7	25.6
(Vwstd)	Standard Water Vapor Volume, ft^3	13.536	14.199	14.294	14.010
(Mfd)	Dry Mole Fraction	0.748	0.741	0.743	0.744
(Md)	Molecular Weight-dry, lb/lb-mole	30.66	30.59	30.66	30.64
(Ms)	Molecular Weight-wet, lb/lb-mole	27.47	27.33	27.40	27.40
(Vs)	Velocity, ft/s	63.5	63.8	64.1	63.8
(A)	Stack Area, ft^2	72.13	72.13	72.13	72.13
(Qa)	Volumetric flow, acfm	274,912	276,218	277,302	276,144
(Qs)	Volumetric flow, dscfm	178,301	177,333	178,377	178,004
(I)	Isokinetic Rate, %	106.4	109.5	109.7	108.5
	HYDROGEN CYANIDE EMISSIONS DATA				
(Fwt)	Formula Weight, g/g-mol	27.03	27.03	27.03	
(milligrams)	Hydrogen Cyanide Catch, mg	5.896	6.005	6.686	6.196
(ppm)	Concentration, ppm	4.70	4.68	5.12	4.83
(mg/dscm)	Concen., mg/dscm	5.28	5.25	5.75	5.43
(lb/hr)	Emission Rate, lb/hr	3.53	3.49	3.84	3.62

Example Calculation Page

ConocoPhillips
Linden, New Jersey

SAMPLE CALCULATIONS FOR
CTM-033

D-601 Scrubber Stack

Test Date: 9/16/10 Test Number: 601-033-1

1. Volume of dry gas sampled at standard conditions (70 deg F, 29.92 in. Hg), dscf.

$$Vm(std) = \frac{17.71 \times Y \times Vm \times \left(Pb + \frac{\text{delta H}}{13.6} \right)}{(Tm + 460)}$$

$$Vm(std) = \frac{17.71 \times 0.9962 \times 37.942 \times \left(29.94 + \frac{1.219}{13.6} \right)}{74.2 + 460}$$

$$= 37.632$$

Where:

Vm(std)	=	Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscf.
Vm	=	Volume of gas sample measured by the dry gas meter at meter conditions, dcf.
Pb	=	Barometric Pressure, in Hg.
delt H	=	Average pressure drop across the orifice meter, in H_20.
Tm	=	Average dry gas meter temperature , deg F.
Y	=	Dry gas meter calibration factor.

17.71	=	Factor that includes ratio of standard temperature (530 deg R) to standard pressure (29.92 in. Hg), deg R/in. Hg.
13.6	=	Specific gravity of mercury.

2. Volume of water vapor in the gas sample corrected to standard conditions, scf.

Vw(std) = 0.04733 x Vwc

Vw(std) = (0.04733 x 286.0)

= 13.536

Where:

Vw(std)	=	Volume of water vapor in the gas sample corrected to standard conditions, scf.
Vwc	=	Volume of liquid condensed in impingers, ml.
Wwsg	=	Weight of water vapor collected in silica gel, g.
0.04733	=	Factor which includes the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant 21.85 (in. Hg) (ft^3)/lb-mole)(deg R); absolute temperature at standard conditions (528 deg R), absolute pressure at standard conditions (29.92 in. Hg), and 453.6 g/lb, ft^3/g.

3. Moisture content

$$Bws = \frac{Vw(std)}{Vw(std) + Vm(std)}$$

$$Bws = \frac{13.54}{13.54 + 37.632}$$

= 0.265 or 26.5 %

Where:

Bws	=	Proportion of water vapor, by volume, in the gas stream, dimensionless.

4. Mole fraction of dry gas.

Md	=	1 - Bws
Md	=	1 - 0.252
	=	0.735

Where:

Md	=	Mole fraction of dry gas, dimensionless.

5. Dry molecular weight of gas stream, lb/lb-mole.

MWd	=	$(0.440 \times \% CO_2) + (0.320 \times \% O_2) + (0.280 \times (\% N_2 + \% CO))$
MWd	=	$(0.440 \times 16.30) + (0.320 \times 1.40) + (0.280 \times (82.30))$
	=	30.66

Where:

MWd	=	Dry molecular weight , lb/lb-mole.
$\% CO_2$	=	Percent carbon dioxide by volume, dry basis.
$\% O_2$	=	Percent oxygen by volume, dry basis.
$\% N_2$	=	Percent nitrogen by volume, dry basis.
% CO	=	Percent carbon monoxide by volume, dry basis.
0.440	=	Molecular weight of carbon dioxide, divided by 100.
0.320	=	Molecular weight of oxygen, divided by 100.
0.280	=	Molecular weight of nitrogen or carbon monoxide, divided by 100.

6. Actual molecular weight of gas stream (wet basis), lb/lb-mole.

$$MWs = (MWd \times Md) + (18 \times (1 - Md))$$

$$MWs = (0.735 \times 30.664) + (18 (1 - 0.735))$$

$$= 27.31$$

Where:

MWs = Molecular weight of wet gas, lb/lb-mole.

18 = Molecular weight of water, lb/lb-mole.

7. Average velocity of gas stream at actual conditions, ft/sec.

$$Vs = 85.49 \times Cp \times ((\text{delt } p)^{1/2})avg \times \left(\frac{Ts\ (avg)}{Ps \times MWs}\right)^{1/2}$$

$$Vs = 85.49 \times 0.84 \times 1.02588 \times \left(\frac{611}{29.93 \times 27.47}\right)^{1/2}$$

$$= 63.71$$

Where:

Vs = Average gas stream velocity, ft/sec.

85.49 = Pitot tube constant, ft/sec x $\frac{(lb/lb\text{-}mole)(in.\ Hg)^{1/2}}{(deg\ R)(in\ H2O)}$

Cp = Pitot tube coefficient, dimensionless.

Ts = Absolute gas stream temperature, deg R = Ts, deg F + 460.

Ps = Absolute gas stack pressure, in. Hg. = Pb + $\frac{P(static)}{13.6}$

delt p = Velocity head of stack, in. H_2O.

8. Average gas stream volumetric flowrate at actual conditions, wacf/min.

$$Qa(act) = 60 \times Vs \times As$$

$$Qa(act) = 60 \times 63.52 \times 72.13$$

$$= 275{,}710$$

Where:

Qa(act) = Volumetric flowrate of wet stack gas at actual conditions, wacf/min.

As = Cross-sectional area of stack, ft^2.

60 = Conversion, sec/min

9. Average gas stream dry volumetric flowrate at standard conditions, dscf/min.

$$Qs(std) = 17.71 \times Md \times \frac{Ps}{Ts} \times Qa(act)$$

$$Qs(std) = 17.71 \times 30.664 \times \frac{29.93}{611} \times 274912$$

$$= 175{,}820$$

Where:

Qs(std) = Volumetric flowrate of dry stack gas at standard conditions, dscf/min.

10. Isokinetic variation calculated from intermediate values, percent.

$$I = \frac{17.262 \times Ts \times Vm(std)}{Vs \times \Theta \times Ps \times Md \times (Dn)^2}$$

$$I = \frac{17.262 \times 611 \times 37.632}{63.52 \times 60 \times 29.93 \times 0.748 \times (0.214)^2} = 106.35$$

Where:

I	=	Percent of isokinetic sampling.
Θ	=	Total sampling time, minutes.
Dn	=	Diameter of nozzle, inches.
17.262	=	Factor which includes standard temperature (530 deg R), standard pressure (29.92 in. Hg), the formula for calculating area of circle $D^{2/4}$, conversion of square feet to square inches (144), conversion of seconds to minutes (60), and conversion to percent (100), $\frac{(\text{in. Hg})(\text{in}^2)(\text{min})}{(\text{deg R})(\text{ft}^2)(\text{sec})}$

11. Hydrogen Cyanide Concentration, ppmvd

$$C_{(ppmvd)} = \frac{385.3 \times g \times 1{,}000{,}000}{453.592 \times \text{Mol. Wt.} \times Vm(std)}$$

$$C_{(ppmvd)} = \frac{385.3 \times 0.005896 \times 1000000}{453.592 \times 27.03 \times 37.632}$$

$$= 4.70$$

Where:

$C_{(ppmvd)}$	=	Hydrogen Cyanide Concentration in parts per million dry basis, ppmvd
385.3	=	Molar volume in cubic feet/pound-mole at standard conditions
1000000	=	Conversion factor
453.592	=	Grams per pound
Mol. Wt	=	Molecular Weight of Hydrogen Cyanide, 27.03 g/g-mol

12. Hydrogen Cyanide mass emission rate, lbs/hr.

$$RT = \frac{60 \times g \times Qsd}{453.592 \times Vm(std)}$$

$$RT = \frac{60 \times 0.005896 \times 175820}{453.592 \times 37.632}$$

$$= 3.53$$

Where:

Rt = Hydrogen Cyanide mass emission rate, lbs/hr.

APPENDIX A

CALCULATIONS AND DATA REDUCTION

2. Hydrogen Cyanide Emissions
b. D-602 Stack

HYDROGEN CYANIDE TEST RESULTS
ConocoPhillips
D-602 Scrubber Stack
Linden, New Jersey

	RUN NUMBER	602-033-1	602-033-2	602-033-3	
	RUN DATE	9/16/2010	9/16/2010	9/16/2010	AVERAGE
	RUN TIME	930-1044	1214-1326	1415-1528	
	MEASURED DATA				
(Y)	Meter Box Y	1.002	1.002	1.002	1.002
(DeltaH)	Avg Delta H, inches H_2O	1.25	1.25	1.26	1.25
(Pbar)	Barometric Pressure, inches Hg	29.94	29.94	29.94	29.94
(Vm)	Meter Volume, ft^3	34.781	35.483	36.649	35.638
(Tm)	Avg Meter Temp, deg F	71	73	75	73
(Pg)	Static Pressure, inches H_2O	-0.27	-0.31	-0.32	-0.30
(Ts)	Avg Stack Temp, deg F	163	162	162	162
(%CO_2)	Carbon Dioxide, %	15.3	15.3	15.5	15.4
(%O_2)	Oxygen, %	2.4	2.5	2.4	2.4
(%N_2)	Nitrogen, %	82.3	82.2	82.1	82.2
(DGM %CO_2)	Carbon Dioxide, % (@DGGM outlet)	10.5	10.1	10.2	10.3
(Delta %CO_2)	Carbon Dioxide, % (removed in reagent)	4.8	5.2	5.3	5.1
(Cp)	Pitot Tube Coefficient	0.84	0.84	0.84	0.84
(DeltaP)	Avg Sqrt Delta P, (inches H2O)½	1.007	1.008	1.014	1.010
(Theta)	Sample Time, min	60	60	60	60
(Dn)	Nozzle Diameter, inches	0.215	0.215	0.215	0.215
	CALCULATED DATA				
(An)	Nozzle Area, square feet	2.52E-04	2.52E-04	2.52E-04	2.52E-04
(Vmstd)	Standard Meter Volume, ft^3	34.940	35.478	36.496	35.638
(Vmstd, adj)	Adj. Standard Meter Volume, ft^3	36.617	37.323	38.431	37.457
(Ps)	Stack Pressure, inches Hg	29.92	29.92	29.92	29.92
(%H_2O)	Moisture (gravimetrically), %	26.1	27.0	26.6	26.6
(%H_2Osat)	Moisture (at saturation), %	34.1	33.8	33.8	33.9
(Bws)	Moisture (actual - From NJ1)	25.9	26.2	26.4	26.2
(Vwstd)	Standard Water Vapor Volume, ft^3	12.921	13.773	13.962	13.552
(Mfd)	Dry Mole Fraction	0.741	0.738	0.736	0.738
(Md)	Molecular Weight-dry, lb/lb-mole	30.54	30.55	30.58	30.56
(Ms)	Molecular Weight-wet, lb/lb-mole	27.30	27.26	27.26	27.27
(Vs)	Velocity, ft/s	63.1	63.2	63.6	63.3
(A)	Stack Area, ft^2	72.13	72.13	72.13	72.13
(Qa)	Volumetric flow, acfm	273,256	273,597	275,295	274,049
(Qs)	Volumetric flow, dscfm	172,358	171,995	172,590	172,314
(I)	Isokinetic Rate, %	101.3	103.5	106.2	103.6
	HYDROGEN CYANIDE EMISSIONS DATA				
(Fwt)	Formula Weight, g/g-mol	27.03	27.03	27.03	
(milligrams)	Hydrogen Cyanide Catch, mg	4.446	5.414	5.619	5.160
(ppm)	Concentration, ppm	4.00	4.80	4.84	4.54
(mg/dscm)	Concen., mg/dscm	4.49	5.39	5.44	5.11
(lb/hr)	Emission Rate, lb/hr	2.90	3.47	3.51	3.30

Example Calculation Page

ConocoPhillips
Linden, New Jersey

SAMPLE CALCULATIONS FOR CTM-033

D-602 Scrubber Stack

Test Date: 9/16/10 Test Number: 602-033-1

1. Volume of dry gas sampled at standard conditions (70 deg F, 29.92 in. Hg), dscf.

$$Vm(std) = \frac{17.71 \times Y \times Vm \times \left(Pb + \frac{\text{delta H}}{13.6} \right)}{(Tm + 460)}$$

$$Vm(std) = \frac{17.71 \times 1.0020 \times 34.781 \times \left(29.94 + \frac{1.245}{13.6} \right)}{70.5 + 460}$$

$$= 34.940$$

Where:

Vm(std)	=	Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscf.
Vm	=	Volume of gas sample measured by the dry gas meter at meter conditions, dcf.
Pb	=	Barometric Pressure, in Hg.
delt H	=	Average pressure drop across the orifice meter, in H_20.
Tm	=	Average dry gas meter temperature , deg F.
Y	=	Dry gas meter calibration factor.

17.71	=	Factor that includes ratio of standard temperature (530 deg R) to standard pressure (29.92 in. Hg), deg R/in. Hg.
13.6	=	Specific gravity of mercury.

2. Volume of water vapor in the gas sample corrected to standard conditions, scf.

Vw(std) = 0.04733 x Vwc

Vw(std) = (0.04733 x 273.0)

= 12.921

Where:

Vw(std)	=	Volume of water vapor in the gas sample corrected to standard conditions, scf.
Vwc	=	Volume of liquid condensed in impingers, ml.
Wwsg	=	Weight of water vapor collected in silica gel, g.
0.04733	=	Factor which includes the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant 21.85 (in. Hg) (ft^3)/lb-mole)(deg R); absolute temperature at standard conditions (528 deg R), absolute pressure at standard conditions (29.92 in. Hg), and 453.6 g/lb, ft^3/g.

3. Moisture content

$$Bws = \frac{Vw(std)}{Vw(std) + Vm(std)}$$

$$Bws = \frac{12.92}{12.92 + 34.940}$$

= 0.270 or 27.0 %

Where:

Bws	=	Proportion of water vapor, by volume, in the gas stream, dimensionless.

4. Mole fraction of dry gas.

$$Md = 1 - Bws$$

$$Md = 1 - 0.259$$

$$= 0.730$$

Where:

Md	=	Mole fraction of dry gas, dimensionless.

5. Dry molecular weight of gas stream, lb/lb-mole.

$$MWd = (0.440 \times \% CO_2) + (0.320 \times \% O_2) + (0.280 \times (\% N_2 + \% CO))$$

$$MWd = (0.440 \times 15.30) + (0.320 \times 2.40) + (0.280 \times (82.30))$$

$$= 30.54$$

Where:

MWd	=	Dry molecular weight , lb/lb-mole.
$\% CO_2$	=	Percent carbon dioxide by volume, dry basis.
$\% O_2$	=	Percent oxygen by volume, dry basis.
$\% N_2$	=	Percent nitrogen by volume, dry basis.
% CO	=	Percent carbon monoxide by volume, dry basis.
0.440	=	Molecular weight of carbon dioxide, divided by 100.
0.320	=	Molecular weight of oxygen, divided by 100.
0.280	=	Molecular weight of nitrogen or carbon monoxide, divided by 100.

6. Actual molecular weight of gas stream (wet basis), lb/lb-mole.

$$MWs = (MWd \times Md) + (18 \times (1 - Md))$$

$$MWs = (0.730 \times 30.544) + (18 (1 - 0.730))$$

$$= 27.16$$

Where:

MWs = Molecular weight of wet gas, lb/lb-mole.

18 = Molecular weight of water, lb/lb-mole.

7. Average velocity of gas stream at actual conditions, ft/sec.

$$Vs = 85.49 \times Cp \times ((delt\ p)^{1/2})avg \times \left(\frac{Ts\ (avg)}{Ps \times MWs}\right)^{1/2}$$

$$Vs = 85.49 \times 0.84 \times 1.00706 \times \left(\frac{623}{29.92 \times 27.30}\right)^{1/2}$$

$$= 63.30$$

Where:

Vs = Average gas stream velocity, ft/sec.

85.49 = Pitot tube constant, ft/sec x $\frac{(lb/lb\text{-}mole)(in.\ Hg)^{1/2}}{(deg\ R)(in\ H2O)}$

Cp = Pitot tube coefficient, dimensionless.

Ts = Absolute gas stream temperature, deg R = Ts, deg F + 460.

Ps = Absolute gas stack pressure, in. Hg. = Pb + $\frac{P(static)}{13.6}$

delt p = Velocity head of stack, in. H_2O.

8. Average gas stream volumetric flowrate at actual conditions, wacf/min.

$$Qa(act) = 60 \times Vs \times As$$

$$Qa(act) = 60 \times 63.14 \times 72.13$$

$$= 273{,}947$$

Where:

Qa(act) = Volumetric flowrate of wet stack gas at actual conditions, wacf/min.

As = Cross-sectional area of stack, ft^2.

60 = Conversion, sec/min

9. Average gas stream dry volumetric flowrate at standard conditions, dscf/min.

$$Qs(std) = 17.71 \times Md \times \frac{Ps}{Ts} \times Qa(act)$$

$$Qs(std) = 17.71 \times 30.544 \times \frac{29.92}{623} \times 273256$$

$$= 170{,}235$$

Where:

Qs(std) = Volumetric flowrate of dry stack gas at standard conditions, dscf/min.

10. Isokinetic variation calculated from intermediate values, percent.

$$I = \frac{17.262 \times Ts \times Vm(std)}{Vs \times \Theta \times Ps \times Md \times (Dn)^2}$$

$$I = \frac{17.262 \times 623 \times 34.940}{63.14 \times 60 \times 29.92 \times 0.741 \times (0.215)^2} = 101.30$$

Where:

I	=	Percent of isokinetic sampling.
Θ	=	Total sampling time, minutes.
Dn	=	Diameter of nozzle, inches.
17.262	=	Factor which includes standard temperature (530 deg R), standard pressure (29.92 in. Hg), the formula for calculating area of circle $D^{2/4}$, conversion of square feet to square inches (144), conversion of seconds to minutes (60), and conversion to percent (100), $\frac{(\text{in. Hg})(\text{in}^2)(\text{min})}{(\text{deg R})(\text{ft}^2)(\text{sec})}$

11. Hydrogen Cyyanide Concentration, ppmvd

$$C_{(ppmvd)} = \frac{385.3 \times g \times 1{,}000{,}000}{453.592 \times \text{Mol. Wt.} \times Vm(std)}$$

$$C_{(ppmvd)} = \frac{385.3 \times 0.004446 \times 1000000}{453.592 \times 27.03 \times 34.940}$$

$$= 4.00$$

Where:

$C_{(ppmvd)}$	=	Hydrogen Cyanide Concentration in parts per million dry basis, ppmvd
385.3	=	Molar volume in cubic feet/pound-mole at standard conditions
1000000	=	Conversion factor
453.592	=	Grams per pound
Mol. Wt	=	Molecular Weight of Hydrogen Cyanide, 27.03 g/g-mol

12. Hydrogen Cyanide mass emission rate, lbs/hr.

$$RT = \frac{60 \times g \times Qsd}{453.592 \times Vm(std)}$$

$$RT = \frac{60 \times 0.004446 \times 170235}{453.592 \times 34.940}$$

$$= 2.90$$

Where:

Rt = Hydrogen Cyanide mass emission rate, lbs/hr.

APPENDIX B

FIELD DATA SHEETS

APPENDIX B

FIELD DATA SHEETS

1. Particulate Matter Emissions
   a. D-601 Stack

ISOKINETIC FIELD DATA SHEET

METHOD(S) NJ1

Page 1 of 1

TRC

Client Name	Conoco Phillips Company	Run Number	D601-NJ1-1
Plant Name	Bayway Refinery	Job Number	178819
City / State	Linden, N.J.	Test Date	9/16/10
Sampling Location	D-601 Stack	Start Time	0930
Test Personnel	GPB	Stop Time	1044

Operator Signature

Filter/XAD	Tare	P barometer (in Hg)	P static (in H2O)	Meterbox ID	M16	Nozzle		Pitot Tube		TC	Probe	Liner
				Y (Gamma)	Delta H@	ID #	Diameter	ID #	Cp	ID #	ID #	Material
RQ-8550	0.3645	29.94	-0.17	0.9961	1.945	S-4-68	0.215	RPT-53	0.84	RT-46	RP-46	GL

Equipment Leak Checks		Sample Train Leak Check							Fyrites		Orsat
		Initial	Final	Interm 1	Interm 2	Interm 3	Interm 4	Time	%O2	%CO2	Check
✓ Pitot, pretest	in Hg	15"	7"								1.2-S
✓ Pitot, post-test	cfm	0.000	0.000								Bag ID
✓ Positive DGM, pretest	Start Volume										1-1-S
✓ Positive DGM, post-test	Stop Volume										

K Factor Setup Data		K = 1.363									
Delta H@	Meter Y	Nozzle Dia	Avg DeltaP	% H2O	T stack	T meter	Pbar	Pstatic	% O2	%CO2	Cp

Line	Point No.	Time Clock (24-hr)	Time Test (min)	Dry Gas Meter Reading (cu. ft.)	Pitot Reading (in. H2O)	Delta H Actual (in. H2O)	DGM Temp (°F)	Stack Temp (°F)	Probe Temp (°F)	Filter/Box Temp (°F)	Gauge Vacuum (in Hg)	Imp Exit Temp (°F)	~~XAD~~ Temp (°F)	F. Exit Temp (°F)
1	A-3	0930	0	218.118	1.3	1.77	69	150	228	222	4	60	—	195
2	2		5	221.715	1.2	1.64	69	149	227	210	4	51	—	221
3	1		10	225.000	0.83	1.13	70	149	227	209	3	50	—	222
4	B-3	0945/0949	15	227.984	1.2	1.64	73	150	227	209	3	58	—	197
5	2		20	231.465	1.0	1.36	73	150	225	210	3	52	—	221
6	1		25	234.560	0.71	0.96	74	150	226	216	2	53	—	223
7	C-3	1004/1009	30	237.225	1.2	1.64	76	150	223	212	3	62	—	195
8	2		35	240.790	1.1	1.50	76	150	226	220	3	53	—	210
9	1		40	244.025	1.1	1.50	76	150	226	220	3	54	—	219
10	D-3	1024/1029	45	247.269	1.3	1.77	77	151	228	214	4	61	—	193
11	2		50	250.735	1.2	1.64	77	151	219	207	4	55	—	224
12	1		55	254.155	0.79	1.08	76	151	199	206	3	56	—	225
13	END	1044	60	256.911										
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														

Run Time	Total Volume	RMS Delta P	Delta H	Tmeter Avg	Tstack Avg
60	38.793	1.034	1.47	74	150

ed By: _____ Date: 9/16/10

(Project Manager or QA Manager)

ts

ISOKINETIC FIELD DATA SHEET

METHOD(S) NJ1

Page 1 of 1

TRC

Client Name	Conoco Phillips Company	Run Number	D601-NJ1-2
Plant Name	Bayway Refinery	Job Number	178819
City / State	Linden, N.J.	Test Date	9/16/10
Sampling Location	D-601 Stack	Start Time	1214
Test Personnel	GPB	Operator Signature	
		Stop Time	1326

Filter/XAD	Tare	P barometer (in Hg)	P static (in H2O)	Meterbox ID	M16	Nozzle ID #	Nozzle Diameter	Pitot Tube ID #	Pitot Tube Cp	TC ID #	Probe ID #	Liner Material
RQ-5990	0.3726	29.94	-0.19	Y (Gamma)	0.9961	Delta H@ 1.945	64-68	0.215	RPT-53	0.84	RT-46	RP-46	GL

Equipment Leak Checks		Initial	Final	Interm 1	Interm 2	Interm 3	Interm 4
Sample Train Leak Check							
✓ Pitot, pretest	in Hg	14"	7"				
✓ Pitot, post-test	cfm	0.000	0.001				
✓ Positive DGM, pretest	Start Volume						
✓ Positive DGM, post-test	Stop Volume						

Fyrites Time	%O2	%CO2	Orsat Check	Bag ID
			✓	1-25

K Factor Setup Data		K = 1.363								
Delta H@	Meter Y	Nozzle Dia	Avg DeltaP	~~% H2O~~ 1.916	T stack	T meter	Pbar	Pstatic	% O2	%CO2	Cp

Line	Point No	Time Clock (24-hr)	Time Test (min)	Dry Gas Meter Reading (cu. ft)	Pitot Reading (in H2O)	Delta H Actual (in H2O)	DGM Temp (°F)	Stack Temp (°F)	Probe Temp (°F)	Filter/Box Temp (°F)	Gauge Vacuum (in. Hg)	Imp Exit Temp (°F)	~~XAD~~ Temp (°F)	F. EXIT Temp (°F)
1	D-3	1214	0	257.134	1.4	1.91	73	151	225	222	2	65	—	191
2	2		5	260.950	1.3	1.77	73	151	227	222	2	61	—	214
3	1		10	264.430	0.76	1.04	73	151	227	223	2	62	—	220
4	C-3	1229	15	267.176	1.3	1.77	74	151	233	223	2	65	—	191
5	2	1232	20	270.635	1.1	1.50	74	152	234	214	2	63	—	212
6	1		25	273.910	0.75	1.02	74	151	232	213	2	63	—	214
7	B-3	1247	30	276.619	1.2	1.64	75	151	242	227	2	66	—	200
8	2	1251	35	280.010	1.0	1.36	75	151	239	225	2	62	—	206
9	1		40	283.110	0.75	1.02	76	151	241	238	2	63	—	209
10	A-3	1306	45	285.825	1.3	1.77	76	151	247	237	3	66	—	190
11	2	1311	50	289.865	1.1	1.50	76	150	250	239	2	65	—	214
12	1		55	293.140	0.75	1.02	77	151	246	237	2	66	—	222
13	END	1326	60	295.891										
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														

Run Time	Total Volume	RMS Delta P	Delta H	Tmeter Avg	Tstack Avg
60	38.757	1.322	1.44	75	151

Checked By: (Project Manager or QA Manager) Date: 9/16/10

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ISOKINETIC FIELD DATA SHEET

METHOD(S) NJI

Page 1 of 1

TRC

Client Name	Conoco Phillips Company	Run Number	D-601-NJI-3
Plant Name	Bayway Refinery	Job Number	17889
City / State	Linden, N.J.	Test Date	9/16/10
Sampling Location	D-601 Stack	Start Time	1415
Test Personnel	GPB	Operator Signature	
		Stop Time	1528

Filter/XAD	Tare	P barometer (in Hg)	P static (in H2O)	Meterbox ID / Y (Gamma)	M16 / Delta H@	Nozzle ID #	Nozzle Diameter	Pitot Tube ID #	Pitot Tube Cp	TC ID #	Probe ID #	Liner Material
RA8976	0.3733	29.94	-0.21	0.9961	1.945	G-4-B8	0.215	RT-SB	0.84	RT-4G	RP-4G	GL

Sample Train Leak Check		Initial	Final	Interm 1	Interm 2	Interm 3	Interm 4	Fyrites Time	%O2	%CO2	Orsat Check
Equipment Leak Checks											
✓ Pitot, pretest	in Hg	14"	8"								
Pitot, post-test	cfm	0.000	0.000								Bag ID
✓ Positive DGM, pretest	Start Volume										
Positive DGM, post-test	Stop Volume										

K Factor Setup Data		K = 1.363									
Delta H@	Meter Y	Nozzle Dia	Avg DeltaP	% H2O	T stack	T meter	Pbar	Pstatic	% O2	%CO2	Cp

Line	Point No.	Time Clock (24-hr)	Time Test (min)	Dry Gas Meter Reading (cu. ft)	Pitot Reading (in H2O)	Delta H Actual (in H2O)	DGM Temp (°F)	Stack Temp (°F)	Probe Temp (°F)	Filter/Box Temp (°F)	Gauge Vacuum (in Hg)	Imp Exit Temp (°F)	~~XAD~~ Temp (°F)	FEXT Temp (°F)
1	A-3	1415	0	296.059	1.3	1.77	74	150	254	215	3	63	—	180
2	2		5	299.675	1.0	1.36	74	150	260	216	3	52	—	190
3	1	1430	10	302.765	0.83	1.13	74	151	220	200	3	52	—	209
4	B-3	1434	15	305.619	1.3	1.77	75	151	221	212	3	58	—	181
5	2		20	309.240	1.1	1.50	75	151	221	213	3	63	—	219
6	1	1449	25	312.625	0.81	1.10	76	151	221	215	3	63	—	219
7	C-3	1453	30	315.479	1.3	1.77	77	151	225	210	4	62	—	183
8	2		35	318.975	1.1	1.50	77	151	227	226	3	55	—	197
9	1	1506	40	322.255	0.83	1.13	78	151	246	251	3	56	—	213
10	D-3	1513	45	325.198	1.3	1.77	79	151	233	222	4	63	—	180
11	2		50	328.665	1.1	1.50	80	150	234	224	3	55	—	185
12	1		55	332.320	0.73	0.99	80	151	230	210	3	56	—	224
13	END	1528	60	334.936										
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														

Run Time	Total Volume	RMS Delta P	Delta H	Tmeter Avg	Tstack Avg
60	38.667	1.24	1.44	77	151

Checked By: (Project Manager or QA Manager) Date: 9/16/10

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METHOD 4 - MOISTURE ANALYSIS DATA SHEET

TRC

Client Name	CONOCOPHILLIPS COMPANY	Project Number	178919
Plant Name	BAYWAY REFINERY	Sample Method	NJ1
City / State	LINDEN NJ	Recovery Location	STACK
Test Location	D602 STACK	Analyst Signature	[illegible]

Run Number	D602-NJ1-1	D602-NJ1-2	D602-NJ1-3	
Test Date	16 SEP 10	16 SEP 10	16 SEP 10	
Recovery Date	16 SEP 10	16 SEP 10	16 SEP 10	
Recovered By	JP	JP	JP	
Impinger 1 DI H_2O		977.1		
Final Weight, g	954.3	~~964.7~~	937.7	
Initial Weight, g	725.1	743.1	699.2	739.7
Net weight, g	229.2	234.0	238.5	
Impinger 2 DI H_2O				
Final Weight, g	796.4	636.9	832.6	
Initial Weight, g	754.9	604.1	796.4	636.9
Net weight, g	41.5	32.8	36.2	
Impinger 3 WT				
Final Weight, g	623.3	669.9	626.5	
Initial Weight, g	620.8	666.3	623.3	669.9
Net weight, g	2.5	3.6	3.2	
Impinger 4 SIL GEL				
Final Weight, g	907.2	964.7	915.7	
Initial Weight, g	896.6	954.5	907.2	964.7
Net weight, g	10.6	10.2	8.5	
Impinger 5 FILTER	RQ-5626	RQ-5551	RQ-5584	
Final Weight, g				
Initial Weight, g	0.3268	0.3627	0.3737	
Net weight, g				
Impinger 6				
Final Weight, g				
Initial Weight, g				
Net weight, g				
Impinger 7				
Final Weight, g				
Initial Weight, g				
Net weight, g				
Total Catch, g	283.8 ✓	250.6 ✓	286.4 ✓	

Checked By: [signature] Date: 9/16/10
(Project Manager or QA Manager)

RAL-M4ANAL.XLS

METHOD 3 - ORSAT ANALYSIS FIELD DATA

TRC

Client Name	Conoco Phillips	Project No.	178819
Plant Name	Bayway Refinery	Fuel Type	CCU
City / State	Linden, NJ	Orsat ID	3
Test Location	D601	Analysis Location	TRAILER

Run No. D601-NSI-1 Date 9/16/10 Bag ID 1 Operator (signature)

Run Time	Time of Analysis	%CO_2 Reading (A)	%O_2 Reading (B)	%O_2 Value (B-A)	%CO Reading (C)	%CO Value (C-B)	%N_2 Value (100-C)
Start 930	1130	16.3	17.7	1.4			
Stop 1044	1	16.3	17.7	1.4			
Leak Chk ✓	1140	16.3	17.7	1.4			
F_o _____	Avg	16.3	Avg	1.4	Avg		

Run No. D601-NSI-2 Date 9/16/10 Bag ID 2 Operator (signature)

Run Time	Time of Analysis	%CO_2 Reading (A)	%O_2 Reading (B)	%O_2 Value (B-A)	%CO Reading (C)	%CO Value (C-B)	%N_2 Value (100-C)
Start 1214	1600	15.6	17.9	2.3			
Stop 1326	1	15.6	17.9	2.3			
Leak Chk ✓	1610	15.6	17.9	2.3			
F_o _____	Avg	15.6	Avg	2.3	Avg		

Run No. D601-NSI-3 Date 9/16/10 Bag ID 3 Operator (signature)

Run Time	Time of Analysis	%CO_2 Reading (A)	%O_2 Reading (B)	%O_2 Value (B-A)	%CO Reading (C)	%CO Value (C-B)	%N_2 Value (100-C)
Start 1415	1630	16.2	17.8	1.6			
Stop 1528	1	16.2	17.8	1.6			
Leak Chk ✓	1640	16.2	17.8	1.6			
F_o _____	Avg	16.2	Avg	1.6	Avg		

QC Validation

F_o = (20.9 - %O2) / %CO2

Expected F_o Ranges

Distillate Oil	1.260 - 1.413	Anthracite/Lignite Coal	1.015 - 1.130
Residual Oil	1.210 - 1.370	Bituminous Coal	1.083 - 1.230
Natural Gas	1.600 - 1.836	Municipal Solid Waste	1.043 - 1.177
Wood/Bark	1.000 - 1.130		

Checked By: _____ Date: 9/16/10

RAL-M3.XLS

METHOD 1 - TRAVERSE POINT LOCATIONS

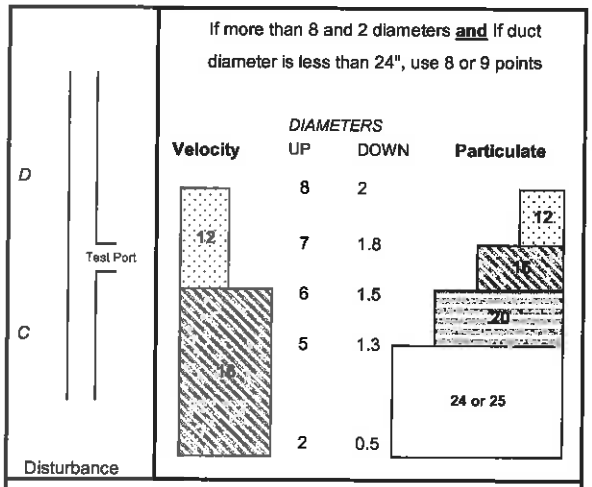
TRC
Environmental Corporation

Plant Name	ConocoPhillips
City/State	Linden, NJ
Test Location	D601 & D602 Scrubber Stacks
Personnel / Date	Oct 2010

Stack / Ports	Type of Stack	Round	x	Rectangle	
	No. of Ports Available			4	
	No. of Ports Used			4	
	Port Inside Diameter, in			6	in

Dimensions			
Put diagram of test location(s) on back of this sheet	Far Wall to Outside of Port, in	123.0	in
	Port Length, in	8.0	in
	Stack Diameter or Depth, in	115.0	in
	Stack Width (if rectangle), in		in
	Equivalent Stack Diameter, in	115.0	in
	Area of Stack, ft^2	72.13	ft^2

Distance to Flow Disturbances	Distance ft	Distance in	Diameters
Upstream (C)	80.0	0.0	8.348
Downstream (D)	23.0	0.0	2.400



DRAW HORIZONTAL LINES THROUGH UPSTREAM AND DOWNSTREAM DIAMETERS AND USE THE HIGHER NUMBER OF POINTS.

Number of Traverse Points			Minimum Required	Actual Number of Points Used	
		Particulate Traverse	12		
		Velocity Traverse	12	12	x
# of Ports Used	4	# Points/Port	3		
Number of Traverse Points Used			12		

Equivalent Diameter (for rectangular ducts):

De = 2 * Depth * Width / (Depth + Width)

De = 2 * ( ) * ( ) / ( ) + ( ) =

Point No.	Fraction of Stack Dia.	Dist. from Inside Wall	Port Length	Dist. From Edge of Port
1	0.044	5.06	8.0	13
2	0.146	16.79	8.0	24 6/8
3	0.296	34.04	8.0	42
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

Note: When using 4 ports in a circular duct, the probe is marked with only the points for the first half of the full diameter traverse.

LOCATION OF POINTS IN CIRCULAR STACKS OR DUCTS
(Fraction of stack diameter from inside wall to traverse point)

	2	4	6	8	10	12	14	16	18	20
1	.146	.067	.044	.032	.026	.021	.018	.016	.014	.013
2	.854	.250	.146	.105	.082	.067	.057	.049	.044	.039
3		.750	.296	.194	.146	.118	.099	.085	.075	.067
4		.933	.704	.323	.226	.177	.146	.125	.109	.097
5			.854	.677	.342	.250	.201	.169	.146	.129
6			.956	.806	.658	.356	.269	.220	.188	.165
7				.895	.774	.644	.366	.283	.236	.204
8				.968	.854	.750	.634	.375	.296	.250
9					.918	.823	.731	.625	.382	.306
10					.974	.882	.799	.717	.618	.388
11						.933	.854	.780	.704	.612
12						.979	.901	.831	.764	.694
13							.943	.875	.812	.750
14							.982	.915	.854	.796
15								.951	.891	.835
16								.984	.925	.871
17									.956	.903
18									.986	.933
19										.961
20										.987

For 22 or 24 test points, see Method 1 table in CFR

LOCATION OF POINTS IN RECTANGULAR STACKS OR DUCTS
(Fraction of stack diameter from inside wall to traverse point)

	2	3	4	5	6	7	8	9	10	11	12
1	.250	.167	.125	.100	.083	.071	.063	.056	.050	.045	.042
2	.750	.500	.375	.300	.250	.214	.188	.167	.150	.136	.125
3		.833	.625	.500	.417	.357	.313	.278	.250	.227	.208
4			.875	.700	.583	.500	.438	.389	.350	.318	.292
5				.900	.750	.643	.563	.500	.450	.409	.375
6					.917	.786	.688	.611	.550	.500	.458
7						.929	.813	.722	.650	.591	.542
8							.938	.833	.750	.682	.625
9								.944	.850	.773	.708
10									.950	.864	.792
11										.955	.875
12											.958

Checked By: _____ (sign) _____ (print)

METHOD 2 - VELOCITY TRAVERSE DATA SHEET (3-RUN)

TRC
Environmental Corporation

Client Name	Conoco Phillips			Project No.	157605
Plant Name	Bay Way			Date	4/15/2008
City, State	Linden, NJ			Barometer, "Hg	29.85
Location	601 Stack	Pitot ID	RPT-101	Thermocouple ID	RT-4A
Personnel	MB/JP	Pitot Coef.	0.84	Pressure Gauge ID	M14

	Run No:	Cyclonic Flow Check	
	Run Time:	09:02-09:12	
	P static		
	Pitot Check:	Pre ✓	Post ✓
	Tester Signature	[signature]	
	Point No.	Delta P in H2O	Temp Deg. F
1	A 1	0°	
2	2	-2°	
3	3	0°	
4			
5	B 1	0°	
6	2	0°	
7	3	0°	
8			
9	C 1	0°	
10	2	2°	
11	3	0°	
12			
13	D 1	0°	
14	2	0°	
15	3	0°	
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
	Avg		

	Run No:		
	Run Time:		
	P static		
	Pitot Check:	Pre ____	Post ____
	Tester Signature		
	Point No.	Delta P in H2O	Temp Deg. F
	Avg		

	Run No:		
	Run Time:		
	P static		
	Pitot Check:	Pre ____	Post ____
	Tester Signature		
	Point No.	Delta P in H2O	Temp Deg. F
	Avg		

Delta P avg is square of average square root

Checked By: [signature] (sign) Jeff Kunsman (print)
(Project Manager or QA Manager)

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APPENDIX B

FIELD DATA SHEETS

1. Particulate Matter Emissions
b. D-602 Stack

ISOKINETIC FIELD DATA SHEET

METHOD(S) NJ1

Page 1 of 1

TRC

Client Name	CONOCO PHILLIPS	Run Number	D602-NJ1-1
Plant Name	BAYWAY REFINERY	Job Number	175919
City / State	LINDEN, NJ	Test Date	16 SEP 10
Sampling Location	D-602 STACK	Start Time	0930
Test Personnel	SP-MW-GB-SE	Operator Signature	
		Stop Time	1044

Filter/XAD	Tare	P barometer (in. Hg)	P static (in H2O)	Meterbox ID	M12	Nozzle		Pitot Tube		TC	Probe	Liner
				Y (Gamma)	Delta H@	ID #	Diameter	ID #	Cp	ID #	ID #	Material
RO-5626	0.3265	29.94	-0.26	0.9998	1.939	G-4-13	0.217	RS-161	0.84	RS-49	RP-49	GLS

Equipment Leak Checks		Initial	Final	Interm 1	Interm 2	Interm 3	Interm 4	Time	%O2	%CO2	Orsat Check
		Sample Train Leak Check						Fyrites			
Pitot, pretest	in Hg	15	0.00								✓
Pitot, post-test	cfm	0.001	0.000								Bag ID
Positive DGM, pretest	Start Volume										Z-1-5
Positive DGM, post-test	Stop Volume										

K Factor Setup Data		K = 1.3911									
Delta H@	Meter Y	Nozzle Dia	Avg DeltaP	% H2O	T stack	T meter	Pbar	Pstatic	% O2	%CO2	Cp

Line	Point No	Time Clock (24-hr)	Time Test (min)	Dry Gas Meter Reading (cu ft)	Pitot Reading (in H2O)	Delta H Actual (in H2O)	DGM Temp (°F)	Stack Temp (°F)	Probe Temp (°F)	Filter/Box Temp (°F)	Gauge Vacuum (in Hg)	Imp Exit Temp (°F)	XAD Temp (°F)	Exit Temp (°F)
1	D-1	0930	0	661.275	1.20	1.66	67	165	211	242	2	52	N/A	209
2	2		5	664.77	1.15	1.59	67	165	207	236	2	45		217
3	3		10	668.15	0.85	1.18	69	163	206	235	2	45		204
4		0945	15	670.927	PORT CHANGE				SP					
5	C-1	0949	15	670.927	1.25	1.73	68	168	211	235	2	58		204
6	2	~~1004~~ 30	20	674.22	1.30	1.80	69	170	210	231	2	47		219
7	3		25	677.91	0.95	~~1.31~~ 1.32	69	169	193	207	2	48		223
8		1004	30	680.840	PORT CHANGE				SP					
9	B-1	1007	30	680.840	1.20	1.66	70	163	198	207	2	62	SP	190
10	2		35	684.33	1.10	1.53	71	163	196	210	2	50		195
11	3		40	687.37	0.65	0.90	71	158	193	222	2	50		195
12		1024	45	689.874	PORT CHANGE				SP					
13	A-1	1029	45	689.874	1.45	2.01	73	161	198	213	2	54		189
14	2		50	693.55	1.20	1.66	72	160	195	225	2	50		201
15	3		55	696.87	0.71	0.98	71	157	194	212	2	52		201
16		1044	60	699.494	END RUN				SP				N/A	
17														
18														
19														
20														
21														
22														
23														
24														
25														

Run Time	Total Volume	RMS Delta P	Delta H	Tmeter Avg	Tstack Avg
60	38.215	1.033	1.50	70	164

Checked By: _____ (Project Manager or QA Manager) Date: 9/16/10

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ISOKINETIC FIELD DATA SHEET

METHOD(S) NSI

Page 1 of 1

TRC

Client Name	CONOCO PHILIPS	Run Number	D602-NSI-2
Plant Name	BAYOU REFINERY	Job Number	179819
City / State	LEWISTON, MS	Test Date	16 SEP 10
Sampling Location	D-602 STACK	Start Time	1214
Test Personnel	SP-MW-BB-SE	Operator Signature	[signature]
		Stop Time	1326

Filter/XAD	Tare	P barometer (in Hg)	P static (in H2O)	Meterbox ID	M12	Nozzle		Pitot Tube		TC	Probe	Liner
				Y (Gamma)	Delta H@	ID #	Diameter	ID #	Cp	ID #	ID #	Material
RQ-5551	0.3627	29.94	-0.26	0.9995	1.939	6-4-13	0.217	RP-101	0.84	RT-44	RP-40	GLS

Equipment Leak Checks		Sample Train Leak Check Initial	Final	Interim 1	Interim 2	Interim 3	Interim 4	Fyrites Time	%O2	%CO2	Orsat Check
✓ Pitot, pretest	in Hg	15	5"								✓
✓ Pitot, post-test	cfm	0.001	0.000								Bag ID
✓ Positive DGM, pretest	Start Volume										229
✓ Positive DGM, post-test	Stop Volume										

K Factor Setup Data		K = 1.391									
Delta H@	Meter Y	Nozzle Dia	Avg DeltaP	% H2O	T stack	T meter	Pbar	Pstatic	% O2	%CO2	Cp

Line	Point No	Time Clock (24-hr)	Time Test (min)	Dry Gas Meter Reading (cu. ft)	Pitot Reading (in H2O)	Delta H Actual (in H2O)	DGM Temp (°F)	Stack Temp (°F)	Probe Temp (°F)	Filter/Box Temp (°F)	Gauge Vacuum (in Hg)	Imp Exit Temp (°F)	XAD Temp (°F)	Filter Exit Temp (°F)
1	A-1	1214	0	699.738	1.20	1.66	68	160	199	221	2	62	N/A	175
2	2		5	703.21	1.10	1.53	68	158	196	220	2	56		205
3	3		10	706.32	0.71	0.98	67	153	195	219	2	57		211
4		1229	15	708.904	PORT CHANGE				SP					
5	B-1	1232	15	708.904	1.20	1.66	68	159	198	217	2	63		195
6	2		20	712.24	1.10	1.53	68	160	197	218	2	63		205
7	3		25	715.47	0.72	1.00	69	153	202	219	2	65		197
8		1247	30	718.996	PORT CHANGE				SP					
9	C-1	1251	30	718.996	1.15	1.59	69	166	203	222	2	63	SP	190
10	2		35	721.25	1.20	1.66	70	169	197	224	2	56		205
11	3		40	724.60	0.95	1.32	70	167	195	224	2	56		217
12		1306	45	727.602	PORT CHANGE				SP					
13	D-1	1311	45	727.602	1.10	1.53	70	168	204	223	2	63		189
14	2		50	730.93	1.05	1.46	70	166	203	224	2	55		204
15	3		55	734.01	0.95	1.32	71	165	202	224	2	56		206
16		1326	60	737.007	END RUN				SP				N/A	
17														
18														
19														
20														
21														
22														
23														
24														
25														

Run Time	Total Volume	RMS Delta P	Delta H	Tmeter Avg	Tstack Avg
60	37.269	1.014	1.44	69	162

Checked By: [signature] (Project Manager or QA Manager) Date: 9/16/10

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ISOKINETIC FIELD DATA SHEET

METHOD(S) N51

Page 1 of 1

TRC

Client Name	CONOCO PHILLIPS	Run Number	D602-N51-3
Plant Name	BAYWAY REFINERY	Job Number	178819
City / State	LINDEN, NJ	Test Date	16 SEP 10
Sampling Location	D-602 STACK	Start Time	1415
Test Personnel	SP-MW-GB-JE	Operator Signature	[signature]
		Stop Time	1528

Filter/XAD	Tare	P barometer (in Hg)	P static (in H2O)	Meterbox ID Y (Gamma)	Delta H@	Nozzle ID #	Nozzle Diameter	Pitot Tube ID #	Pitot Tube Cp	TC ID #	Probe ID #	Liner Material
RO-5584	0.3737	29.94	-0.26	0.9998	1.939	G-4-13	0.217	RPT-161	0.84	KT-4A	RP4A	GCS

Sample Train Leak Check		Initial	Final	Interm 1	Interm 2	Interm 3	Interm 4	Fyrites Time	Fyrites %O2	Fyrites %CO2	Orsat Check
Equipment Leak Checks											
Pitot, pretest	in Hg	15	5								
Pitot, post-test	cfm	0.000	0.000								Bag ID
Positive DGM, pretest	Start Volume										
Positive DGM, post-test	Stop Volume										

K Factor Setup Data		K = 1.391										
Delta H@	Meter Y	Nozzle Dia	Avg DeltaP	% H2O	T stack	T meter	Pbar	Pstatic	% O2	%CO2	Cp	
												E:Hec

Line	Point No	Time Clock (24-hr)	Time Test (min)	Dry Gas Meter Reading (cu. ft.)	Pitot Reading (in. H2O)	Delta H Actual (in. H2O)	DGM Temp (°F)	Stack Temp (°F)	Probe Temp (°F)	Filter/Box Temp (°F)	Gauge Vacuum (in. Hg)	Imp Exit Temp (°F)	XAD Temp (°F)	Exit Temp (°F)
1	D-1	1415	0	737.216	1.10	1.53	69	168	204	221	2	55	N/A	189
2	2		5	740.48	1.00	1.39	70	170	202	223	2	42		192
3	3		10	743.61	0.76	1.65	69	166	200	223	2	46		207
4		1430	15	746.235	POST CHANGE				SP					
5	C-1	1434	15	746.235	1.20	1.66	69	167	199	221	2	51		193
6	2		20	749.61	1.20	1.66	70	169	198	224	2	46		207
7	3		25	753.03	0.93	1.27	70	167	204	224	2	47		212
8		1449	30	755.971	POST CHANGE				SP					
9	B-1	1453	30	755.971	1.25	1.73	71	~~162~~ 164 SP	~~202~~ 202	219	2	59	SP	179
10	2		35	759.37	1.05	1.46	72	164	199	225	2	50		175
11	3		40	762.71	0.66	0.91	72	159	201	227	2	50		191
12		1508	45	765.742	POST CHANGE				SP					
13	A-1	1513	45	765.742	1.26	1.66	73	164	198	227	2	56		169
14	2		50	769.13	1.10	1.53	74	161	194	227	2	50		184
15	3		55	772.27	0.74	1.02	74	158	197	228	3	51		201
16		1528	60	774.983	END RUN				SP				N/A	
17														
18														
19														
20														
21														
22														
23														
24														
25														

Run Time	Total Volume	RMS Delta P	Delta H	Tmeter Avg	Tstack Avg
60	37.767	1.003	1.41	71	165

Checked By: [signature] (Project Manager or QA Manager) Date: 9/16/10

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METHOD 4 - MOISTURE ANALYSIS DATA SHEET

TRC

Client Name	Conoco Phillips Company	Project Number	178819
Plant Name	Bayway Refinery	Sample Method	NJ1
City / State	Linden, N.J.	Recovery Location	Stack
Test Location	D-601 Stack	Analyst Signature	Greg Byrd

Run Number	D601-NJ1-1	D601-NJ1-2	D601-NJ1-3	
Test Date	9/16/10	9/16/10	9/16/10	
Recovery Date	9/16/10	9/16/10	9/16/10	
Recovered By	G. Byrd	G. Byrd	G. Byrd	
Impinger 1 DI				
Final Weight, g	959.4	973.8	959.9	
Initial Weight, g	742.3	716.5	747.0	
Net weight, g	217.1	257.3	212.9	
Impinger 2 DI				
Final Weight, g	836.5	778.0	823.5	
Initial Weight, g	765.4	744.7	740.3	
Net weight, g	71.1	33.3	79.2	
Impinger 3 Empty				
Final Weight, g	662.2	628.8	665.5	
Initial Weight, g	659.3	623.8	662.2	
Net weight, g	2.9	5.0	3.3	
Impinger 4 Silgel				
Final Weight, g	927.9	888.1	934.8	
Initial Weight, g	918.2	886.6	927.9	
Net weight, g	9.7	1.5	6.9	
Impinger 5				
Final Weight, g				
Initial Weight, g				
Net weight, g				
Impinger 6				
Final Weight, g				
Initial Weight, g				
Net weight, g				
Impinger 7				
Final Weight, g				
Initial Weight, g				
Net weight, g				
Total Catch, g	295.8	297.1	302.3	

Checked By: [signature] Date: 9/16/10
(Project Manager or QA Manager)

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METHOD 3 - ORSAT ANALYSIS FIELD DATA

TRC

Client Name	Conoco Phillips	Project No.	78819
Plant Name	Bayway Refinery	Fuel Type	CCU
City / State	LINDEN, NJ	Orsat ID	3
Test Location	D602	Analysis Location	TRAILER

Run No. D602-NSI-1 Date 9/16/10 Bag ID 1 Operator (signature)

Run Time	Time of Analysis	%CO_2 Reading (A)	%O_2 Reading (B)	%O_2 Value (B-A)	%CO Reading (C)	%CO Value (C-B)	%N_2 Value (100-C)
Start 930	1120	15.3	17.7	2.4			
Stop 1044	1	15.3	17.7	2.4			
Leak Chk ✓	1130	15.3	17.7	2.4			
F_o _____	Avg	15.3	Avg	2.4	Avg		

Run No. D602-NSI-2 Date 9/16/10 Bag ID 2 Operator (signature)

Run Time	Time of Analysis	%CO_2 Reading (A)	%O_2 Reading (B)	%O_2 Value (B-A)	%CO Reading (C)	%CO Value (C-B)	%N_2 Value (100-C)
Start 1214	1550	15.3	17.8	2.5			
Stop 1326	1	15.3	17.8	2.5			
Leak Chk ✓	1600	15.3	17.8	2.5			
F_o _____	Avg	15.3	Avg	2.5	Avg		

Run No. D602-NSI-3 Date 9/16/10 Bag ID 3 Operator (signature)

Run Time	Time of Analysis	%CO_2 Reading (A)	%O_2 Reading (B)	%O_2 Value (B-A)	%CO Reading (C)	%CO Value (C-B)	%N_2 Value (100-C)
Start 1415	1640	15.5	17.9	2.4			
Stop 1528	1	15.5	17.9	2.4			
Leak Chk ✓	1650	15.5	17.9	2.4			
F_o _____	Avg	15.5	Avg	2.4	Avg		

QC Validation

$F_o = (20.9 - \%O2) / \%CO2$

Expected F_o Ranges

Distillate Oil	1.260 - 1.413	Anthracite/Lignite Coal	1.015 - 1.130
Residual Oil	1.210 - 1.370	Bituminous Coal	1.083 - 1.230
Natural Gas	1.600 - 1.836	Municipal Solid Waste	1.043 - 1.177
Wood/Bark	1.000 - 1.130		

Checked By: _____ Date: 9/16/10

RAL-M3.XLS

METHOD 1 - TRAVERSE POINT LOCATIONS

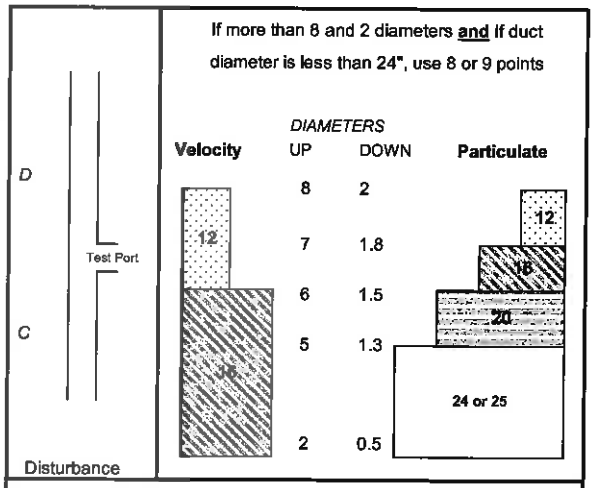
TRC
Environmental Corporation

Plant Name	ConocoPhillips
City/State	Linden, NJ
Test Location	D601 & D602 Scrubber Stacks
Personnel / Date	Sept 2010

Stack / Ports	Type of Stack	Round	x	Rectangle	
	No. of Ports Available			4	
	No. of Ports Used			4	
	Port Inside Diameter, in			6	in

Dimensions			
Put diagram of test location(s) on back of this sheet	Far Wall to Outside of Port, in	123.0	in
	Port Length, in	5.0	in
	Stack Diameter or Depth, in	115.0	in
	Stack Width (if rectangle), in		in
	Equivalent Stack Diameter, in	115.0	in
	Area of Stack, ft^2	72.13	ft^2

Distance to Flow Disturbances	Distance ft	Distance in	Diameters
Upstream (C)	80.0	0.0	8.348
Downstream (D)	23.0	0.0	2.400



DRAW HORIZONTAL LINES THROUGH UPSTREAM AND DOWNSTREAM DIAMETERS AND USE THE HIGHER NUMBER OF POINTS.

Number of Traverse Points	Minimum Required	Actual Number of Points Used	
Particulate Traverse	12		
Velocity Traverse	12	12	x
# of Ports Used: 4	# Points/Port	3	
Number of Traverse Points Used		12	

Equivalent Diameter (for rectangular ducts):

De = 2 * Depth * Width / (Depth + Width)

De = 2 * ( ) * ( ) / ( ) + ( ) =

Point No.	Fraction of Stack Dia.	Dist. from Inside Wall	Port Length	Dist. From Edge of Port
1	0.044	5.06	8.0	13
2	0.146	16.79	8.0	24 6/8
3	0.296	34.04	8.0	42
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

Note: When using 4 ports in a circular duct, the probe is marked with only the points for the first half of the full diameter traverse.

LOCATION OF POINTS IN CIRCULAR STACKS OR DUCTS
(Fraction of stack diameter from inside wall to traverse point)

	2	4	6	8	10	12	14	16	18	20
1	.146	.067	.044	.032	.026	.021	.018	.016	.014	.013
2	.854	.250	.146	.105	.082	.067	.057	.049	.044	.039
3		.750	.296	.194	.146	.118	.099	.085	.075	.067
4		.933	.704	.323	.226	.177	.146	.125	.109	.097
5			.854	.677	.342	.250	.201	.169	.146	.129
6			.956	.806	.658	.356	.269	.220	.188	.165
7				.895	.774	.644	.366	.283	.236	.204
8				.968	.854	.750	.634	.375	.296	.250
9					.918	.823	.731	.625	.382	.306
10					.974	.882	.799	.717	.618	.388
11						.933	.854	.780	.704	.612
12						.979	.901	.831	.764	.694
13							.943	.875	.812	.750
14							.982	.915	.854	.796
15								.951	.891	.835
16								.984	.925	.871
17									.956	.903
18									.986	.933
19										.961
20										.987

For 22 or 24 test points, see Method 1 table in CFR

LOCATION OF POINTS IN RECTANGULAR STACKS OR DUCTS
(Fraction of stack diameter from inside wall to traverse point)

	2	3	4	5	6	7	8	9	10	11	12
1	.250	.167	.125	.100	.083	.071	.063	.056	.050	.045	.042
2	.750	.500	.375	.300	.250	.214	.188	.167	.150	.136	.125
3		.833	.625	.500	.417	.357	.313	.278	.250	.227	.208
4			.875	.700	.583	.500	.438	.389	.350	.318	.292
5				.900	.750	.643	.563	.500	.450	.409	.375
6					.917	.786	.688	.611	.550	.500	.458
7						.929	.813	.722	.650	.591	.542
8							.938	.833	.750	.682	.625
9								.944	.850	.773	.708
10									.950	.864	.792
11										.955	.875
12											.958

Checked By: _____ (sign) Joe Kuson (print)

CYCLONIC FLOW DETERMINATION DATA SHEET
(WITH PRELIMINARY VELOCITY AND MOISTURE)

TRC
Environmental Corporation

Client Name	Conoco Phillips			Velocity Run No.	—
Plant Name	Bayway Refinery			Moisture Run No.	—
City/State	Linden N.J.			Project Number	157609
Test Location	602 stack			Test Date	4/15/08
Personnel	GPB, MGW			Time Start	Stop
Pitot I.D	RPT-41	Pitot Coeff.	0.84	P barometer, "Hg	29.85 (5) GB
Meter Box ID	M16	Gas Meter Y	0.9946	P static, " H_2O	
Pressure Gauge ID		TC ID	RT-4F	Tester Signature	

Cyclonic Flow / Velocity Traverse

Point No.	Yaw Angle (deg)	Delta P in. H_2O	Temp Deg. F
A-1	-8°	1.1	167
2	-8°	1.0	166
3	-10°	0.86	163
B-1	-8°	1.08	161
2	-8°	1.1	164
3	-10°	1.2	166
C-1	0°	1.1	150
2	+3°	0.97	151
3	+3°	0.73	151
D-1	+4°	1.1	~~133~~ 143
2	+2°	1.1	~~132~~ 142
3	+2°	1.0	140
Avg			

Location is acceptable if avg of ABS(Yaw) ≤ 20°

Preliminary Moisture Sample Data

Test Time	DGM Reading Cubic Feet	Avg DGM Temp (F)	Delta H in. H_2O	Vac. in. Hg	Imp Exit Temp (F)
0/					
5					
10					
15					
20					
25					
30/					
35					
40					
45					
50					
55					
60/					

Gas Parameters

Moisture Analytical Results

	# 1	# 2	# 3	# 4	Sil Gel
Final Wt. / Vol					
Initial Wt. / Vol					
Moisture Gain					

Balance No. _____ **Total Catch** _____

O_2 / CO_2 Data

	Fyrite	Orsat	CEM
O_2 %			
CO_2%			

Leak Check Data

Meter	Pre	Post
in. Hg		
cfm		
Pitot		

Delta P avg is square of the average of the individual square roots

Checked By: _____ (sign) Jack Kunsman (print)
(Project Manager or QA Manager)

RAL-M2CYC-4.XLS

APPENDIX B

FIELD DATA SHEETS

2. Hydrogen Cyanide Emissions
a. D-601 Stack

ISOKINETIC FIELD DATA SHEET

METHOD(S) CTM-039

Page 1 of 1

TRC

Client Name	Conoco Phillips	Run Number	D601-CTM039-1
Plant Name	Bayway Refinery	Job Number	178819
City / State	Linden, NJ	Test Date	9/16/10
Sampling Location	D601	Start Time	0930
Test Personnel	JF	Operator Signature		Stop Time	1044

Filter/XAD	Tare	P barometer (in. Hg)	P static (in H2O)	Meterbox ID	MH	Nozzle		Pitot Tube		TC	Probe	Liner
				Y (Gamma)	Delta H@	ID #	Diameter	ID #	Cp	ID #	ID #	Material
—	—	29.94	-0.18	0.9962	1.780	C-4-99	0.214	RP-15	0.84	RP-44	RP	GLS

Sample Train Leak Check		Initial	Final	Interm 1	Interm 2	Interm 3	Interm 4	Fyrites Time	%O2	%CO2	Orsat Check
Equipment Leak Checks											
✓ Pitot, pretest	in Hg	15	5								✓
✓ Pitot, post-test	cfm	0.004	0.004								Bag ID
✓ Positive DGM, pretest	Start Volume										1-1-0
✓ Positive DGM, post-test	Stop Volume										

K Factor Setup Data		K = 1.151									
Delta H@	Meter Y	Nozzle Dia	Avg DeltaP	% H2O	T stack	T meter	Pbar	Pstatic	% O2	%CO2	Cp

Line	Point No	Time Clock (24-hr)	Time Test (min)	Dry Gas Meter Reading (cu. ft.)	Pitot Reading (in. H2O)	Delta H Actual (in. H2O)	DGM Temp (°F)	Stack Temp (°F)	Probe Temp (°F)	Filter/Box Temp (°F)	Gauge Vacuum (in. Hg)	Imp Exit Temp (°F)	XAD Temp (°F)	____ Temp (°F)
1	D-3	0930	0	475.292	1.1	1.27	151	234	234	250	5	65	NA	NA
2	-2		5	478.775	1.2	1.38	151	233	234	252	5	59		
3	-1		10	482.07	1.0	1.15	73	151	229	255	5	59		
4	C-3	0945	15	485.280	1.2	1.38	74	151	237	251	5	62		
5	-2		20	488.65	1.1	1.27	74	152	246	252	5	63		
6	-1		25	491.94	0.87	1.00	74	151	246	251	5	59		
7	B-3	1004	30	494.986	1.1	1.27	75	151	235	226	5	60		
8	-2		35	498.20	1.0	1.15	75	152	225	226	5	60		
9	-1		40	501.39	0.77	0.88	75	152	226	245	5	62		
10	A-3	1024	45	504.088	1.2	1.38	75	151	259	266	5	67		
11	-2		50	506.82	0.94	1.08	75	151	273	266	5	58		
12	-1		55	510.00	0.86	0.99	74	151	260	265	5	56		
13	END	1044	60	513.234	END									
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														

Run Time	Total Volume	RMS Delta P	Delta H	Tmeter Avg	Tstack Avg
60	37.942	1.026	1.22	74	151

Checked By: _____ (Project Manager or QA Manager) Date: 9/16/10

RAL-ISO1.xls

ISOKINETIC FIELD DATA SHEET

METHOD(S) CTM-033

Page 1 of 1

TRC

Client Name	Conoco Phillips	Run Number	D601-CTM033-2
Plant Name	Bayway Refinery	Job Number	1-6814
City / State	Linden, NJ	Test Date	9/16/10
Sampling Location	D601	Start Time	1214
Test Personnel	JE	Operator Signature	[signature]
		Stop Time	1326

Filter/XAD	Tare	P barometer (in Hg)	P static (in H2O)	Meterbox ID	M14	Nozzle		Pitot Tube		TC	Probe	Liner
				Y (Gamma)	Delta H@	ID #	Diameter	ID #	Cp	ID #	ID #	Material
		29.94	-0.22	0.9962	1.780	G-4-9	0.214	RPT-15	0.84	RT4-4	RP4-4	GLS

Equipment Leak Checks		Sample Train Leak Check Initial	Final	Interm 1	Interm 2	Interm 3	Interm 4	Fyrites Time	%O2	%CO2	Orsat Check
✓ Pitot, pretest	in Hg	15	6								✓
✓ Pitot, post-test	cfm	0.001	0.004								Bag ID
✓ Positive DGM, pretest	Start Volume										120
✓ Positive DGM, post-test	Stop Volume										

K Factor Setup Data		K = 1.151									
Delta H@	Meter Y	Nozzle Dia	Avg DeltaP	% H2O	T stack	T meter	Pbar	Pstatic	% O2	%CO2	Cp

Line	Point No	Time Clock (24-hr)	Time Test (min)	Dry Gas Meter Reading (cu. ft)	Pitot Reading (in H2O)	Delta H Actual (in H2O)	DGM Temp (°F)	Stack Temp (°F)	Probe Temp (°F)	Filter/Box Temp (°F)	Gauge Vacuum (in Hg)	Imp Exit Temp (°F)	XAD Temp (°F)	___ Temp (°F)
1	A-3	1214	0	514.746	1.2	1.38	71	151	233	241	5	56	NA	NA
2	-2		5	518.29	1.1	1.27	71	151	261	250	5	56		
3	-1		10	521.42	0.83	0.95	71	151	266	267	5	57		
4	B-3	1229 / 1232	15	524.235	1.1	1.27	71	152	248	239	5	60		
5	-2		20	527.61	1.0	1.15	72	152	227	226	5	64		
6	-1		25	530.93	0.79	0.91	72	152	226	228	5	65		
7	C-3	1247 / 1251	30	533.894	1.3	1.50	72	152	244	249	5	65		
8	-2		35	537.24	1.2	1.38	72	152	251	268	5	64		
9	-1		40	540.69	1.1	1.15	73	152	256	260	5	65		
10	D-3	1306 / 1311	45	543.816	1.3	1.50	73	151	260	257	5	63		
11	-2		50	547.51	1.2	1.38	73	152	258	258	5	57		
12	-1		55	550.84	0.67	0.77	73	152	252	259	4	56		
13	END	1326	60	553.631	END									
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														

Run Time	Total Volume	RMS Delta P	Delta H	Tmeter Avg	Tstack Avg
60	38.891	1.28	1.22	72	152

Checked By: [signature] (Project Manager or QA Manager) Date: 9/16/10

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ISOKINETIC FIELD DATA SHEET

METHOD(S) CTM03 5

Page ____ of ____

Client Name	Conoco Phillips	Run Number	D601-CTM03
Plant Name	Bayway Refinery	Job Number	178819
City / State	Linden, NJ	Test Date	9/16/10
Sampling Location	D601	Start Time	1415
Test Personnel	JE	Stop Time	1529
Operator Signature			

Filter/XAD	Tare	P barometer (in. Hg)	P static (in H2O)	Meterbox ID	Y (Gamma)	Delta H@	Nozzle ID #	Nozzle Diameter	Pitot Tube ID #	Pitot Tube Cp	TC ID #	Probe ID #	Liner Material
		29.94	-0.19	U14	0.9962	1.780	6.459	0.216	RPT-5	0.84	R14	RPS-6	G

Sample Train Leak Check

Equipment Leak Checks		Initial	Final	Interim 1	Interim 2	Interim 3	Interim 4
✓ Pitot, pretest	in Hg	15	6				
✓ Pitot, post-test	cfm	0.001	0.004				
✓ Positive DGM, pretest	Start Volume						
✓ Positive DGM, post-test	Stop Volume						

Fyrites: Time, %O2, %CO2, Orsat Check ✓, Bag ID 1-3

K Factor Setup Data		K =	1.173
Delta H@	Meter Y	Nozzle Dia	Avg DeltaP

Line	Point No.	Time Clock (24-hr)	Time Test (min)	Dry Gas Meter Reading (cu. ft.)	Pitot Reading (in H2O)	Delta H Actual (in H2O)	DGM Temp (°F)	Stack Temp (°F)	Probe Temp (°F)	Pstatic	% O2	%CO2	Cp
1	D-3	1415	0	554.075	1.3	1.52	71	152	23[illegible]	251	4	60	NA
2	-2		5	557.78	1.2	1.41	71	152	24[illegible]	259	4	56	
3	-1		10	560.59	0.84	0.96	71	152	24[illegible]	268	4	59	
4	C-3	1430 / 1434	15	563.910	1.2	1.41	72	152	252	270	4	61	
5	-2		20	567.37	1.1	1.29	72	153	25[illegible]	247	4	61	
6	-1		25	570.73	0.81	0.95	73	153	260	245	4	63	
7	B-3	1449 / 1453	30	574.089	1.2	1.41	73	152	25[illegible]	229	4	63	
8	-2		35	577.53	1.1	1.29	74	152	24[illegible]	243	4	58	
9	-1		40	580.96	0.79	0.93	74	152	24[illegible]	253	4	59	
10	A-3	1508 / 1513	45	583.537	1.3	1.52	75	152	262	272	4	63	
11	-2		50	587.01	1.2	1.41	75	152	25[illegible]	275	4	64	
12	-1		55	590.447	0.86	1.01	76	152	254	267	4	69	
13	END	1529	60	593.596	END								
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													
25													

Run Time	Total Volume	RMS Delta P	Delta H	Tmeter Avg	Tstack Avg
60	39.521	1.033	1.26	73	152

Checked By: _____ (Project Manager or QA Manager) Date: 10/01/10

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METHOD 4 - MOISTURE ANALYSIS DATA SHEET

TRC

Client Name	ConocoPhillips	Project Number	178819
Plant Name	BAYWAY REFINERY	Sample Method	CTM033
City / State	LINDEN, NJ	Recovery Location	TRAILER
Test Location	D601	Analyst Signature	[illegible]

Run Number	D601-CTM033-1	D601-CTM033-2	D601-CTM033-3	
Test Date	9-16-10	9-16-10	9-16-10	
Recovery Date	9-16-10	9-16-10	9-16-10	
Recovered By	SDK	SDK	~~9-16 DK~~	
Impinger 1 NaOH	pH=12	pH=12	pH=13	← 1802.1
Final Weight, g	1853.0	1763.4	1933.0	
Initial Weight, g	1593.3	1431.9	~~1589.2 gk~~	
Net weight, g	259.7	331.5	369.1	
Impinger 2 NaOH	pH=14	pH=14	pH=14	← 1527.6
Final Weight, g	1658.1	1572.6	1459.4	
Initial Weight, g	1495.2	1476.9	~~1491.4 gk~~	
Net weight, g	~~242.8~~ 1629	95.7	68.2	
Impinger 3 NaOH	pH=14	pH=14	pH=14	← 1457.5
Final Weight, g	1456.6	1629.7	1420.3	
Initial Weight, g	1413.8	1583.2	~~1416.2 gk~~	
Net weight, g	42.8	46.5	37.2	
Impinger 4 Silgel	~~pH=14~~		866.9	
Final Weight, g	908.9	881.5	856.1	
Initial Weight, g	898.3	862.5	~~851.0 gk~~	
Net weight, g	10.6	19.0	10.8	
Impinger 5				
Final Weight, g				
Initial Weight, g				
Net weight, g				
Impinger 6				
Final Weight, g				
Initial Weight, g				
Net weight, g	NOTE: (CALCULATED) MOISTURE FROM			
Impinger 7	NJ1 RUNS USED IN ALL (CTM-033)			
Final Weight, g	CALCULATIONS DUE TO			
Initial Weight, g	PRECIPITATE IN IMPINGERS			
Net weight, g				
Total Catch, g	~~555.9~~ 476.0	492.7	485.3	

Checked By: [signature] Date: 9/16/10
(Project Manager or QA Manager)

RAL-M4ANAL.XLS

METHOD 3 - ORSAT ANALYSIS FIELD DATA

TRC

Client Name	Conoco Phillips	Project No.	178819
Plant Name	Bayway Refinery	Fuel Type	CCU
City / State	Linden, NJ	Orsat ID	3
Test Location	D601	Analysis Location	TRAILER

Run No. D601-033BH-1 Date 9/16/10 Bag ID 4 Operator (signature)

Run Time	Time of Analysis	%CO_2 Reading (A)	%O_2 Reading (B)	%O_2 Value (B-A)	%CO Reading (C)	%CO Value (C-B)	%N_2 Value (100-C)
Start 930	1140	11.6	13.0	1.4			
Stop 1044	1	11.6	13.0	1.4			
Leak Chk ✓	1150	11.6	13.0	1.4			
F_o	Avg	11.6	Avg	1.4	Avg		

Run No. D601-033BH-2 Date 9/16/10 Bag ID 5 Operator (signature)

Run Time	Time of Analysis	%CO_2 Reading (A)	%O_2 Reading (B)	%O_2 Value (B-A)	%CO Reading (C)	%CO Value (C-B)	%N_2 Value (100-C)
Start 1214	1610	11.4	13.1	1.7			
Stop 1326	1	11.4	13.1	1.7			
Leak Chk ✓	1620	11.4	13.1	1.7			
F_o	Avg	11.4	Avg	1.7	Avg		

Run No. D601-033BH-3 Date 9/16/10 Bag ID 6 Operator (signature)

Run Time	Time of Analysis	%CO_2 Reading (A)	%O_2 Reading (B)	%O_2 Value (B-A)	%CO Reading (C)	%CO Value (C-B)	%N_2 Value (100-C)
Start 1415	1620	11.7	13.4	1.7			
Stop 1528	1	11.7	13.4	1.7			
Leak Chk ✓	1680	11.7	13.4	1.7			
F_o	Avg	11.7	Avg	1.7	Avg		

QC Validation

F_o = (20.9 - %O2) / %CO2

Expected F_o Ranges

Distillate Oil	1.260 - 1.413	Anthracite/Lignite Coal	1.015 - 1.130
Residual Oil	1.210 - 1.370	Bituminous Coal	1.083 - 1.230
Natural Gas	1.600 - 1.836	Municipal Solid Waste	1.043 - 1.177
Wood/Bark	1.000 - 1.130		

Checked By: Date: 9/16/10

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APPENDIX B

FIELD DATA SHEETS

2. Hydrogen Cyanide Emissions
b. D-602 Stack

ISOKINETIC FIELD DATA SHEET

METHOD(S) CTM033

Page 1 of 1

TRC

Client Name	ConocoPhillips Company	Run Number	D602-CTM033-1
Plant Name	Bayway Refinery	Job Number	176819
City / State	Linden N.J.	Test Date	9/16/10
Sampling Location	D602 Stack	Start Time	0930
Test Personnel	Mike Jed	Operator Signature	[signature]
		Stop Time	1044

Filter/XAD	Tare	P barometer (in. Hg)	P static (in H2O)	Meterbox ID	M2	Nozzle ID #	Nozzle Diameter	Pitot Tube ID #	Pitot Tube Cp	TC ID #	Probe ID #	Liner Material
Q	N/A	29.94	-0.27	Y (Gamma) 1.020	Delta H@ 1.901	G-4-18	0.215	RPT-50	0.84	BT-40	RP-50	OL

Equipment Leak Checks		Sample Train Leak Check Initial	Final	Interim 1	Interim 2	Interim 3	Interim 4	Fyrites Time	%O2	%CO2	Orsat Check
✓ Pitot, pretest	in Hg	15"	5"								✓
✓ Pitot, post-test	cfm	0.002	0.000								Bag ID
✓ Positive DGM, pretest	Start Volume										2-10
Positive DGM, post-test	Stop Volume										

K Factor Setup Data		K= 1.215									
Delta H@	Meter Y	Nozzle Dia	Avg DeltaP	% H2O	T stack	T meter	Pbar	Pstatic	% O2	%CO2	Cp

Line	Point No.	Time Clock (24-hr)	Time Test (min)	Dry Gas Meter Reading (cu. ft.)	Pitot Reading (in. H2O)	Delta H Actual (in. H2O)	DGM Temp (°F)	Stack Temp (°F)	Probe Temp (°F)	Filter/Box Temp (°F)	Gauge Vacuum (in. Hg)	Imp Exit Temp (°F)	XAD Temp (°F)	___ Temp (°F)
1	A-3	0930	0	161.846	1.10	1.35	63	162	234	242	5	63	N/A	N/A
2	2		5	165.17	1.10	1.35	66	159	227	241	5	46		
3	1		10	167.86	1.05	1.30	67	163	228	239	5	46		
4	B-3	0939	0/15	170.878	1.10	1.35	69	152	247	240	5	55		
5	2		20	173.94	1.00	1.20	69	159	253	260	5	49		
6	1		25	176.63	0.95	1.15	70	160	245	253	5	51		
7	C-3	1004	0/30	179.49	1.10	1.35	72	166	233	251	5	61		
8	2		35	182.37	1.10	1.35	72	166	241	253	5	54		
9	1		40	185.38	0.88	1.10	73	168	238	252	5	55		
10	D-3	1019	0/45	188.196	1.10	1.35	75	165	246	257	5	61		
11	2		50	191.16	1.00	1.20	75	169	253	256	5	55		
12	1		55	194.06	0.73	0.89	75	161	252	257	5	57		
13	END	1044	60	196.627										
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														

Run Time	Total Volume 37.701	RMS Delta P	Delta H	Tmeter Avg	Tstack Avg
60	38.781	1.007	1.25	71	163

Checked By: [signature] (Project Manager or QA Manager) Date: 9/16/10

RAL-ISO1.xls

ISOKINETIC FIELD DATA SHEET

METHOD(S) CTM033

Page 1 of 1

TRC

Client Name	ConocoPhillips	Run Number	D602-CTM033-2
Plant Name	Bayway Refinery	Job Number	174815
City / State	Linden NJ	Test Date	9/16/10
Sampling Location	D602 Stack	Start Time	1214
Test Personnel	MGW JCP	Operator Signature	[signature]
		Stop Time	1326

Filter/XAD	Tare	P barometer (in Hg)	P static (in H2O)	Meterbox ID	M2	Nozzle ID #	Nozzle Diameter	Pitot Tube ID #	Pitot Tube Cp	TC ID #	Probe ID #	Liner Material
✓	n/A	28.94	-0.31	Y (Gamma) 1.0021	Delta H@ 1.901	G-4-118	0.215	RPT-50	0.84	RT-40	RP-50	GL

Equipment Leak Checks		Sample Train Leak Check Initial	Final	Interim 1	Interim 2	Interim 3	Interim 4
✓ Pitot, pretest	in Hg	15"	5"				
✓ Pitot, post-test	cfm	0.001	0.000				
✓ Positive DGM, pretest	Start Volume						
✓ Positive DGM, post-test	Stop Volume						

Fyrites Time	%O2	%CO2	Orsat Check	Bag ID
			✓	1-20

K Factor Setup Data		K = 1.215									
Delta H@	Meter Y	Nozzle Dia	Avg DeltaP	% H2O	T stack	T meter	Pbar	Pstatic	% O2	%CO2	Cp

Line	Point No.	Time Clock (24-hr)	Time Test (min)	Dry Gas Meter Reading (cu ft)	Pitot Reading (in H2O)	Delta H Actual (in H2O)	DGM Temp (°F)	Stack Temp (°F)	Probe Temp (°F)	Filter/Box Temp (°F)	Gauge Vacuum (in Hg)	Imp Exit Temp (°F)	XAD Temp (°F)	___ Temp (°F)
1	D-5	1214	0	197.129	1.00	1.20	71	168	251	255	4	63	n/A	n/A
2	2		5	199.45	1.10	1.35	71	166	253	257	4	58		
3	1		10	203.03	0.95	1.15	71	163	251	257	4	57		
4	C-3	1232	15	205.839	1.10	1.35	72	165	236	249	4	61		
5	2		20	208.91	1.10	1.35	72	165	241	249	4	61		
6	1		25	211.77	0.95	1.15	73	169	240	248	4	62		
7	B-3	1251	30	214.853	1.10	1.35	73	159	245	251	5	64		
8	2		35	217.85	1.10	1.35	74	159	245	251	5	65		
9	1		40	221.00	0.95	1.15	74	159	247	251	5	65		
10	A-3	1311	45	223.578	1.10	1.35	75	155	236	256	5	64		
11	2		50	226.93	1.10	1.35	75	158	231	249	5	63		
12	1		55	230.05	0.69	0.84	75	158	249	242	4	62		
13	END	1326	60	232.612										
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														

Run Time	Total Volume	RMS Delta P	Delta H	Tmeter Avg	Tstack Avg
60	35.483	1.208	1.25	73	162

Checked By: [signature] (Project Manager or QA Manager) Date: 9/16/10

RAL-ISO1.xls

ISOKINETIC FIELD DATA SHEET

METHOD(S) CTM033

Page 1 of 1

TRC

Client Name	ConocoPhillips Company	Run Number	D602-CTM033-3
Plant Name	Bayway Refinery	Job Number	179339
City / State	Linden, N.J.	Test Date	9/16/10
Sampling Location	D602 Stack	Start Time	1415
Test Personnel	Mike Scb	Operator Signature	[signature]
		Stop Time	1528

Filter/XAD	Tare	P barometer (in. Hg)	P static (in H2O)	Meterbox ID	M2	Nozzle ID #	Nozzle Diameter	Pitot Tube ID #	Pitot Tube Cp	TC ID #	Probe ID #	Liner Material
	nA	29.94	-0.32	Y (Gamma) 1.0021	Delta H@ 1.901	6-1-118	0.215	RPT-50	0.84	RT-48	RP-50	UL

Equipment Leak Checks		Initial	Final	Interm 1	Interm 2	Interm 3	Interm 4	Time	%O2	%CO2	Orsat Check
✓ Pitot, pretest	in Hg	15"	6"								✓
✓ Pitot, post-test	cfm	0.001	0.001								Bag ID
Positive DGM, pretest	Start Volume										7.3R
Positive DGM, post-test	Stop Volume										

Sample Train Leak Check

Fyrites

K Factor Setup Data		K = 1.215									
Delta H@	Meter Y	Nozzle Dia	Avg DeltaP	% H2O	T stack	T meter	Pbar	Pstatic	% O2	%CO2	Cp

Line	Point No	Time Clock (24-hr)	Time Test (min)	Dry Gas Meter Reading (cu. ft.)	Pitot Reading (in. H2O)	Delta H Actual (in H2O)	DGM Temp (°F)	Stack Temp (°F)	Probe Temp (°F)	Filter/Box Temp (°F)	Gauge Vacuum (in Hg)	Imp Exit Temp (°F)	XAD Temp (°F)	___ Temp (°F)
1	A-3	1415	0	233.029	1.10	1.35	73	159	237	243	6	62	nA	nA
2	2		5	235.99	1.10	1.35	73	159	238	249	6	57		
3	1		10	239.36	1.00	1.20	74	157	240	246	6	60		
4	B-3	1434	15	242.350	1.10	1.35	74	156	242	245	6	61		
5	2		20	245.51	1.10	1.35	74	156	253	255	6	61		
6	1		25	248.56	0.85	1.00	75	157	253	254	6	62		
7	C-3	1453	30	251.352	1.20	1.50	75	166	250	253	6	60		
8	2		35	254.67	1.10	1.35	76	165	247	254	6	59		
9	1		40	257.43	0.80	1.10	76	168	247	255	6	59		
10	D-3	1513	45	260.773	1.10	1.35	77	166	252	258	6	61		
11	2		50	263.86	1.00	1.20	77	168	254	256	6	63		
12	1		55	266.87	0.95	1.00	78	166	255	258	6	63		
13	END	1528	60	269.678										
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														

Run Time	Total Volume	RMS Delta P	Delta H	Tmeter Avg	Tstack Avg
60	36.646	1.014	1.26	75	162

Checked By: [signature] (Project Manager or QA Manager) Date: 10/1/10

RAL-ISO1.xls

METHOD 4 - MOISTURE ANALYSIS DATA SHEET

TRC

Client Name	Conoco Phillips	Project Number	178819
Plant Name	Bayway Refinery	Sample Method	CTM033
City / State	Linden, NJ	Recovery Location	Trailer
Test Location	D602	Analyst Signature	DB

Run Number	D602-CTM033-1	D602-CTM033-2	D602-CTM033-3	
Test Date	9-16-10	9-16-10	9-16-10	
Recovery Date	9-16-10	9-16-10	9-16-10	
Recovered By	SDK	SDK	SDK	
Impinger 1 NaOH	pH=14	pH-14	pH-14 ←	1883.7
Final Weight, g	1740.8	1722.5	1589.2	
Initial Weight, g	1426.7	1405.9	~~1433.0~~ 92	
Net weight, g	314.1	316.6	294.5	
Impinger 2 NaOH	pH-14	pH-14	pH-14 ←	1596.5
Final Weight, g	1492.7	1557.1	1491.4	
Initial Weight, g	1443.9	1494.5	~~1459.4~~ 92	
Net weight, g	~~314.1~~ 48.8	62.6	105.1	
Impinger 3 NaOH	pH=14	pH-14	pH-14 ←	1457.5
Final Weight, g	1446.5	1484.0	1416.2	
Initial Weight, g	1419.3	1450.9	~~1420.3~~ 92	
Net weight, g	27.2	33.1	35.3	
Impinger 4 Silgel			864.9	
Final Weight, g	882.3	882.6	851.0	
Initial Weight, g	876.6	876.2	~~856.1~~ 92	
Net weight, g	5.7	6.4	13.9	
Impinger 5				
Final Weight, g				
Initial Weight, g				
Net weight, g				
Impinger 6				
Final Weight, g	NOTE! NO1 CALCULATED MOISTURE			
Initial Weight, g	USED FOR ALL CTM-033 CALCULATIONS			
Net weight, g	DUE TO PERCIPITATE MASS IN IMPINGERS.			
Impinger 7				
Final Weight, g				
Initial Weight, g				
Net weight, g				
Total Catch, g	395.8	418.7	448.8	

Checked By: _____ Date: 9/16/10
(Project Manager or QA Manager)

RAL-M4ANAL.XLS

METHOD 3 - ORSAT ANALYSIS FIELD DATA

TRC

Client Name	Conoco Phillips	Project No	178819
Plant Name	Bayway Refinery	Fuel Type	CCU
City / State	Linden, NJ	Orsat ID	3
Test Location	D602	Analysis Location	TRAILER

Run No. D602-033BH-1 Date 9/16/10 Bag ID 4 Operator (signature)

Run Time	Time of Analysis	% CO_2 Reading (A)	% O_2 Reading (B)	% O_2 Value (B-A)	% CO Reading (C)	% CO Value (C-B)	% N_2 Value (100-C)
Start 930	1150	10.5	13.2	2.7			
Stop 1044	1	10.5	13.2	2.7			
Leak Chk ✓	1200	10.5	13.2	2.7			
F_o _____	Avg	10.5	Avg	2.7	Avg		

Run No. D602-033BH-2 Date 9/16/10 Bag ID 5 Operator (signature)

Run Time	Time of Analysis	% CO_2 Reading (A)	% O_2 Reading (B)	% O_2 Value (B-A)	% CO Reading (C)	% CO Value (C-B)	% N_2 Value (100-C)
Start 1214	1540	10.1	12.8	2.7			
Stop 1326	1	10.1	12.8	2.7			
Leak Chk ✓	1550	10.1	12.8	2.7			
F_o _____	Avg	10.1	Avg	2.7	Avg		

Run No. D602-033BH-3 Date 9/16/10 Bag ID 6 Operator (signature)

Run Time	Time of Analysis	% CO_2 Reading (A)	% O_2 Reading (B)	% O_2 Value (B-A)	% CO Reading (C)	% CO Value (C-B)	% N_2 Value (100-C)
Start 1415	1650	10.2	12.8	2.6			
Stop 1528	1	10.2	12.8	2.6			
Leak Chk ✓	1700	10.2	12.8	2.6			
F_o _____	Avg	10.2	Avg	2.6	Avg		

QC Validation

F_o = (20.9 - %O2) / %CO2

Expected F_o Ranges

Distillate Oil	1.260 - 1.413	Anthracite/Lignite Coal	1.015 - 1.130
Residual Oil	1.210 - 1.370	Bituminous Coal	1.083 - 1.230
Natural Gas	1.600 - 1.836	Municipal Solid Waste	1.043 - 1.177
Wood/Bark	1.000 - 1.130		

Checked By: Date: 9/16/10

RAL-M3.XLS

APPENDIX C

ANALYTICAL DATA

APPENDIX C

ANALYTICAL DATA

1. Particulate Matter

RESOLUTION ANALYTICS, INC.

Specialists in Air Emissions Analysis

ANALYTICAL REPORT

CLIENT: **TRC ENVIRONMENTAL, INC.**

PROJECT: 178819 ConocoPhillips

ANALYTICAL SERVICES PROVIDED:

- FILTERABLE PARTICULATE
  (NJ METHOD 1)

Confirmation of Data Review:

To the best of my knowledge this analytical data has been checked thoroughly for completeness and the results presented are accurate, error-free, legible, and have been performed and validated in accordance with the approved method(s).

Date of Review: September 24, 2010

J. Bruce Nemet

Quality Assurance Officer

www.resolutionanalytics.com
2733 Lee Avenue • Sanford, NC 27332 • Phone: 919-774-5557 • Fax: 919-776-6785

SAMPLE LOG and CHAIN OF CUSTODY RECORD

Client:	TRC Environmental Corporation	TRC Project Manager :	Jeff Kunstling
Location:	Raleigh, NC	Telephone No.	(919) 256-6234
Project Name :	ConocoPhillips Linden, New Jersey	TRC Project No.	178819
		Carrier or Delivery:	Pick up by RAI
		Date Delivered to Lab:	September 21, 2010
		Results Due Date:	Standard Turn Around

Page #
Resolution Analytics, Inc.
(919) 774-5557

Sample I.D. No. and Description

Location :	Train #	Run #	Fraction :	Sample Date :	Sample Type :	Type of Container :	Analysis Requested
D602	NJ1	602-NJ1-1	FH Acetone Rinse	9/16/10	Acetone	500 ml Glass	PM by NJ1
D602	NJ1	602-NJ1-1	Filter	9/16/10	Filter	Petri Dish	PM by NJ1
D602	NJ1	602-NJ1-2	FH Acetone Rinse	9/16/10	Acetone	500 ml Glass	PM by NJ1
D602	NJ1	602-NJ1-2	Filter	9/16/10	Filter	Petri Dish	PM by NJ1
D602	NJ1	602-NJ1-3	FH Acetone Rinse	9/16/10	Acetone	500 ml Glass	PM by NJ1
D602	NJ1	602-NJ1-3	Filter	9/16/10	Filter	Petri Dish	PM by NJ1

Released by TRC: Signature — Date: 9/20/10

Accepted by Laboratory: Jeffrey S. Coppedge — Signature and Date: 9/20/10

SAMPLE LOG and CHAIN OF CUSTODY RECORD

Client:	TRC Environmental Corporation	TRC Project Manager :	Jeff Kunstling
Location:	Raleigh, NC	Telephone No.	(919) 256-6234
Project Name :	ConocoPhillips Linden, New Jersey	TRC Project No.	178819
		Carrier or Delivery:	Pick up by RAI
		Date Delivered to Lab:	September 21, 2010
		Results Due Date:	Standard Turn Around

Page #
Resolution Analytics, Inc.
(919) 774-5557

Sample I.D. No. and Description

Location :	Train #	Run #	Fraction :	Sample Date :	Sample Type :	Type of Container :	Analysis Requested
D601	NJ1	601-NJ1-1	FH Acetone Rinse	9/16/10	Acetone	500 ml Glass	PM by NJ1
D601	NJ1	601-NJ1-1	Filter	9/16/10	Filter	Petri Dish	PM by NJ1
D601	NJ1	601-NJ1-2	FH Acetone Rinse	9/16/10	Acetone	500 ml Glass	PM by NJ1
D601	NJ1	601-NJ1-2	Filter	9/16/10	Filter	Petri Dish	PM by NJ1
D601	NJ1	601-NJ1-3	FH Acetone Rinse	9/16/10	Acetone	500 ml Glass	PM by NJ1
D601	NJ1	601-NJ1-3	Filter	9/16/10	Filter	Petri Dish	PM by NJ1
		Reagent Blank	Acetone Blank	9/16/10	Acetone	500 ml Glass	PM by NJ1

Released by TRC: Signature — Date: 9/20/2010 9/20/10

Accepted by Laboratory: Jeffrey S. Coppola — Signature and Date: 9/20/10

RESOLUTION ANALYTICS, INC.
Specialists in Air Emissions Analysis

Client: TRC
RFA #: 178819
Method: NJATM 1

Report Summary

SAMPLE ID	TOTAL FILTERABLE PARTICULATE
Acetone Blank	0.9 mg (in 220 mls)
601-NJ1-1	15.2 mg
601-NJ1-2	17.0 mg
601-NJ1-3	19.3 mg
602-NJ1-1	19.7 mg
602-NJ1-2	14.8 mg
602-NJ1-3	14.8 mg

RESOLUTION ANALYTICS, INC.

Specialists in Air Emissions Analysis

Client: TRC
RFA #: 178819
Date Received: 9/20/10
Date Analyzed: 9/21/10
Analyst: JSC
Analysis: NJATM 1
Analyte(s): Filterable Particulate

Analytical Narrative

Sample Matrix & Components:

Dry Filters, Front½ Acetone Rinses, Acetone Blank

Summary of Sample Prep:

The acetone rinses and pre-tared filters were transferred to pre-tared teflon "baggies" in a low humidity environment. The acetone rinses were evaporated overnight, baked 2 to 3 hours at 105° C, desiccated for 24 hours,then weighed to constant weight. The filters were baked 2 to 3 hours at 105° C, desiccated for 24 hours,then weighed to constant weight.

All weights were recorded to the nearest 0.1 mg and include filterable particulate catch only. The total catch reported for each run is a sum of the filter and rinse catches. The acetone blank catch has been subtracted from sample rinse catches in proportion with their respective volumes.

Summary of Instrumentation:

Denver model Pinnacle Series analytical balance

Analytical Detection Limit(s): 0.1 mg

Miscellaneous Comments Regarding Sample Analysis: (Note unusual catch weights, interferences, odd sample behavior, and steps taken to confirm unusual results. Also note any deviations from standard analytical procedures, together with justification and possible affect on results. Specify samples when applicable.)

No modifications to NJATM 1 analytical procedure were made. See data sheets for individual sample descriptions.

PARTICULATE SAMPLING LABORATORY RESULTS

Client: **TRC**
Method: NJATM 1

RFA #: **178819**

Run Number			601-NJ1-1			601-NJ1-2			601-NJ1-3
Filter Container #									
	Date	Init		Date			Date		
	9/24/10	JSC F	0.3776	9/24/10	F	0.3864	9/24/10		0.3883
	9/23/10	JSC	0.3780	9/23/10		0.3866	9/23/10	F	0.3882
Baggie Tare Wt., g.			0.0000			0.0000			0.0000
Filter Tare Wt., g.			0.3645			0.3726			0.3733
FILTER SAMPLE WT., g.			0.0131			0.0138			0.0149
Front ½ Rinse Container #			247			1676			957
	Date	Init		Date			Date		
	9/24/10	JSC	3.6178	9/24/10	F	3.7038	9/24/10	F	3.5185
	9/23/10	JSC F	3.6176	9/23/10		3.7040	9/23/10		3.5188
Tare Wt., g.		(30 ml)	3.6154	(30	ml)	3.7005	(30	ml)	3.5140
RINSE SAMPLE WT., g.			0.0022			0.0033			0.0045
Filter Catch, mg.			13.1			13.8			14.9
Rinse Catch, mg.			2.2			3.3			4.5
Rinse Blank Residue, mg.			0.1			0.1			0.1
Net Rinse Catch, mg.			2.1			3.2			4.4
FILTERABLE PARTICULATE, mg.			15.2			17.0			19.3

Legend: F = Final Weight

Notes & Comments:

PARTICULATE SAMPLING LABORATORY RESULTS

Client: **TRC**
Method: NJATM 1

RFA #: **178819**

Run Number			602-NJ1-1			602-NJ1-2			602-NJ1-3
Filter Container #	Date	Init		Date			Date		
	9/24/10	JSC	0.3418	9/24/10		0.3768	9/24/10	F	0.3801
	9/23/10	JSC F	0.3415	9/23/10	F	0.3763	9/23/10	F	0.3801
Baggie Tare Wt., g.			0.0000			0.0000			0.0000
Filter Tare Wt., g.			0.3268			0.3627			0.3671
FILTER SAMPLE WT., g.			0.0147			0.0136			0.0130
Front ½ Rinse Container #	Date	Init	1205	Date		568	Date		1537
	9/24/10	JSC F	3.4079	9/24/10	F	3.4910	9/24/10	F	3.6910
	9/23/10	JSC	3.4080	9/23/10		3.4911	9/23/10	F	3.6910
Tare Wt., g.		(40 ml)	3.4027	(30 ml)		3.4897	(30 ml)		3.6891
RINSE SAMPLE WT., g.			0.0052			0.0013			0.0019
Filter Catch, mg.			**14.7**			**13.6**			**13.0**
Rinse Catch, mg.			5.2			1.3			1.9
Rinse Blank Residue, mg.			0.2			0.1			0.1
Net Rinse Catch, mg.			**5.0**			**1.2**			**1.8**
FILTERABLE PARTICULATE, mg.			**19.7**			**14.8**			**14.8**

Legend: F = Final Weight

Notes & Comments:

REAGENT BLANK LABORATORY RESULTS

Client: **TRC**
Method: NJATM 1

RFA #: **178819**

Run Number	Acetone Blank
Sample ID/Container #	1489

	Date	Init		
	9/24/10	JSC	F	3.5441
	9/23/10	JSC	F	3.5441
Tare Wt., g.	(	220	ml)	3.5432
SAMPLE WT., g.				0.0009

Blank Beaker #	1489
Final wt., mg.	3.5441
Tare wt., mg.	3.5432
Residue, mg.	0.9
Volume, ml.	220
Density, mg/ml	785.0
Conc., mg/mg	5.21E-06 <--
Upper Limit, mg	1.00E-05

Legend: F = Final Weight

Notes & Comments:

M5/17 Particulate Bench Sheet

Client: TRC
Analyst: JSC

RFA #: 178819
Method: MJ1

Date Received: 9/20/10
Date Analyzed: 9/21/10

Run #	Filter			Acetone Rinse	
	Baggie #	Filter #	Filter Tare	Baggie #	Rinse Volume
601-MJ1-1		RQ-5550	0.3645	247	30
-2		RQ-5998	0.3726	1676	30
-3		RQ-5996	0.3733	957	30
602-MJ1-1		RQ-5626	0.3268	1205	40
-2		RQ-5551	0.3627	568	30
-3		RQ-5553	0.3671	1537	30
ACETONE BLANK				1489	220

APPENDIX C

ANALYTICAL DATA

2. Hydrogen Cyanide

TRC Environmental Corporation

5540 Centerview Drive, Suite 100
Raleigh, NC 27606

ConocoPhillips - D601, D602
Linden, NJ

Project # 178819
PO # 27528

Analytical Report
(0910-26)

EPA CTM-033

Hydrogen cyanide

Enthalpy Analytical, Inc.
Phone: (919) 850 - 4392 / Fax: (919) 850 - 9012 / www.enthalpy.com
2202 Ellis Road Durham, NC 27703 - 5518

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 98 pages.

Bonnie L Evans

QA Review Performed by – Bonnie L Evans

Summary of Results

Company	TRC Environmental Corp
Analyst	KHB
Parameters	EPA CTM-033
# Samples	6 Runs, 1 blank, 1 spike

Client #	178819
Job #	0910-26
PO #	27528
Report Date	9/30/2010

Compound	Sample ID / Catch Weight (ug)		
	601-033-1	***601-033-2***	***601-033-3***
Hydrogen cyanide	5,896	6,005	6,686
	602-033-1	***602-033-2***	***602-033-3***
Hydrogen cyanide	4,446	5,414	5,619
	CTM-033 Spike	***Reagent Blank***	
Hydrogen cyanide	1,940	32.6 ND	

Results

Company	TRC Environmental Corp
Analyst	KHB
Parameters	EPA CTM-033
# Samples	6 Runs, 1 blank, 1 spike

Client #	178819
Job #	0910-26
PO #	27528
Report Date	9/30/2010

MDL 0.0104 (ug/mL)
LOQ 0.104 (ug/mL)
Compound Hydrogen cyanide

Lower Curve Limit 0.104 (ug/mL)
Upper Curve Limit 2.08 (ug/mL)

Sample ID	Lab ID # 1	Lab ID # 2	Analysis Method	Ret Time (min)	Ret Time (min)	% Diff Ret	Conc # 1 (ug/mL)	Conc # 2 (ug/mL)	% Diff Conc	Avg Conc (ug/mL)	DF	Vol (mL)	Catch Weight (ug)	Qual
601-033-1 Imp 1-2	008-0901.D	008-0902.D	HPLC50PG172.M	8.30	8.26	0.5	0.798	0.795	0.2	0.797	5	1,480	5,896	
601-033-1 Imp 3	009-1001.D	NA	HPLC50PG172.M	NA	NA	NA	0.0104	NA	NA	0.0104	5	565	29.2	ND
													5,896	
601-033-2 Imp 1-2	010-1101.D	010-1102.D	HPLC50PG172.M	8.27	8.25	0.2	0.737	0.728	0.6	0.732	5	1,640	6,005	
601-033-2 Imp 3	011-1201.D	NA	HPLC50PG172.M	NA	NA	NA	0.0104	NA	NA	0.0104	5	620	32.1	ND
													6,005	
601-033-3 Imp 1-2	012-1301.D	012-1302.D	HPLC50PG172.M	8.30	8.30	0.0	0.855	0.859	0.3	0.857	5	1,560	6,686	
601-033-3 Imp 3	013-1401.D	NA	HPLC50PG172.M	NA	NA	NA	0.0104	NA	NA	0.0104	5	580	30.0	ND
													6,686	
602-033-1 Imp 1-2	014-1701.D	014-1702.D	HPLC50PG172.M	8.27	8.29	0.3	0.614	0.613	0.1	0.613	5	1,450	4,446	
602-033-1 Imp 3	015-1801.D	NA	HPLC50PG172.M	NA	NA	NA	0.0104	NA	NA	0.0104	5	560	29.0	ND
													4,446	
602-033-2 Imp 1-2	016-1901.D	016-1902.D	HPLC50PG172.M	8.29	8.30	0.2	0.728	0.736	0.6	0.732	5	1,480	5,414	
602-033-2 Imp 3	017-2001.D	NA	HPLC50PG172.M	NA	NA	NA	0.0104	NA	NA	0.0104	5	610	31.6	ND
													5,414	
602-033-3 Imp 1-2	018-2101.D	018-2102.D	HPLC50PG172.M	8.30	8.27	0.4	0.738	0.741	0.2	0.739	5	1,520	5,619	
602-033-3 Imp 3	019-2201.D	NA	HPLC50PG172.M	NA	NA	NA	0.0104	NA	NA	0.0104	5	600	31.1	ND
													5,619	
CTM-033 Spike	020-2501.D	020-2502.D	HPLC50PG172.M	8.32	8.27	0.5	0.647	0.646	0.0	0.647	5	600	1,940	
												Spike Amount (ug)	2,019	
												Spike Recovery (%)	96.1%	
Reagent Blank	021-2601.D	NA	HPLC50PG172.M	NA	NA	NA	0.0104	NA	NA	0.0104	5	630	32.6	ND

Company	TRC Environmental Corp
Analyst	KHB
Parameters	EPA CTM-033
# Samples	6 Runs, 1 blank, 1 spike

Client #	178819
Job #	0910-26
PO #	27528
Report Date	9/30/2010

MDL 0.0104 (ug/mL)
LOQ 0.104 (ug/mL)
Compound Hydrogen cyanide

Lower Curve Limit 0.104 (ug/mL)
Upper Curve Limit 2.08 (ug/mL)

Sample ID	Lab ID # 1	Lab ID # 2	Analysis Method	Ret Time (min)	Ret Time (min)	% Diff Ret	Conc # 1 (ug/mL)	Conc # 2 (ug/mL)	% Diff Conc	Avg Conc (ug/mL)	DF	Vol (mL)	Catch Weight (ug)	Qual
LD/601-033-1-Imp 1-2	022-2701.D	022-2702.D	HPLC50PG172.M	8.27	8.30	0.4	0.668	0.679	0.9	0.673	5	1,480	4,984	
												difference	15.5%	
0.1N NaOH - RB	007-0801.D	007-0802.D	HPLC50PG172.M	NA	NA	NA	0.0104	0.0104	0.0	0.0104	1	1.00	0.0104	ND
0.1N NaOH - RB	007-0801.D	007-0802.D	HPLC50PG174.M	NA	NA	NA	0.0104	0.0104	0.0	0.0104	1	1.00	0.0104	ND
MS/601-033-1-Imp 1-2	023-2801.D	023-2802.D	HPLC50PG172.M	8.29	8.29	0.0	1.65	1.62	0.7	1.63	1	0.525	0.858	
												Spike Amount (ug)	0.520	
												Native Amount (ug)	0.398	
												Spike Recovery (%)	88.4%	
MSD/601-033-1-Imp 1-2	024-2901.D	024-2902.D	HPLC50PG172.M	8.29	8.28	0.2	1.69	1.68	0.3	1.68	1	0.525	0.884	
												Spike Amount (ug)	0.520	
												Native Amount (ug)	0.398	
												Spike Recovery (%)	**93.4%**	
LCS-1	024-0901.D	024-0902.D	HPLC50PG174.M	8.22	8.19	0.4	1.04	1.03	0.2	1.04	200	10.0	2,071	
												Spike Amount (ug)	2,019	
												Spike Recovery (%)	103%	
LCS-2	025-1001.D	025-1002.D	HPLC50PG174.M	8.21	8.21	0.0	1.05	1.06	0.1	1.05	200	10.0	2,110	
												Spike Amount (ug)	2,019	
												Spike Recovery (%)	105%	
hplc50pg166 #SS	006-0701.D	006-0702.D	HPLC50PG172.M	8.28	8.30	0.1	1.01	1.01	0.1	1.01	1	1.00	1.01	
												Spike Conc (µg/mL)	1.02	
												Spike Recovery (%)	99.1%	
hplc50pg166 #SS	006-0701.D	006-0702.D	HPLC50PG174.M	8.18	8.18	0.0	1.05	1.04	0.2	1.05	1	1.00	1.05	
												Spike Conc (µg/mL)	1.02	
												Spike Recovery (%)	103%	

Narrative Summary

Enthalpy Analytical Narrative Summary

Company	TRC Environmental Corp.
Analyst	KHB
Parameters	EPA CTM-033
# Samples	6 Runs, 1 blank, 1 spike

Client #	178819
Job #	0910-26
PO #	27528
Report Date	September 30, 2010

Custody

Heather Tarjeft of Enthalpy Analytical, Inc. received the samples on 9/20/10 at -1.3°C and -2.3°C after being relinquished by TRC Environmental Corporation of Raleigh, NC. The samples were received at a pH of 14 and 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 hydrogen cyanide using the analytical procedures in EPA Conditional Test Method 033, Sampling and Analysis for Hydrogen Cyanide Emissions from Stationary Sources.

The Dionex Model 500, High Performance Liquid Chromatograph ("Grandmama") was equipped with a Dionex ED40 Electrochemical Detector and a Dionex Ion Pac AS7, 4 x 250 mm (S/N 012759) column.

Calibration

The calibration curves are located in the Calibration Curve Chromatograms section of this report and referenced in the Analysis Method column on the Detailed Results page.

For each calibration curve used, the first page of the curve contains all method specific parameters (i.e., curve type, origin, weight, etc.) used to quantify the samples. The calibration curve section also includes a table with the Retention Time (RetTime), Level (Lvl), Amount (corresponding units), Area, Response Factor (Amt/Area) and the analyte Name. The calibration table is used to identify (by retention time) and quantify each target compound.

Chromatographic Conditions

The acquisition method 1000.M is included in the Calibration Curve Chromatograms section of this report.

QC Notes

As required in Section 9.0, Quality Control, a client-provided reagent blank and field spike were analyzed. A client-provided field blank was not received. In the laboratory the following QC samples were analyzed: method blank, Matrix Spike/Matrix Spike Duplicate, and a replicate analysis. All method required acceptance criteria were met.

Prior to sample collection, the laboratory prepared aqueous spikes containing 2,019 µg of HCN. Three spikes were shipped to the client and two spikes were retained as Laboratory Control Samples (LCS). The LCS recovery values were 103% and 105%.

Enthalpy Analytical Narrative Summary
(continued)

QC Notes (continued)	The field spike sample, ***CTM-033 Spike,*** exhibited a 96.1% recovery value. A matrix spike and matrix spike duplicate was prepared using an aliquot of the sample, ***601-033-1-Imp 1-2***. The recovery values were 88.4% and 93.4%. A Laboratory Duplicate (LD) analysis was performed on sample ***601-033-1-Imp 1-2***. The result differed from the initial result by 15.5%. All sample preparation and analytical holding times specified in the method were met. In Section 11.1.2 the specified analytical holding time is 30 days from collection.
Reporting Notes	The results presented in this report are representative of the samples as provided to the laboratory. The laboratory measured volumes were used for reporting purposes. Enthalpy Analytical, Inc. is accredited to perform this method for compliance purposes by the National Environmental Laboratory Accreditation Conference (NELAC) through the Louisiana Environmental Laboratory Accreditation Program (LELAP), certificate number 04010.

General Reporting Notes

The following are general reporting notes that are applicable to all Enthalpy Analytical, Inc. data reports, unless specifically noted otherwise.

- The acronym ***MDL*** represents the Minimum Detection Limit. Below this value the laboratory cannot determine the presence of the analyte of interest reliably.
- The acronym ***LOQ*** represents the Limit of Quantification. Below this value the laboratory cannot quantitate the analyte of interest within the criteria of the method.
- The acronym ***ND*** following a value indicates a non-detect or analytical result below the MDL.
- The letter ***J*** following a value indicates an analytical result between the MDL and the LOQ. A J flag indicates that the laboratory can positively identify the analyte of interest as present, but the value should be considered an estimate.
- The letter ***E*** following a value indicates an analytical result exceeding 100% of the highest calibration point. The associated value should be considered as an estimate.
- The acronym ***DF*** represents Dilution Factor. This number represents dilution of the sample during the preparation and/or analysis process. The analytical result taken from a laboratory instrument is multiplied by the DF to determine the final undiluted sample results.
- The addition of ***MS*** to the Sample ID represents a Matrix Spike. An aliquot of an actual sample is spiked with a known amount of analyte so that a percent recovery value can be determined. This shows what effect the sample matrix may have on the target analyte, i.e. whether or not anything in the sample matrix interferes with the analysis of the analyte(s).
- The addition of ***MSD*** to the Sample ID represents a Matrix Spike Duplicate. Prepared in the same manner as an MS, the use of duplicate matrix spikes allows further confirmation of laboratory quality by showing the consistency of results gained by performing the same steps multiple times.
- The addition of ***LD*** to the Sample ID represents a Laboratory Duplicate. The analyst prepares an additional aliquot of sample for testing and the results of the duplicate analysis are compared to the initial result. The result should have a difference value of within 10% of the initial result (if the results of the original analysis are greater than the LOQ).
- The addition of ***AD*** to the Sample ID represents an Alternate Dilution. The analyst prepares an additional aliquot at a different dilution factor (usually double the initial factor). This analysis helps confirm that no additional compound is present and coeluting or sharing absorbance with the analyte of interest, as they would have a different response/absorbance than the analyte of interest.
- 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 extra spikes are prepared. The extras (randomly chosen) 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.

General Reporting Notes

(continued)

- **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. 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.

APPENDIX D

EQUIPMENT CALIBRATION RECORDS

Dry Gas Meter 5-Point Full Test

Meter Box ID	**M2**
Gas Meter Number	**343389**
Calibrated By	**J. Pennington**

Calibration Date	**7/8/2010**
Barometric Pressure	**29.4**
Orifice Set Calibration Date	**2/10/2010**

	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2
Orifice ID	MS-40		BU-48		BU-55		BU-63		BU-73	
Orifice Coefficient K'	0.2371		0.3426		0.4524		0.5853		0.7999	
Ambient Temperature	73	73	73	73	73	73	73	73	73	73
	Meter Readings									
Vacuum (≥14.0" Hg)	24.5	24.5	23	23	21.5	21.5	19	19	17.5	17.5
Delta H	0.28	0.28	0.63	0.63	1.20	1.20	2.00	2.00	3.75	3.75
Initial Volume Ft^3	105.200	110.500	93.300	99.700	117.100	149.400	131.700	141.600	78.200	86.500
Final Volume Ft^3	110.400	116.700	99.500	104.900	123.200	161.200	140.800	148.700	86.100	92.400
Total (≥5 Ft^3)	5.2	6.2	6.2	5.2	6.1	11.8	9.1	7.1	7.9	5.9
Initial DGM Temperature °F	72	73	73	73	73	73	73	73	72	73
Final DGM Temperature °F	73	73	73	72	73	73	73	73	73	73
Average Temperature °F	72.5	73.0	73.0	72.5	73.0	73.0	73.0	73.0	72.5	73.0
Time Minutes	16	20	13	11	10	19	11	9	7	5
Time Seconds	52.25	7.06	54.84	40.73	26.02	53.93	57.45	20.48	34.53	39.95
Delta H@	1.686	1.684	1.818	1.820	1.991	1.991	1.991	1.991	2.018	2.016
Gamma (Y)	1.0051	1.0062	1.0047	1.0045	1.0097	0.9955	1.0016	1.0028	0.9936	0.9960
Average Gamma (Y)	**Pass**	**1.0057**	**Pass**	**1.0046**	**Pass**	**1.0026**	**Pass**	**1.0022**	**Pass**	**0.9948**
Delta H@ tolerance	**Fail**		**Pass**		**Pass**		**Pass**		**Pass**	

Gamma (Y)	**1.0020**
Delta H@	**1.901**

TRC

QA / QC Check: Sign and Date 07-09-10

Dry Gas Meter Temperature Display Calibration

Meter Box ID	M2
Date	7/8/2010
Calibrated By	J. Pennington

Reference Calibrator	Omega-CL23A
Serial Number	T-235647
Reference Calibration Date	8/13/2009

Input Temperature		Temperature Reading from Individual Thermocouple Input[1]									
		Channel Number									
Deg. F	Deg. R	1	% Diff	2	% Diff	3	% Diff	4	% Diff	5	% Diff
0	460	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
50	510	49	0.2%	48	0.4%	48	0.4%	48	0.4%	48	0.4%
100	560	97	0.5%	97	0.5%	98	0.4%	98	0.4%	98	0.4%
500	960	498	0.2%	497	0.3%	498	0.2%	498	0.2%	497	0.3%
900	1360	900	0.0%	900	0.0%	900	0.0%	900	0.0%	901	-0.1%
1900	2360	1900	0.0%	1900	0.0%	1900	0.0%	1900	0.0%	1900	0.0%
		Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass

[1] - Channel temperatures must agree with +/- 5 °F or 3 °C

[2] - Acceptable temperature difference is less than 1.5 %

Dry Gas Meter Thermocouple Calibration[3]

Readout Display Temperature oF	Reference Thermometer °F	Percent Difference
71	73	-0.4%

Pass

[3] - Dry gas meter thermicouple is compared to an ASTM type mercury in glass reference thermometer

TRC

QA / QC Check: Sign and Date 07-09-10

Dry Gas Meter 5-Point Full Test

Meter Box ID	**M12**
Gas Meter Number	**9543632**
Calibrated By	**J. Pennington**

Calibration Date	**4/6/2010**
Barometric Pressure	**29.42**
Orifice Set Calibration Date	**2/10/2010**

	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2
Orifice ID	MS-40		BU-48		BU-55		BU-63		BU-73	
Orifice Coefficient K'	0.2371		0.3426		0.4524		0.5853		0.7999	
Ambient Temperature	75	75	76	76	75	75	75	75	75	75
	Meter Readings									
Vacuum (≥14.0" Hg)	23	23	22	22	19	19	19.5	19.5	16.5	16.5
Delta H	0.30	0.30	0.65	0.65	1.20	1.20	2.00	2.00	3.80	3.80
Initial Volume Ft^3	180.800	186.600	204.500	209.700	157.900	163.400	192.200	197.500	169.600	175.100
Final Volume Ft^3	186.400	191.700	209.600	214.800	163.100	169.200	197.300	204.100	174.700	180.200
Total (≥5 Ft^3)	5.6	5.1	5.1	5.1	5.2	5.8	5.1	6.6	5.1	5.1
Initial DGM Temperature °F	76	75	74	74	79	79	74	74	76	76
Final DGM Temperature °F	75	74	74	74	78	76	74	74	76	76
Average Temperature °F	75.5	74.5	74.0	74.0	78.5	77.5	74.0	74.0	76.0	76.0
Time Minutes	18	16	11	11	8	9	6	8	4	4
Time Seconds	4.11	28.56	25.57	26.17	43.50	45.02	41.84	39.57	52.43	52.19
Delta H@	1.802	1.805	1.882	1.882	1.977	1.981	1.993	1.993	2.038	2.038
Gamma (Y)	1.0033	1.0027	1.0020	1.0029	0.9988	0.9989	1.0009	1.0001	0.9948	0.9939
Average Gamma (Y)	Pass	1.0030	Pass	1.0025	Pass	0.9989	Pass	1.0005	Pass	0.9944
Delta H@ tolerance	Pass		Pass		Pass		Pass		Pass	

Gamma (Y)	**0.9998**
Delta H@	**1.939**

TRC

QA / QC Check: Sign and Date 04-09-10

Dry Gas Meter Temperature Display Calibration

Meter Box ID	M12
Date	4/6/2010
Calibrated By	J. Pennington

Reference Calibrator	Omega-CL23A
Serial Number	T-235647
Reference Calibration Date	8/13/2009

Input Temperature		Temperature Reading from Individual Thermocouple Input[1]									
		Channel Number									
Deg. F	Deg. R	1	% Diff	2	% Diff	3	% Diff	4	% Diff	5	% Diff
0	460	0	0.0%	0	0.0%	0	0.0%	-1	0.2%	0	0.0%
50	510	48	0.4%	48	0.4%	48	0.4%	46	0.8%	47	0.6%
100	560	97	0.5%	97	0.5%	97	0.5%	96	0.7%	96	0.7%
500	960	498	0.2%	498	0.2%	497	0.3%	496	0.4%	497	0.3%
900	1360	901	-0.1%	902	-0.1%	901	-0.1%	900	0.0%	900	0.0%
1900	2360	1902	-0.1%	1902	-0.1%	1901	0.0%	1900	0.0%	1901	0.0%
		Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass

[1] - Channel temperatures must agree with +/- 5 °F or 3 °C

[2] - Acceptable temperature difference is less than 1.5 %

Dry Gas Meter Thermocouple Calibration[3]

Readout Display Temperature oF	Reference Thermometer °F	Percent Difference
72	75	-0.6%

Pass

[3] - Dry gas meter thermicouple is compared to an ASTM type mercury in glass reference thermometer

TRC

QA / QC Check: Sign and Date 04-09-10

Dry Gas Meter 5-Point Full Test

Meter Box ID	**M14**
Gas Meter Number	**8804086**
Calibrated By	**J. Pennington**

Calibration Date	**4/7/2010**
Barometric Pressure	**29.40**
Orifice Set Calibration Date	**2/10/2010**

	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2
Orifice ID	MS-40		BU-48		BU-55		BU-63		BU-73	
Orifice Coefficient K'	0.2371		0.3426		0.4524		0.5853		0.7999	
Ambient Temperature	73	73	74	74	74	74	73	73	75	75
	Meter Readings									
Vacuum (≥14.0" Hg)	24.5	24.5	23	23	21.5	21.5	20	20	16.5	16.5
Delta H	0.27	0.27	0.58	0.58	1.10	1.10	1.80	1.80	3.70	3.70
Initial Volume Ft^3	578.800	584.000	589.300	594.500	600.300	608.700	568.100	573.400	620.500	626.600
Final Volume Ft^3	583.900	589.100	594.400	600.000	605.400	615.800	573.200	578.500	626.200	631.700
Total (≥5 Ft^3)	5.1	5.1	5.1	5.5	5.1	7.1	5.1	5.1	5.7	5.1
Initial DGM Temperature °F	72	73	73	74	74	74	71	72	75	76
Final DGM Temperature °F	73	73	74	74	74	75	72	72	76	76
Average Temperature °F	72.5	73.0	73.5	74.0	74.0	74.5	71.5	72.0	75.5	76.0
Time Minutes	16	16	11	12	8	11	6	6	5	4
Time Seconds	29.97	25.88	23.16	16.50	36.84	59.53	39.63	39.69	24.31	50.80
Delta H@	1.625	1.624	1.675	1.673	1.825	1.823	1.795	1.793	1.987	1.985
Gamma (Y)	1.0023	0.9991	0.9996	1.0002	0.9982	0.9992	0.9931	0.9942	0.9864	0.9895
Average Gamma (Y)	Pass	1.0007	Pass	0.9999	Pass	0.9987	Pass	0.9937	Pass	0.9879
Delta H@ tolerance	Pass		Pass		Pass		Pass		Fail	

Gamma (Y)	**0.9962**
Delta H@	**1.780**

TRC

QA / QC Check: Sign and Date 04-09-10

Dry Gas Meter Temperature Display Calibration

Meter Box ID	M14
Date	4/7/2010
Calibrated By	J. Pennington

Reference Calibrator	Omega-CL23A
Serial Number	T-235647
Reference Calibration Date	8/13/2009

Input Temperature		Temperature Reading from Individual Thermocouple Input[1]									
		Channel Number									
Deg. F	Deg. R	1	% Diff	2	% Diff	3	% Diff	4	% Diff	5	% Diff
0	460	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
50	510	48	0.4%	48	0.4%	48	0.4%	48	0.4%	48	0.4%
100	560	98	0.4%	98	0.4%	98	0.4%	98	0.4%	98	0.4%
500	960	497	0.3%	497	0.3%	497	0.3%	497	0.3%	497	0.3%
900	1360	900	0.0%	900	0.0%	900	0.0%	900	0.0%	900	0.0%
1900	2360	1900	0.0%	1899	0.0%	1900	0.0%	1900	0.0%	1900	0.0%
		Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass

[1] - Channel temperatures must agree with +/- 5 °F or 3 °C

[2] - Acceptable temperature difference is less than 1.5 %

Dry Gas Meter Thermocouple Calibration[3]

Readout Display Temperature oF	Reference Thermometer °F	Percent Difference	
71	73	-0.4%	Pass

[3] - Dry gas meter thermicouple is compared to an ASTM type mercury in glass reference thermometer

TRC

QA / QC Check: Sign and Date 04-09-10

Dry Gas Meter 5-Point Full Test

Meter Box ID	**M16**
Gas Meter Number	**14435277**
Calibrated By	**M. Brooks**

Calibration Date	**4/14/2010**
Barometric Pressure	**29.97**
Orifice Set Calibration Date	**2/10/2010**

	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2
Orifice ID	MS-40		BU-48		BU-55		BU-63		BU-73	
Orifice Coefficient K'	0.2371		0.3426		0.4524		0.5853		0.7999	
Ambient Temperature	70.8	71.2	71.6	71.6	71.4	71.6	70.7	70.7	70.5	70.7
	Meter Readings									
Vacuum (≥14.0" Hg)	24	24	23	23	21.5	21.5	20	20	18	18
Delta H	0.31	0.31	0.64	0.64	1.20	1.20	2.10	2.10	3.90	3.90
Initial Volume Ft^3	549.800	554.950	571.300	576.450	560.450	565.650	539.000	544.049	527.200	532.401
Final Volume Ft^3	554.950	560.002	576.450	581.650	565.650	570.901	544.049	549.103	532.401	537.455
Total (≥5 Ft^3)	5.15	5.052	5.15	5.2	5.2	5.251	5.049	5.054	5.201	5.054
Initial DGM Temperature °F	70	70	71	71	70	71	69	69	68	69
Final DGM Temperature °F	70	70	71	71	70	71	69	70	68	69
Average Temperature °F	70.0	70.0	71.0	71.0	70.0	71.0	69.0	69.5	68.0	69.0
Time Minutes	16	16	11	11	8	8	6	6	4	4
Time Seconds	43.31	21.93	33.33	39.95	49.40	54.39	38.03	36.11	58.06	49.89
Delta H@	1.832	1.833	1.814	1.814	1.959	1.956	2.058	2.056	2.067	2.064
Gamma (Y)	1.0032	1.0005	1.0021	1.0019	0.9976	0.9989	0.9960	0.9911	0.9835	0.9860
Average Gamma (Y)	Pass	1.0019	Pass	1.0020	Pass	0.9982	Pass	0.9935	Pass	0.9847
Delta H@ tolerance	Pass		Pass		Pass		Pass		Pass	

Gamma (Y)	**0.9961**
Delta H@	**1.945**

TRC

QA / QC Check: Sign and Date 04-14-10

Dry Gas Meter Temperature Display Calibration

Meter Box ID	M16
Date	4/14/2010
Calibrated By	M. Brooks

Reference Calibrator	Omega-CL23A
Serial Number	T-235647
Reference Calibration Date	8/13/2009

Input Temperature		Temperature Reading from Individual Thermocouple Input[1]									
		Channel Number									
Deg. F	Deg. R	1	% Diff	2	% Diff	3	% Diff	4	% Diff	5	% Diff
0	460	0	0.0%	0	0.0%	0	0.0%	1	-0.2%	0	0.0%
50	510	48	0.4%	48	0.4%	48	0.4%	48	0.4%	48	0.4%
100	560	98	0.4%	98	0.4%	98	0.4%	97	0.5%	97	0.5%
500	960	498	0.2%	498	0.2%	498	0.2%	498	0.2%	498	0.2%
900	1360	902	-0.1%	902	-0.1%	902	-0.1%	901	-0.1%	901	-0.1%
1900	2360	1900	0.0%	1900	0.0%	1900	0.0%	1900	0.0%	1900	0.0%
		Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass

[1] - Channel temperatures must agree with +/- 5 °F or 3 °C

[2] - Acceptable temperature difference is less than 1.5 %

Dry Gas Meter Thermocouple Calibration[3]

Readout Display Temperature oF	Reference Thermometer °F	Percent Difference	
71	74	-0.6%	Pass

[3] - Dry gas meter thermicouple is compared to an ASTM type mercury in glass reference thermometer

TRC

QA / QC Check: Sign and Date 04-14-10

APPENDIX TABLE

Alternative Method 5 Post-Test Calibration
EPA Approved Alternative Method (ALT-009)
ConocoPhillips
Linden, New Jersey
D-602 Scrubber Stack

Meter Box #: M-12

Calibrated by: JP
5-Pt Cal Date: 4/6/10

Delta H @ 1.939
Gamma, initial 0.9998

1) Does the Meter Box pass the leak check procedure defined in 5.6 of Method 5? ✓ Yes ___ No

2) Calculate Yqa for each test run using the following equation:

$$Y_{qa} = \frac{\theta}{V_m}\sqrt{\frac{0.0319\,T_m \quad 29}{\Delta H_@\left(P_b + \Delta\frac{H_{avg}}{13.6}\right) M_d}}\,\left(\sqrt{\Delta H}\right)_{avg}$$

where:

Yqa	dry gas meter calibration check value, dimensionless.
q	total run time, min.
Vm	total sample volume measured by dry gas meter, dcf.
Tm	absolute average dry gas meter temp., °R.
Pb	barometric pressure, in. Hg.
0.0319	= (29.92/528)(0.75)2 (in. Hg/°/R) cfm2.
DHavg	average orifice meter differential, in. H20.
DH@	orifice meter calibration coefficient, in. H2O.
Md	dry molecular weight of stack gas, lb/lb-mole.
29	dry molecular weight of air, lb/lb-mole.
13.6	specific gravity of mercury.

After each test run series, do the following:

Average the three or more Yqa's obtained from the test run series and compare this average with the dry gas meter calibration factor, Y. The average Yqa must be within 5 percent of Y.

If the average Yqa does not meet the +5 percent criterion, recalibrate the meter over the full range of orifice settings, as detailed in Section 5.3.1 of Method 5. Then follow the procedure in Section 5.3.3 of Method 5.

	Test 1	Test 2	Test 3	Average
time	60	60	60	
Vm - total	38.219	37.269	37.767	
Tm avg	69.8	69.0	71.1	
Tm -R	530	529	531	
Barometric	29.94	29.94	29.94	
DH_{avg}	1.502	1.437	1.408	
DH@	1.9390	1.9390	1.9390	
Md stack gas	30.54	30.55	30.58	
Md Air	29.00	29.00	29.00	
Meter Box Gamma	1.000	1.000	1.000	
QA Gamma	0.9699	0.9749	0.9523	
Difference:	3.0%	2.5%	4.8%	3.4%
within 5%?				PASS

APPENDIX TABLE

Alternative Method 5 Post-Test Calibration
EPA Approved Alternative Method (ALT-009)
ConocoPhillips
Linden, New Jersey
D-601 Scrubber Stack

Meter Box #: M-16

Calibrated by: MB
5-Pt Cal Date: 4-14-10

Delta H @ 1.945
Gamma, initial 0.9961

1) Does the Meter Box pass the leak check procedure defined in 5.6 of Method 5? ✓ Yes ___ No

2) Calculate Yqa for each test run using the following equation:

$$Y_{qa} = \frac{\theta}{V_m}\sqrt{\frac{0.0319\,T_m \quad 29}{\Delta H_@ (P_b + \Delta \frac{H_{avg}}{13.6})\,M_d}}\,(\sqrt{\Delta H})_{avg}$$

where:

Yqa	dry gas meter calibration check value, dimensionless.
q	total run time, min.
Vm	total sample volume measured by dry gas meter, dcf.
Tm	absolute average dry gas meter temp., °R.
Pb	barometric pressure, in. Hg.
0.0319	= (29.92/528)(0.75)2 (in. Hg/°/R) cfm2.
DHavg	average orifice meter differential, in. H20.
DH@	orifice meter calibration coefficient, in. H2O.
Md	dry molecular weight of stack gas, lb/lb-mole.
29	dry molecular weight of air, lb/lb-mole.
13.6	specific gravity of mercury.

After each test run series, do the following:

Average the three or more Yqa's obtained from the test run series and compare this average with the dry gas meter calibration factor, Y. The average Yqa must be within 5 percent of Y.

If the average Yqa does not meet the +5 percent criterion, recalibrate the meter over the full range of orifice settings, as detailed in Section 5.3.1 of Method 5. Then follow the procedure in Section 5.3.3 of Method 5.

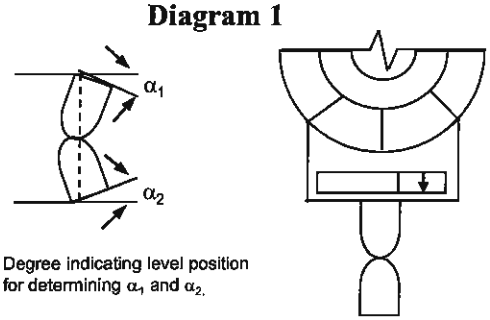
	Test 1	Test 2	Test 3	Average
time	60	60	60	
Vm - total	38.793	38.757	38.877	
Tm avg	73.8	74.7	76.6	
Tm -R	534	535	537	
Barometric	29.94	29.94	29.94	
DH_{avg}	1.469	1.443	1.441	
DH@	1.9450	1.9450	1.9450	
Md stack gas	30.66	30.59	30.66	
Md Air	29.00	29.00	29.00	
Meter Box Gamma	0.996	0.996	0.996	
QA Gamma	0.9798	0.9717	0.9702	
Difference:	1.6%	2.4%	2.6%	2.2%
within 5%?				PASS

Pitot Tube Inspection Sheet

Pitot Number:	RPT-15	Calibrated By:	M. Brooks
Inspection Date:	01/04/2010	Reviewed By:	

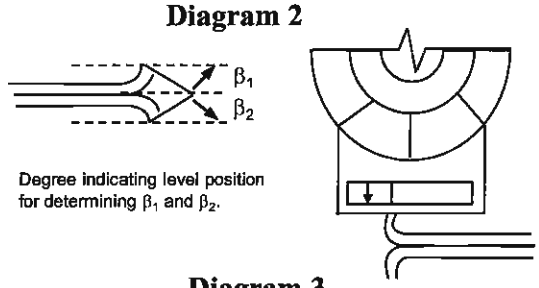
Pitot Type:	Detachable Tip	X	Fixed		PM10		
Wind Tunnel Calibration?	No	X	Yes		→ Coefficient:	A side	
						B side	

Diagram 1



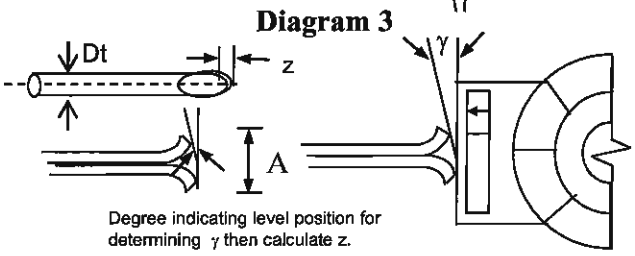
Degree indicating level position for determining α_1 and α_2.

Diagram 2

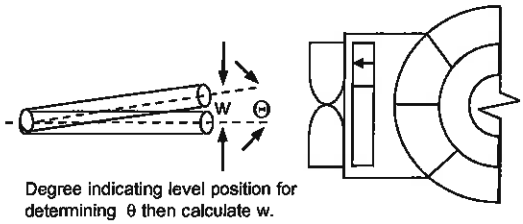


Degree indicating level position for determining β_1 and β_2.

Diagram 3



Degree indicating level position for determining γ then calculate z.



Degree indicating level position for determining θ then calculate w.

Level?	YES
Obstructions?	NO
Damaged?	NO
Diagram 1	
$-10^\circ < \alpha_1 < +10^\circ =$	1
$-10^\circ < \alpha_2 < +10^\circ =$	0
Diagram 2	
$-5^\circ < \beta_1 < +5^\circ =$	0
$-5^\circ < \beta_2 < +5^\circ =$	1
Diagram 3	
$\gamma =$	0
$\Theta =$	0
A =	0.925
$P_a = P_b = A/2 =$	0.463
$0.188" \leq D_t \leq 0.375" =$	0.375
$1.05\ D_t < A/2 < 1.5\ D_t =$	YES
$z = A \tan \gamma < 0.125" =$	0.0000
$w = A \tan \Theta < 0.03125" =$	0.0000
w and z meet specs?	YES

Comments: Installed on Probe RP-4H

TC: RT-4H

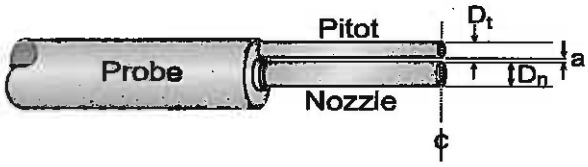
The pitot tube/probe meets or exceeds all specifications criteria and/or applicable design features and is hereby assigned a pitot tube coefficient factor of 0.84, unless a specific wind tunnel calibration coefficient has been determined.

40 CFR 60, Appendix A, Method 2. Verify the minimum 3/4 inch separation between the pitot tube and the nozzle and minimum 2 inch setback of the thermocouple (or 3/4" separation) in the assembled probe.

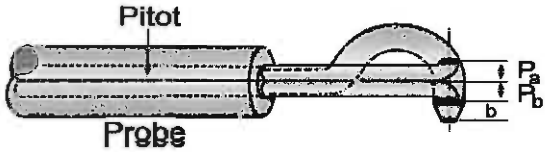
Pitot Tube Inspection Sheet
Probe Configuration

Pitot Number:	RPT-15	Calibrated By:	M. Brooks
Inspection Date:	01/04/2010	Reviewed By:	0

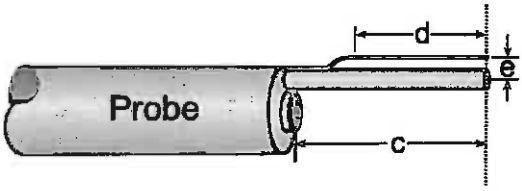
A.



B.

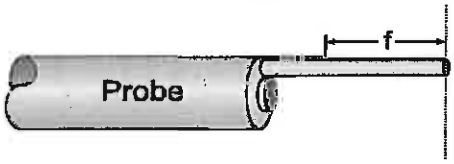


C.



OR

D.



D_t =	0.375
D_n =	0.500
a =	0.875
P_a =	0.463
P_b =	0.463
b =	0.500
c =	4.750
d =	10.750
e =	1.500
OR	
c =	
f =	

Specifications (EPA Method 2)

Dt = 3/16" to 3/8"	c ≥ 3"	Pa = Pb
Dn = 1/2"	d ≥ 3"	
a ≥ 3/4"	e ≥ 3/4"	1.05 Dt ≤ P ≤ 1.50 Dt
b ≥ 0	f ≥ 2"	

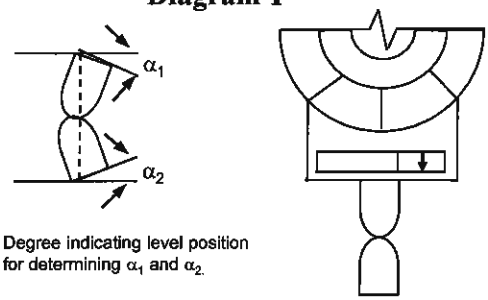
DOES PITOT CONFIGURATION MEET SPECIFICATIONS?	**YES**

Pitot Tube Inspection Sheet

Pitot Number:	RPT-50	Calibrated By:	M. Brooks
Inspection Date:	01/04/2010	Reviewed By:	

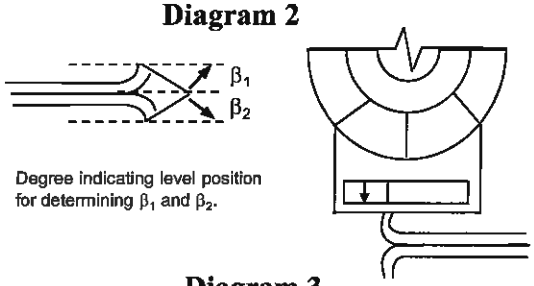
Pitot Type:	Detachable Tip	X	Fixed		PM10		
Wind Tunnel Calibration?	No	X	Yes		→	Coefficient:	A side
							B side

Diagram 1



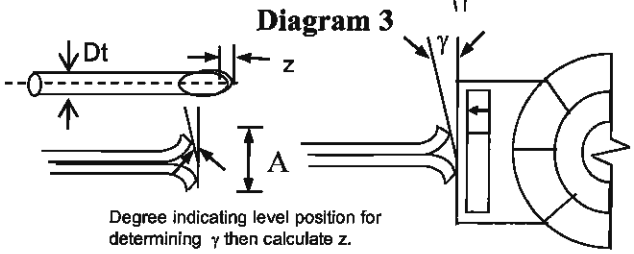
Degree indicating level position for determining α_1 and α_2.

Diagram 2

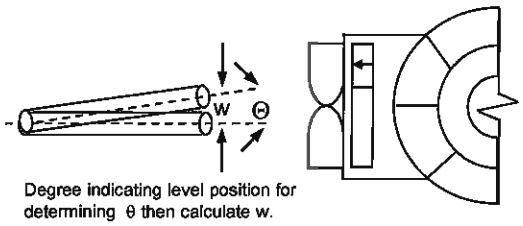


Degree indicating level position for determining β_1 and β_2.

Diagram 3



Degree indicating level position for determining γ then calculate z.



Degree indicating level position for determining θ then calculate w.

Level?	YES
Obstructions?	NO
Damaged?	NO
Diagram 1	
$-10^\circ < \alpha_1 < +10^\circ =$	0
$-10^\circ < \alpha_2 < +10^\circ =$	1
Diagram 2	
$-5^\circ < \beta_1 < +5^\circ =$	0
$-5^\circ < \beta_2 < +5^\circ =$	0
Diagram 3	
$\gamma =$	1
$\Theta =$	1
$A =$	0.932
$P_a = P_b = A/2 =$	0.466
$0.188" \leq D_t \leq 0.375" =$	0.375
$1.05\ D_t < A/2 < 1.5\ D_t =$	YES
$z = A \tan \gamma < 0.125" =$	0.0163
$w = A \tan \Theta < 0.03125" =$	0.0163
w and z meet specs?	YES

Comments: Installed on Probe RP-4D

TC: RT_4D

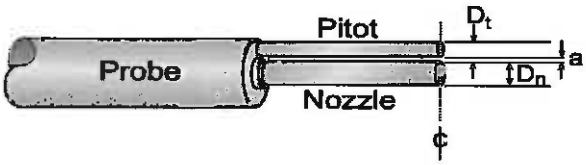
The pitot tube/probe meets or exceeds all specifications criteria and/or applicable design features and is hereby assigned a pitot tube coefficient factor of 0.84, unless a specific wind tunnel calibration coefficient has been determined.

40 CFR 60, Appendix A, Method 2. Verify the minimum 3/4 inch separation between the pitot tube and the nozzle and minimum 2 inch setback of the thermocouple (or 3/4" separation) in the assembled probe.

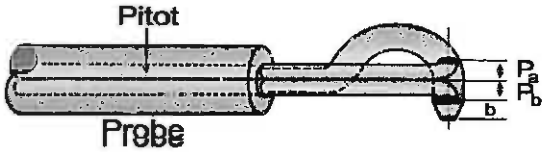
Pitot Tube Inspection Sheet
Probe Configuration

Pitot Number:	RPT-50	Calibrated By:	M. Brooks
Inspection Date:	01/04/2010	Reviewed By:	0

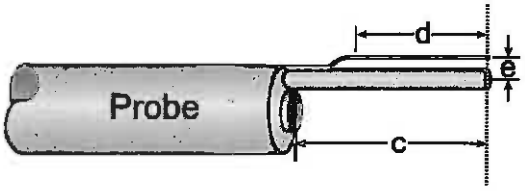
A.



B.

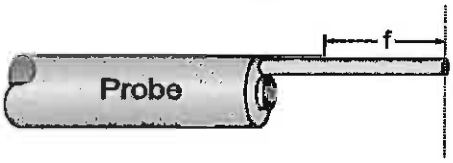


C.



OR

D.



D_t =	0.375
D_n =	0.500
a =	0.855
P_a =	0.466
P_b =	0.466
b =	0.275
c =	4.500
d =	4.750
e =	1.000
OR	
c =	
f =	

Specifications (EPA Method 2)

Dt = 3/16" to 3/8"	c $\geq$ 3"	Pa = Pb
Dn = 1/2"	d $\geq$ 3"	
a $\geq$ 3/4"	e $\geq$ 3/4"	1.05 Dt $\leq$ P $\leq$ 1.50 Dt
b $\geq$ 0	f $\geq$ 2"	

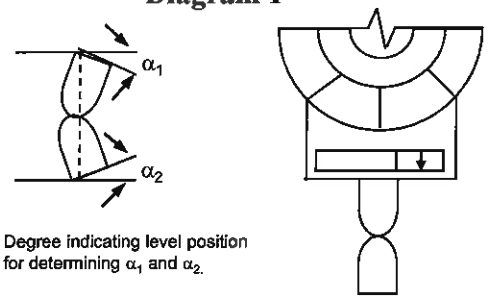
DOES PITOT CONFIGURATION MEET SPECIFICATIONS?	**YES**

Pitot Tube Inspection Sheet

Pitot Number:	RPT-53	Calibrated By:	M. Brooks
Inspection Date:	01/04/2010	Reviewed By:	

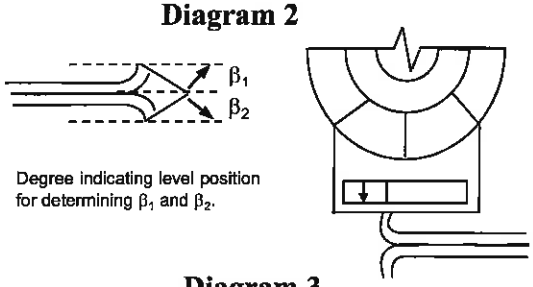
Pitot Type:	Detachable Tip	X	Fixed		PM10		
Wind Tunnel Calibration?	No	X	Yes		→ Coefficient:	A side	
						B side	

Diagram 1



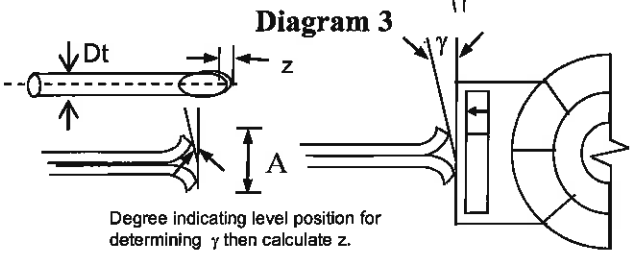
Degree indicating level position for determining α_1 and α_2.

Diagram 2

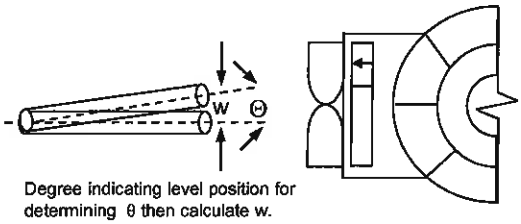


Degree indicating level position for determining β_1 and β_2.

Diagram 3



Degree indicating level position for determining γ then calculate z.



Degree indicating level position for determining θ then calculate w.

Level?	YES
Obstructions?	NO
Damaged?	NO
Diagram 1	
$-10^o < \alpha_1 < +10^o =$	1
$-10^o < \alpha_2 < +10^o =$	2
Diagram 2	
$-5^o < \beta_1 < +5^o =$	2
$-5^o < \beta_2 < +5^o =$	0
Diagram 3	
$\gamma =$	0
$\Theta =$	0
A =	0.956
$P_a = P_b = A/2 =$	0.478
$0.188" \leq D_t \leq 0.375" =$	0.375
$1.05\ D_t < A/2 < 1.5\ D_t =$	YES
$z = A \tan \gamma < 0.125" =$	0.0000
$w = A \tan \Theta < 0.03125" =$	0.0000
w and z meet specs?	YES

Comments: Installed on Probe RP-4G

TC: RT-4G

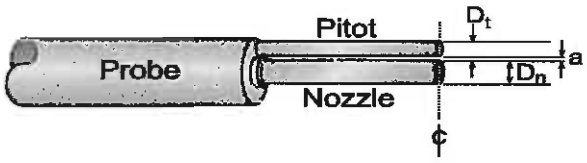
The pitot tube/probe meets or exceeds all specifications criteria and/or applicable design features and is hereby assigned a pitot tube coefficient factor of 0.84, unless a specific wind tunnel calibration coefficient has been determined.

40 CFR 60, Appendix A, Method 2. Verify the minimum 3/4 inch separation between the pitot tube and the nozzle and minimum 2 inch setback of the thermocouple (or 3/4" separation) in the assembled probe.

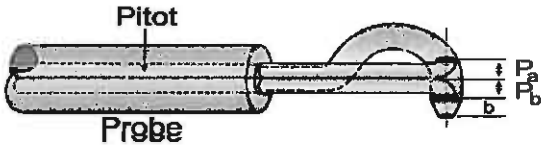
Pitot Tube Inspection Sheet
Probe Configuration

Pitot Number:	RPT-53	Calibrated By:	M. Brooks
Inspection Date:	01/04/2010	Reviewed By:	0

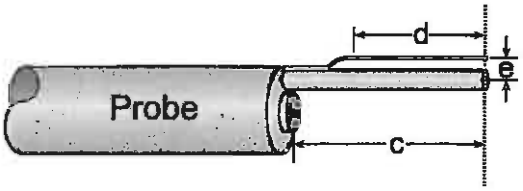
A.



B.

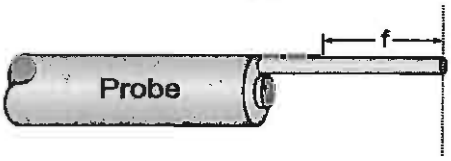


C.



OR

D.



D_t =	0.375
D_n =	0.500
a =	0.750
P_a =	0.478
P_b =	0.478
b =	0.875
c =	4.250
d =	4.750
e =	1.625
OR	
c =	
f =	

Specifications (EPA Method 2)

Dt = 3/16" to 3/8"	c ≥ 3"	Pa = Pb
Dn = 1/2"	d ≥ 3"	
a ≥ 3/4"	e ≥ 3/4"	1.05 Dt ≤ P ≤ 1.50 Dt
b ≥ 0	f ≥ 2"	

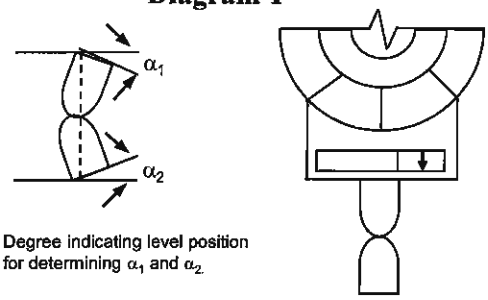
DOES PITOT CONFIGURATION MEET SPECIFICATIONS?	**YES**

Pitot Tube Inspection Sheet

Pitot Number:	RPT-101	Calibrated By:	M. Brooks
Inspection Date:	01/04/2010	Reviewed By:	

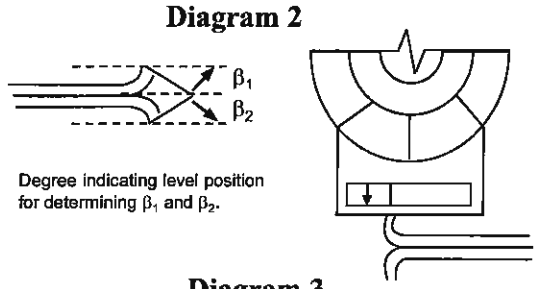
Pitot Type:	Detachable Tip	X	Fixed		PM10		
Wind Tunnel Calibration?	No	X	Yes		→	Coefficient: A side	
						B side	

Diagram 1



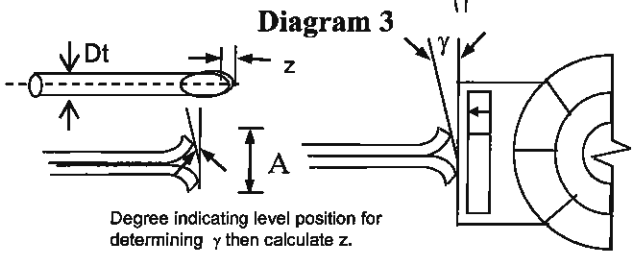
Degree indicating level position for determining α_1 and α_2.

Diagram 2

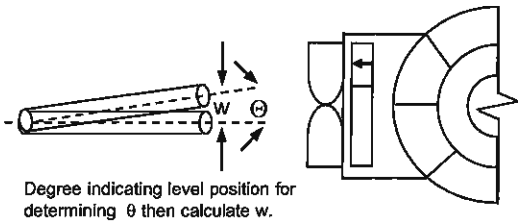


Degree indicating level position for determining β_1 and β_2.

Diagram 3



Degree indicating level position for determining γ then calculate z.



Degree indicating level position for determining θ then calculate w.

Level?	YES
Obstructions?	NO
Damaged?	NO
Diagram 1	
$-10^o < \alpha_1 < +10^o =$	0
$-10^o < \alpha_2 < +10^o =$	1
Diagram 2	
$-5^o < \beta_1 < +5^o =$	0
$-5^o < \beta_2 < +5^o =$	1
Diagram 3	
$\gamma =$	1
$\Theta =$	1
$A =$	1.065
$P_a = P_b = A/2 =$	0.533
$0.188" \leq D_t \leq 0.375" =$	0.375
$1.05\ D_t < A/2 < 1.5\ D_t =$	YES
$z = A \tan \gamma < 0.125" =$	0.0186
$w = A \tan \Theta < 0.03125" =$	0.0186
w and z meet specs?	YES

Comments: Installed on Probe RP-4A

TC: RT-4A

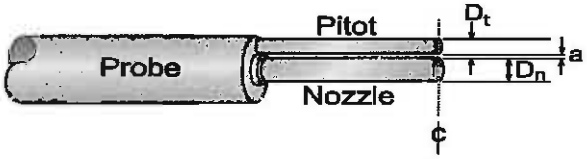
The pitot tube/probe meets or exceeds all specifications criteria and/or applicable design features and is hereby assigned a pitot tube coefficient factor of 0.84, unless a specific wind tunnel calibration coefficient has been determined.

40 CFR 60, Appendix A, Method 2. Verify the minimum 3/4 inch separation between the pitot tube and the nozzle and minimum 2 inch setback of the thermocouple (or 3/4" separation) in the assembled probe.

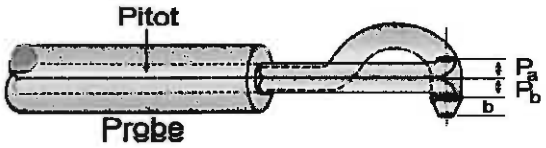
Pitot Tube Inspection Sheet
Probe Configuration

Pitot Number:	RPT-101	Calibrated By:	M. Brooks
Inspection Date:	01/04/2010	Reviewed By:	0

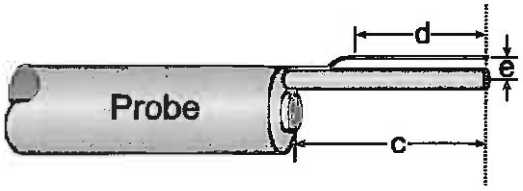
A.



B.

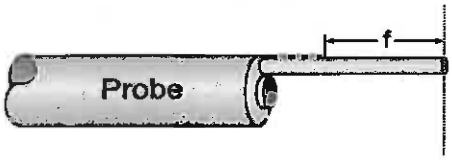


C.



OR

D.



D_t =	0.375
D_n =	0.500
a =	0.920
P_a =	0.535
P_b =	0.535
b =	1.125
c =	4.500
d =	4.500
e =	2.250
OR	
c =	
f =	

Specifications (EPA Method 2)

Dt = 3/16" to 3/8"	c ≥ 3"	Pa = Pb
Dn = 1/2"	d ≥ 3"	
a ≥ 3/4"	e ≥ 3/4"	1.05 Dt ≤ P ≤ 1.50 Dt
b ≥ 0	f ≥ 2"	

DOES PITOT CONFIGURATION MEET SPECIFICATIONS?	**YES**

THERMOCOUPLE CALIBRATION DATA FORM

TRC

THERMOCOUPLE ID: RT-4A **PITOT or PROBE ID:** RP-4A

3-POINT CALIBRATION							
Date	***Calibrated By***	***Source (specify)***	***Reference Temp, °F***	***Thermocouple Temp, °F***	***Percent Error (1)***	***Mantle Heat -250 F***	***Reviewed By***
04/02/03	J. Winslow	Ambient Air	78.2	77.6	-0.11	NA	C. Fink
		Ice Bath	34.5	34.8	0.06		
		Boiling Water	212.0	212.0	0.00		
07/21/05	J. Lowe	Ambient Air	85.0	85.0	0.00	NA	C. Fink
		Ice Bath	37.0	37.0	0.00		
		Boiling Water	211.0	212.0	0.15		

EPA APPROVED ALTERNATIVE METHOD (Alt - 011) SINGLE POINT CALIBRATION							
Date	***Calibrated By***	***Reference Temp, °F (2)***	***Thermocouple Temp, °F***	***Difference (3) (within ± 2°F)***	***Continuity Check (4)***	***Pass / Fail***	***Reviewed By***
06/05/03	D. Brewster	80	81	1	Good	Pass	C. Fink
12/04/03	J. Lowe	70	71	1	Good	Pass	C. Fink
01/13/05	J. Lowe	72	71	-1	Good	Pass	C. Fink
01/09/06	J. Lowe	73	73	0	Good	Pass	C. Fink
01/04/07	J. Kunstling	70	69	-1	Good	Pass	C. Fink
02/19/07	J. Kunstling	73	72	-1	Good	Pass	C. Fink
06/13/07	J.Kunstling	74	74	0	Good	Pass	C. Fink
01/22/08	J. Lowe	76	76	0	Good	Pass	C. Fink
06/04/08	J.Kunstling	76	75	-1	Good	Pass	C. Fink
10/02/08	M.Worthy	74	75	1	Good	Pass	C. Fink
10/31/08	J. Kunstling	75	75	0	Good	Pass	C. Fink
01/06/09	G. Byrd	77	76	-1	Good	Pass	C. Fink
02/09/09	J.Kunstling	74	73	-1	Good	Pass	C. Fink
09/24/10	J. Kunstling	75	74	-1	Good	Pass	C. Fink

1) % error = $\frac{(\text{Thermocouple Temperature} + 460) - (\text{Reference Temperature} + 460) \times 100}{\text{Reference Temperature} + 460}$, should be < 1.5%

2) Reference Thermometer is mercury-in-glass and ASTM certified, unless otherwise noted.

3) After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature. The temperatures of the thermocouple and reference thermometers shall agree within + 2°F

4) The continuity check involves subjecting the tip of the thermocouple to a change in temperature to check for crimps, loose connections, or reversed connections. Thermocouples with crimps and loose connections will not immediately respond to temperature changes, and those with reversed connections will show a temperature change in the opposite direction.

THERMOCOUPLE CALIBRATION DATA FORM

THERMOCOUPLE ID: RT-4D **PITOT or PROBE ID:** RP-4D

3-POINT CALIBRATION							
Date	*Calibrated By*	*Source (specify)*	*Reference Temp, °F*	*Thermocouple Temp, °F*	*Percent Error (1)*	*Mantle Heat -250 F*	*Reviewed By*
11/02/04	J. Lowe	Ambient Air	74.0	74.0	0.00	NA	C. Fink
		Ice Bath	34.0	34.0	0.00		
		Boiling Water	212.0	211.0	-0.15		

EPA APPROVED ALTERNATIVE METHOD (Alt - 011) SINGLE POINT CALIBRATION							
Date	*Calibrated By*	*Reference Temp, °F (2)*	*Thermocouple Temp, °F*	*Difference (3) (within ± 2°F)*	*Continuity Check (4)*	*Pass / Fail*	*Reviewed By*
01/13/05	J. Lowe	72	70	-2	Good	Pass	C. Fink
02/09/05	M. Riley	71	71	0	Good	Pass	C. Fink
05/24/05	J. Kunstling	74	74	0	Good	Pass	C. Fink
01/04/06	J. Kunstling	70	70	0	Good	Pass	J. Kunstling
01/09/06	J. Lowe	73	73	0	Good	Pass	C. Fink
01/04/07	J. Kunstling	70	70	0	Good	Pass	C. Fink
02/19/07	J. Kunstling	72	72	0	Good	Pass	C. Fink
03/15/07	M. Worthy	72	72	0	Good	Pass	C. Fink
06/13/07	J.Kunstling	74	74	0	Good	Pass	C. Fink
07/27/07	M. Worthy	73	73	0	Good	Pass	C. Fink
01/22/08	J. Lowe	76	76	0	Good	Pass	C. Fink
10/31/08	J.Kunstling	75	75	0	Good	Pass	C. Fink
01/06/09	G. Byrd	77	76	-1	Good	Pass	C. Fink
05/08/09	J. Kunstling	74	73	-1	Good	Pass	C. Fink
04/19/10	J. Evans	74	74	0	Good	Pass	C. Fink
09/24/10	J. Kunstling	75	75	0	Good	Pass	C. Fink

1) % error = $\frac{(\text{Thermocouple Temperature} + 460) - (\text{Reference Temperature} + 460) \times 100}{\text{Reference Temperature} + 460}$, should be < 1.5%

2) Reference Thermometer is mercury-in-glass and ASTM certified, unless otherwise noted.

3) After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature. The temperatures of the thermocouple and reference thermometers shall agree within + 2°F

4) The continuity check involves subjecting the tip of the thermocouple to a change in temperature to check for crimps, loose connections, or reversed connections. Thermocouples with crimps and loose connections will not immediately respond to temperature changes, and those with reversed connections will show a temperature change in the opposite direction.

THERMOCOUPLE CALIBRATION DATA FORM

THERMOCOUPLE ID: RT-4G **PITOT or PROBE ID:** RP-4G

3-POINT CALIBRATION							
Date	*Calibrated By*	*Source (specify)*	*Reference Temp, °F*	*Thermocouple Temp, °F*	*Percent Error (1)*	*Mantle Heat -250 F*	*Reviewed By*
11/02/04	J. Lowe	Ambient Air	73.0	74.0	0.19	NA	C. Fink
		Ice Bath	35.0	35.0	0.00		
		Boiling Water	212.0	212.0	0.00		

EPA APPROVED ALTERNATIVE METHOD (Alt - 011) SINGLE POINT CALIBRATION							
Date	*Calibrated By*	*Reference Temp, °F (2)*	*Thermocouple Temp, °F*	*Difference (3) (within ± 2°F)*	*Continuity Check (4)*	*Pass / Fail*	*Reviewed By*
01/13/05	J. Lowe	72	71	-1	Good	Pass	C. Fink
01/09/06	J. Lowe	73	73	0	Good	Pass	C. Fink
01/04/07	J. Kunstling	70	69	-1	Good	Pass	C. Fink
02/19/07	J. Kunstling	72	72	0	Good	Pass	C. Fink
06/13/07	J.Kunstling	74	75	1	Good	Pass	C. Fink
01/22/08	J. Lowe	79	79	0	Good	Pass	C. Fink
02/29/08	D. Brewster	77	77	0	Good	Pass	C. Fink
10/06/08	J. Winslow	72	72	0	Good	Pass	C. Fink
01/06/09	G. Byrd	76	76	0	Good	Pass	C. Fink
02/09/09	J. Kunstling	74	74	0	Good	Pass	C. Fink
05/08/09	J. Kunstling	74	73	-1	Good	Pass	C. Fink
07/02/09	D. Brewster	75	75	0	Good	Pass	C. Fink
09/24/10	J. Kunstling	75	75	0	Good	Pass	C. Fink

1) % error = $\frac{(\text{Thermocouple Temperature} + 460) - (\text{Reference Temperature} + 460) \times 100}{\text{Reference Temperature} + 460}$, should be < 1.5%

2) Reference Thermometer is mercury-in-glass and ASTM certified, unless otherwise noted.

3) After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature. The temperatures of the thermocouple and reference thermometers shall agree within + 2°F

4) The continuity check involves subjecting the tip of the thermocouple to a change in temperature to check for crimps, loose connections, or reversed connections. Thermocouples with crimps and loose connections will not immediately respond to temperature changes, and those with reversed connections will show a temperature change in the opposite direction.

THERMOCOUPLE CALIBRATION DATA FORM

TRC

THERMOCOUPLE ID: RT-4H **PITOT or PROBE ID:** RP-4H

3-POINT CALIBRATION							
Date	***Calibrated By***	***Source (specify)***	***Reference Temp, °F***	***Thermocouple Temp, °F***	***Percent Error (1)***	***Mantle Heat -250 F***	***Reviewed By***
04/24/03	J. Lowe	Ambient Air	79.4	76.8	-0.48	NA	C. Fink
		Ice Bath	34.7	35.4	0.14		
		Boiling Water	212.0	207.6	-0.65		

EPA APPROVED ALTERNATIVE METHOD (Alt - 011) SINGLE POINT CALIBRATION							
Date	***Calibrated By***	***Reference Temp, °F (2)***	***Thermocouple Temp, °F***	***Difference (3) (within ± 2°F)***	***Continuity Check (4)***	***Pass / Fail***	***Reviewed By***
12/04/03	J. Lowe	72	72	0	Good	Pass	C. Fink
01/13/05	J. Lowe	72	71	-1	Good	Pass	C. Fink
01/09/06	J. Lowe	73	73	0	Good	Pass	C. Fink
03/31/06	MP Riley	69	69	0	Good	Pass	C. Fink
07/27/06	D. Brewster	74	73	-1	Good	Pass	C. Fink
06/13/07	J.Kunstling	74	73	-1	Good	Pass	C. Fink
01/22/08	J. Lowe	76	76	0	Good	Pass	C. Fink
01/06/09	G. Byrd	76	75	-1	Good	Pass	C. Fink
03/10/09	D. Brewster	73	73	0	Good	Pass	C. Fink
11/12/09	J. Kunstling	74	74	0	Good	Pass	C. Fink
04/19/10	J. Evans	74	73	-1	Good	Pass	C. Fink
09/24/10	J. Kunstling	75	74	-1	Good	Pass	C. Fink

1) % error = $\frac{(\text{Thermocouple Temperature} + 460) - (\text{Reference Temperature} + 460) \times 100}{\text{Reference Temperature} + 460}$, should be < 1.5%

2) Reference Thermometer is mercury-in-glass and ASTM certified, unless otherwise noted.

3) After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature. The temperatures of the thermocouple and reference thermometers shall agree within + 2°F

4) The continuity check involves subjecting the tip of the thermocouple to a change in temperature to check for crimps, loose connections, or reversed connections. Thermocouples with crimps and loose connections will not immediately respond to temperature changes, and those with reversed connections will show a temperature change in the opposite direction.

TRC Raleigh, NC
Glass Nozzle Calibration

Size Designation	Nominal Diameter (Decimal In.)	Nominal Diameter (Fraction In.)	Nozzle Identification Number	Date Calibrated	Calibrated By	D1,inches	D2,inches	D3,inches	D, inches	Nozzle Diameter (average)
4	7/32	0.219	G-4-65	2/21/2008	CA	0.215	0.216	0.215	0.001	0.215
4	7/32	0.219	G-4-68	10/16/2008	JRL	0.214	0.216	0.215	0.002	0.215
4	7/32	0.219	G-4-99	1/29/2009	JE	0.214	0.214	0.214	0.000	0.214
4	7/32	0.219	G-4-118	6/4/2010	CA	0.215	0.215	0.215	0.000	0.215
4	7/32	0.219	G-4-131	5/7/2009	CA	0.217	0.217	0.217	0.000	0.217

APPENDIX E

PROCESS DATA

Start Time	9/16/2010 9:30		JF001.PV	HC090.PV	HC064.PV	MA005.PV	MA006.PV	MF008.PV	MP018.PV	DV-EPA-COKE
			FRESH FEED FLOW	FCBW TOTAL AIR	CATALYST CIRC. RATE	RECIR H2O PH	RECIR H2O PH	RECIRC NAOH	P-601 DISCHARGE PRESSURE	Intermediate epa-COKE calc.
End Time	9/16/2010 10:44	#NAME?								
		9/16/2010 9:30	132.3	275.5	80.4	6.7	6.6	11.6	212.8	110.9
		9/16/2010 9:31	132.3	275.6	80.6	6.7	6.5	11.7	212.8	111.1
		9/16/2010 9:32	132.3	275.5	80.8	6.7	6.5	11.7	212.9	111.1
		9/16/2010 9:33	132.3	275.2	80.6	6.7	6.6	11.7	213.0	110.7
		9/16/2010 9:34	132.1	275.0	80.5	6.7	6.6	11.7	212.9	110.8
		9/16/2010 9:35	132.0	274.8	80.4	6.7	6.6	11.7	212.8	110.7
		9/16/2010 9:36	132.3	275.4	80.5	6.7	6.6	11.8	212.8	110.7
		9/16/2010 9:37	132.1	274.5	80.5	6.7	6.6	12.1	212.9	110.5
		9/16/2010 9:38	132.0	274.6	80.5	6.7	6.6	12.3	212.8	110.6
		9/16/2010 9:39	132.4	273.9	80.3	6.7	6.6	12.8	212.7	110.4
		9/16/2010 9:40	132.5	273.5	80.3	6.7	6.6	13.2	212.7	110.3
		9/16/2010 9:41	132.5	273.7	79.8	6.7	6.6	13.9	212.8	110.2
		9/16/2010 9:42	132.3	273.6	80.0	6.7	6.6	14.4	212.8	110.2
		9/16/2010 9:43	132.2	273.0	80.0	6.7	6.6	14.7	212.9	109.9
		9/16/2010 9:44	132.2	274.2	79.9	6.7	6.6	14.7	212.7	110.3
		9/16/2010 9:45	132.1	274.2	80.2	6.7	6.6	14.8	212.5	110.3
		9/16/2010 9:46	132.2	273.8	80.4	6.7	6.6	14.9	212.5	110.3
		9/16/2010 9:47	132.2	273.8	80.4	6.7	6.6	14.9	212.5	110.2
		9/16/2010 9:48	131.9	274.0	80.3	6.7	6.6	14.8	212.5	110.4
		9/16/2010 9:49	132.0	274.3	80.4	6.7	6.6	14.4	212.7	110.4
		9/16/2010 9:50	131.9	273.8	80.7	6.7	6.6	14.1	212.7	110.3
		9/16/2010 9:51	131.9	274.1	80.6	6.7	6.6	13.9	212.7	110.3
		9/16/2010 9:52	131.8	273.8	80.7	6.7	6.6	13.8	212.6	110.2
		9/16/2010 9:53	131.7	274.0	80.9	6.7	6.6	13.8	212.7	110.5
		9/16/2010 9:54	131.7	274.2	80.8	6.7	6.6	13.7	212.9	110.6
		9/16/2010 9:55	131.9	274.3	80.9	6.7	6.6	13.7	213.0	110.4
		9/16/2010 9:56	131.9	274.4	80.8	6.7	6.6	13.7	213.0	110.4
		9/16/2010 9:57	131.8	274.1	80.9	6.7	6.6	13.3	212.9	110.2
		9/16/2010 9:58	131.8	273.8	80.5	6.7	6.6	12.9	212.9	110.0
		9/16/2010 9:59	131.7	273.8	80.7	6.7	6.6	12.7	212.9	110.0
		9/16/2010 10:00	131.8	273.8	80.8	6.7	6.6	12.6	212.9	110.1
		9/16/2010 10:01	131.9	274.1	80.6	6.7	6.6	12.6	212.9	110.2
		9/16/2010 10:02	131.9	273.9	80.5	6.7	6.6	12.6	212.8	110.1
		9/16/2010 10:03	131.6	273.6	80.4	6.7	6.6	12.5	212.7	110.0
		9/16/2010 10:04	131.5	273.3	80.5	6.7	6.6	12.5	212.6	109.9
		9/16/2010 10:05	131.5	273.8	80.6	6.7	6.6	12.2	212.7	109.9
		9/16/2010 10:06	131.4	273.7	81.1	6.7	6.6	11.9	212.8	110.0
		9/16/2010 10:07	131.5	273.4	81.1	6.7	6.6	11.7	212.8	109.8
		9/16/2010 10:08	131.6	273.5	80.8	6.7	6.6	11.7	212.8	109.7
		9/16/2010 10:09	131.3	273.1	80.8	6.7	6.6	11.6	212.9	109.8
		9/16/2010 10:10	131.4	273.0	80.7	6.7	6.6	11.6	212.8	109.6
		9/16/2010 10:11	131.3	273.2	80.6	6.7	6.6	11.6	212.7	109.7
		9/16/2010 10:12	131.1	273.1	80.8	6.7	6.6	11.5	212.5	109.9
		9/16/2010 10:13	131.0	274.0	81.2	6.7	6.6	11.3	212.5	110.3
		9/16/2010 10:14	131.1	274.0	81.2	6.7	6.6	11.0	212.7	110.2
		9/16/2010 10:15	131.0	274.1	81.3	6.7	6.6	10.8	212.7	110.0
		9/16/2010 10:16	131.0	273.8	81.4	6.7	6.6	10.8	212.7	110.0
		9/16/2010 10:17	130.6	274.1	81.3	6.7	6.6	10.7	212.8	110.0
		9/16/2010 10:18	130.6	274.3	81.6	6.7	6.6	10.7	212.8	110.3
		9/16/2010 10:19	130.3	274.5	81.7	6.7	6.6	10.7	212.8	110.3
		9/16/2010 10:20	130.3	274.6	81.7	6.7	6.6	10.6	212.7	110.3
		9/16/2010 10:21	130.2	274.4	81.5	6.7	6.6	10.6	212.6	110.3
		9/16/2010 10:22	130.4	274.3	81.5	6.7	6.6	10.6	212.7	110.1
		9/16/2010 10:23	130.6	274.2	81.4	6.7	6.6	10.6	212.7	110.0
		9/16/2010 10:24	130.7	274.2	81.5	6.7	6.6	10.6	212.6	109.9
		9/16/2010 10:25	130.4	274.1	81.4	6.7	6.6	10.7	212.5	109.9
		9/16/2010 10:26	130.6	274.2	81.3	6.7	6.6	10.7	212.6	110.0
		9/16/2010 10:27	130.8	274.4	81.2	6.7	6.6	10.7	212.7	110.1
		9/16/2010 10:28	130.6	274.3	81.4	6.7	6.6	10.6	212.7	109.9
		9/16/2010 10:29	130.7	274.6	81.3	6.7	6.6	10.8	212.7	109.9
		9/16/2010 10:30	130.7	274.5	81.5	6.7	6.6	10.9	212.7	109.8
		9/16/2010 10:31	130.6	274.2	81.1	6.7	6.6	11.1	212.6	109.6
		9/16/2010 10:32	131.0	274.0	81.2	6.7	6.6	11.2	212.6	109.7
		9/16/2010 10:33	130.9	274.1	81.1	6.7	6.6	11.4	212.6	109.6
		9/16/2010 10:34	130.5	274.0	80.9	6.7	6.6	11.4	212.7	109.6
		9/16/2010 10:35	130.4	274.0	80.8	6.7	6.6	11.4	212.8	109.7
		9/16/2010 10:36	130.4	274.1	80.9	6.7	6.6	11.5	212.9	109.7
		9/16/2010 10:37	130.7	273.9	80.7	6.7	6.6	11.3	212.8	109.6
		9/16/2010 10:38	130.8	273.7	80.9	6.7	6.6	11.1	212.8	109.4
		9/16/2010 10:39	130.9	273.8	80.9	6.7	6.6	10.9	212.9	109.5
		9/16/2010 10:40	131.0	273.9	80.8	6.7	6.6	10.7	212.9	109.5
		9/16/2010 10:41	131.0	274.2	80.7	6.7	6.6	10.7	212.9	109.7
		9/16/2010 10:42	131.0	274.0	80.8	6.7	6.6	10.7	212.8	109.6
		9/16/2010 10:43	131.1	274.2	80.9	6.7	6.6	10.6	212.7	109.6
		9/16/2010 10:44	131.1	273.7	80.8	6.7	6.6	10.6	212.7	109.5
		avg								110.095

Start Time	9/16/2010 12:14		JF001.PV	HC090.PV	HC064.PV	MA005.PV	MA006.PV	MF008.PV	MP018.PV	DV-EPA-COKE
End Time	9/16/2010 13:26:00 PM	#NAME?	FRESH FEED FLOW	FCBW TOTAL AIR	CATALYST CIRC. RATE	RECIR H2O PH	RECIR H2O PH	RECIRC NAOH	P-601 DISCHARGE PRESSURE	Intermediate epa-COKE calc.
		9/16/2010 12:14	130.9	274.2	80.3	6.6	6.5	11.7	212.8	109.3
		9/16/2010 12:15	130.8	274.3	80.3	6.6	6.5	11.8	212.6	109.3
		9/16/2010 12:16	131.0	274.4	80.2	6.6	6.5	12.0	212.6	109.2
		9/16/2010 12:17	131.3	274.5	80.2	6.6	6.5	12.0	212.6	109.2
		9/16/2010 12:18	131.3	273.8	80.3	6.6	6.5	12.1	212.7	109.0
		9/16/2010 12:19	131.1	273.4	80.1	6.6	6.5	12.1	212.8	108.7
		9/16/2010 12:20	130.9	273.5	80.1	6.6	6.5	12.1	212.9	108.9
		9/16/2010 12:21	130.8	273.7	80.0	6.6	6.5	12.1	212.8	108.9
		9/16/2010 12:22	130.8	273.4	80.0	6.6	6.5	12.1	212.8	108.8
		9/16/2010 12:23	130.7	273.2	80.2	6.6	6.5	12.1	212.7	108.8
		9/16/2010 12:24	130.6	273.2	80.3	6.6	6.5	12.1	212.7	108.8
		9/16/2010 12:25	130.5	273.2	80.1	6.6	6.5	12.1	212.7	108.8
		9/16/2010 12:26	130.5	273.1	80.3	6.6	6.5	12.1	212.7	108.8
		9/16/2010 12:27	130.6	273.5	80.2	6.6	6.5	12.1	212.7	108.9
		9/16/2010 12:28	130.6	272.8	80.4	6.6	6.5	12.1	212.7	108.9
		9/16/2010 12:29	130.7	273.3	80.3	6.6	6.5	12.4	212.7	108.9
		9/16/2010 12:30	130.9	273.2	80.4	6.6	6.5	12.7	212.8	109.0
		9/16/2010 12:31	131.0	273.0	80.3	6.6	6.5	12.8	212.7	108.9
		9/16/2010 12:32	131.3	272.9	80.2	6.6	6.5	13.0	212.7	108.8
		9/16/2010 12:33	130.8	273.1	80.4	6.7	6.5	13.0	212.7	108.7
		9/16/2010 12:34	130.6	272.6	80.4	6.7	6.5	13.1	212.7	108.7
		9/16/2010 12:35	130.6	272.8	80.4	6.7	6.5	13.1	212.6	108.9
		9/16/2010 12:36	130.5	273.3	80.6	6.7	6.6	13.0	212.6	109.0
		9/16/2010 12:37	130.6	272.7	80.7	6.7	6.5	12.8	212.5	108.9
		9/16/2010 12:38	130.5	273.1	80.5	6.7	6.6	12.5	212.5	108.8
		9/16/2010 12:39	130.3	272.8	80.7	6.7	6.6	12.2	212.5	108.7
		9/16/2010 12:40	130.4	272.5	80.7	6.7	6.6	12.2	212.5	108.7
		9/16/2010 12:41	130.2	272.5	80.7	6.7	6.6	12.1	212.5	108.6
		9/16/2010 12:42	130.2	272.5	80.7	6.7	6.6	12.1	212.6	108.8
		9/16/2010 12:43	130.2	272.3	80.4	6.7	6.6	12.0	212.6	108.6
		9/16/2010 12:44	130.2	272.4	80.6	6.7	6.6	12.0	212.6	108.8
		9/16/2010 12:45	130.2	272.5	80.7	6.7	6.6	11.7	212.8	108.7
		9/16/2010 12:46	130.3	272.7	80.6	6.7	6.6	11.5	212.8	108.9
		9/16/2010 12:47	129.9	272.6	80.8	6.7	6.6	11.3	212.6	108.9
		9/16/2010 12:48	129.7	272.4	81.1	6.7	6.6	11.2	212.6	108.8
		9/16/2010 12:49	129.8	272.8	81.1	6.7	6.6	11.1	212.6	109.0
		9/16/2010 12:50	129.9	273.3	81.1	6.7	6.6	11.1	212.6	109.1
		9/16/2010 12:51	129.8	273.2	81.2	6.7	6.6	11.0	212.7	109.1
		9/16/2010 12:52	129.7	273.3	81.1	6.7	6.6	11.0	212.7	109.0
		9/16/2010 12:53	129.5	273.2	81.1	6.7	6.6	10.8	212.8	109.1
		9/16/2010 12:54	129.6	273.4	80.9	6.7	6.6	10.6	212.7	109.1
		9/16/2010 12:55	129.6	273.5	81.3	6.7	6.6	10.4	212.7	109.1
		9/16/2010 12:56	129.5	273.8	81.3	6.7	6.6	10.3	212.9	109.2
		9/16/2010 12:57	129.4	274.1	81.4	6.7	6.6	10.2	212.8	109.2
		9/16/2010 12:58	129.3	273.8	81.1	6.7	6.5	10.1	212.8	109.1
		9/16/2010 12:59	129.3	273.4	81.3	6.7	6.5	10.1	212.9	108.9
		9/16/2010 13:00	129.2	273.7	81.1	6.7	6.5	10.2	212.8	109.0
		9/16/2010 13:01	129.3	273.4	81.3	6.7	6.5	9.9	212.7	109.0
		9/16/2010 13:02	129.3	273.5	81.0	6.7	6.5	9.7	212.7	109.0
		9/16/2010 13:03	129.1	273.7	81.1	6.6	6.5	9.5	212.8	108.9
		9/16/2010 13:04	129.2	273.9	81.1	6.6	6.5	9.4	212.8	109.1
		9/16/2010 13:05	129.0	273.8	81.1	6.6	6.5	9.4	212.8	109.1
		9/16/2010 13:06	129.0	273.5	80.9	6.6	6.5	9.5	212.8	108.8
		9/16/2010 13:07	129.3	273.6	80.9	6.6	6.5	9.8	212.7	108.8
		9/16/2010 13:08	128.9	273.6	80.8	6.6	6.5	10.1	212.7	108.8
		9/16/2010 13:09	128.7	274.1	81.0	6.6	6.5	10.4	212.6	108.8
		9/16/2010 13:10	128.7	273.9	80.9	6.6	6.5	10.6	212.6	108.7
		9/16/2010 13:11	129.1	274.0	80.7	6.6	6.5	10.7	212.7	108.6
		9/16/2010 13:12	129.3	274.1	80.6	6.6	6.5	11.0	212.8	108.6
		9/16/2010 13:13	129.3	274.0	80.7	6.6	6.5	11.4	212.8	108.7
		9/16/2010 13:14	129.3	274.3	80.6	6.6	6.5	11.8	212.8	108.8
		9/16/2010 13:15	129.2	274.2	80.4	6.6	6.5	12.3	212.8	108.5
		9/16/2010 13:16	129.1	273.7	80.3	6.7	6.5	12.5	212.8	108.4
		9/16/2010 13:17	129.0	273.0	80.3	6.6	6.5	12.5	212.7	108.1
		9/16/2010 13:18	128.9	272.7	79.9	6.7	6.5	12.6	212.6	108.0
		9/16/2010 13:19	128.8	272.8	80.0	6.7	6.5	12.8	212.5	108.0
		9/16/2010 13:20	129.3	272.9	80.0	6.7	6.5	12.9	212.6	108.0
		9/16/2010 13:21	129.5	272.2	79.8	6.7	6.5	12.9	212.6	107.7
		9/16/2010 13:22	129.6	272.2	79.9	6.7	6.5	12.5	212.8	107.7
		9/16/2010 13:23	129.7	272.2	79.9	6.7	6.5	12.1	212.9	107.8
		9/16/2010 13:24	129.7	272.2	80.0	6.7	6.5	12.0	212.7	107.9
		9/16/2010 13:25	129.8	271.5	79.7	6.7	6.5	11.9	212.6	107.8
		9/16/2010 13:26	129.7	272.0	79.9	6.7	6.5	11.8	212.7	107.9
		avg								108.753

Start Time	9/16/2010 14:15		JF001.PV	HC090.PV	HC064.PV	MA005.PV	MA006.PV	MF008.PV	MP018.PV	DV-EPA-COKE
			FRESH FEED FLOW	FCBW TOTAL AIR	CATALYST CIRC. RATE	RECIR H2O PH	RECIR H2O PH	RECIRC NAOH	P-601 DISCHARGE PRESSURE	Intermediate epa-COKE calc.
End Time	9/16/2010 15:28	#NAME?								
		9/16/2010 14:15	129.4	273.8	80.0	6.6	6.5	11.5	212.9	108.2
		9/16/2010 14:16	129.1	273.8	80.1	6.6	6.5	11.4	212.9	108.1
		9/16/2010 14:17	129.1	273.1	79.8	6.6	6.5	11.5	213.1	108.2
		9/16/2010 14:18	129.6	272.9	79.9	6.6	6.5	11.5	212.9	108.1
		9/16/2010 14:19	129.7	272.4	79.6	6.6	6.5	11.5	212.7	107.9
		9/16/2010 14:20	129.9	273.2	79.9	6.6	6.5	11.5	212.7	108.2
		9/16/2010 14:21	130.2	273.0	80.1	6.6	6.5	11.5	212.8	108.3
		9/16/2010 14:22	130.2	273.1	79.9	6.6	6.5	11.6	212.8	108.1
		9/16/2010 14:23	130.3	273.4	80.1	6.6	6.5	11.7	212.7	108.2
		9/16/2010 14:24	130.2	274.1	80.4	6.6	6.5	11.6	212.7	108.6
		9/16/2010 14:25	129.8	274.2	80.6	6.6	6.5	11.6	212.8	108.8
		9/16/2010 14:26	129.8	274.1	80.5	6.6	6.5	11.8	212.8	108.7
		9/16/2010 14:27	130.0	274.1	80.6	6.6	6.5	12.1	212.8	108.7
		9/16/2010 14:28	130.0	274.1	80.6	6.7	6.5	12.4	212.7	108.8
		9/16/2010 14:29	129.8	274.6	80.7	6.7	6.5	12.4	212.6	108.8
		9/16/2010 14:30	129.7	274.6	80.7	6.7	6.5	12.9	212.6	108.7
		9/16/2010 14:31	129.8	274.3	80.8	6.7	6.5	13.1	212.8	108.8
		9/16/2010 14:32	129.7	274.6	80.7	6.7	6.5	13.7	212.8	108.7
		9/16/2010 14:33	129.7	274.7	80.8	6.7	6.5	14.1	212.7	108.9
		9/16/2010 14:34	129.8	274.6	80.6	6.7	6.6	14.5	212.7	108.7
		9/16/2010 14:35	129.9	274.5	80.6	6.7	6.6	14.6	212.9	108.6
		9/16/2010 14:36	130.0	274.4	80.7	6.7	6.6	14.6	212.9	108.9
		9/16/2010 14:37	130.0	274.2	80.8	6.7	6.6	14.5	212.8	108.7
		9/16/2010 14:38	129.9	273.8	80.7	6.7	6.6	14.5	212.8	108.4
		9/16/2010 14:39	130.0	274.3	80.9	6.7	6.6	14.4	212.7	108.6
		9/16/2010 14:40	130.1	274.3	81.0	6.7	6.6	14.1	212.7	108.7
		9/16/2010 14:41	129.8	274.1	80.7	6.7	6.6	13.9	212.8	108.5
		9/16/2010 14:42	130.0	274.1	80.5	6.7	6.6	13.7	212.8	108.5
		9/16/2010 14:43	129.6	274.2	80.6	6.7	6.6	13.6	212.7	108.4
		9/16/2010 14:44	129.6	273.8	80.6	6.7	6.6	13.3	212.6	108.4
		9/16/2010 14:45	129.5	274.0	80.5	6.7	6.6	13.4	212.6	108.5
		9/16/2010 14:46	129.6	273.6	80.4	6.7	6.6	13.5	212.7	108.3
		9/16/2010 14:47	129.6	273.8	80.3	6.7	6.6	13.5	212.7	108.4
		9/16/2010 14:48	129.6	274.1	80.4	6.7	6.6	13.1	212.7	108.3
		9/16/2010 14:49	129.5	274.3	80.7	6.7	6.6	12.5	212.8	108.5
		9/16/2010 14:50	129.4	274.2	80.8	6.7	6.6	12.5	212.9	108.5
		9/16/2010 14:51	129.4	274.1	80.8	6.7	6.6	12.4	212.9	108.3
		9/16/2010 14:52	129.5	274.3	80.5	6.7	6.6	12.3	212.9	108.5
		9/16/2010 14:53	129.4	273.8	80.4	6.7	6.6	12.3	212.9	108.2
		9/16/2010 14:54	129.7	273.5	80.5	6.7	6.6	12.4	212.8	108.0
		9/16/2010 14:55	129.5	273.3	80.3	6.7	6.6	12.4	212.8	108.0
		9/16/2010 14:56	129.3	273.2	80.2	6.7	6.6	11.8	212.8	107.8
		9/16/2010 14:57	129.3	273.4	80.4	6.7	6.6	11.6	212.8	108.0
		9/16/2010 14:58	129.4	273.0	80.3	6.7	6.6	11.6	212.9	107.9
		9/16/2010 14:59	129.4	273.4	80.3	6.7	6.6	11.4	212.8	108.0
		9/16/2010 15:00	129.4	273.2	80.5	6.7	6.6	11.4	212.7	108.0
		9/16/2010 15:01	129.2	273.2	80.4	6.7	6.6	11.5	212.6	107.8
		9/16/2010 15:02	128.9	272.9	80.4	6.7	6.6	11.3	212.6	107.8
		9/16/2010 15:03	129.0	273.1	80.4	6.7	6.6	11.3	212.6	107.8
		9/16/2010 15:04	128.9	273.2	80.7	6.7	6.6	11.0	212.6	108.1
		9/16/2010 15:05	128.7	273.3	80.7	6.7	6.6	10.8	212.8	108.2
		9/16/2010 15:06	129.0	273.3	80.7	6.7	6.6	10.7	212.8	108.2
		9/16/2010 15:07	129.2	273.1	80.7	6.7	6.6	10.5	212.8	108.1
		9/16/2010 15:08	129.0	273.1	80.6	6.7	6.6	10.4	212.8	107.8
		9/16/2010 15:09	129.0	273.5	80.5	6.7	6.6	10.4	212.7	107.9
		9/16/2010 15:10	128.6	273.3	80.7	6.7	6.6	10.3	212.6	107.9
		9/16/2010 15:11	128.6	272.9	81.0	6.7	6.6	10.4	212.7	107.9
		9/16/2010 15:12	128.5	273.3	80.8	6.7	6.6	10.2	212.6	107.9
		9/16/2010 15:13	128.4	272.9	80.9	6.7	6.6	10.0	212.7	107.9
		9/16/2010 15:14	128.5	273.1	80.7	6.7	6.6	9.8	212.7	108.0
		9/16/2010 15:15	128.6	273.0	80.5	6.7	6.6	9.7	212.7	107.9
		9/16/2010 15:16	128.5	272.7	80.8	6.7	6.6	9.7	212.7	107.8
		9/16/2010 15:17	128.7	273.1	81.0	6.7	6.6	9.7	212.7	107.9
		9/16/2010 15:18	128.7	273.4	80.8	6.7	6.6	9.6	212.6	107.9
		9/16/2010 15:19	128.5	273.1	80.8	6.7	6.6	9.6	212.6	107.9
		9/16/2010 15:20	128.5	272.9	80.8	6.7	6.6	9.4	212.6	107.6
		9/16/2010 15:21	128.6	273.0	80.9	6.7	6.6	9.1	212.7	107.6
		9/16/2010 15:22	128.3	272.9	80.8	6.7	6.6	8.9	212.7	107.8
		9/16/2010 15:23	128.3	273.1	80.9	6.7	6.6	8.9	212.8	107.6
		9/16/2010 15:24	128.3	272.9	80.7	6.7	6.6	8.9	212.9	107.9
		9/16/2010 15:25	128.6	273.1	80.6	6.7	6.6	8.9	212.8	107.9
		9/16/2010 15:26	128.4	273.2	80.7	6.7	6.6	8.8	212.8	107.8
		9/16/2010 15:27	128.3	273.1	80.7	6.7	6.6	8.8	212.8	107.8
		9/16/2010 15:28	128.3	273.3	80.7	6.7	6.6	8.6	212.8	107.8
		avg								108.203