ConocoPhillips

Ferndale Refinery

Compliance Test Report

Sulfur Recovery Unit #2

Determination of: *CO, NO_x, SO_2, and Visible Emissions (Opacity)*

Project No. 2010.1601

Prepared for:

ConocoPhillips Ferndale Refinery
PO Box 8
3901 Unick Road
Ferndale, Washington 98248

Test Date:

February 2, 2010

Performed by:

4848 Airway Drive
Central Point, Oregon 97502

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7.0 Appendix C: Supporting Data/ Documentation

1.0 SOURCE EMISSION TEST CERTIFICATION SHEET

Emission Source: *ConocoPhillips*
Ferndale Refinery
PO Box 8
3901 Unick Road
Ferndale, Washington 98248

Contact: Mr. Steve Burton
Construction Manager
ConocoPhillips
Ferndale Refinery
PO Box 8
3901 Unick Road
Ferndale, Washington 98248
Phone: (360) 384-8325

Final Permit Identification Number: *PSD-05-01*

Order of Approval to Construct (OAC): *#908A*

Emission Units Tested:

Sulfur Recovery Unit #2 (SRU #2)

Dates Tested: *February 2, 2010*

Testing Firm: *Environmental Technical Services, Inc.*
4848 Airway Drive
Central Point, Oregon 97502
Phone: (541) 779-2646
Facsimile: (541) 734-5537
E-Mail: ETSLLC@msn.com

The data and results presented in this report are, to the best of my knowledge, accurate and complete:

By: _____
James DeHoog, PhD, *Environmental Engineer*

BY/FOR

By: _____
Andy Winkler, *Sr. Project Manager*

2.0 INTRODUCTION

2.1 Test Purpose:

The purpose of the source testing conducted on the Sulfur Recovery Unit #2 (SRU #2) was to satisfy the New Source Performance Standards (NSPS) and to demonstrate compliance with annual source testing requirements Washington Department of Ecology Final Permit PSD-05-01.

Test Location:

Sulfur Recovery Unit #2: The test location for carbon monoxide (CO), nitrogen oxides (NOx), sulfur dioxide (SO_2), and visible emission measurements was the exhaust duct of SRU #2.

2.2 Test Date:

Tuesday, February 2, 2010: Conduct carbon monoxide, nitrogen oxides, sulfur dioxide, and visible emission testing on SRU #2. Three, sixty minute sampling replicates were completed.

Fieldwork was completed by the following ETS, Inc. test personnel: Jacob Buss, Field Technician and Andy Winkler, Senior Project Manager.

2.3 Pollutants Tested: The pollutants tested are listed as follows:

Sulfur Recovery Unit #2 Exhaust Duct:

Carbon Monoxide (CO)

Nitrogen Oxides (NOx)

Sulfur Dioxide

Visible Emissions (Opacity)

2.4 Observers Name(s):

2.4.1 **Agency Observer:** Notified, but not present.
Northwest Clean Air Agency

3.0 Summary of results

3.1 Sulfur Recovery Unit #2 (SRU #2) Exhaust Duct, Gaseous Emissions – Test Date: February 2, 2010

Test Run	1	2	3		
Date:	2/2/2010	2/2/2010	2/2/2010	Average	
Start Time:	12:40	13:58	15:18		
End Time:	13:40	14:58	16:18		
Sulfur Recovery Unit #2 Exhaust Duct - Gaseous Emissions					
Carbon Monoxide Emissions					*CO Permit Limit:* *PSD-05-01, condition #2*
Concentration – ppm CO, dry:	1.2	1.2	1.2	***1.2***	
ppm CO @ 7% O_2:	1.1	1.0	1.0	***1.0***	*57.1 @ 7%O_2*
Emission Rate – lbs CO /hour:	0.02	0.02	0.02	***0.02***	*1.9 lbs/hour*
Nitrogen Oxides Emissions					*NOx Permit Limit:* *PSD-05-01, condition #1*
Concentration – ppm NOx, dry:	28.2	28.6	28.1	***28.3***	
ppm NOx @ 7% O_2:	24.8	25.0	24.4	***24.7***	*42.2 @ 7%O_2*
Emission Rate – lbs NOx /hour:	0.84	0.88	0.88	***0.87***	*2.3 lbs/hour*
Sulfur Dioxide Emissions					*SO_2 Permit Limit:* *OAC #908a, condition #3C*
Concentration – ppm SO_2, dry:	24.2	21.7	21.9	***22.6***	
ppm SO_2 @ 0% O_2:	32.0	28.5	28.6	***29.7***	*250 ppm @ 0%O_2*
Emission Rate – lbs SO_2 /hour:	1.00	0.93	0.95	***0.96***	
- Tons SO_2/Year (365 days per year)	4.29	4.07	4.16	***4.17***	*22.3 Tons/Year*
Visible Emissions					*VE Permit Limit:* *OAC #908a, condition #2*
Opacity ,%:	0.0	0.0	0.0	***0.0***	*≤10%, 3min in 1hour.*
Sulfur Recovery Unit #2 Exhaust Duct Emissions Parameters					
Temperature - °F	364.9	353.4	348.5	***355.6***	
Moisture - %	10.2	10.5	9.6	***10.1***	
Oxygen - %	5.1	5.0	4.9	***5.0***	
Velocity – fps	4.7	4.8	4.8	***4.8***	
Flow Rate - acfm	7,324	7,479	7,479	***7,427***	
- scfm	4,641	4,807	4,836	***4,764***	
- sdcfm	4,166	4,300	4,370	***4,279***	

Sulfur Recovery Unit #2 Estimated Sulfur Production

Run No.	Start	End	(Long ton per day)
1	12:40	13:40	19.88
2	13:58	14:58	20.08
3	15:18	16:18	20.11

3.2 *Data Representation:*

Calculations presented in this report utilize a standard temperature of 528R (68 Deg F) and standard pressure (29.92 in Hg). Calculation final results listed in Section 3 are manually rounded according to the procedures outlined in *"Standard Methods for the Examination of Water and Wastewater"*, 14th edition, 1975.

4.0 PROCEDURES

4.1 *Sample and Traverse Point Determination Sheets:*

Sulfur Recovery Unit #2 Exhaust Duct:

A) Volume Flow Rate Determination See Appendix A, Section 5.2.4.

B) Gaseous Emissions Determination See Appendix A, Section 5.1.5.

4.2 *Sampling Methods Utilized:*

The following methods were utilized for the pollutants tested:

Volume Flow Rates.....EPA Methods 1-4

Sulfur Dioxide .....EPA Method 6C

Nitrogen Oxides.....EPA Method 7E

Opacity.....WDOE Method 9A

Carbon Monoxide.....EPA Method 10

4.3 *Summary of Procedures:*

The reference methods followed during the emission testing were the same as outlined in the submitted *Source Test Plan*, previously submitted to the *Northwest Clean Air Agency* (NWCAA) Clarifications from the submitted plan are as follows:

EPA Method 1:
Sample port locations met method requirements for straight run diameters required before and after the sampling plane. Sampling port descriptions are detailed as follows:

Sulfur Recovery Unit #2 (SRU #2) Exhaust Duct:
Duct diameter, inches 69.0"
Distance A (Method 1): 52.0" or 0.7 equivalent diameters.
Distance B (Method 1): 208.0" or 3.0 equivalent diameters.
Sixteen (16 qty.) total sample points were utilized at the SRU #2 exhaust duct.

EPA Method 2:
Volume flow measurements were taken during each test run. No deviations were made from the published method. The SRU #2 exhaust duct was checked for cyclonic flow conditions prior to testing. The exhaust duct did not exhibit conditions of cyclonic flow. Documentation of the cyclonic flow check is included in the Appendix A, section 5.2.3.

Due to the low exhaust flow rates a digital differential pressure manometer was used to measure the pitot measurements. The digital manometer used was the Shortridge Model 860C which has an accuracy tolerance of ±2% ±0.001 inches of water column.

Additionally, mass flow rates were calculated using process parameters (flow balance) for comparison. Flow balance calculations were performed by ConocoPhillips engineering personnel, example calculations are presented in Appendix C, section 7.2. The results are presented below:

Run No.	*Start Time*	*End Time*	*Calculated dscf/min*	*Measured EPA 1-4 dscf/min*
1	12:40	13:40	2921	4,079
2	13:58	14:58	2931	4,297
3	15:18	16:18	2958	4,370

EPA-2 measured volume flow values (dscf/min) were used to calculate emission mass rates (lbs/hour).

EPA Method 3A:
Exhaust gas measurements were taken during each volume flow rate measurement test run. No deviations were made from the published method. The requirements of EPA Methods 3A/7E were met by using the maximum number/location of sampling points for the $\%O_2$ and $\%CO_2$ sampling. During the EPA Method 3A sampling, twenty-four sampling points, or twelve (12 Qty.) sampling points per traverse, were used for measuring $\%O_2$ and $\%CO_2$ concentrations.

EPA Method 3A Measurement Specifications:

Oxygen, $\%O_2$:
Analyzer Manufacture: Siemens
Model: Oxymat 5E
Serial Number: E2-301a
Analyzer Range: 0.0 – 22.01%
Operating Sensitivity: 0.44%

EPA Method 3A Measurement Specifications:

Carbon Dioxide, $\%CO_2$:
Analyzer Manufacture: Siemens
Model: Ultramat 5E
Serial Number: ED-641
Analyzer Range: 0.0 – 18.6%
Operating Sensitivity: 0.37%

EPA Method 4:
No deviations were made from the published method.

EPA Method 6C:
EPA Method 6C was used to determine the sulfur dioxide (SO_2) emissions from the exhaust duct. No deviations were made from the published methods. EPA Method 205 data and cylinder certification are located in Appendix B, Sections 6.2.1 & 6.2.2.

The requirements of EPA Method 6C were met by using the maximum number/location of sampling points for the 6c sampling. During the EPA Method 6C sampling, twenty-four sampling points, or twelve (12 Qty.) sampling points per traverse, were used for measuring 6C concentrations.

EPA Method 6C Measurement Specifications:

Analyzer Manufacture: Bovar (Western Research)
Model: 721 M
Serial Number: 93-721M-8000-4
Analyzer Range: 0.0 – 58.4 ppm SO_2
Operating Sensitivity: 1.2 ppm

EPA Method 7E:

EPA Method 7E was used to determine the nitrogen oxide(s) (NO_x) emissions from the exhaust duct. No deviations were made from the published methods. EPA Method 205 data and cylinder certification are located in Appendix B, Sections 6.2.1 & 6.2.2.

The requirements of EPA Method 7E were met by using the maximum number/location of sampling points for the NO_x sampling. During the EPA Method 7e sampling, twenty-four sampling points, or twelve (12 Qty.) sampling points per traverse, were used for measuring NO_X concentrations. The results of converter check are also included in the Appendix B, Section 6.2.5.

EPA Method 7E Measurement Specifications:

Analyzer Manufacture: EcoPhysics
Model: 70CLD
Serial Number: 8350006
Converter Check Date/Status: 1/29/2010; Pass
Analyzer Range: 0 – 58.7 ppm NOx
Operating Sensitivity: 1.2 ppm

EPA Method 10:

EPA Method 10 was used to determine the carbon monoxide (CO) emissions from the sulfur recovery unit #2 (SRU #2) exhaust duct. No deviations were made from the published methods. EPA Method 205 data and cylinder certification sheets are located in Appendix B, Sections 6.2.1 & 6.2.2.

The requirements of EPA Method 10 were met by using the maximum number/location of sampling points for the carbon monoxide sampling. During the EPA Method 10 sampling, twenty-four sampling points, or twelve (12 Qty.) sampling points per traverse, were used for measuring carbon monoxide concentrations.

EPA Method 10 Measurement Specifications:

Analyzer Manufacture: Siemens
Model: Ultramat 5E
Serial Number: BN-978
Analyzer Range: 0.0 – 60.0 ppm CO
Operating Sensitivity: 1.2 ppm

5.0 Appendix A: Sulfur Recovery Unit #2 - NOx, CO, SO_2 and Visible Emissions

5.1 Sulfur Recovery Unit #2 – NOx, CO, and SO_2 Gaseous Emissions

- 5.1.1 Calculation of Average Emissions
- 5.1.2 Sample System Bias and Drift
- 5.1.3 Calibration Error
- 5.1.4 NOx, CO, SO_2, and Raw Data Readings
- 5.1.5 CEM Sample Traverse Points

5.2 Sulfur Recovery Unit #2 - EPA Method 1-4, Volume Flow Rates

- 5.2.1 SRU #2 Emission Parameters -
- 5.2.2 EPA Method 4 Field Data Sheets
- 5.2.3 Cyclonic Flow Check Documentation
- 5.2.4 Velocity Measurement Traverse Points
- 5.2.5 Visible Emission Observation Sheets

Calculation of Average Emissions

Test Performed For:
ConocoPhillips
Ferndale Refinery
SRU #2 Exhaust Duct
O2, CO2, CO, NOx, & SO2
Date:2/2/10

Test Performed By:
ETS, Inc.
Emission Testing
CEMs 2
Project #2010.1601
Run 1

Calibration Gas Value	Initial Calibration	Final Calibration	Average
0.00 percent O_2	0.01 %	-0.14 %	-0.07
12.50 percent O_2	12.41 %	12.49 %	12.45
0.0 ppm NO_X	0.0 ppm	0.3 ppm	0.15
34.3 ppm NO_X	34.0 ppm	33.6 ppm	33.82
0.00 percent CO_2	0.00 %	0.01 %	0.01
9.93 percent CO_2	9.91 %	9.78 %	9.84
0.0 ppm CO	-0.1 ppm	0.0 ppm	-0.03
35.0 ppm CO	34.6 ppm	34.8 ppm	34.69
0.0 ppm SO_2	-0.3 ppm	1.1 ppm	0.40
34.1 ppm SO_2	34.2 ppm	32.6 ppm	33.42

Mean Reference Values:	**Corrected Results:**	**Basis:**
5.03 percent O_2	**5.10** percent O_2	DRY
27.8 ppm NO_X	**28.2** ppm NO_X	DRY
6.36 percent CO_2	**6.40** percent CO_2	DRY
0.0 ppm CO	**0.0** ppm CO	DRY
	1.2 ppm CO	At Detection Limit
23.9 ppm SO_2	**24.2** ppm SO_2	DRY
	249,960 SCFH Gas Flow	DRY

Emission Calculations:

32.0 SO_2 @ 0% O_2	
24.8 NOx @ 7% O_2	
0.0 CO @ 7% O_2	As Measured
1.1 CO @ 7% O_2	At Detection Limit
1.00 SO_2 lbs/hour	
0.84 NO_X lbs/hour	
0.00 CO lbs/hour	As Measured
0.02 CO lbs/hour	At Detection Limit

Calculation of Average Emissions

Test Performed For:
ConocoPhillips
Ferndale Refinery
SRU #2 Exhaust Duct
O2, CO2, CO, NOx, & SO2
Date:2/2/10

Test Performed By:
ETS, Inc.
Emission Testing
CEMs 2
Project #2010.1601
Run 2

Calibration Gas Value	Initial Calibration	Final Calibration	Average
0.00 percent O_2	-0.14 %	-0.01 %	-0.07
12.50 percent O_2	12.41 %	12.49 %	12.45
0.0 ppm NO_X	0.3 ppm	0.2 ppm	0.25
34.3 ppm NO_X	33.6 ppm	34.2 ppm	33.92
0.00 percent CO_2	0.01 %	0.00 %	0.01
9.93 percent CO_2	9.78 %	9.83 %	9.81
0.0 ppm CO	0.0 ppm	0.0 ppm	0.00
35.0 ppm CO	34.8 ppm	34.6 ppm	34.68
0.0 ppm SO_2	1.1 ppm	-0.3 ppm	0.36
34.1 ppm SO_2	32.6 ppm	33.9 ppm	33.24

Mean Reference Values:	**Corrected Results:**	**Basis:**
4.90 percent O_2	**5.00** percent O_2	DRY
28.3 ppm NO_X	**28.6** ppm NO_X	DRY
6.41 percent CO_2	**6.50** percent CO_2	DRY
0.0 ppm CO	**0.0** ppm CO	DRY
	1.2 ppm CO	At Detection Limit
21.3 ppm SO_2	**21.7** ppm SO_2	DRY
	258,000 SCFH Gas Flow	DRY

Emission Calculations:

28.5 SO_2 @ 0% O_2	
25.0 NOx @ 7% O_2	
0.0 CO @ 7% O_2	As Measured
1.0 CO @ 7% O_2	At Detection Limit
0.93 SO_2 lbs/hour	
0.88 NO_X lbs/hour	
0.00 CO lbs/hour	As Measured
0.02 CO lbs/hour	At Detection Limit

Calculation of Average Emissions

Test Performed For:
ConocoPhillips
Ferndale Refinery
SRU #2 Exhaust Duct
O2, CO2, CO, NOx, & SO2
Date:2/2/10

Test Performed By:
ETS, Inc.
Emission Testing
CEMs 2
Project #2010.1601
Run 3

Calibration Gas Value	Initial Calibration	Final Calibration	Average
0.00 percent O_2	-0.01 %	0.10 %	0.05
12.50 percent O_2	12.49 %	12.41 %	12.45
0.0 ppm NO_X	0.2 ppm	0.3 ppm	0.28
34.3 ppm NO_X	34.2 ppm	34.3 ppm	34.27
0.00 percent CO_2	0.00 %	0.02 %	0.01
9.93 percent CO_2	9.83 %	9.83 %	9.83
0.0 ppm CO	0.0 ppm	0.0 ppm	0.00
35.0 ppm CO	34.6 ppm	34.5 ppm	34.55
0.0 ppm SO_2	-0.3 ppm	-0.9 ppm	-0.60
34.1 ppm SO_2	33.9 ppm	34.4 ppm	34.13

Mean Reference Values:	**Corrected Results:**	**Basis:**
4.90 percent O_2	**4.90** percent O_2	DRY
28.2 ppm NO_X	**28.1** ppm NO_X	DRY
6.39 percent CO_2	**6.50** percent CO_2	DRY
0.0 ppm CO	**0.0** ppm CO	DRY
	1.2 ppm CO	At Detection Limit
21.7 ppm SO_2	**21.9** ppm SO_2	DRY
	262,200 SCFH Gas Flow	DRY

Emission Calculations:

28.6 SO_2@ 0% O_2	
24.4 NOx @ 7% O_2	
0.0 CO @ 7% O_2	As Measured
1.0 CO @ 7% O_2	At Detection Limit
0.95 SO_2 lbs/hour	
0.88 NO_X lbs/hour	
0.00 CO lbs/hour	As Measured
0.02 CO lbs/hour	At Detection Limit

Sampling System Bias and Drift

Test Performed For:
ConocoPhillips
Ferndale Refinery
SRU #2 Exhaust Duct
O2, CO2, CO, NOx, & SO2
Date:2/2/10

Test Performed By:
ETS, Inc.
Emission Testing
CEMs 2
Project #2010.1601
Run 1

Monitor Type	Analyzer Cal Response	Initial Cal Value	Pre Run Bias (%)	Final Cal Value	Post Run Bias (%)	Total Run Drift (%)
O_2	0.01 %	0.01 %	0.00 %	-0.14 %	-0.68 %	-0.68 %
O_2	12.54 %	12.41 %	-0.59 %	12.49 %	-0.23 %	0.36 %
NO_X	0.0 ppm	0.0 ppm	0.00 %	0.3 ppm	0.51 %	0.51 %
NO_X	34.2 ppm	34.0 ppm	-0.34 %	33.6 ppm	-1.02 %	-0.68 %
CO_2	0.02 %	0.00 %	-0.11 %	0.01 %	-0.05 %	0.05 %
CO_2	9.93 %	9.91 %	-0.11 %	9.78 %	-0.81 %	-0.70 %
CO	0.0 ppm	-0.1 ppm	-0.17 %	0.0 ppm	0.00 %	0.17 %
CO	35.2 ppm	34.6 ppm	-1.00 %	34.8 ppm	-0.67 %	0.33 %
SO_2	-0.2 ppm	-0.3 ppm	-0.17 %	1.1 ppm	2.23 %	2.40 %
SO_2	34.1 ppm	34.2 ppm	0.17 %	32.6 ppm	-2.57 %	-2.74 %

Sampling System Bias and Drift

Test Performed For:
ConocoPhillips
Ferndale Refinery
SRU #2 Exhaust Duct
O2, CO2, CO, NOx, & SO2
Date:2/2/10

Test Performed By:
ETS, Inc.
Emission Testing
CEMs 2
Project #2010.1601
Run 2

Monitor Type	Analyzer Cal Response	Initial Cal Value	Pre Run Bias (%)	Final Cal Value	Post Run Bias (%)	Total Run Drift (%)
O_2	0.01 %	-0.14 %	-0.68 %	-0.01 %	-0.09 %	0.59 %
O_2	12.54 %	12.41 %	-0.59 %	12.49 %	-0.23 %	0.36 %
NO_X	0.0 ppm	0.3 ppm	0.51 %	0.2 ppm	0.34 %	-0.17 %
NO_X	34.2 ppm	33.6 ppm	-1.02 %	34.2 ppm	0.00 %	1.02 %
CO_2	0.02 %	0.01 %	-0.05 %	0.00 %	-0.11 %	-0.05 %
CO_2	9.93 %	9.78 %	-0.81 %	9.83 %	-0.54 %	0.27 %
CO	0.0 ppm	0.0 ppm	0.00 %	0.0 ppm	0.00 %	0.00 %
CO	35.2 ppm	34.8 ppm	-0.67 %	34.6 ppm	-1.00 %	-0.33 %
SO_2	-0.2 ppm	1.1 ppm	2.23 %	-0.3 ppm	-0.17 %	-2.40 %
SO_2	34.1 ppm	32.6 ppm	-2.57 %	33.9 ppm	-0.34 %	2.23 %

Sampling System Bias and Drift

Test Performed For:
ConocoPhillips
Ferndale Refinery
SRU #2 Exhaust Duct
O2, CO2, CO, NOx, & SO2
Date:2/2/10

Test Performed By:
ETS, Inc.
Emission Testing
CEMs 2
Project #2010.1601
Run 3

Monitor Type	Analyzer Cal Response	Initial Cal Value	Pre Run Bias (%)	Final Cal Value	Post Run Bias (%)	Total Run Drift (%)
O_2	0.01 %	-0.01 %	-0.09 %	0.10 %	0.41 %	0.50 %
O_2	12.54 %	12.49 %	-0.23 %	12.41 %	-0.59 %	-0.36 %
NO_X	0.0 ppm	0.2 ppm	0.34 %	0.3 ppm	0.51 %	0.17 %
NO_X	34.2 ppm	34.2 ppm	0.00 %	34.3 ppm	0.17 %	0.17 %
CO_2	0.02 %	0.00 %	-0.11 %	0.02 %	0.00 %	0.11 %
CO_2	9.93 %	9.83 %	-0.54 %	9.83 %	-0.54 %	0.00 %
CO	0.0 ppm	0.0 ppm	0.00 %	0.0 ppm	0.00 %	0.00 %
CO	35.2 ppm	34.6 ppm	-1.00 %	34.5 ppm	-1.17 %	-0.17 %
SO_2	-0.2 ppm	-0.3 ppm	-0.17 %	-0.9 ppm	-1.20 %	-1.03 %
SO_2	34.1 ppm	33.9 ppm	-0.34 %	34.4 ppm	0.51 %	0.86 %

Analyzer Calibration Error

Test Performed For:
ConocoPhillips
Ferndale Refinery
SRU #2 Exhaust Duct
O2, CO2, CO, NOx, & SO2
Date:2/2/10

Test Performed By:
ETS, Inc.
Emission Testing
CEMs 2
Project #2010.1601
Run 1

Oxygen Monitor

Method 3A

Full Scale: 22.01 %

Serial Number: E2-301A

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero N2/cg1	0.00 %	0.01 %	0.01 %	0.05 %
CC50904/cg3	12.50 %	12.54 %	0.04 %	0.18 %
CC48291/cg2	22.01 %	22.01 %	0.00 %	0.00 %

Nitrogen Oxides Monitor

Method 7E

Full Scale: 58.7 ppm

Serial Number: 8350006

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero N2/cg1	0.0 ppm	0.0 ppm	0.0 ppm	0.00 %
SG9147518/dg2	34.3 ppm	34.2 ppm	-0.1 ppm	-0.11 %
SG9147518/dg1	58.7 ppm	58.6 ppm	-0.1 ppm	-0.24 %

Carbon Dioxide Monitor

Method 3A

Full Scale: 18.63 %

Serial Number: ED-641

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero N2/cg1	0.00 %	0.02 %	0.02 %	0.11 %
CC50904/cg3	9.93 %	9.93 %	0.00 %	0.00 %
CC48291/cg2	18.63 %	18.64 %	0.01 %	0.05 %

Carbon Monoxide Monitor

Method 10

Full Scale: 60.0 ppm

Serial Number: BN-978

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero N2/cg1	0.0 ppm	0.0 ppm	0.0 ppm	0.00 %
SG9147518/dg3	20.0 ppm	19.7 ppm	-0.3 ppm	-0.50 %
SG9147518/dg2	35.0 ppm	35.2 ppm	0.2 ppm	0.33 %
SG9147518/dg1	60.0 ppm	59.8 ppm	-0.2 ppm	-0.33 %

Analyzer Calibration Error

Test Performed For:
ConocoPhillips
Ferndale Refinery
SRU #2 Exhaust Duct
O2, CO2, CO, NOx, & SO2
Date:2/2/10

Test Performed By:
ETS, Inc.
Emission Testing
CEMs 2
Project #2010.1601
Run 1

Sulfur Dioxide Monitor **Method 6C**

Full Scale: 58.4 ppm Serial Number: 93-721M-8000-4

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero N2/cg1	0.0 ppm	-0.2 ppm	-0.2 ppm	-0.34 %
SG9147518/dg2	34.1 ppm	34.1 ppm	0.0 ppm	0.02 %
SG9147518/dg1	58.4 ppm	58.5 ppm	0.1 ppm	0.17 %

Analyzer Calibration Error

Test Performed For:
ConocoPhillips
Ferndale Refinery
SRU #2 Exhaust Duct
O2, CO2, CO, NOx, & SO2
Date:2/2/10

Test Performed By:
ETS, Inc.
Emission Testing
CEMs 2
Project #2010.1601
Run 2

Oxygen Monitor

Method 3A

Full Scale: 22.01 %

Serial Number: E2-301A

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero N2/cg1	0.00 %	0.01 %	0.01 %	0.05 %
CC50904/cg3	12.50 %	12.54 %	0.04 %	0.18 %
CC48291/cg2	22.01 %	22.01 %	0.00 %	0.00 %

Nitrogen Oxides Monitor

Method 7E

Full Scale: 58.7 ppm

Serial Number: 8350006

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero N2/cg1	0.0 ppm	0.0 ppm	0.0 ppm	0.00 %
SG9147518/dg2	34.3 ppm	34.2 ppm	-0.1 ppm	-0.11 %
SG9147518/dg1	58.7 ppm	58.6 ppm	-0.1 ppm	-0.24 %

Carbon Dioxide Monitor

Method 3A

Full Scale: 18.63 %

Serial Number: ED-641

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero N2/cg1	0.00 %	0.02 %	0.02 %	0.11 %
CC50904/cg3	9.93 %	9.93 %	0.00 %	0.00 %
CC48291/cg2	18.63 %	18.64 %	0.01 %	0.05 %

Carbon Monoxide Monitor

Method 10

Full Scale: 60.0 ppm

Serial Number: BN-978

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero N2/cg1	0.0 ppm	0.0 ppm	0.0 ppm	0.00 %
SG9147518/dg3	20.0 ppm	19.7 ppm	-0.3 ppm	-0.50 %
SG9147518/dg2	35.0 ppm	35.2 ppm	0.2 ppm	0.33 %
SG9147518/dg1	60.0 ppm	59.8 ppm	-0.2 ppm	-0.33 %

Analyzer Calibration Error

Test Performed For:
ConocoPhillips
Ferndale Refinery
SRU #2 Exhaust Duct
O2, CO2, CO, NOx, & SO2
Date:2/2/10

Test Performed By:
ETS, Inc.
Emission Testing
CEMs 2
Project #2010.1601
Run 2

Sulfur Dioxide Monitor

Method 6C

Full Scale: 58.4 ppm

Serial Number: 93-721M-8000-4

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero N2/cg1	0.0 ppm	-0.2 ppm	-0.2 ppm	-0.34 %
SG9147518/dg2	34.1 ppm	34.1 ppm	0.0 ppm	0.02 %
SG9147518/dg1	58.4 ppm	58.5 ppm	0.1 ppm	0.17 %

Analyzer Calibration Error

Test Performed For:
ConocoPhillips
Ferndale Refinery
SRU #2 Exhaust Duct
O2, CO2, CO, NOx, & SO2
Date:2/2/10

Test Performed By:
ETS, Inc.
Emission Testing
CEMs 2
Project #2010.1601
Run 3

Oxygen Monitor

Method 3A

Full Scale: 22.01 %

Serial Number: E2-301A

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero N2/cg1	0.00 %	0.01 %	0.01 %	0.05 %
CC50904/cg3	12.50 %	12.54 %	0.04 %	0.18 %
CC48291/cg2	22.01 %	22.01 %	0.00 %	0.00 %

Nitrogen Oxides Monitor

Method 7E

Full Scale: 58.7 ppm

Serial Number: 8350006

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero N2/cg1	0.0 ppm	0.0 ppm	0.0 ppm	0.00 %
SG9147518/dg2	34.3 ppm	34.2 ppm	-0.1 ppm	-0.11 %
SG9147518/dg1	58.7 ppm	58.6 ppm	-0.1 ppm	-0.24 %

Carbon Dioxide Monitor

Method 3A

Full Scale: 18.63 %

Serial Number: ED-641

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero N2/cg1	0.00 %	0.02 %	0.02 %	0.11 %
CC50904/cg3	9.93 %	9.93 %	0.00 %	0.00 %
CC48291/cg2	18.63 %	18.64 %	0.01 %	0.05 %

Carbon Monoxide Monitor

Method 10

Full Scale: 60.0 ppm

Serial Number: BN-978

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero N2/cg1	0.0 ppm	0.0 ppm	0.0 ppm	0.00 %
SG9147518/dg3	20.0 ppm	19.7 ppm	-0.3 ppm	-0.50 %
SG9147518/dg2	35.0 ppm	35.2 ppm	0.2 ppm	0.33 %
SG9147518/dg1	60.0 ppm	59.8 ppm	-0.2 ppm	-0.33 %

Analyzer Calibration Error

Test Performed For:
ConocoPhillips
Ferndale Refinery
SRU #2 Exhaust Duct
O2, CO2, CO, NOx, & SO2
Date:2/2/10

Test Performed By:
ETS, Inc.
Emission Testing
CEMs 2
Project #2010.1601
Run 3

Sulfur Dioxide Monitor

Method 6C

Full Scale: 58.4 ppm

Serial Number: 93-721M-8000-4

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero N2/cg1	0.0 ppm	-0.2 ppm	-0.2 ppm	-0.34 %
SG9147518/dg2	34.1 ppm	34.1 ppm	0.0 ppm	0.02 %
SG9147518/dg1	58.4 ppm	58.5 ppm	0.1 ppm	0.17 %

filename	2/2/2010	10:12:53 C:\RM\DATA\CP1601.CSV					
testby1	ETS, Inc.						
testby2	Emission Testing						
testby3	CEMs 2						
testby4	Project #2010.1601						
testfor1	ConocoPhillips						
testfor2	Ferndale Refinery						
testfor3	SRU #2						
testfor4	O2, CO2, CO, NOx, & SO2						
name			2 O2	1 CO2	4 NOx	7 SO2	3 CO
sn			E2-301A	ED-641	8350006	93-721M-8000-4	BN-978
offset			0	0	0	0	0
fullscale			22.0	18.6	58.7	58.4	60.0
train			1	1	1	1	1
gastype			o2 3a	co2 3a	nox 7e	so2 6c	co 10
run1	2/2/2010	12:40:00	4.28	6.61	28.7	20.3	0.0
run1	2/2/2010	12:40:15	4.50	6.42	28.1	20.5	0.0
run1	2/2/2010	12:40:30	4.95	6.33	27.3	20.5	0.0
run1	2/2/2010	12:40:45	4.95	6.38	28.1	20.7	0.0
run1	2/2/2010	12:41:00	5.00	6.13	26.7	20.9	0.0
run1	2/2/2010	12:41:15	5.21	6.53	28.3	20.8	0.0
run1	2/2/2010	12:41:30	4.75	6.65	28.7	21.4	0.0
run1	2/2/2010	12:41:45	4.51	6.63	29.1	21.9	0.0
run1	2/2/2010	12:42:00	4.32	6.62	29.2	22.3	0.0
run1	2/2/2010	12:42:15	4.35	6.47	28.6	22.4	0.0
run1	2/2/2010	12:42:30	4.50	6.59	29.0	22.3	0.0
run1	2/2/2010	12:42:45	4.87	6.03	26.3	22.2	0.0
run1	2/2/2010	12:43:00	5.55	6.26	27.1	21.8	0.0
run1	2/2/2010	12:43:15	5.11	6.55	28.6	21.9	0.0
run1	2/2/2010	12:43:30	4.71	6.58	28.4	22.3	0.0
run1	2/2/2010	12:43:45	4.52	6.65	29.2	22.6	0.0
run1	2/2/2010	12:44:00	4.45	6.69	29.2	22.9	0.0
run1	2/2/2010	12:44:15	4.25	6.68	29.3	23.1	0.0
run1	2/2/2010	12:44:30	4.27	6.57	28.9	23.4	0.0
run1	2/2/2010	12:44:45	4.57	6.63	28.7	23.4	0.0
run1	2/2/2010	12:45:00	4.50	6.49	28.6	23.4	0.0
run1	2/2/2010	12:45:15	4.70	6.57	28.2	23.4	0.0
run1	2/2/2010	12:45:30	4.43	6.61	29.1	23.6	0.0
run1	2/2/2010	12:45:45	4.55	6.54	28.4	23.7	0.0
run1	2/2/2010	12:46:00	4.72	6.37	27.9	23.6	0.0
run1	2/2/2010	12:46:15	4.86	6.72	29.0	23.3	0.0
run1	2/2/2010	12:46:30	4.46	6.56	28.8	23.5	0.0
run1	2/2/2010	12:46:45	4.48	6.76	28.7	23.6	0.0
run1	2/2/2010	12:47:00	4.24	6.57	28.8	23.8	0.0
run1	2/2/2010	12:47:15	4.47	6.54	28.7	23.8	0.0
run1	2/2/2010	12:47:30	4.74	6.60	28.5	23.6	0.0
run1	2/2/2010	12:47:45	4.47	6.78	29.2	23.5	0.0
run1	2/2/2010	12:48:00	4.14	6.81	29.5	23.9	0.0
run1	2/2/2010	12:48:15	4.06	6.73	29.3	24.2	0.0
run1	2/2/2010	12:48:30	4.21	6.72	29.2	24.4	0.0
run1	2/2/2010	12:48:45	4.38	6.38	28.5	24.4	0.0
run1	2/2/2010	12:49:00	4.85	6.57	28.2	24.2	0.0
run1	2/2/2010	12:49:15	4.53	6.35	28.5	24.2	0.0
run1	2/2/2010	12:49:30	4.85	6.73	28.4	24.1	0.0
run1	2/2/2010	12:49:45	4.33	6.79	29.5	24.3	0.0
run1	2/2/2010	12:50:00	4.33	6.37	28.2	24.6	0.0
run1	2/2/2010	12:50:15	4.75	6.51	28.5	24.2	0.0

run1	2/2/2010	12:50:30	4.72	6.55	28.4	24.2	0.0
run1	2/2/2010	12:50:45	4.53	6.57	28.5	24.2	0.0
run1	2/2/2010	12:51:00	4.42	6.70	28.9	24.2	0.0
run1	2/2/2010	12:51:15	4.29	6.74	29.3	24.5	0.0
run1	2/2/2010	12:51:30	4.24	6.71	29.2	24.8	0.0
run1	2/2/2010	12:51:45	4.16	6.69	29.3	24.8	0.0
run1	2/2/2010	12:52:00	4.24	6.49	28.6	24.9	0.0
run1	2/2/2010	12:52:15	4.63	6.56	28.5	24.7	0.0
run1	2/2/2010	12:52:30	4.67	6.45	28.4	24.6	0.0
run1	2/2/2010	12:52:45	4.78	6.70	29.0	24.5	0.0
run1	2/2/2010	12:53:00	4.45	6.51	29.0	24.6	0.0
run1	2/2/2010	12:53:15	5.13	5.84	25.7	24.4	0.0
run1	2/2/2010	12:53:30	5.84	5.74	25.7	23.3	0.0
run1	2/2/2010	12:53:45	6.22	6.42	26.9	22.5	0.0
run1	2/2/2010	12:54:00	5.23	6.51	28.7	22.9	0.0
run1	2/2/2010	12:54:15	5.31	6.15	26.7	23.4	0.0
run1	2/2/2010	12:54:30	5.19	6.72	29.3	23.4	0.0
run1	2/2/2010	12:54:45	4.47	6.72	29.4	24.0	0.0
run1	2/2/2010	12:55:00	4.19	6.70	29.5	24.4	0.0
run1	2/2/2010	12:55:15	4.20	6.67	29.1	24.6	0.0
run1	2/2/2010	12:55:30	4.25	6.67	29.2	24.7	0.0
run1	2/2/2010	12:55:45	4.41	6.55	28.9	24.6	0.0
run1	2/2/2010	12:56:00	4.83	6.17	27.4	24.4	0.0
run1	2/2/2010	12:56:15	5.42	6.47	27.8	23.8	0.0
run1	2/2/2010	12:56:30	4.90	6.67	28.9	23.7	0.0
run1	2/2/2010	12:56:45	4.53	6.70	29.0	24.1	0.0
run1	2/2/2010	12:57:00	4.46	6.45	28.5	24.3	0.0
run1	2/2/2010	12:57:15	4.59	6.61	28.7	24.4	0.0
run1	2/2/2010	12:57:30	4.57	6.48	28.4	24.4	0.0
run1	2/2/2010	12:57:45	4.61	6.78	29.1	24.4	0.0
run1	2/2/2010	12:58:00	4.22	6.65	29.2	24.7	0.0
run1	2/2/2010	12:58:15	4.40	6.61	28.8	24.7	0.0
run1	2/2/2010	12:58:30	4.55	6.50	28.7	24.7	0.0
run1	2/2/2010	12:58:45	4.76	6.54	28.9	28.0	0.0
run1	2/2/2010	12:59:00	4.78	6.30	28.2	28.4	0.0
run1	2/2/2010	12:59:15	5.19	5.97	26.4	25.3	0.0
run1	2/2/2010	12:59:30	5.56	6.29	27.7	23.5	0.0
run1	2/2/2010	12:59:45	5.24	6.42	28.2	23.3	0.0
run1	2/2/2010	13:00:00	5.01	6.40	28.3	23.5	0.0
run1	2/2/2010	13:00:15	5.36	5.76	25.9	23.7	0.0
run1	2/2/2010	13:00:30	6.19	5.89	26.3	23.1	0.0
run1	2/2/2010	13:00:45	6.25	6.31	26.8	22.7	0.0
run1	2/2/2010	13:01:00	5.49	6.07	27.2	22.8	0.0
run1	2/2/2010	13:01:15	5.61	6.08	26.9	23.0	0.0
run1	2/2/2010	13:01:30	5.67	6.20	27.3	23.1	0.0
run1	2/2/2010	13:01:45	5.38	6.19	27.7	23.2	0.0
run1	2/2/2010	13:02:00	5.84	5.65	25.0	23.0	0.0
run1	2/2/2010	13:02:15	6.19	6.30	27.4	22.4	0.0
run1	2/2/2010	13:02:30	5.54	5.51	26.0	22.7	0.0
run1	2/2/2010	13:02:45	6.99	5.77	24.1	22.3	0.0
run1	2/2/2010	13:03:00	6.50	6.08	26.8	21.7	0.0
run1	2/2/2010	13:03:15	5.78	6.23	27.4	22.2	0.0
run1	2/2/2010	13:03:30	5.49	6.29	27.7	22.9	0.0
run1	2/2/2010	13:03:45	5.35	6.50	27.8	23.1	0.0
run1	2/2/2010	13:04:00	4.73	6.70	29.2	23.6	0.0
run1	2/2/2010	13:04:15	4.59	6.23	27.9	24.2	0.0
run1	2/2/2010	13:04:30	5.15	6.22	27.8	24.0	0.0

run1	2/2/2010	13:04:45	5.40	6.05	26.5	23.6	0.0
run1	2/2/2010	13:05:00	5.60	6.35	27.7	23.3	0.0
run1	2/2/2010	13:05:15	5.33	6.04	27.0	23.3	0.0
run1	2/2/2010	13:05:30	5.74	6.16	26.6	23.3	0.0
run1	2/2/2010	13:05:45	5.49	6.30	27.6	23.2	0.0
run1	2/2/2010	13:06:00	5.04	6.43	28.3	23.6	0.0
run1	2/2/2010	13:06:15	4.85	6.60	28.7	24.0	0.0
run1	2/2/2010	13:06:30	4.84	5.95	26.8	24.3	0.0
run1	2/2/2010	13:06:45	5.62	6.08	26.7	23.9	0.0
run1	2/2/2010	13:07:00	5.53	6.41	28.2	23.5	0.0
run1	2/2/2010	13:07:15	5.14	6.17	27.1	23.6	0.0
run1	2/2/2010	13:07:30	5.25	6.28	27.7	23.5	0.0
run1	2/2/2010	13:07:45	5.33	6.16	26.8	23.5	0.0
run1	2/2/2010	13:08:00	5.55	6.48	27.0	23.3	0.0
run1	2/2/2010	13:08:15	4.87	6.24	28.0	23.4	0.0
run1	2/2/2010	13:08:30	5.27	6.37	27.4	23.6	0.0
run1	2/2/2010	13:08:45	4.98	6.56	28.4	23.6	0.0
run1	2/2/2010	13:09:00	4.63	6.39	28.2	24.0	0.0
run1	2/2/2010	13:09:15	4.84	6.17	27.6	24.0	0.0
run1	2/2/2010	13:09:30	5.43	6.46	27.4	23.9	0.0
run1	2/2/2010	13:09:45	4.95	6.42	28.1	23.7	0.0
run1	2/2/2010	13:10:00	4.88	6.21	28.0	23.9	0.0
run1	2/2/2010	13:10:15	5.20	6.47	27.3	23.8	0.0
run1	2/2/2010	13:10:30	4.79	6.57	28.7	23.9	0.0
run1	2/2/2010	13:10:45	4.71	6.29	27.8	24.1	0.0
run1	2/2/2010	13:11:00	5.15	6.10	26.4	24.1	0.0
run1	2/2/2010	13:11:15	5.43	6.19	27.4	23.8	0.0
run1	2/2/2010	13:11:30	5.78	6.04	25.5	23.3	0.0
run1	2/2/2010	13:11:45	5.62	6.66	28.2	22.4	0.0
run1	2/2/2010	13:12:00	4.73	6.41	28.1	23.0	0.0
run1	2/2/2010	13:12:15	4.83	6.57	28.4	23.9	0.0
run1	2/2/2010	13:12:30	4.59	6.28	28.2	24.4	0.0
run1	2/2/2010	13:12:45	5.22	6.35	26.8	24.3	0.0
run1	2/2/2010	13:13:00	4.98	6.43	28.2	24.0	0.0
run1	2/2/2010	13:13:15	4.84	6.10	27.2	24.3	0.0
run1	2/2/2010	13:13:30	5.47	6.36	26.6	24.1	0.0
run1	2/2/2010	13:13:45	5.05	6.53	28.1	24.1	0.0
run1	2/2/2010	13:14:00	4.56	6.52	28.4	24.4	0.0
run1	2/2/2010	13:14:15	4.63	6.58	28.3	23.9	0.0
run1	2/2/2010	13:14:30	4.77	5.52	25.5	22.8	0.0
run1	2/2/2010	13:14:45	6.41	6.16	25.4	22.2	0.0
run1	2/2/2010	13:15:00	5.81	5.98	26.2	22.1	0.0
run1	2/2/2010	13:15:15	5.99	5.93	25.7	22.7	0.0
run1	2/2/2010	13:15:30	5.92	6.26	26.7	22.9	0.0
run1	2/2/2010	13:15:45	5.40	5.98	26.3	23.2	0.0
run1	2/2/2010	13:16:00	5.77	6.04	26.2	23.4	0.0
run1	2/2/2010	13:16:15	5.62	6.29	27.3	23.4	0.0
run1	2/2/2010	13:16:30	5.21	6.45	27.9	23.7	0.0
run1	2/2/2010	13:16:45	4.84	6.30	27.8	24.0	0.0
run1	2/2/2010	13:17:00	4.87	6.51	28.2	24.1	0.0
run1	2/2/2010	13:17:15	4.85	6.01	26.7	24.2	0.0
run1	2/2/2010	13:17:30	5.53	6.51	27.6	24.0	0.0
run1	2/2/2010	13:17:45	4.84	6.33	28.0	24.1	0.0
run1	2/2/2010	13:18:00	4.83	6.45	28.1	24.4	0.0
run1	2/2/2010	13:18:15	5.14	5.53	25.1	23.7	0.0
run1	2/2/2010	13:18:30	6.56	6.03	25.4	21.8	0.0
run1	2/2/2010	13:18:45	6.23	5.96	25.2	21.4	0.0

run1	2/2/2010	13:19:00	5.97	6.16	26.4	21.8	0.0
run1	2/2/2010	13:19:15	5.33	6.60	28.6	22.6	0.0
run1	2/2/2010	13:19:30	4.66	6.21	27.9	23.6	0.0
run1	2/2/2010	13:19:45	5.43	5.82	24.9	24.0	0.0
run1	2/2/2010	13:20:00	6.19	5.53	25.0	23.4	0.0
run1	2/2/2010	13:20:15	6.83	5.93	24.8	22.8	0.0
run1	2/2/2010	13:20:30	6.39	6.16	25.7	22.6	0.0
run1	2/2/2010	13:20:45	5.56	6.38	28.2	23.0	0.0
run1	2/2/2010	13:21:00	5.13	6.43	27.9	23.8	0.0
run1	2/2/2010	13:21:15	4.70	6.63	28.7	24.3	0.0
run1	2/2/2010	13:21:30	4.41	6.38	28.4	25.0	0.0
run1	2/2/2010	13:21:45	4.82	6.26	27.7	25.2	0.0
run1	2/2/2010	13:22:00	5.70	5.59	24.4	24.8	0.0
run1	2/2/2010	13:22:15	6.36	6.33	26.9	23.6	0.0
run1	2/2/2010	13:22:30	5.24	6.32	28.3	23.7	0.0
run1	2/2/2010	13:22:45	5.02	6.50	28.0	24.2	0.0
run1	2/2/2010	13:23:00	4.69	6.42	28.5	24.7	0.0
run1	2/2/2010	13:23:15	5.00	6.06	27.1	25.0	0.0
run1	2/2/2010	13:23:30	5.42	6.43	28.1	24.7	0.0
run1	2/2/2010	13:23:45	4.78	6.53	28.8	24.8	0.0
run1	2/2/2010	13:24:00	4.69	6.50	28.5	25.1	0.0
run1	2/2/2010	13:24:15	4.62	6.42	28.6	25.3	0.0
run1	2/2/2010	13:24:30	4.76	6.39	28.4	25.3	0.0
run1	2/2/2010	13:24:45	4.88	6.24	28.0	25.1	0.0
run1	2/2/2010	13:25:00	5.37	6.32	27.2	25.0	0.0
run1	2/2/2010	13:25:15	5.29	6.02	27.0	24.6	0.0
run1	2/2/2010	13:25:30	5.58	6.40	28.0	23.5	0.0
run1	2/2/2010	13:25:45	5.13	6.41	28.1	22.8	0.0
run1	2/2/2010	13:26:00	4.86	6.31	28.6	23.4	0.0
run1	2/2/2010	13:26:15	5.04	6.41	28.2	24.0	0.0
run1	2/2/2010	13:26:30	5.36	5.69	25.6	24.2	0.0
run1	2/2/2010	13:26:45	5.96	6.28	27.6	23.8	0.0
run1	2/2/2010	13:27:00	5.45	6.20	27.8	23.8	0.0
run1	2/2/2010	13:27:15	5.38	6.18	27.5	24.0	0.0
run1	2/2/2010	13:27:30	5.27	6.30	28.3	24.1	0.0
run1	2/2/2010	13:27:45	5.43	6.07	26.8	24.2	0.0
run1	2/2/2010	13:28:00	5.54	6.47	28.1	24.0	0.0
run1	2/2/2010	13:28:15	4.89	6.30	28.4	24.3	0.0
run1	2/2/2010	13:28:30	5.12	6.29	27.8	24.5	0.0
run1	2/2/2010	13:28:45	5.14	6.22	27.7	24.6	0.0
run1	2/2/2010	13:29:00	5.33	6.46	28.0	24.5	0.0
run1	2/2/2010	13:29:15	4.93	6.21	28.0	24.6	0.0
run1	2/2/2010	13:29:30	5.30	6.33	27.5	24.6	0.0
run1	2/2/2010	13:29:45	5.00	6.59	28.7	24.5	0.0
run1	2/2/2010	13:30:00	4.58	6.61	28.9	24.9	0.0
run1	2/2/2010	13:30:15	4.50	6.39	28.3	25.2	0.0
run1	2/2/2010	13:30:30	4.80	6.28	28.0	25.2	0.0
run1	2/2/2010	13:30:45	5.56	5.71	25.2	24.9	0.0
run1	2/2/2010	13:31:00	5.95	6.10	27.1	24.2	0.0
run1	2/2/2010	13:31:15	5.68	6.23	26.9	24.0	0.0
run1	2/2/2010	13:31:30	5.79	5.83	25.7	24.0	0.0
run1	2/2/2010	13:31:45	6.12	6.10	26.2	23.8	0.0
run1	2/2/2010	13:32:00	5.50	6.09	27.0	23.7	0.0
run1	2/2/2010	13:32:15	5.52	6.50	27.6	23.9	0.0
run1	2/2/2010	13:32:30	4.88	6.55	28.6	24.0	0.0
run1	2/2/2010	13:32:45	4.56	6.67	28.9	23.6	0.0
run1	2/2/2010	13:33:00	4.29	6.54	29.1	24.0	0.0

run1	2/2/2010	13:33:15	4.47	6.41	28.1	24.6	0.0
run1	2/2/2010	13:33:30	4.51	6.58	28.9	24.9	0.0
run1	2/2/2010	13:33:45	4.48	6.43	28.2	25.3	0.0
run1	2/2/2010	13:34:00	4.66	6.42	28.7	25.3	0.0
run1	2/2/2010	13:34:15	4.91	6.38	27.5	25.2	0.0
run1	2/2/2010	13:34:30	4.74	6.52	28.6	25.0	0.0
run1	2/2/2010	13:34:45	4.38	6.66	29.2	25.2	0.0
run1	2/2/2010	13:35:00	4.33	6.38	28.5	25.3	0.0
run1	2/2/2010	13:35:15	4.74	6.40	28.1	25.4	0.0
run1	2/2/2010	13:35:30	4.85	6.50	28.6	25.2	0.0
run1	2/2/2010	13:35:45	4.60	6.62	28.7	25.1	0.0
run1	2/2/2010	13:36:00	4.35	6.70	29.1	25.3	0.0
run1	2/2/2010	13:36:15	4.28	6.14	28.3	25.5	0.0
run1	2/2/2010	13:36:30	5.52	6.07	25.4	25.2	0.0
run1	2/2/2010	13:36:45	5.47	6.69	28.3	24.4	0.0
run1	2/2/2010	13:37:00	4.53	6.56	28.6	24.8	0.0
run1	2/2/2010	13:37:15	4.74	6.16	27.4	25.2	0.0
run1	2/2/2010	13:37:30	5.15	6.65	28.2	25.1	0.0
run1	2/2/2010	13:37:45	4.45	6.68	28.8	25.2	0.0
run1	2/2/2010	13:38:00	4.42	6.20	27.4	25.5	0.0
run1	2/2/2010	13:38:15	5.13	6.41	27.3	25.4	0.0
run1	2/2/2010	13:38:30	4.89	6.40	28.0	25.2	0.0
run1	2/2/2010	13:38:45	4.78	6.35	27.6	25.2	0.0
run1	2/2/2010	13:39:00	4.78	6.20	27.3	25.2	0.0
run1	2/2/2010	13:39:15	5.20	6.32	27.5	25.0	0.0
run1	2/2/2010	13:39:30	4.90	6.60	28.6	25.0	0.0
run1	2/2/2010	13:39:45	4.49	6.32	28.0	25.4	0.0
averun1	2/2/2010	12:40:00	5.03	6.36	27.8	23.9	0.0
run2	2/2/2010	13:58:15	4.30	6.74	30.1	24.0	0.0
run2	2/2/2010	13:58:30	4.30	6.75	30.0	24.0	0.0
run2	2/2/2010	13:58:45	4.31	6.69	29.8	23.9	0.0
run2	2/2/2010	13:59:00	4.28	6.77	30.2	24.0	0.0
run2	2/2/2010	13:59:15	4.38	6.41	28.9	23.9	0.0
run2	2/2/2010	13:59:30	4.65	6.77	29.9	23.4	0.0
run2	2/2/2010	13:59:45	4.30	6.43	29.6	23.3	0.0
run2	2/2/2010	14:00:00	4.90	6.53	28.2	23.2	0.0
run2	2/2/2010	14:00:15	4.59	6.67	29.8	22.9	0.0
run2	2/2/2010	14:00:30	4.47	6.18	28.5	22.9	0.0
run2	2/2/2010	14:00:45	5.34	6.34	27.4	22.7	0.0
run2	2/2/2010	14:01:00	5.06	6.65	29.4	22.3	0.0
run2	2/2/2010	14:01:15	4.65	6.66	29.4	22.5	0.0
run2	2/2/2010	14:01:30	4.46	6.70	29.8	22.7	0.0
run2	2/2/2010	14:01:45	4.42	6.74	29.7	22.8	0.0
run2	2/2/2010	14:02:00	4.32	6.51	29.2	23.1	0.0
run2	2/2/2010	14:02:15	4.69	6.53	28.8	23.0	0.0
run2	2/2/2010	14:02:30	4.70	6.71	29.4	22.8	0.0
run2	2/2/2010	14:02:45	4.44	6.74	29.6	22.9	0.0
run2	2/2/2010	14:03:00	4.33	6.69	29.6	23.1	0.0
run2	2/2/2010	14:03:15	4.41	6.73	29.5	23.1	0.0
run2	2/2/2010	14:03:30	4.51	6.41	28.5	23.1	0.0
run2	2/2/2010	14:03:45	4.59	6.72	29.6	22.9	0.0
run2	2/2/2010	14:04:00	4.59	6.39	28.1	22.8	0.0
run2	2/2/2010	14:04:15	4.89	6.09	27.3	22.6	0.0
run2	2/2/2010	14:04:30	5.23	6.73	29.0	22.2	0.0
run2	2/2/2010	14:04:45	4.52	6.61	29.3	22.3	0.0
run2	2/2/2010	14:05:00	4.85	6.08	27.3	22.5	0.0
run2	2/2/2010	14:05:15	5.25	6.75	29.3	22.2	0.0

run2	2/2/2010	14:05:30	4.52	6.66	29.6	22.2	0.0
run2	2/2/2010	14:05:45	4.53	6.50	29.1	22.4	0.0
run2	2/2/2010	14:06:00	4.75	6.36	28.2	22.5	0.0
run2	2/2/2010	14:06:15	4.72	6.73	29.6	22.4	0.0
run2	2/2/2010	14:06:30	4.25	6.71	29.8	22.4	0.0
run2	2/2/2010	14:06:45	4.25	6.30	28.8	22.5	0.0
run2	2/2/2010	14:07:00	4.95	6.69	29.0	22.5	0.0
run2	2/2/2010	14:07:15	4.68	6.33	28.9	22.5	0.0
run2	2/2/2010	14:07:30	4.97	6.53	28.9	22.3	0.0
run2	2/2/2010	14:07:45	4.93	6.45	28.6	22.0	0.0
run2	2/2/2010	14:08:00	4.79	6.57	29.3	22.0	0.0
run2	2/2/2010	14:08:15	4.80	6.40	28.6	22.1	0.0
run2	2/2/2010	14:08:30	5.06	6.24	28.1	22.0	0.0
run2	2/2/2010	14:08:45	5.26	6.51	28.4	21.8	0.0
run2	2/2/2010	14:09:00	4.86	6.50	28.7	21.7	0.0
run2	2/2/2010	14:09:15	4.68	6.52	29.3	21.8	0.0
run2	2/2/2010	14:09:30	4.74	6.62	29.0	22.0	0.0
run2	2/2/2010	14:09:45	4.86	6.09	27.8	22.1	0.0
run2	2/2/2010	14:10:00	5.83	6.14	26.2	21.9	0.0
run2	2/2/2010	14:10:15	5.47	6.32	28.2	21.4	0.0
run2	2/2/2010	14:10:30	5.41	5.81	26.4	20.5	0.0
run2	2/2/2010	14:10:45	6.28	6.24	25.9	19.0	0.0
run2	2/2/2010	14:11:00	5.44	6.03	27.9	18.1	0.0
run2	2/2/2010	14:11:15	6.07	5.95	25.2	18.2	0.0
run2	2/2/2010	14:11:30	6.22	5.97	26.3	18.5	0.0
run2	2/2/2010	14:11:45	6.02	5.87	26.4	19.1	0.0
run2	2/2/2010	14:12:00	6.42	5.81	25.4	19.3	0.0
run2	2/2/2010	14:12:15	6.50	6.06	26.5	19.3	0.0
run2	2/2/2010	14:12:30	5.74	6.31	28.2	19.6	0.0
run2	2/2/2010	14:12:45	5.26	6.00	27.1	20.1	0.0
run2	2/2/2010	14:13:00	5.74	6.29	27.6	20.3	0.0
run2	2/2/2010	14:13:15	5.57	6.13	27.2	20.5	0.0
run2	2/2/2010	14:13:30	5.59	6.17	27.5	20.7	0.0
run2	2/2/2010	14:13:45	5.45	6.41	28.4	20.7	0.0
run2	2/2/2010	14:14:00	5.05	5.91	27.5	21.0	0.0
run2	2/2/2010	14:14:15	5.98	6.05	26.1	21.0	0.0
run2	2/2/2010	14:14:30	6.03	5.81	26.4	20.6	0.0
run2	2/2/2010	14:14:45	6.37	5.79	25.6	20.2	0.0
run2	2/2/2010	14:15:00	6.73	5.68	25.2	19.7	0.0
run2	2/2/2010	14:15:15	6.56	6.33	27.6	19.5	0.0
run2	2/2/2010	14:15:30	5.48	6.29	28.3	19.9	0.0
run2	2/2/2010	14:15:45	5.04	6.52	29.1	20.6	0.0
run2	2/2/2010	14:16:00	4.98	5.98	27.1	21.1	0.0
run2	2/2/2010	14:16:15	5.60	6.49	27.5	20.0	0.0
run2	2/2/2010	14:16:30	5.01	6.33	28.3	18.9	0.0
run2	2/2/2010	14:16:45	5.02	6.48	28.5	19.5	0.0
run2	2/2/2010	14:17:00	4.83	6.51	28.8	20.3	0.0
run2	2/2/2010	14:17:15	4.77	6.46	28.7	20.9	0.0
run2	2/2/2010	14:17:30	4.74	6.34	28.3	21.1	0.0
run2	2/2/2010	14:17:45	5.15	5.92	26.6	21.2	0.0
run2	2/2/2010	14:18:00	6.10	5.95	25.7	20.7	0.0
run2	2/2/2010	14:18:15	5.77	6.50	28.2	20.2	0.0
run2	2/2/2010	14:18:30	4.89	6.38	28.9	20.5	0.0
run2	2/2/2010	14:18:45	4.88	6.47	28.5	21.0	0.0
run2	2/2/2010	14:19:00	4.89	6.44	28.4	21.1	0.0
run2	2/2/2010	14:19:15	4.98	6.46	28.3	21.1	0.0
run2	2/2/2010	14:19:30	4.88	6.36	28.4	20.4	0.0

run2	2/2/2010	14:19:45	4.86	6.44	28.7	20.3	0.0
run2	2/2/2010	14:20:00	4.71	6.56	29.2	20.7	0.0
run2	2/2/2010	14:20:15	4.49	6.34	28.8	21.0	0.0
run2	2/2/2010	14:20:30	5.08	6.13	27.5	21.1	0.0
run2	2/2/2010	14:20:45	5.35	6.34	28.5	20.9	0.0
run2	2/2/2010	14:21:00	5.11	6.54	28.5	20.7	0.0
run2	2/2/2010	14:21:15	4.62	6.30	28.9	20.8	0.0
run2	2/2/2010	14:21:30	4.98	6.43	28.4	21.0	0.0
run2	2/2/2010	14:21:45	4.85	6.56	29.2	21.0	0.0
run2	2/2/2010	14:22:00	4.61	6.42	29.2	21.1	0.0
run2	2/2/2010	14:22:15	4.91	6.46	28.5	21.2	0.0
run2	2/2/2010	14:22:30	4.89	6.48	28.5	21.2	0.0
run2	2/2/2010	14:22:45	4.63	6.68	29.5	21.2	0.0
run2	2/2/2010	14:23:00	4.43	6.57	29.3	21.5	0.0
run2	2/2/2010	14:23:15	4.62	6.38	28.7	21.7	0.0
run2	2/2/2010	14:23:30	5.05	6.12	27.1	21.5	0.0
run2	2/2/2010	14:23:45	5.43	6.39	27.7	21.1	0.0
run2	2/2/2010	14:24:00	4.97	6.55	28.5	21.0	0.0
run2	2/2/2010	14:24:15	4.72	6.27	28.2	21.3	0.0
run2	2/2/2010	14:24:30	5.34	6.53	27.9	21.3	0.0
run2	2/2/2010	14:24:45	4.69	6.63	29.2	21.4	0.0
run2	2/2/2010	14:25:00	4.41	6.44	28.7	21.9	0.0
run2	2/2/2010	14:25:15	4.64	6.54	28.9	22.0	0.0
run2	2/2/2010	14:25:30	4.70	6.45	28.3	22.1	0.0
run2	2/2/2010	14:25:45	4.75	6.28	28.3	22.1	0.0
run2	2/2/2010	14:26:00	5.42	6.03	25.9	21.9	0.0
run2	2/2/2010	14:26:15	5.82	5.91	25.7	21.3	0.0
run2	2/2/2010	14:26:30	5.77	6.46	27.6	20.7	0.0
run2	2/2/2010	14:26:45	4.86	6.38	28.5	20.9	0.0
run2	2/2/2010	14:27:00	4.94	6.65	28.2	21.4	0.0
run2	2/2/2010	14:27:15	4.46	6.44	28.7	21.8	0.0
run2	2/2/2010	14:27:30	4.79	6.41	27.4	22.0	0.0
run2	2/2/2010	14:27:45	4.62	6.58	29.0	21.9	0.0
run2	2/2/2010	14:28:00	4.38	6.60	29.0	22.0	0.0
run2	2/2/2010	14:28:15	4.28	6.70	29.3	22.2	0.0
run2	2/2/2010	14:28:30	4.21	6.68	29.4	22.4	0.0
run2	2/2/2010	14:28:45	4.29	6.28	28.4	22.6	0.0
run2	2/2/2010	14:29:00	5.07	6.01	26.4	22.2	0.0
run2	2/2/2010	14:29:15	5.65	6.49	27.4	21.5	0.0
run2	2/2/2010	14:29:30	4.83	6.65	29.3	21.2	0.0
run2	2/2/2010	14:29:45	4.51	6.56	29.0	21.6	0.0
run2	2/2/2010	14:30:00	4.49	6.65	29.0	21.9	0.0
run2	2/2/2010	14:30:15	4.34	6.32	28.5	21.9	0.0
run2	2/2/2010	14:30:30	4.93	6.48	28.4	21.9	0.0
run2	2/2/2010	14:30:45	4.89	6.30	27.8	21.6	0.0
run2	2/2/2010	14:31:00	5.02	6.62	28.5	21.5	0.0
run2	2/2/2010	14:31:15	4.50	6.68	29.1	21.5	0.0
run2	2/2/2010	14:31:30	4.22	6.75	29.5	21.8	0.0
run2	2/2/2010	14:31:45	4.51	6.24	27.5	22.0	0.0
run2	2/2/2010	14:32:00	4.84	6.69	29.0	21.9	0.0
run2	2/2/2010	14:32:15	4.38	6.62	28.9	21.9	0.0
run2	2/2/2010	14:32:30	4.34	6.71	29.4	22.1	0.0
run2	2/2/2010	14:32:45	4.33	6.67	29.2	22.2	0.0
run2	2/2/2010	14:33:00	4.36	6.52	28.8	22.4	0.0
run2	2/2/2010	14:33:15	4.42	6.64	29.0	22.4	0.0
run2	2/2/2010	14:33:30	4.43	6.47	28.6	22.3	0.0
run2	2/2/2010	14:33:45	4.67	6.51	28.5	22.2	0.0

run2	2/2/2010	14:34:00	4.73	6.20	27.5	22.2	0.0
run2	2/2/2010	14:34:15	4.98	6.69	28.7	22.0	0.0
run2	2/2/2010	14:34:30	4.58	6.19	28.0	22.0	0.0
run2	2/2/2010	14:34:45	5.09	6.47	28.3	22.0	0.0
run2	2/2/2010	14:35:00	4.81	6.51	28.3	22.0	0.0
run2	2/2/2010	14:35:15	4.60	6.06	27.8	22.0	0.0
run2	2/2/2010	14:35:30	5.46	6.48	27.4	21.8	0.0
run2	2/2/2010	14:35:45	4.92	6.60	28.9	21.6	0.0
run2	2/2/2010	14:36:00	4.47	6.66	29.4	21.9	0.0
run2	2/2/2010	14:36:15	4.34	6.29	28.4	22.1	0.0
run2	2/2/2010	14:36:30	4.76	6.60	29.1	22.1	0.0
run2	2/2/2010	14:36:45	4.47	6.64	29.1	22.0	0.0
run2	2/2/2010	14:37:00	4.31	6.70	29.6	22.2	0.0
run2	2/2/2010	14:37:15	4.28	6.71	29.7	22.4	0.0
run2	2/2/2010	14:37:30	4.49	5.12	25.9	22.5	0.0
run2	2/2/2010	14:37:45	6.90	6.22	25.1	21.5	0.0
run2	2/2/2010	14:38:00	5.59	6.54	28.9	20.5	0.0
run2	2/2/2010	14:38:15	5.14	6.15	26.9	20.7	0.0
run2	2/2/2010	14:38:30	5.45	6.35	27.6	20.8	0.0
run2	2/2/2010	14:38:45	5.19	6.30	27.5	20.7	0.0
run2	2/2/2010	14:39:00	4.89	6.63	28.9	20.9	0.0
run2	2/2/2010	14:39:15	4.59	6.66	28.9	21.3	0.0
run2	2/2/2010	14:39:30	4.55	6.40	28.4	21.7	0.0
run2	2/2/2010	14:39:45	4.71	6.63	28.9	21.7	0.0
run2	2/2/2010	14:40:00	4.36	6.63	29.1	21.8	0.0
run2	2/2/2010	14:40:15	4.49	6.36	28.2	22.1	0.0
run2	2/2/2010	14:40:30	4.90	6.39	27.7	22.0	0.0
run2	2/2/2010	14:40:45	4.90	6.00	26.8	21.7	0.0
run2	2/2/2010	14:41:00	5.57	6.44	27.3	21.4	0.0
run2	2/2/2010	14:41:15	4.93	6.63	28.9	21.2	0.0
run2	2/2/2010	14:41:30	4.43	6.56	28.9	21.5	0.0
run2	2/2/2010	14:41:45	4.49	6.53	28.1	21.8	0.0
run2	2/2/2010	14:42:00	4.40	6.62	29.1	21.7	0.0
run2	2/2/2010	14:42:15	4.29	6.64	29.1	21.9	0.0
run2	2/2/2010	14:42:30	4.32	6.64	29.2	22.1	0.0
run2	2/2/2010	14:42:45	4.18	6.68	29.4	22.3	0.0
run2	2/2/2010	14:43:00	4.17	6.62	29.5	22.4	0.0
run2	2/2/2010	14:43:15	4.47	6.18	27.7	22.5	0.0
run2	2/2/2010	14:43:30	5.07	6.40	28.7	22.1	0.0
run2	2/2/2010	14:43:45	5.37	5.84	25.5	21.6	0.0
run2	2/2/2010	14:44:00	5.55	6.33	28.3	20.9	0.0
run2	2/2/2010	14:44:15	5.26	6.13	27.5	20.8	0.0
run2	2/2/2010	14:44:30	5.81	5.98	26.1	20.6	0.0
run2	2/2/2010	14:44:45	6.16	5.46	24.6	20.1	0.0
run2	2/2/2010	14:45:00	6.32	6.29	27.5	19.4	0.0
run2	2/2/2010	14:45:15	5.43	6.54	28.5	19.6	0.0
run2	2/2/2010	14:45:30	4.93	6.40	28.6	20.2	0.0
run2	2/2/2010	14:45:45	4.74	6.40	28.6	20.5	0.0
run2	2/2/2010	14:46:00	4.79	6.69	29.0	20.7	0.0
run2	2/2/2010	14:46:15	4.42	6.64	29.7	20.9	0.0
run2	2/2/2010	14:46:30	4.71	6.10	27.7	21.1	0.0
run2	2/2/2010	14:46:45	5.23	6.54	28.5	20.8	0.0
run2	2/2/2010	14:47:00	4.82	6.23	27.9	20.7	0.0
run2	2/2/2010	14:47:15	5.02	6.59	28.8	20.6	0.0
run2	2/2/2010	14:47:30	4.66	6.66	29.0	20.7	0.0
run2	2/2/2010	14:47:45	4.58	6.41	28.7	20.9	0.0
run2	2/2/2010	14:48:00	4.87	6.50	28.3	21.0	0.0

run2	2/2/2010	14:48:15	4.71	6.50	28.9	21.0	0.0
run2	2/2/2010	14:48:30	4.78	6.51	28.5	21.1	0.0
run2	2/2/2010	14:48:45	4.65	6.11	27.7	21.1	0.0
run2	2/2/2010	14:49:00	5.28	6.45	27.8	20.8	0.0
run2	2/2/2010	14:49:15	4.80	6.50	28.4	20.7	0.0
run2	2/2/2010	14:49:30	4.64	6.27	28.1	21.0	0.0
run2	2/2/2010	14:49:45	5.06	6.63	28.4	21.0	0.0
run2	2/2/2010	14:50:00	4.50	6.66	29.1	21.1	0.0
run2	2/2/2010	14:50:15	4.23	6.74	29.4	21.4	0.0
run2	2/2/2010	14:50:30	4.11	6.46	28.6	21.5	0.0
run2	2/2/2010	14:50:45	4.45	6.38	28.4	20.7	0.0
run2	2/2/2010	14:51:00	5.20	6.02	25.5	19.9	0.0
run2	2/2/2010	14:51:15	5.32	6.62	28.5	19.1	0.0
run2	2/2/2010	14:51:30	4.50	6.50	29.0	19.3	0.0
run2	2/2/2010	14:51:45	4.65	6.47	28.1	19.8	0.0
run2	2/2/2010	14:52:00	4.53	6.61	29.3	20.1	0.0
run2	2/2/2010	14:52:15	4.55	6.29	28.0	20.4	0.0
run2	2/2/2010	14:52:30	4.90	6.32	27.9	20.4	0.0
run2	2/2/2010	14:52:45	4.83	6.28	27.7	20.1	0.0
run2	2/2/2010	14:53:00	4.94	6.37	27.7	19.8	0.0
run2	2/2/2010	14:53:15	4.83	6.44	28.4	19.6	0.0
run2	2/2/2010	14:53:30	4.63	6.34	28.5	19.7	0.0
run2	2/2/2010	14:53:45	4.90	6.51	28.6	19.8	0.0
run2	2/2/2010	14:54:00	4.97	6.24	27.7	19.7	0.0
run2	2/2/2010	14:54:15	4.95	6.47	28.9	19.5	0.0
run2	2/2/2010	14:54:30	4.76	6.09	27.8	19.6	0.0
run2	2/2/2010	14:54:45	5.42	6.25	26.6	19.4	0.0
run2	2/2/2010	14:55:00	5.11	6.36	28.4	19.2	0.0
run2	2/2/2010	14:55:15	5.09	6.46	27.8	19.2	0.0
run2	2/2/2010	14:55:30	4.89	6.65	28.8	19.2	0.0
run2	2/2/2010	14:55:45	4.53	6.51	28.6	19.4	0.0
run2	2/2/2010	14:56:00	4.37	6.77	29.4	19.6	0.0
run2	2/2/2010	14:56:15	4.05	6.70	29.4	19.8	0.0
run2	2/2/2010	14:56:30	4.12	6.62	29.0	20.0	0.0
run2	2/2/2010	14:56:45	4.29	6.66	28.9	20.2	0.0
run2	2/2/2010	14:57:00	4.24	6.75	29.4	20.2	0.0
run2	2/2/2010	14:57:15	4.24	6.42	28.7	20.3	0.0
run2	2/2/2010	14:57:30	4.61	6.58	28.7	20.2	0.0
run2	2/2/2010	14:57:45	4.65	6.03	27.1	20.1	0.0
run2	2/2/2010	14:58:00	5.45	6.13	26.8	19.7	0.0
run2	2/2/2010	14:58:15	5.24	6.63	28.4	19.4	0.0
run2	2/2/2010	14:58:30	4.49	6.67	28.9	19.5	0.0
averun2	2/2/2010	13:58:15	4.90	6.41	28.3	21.3	0.0
run3	2/2/2010	15:18:00	4.40	6.67	28.8	23.8	0.0
run3	2/2/2010	15:18:15	4.23	6.65	29.1	23.7	0.0
run3	2/2/2010	15:18:30	4.22	6.67	29.2	23.7	0.0
run3	2/2/2010	15:18:45	4.15	6.71	29.4	23.6	0.0
run3	2/2/2010	15:19:00	4.12	6.68	29.3	23.8	0.0
run3	2/2/2010	15:19:15	4.25	6.30	28.3	23.8	0.0
run3	2/2/2010	15:19:30	4.74	6.46	28.0	23.5	0.0
run3	2/2/2010	15:19:45	4.78	6.39	28.0	23.2	0.0
run3	2/2/2010	15:20:00	4.97	6.28	27.4	23.0	0.0
run3	2/2/2010	15:20:15	5.00	6.71	28.5	22.8	0.0
run3	2/2/2010	15:20:30	4.45	6.74	29.3	22.9	0.0
run3	2/2/2010	15:20:45	4.36	6.59	29.0	23.1	0.0
run3	2/2/2010	15:21:00	4.60	6.54	28.4	23.3	0.0
run3	2/2/2010	15:21:15	4.46	6.76	29.3	23.2	0.0

run3	2/2/2010	15:21:30	4.30	6.48	28.7	23.2	0.0
run3	2/2/2010	15:21:45	4.57	6.68	28.5	22.4	0.0
run3	2/2/2010	15:22:00	4.31	6.71	29.2	22.0	0.0
run3	2/2/2010	15:22:15	4.23	6.66	29.1	21.2	0.0
run3	2/2/2010	15:22:30	4.24	6.50	28.8	21.1	0.0
run3	2/2/2010	15:22:45	4.42	6.68	29.0	21.7	0.0
run3	2/2/2010	15:23:00	4.21	6.16	28.4	22.1	0.0
run3	2/2/2010	15:23:15	5.40	6.24	26.4	22.4	0.0
run3	2/2/2010	15:23:30	5.15	6.55	28.5	22.0	0.0
run3	2/2/2010	15:23:45	4.50	6.55	28.9	22.2	0.0
run3	2/2/2010	15:24:00	4.42	6.66	28.9	22.5	0.0
run3	2/2/2010	15:24:15	4.40	6.22	27.8	22.7	0.0
run3	2/2/2010	15:24:30	4.81	6.63	28.9	22.6	0.0
run3	2/2/2010	15:24:45	4.40	6.69	29.4	22.7	0.0
run3	2/2/2010	15:25:00	4.28	6.66	29.3	22.9	0.0
run3	2/2/2010	15:25:15	4.48	6.35	28.5	23.1	0.0
run3	2/2/2010	15:25:30	4.86	6.70	29.2	22.9	0.0
run3	2/2/2010	15:25:45	4.47	6.70	29.6	22.8	0.0
run3	2/2/2010	15:26:00	4.37	6.42	28.9	22.9	0.0
run3	2/2/2010	15:26:15	4.89	6.30	28.0	22.8	0.0
run3	2/2/2010	15:26:30	5.10	6.42	28.1	22.5	0.0
run3	2/2/2010	15:26:45	4.91	6.68	29.1	22.5	0.0
run3	2/2/2010	15:27:00	4.48	6.67	29.5	22.7	0.0
run3	2/2/2010	15:27:15	4.33	6.66	29.4	22.9	0.0
run3	2/2/2010	15:27:30	4.36	6.50	29.0	23.1	0.0
run3	2/2/2010	15:27:45	4.64	6.31	28.4	23.0	0.0
run3	2/2/2010	15:28:00	4.87	6.51	28.5	22.8	0.0
run3	2/2/2010	15:28:15	4.75	6.46	28.6	22.8	0.0
run3	2/2/2010	15:28:30	4.57	6.70	29.6	22.8	0.0
run3	2/2/2010	15:28:45	4.29	6.56	29.4	23.0	0.0
run3	2/2/2010	15:29:00	4.44	6.58	28.9	23.1	0.0
run3	2/2/2010	15:29:15	4.36	6.53	29.3	23.2	0.0
run3	2/2/2010	15:29:30	4.70	6.25	27.6	23.3	0.0
run3	2/2/2010	15:29:45	4.84	6.68	29.2	22.9	0.0
run3	2/2/2010	15:30:00	4.26	6.77	29.8	23.0	0.0
run3	2/2/2010	15:30:15	4.08	6.63	29.5	23.4	0.0
run3	2/2/2010	15:30:30	4.25	6.63	29.4	23.7	0.0
run3	2/2/2010	15:30:45	4.35	6.59	29.0	23.3	0.0
run3	2/2/2010	15:31:00	4.59	6.26	27.8	21.2	0.0
run3	2/2/2010	15:31:15	4.85	6.42	28.1	19.1	0.0
run3	2/2/2010	15:31:30	4.75	6.00	27.4	18.0	0.0
run3	2/2/2010	15:31:45	5.66	5.97	26.5	17.5	0.0
run3	2/2/2010	15:32:00	6.12	5.85	25.0	17.5	0.0
run3	2/2/2010	15:32:15	6.21	5.95	26.2	17.6	0.0
run3	2/2/2010	15:32:30	6.06	6.20	26.6	18.0	0.0
run3	2/2/2010	15:32:45	5.62	6.21	27.6	18.5	0.0
run3	2/2/2010	15:33:00	5.53	6.06	27.1	19.1	0.0
run3	2/2/2010	15:33:15	5.70	6.01	26.8	19.4	0.0
run3	2/2/2010	15:33:30	6.04	5.78	25.6	19.5	0.0
run3	2/2/2010	15:33:45	6.47	5.60	24.8	19.3	0.0
run3	2/2/2010	15:34:00	6.53	6.18	26.9	19.0	0.0
run3	2/2/2010	15:34:15	5.59	6.18	27.6	19.2	0.0
run3	2/2/2010	15:34:30	5.67	5.66	25.3	19.1	0.0
run3	2/2/2010	15:34:45	6.25	6.14	26.5	18.4	0.0
run3	2/2/2010	15:35:00	5.50	6.27	28.0	18.4	0.0
run3	2/2/2010	15:35:15	5.33	6.01	27.0	19.1	0.0
run3	2/2/2010	15:35:30	5.73	6.24	27.4	19.5	0.0

run3	2/2/2010	15:35:45	5.32	6.30	28.3	19.8	0.0
run3	2/2/2010	15:36:00	5.19	6.32	27.8	20.3	0.0
run3	2/2/2010	15:36:15	5.06	6.31	28.1	20.7	0.0
run3	2/2/2010	15:36:30	5.00	6.23	28.1	20.8	0.0
run3	2/2/2010	15:36:45	5.11	6.34	28.0	20.9	0.0
run3	2/2/2010	15:37:00	4.83	6.43	28.6	21.1	0.0
run3	2/2/2010	15:37:15	4.97	6.09	26.9	21.3	0.0
run3	2/2/2010	15:37:30	5.41	6.23	27.2	21.1	0.0
run3	2/2/2010	15:37:45	5.33	6.28	27.4	20.9	0.0
run3	2/2/2010	15:38:00	5.17	6.29	28.0	21.0	0.0
run3	2/2/2010	15:38:15	5.17	6.24	27.5	21.0	0.0
run3	2/2/2010	15:38:30	5.41	6.02	26.3	21.1	0.0
run3	2/2/2010	15:38:45	5.63	6.19	27.1	21.0	0.0
run3	2/2/2010	15:39:00	5.60	5.98	25.9	20.9	0.0
run3	2/2/2010	15:39:15	5.95	6.29	26.4	20.8	0.0
run3	2/2/2010	15:39:30	5.52	6.11	26.4	20.9	0.0
run3	2/2/2010	15:39:45	5.51	6.41	27.3	21.3	0.0
run3	2/2/2010	15:40:00	5.05	6.17	27.2	21.5	0.0
run3	2/2/2010	15:40:15	5.34	6.33	27.5	21.7	0.0
run3	2/2/2010	15:40:30	5.20	6.27	27.6	21.9	0.0
run3	2/2/2010	15:40:45	5.15	6.55	28.0	21.9	0.0
run3	2/2/2010	15:41:00	4.66	6.35	28.4	22.2	0.0
run3	2/2/2010	15:41:15	4.97	6.45	28.0	22.5	0.0
run3	2/2/2010	15:41:30	4.62	6.65	29.1	22.4	0.0
run3	2/2/2010	15:41:45	4.60	6.21	27.4	22.6	0.0
run3	2/2/2010	15:42:00	4.83	6.36	28.3	22.6	0.0
run3	2/2/2010	15:42:15	4.95	6.56	27.6	22.5	0.0
run3	2/2/2010	15:42:30	4.43	6.69	29.1	22.5	0.0
run3	2/2/2010	15:42:45	4.21	6.10	27.6	22.8	0.0
run3	2/2/2010	15:43:00	5.29	6.44	27.2	22.7	0.0
run3	2/2/2010	15:43:15	4.84	6.60	28.5	22.3	0.0
run3	2/2/2010	15:43:30	4.43	6.69	29.1	22.5	0.0
run3	2/2/2010	15:43:45	4.24	6.51	28.7	22.8	0.0
run3	2/2/2010	15:44:00	4.45	6.38	28.4	23.0	0.0
run3	2/2/2010	15:44:15	4.95	6.14	27.1	22.8	0.0
run3	2/2/2010	15:44:30	5.35	6.32	27.2	22.4	0.0
run3	2/2/2010	15:44:45	5.06	6.56	28.7	22.0	0.0
run3	2/2/2010	15:45:00	4.56	6.17	28.5	22.1	0.0
run3	2/2/2010	15:45:15	5.57	6.25	26.1	22.1	0.0
run3	2/2/2010	15:45:30	5.30	6.55	28.6	21.7	0.0
run3	2/2/2010	15:45:45	4.57	6.66	29.4	21.9	0.0
run3	2/2/2010	15:46:00	4.74	6.11	27.1	22.2	0.0
run3	2/2/2010	15:46:15	5.07	6.71	28.7	22.0	0.0
run3	2/2/2010	15:46:30	4.36	6.69	29.1	22.2	0.0
run3	2/2/2010	15:46:45	4.18	6.52	28.8	22.7	0.0
run3	2/2/2010	15:47:00	4.42	6.25	27.9	22.7	0.0
run3	2/2/2010	15:47:15	5.13	6.60	27.5	22.6	0.0
run3	2/2/2010	15:47:30	4.63	6.70	29.1	22.5	0.0
run3	2/2/2010	15:47:45	4.39	6.70	29.0	22.7	0.0
run3	2/2/2010	15:48:00	4.50	6.44	28.3	22.9	0.0
run3	2/2/2010	15:48:15	4.78	6.16	28.0	22.8	0.0
run3	2/2/2010	15:48:30	5.26	6.39	27.6	22.6	0.0
run3	2/2/2010	15:48:45	5.00	6.34	27.9	22.4	0.0
run3	2/2/2010	15:49:00	4.86	6.65	28.8	22.4	0.0
run3	2/2/2010	15:49:15	4.29	6.61	29.3	22.7	0.0
run3	2/2/2010	15:49:30	4.22	6.63	29.1	22.9	0.0
run3	2/2/2010	15:49:45	4.26	6.21	28.1	23.0	0.0

run3	2/2/2010	15:50:00	5.03	6.31	27.3	22.8	0.0
run3	2/2/2010	15:50:15	4.99	6.66	28.9	22.3	0.0
run3	2/2/2010	15:50:30	4.66	5.94	27.0	22.6	0.0
run3	2/2/2010	15:50:45	5.57	5.97	26.5	22.1	0.0
run3	2/2/2010	15:51:00	5.88	5.94	26.1	21.6	0.0
run3	2/2/2010	15:51:15	6.15	5.91	26.2	21.2	0.0
run3	2/2/2010	15:51:30	6.14	6.35	27.0	20.9	0.0
run3	2/2/2010	15:51:45	5.19	6.71	29.5	20.9	0.0
run3	2/2/2010	15:52:00	4.47	6.56	29.3	21.5	0.0
run3	2/2/2010	15:52:15	4.53	6.39	28.8	22.0	0.0
run3	2/2/2010	15:52:30	5.26	5.97	26.3	22.1	0.0
run3	2/2/2010	15:52:45	5.59	6.55	28.6	21.5	0.0
run3	2/2/2010	15:53:00	4.95	6.44	28.6	21.4	0.0
run3	2/2/2010	15:53:15	4.79	6.42	28.6	21.5	0.0
run3	2/2/2010	15:53:30	4.79	6.67	29.2	21.8	0.0
run3	2/2/2010	15:53:45	4.43	6.61	29.2	22.0	0.0
run3	2/2/2010	15:54:00	4.43	6.50	29.0	22.2	0.0
run3	2/2/2010	15:54:15	4.54	6.42	28.5	22.2	0.0
run3	2/2/2010	15:54:30	4.76	6.44	28.4	22.2	0.0
run3	2/2/2010	15:54:45	4.98	6.45	27.6	21.9	0.0
run3	2/2/2010	15:55:00	4.89	5.91	26.9	21.8	0.0
run3	2/2/2010	15:55:15	5.83	6.33	27.2	21.5	0.0
run3	2/2/2010	15:55:30	5.25	6.66	28.8	21.2	0.0
run3	2/2/2010	15:55:45	4.53	6.59	29.1	21.7	0.0
run3	2/2/2010	15:56:00	4.33	6.65	29.2	22.0	0.0
run3	2/2/2010	15:56:15	4.21	6.72	29.6	22.1	0.0
run3	2/2/2010	15:56:30	4.09	6.65	29.6	22.3	0.0
run3	2/2/2010	15:56:45	4.23	6.51	28.9	22.5	0.0
run3	2/2/2010	15:57:00	4.58	6.36	28.5	22.5	0.0
run3	2/2/2010	15:57:15	5.06	6.23	27.4	22.3	0.0
run3	2/2/2010	15:57:30	5.10	6.35	28.3	22.0	0.0
run3	2/2/2010	15:57:45	5.00	5.94	26.9	21.8	0.0
run3	2/2/2010	15:58:00	5.45	6.43	28.4	21.5	0.0
run3	2/2/2010	15:58:15	4.91	6.46	28.9	21.4	0.0
run3	2/2/2010	15:58:30	5.04	6.31	27.8	21.6	0.0
run3	2/2/2010	15:58:45	4.98	6.41	28.9	21.7	0.0
run3	2/2/2010	15:59:00	4.91	6.23	27.9	21.7	0.0
run3	2/2/2010	15:59:15	5.41	5.83	26.1	21.7	0.0
run3	2/2/2010	15:59:30	5.82	6.52	28.2	21.2	0.0
run3	2/2/2010	15:59:45	4.95	6.43	28.9	21.2	0.0
run3	2/2/2010	16:00:00	5.00	6.35	28.0	21.5	0.0
run3	2/2/2010	16:00:15	4.81	6.61	29.3	21.6	0.0
run3	2/2/2010	16:00:30	4.40	6.73	29.6	21.8	0.0
run3	2/2/2010	16:00:45	4.15	6.41	29.4	22.3	0.0
run3	2/2/2010	16:01:00	5.01	6.35	27.4	22.4	0.0
run3	2/2/2010	16:01:15	4.88	6.57	29.6	22.2	0.0
run3	2/2/2010	16:01:30	4.98	6.05	27.3	22.2	0.0
run3	2/2/2010	16:01:45	5.31	6.27	28.5	21.9	0.0
run3	2/2/2010	16:02:00	5.43	6.13	26.9	21.6	0.0
run3	2/2/2010	16:02:15	5.22	6.62	29.2	20.9	0.0
run3	2/2/2010	16:02:30	4.66	6.48	28.8	21.0	0.0
run3	2/2/2010	16:02:45	5.13	6.07	26.8	21.3	0.0
run3	2/2/2010	16:03:00	5.50	5.87	26.8	21.3	0.0
run3	2/2/2010	16:03:15	5.76	6.43	27.8	21.0	0.0
run3	2/2/2010	16:03:30	4.95	6.71	29.0	21.1	0.0
run3	2/2/2010	16:03:45	4.40	6.71	29.4	21.6	0.0
run3	2/2/2010	16:04:00	4.40	6.53	29.0	22.2	0.0

run3	2/2/2010	16:04:15	4.57	6.55	28.7	22.3	0.0
run3	2/2/2010	16:04:30	4.35	6.74	29.5	22.5	0.0
run3	2/2/2010	16:04:45	4.42	6.19	27.9	22.6	0.0
run3	2/2/2010	16:05:00	5.43	5.72	25.7	22.3	0.0
run3	2/2/2010	16:05:15	6.08	6.52	27.5	21.5	0.0
run3	2/2/2010	16:05:30	4.81	6.56	28.9	21.5	0.0
run3	2/2/2010	16:05:45	4.47	6.69	29.0	22.0	0.0
run3	2/2/2010	16:06:00	4.28	6.62	29.3	22.4	0.0
run3	2/2/2010	16:06:15	4.35	6.49	28.8	22.8	0.0
run3	2/2/2010	16:06:30	4.81	6.34	27.4	22.7	0.0
run3	2/2/2010	16:06:45	4.79	6.28	28.2	22.4	0.0
run3	2/2/2010	16:07:00	5.26	6.49	27.2	22.2	0.0
run3	2/2/2010	16:07:15	4.65	6.69	28.8	22.0	0.0
run3	2/2/2010	16:07:30	4.18	6.56	29.1	22.2	0.0
run3	2/2/2010	16:07:45	4.43	5.73	27.3	22.5	0.0
run3	2/2/2010	16:08:00	6.33	6.28	25.3	21.9	0.0
run3	2/2/2010	16:08:15	5.42	6.48	28.9	21.2	0.0
run3	2/2/2010	16:08:30	4.74	6.59	29.0	21.4	0.0
run3	2/2/2010	16:08:45	4.40	6.57	29.2	21.7	0.0
run3	2/2/2010	16:09:00	4.48	6.43	28.5	22.0	0.0
run3	2/2/2010	16:09:15	4.61	6.25	28.1	22.1	0.0
run3	2/2/2010	16:09:30	4.94	6.03	28.0	22.0	0.0
run3	2/2/2010	16:09:45	5.74	6.01	25.9	21.6	0.0
run3	2/2/2010	16:10:00	5.79	6.56	28.3	21.0	0.0
run3	2/2/2010	16:10:15	4.74	6.62	29.7	21.1	0.0
run3	2/2/2010	16:10:30	4.47	6.34	28.5	21.5	0.0
run3	2/2/2010	16:10:45	5.14	6.15	27.0	21.5	0.0
run3	2/2/2010	16:11:00	5.02	6.71	29.4	21.2	0.0
run3	2/2/2010	16:11:15	4.36	6.63	29.4	21.5	0.0
run3	2/2/2010	16:11:30	4.38	6.37	28.7	21.7	0.0
run3	2/2/2010	16:11:45	4.93	6.21	27.6	21.7	0.0
run3	2/2/2010	16:12:00	5.31	6.30	27.7	21.4	0.0
run3	2/2/2010	16:12:15	5.22	6.52	28.5	21.2	0.0
run3	2/2/2010	16:12:30	4.73	6.78	29.5	21.4	0.0
run3	2/2/2010	16:12:45	4.34	6.52	29.1	21.7	0.0
run3	2/2/2010	16:13:00	4.53	6.55	29.3	22.0	0.0
run3	2/2/2010	16:13:15	4.78	6.39	27.8	22.0	0.0
run3	2/2/2010	16:13:30	4.71	6.49	28.8	21.7	0.0
run3	2/2/2010	16:13:45	4.56	6.46	28.7	21.8	0.0
run3	2/2/2010	16:14:00	4.52	6.40	28.8	21.8	0.0
run3	2/2/2010	16:14:15	4.89	6.38	27.8	21.7	0.0
run3	2/2/2010	16:14:30	4.88	6.15	28.0	21.7	0.0
run3	2/2/2010	16:14:45	5.24	6.68	28.7	21.6	0.0
run3	2/2/2010	16:15:00	4.52	6.18	28.3	21.4	0.0
run3	2/2/2010	16:15:15	5.14	6.58	28.6	21.5	0.0
run3	2/2/2010	16:15:30	4.54	6.49	29.5	21.2	0.0
run3	2/2/2010	16:15:45	4.75	6.07	27.5	20.2	0.0
run3	2/2/2010	16:16:00	5.59	6.53	27.8	19.6	0.0
run3	2/2/2010	16:16:15	5.02	6.24	28.1	19.6	0.0
run3	2/2/2010	16:16:30	5.26	6.27	27.9	19.7	0.0
run3	2/2/2010	16:16:45	5.23	6.10	28.0	19.7	0.0
run3	2/2/2010	16:17:00	5.51	6.43	27.8	19.6	0.0
run3	2/2/2010	16:17:15	5.02	5.91	27.4	19.6	0.0
run3	2/2/2010	16:17:30	5.49	6.67	29.2	19.5	0.0
run3	2/2/2010	16:17:45	4.83	5.89	27.5	19.6	0.0
averun3	2/2/2010	15:18:00	4.90	6.39	28.2	21.7	0.0

Sample & Traverse Point Determination

Sample Traverse Points for Method 7E, NOx Determination

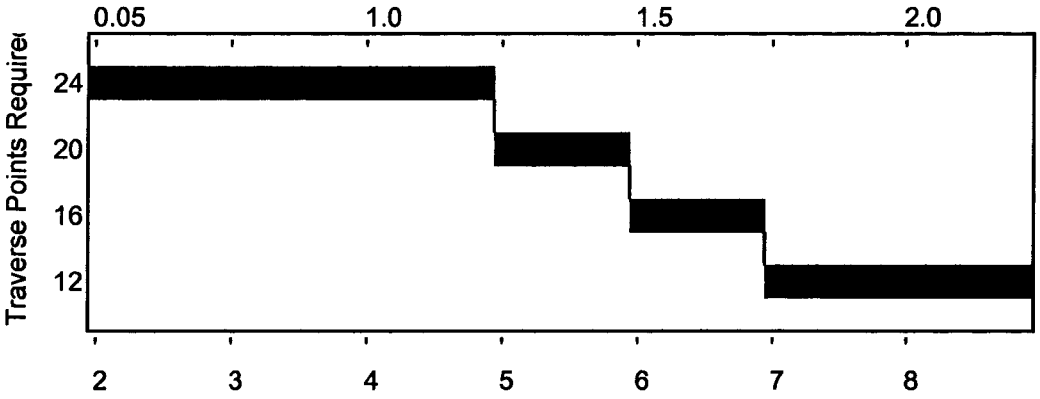
EPA Method 1 Circular Ducts

Client: ConocoPhillips
Location: Ferndale Refinery
Source: SRU#2
Date: February 2, 2010
Project No.: 2010.1601

Stack Diameter(in.): 69
Points Required: 24
Distance A(in.): 52.0
Distance A(dia.): 0.8
Distance B: 208.0
Distance B(dia.): 3.0

Sample Port Location

Duct Diameters upstream from flow disturbance (distance A)



Sample Port Location

Duct Diameters downstream from flow disturbance (distance B)

Traverse Point No.	Number of Traverse Points on a Diameter					***Sample Points***	Port *18.0*
	3	6	8	10	12		
1	16.7	4.4	3.2	2.6	2.1	*1.4*	***19.4***
2	50.0	14.6	10.5	8.2	6.7	*4.6*	***22.6***
3	83.3	29.6	19.4	14.6	11.8	*8.1*	***26.1***
4		70.4	32.2	22.6	17.7	*12.2*	***30.2***
5		85.5	67.7	34.2	25	*17.3*	***35.3***
6		95.6	80.6	65.8	35.6	*24.6*	***42.6***
7			89.5	77.4	64.4	*44.4*	***62.4***
8			96.8	85.4	75	*51.8*	***69.8***
9				91.8	82.3	*56.8*	***74.8***
10				97.4	88.2	*60.9*	***78.9***
11					93.3	*64.4*	***82.4***
12					97.9	*67.6*	***85.6***

SRU #2 Exhaust Duct EPA 1-4

Client: ConocoPhillips
Location: Ferndale, Washington
Source: SRU #2 Exhaust Duct
Date: February 2, 2010
Project No.: 2010.1601

		Run #1	Run #2	Run #3	
		2/2/2010	2/2/2010	2/2/2010	
	Start	12:40	13:58	15:18	
	End	13:40	14:58	16:18	**Averages**
Q:	Total sample time[1]:	60	60	60	**60**
Vm:	(Volume,dry gas meter,cf)	33.600	34.000	33.600	**33.733**
Y:	(Dry gas meter calibration factor)	1.004	1.004	1.004	**1.004**
Pbar:	(Barometric pressure,in.Hg)	29.62	29.62	29.62	**29.62**
ΔH:	(Avg. differential pressure,in.H2O)	1.00	1.00	1.00	**1.00**
Tm:	(Avg. meter temperature,ºF)	67.6	75.8	77.8	**73.7**
Vm(std.):	(Std.* sample gas volume, DSCF)	33.491	33.371	32.856	**33.239**
	(Std.* sample gas volume, DSCM)	0.95	0.95	0.93	**0.943**
Vlc:	(Liquid volume collected,ml)	72.6	77.9	69.7	**73.4**
WV:	(Final silica weight)	7.9	5.5	4.2	**5.9**
Vw(std):	(Std.* water vapor volume,scf)	3.790	3.926	3.479	**3.732**
SVP:	(Saturated H_2O vapor pressure, in. Hg)	187.95	168.28	160.34	**172.19**
Bwsat:	(Saturated Moisture @ Ts)	6.347	5.683	5.415	**5.815**
Bwsvol	(Volumemetric Moisture content)	0.102	0.105	0.096	**0.101**
Bws:	(SCF H_2O / SCF Total)[2]	0.102	0.105	0.096	**0.101**
%CO_2:	(Carbon Dioxide,% by volume,dry)	6.40	6.50	6.50	**6.47**
%O_2:	(Oxygen,% by volume,dry)	5.10	5.00	4.90	**5.00**
%N_2:	(Nitrogen,% by volume,dry)	88.50	88.50	88.60	**88.53**
Md:	(Molecular Weight,lb/lb-mole,dry)	29.23	29.24	29.24	**29.24**
Mw:	(Molecular Weight,lb/lb-mole,wet)	28.08	28.06	28.16	**28.10**
D:	(Duct diameter, in.) non-circular	69.00	69.00	69.00	**69.00**
A:	(Duct area, sq. ft.)	25.97	25.97	25.97	**25.97**
Ts:	(Stack temperature, ºF)	364.9	353.4	348.5	**355.6**
Pg:	(Static pressure of flue gas, in. H_2O)	-0.13	-0.13	-0.13	**-0.13**
Ps:	(Absolute stack gas pressure, in. Hg)	29.61	29.61	29.61	**29.61**
Cp:	(Pitot tube coefficient)	0.80	0.80	0.80	**0.80**
ΔP:	(Average velocity head, in. H_2O)	0.005	0.005	0.005	**0.005**
ΔP:	(Average velocity head, SqRt in. H_2O)	0.069	0.072	0.070	**0.070**
Vs:	(Gas velocity, ft./second)	4.7	4.8	4.8	**4.8**
ACFM:	(Actual cubic feet/min., wet)	7,324	7,479	7,479	**7,427**
SCFM	(Std. cubic ft/min., wet)	4,641	4,807	4,836	**4,761**
SDCFM:	(Std.* cubic feet/min., dry)	4,166	4,300	4,370	**4,279**
SDCMM:	(Std.* cubic meter/min., dry)	118	122	124	**121**

[1] - Total sample time does not include port change.

[2] - If the Volumetric moisture exceeds the calculated saturated moisture, the calculated saturated moisture is used.

Client: Conoco Phillips
Location: Ferndale WA
Source: SRU #2
Date: 2-2-10
Project No.: 2010.1601

ETS ENVIRONMENTAL TECHNICAL SERVICES, LLC

		Run #1	Run #2	Run #3
Time:	start:	1240	1358	518
	finish:	1340	1458	1618
Q: Total sample time(min.):		60	60	60
Vm: (Volume,dry gas meter,cf)		33.600	34.000	33.600
Y: (Dry gas meter calibration factor)		1.004	1.004	1.004
Pbar: (Barometric pressure,in.Hg)		29.62	29.62	29.62
DH: (Avg. differential pressure,in.H2O)		1.00	1.00	1.00
Tm: (Avg. meter temperature,°F)		67.0	75.8	77.8

	RUN #: 1 Filter #:			RUN #: Filter #:			RUN #: Filter #:		
	Filter tare weight, gms.:			Filter tare weight, gms.:			Filter tare weight, gms.:		
CONTENTS	FINAL	TARE	NET	FINAL	TARE	NET	FINAL	TARE	NET
100 ml	841.2	770.5	70.7	891.2	841.2	50.0	834.0	772.5	61.5
100 ml	740.3	738.6	1.7	763.9	740.3	23.6	770.4	763.9	6.5
K.O.	548.3	548.1	0.2	552.6	548.3	4.3	554.3	552.6	1.7
Silica	921.5	913.6	7.9	927.0	921.5	5.5	931.2	927.0	4.2
Vlc: (Liquid volume collected, ml)			72.6			77.9			68.7
Si: (Silica Gel)			7.9			5.5			4.2

%CO2: (Carbon Dioxide,% by volume,dry)	6.40	6.50	6.50
%O2: (Oxygen,% by volume,dry)	5.1	5.0	4.9
%N: (Nitrogen,% by volume,dry)	88.5	88.5	88.6
D: (Duct diameter, in.)	62.0	69.0	69.0
A: (Duct area, sq. ft.)	25.97	25.97	25.97
Dn: (Nozzle diameter, inches)	—	—	—
Ts: (Stack temperature, °F)	364.9	353.9	348.5
Pg: (Static pressure of flue gas, in. H_2O)	-0.13	-0.13	-0.13
Ps: (Absolute stack gas pressure, in. Hg)	29.61	29.61	29.61
Cp: (Pitot tube coefficient)	0.80	0.80	0.80
#: (Pitot tube number)	I.10.1	I.10.1	I.10.1
$\sqrt{DP}$: (Average velocity head, in. H_2O)	0.064	0.072	0.070
% ISO: (Mini iso)	—	—	—

*Standard conditions corrected to 68°F, 29.92 in. Hg.

Method 4 Data Sheet

Method: EPA 1-4
Company/Plant: Conoco Phillips
Sampling location: SRU #2
Date: 2-2-10 Project #: 2010.16001
Operator: GH
Meter Box #: HE-5 Meter Box H@: 1.84
Meter Box Calibration(Y): 1.004
Probe #: I, 10, 1 C_p: 0.50

Pitot Tube Leak Check			
Side A:	✓	@ 5	(in)H_2O
Side B:	✓	@ 5	(in)H_2O

Sample Train Leak Check				
Initial:	✓	Cuft@ -10		(in)Hg
Final:	0.004	Cuft@ -10		(in)Hg

Run #: 1
Barometric Pressure(P_b): 25.62 (in)Hg
Duct Diameter(in): 69.0 (D_b) (D_a)
Assumed Moisture(%) (T_w): (T_d):
Static Pressure("H_2O): -0.13
Probe Material: SS
Impinger Exit #: X-3

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min./pt	Time		Sample	Stack	Velocity	Pressure	Gas sample	Dry Gas Meter Temp (°F)		Sample Probe Temps(°F)		Exit
Traverse Pt. Number	Sampling Time	Clock (24 hr.)	Vacuum (in)Hg.	Temp (°F)	Head $\Delta Ps(in)H_2O$	Differential ΔH (in) H_2O	Volume (Vm) (Cuft)	Inlet	Outlet	Probe	Filter	Gas Temp(°F)
8	0	1240	-1	370	0.0023	1.0	850.700	62	62			—
7	5	1245	-1	373	0.0066	1.0		63	61			41
6	10	1250	-1	375	0.0071	1.0		65	62			42
5	15	1255	-1	384	0.0078	1.0		68	62			48
4	20	1300	-1	390	0.0049	1.0		70	63			50
3	25	1305	-1	381	0.0031	1.0		72	64			52
2	30	1310	-1	345	0.0033	1.0		72	64			51
1	35	1315	-1	336	0.0041	1.0		74	65			52
8	40	1320	-1	320	0.0037	1.0		75	66			53
7	45	1325	-1	348	0.0053	1.0		76	67			54
6	50	1330	-1	363	0.0076	1.0		77	68			55
5	55	1335	-1	377	0.0069	1.0		77	68			52
4	60	1340		380	0.0043		884.300					
3				384	0.0030							
2				373	0.0025							
1				340	0.0036							
Average												

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Method 4 Data Sheet

Method: EPA 1-4
Company/Plant: Cleco Rodemacher
Sampling location: Emission
Date: 2-2-10 Project #: 2010.1601
Operator: CAW
Meter Box #: 16 Meter Box H@: 1.84
Meter Box Calibration(Y): 1.004
Probe #: 7.10.1 C_p: 0.90

Pitot Tube Leak Check			
Side A:	—	@ 5	(in)H_2O
Side B:	—	@ 5	(in)H_2O

Sample Train Leak Check			
Initial:	—	Cuft@ -0	(in)Hg
Final:	0.032	Cuft@ -8	(in)Hg

Run #: 2
Barometric Pressure(P_b): 29.62 (in)Hg
Duct Diameter(in): 69.0 (D_b) (D_a)
Assumed Moisture(%) (T_w): (T_d):
Static Pressure("H_2O): -0.12
Probe Material: SS
Impinger Exit #: 1-3

min./pt	Time		Sample	Stack	Velocity	Pressure	Gas sample	Dry Gas Meter Temp (°F)		Sample Probe Temps(°F)		Exit
Traverse Pt. Number	Sampling Time	Clock (24 hr.)	Vacuum (in)Hg.	Temp (°F)	Head $\Delta Ps(in)H_2O$	Differential ΔH (in) H_2O	Volume (Vm) (Cuft)	Inlet	Outlet	Probe	Filter	Gas Temp(°F)
8	0	1358	-2	290	0.031	1.0	884.520	72	70			—
7	5	1403	-2	327	0.0065	1.0		74	71			51
6	10	1408	-2	354	0.087	1.0		75	72			57
5	15	1413	-2	372	0.063	1.0		77	71			50
4	20	1418	-2	370	0.057	1.0		78	71			50
3	25	1423	-2	365	0.0045	1.0		80	72			50
2	30	1428	-2	336	0.029	1.0		81	73			49
1	35	1433	-2	317	0.045	1.0		81	73			49
8	40	1438	-2	310	0.021	1.0		82	74			49
7	45	1443	-2	347	0.064	1.0		82	74			50
6	50	1448	-2	371	0.068	1.0		83	75			50
5	55	1453	-2	388	0.069	1.0		83	75			51
4	60	1458		388	0.051		918.520					
3				388	0.041							
2				374	0.051							
1				345	0.047							
Average												

Method 4 Data Sheet

Method: EPA 1-4
Company/Plant: Cypress Pipelines
Sampling location: Farmington NM
Date: 2-2-10 Project #: 2010.1001
Operator: CTW
Meter Box #: 1A-5 Meter Box H@: 1.824
Meter Box Calibration(Y): 1.004
Probe #: Z,10.1 C_p: 0.80

Pitot Tube Leak Check			
Side A:	✓ @	5	(in)H_2O
Side B:	✓ @	5	(in)H_2O

Sample Train Leak Check				
Initial:	✓	Cuft@	-10	(in)Hg
Final:	0.004	Cuft@	-10	(in)Hg

Run #: 3
Barometric Pressure(P_b): 29.62 (in)Hg
Duct Diameter(in): 65 (D_b) (D_a)
Assumed Moisture(%) (T_w): (T_d):
Static Pressure("H_2O): -0.12
Probe Material: SS
Impinger Exit #: X-3

min./pt	Time		Sample	Stack	Velocity	Pressure	Gas sample	Dry Gas Meter Temp (°F)		Sample Probe Temps(°F)		Exit
Traverse Pt. Number	Sampling Time	Clock (24 hr.)	Vacuum (in)Hg.	Temp (°F)	Head ΔPs(in)H_2O	Differential ΔH (in) H_2O	Volume (Vm) (Cuft)	Inlet	Outlet	Probe	Filter	Gas Temp(°F)
8	0	1518	-2	290	0.0028	1.0	918.900	70	70			—
7	5	1523	-2	315	0.0057	1.0		77	75			55
6	10	1528	-2	350	0.0072	1.0		78	75			54
5	15	1533	-2	344	0.0075	1.0		79	75			52
4	20	1538	-2	372	0.0070	1.0		80	75			52
3	25	1543	-2	348	0.0036	1.0		80	75			52
2	30	1548	-2	345	0.0051	1.0		81	75			52
1	35	1553	-2	313	0.0039	1.0		82	75			52
8	40	1558	-2	318	0.0031	1.0		82	75			51
7	45	1603	-2	344	0.0054	1.0		83	76			51
6	50	1608	-2	365	0.0061	1.0		83	77			51
5	55	1613	-2	385	0.0066	1.0		82	76			51
4	60	1618		391	0.0049		952.500					
3				387	0.0029							
2				364	0.0044							
1				323	0.0041							
Average												

Sample & Traverse Point Determination

Minimum Number of Traverse Points for Velocity Traverses

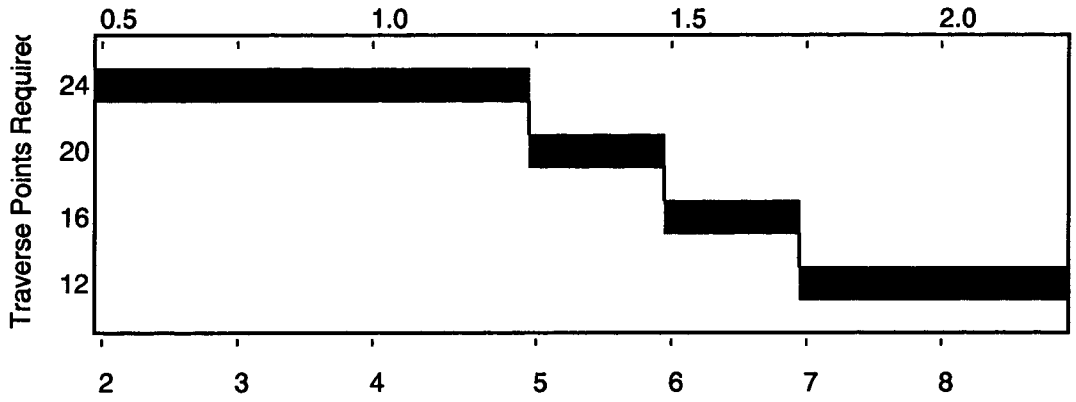
EPA Method 1 Circular Ducts

Client: ConocoPhillips
Location: Ferndale, Washington
Source: SRU #2 Exhaust Duct
Date: 2/2/2010
Project No.: 2010.1601

Stack Diameter(in.): 69
Points Required: 16
Distance A(in.): 120.0
Distance A(dia.): 1.7
Distance B: 192.0
Distance B(dia.): 2.8

Sample Port Location

Duct Diameters upstream from flow disturbance (distance A)



Sample Port Location

Duct Diameters downstream from flow disturbance (distance B)

Traverse Point No.	Number of Traverse Points on a Diameter					*Sample Points*	*Port 18.0*
	4	6	**8**	10	12		
1	6.7	4.4	**3.2**	2.6	2.1	***2.2***	***20.2***
2	25.0	14.6	**10.5**	8.2	6.7	***7.2***	***25.2***
3	75.0	29.6	**19.4**	14.6	11.8	***13.4***	***31.4***
4	93.3	70.4	**32.2**	22.6	17.7	***22.2***	***40.2***
5		85.5	**67.7**	34.2	25	***46.7***	***64.7***
6		95.6	**80.6**	65.8	35.6	***55.6***	***73.6***
7			**89.5**	77.4	64.4	***61.8***	***79.8***
8			**96.8**	85.4	75	***66.8***	***84.8***
9				91.8	82.3		
10				97.4	88.2		
11					93.3		
12					97.9		

Cyclonic Cutoff

Method 4 Data Sheet

Method: 2H 2

Company/Plant: Conoco Phillips

Sampling location: SRU #2

Date: 2-2-10 Project #: 2070.1601

Operator: Gabe

Meter Box #: 1H Meter Box H@: —

Meter Box Calibration(Y): —

Probe #: 2.10.1 C_p:

Pitot Tube Leak Check			
Side A:	✓	@ 5	(in)H_2O
Side B:	✓	@ 5	(in)H_2O

Sample Train Leak Check		
Initial:	Cuft@	(in)Hg
Final:	Cuft@	(in)Hg

Run #: Init

Barometric Pressure(P_b): 29.62 (in)Hg

Duct Diameter(in): 6.4 (D_b) (D_a)

Assumed Moisture(%) — (T_w): (T_d):

Static Pressure("H_2O): —

Probe Material: —

Impinger Exit #: —

min./pt Traverse Pt. Number	Time: Sampling Time	Time: Clock (24 hr.)	Sample Vacuum (in)Hg.	Stack Temp (°F)	Velocity Head ΔPs(in)H_2O	Pressure Differential ΔH (in) H_2O	Gas sample Volume (Vm) (Cuft)	Dry Gas Meter Temp (°F): Inlet	Dry Gas Meter Temp (°F): Outlet	Sample Probe Temps(°F): Probe	Sample Probe Temps(°F): Filter	Exit Gas Temp(°F)
8					0							
7					0							
6					0							
5					0							
4					0							
3					0							
2					0							
1					0							
8					0							
7					0							
6					0							
5					0							
4					0							
3					0							
2					0							
1					0							
Average												

Run #1

VISIBLE EMISSION OBSERVATION FORM

Company Name: Conoco Phillips		
Location:		
City: Ferndale	State: WA	Zip:
Process Equipment: SRU #2		Operating Mode:
Control Equipment:		Operating Mode:

Describe Emission Point: Exhaust of stack

Height Above Ground Level: 140'	Height Relative to Observer: Start 134' End 134'
Distance From Observer: Start 280' End 280'	Direction From Observer: Start N End N
Vertical Angle to Plume: 15°	Horizontal Angle to Plume: 0°

Describe Emissions: Start lofting End lofting

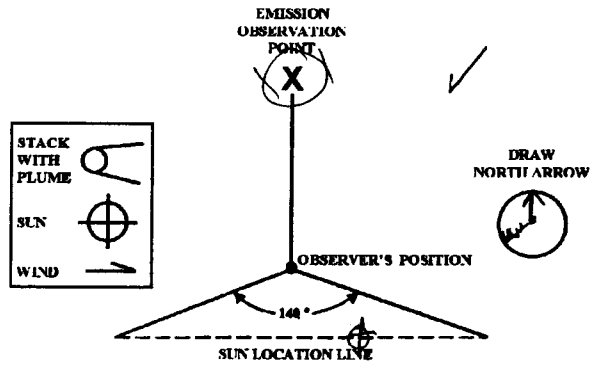
Emission Color: Start clear End clear	If Water Droplet Plume: Attached ☐ Detached ☐ N/A ☒

Point In The Plume At Which Opacity Was Determined: Start Exhaust of stack End Exhaust of stack

Describe Plume Background: Start Sky End Sky

Background Color: Start Blue End Blue	Sky Condition: Start partly (cloudy) End Partly Cloudy	
Wind Speed: Start 0-8 End 0-8	Wind Direction: Start NE End NE	
Ambient Temp: Start End	Wet Bulb Temp	RH Percent

SOURCE LAYOUT SKETCH



Observation Date	Start Time	End Time
2/2/2010	1310	1316

Min \ Sec	0	15	30	45	Comments
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	0% Average Opacity
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	
7					
8					
9					
10					
11					
12					
13					
14					
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16					
17					
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28					
29					
30					

Observer's Name (Print): Jacob Buss	
Observer's Signature: Jacob Buss	Date: 2/2/2010
Organization: ETS	
Certified by: Smoke School Inc.	Date:

Continue on reverse side

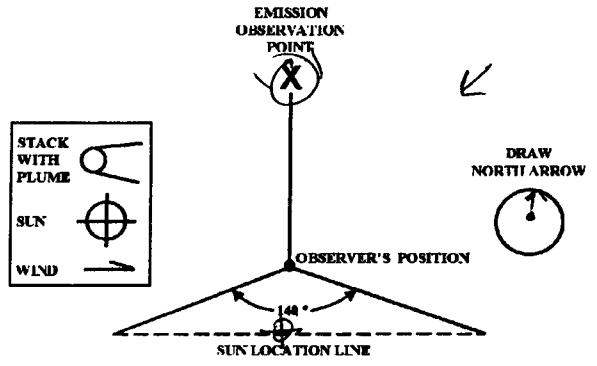
Additional Information: Run #1

Run #2

VISIBLE EMISSION OBSERVATION FORM

Company Name: Conoco Phillips		
Location:		
City: Ferndale	State: WA	Zip:
Process Equipment: SRU #2		Operating Mode:
Control Equipment:		Operating Mode:
Describe Emission Point: Exhaust of stack		
Height Above Ground Level: 140'	Height Relative to Observer: Start 134' End 134'	
Distance From Observer: Start 280' End 280'	Direction From Observer: Start N End N	
Vertical Angle to Plume: 15°	Horizontal Angle to Plume: 0°	
Describe Emissions: Start lofting End lofting		
Emission Color: Start Clear End Clear	If Water Droplet Plume: Attached ☐ Detached ☐ N/A ☒	
Point In The Plume At Which Opacity Was Determined: Start Exhaust of stack End Exhaust of stack		
Describe Plume Background: Start sky End sky		
Background Color: Start Blue End Blue	Sky Condition: Start partly cloudy End partly cloudy	
Wind Speed: Start 0-8 End 0-8	Wind Direction: Start NE End NE	
Ambient Temp: Start End	Wet Bulb Temp	RH Percent

SOURCE LAYOUT SKETCH



Additional Information
Run #2

Observation Date	Start Time	End Time
2/2/2010	1430	1436

Min \ Sec	0	15	30	45	Comments
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	0% Average Opacity
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

Observer's Name (Print): Jacob Buss	
Observer's Signature: Jacob Buss	Date: 2/2/2010
Organization: ETS	
Certified by: Smoke School Inc.	Date

Continue on reverse side

Run #3

VISIBLE EMISSION OBSERVATION FORM

Company Name: Conoco Phillips		
Location:		
City: Ferndale	State: WA	Zip:
Process Equipment: SRU #2		Operating Mode:
Control Equipment:		Operating Mode:

Describe Emission Point: Exhaust of stack

Height Above Ground Level: 140'	Height Relative to Observer: Start 134' End 134'
Distance From Observer: Start 280' End 280'	Direction From Observer: Start End
Vertical Angle to Plume: 15°	Horizontal Angle to Plume: 0°

Describe Emissions: Start lofting End lofting

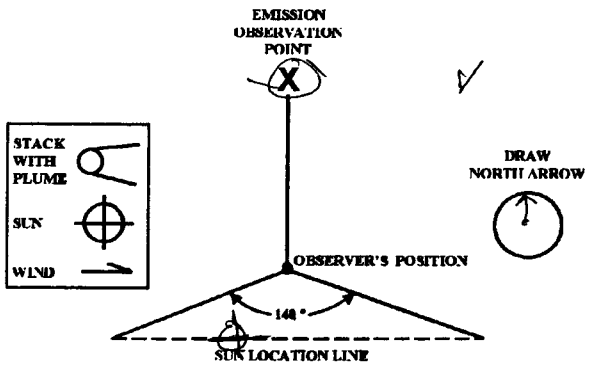
Emission Color: Start clear End clear	If Water Droplet Plume: Attached ☐ Detached ☐ N/A ☒

Point In The Plume At Which Opacity Was Determined: Start Exhaust of stack End Exhaust of stack

Describe Plume Background: Start sky End sky

Background Color: Start Blue End Blue	Sky Condition: Start partly cloud End partly cloud	
Wind Speed: Start 0-8 End 0-8	Wind Direction: Start NE End NE	
Ambient Temp: Start End	Wet Bulb Temp	RH Percent

SOURCE LAYOUT SKETCH



Additional Information: Run #3

Observation Date	Start Time	End Time
2/2/2010	1530	1536

Min \ Sec	0	15	30	45	Comments
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	0% Average Opacity
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	
7					
8					
9					
10					
11					
12					
13					
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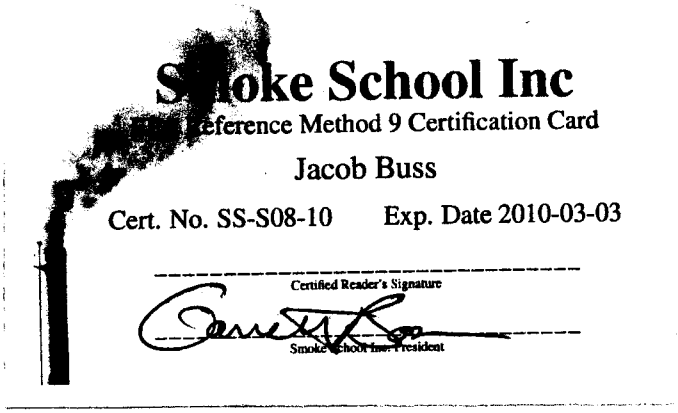
30					

Observer's Name (Print): Jacob Buss	
Observer's Signature: Jacob Buss	Date: 2/2/2010
Organization: ETS	
Certified by: Smoke School Inc.	Date:

Continue on reverse side



Smoke School Inc

Reference Method 9 Certification Card

Jacob Buss

Cert. No. SS-S08-10 Exp. Date 2010-03-03

Certified Reader's Signature

Smoke School Inc. President

6.0 Appendix B: Project Quality Assurance Documentation

6.1 EPA Methods 1-4 Sample Equipment QA/QC

- 6.1.1 Dry Gas Meter Calibrations
- 6.1.2 Pitot Tube Calibrations
- 6.1.3 Thermocouple Calibration
- 6.1.4 Field Barometer Calibration
- 6.1.5 Example Equations for EPA Method 1-4, 6C, 7E, and 10

6.2 EPA Methods 3A, 6C, 7E, and 10 Sample Equipment QA/QC

- 6.2.1 Cylinder Gas Certification Sheets
- 6.2.2 EPA Method 205a Field Verification
- 6.2.3 Sampling System Response Time, CEM Leak Checks
- 6.2.4 Analyzer Interference Check
- 6.2.5 NOx Converter Check

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

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

DATE: 12/23/09 | METER SERIAL #: 1638 | BAROMETRIC PRESSURE (in Hg): INITIAL 28.85, FINAL 28.85, AVG (P_{bar}) 28.85

METER PART #: HF-5 | CRITICAL ORIFICE SET SERIAL #: 1446s

IF Y VARIATION EXCEEDS 2.00%, ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT^3) INITIAL	DGM READINGS (FT^3) FINAL	DGM NET (V_m)	TEMPERATURES °F AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG	ELAPSED TIME (MIN) θ	DGM ΔH ($in\ H_2O$)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	Y VARIATION (%)	$\Delta H_@$
31	1	0.8405	17	764.663	769.964	5.301	48	45	47	45	46	46	5.00	3.9	5.3878	5.3809	0.999		1.93
	2	0.8405	17	771.425	776.736	5.311	48	47	49	46	47	47	5.01	3.9	5.3873	5.3917	1.001		1.92
	3	0.8405	17	776.736	782.052	5.316	48	49	51	47	48	49	5.00	3.9	5.3712	5.3809	1.002		1.91
																AVG =	1.000	-0.35	
24	1	0.6548	18.5	785.935	790.933	4.998	48	51	53	48	51	51	6.00	2.5	5.0124	5.0304	1.004		2.01
	2	0.6548	18.5	790.933	795.932	4.999	49	53	53	51	52	52	6.00	2.5	5.0036	5.0255	1.004		2.01
	3	0.6548	18.5	795.932	800.974	5.042	49	53	55	52	53	53	6.00	2.5	5.0368	5.0255	0.998		2.00
																AVG =	1.002	-0.20	
21	1	0.5708	20	800.974	806.189	5.215	49	55	56	53	53	54	7.00	1.8	5.1902	5.1109	0.985		1.89
	2	0.5708	20	806.189	811.210	5.021	50	56	57	53	54	55	7.00	1.8	4.9874	5.1059	1.024		1.89
	3	0.5708	20	811.210	816.334	5.124	50	57	58	54	55	56	7.00	1.8	5.0799	5.1059	1.005		1.89
																AVG =	1.005	0.06	
16	1	0.4377	22	816.334	821.610	5.276	50	58	58	55	56	57	9.25	0.95	5.2092	5.1738	0.993		1.69
	2	0.4377	22	821.610	826.665	5.055	51	58	59	56	57	58	9.00	0.95	4.9813	5.0291	1.010		1.69
	3	0.4377	22	826.665	831.710	5.045	51	59	60	57	58	59	9.00	0.95	4.9619	5.0291	1.014		1.68
																AVG =	1.005	0.15	
11	1	0.3090	23	831.710	836.910	5.20	51	60	60	58	58	59	13.00	0.47	5.1081	5.1282	1.004		1.67
	2	0.3090	23	836.910	842.278	5.368	51	60	59	58	59	59	13.00	0.47	5.2731	5.1282	0.973		1.67
	3	0.3090	23	842.278	847.270	4.992	51	59	60	59	59	59	13.00	0.47	4.9038	5.1282	1.046		1.67
																AVG =	1.007	0.34	

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:

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

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 1.004

AVERAGE $\Delta H_@$ = 1.83

(1) $$Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$

= Net volume of gas sample passed through DGM, corrected to standard conditions

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

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

(2) $$Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$

= Volume of gas sample passed through the critical orifice, corrected to standard conditions

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

K' = Average K' factor from Critical Orifice Calibration

(3) $$Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$

= DGM calibration factor

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

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

DATE: 2/5/10

METER PART #: HF-5

METER SERIAL #: 1638

CRITICAL ORIFICE SET SERIAL #: 1446s

	INITIAL	FINAL	AVG (P_{bar})
BAROMETRIC PRESSURE (in Hg):	28.35	28.35	28.35

Initial Y value: 1.004

Initial DH@ value: 1.83

IF Y VARIATION EXCEEDS 2.00%, ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT^3) INITIAL	DGM READINGS (FT^3) FINAL	DGM READINGS (FT^3) NET (V_m)	TEMPERATURES °F AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG	ELAPSED TIME (MIN) θ	DGM ΔH (in H_2O)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	Y VARIATION (%)	$\Delta H_@$
21	1	0.5708	20	957.700	962.952	5.252	50	50	52	51	51	51	7.11	1.7	5.1657	5.0963	0.987	-0.8%	1.83
	2	0.5708	20	962.952	968.074	5.122	49	51	52	51	51	51.25	7.00	1.7	5.0354	5.0224	0.997	0.3%	1.83
	3	0.5708	20	968.074	973.191	5.117	49	52	52	51	51	51.5	7.00	1.7	5.0280	5.0224	0.999	0.5%	1.83
																AVG =	0.994		

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:

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

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 0.994

AVERAGE $\Delta H_@$ = 1.83

(1) $$Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$

= Net volume of gas sample passed through DGM, corrected to standard conditions

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

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

(2) $$Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$

= Volume of gas sample passed through the critical orifice, corrected to standard conditions

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

K' = Average K' factor from Critical Orifice Calibration

(3) $$Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$

= DGM calibration factor

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

Post Calibration Difference

Difference from Initial Y value: -1.0%

Difference from Initial DH@ value: -0.1%

SINGLE-VELOCITY "S" TYPE PITOT TUBE CALIBRATION WORKSHEET

PITOT/PROBE ASSEMBLY #	I.10.1	DATE	01/04/10
EFFECTIVE LENGTH- in.	120	CALIBRATOR	JDB/ MTC
FACE-OPENING ALIGNMEN	OK	MANOMETER LEAK CHECK	OK

VELOCITY DETERMINATION DATA

FAN SETTING	I
EXHAUST GAS TEMPERATURE- F.	57.1
BAROMETRIC PRESSURE- "Hg	28.64
STATIC PRESSURE- "H2O	0.48
ABSOLUTE EXHAUST GAS PRESSURE- "Hg	28.68
MOLECULAR WEIGHT OF EXHAUST GAS	28.73
CALIBRATION VELOCITY- fpm	2984

CALIBRATION DATA

FAN SETTING	SIDE "A" dP(std)	dP(s)	Cp
	0.550	0.840	0.801
I	0.550	0.840	0.801
	0.550	0.840	0.801
AVG.	0.550	0.840	0.801

SIDE "A"
Average Cp: 0.80

FAN SETTING	SIDE "B" dP(std)	dP(s)	Cp
	0.550	0.820	0.811
I	0.550	0.820	0.811
	0.550	0.820	0.811
AVG.	0.550	0.820	0.811

SIDE "B"
Average Cp: 0.81

MAXIMUM DIFFERENCE BETWEEN Cp AVERAGES OF SIDES "A" & "B" AT ANY GIVEN FAN SETTING:

ALLOWABLE=	0.01
DIFFERENCE=	0.01

MAXIMUM AVERAGE DEVIATION FROM THE MEAN FOR SIDES "A" & "B" AT ANY GIVEN FAN SETTING:

ALLOWABLE=	0.01
SIDE "A" DEVIATION=	0.00
SIDE "B" DEVIATION=	0.00

SIDE "A" IS THE SIDE UTALIZED DURING SOURCE TESTING

Post Test Pitot Inspection:
Date: 2/5/2010
Results: No Damage/No Change, GMW/MTC

THERMOMETER AND THERMOCOUPLE
IDENTIFICATION AND CALIBRATION

IDENTIFICATION

THERMOMETER ID #: NIST Ertco Hg Thermometer

THERMOCOUPLE ID #: I.10.1

DATE: 1/5/2010

CALIBRATED BY: JDB

CALIBRATION

READING	REFERENCE THERMOMETER °F	TEST THERMOMETER °F
I	32	32
II	210	210
III	476	476
AVERAGE-oF.	239	239

PERCENT DIFFERENCE OF ABSOLUTE READINGS:

ALLOWABLE	± 1.5 %
ACTUAL	0.05%

THERMOMETER AND THERMOCOUPLE
IDENTIFICATION AND CALIBRATION

IDENTIFICATION

THERMOMETER ID #: HF-5

THERMOCOUPLE ID #: I.10.1

JOB #: 2010.1601

DATE: 2/5/2009

CALIBRATED BY: JDB

CALIBRATION

AVG. EXHAUST TEMPERATURE-F.: 350

RANGE OF CALIBRATION-10% ABS.,F.: 269 TO 431

READING	REFERENCE THERMOMETER °F	TEST THERMOMETER °F
I	365	365
II	365	365
III	365	365
AVERAGE-oF.	365	365

PERCENT DIFFERENCE OF ABSOLUTE READINGS:

ALLOWABLE 1.5 %

ACTUAL 0.00%

THERMOMETER AND THERMOCOUPLE
IDENTIFICATION AND CALIBRATION

IDENTIFICATION

THERMOCOUPLE ID: HF-5 Inlet & Outlet TC

THERMOMETER ID # Meter Control Box *HF-5*

CALIBRATION DATE: 1/5/2010

CALIBRATED BY: JDB

CALIBRATION

READING	REFERENCE °F	TEST °F	Difference %
Meter Inlet	210	210	0.0%
	32	32	0.0%
Meter Outlet	210	210	0.0%
	32	32	0.0%
AVERAGE-°F.	121	121	0.0%

Reference: *NIST Traceable Hg Thermometer*

PERCENT DIFFERENCE OF ABSOLUTE READINGS:

Average Meter Inlet 0.0%

Average Meter Outlet 0.0%

ALLOWABLE *1.5 %*

THERMOMETER AND THERMOCOUPLE
IDENTIFICATION AND CALIBRATION

IDENTIFICATION

THERMOCOUPLE ID: NIST Ertco Hg Thermometer

THERMOMETER ID # Imp Ext#3

CALIBRATION DATE: 1/5/2010

CALIBRATED BY: JDB

CALIBRATION

READING	REFERENCE °F	TEST °F	Difference %
temp	165	165	0.0%
temp	33	33	0.0%
AVERAGE-°F.	99	99	0.0%

PERCENT DIFFERENCE OF ABSOLUTE READINGS:

Meter Inlet	0.00%
Meter Outlet	0.00%
ALLOWABLE	*1.5 %*

FIELD BAROMETER
IDENTIFICATION AND CALIBRATION

IDENTIFICATION

BAROMETER ID #: ETS ALT-1

DATE: January 25, 2010

TIME: 10:45

CALIBRATED BY: GAW

CALIBRATION

Medford Station Barometric Pressure, "Hg	Field Barometer Barometric Pressure, "Hg	Pressure Difference %
28.48	28.49	0.04

Medford, Oregon weather station barometric pressure taken at Airport runway elevation, uncorrected barometric pressure is used for calibration of field barometer. Weather Station phone number (541) 776-4303.

Example Equations - EPA Methods 1-4

SRU #2

Absolute pressure in the Stack(P_s)

Where P_{bar} = barometric pressure, In Hg

P_g = static pressure of the stack, in H_2O

P_s: $P_{bar} + (P_g/13.6)$

	Run 1	Run 2	Run 3	Average
	29.62	*29.62*	*29.62*	
	-0.13	*-0.13*	*-0.13*	
P_s:	29.61	29.61	29.61	

Volume of Metered Sample Gas @ Std. Conditions

Where V_m = Volume, Dry Gas Meter, cubic ft.

K_1 = 17.64 °R/in. Hg

Y = DGM calibration factor

P_{bar} = Barometric pressure

ΔH = DGM average differential pressure, in. H_2O

T_m = DGM average temperature, °F

$V_{m(std)}$: $K_1 * V_m * Y * (P_{bar} + (\Delta H/13.6))/(T_m + 460)$

	Run 1	Run 2	Run 3	Average
	33.6	*34*	*33.6*	
	17.64	*17.64*	*17.64*	
	1.004	*1.004*	*1.004*	
	29.62	*29.62*	*29.62*	
	1.00	*1.00*	*1.00*	
	67.6	*75.8*	*77.8*	
$V_{m(std)}$:	33.491	33.371	32.856	

Volume of Water@ Standard Conditions

Where V_{lc} = Impinger liquid volume collected, ml

WV = Final silica weight

$V_{w(std)}$: $(0.04707 * V_{lc}) + (0.04715 * WV)$

	Run 1	Run 2	Run 3	Average
	72.6	*77.9*	*69.7*	
	7.9	*5.5*	*4.2*	
$V_{w(std)}$:	3.790	3.926	3.479	

Moisture(Bws) Volumetric

Where $V_{w(std)}$ = Std. Water vapor volume, scf

$V_{m(std)}$ = Std. Sample gas volume,DSCF

Bws: $V_{w(std)} / (V_{w(std)} + V_{m(std)})$

	Run 1	Run 2	Run 3	Average
	3.79	*3.926*	*3.479*	
	33.491	*33.371*	*32.856*	
Bws:	0.102	0.105	0.096	

Molecular Weight lb/lb - mole, Dry (M_d)

Where: $\%CO_{2=}$

$\%O_{2=}$

$\%N_{2=}$

M_d: $((0.44 * \%CO_2) + (0.32 * \%O_2) + (0.28 * \%N_2)$

	Run 1	Run 2	Run 3	Average
	6.40	*6.50*	*6.50*	
	5.10	*5.00*	*4.90*	
	88.50	*88.50*	*88.60*	
M_d:	29.23	29.24	29.24	

Molecular Weight lb/lb - mole, Wet (M_w)

	Run 1	Run 2	Run 3	Average
Where: Bws =	*0.102*	*0.105*	*0.096*	
M_w: (M_d * (1-Bws) + (18 * Bws)				
M_w:	28.08	28.06	28.16	

Gas Velocity(V_s)

	Run 1	Run 2	Run 3	Average
Where C_p = pitot tube coefficient	*0.80*	*0.80*	*0.80*	
T_s = temperature of the stack	*364.9*	*353.4*	*348.5*	
M_w = molecular weight lb/lb - mole, wet	*28.08*	*28.06*	*28.16*	
Ps = absolute pressure in the stack	*29.61*	*29.61*	*29.61*	
ΔP:=Avg SQRT Velocity Head, in. H_2O	*0.069*	*0.072*	*0.070*	
V_s: (85.49 * C_p * ΔP * SQRT((T_s + 460)/(P_s * M_w))				
V_s:	4.7	4.9	4.7	

Actual Cubic Feet/Minute (acfm)

	Run 1	Run 2	Run 3	Average
Where A = area of the duct in square feet	*25.97*	*25.97*	*25.97*	
V_s = Stack gas velocity, ft/sec	*4.7*	*4.8*	*4.8*	
acfm: A * V_s * 60				
acfm:	7,324	7,479	7,479	

Standard Dry Actual Cubic Feet/Minute (sdcfm)

	Run 1	Run 2	Run 3	Average
Where T_s = temperature of the stack	*364.9*	*353.4*	*348.5*	
acfm = actual cubic ft/min	*7,324*	*7,479*	*7,479*	
Ps = absolute pressure in the stack	*29.61*	*29.61*	*29.61*	
Bws= Gas *Moisture Content*	*0.102*	*0.105*	*0.096*	
sdcfm: (1-(Bws)) * acfm * (528/(T_s + 460)) * (P_s/(29.92))				
sdcfm:	4,166	4,300	4,370	

Example Equations

Client: ConocoPhillips
Location: Ferndale, Washington
Source: SRU #2 exhaust Duct
Date: February 2, 2010
Project No.: 2010.1601

EPA Method 6C, Sulfur dioxide, SO2 ppm

Cavg: Average gas concentration indicated by gas analyzer, dry basis, ppm.
Co: Average of initial & final system calibration bias check responses for zero gas, ppm.
Cm: Average of initial & final system calibration bias check responses for the upscale calib gas, ppm.
Cma: Actual concentration of the upscale calibration gas, ppm.

	Run 1	Run 2	Run 3	Average
	23.9	21.3	21.7	
	0.40	0.36	-0.60	
	33.42	33.24	34.13	
	34.1	34.1	34.1	

C_{gas}: Effluent gas concentration, dry basis, ppm.

$$C_{gas} = (C_{avg} - C_o)\frac{C_{ma}}{(C_m - C_o)} \quad \text{Eq. 6C-1}$$

	24.2	21.7	21.9	*22.6*

Sulfur dioxide pounds per hour, SO2 lbs/hr

Where M_w = Molecular weight of SO2
DSCFM = Dry Standard Cubic Ft/min
ppm = parts per million dry basis SO2

SO2 lbs/hr= (ppm*Mw/385100000)*Dscfm*60

	Run 1	Run 2	Run 3	Average
	64	*64*	*64*	
	4166	*4300*	*4373*	
	24.2	*21.7*	*21.9*	

SO2 lbs/hr:

	1.01	0.93	0.95	*0.96*

Sulfur dioxide pounds corrected to 0% Oxygen

Where % Oxygen of Stack exhaust
ppm = parts per million dry basis SO2

SO2 @ 0% O2 = (ppm*(20.9/(20.9-Stack %O2))

	Run 1	Run 2	Run 3	Average
	5.1	*5*	*4.9*	
	24.2	*21.7*	*21.9*	

SO2 @ 07% O2

	32.0	28.5	28.6	*29.70*

EPA Method 7E, Oxides of Nitrogen, NOx ppm

Cavg: Average gas concentration indicated by gas analyzer, dry basis, ppm.
Co: Average of initial & final system calibration bias check responses for zero gas, ppm.
Cm: Average of initial & final system calibration bias check responses for the upscale calib gas, ppm.
Cma: Actual concentration of the upscale calibration gas, ppm.

	Run 1	Run 2	Run 3	Average
	27.8	28.3	28.2	
	0.15	0.25	0.28	
	33.82	33.92	34.27	
	34.3	34.3	34.3	

C_{gas}: Effluent gas concentration, dry basis, ppm.

$$C_{gas} = (C_{avg} - C_o)\frac{C_{ma}}{(C_m - C_o)} \quad \text{Eq. 6C-1}$$

	28.2	28.6	28.1	*28.3*

Oxides of Nitrogen pounds per Hour

Where M_w = Molecular weight of NO_2
DSCFM = Dry Standard Cubic Ft/min
ppm = parts per million dry basis NOx
NOx lbs/hr: (ppm*Mw/385100000)*Dscfm*60

	Run 1	Run 2	Run 3	Average
	46.0	*46.0*	*46.0*	
	4166	*4300*	*4373*	
	28.2	*28.6*	*28.1*	

NOx lbs/hr:

	0.84	0.88	0.88	*0.87*

Oxides of Nitrogen corrected to 7% Oxygen

Where % Oxygen of Stack exhaust
parts per million dry basis NOx

NOx @ 7% O2 = (ppm*(13.9/(20.9-Stack %O2))

	Run 1	Run 2	Run 3	Average
	5.1	*5*	*4.9*	
	28.2	*28.6*	*28.1*	

NOx @ 7% O2	24.8	25.0	24.4	*24.73*

Airgas

Airgas Specialty Gases
12722 S. Wentworth Avenue
Chicago, IL 60628
1-773-785-3000
FAX: 1-773-785-1928
www.airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E03NI59E15A3452	Reference Number:	54-124190206-1
Cylinder Number:	CC48291	Cylinder Volume:	159 Cu.Ft.
Laboratory:	ASG - Chicago - IL	Cylinder Pressure:	2015 PSIG
Analysis Date:	Sep 14, 2009	Valve Outlet:	590

Expiration Date: Sep 14, 2012

Certification performed in accordance with "EPA Traceability Protocol (Sept. 1997)" using the assay procedures listed. Analytical Methodology does not require correction for analytical interferences. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.
Do Not Use This Cylinder below 150 psig.i.e. 1 Mega Pascal

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
CARBON DIOXIDE	19.00 %	18.63 %	G1	+/- 1% NIST Traceable
OXYGEN	22.00 %	22.01 %	G1	+/- 1% NIST Traceable
NITROGEN	Balance			

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Expiration Date
NTRM/O2	60608	CC206109	22.51% OXYGEN/NITROGEN	May 01, 2010
NTRM/CO2	40604	XC034327B	19.84% CARBON DIOXIDE/	May 15, 2012

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
HORIBA 510	NDIR	Aug 21, 2009
HORIBA MPA-510	Paramagnetic	Aug 21, 2009

Triad Data Available Upon Request

Notes:

Curt Stewart

QA Approval

Airgas

Airgas Specialty Gases
12722 S. Wentworth Avenue
Chicago, IL 60628
1-773-785-3000
FAX: 1-773-785-1928
www.airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E03NI77E15A0156	Reference Number:	54-124154835-4
Cylinder Number:	CC50904.	Cylinder Volume:	151 Cu.Ft.
Laboratory:	ASG - Chicago - IL	Cylinder Pressure:	2015 PSIG
Analysis Date:	Oct 14, 2008	Valve Outlet:	590

Expiration Date: Oct 14, 2011

Certification performed in accordance with "EPA Traceability Protocol (Sept. 1997)" using the assay procedures listed. Analytical Methodology does not require correction for analytical interferences. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.
Do Not Use This Cylinder below 150 psig.i.e. 1 Mega Pascal

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
CARBON DIOXIDE	10.00 %	9.930 %	G1	+/- 1% NIST Traceable
OXYGEN	12.50 %	12.50 %	G1	+/- 1% NIST Traceable
NITROGEN	Balance			

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Expiration Date
NTRM/O2	82658	SG9168304BAL	16.04% OXYGEN/	Jan 01, 2010
NTRM/CO2	40604	XC034253B	19.84% CARBON DIOXIDE/	Nov 15, 2008

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
HORIBA 510	NDIR	Oct 08, 2008
(P-1) CAI-110	Paramagnetic	Oct 08, 2008

Triad Data Available Upon Request

Notes:

D. Bolen

QA Approval

Airgas

Airgas Specialty Gases
11711 S. Alameda Street
Los Angeles, CA 90059-2130
(323) 357-6891
Fax: (323) 567-3686
www.airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E03NI99E15AC1P9	Reference Number:	48-124174905-1
Cylinder Number:	CC130542	Cylinder Volume:	144 Cu.Ft.
Laboratory:	ASG - Los Angeles - CA	Cylinder Pressure:	2015 PSIG
Analysis Date:	May 07, 2009	Valve Outlet:	660

Expiration Date: May 07, 2011

Certification performed in accordance with "EPA Traceability Protocol (Sept. 1997)" using the assay procedures listed. Analytical Methodology does not require correction for analytical interferences. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.
Do Not Use This Cylinder below 150 psig.i.e. 1 Mega Pascal

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Analytical Uncertainty	Total Relative Uncertainty
CARBON MONOXIDE	49.38 PPM	48.97 PPM	±1% NIST Traceable	
NITRIC OXIDE	49.38 PPM	48.97 PPM	±1% NIST Traceable	
NITROGEN	Balance			
Total oxides of nitrogen		48.97 PPM		For Reference Only

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Expiration Date
NTRM	060610	CC206141	49.38PPM NITRIC OXIDE/NITROGEN	Feb 10, 2012
NTRM	98050320	SG9197019	50.46PPM CARBON MONOXIDE/NITROGEN	Oct 02, 2010

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nocolet 6700 CO	FTIR	Apr 09, 2009
Nicolet 6700 NO	FTIR	May 05, 2009

Triad Data Available Upon Request

Notes:

QA Approval

Airgas

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11711 S. Alameda Street
Los Angeles, CA 90059-2130
(323) 357-6891
Fax: (323) 567-3686
www.airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E04NI99E15AC1M3	Reference Number:	48-124132215-2
Cylinder Number:	SG9147518	Cylinder Volume:	144 Cu.Ft.
Laboratory:	ASG - Los Angeles - CA	Cylinder Pressure:	2015 PSIG
Analysis Date:	Apr 08, 2008	Valve Outlet:	660

Expiration Date: Apr 08, 2010

Certification performed in accordance with "EPA Traceability Protocol (Sept. 1997)" using the assay procedures listed. Analytical Methodology does not require correction for analytical interferences. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.
Do Not Use This Cylinder below 150 psig.i.e. 1 Mega Pascal

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
CARBON MONOXIDE	97.00 PPM	96.34 PPM	G1	+/- 1% NIST Traceable
NITRIC OXIDE	97.00 PPM	97.58 PPM	G1	+/- 1% NIST Traceable
SULFUR DIOXIDE	97.00 PPM	96.83 PPM	G1	+/- 1% NIST Traceable
NITROGEN	Balance			

Total oxides of nitrogen 97.92 PPM For Reference Only

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Expiration Date
NTRM	5120404	CC180127	99.49PPM CARBON MONOXIDE/	Feb 02, 2009
NTRM	60604	CC208254	93.2PPM NITRIC OXIDE/NITROGEN	Jan 01, 2010
NTRM	40603	XC017562B	98.0PPM SULFUR DIOXIDE/NITROGEN	Apr 12, 2008

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet CO	FTIR	Mar 13, 2008
Nicolet NO	FTIR	Mar 21, 2008
Nicolet SO2	FTIR	Mar 19, 2008

Triad Data Available Upon Request

Notes:

QA Approval

Airgas

Airgas Specialty Gases
11711 S. Alameda Street
Los Angeles, CA 90059-2130
(323) 357-6891
Fax: (323) 567-3686
www.airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E04NI99E15AC1M2	Reference Number:	48-124132217-3
Cylinder Number:	XC025829B	Cylinder Volume:	144 Cu.Ft.
Laboratory:	ASG - Los Angeles - CA	Cylinder Pressure:	2015 PSIG
Analysis Date:	Apr 10, 2008	Valve Outlet:	660

Expiration Date: Apr 10, 2010

Certification performed in accordance with "EPA Traceability Protocol (Sept. 1997)" using the assay procedures listed. Analytical Methodology does not require correction for analytical interferences. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.
Do Not Use This Cylinder below 150 psig.i.e. 1 Mega Pascal

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
CARBON MONOXIDE	487.0 PPM	486.5 PPM	G1	+/- 1% NIST Traceable
NITRIC OXIDE	487.0 PPM	489.9 PPM	G1	+/- 1% NIST Traceable
SULFUR DIOXIDE	487.0 PPM	487.7 PPM	G1	+/- 1% NIST Traceable
NITROGEN	Balance			

Total oxides of nitrogen 490.7 PPM For Reference Only

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Expiration Date
NTRM	05120506	CC180354	495.8PPM CARBON MONOXIDE/NITROGEN	Feb 02, 2009
NTRM	51004	CC205989	475.0PPM SULFUR DIOXIDE/	Sep 01, 2010
NTRM	60615	CC207527	490.0PPM NITRIC OXIDE/NITROGEN	Jan 01, 2010

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS CARBON MONOXIDE	NDIR	Mar 11, 2008
Nicolet NO	FTIR	Mar 21, 2008
Nicolet SO2	FTIR	Mar 19, 2008

Triad Data Available Upon Request

Notes:

QA Approval

EPA METHOD 205a

Mass Flow Controller Verification

Company: ConocoPhillips
Date: 02/02/10
Site Location: Ferndale, Washington
Technician's Name: G. A. Winkler
Gas Tracibility: EPA Protocol 1
High-Level Supply Gas ID: SG147518
High-Level Supply Gas Value: 97.7 ppm
Mid-Level Supply Gas ID: CC130542
Mid-Level Supply Gas Value: 48.5 ppm
Upper Dilution Target: 70 ppm
Lower Dilution Target: 45 ppm

Analyzer Mfg.: EcoPhysics
Model: CLD 70
Serial No.: 8311126
Analyzer Type: NOx
Analyzer Range: 0-100 ppm
Dilution Mfg.: Environics, Inc.
Model: Series 4040
S/N: 2627
Blender Calibration Date: 9/6/2008
Next Calibration Due: 9/6/2009
Total Flow Fate, cc/m: 3500

STATUS OF TEST: PASSED

Mass Flow Controller Verification 1 & 2								
Diluted Calibration Points	Target Concentration		Flow Rate, cc/m Mass Flow Controller 1	Flow Rate, cc/m Mass Flow Controller 2	Analyzer Reading		Run vs Average Error	Target vs Average Error
	Run	Value			Per Run	Average		
Lower Point Injections	1	45.0	1888	1612	45.1	45.2	-0.20 %	0.40 %
	2	45.0	1888	1612	45.2		0.00 %	
	3	45.0	1888	1612	45.4		0.40 %	
Upper Point Injections	1	70.0	992	2508	69.9	70.4	-0.70 %	0.60 %
	2	70.0	992	2508	70.7		0.40 %	
	3	70.0	992	2508	70.5		0.10 %	

All dilution points must be within ± 2% of analyzer reading

STATUS OF TEST: PASSED

Mid-level Supply Gas Verification				
Mid-Level Supply Gas Injections	Mid-level Supply Gas Concentraion	Analyzer Reading		Mid-Level vs Average Error
		Per Run	Average	
1	48.5	48.5	48.5	0.00 %
2	48.5	48.7		
3	48.5	48.4		

Mid-level Supply Gas must be within ± 2% of analyzer reading

***Notes:** 1. A Reference Method Analyzer was used to perform this test.
2. This test verifies Mass flow controllers 1 and 2.
3. Maximum flow, controller 1: 10000 ccm
4. Maximum flow, controller 2: 10000 ccm

EPA METHOD 205a

Mass Flow Controller Verification

Company: ConocoPhillips
Date: 02/02/10
Site Location: Ferndale, Washington
Technician's Name: G. A. Winkler
Gas Tracibility: EPA Protocol 1
High-Level Supply Gas ID: XC025829B
High-Level Supply Gas Value: 489.9 ppm
Mid-Level Supply Gas ID: CC130542
Mid-Level Supply Gas Value: 48.5
Upper Dilution Target: 70 ppm
Lower Dilution Target: 45 ppm

Analyzer Mfg.: EcoPhysics
Model: CLD 70
Serial No.: 8311126
Analyzer Type: NOx
Analyzer Range: 0-100 ppm
Dilution Mfg.: Environics, Inc.
Model: Series 4040
S/N: 2627
Blender Calibration Date: 9/6/2008
Next Calibration Due: 9/6/2009
Total Flow Fate, cc/m: 4500

STATUS OF TEST: PASSED

Mass Flow Controller Verification 1 & 3								
Diluted Calibration Points	Target Concentration		Flow Rate, cc/m Mass Flow Controller 1	Flow Rate, cc/m Mass Flow Controller 3	Analyzer Reading		Run vs Average Error	Target vs Average Error
	Run	Value			Per Run	Average		
Lower Point Injections	1	45.0	4087	413	44.8	44.7	0.20 %	-0.70 %
	2	45.0	4087	413	44.5		-0.40 %	
	3	45.0	4087	413	44.9		0.40 %	
Upper Point Injections	1	70.0	3857	643	69.0	69.7	-1.00 %	-0.40 %
	2	70.0	3857	643	69.9		0.30 %	
	3	70.0	3857	643	70.1		0.60 %	

All dilution points must be within ± 2% of analyzer reading

STATUS OF TEST: PASSED

Mid-level Supply Gas Verification				
Mid-Level Supply Gas Injections	Mid-level Supply Gas Concentraion	Analyzer Reading		Mid-Level vs Average Error
		Per Run	Average	
1	48.5	48.5	48.5	0.00 %
2	48.5	48.7		
3	48.5	48.4		

Mid-level Supply Gas must be within ± 2% of analyzer reading

***Notes:** 1. A Reference Method Analyzer was used to perform this test.
2. This test verifies Mass flow controllers 1 and 3.
3. Maximum flow, controller 1: 10000 cc/m
4. Maximum flow, controller 3: 1000 cc/m

Environics®

Series 4040

System S/N 2210

ENVIRONICS FLOW CONTROLLER CALIBRATION SHEET

MFC#: 1 Size: 10000 SCCM

SERIAL NUMBER AW9611159

This flow controller was calibrated using a Sierra Cal Bench ™, a NIST traceable Primary Flow Standard Calibration System. This calibration was performed with Nitrogen at a standard reference temperature and pressure of 32° and 29.92 in.HG. This is not performance data. This data is used by the system operating modes to improve the flow accuracy.

	Set Flow	True Flow
5 %	500.0 SCCM	496.861 SCCM
10 %	1000.0 SCCM	1002.364 SCCM
20 %	2000.0 SCCM	2018.992 SCCM
30 %	3000.0 SCCM	3036.421 SCCM
40 %	4000.0 SCCM	4063.228 SCCM
50 %	5000.0 SCCM	5087.913 SCCM
60 %	6000.0 SCCM	6116.337 SCCM
70 %	7000.0 SCCM	7143.196 SCCM
80 %	8000.0 SCCM	8163.450 SCCM
90 %	9000.0 SCCM	9184.890 SCCM
100 %	10000.0 SCCM	10228.068 SCCM

Verified by: Tanie Lundmark Date: 9-30-09

Computerized Gas Mixing / Dilution / Calibration Systems
Environics Inc. • 69 Industrial Park Road East • Tolland, CT 06084 • (860) 872-1111 • Fax (860) 870-9333
World Wide Web: http://www.environics.com E-mail: info@environics.com

Environics®

Series 4040

System S/N 2210

ENVIRONICS FLOW CONTROLLER CALIBRATION SHEET

MFC#: 2 Size: 10000 SCCM

SERIAL NUMBER AW9407231

This flow controller was calibrated using a Sierra Cal Bench ™, a NIST traceable Primary Flow Standard Calibration System. This calibration was performed with Nitrogen at a standard reference temperature and pressure of 32° and 29.92 in.HG. This is not performance data. This data is used by the system operating modes to improve the flow accuracy.

	Set Flow	True Flow
5 %	500.0 SCCM	488.588 SCCM
10 %	1000.0 SCCM	984.864 SCCM
20 %	2000.0 SCCM	1979.219 SCCM
30 %	3000.0 SCCM	2979.082 SCCM
40 %	4000.0 SCCM	3986.161 SCCM
50 %	5000.0 SCCM	4993.242 SCCM
60 %	6000.0 SCCM	6017.271 SCCM
70 %	7000.0 SCCM	7035.992 SCCM
80 %	8000.0 SCCM	8066.431 SCCM
90 %	9000.0 SCCM	9102.588 SCCM
100 %	10000.0 SCCM	10156.901 SCCM

Verified by: Jenie Lundmark Date: 9-30-09

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Series 4040

System S/N 2210

ENVIRONICS FLOW CONTROLLER CALIBRATION SHEET

MFC#: 3 Size: 1000 SCCM

SERIAL NUMBER AW9610040

This flow controller was calibrated using a Sierra Cal Bench ™, a NIST traceable Primary Flow Standard Calibration System. This calibration was performed with Nitrogen at a standard reference temperature and pressure of 32° and 29.92 in.HG. This is not performance data. This data is used by the system operating modes to improve the flow accuracy.

	Set Flow	True Flow
5 %	50.0 SCCM	45.193 SCCM
10 %	100.0 SCCM	94.236 SCCM
20 %	200.0 SCCM	193.090 SCCM
30 %	300.0 SCCM	291.822 SCCM
40 %	400.0 SCCM	391.822 SCCM
50 %	500.0 SCCM	491.496 SCCM
60 %	600.0 SCCM	592.332 SCCM
70 %	700.0 SCCM	694.330 SCCM
80 %	800.0 SCCM	797.692 SCCM
90 %	900.0 SCCM	901.682 SCCM
100 %	1000.0 SCCM	1007.884 SCCM

Verified by: Tonie Lundmark Date 9-30-09

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Series 4040

System S/N 2210

ENVIRONICS FLOW CONTROLLER CALIBRATION SHEET

MFC#: 4 Size: 100 SCCM

SERIAL NUMBER AW9408093

This flow controller was calibrated using a Sierra Cal Bench ™, a NIST traceable Primary Flow Standard Calibration System. This calibration was performed with Nitrogen at a standard reference temperature and pressure of 32° and 29.92 in.HG. This is not performance data. This data is used by the system operating modes to improve the flow accuracy.

	Set Flow	True Flow
5 %	5.0 SCCM	5.277 SCCM
10 %	10.0 SCCM	10.442 SCCM
20 %	20.0 SCCM	20.744 SCCM
30 %	30.0 SCCM	30.933 SCCM
40 %	40.0 SCCM	41.066 SCCM
50 %	50.0 SCCM	50.981 SCCM
60 %	60.0 SCCM	60.990 SCCM
70 %	70.0 SCCM	71.002 SCCM
80 %	80.0 SCCM	81.410 SCCM
90 %	90.0 SCCM	91.507 SCCM
100 %	100.0 SCCM	101.488 SCCM

Verified by: Terri Lundmark Date: 9-30-09

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World Wide Web: http://www.environics.com E-mail: info@environics.com

CEMs Sampling System Response Time Test

Company: ConocoPhilips
Location: Ferndale Refinery
Emission Source: SRU #2 Exhaust Duct
Date: February 2, 2010
Project No.: 2010.1601
Test Site: SRU #2 Exhaust Duct

Length/Type of Sample line used: 100' TFE

CEMS Sample Rate, liters per minute: 5lpm

Upscale Response Time, seconds:

Gas Injection	*O_2/CO_2*	*CO*	*NOx*	*SO_2*	*VOC*	*TRS*	*SF_6*
#1	60	60	55	60			
#2	60	60	55	60			
#3	60	60	55	60			
Average:	*60*	*60*	*55*	*60*			

Downscale response Time, seconds:

Gas Injection	*O_2/CO_2*	*CO*	*NOx*	*SO_2*	*VOC*	*TRS*	*SF_6*
#1	60	60	55	60			
#2	60	60	55	60			
#3	60	60	55	60			
Average:	*60*	*60*	*55*	*60*			

Initial CEMS Sample System Leak Check: PASS ~~FAIL~~

Final CEMS Sample System Leak Check: PASS ~~FAIL~~

Analyzer Interference Check
EPA Method 20, section 5.4

Date: February 1, 2010
Preformed by: G. A. Winkler

Gas Parameter: Oxygen, O_2
Manufacture: Siemens
Model: Oxymat 5E
Serial Number: E2-301A
Span: 25%

Cylinder ID: SG9147518

Cylinder Components	Concentration, ppm	Analyzer Output Response	% of Span
NOx:	97.7	0	0
CO:	98.3	0	0
SO_2:	96.6	0	0

Cylinder ID: CC48291

Cylinder Components	Concentration, ppm	Analyzer Output Response	% of Span
CO_2:	18.63	0	0

Gas Parameter: Carbon moxide, CO
Manufacture: Siemens
Model: Ultramat 5E
Serial Number: BN-978
Span: 60ppm

Cylinder ID: SG9147518

Cylinder Components	Concentration, ppm	Analyzer Output Response	% of Span
NOx:	97.7	0	0
SO2:	96.6	0	0

Cylinder ID: CC48291

Cylinder Components	Concentration, ppm	Analyzer Output Response	% of Span
O_2:	22.01	0	0

Gas Parameter: Nitrogen oxides, NOx
Manufacture: EcoPhysics
Model: 70-CLD
Serial Number: 8350006
Span: 100 ppm

Cylinder ID: SG9147518

Cylinder Components	Concentration, ppm	Analyzer Output Response	% of Span
CO:	98.3	0	0
SO_2:	96.6	0	0

Cylinder ID: CC48291

Cylinder Components	Concentration, ppm	Analyzer Output Response	% of Span
CO_2:	18.63	0	0
O_2:	22.01	0	0

Gas Parameter: Sulfur dioxide, SO2
Manufacture: Bovar
Model: 721M
Serial Number: 93-721M-8000-4
Span: 60ppm

Cylinder ID: SG9147518

Cylinder Components	Concentration, ppm	Analyzer Output Response	% of Span
NOx:	97.7	0	0
CO:	98.3	0	0

Cylinder ID: CC48291

Cylinder Components	Concentration, ppm	Analyzer Output Response	% of Span
CO_2:	18.63	0	0
O_2:	22.01	0	0

$$\%\ of\ Span = \frac{\text{Analyzer Output Response}}{\text{Instrument Span}} \times 100$$

% of Span must be less than 2% of the analyzer span value

NOx Analyzer Converter Efficiency Check

Date: 1/29/2010

Nitrogen Oxides Monitor **Method 7E**

Full Scale: 100.0 ppm 835006

Cylinder Number	Reference Gas Concentration	Analyzer Response	Difference	Calibration Error (%)
Zero-N2	0.0 ppm	0.0 ppm	0.0 ppm	0.00 %
CC-130542	48.5 ppm	47.8 ppm	-0.7 ppm	-0.70 %

Data Point	*Time*	*NOx*	*Mean Diff., %*
1	11:00	40.5	0.5%
2	11:01	40.7	0.1%
3	11:02	40.6	0.1%
4	11:03	40.7	0.0%
5	11:04	40.7	0.0%
6	11:05	40.7	0.0%
7	11:06	40.7	0.0%
8	11:07	40.7	0.1%
9	11:08	40.6	0.2%
10	11:09	40.7	0.0%
11	11:10	40.6	0.2%
12	11:11	40.6	0.2%
13	11:12	40.6	0.2%
14	11:13	40.6	0.4%
15	11:14	40.7	0.1%
16	11:15	40.5	0.4%
17	11:16	40.5	0.5%
18	11:17	40.4	0.6%
19	11:18	40.5	0.4%
20	11:19	40.5	0.4%
21	11:20	40.3	0.9%
22	11:21	40.4	0.8%
23	11:22	40.4	0.7%
24	11:23	40.4	0.7%
25	11:24	40.2	1.1%
26	11:25	40.3	1.1%
27	11:26	40.2	1.1%
28	11:27	40.3	1.1%
29	11:28	40.3	1.0%
30	11:29	40.4	0.8%
	NOx Peak Reading:	40.7	0.5%
	NOx Final Reading:	40.4	
	Analyzer Mode:	*NOx*	*NO*
	NO Final:		23.9
	Mode Difference, %:		41.3%
	Zero Gas:	0.0	0.1
	Mid Range Gas Responce:	48.0	48.0
	Cylinder Value:	48.0	48.0
	Zero Gas Diff., %:	0.0%	0.1%
	Mid Range Gas Diff., %::	0.0%	0.0%
	Converter Efficency:	99.3%	

Sample & Traverse Point Determination

Sample Traverse Points for Method 7E, NOx Determination

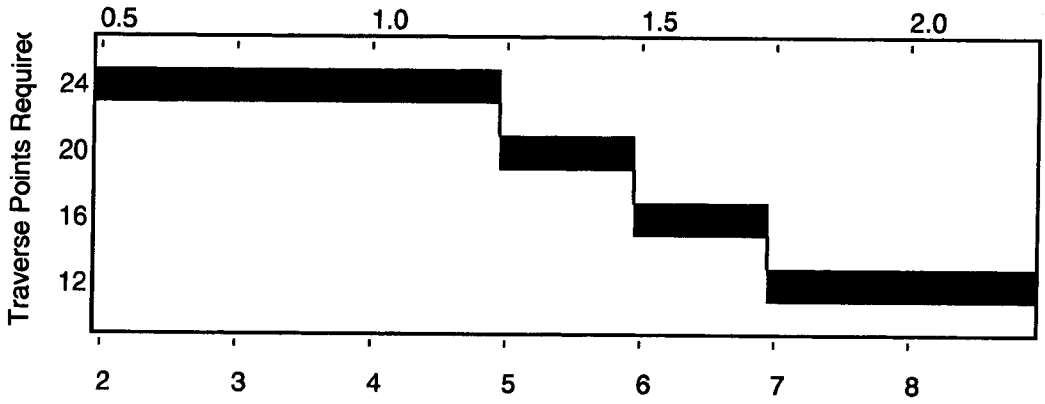
EPA Method 1 Circular Ducts

Client: ConocoPhillips
Location: Ferndale Refinery
Source: SRU#2 Exhaust Duct
Date: February 2, 2010
Project No.: 2010.1601

Stack Diameter(in.): 69
Points Required: 24
Distance A(in.): 52.0
Distance A(dia.): 0.8
Distance B: 208.0
Distance B(dia.): 3.0

Sample Port Location

Duct Diameters upstream from flow disturbance (distance A)



Sample Port Location

Duct Diameters downstream from flow disturbance (distance B)

Traverse Point No.	Number of Traverse Points on a Diameter					***Sample Points***	Port *18.0*
	3	6	8	10	12		
1	16.7	4.4	3.2	2.6	2.1	*1.4*	***19.4***
2	50.0	14.6	10.5	8.2	6.7	*4.6*	***22.6***
3	83.3	29.6	19.4	14.6	11.8	*8.1*	***26.1***
4		70.4	32.2	22.6	17.7	*12.2*	***30.2***
5		85.5	67.7	34.2	25	*17.3*	***35.3***
6		95.6	80.6	65.8	35.6	*24.6*	***42.6***
7			89.5	77.4	64.4	*44.4*	***62.4***
8			96.8	85.4	75	*51.8*	***69.8***
9				91.8	82.3	*56.8*	***74.8***
10				97.4	88.2	*60.9*	***78.9***
11					93.3	*64.4*	***82.4***
12					97.9	*67.6*	***85.6***

7.0 Appendix C: Supporting Data/ Documentation

7.1 #2 SRU Sulfur Production Summary
7.2 SRU #2 Flow Balance Summary
7.3 SRU #2 Source Test Protocol
7.4 Northwest Clean Air Agency Emission Test Summary

ConocoPhillips - Ferndale Refinery

File Name: SRU2 CO_Nox 020210.xls
File Location: S:\Departments\HSE\Environmental\NWCAA\Stack Tests & RATAs

No. 2 SRU CO and NOx Compliance Tests
February 2, 2010

39XX0196 LTON/D #2 SRU EST SULFUR PRODUCTION

		39XX0196
2-Feb-10	12:40:00	19.8
2-Feb-10	12:41:00	19.8
2-Feb-10	12:42:00	19.8
2-Feb-10	12:43:00	19.8
2-Feb-10	12:44:00	19.8
2-Feb-10	12:45:00	19.9
2-Feb-10	12:46:00	20.2
2-Feb-10	12:47:00	20.2
2-Feb-10	12:48:00	20.2
2-Feb-10	12:49:00	20.1
2-Feb-10	12:50:00	20
2-Feb-10	12:51:00	19.9
2-Feb-10	12:52:00	19.7
2-Feb-10	12:53:00	19.6
2-Feb-10	12:54:00	19.7
2-Feb-10	12:55:00	19.8
2-Feb-10	12:56:00	19.8
2-Feb-10	12:57:00	19.8
2-Feb-10	12:58:00	19.7
2-Feb-10	12:59:00	19.5
2-Feb-10	13:00:00	19.5
2-Feb-10	13:01:00	19.6
2-Feb-10	13:02:00	19.8
2-Feb-10	13:03:00	19.8
2-Feb-10	13:04:00	19.8
2-Feb-10	13:05:00	19.8
2-Feb-10	13:06:00	19.7
2-Feb-10	13:07:00	19.7
2-Feb-10	13:08:00	19.7
2-Feb-10	13:09:00	20
2-Feb-10	13:10:00	20.2
2-Feb-10	13:11:00	20.3
2-Feb-10	13:12:00	20.3
2-Feb-10	13:13:00	20.3
2-Feb-10	13:14:00	20.2
2-Feb-10	13:15:00	20.1
2-Feb-10	13:16:00	20.1
2-Feb-10	13:17:00	20.1
2-Feb-10	13:18:00	20.1
2-Feb-10	13:19:00	20
2-Feb-10	13:20:00	20
2-Feb-10	13:21:00	19.9
2-Feb-10	13:22:00	19.8
2-Feb-10	13:23:00	19.6
2-Feb-10	13:24:00	19.5
2-Feb-10	13:25:00	19.4
2-Feb-10	13:26:00	19.5
2-Feb-10	13:27:00	19.6
2-Feb-10	13:28:00	19.7
2-Feb-10	13:29:00	19.8
2-Feb-10	13:30:00	19.9
2-Feb-10	13:31:00	19.8
2-Feb-10	13:32:00	19.8
2-Feb-10	13:33:00	19.7
2-Feb-10	13:34:00	19.8
2-Feb-10	13:35:00	20
2-Feb-10	13:36:00	20.1
2-Feb-10	13:37:00	20.2
2-Feb-10	13:38:00	20.2
2-Feb-10	13:39:00	20.1
2-Feb-10	13:40:00	19.9
2-Feb-10	13:41:00	19.8
2-Feb-10	13:42:00	19.9
2-Feb-10	13:43:00	19.9
2-Feb-10	13:44:00	19.9
2-Feb-10	13:45:00	19.9

Run No.	Start	End	Estimated Sulfur Prod (long Ton/day)
1	12:40	13:40	19.88
2	13:58	14:58	20.08
3	15:18	16:18	20.11

2-Feb-10	13:46:00	19.7
2-Feb-10	13:47:00	19.5
2-Feb-10	13:48:00	19.5
2-Feb-10	13:49:00	19.5
2-Feb-10	13:50:00	19.6
2-Feb-10	13:51:00	19.7
2-Feb-10	13:52:00	19.7
2-Feb-10	13:53:00	19.7
2-Feb-10	13:54:00	19.7
2-Feb-10	13:55:00	19.6
2-Feb-10	13:56:00	19.6
2-Feb-10	13:57:00	19.6
2-Feb-10	13:58:00	19.6
2-Feb-10	13:59:00	19.8
2-Feb-10	14:00:00	20
2-Feb-10	14:01:00	20
2-Feb-10	14:02:00	20
2-Feb-10	14:03:00	19.9
2-Feb-10	14:04:00	19.8
2-Feb-10	14:05:00	19.6
2-Feb-10	14:06:00	19.7
2-Feb-10	14:07:00	19.9
2-Feb-10	14:08:00	20
2-Feb-10	14:09:00	19.8
2-Feb-10	14:10:00	19.8
2-Feb-10	14:11:00	19.7
2-Feb-10	14:12:00	19.6
2-Feb-10	14:13:00	19.5
2-Feb-10	14:14:00	19.7
2-Feb-10	14:15:00	19.8
2-Feb-10	14:16:00	19.9
2-Feb-10	14:17:00	19.9
2-Feb-10	14:18:00	19.7
2-Feb-10	14:19:00	19.6
2-Feb-10	14:20:00	19.6
2-Feb-10	14:21:00	19.9
2-Feb-10	14:22:00	20.1
2-Feb-10	14:23:00	20.2
2-Feb-10	14:24:00	20.3
2-Feb-10	14:25:00	20.3
2-Feb-10	14:26:00	20.1
2-Feb-10	14:27:00	20
2-Feb-10	14:28:00	20.2
2-Feb-10	14:29:00	20.3
2-Feb-10	14:30:00	20.3
2-Feb-10	14:31:00	20.4
2-Feb-10	14:32:00	20.4
2-Feb-10	14:33:00	20.4
2-Feb-10	14:34:00	20.1
2-Feb-10	14:35:00	20
2-Feb-10	14:36:00	20.1
2-Feb-10	14:37:00	20.2
2-Feb-10	14:38:00	20.5
2-Feb-10	14:39:00	20.5
2-Feb-10	14:40:00	20.4
2-Feb-10	14:41:00	20.2
2-Feb-10	14:42:00	19.9
2-Feb-10	14:43:00	19.8
2-Feb-10	14:44:00	19.8
2-Feb-10	14:45:00	20.2
2-Feb-10	14:46:00	20.3
2-Feb-10	14:47:00	20.4
2-Feb-10	14:48:00	20.4
2-Feb-10	14:49:00	20.4
2-Feb-10	14:50:00	20.2
2-Feb-10	14:51:00	20.1
2-Feb-10	14:52:00	20.1
2-Feb-10	14:53:00	20.3
2-Feb-10	14:54:00	20.6
2-Feb-10	14:55:00	20.6
2-Feb-10	14:56:00	20.8
2-Feb-10	14:57:00	20.6
2-Feb-10	14:58:00	20.3
2-Feb-10	14:59:00	20.3
2-Feb-10	15:00:00	20.2

2-Feb-10	15:01:00	20.1
2-Feb-10	15:02:00	20.2
2-Feb-10	15:03:00	20.4
2-Feb-10	15:04:00	20.5
2-Feb-10	15:05:00	20.4
2-Feb-10	15:06:00	20.3
2-Feb-10	15:07:00	20.1
2-Feb-10	15:08:00	19.9
2-Feb-10	15:09:00	19.9
2-Feb-10	15:10:00	20.1
2-Feb-10	15:11:00	20.5
2-Feb-10	15:12:00	20.5
2-Feb-10	15:13:00	20.4
2-Feb-10	15:14:00	20.4
2-Feb-10	15:15:00	20.4
2-Feb-10	15:16:00	20.3
2-Feb-10	15:17:00	20.1
2-Feb-10	15:18:00	20.2
2-Feb-10	15:19:00	20.6
2-Feb-10	15:20:00	20.5
2-Feb-10	15:21:00	20.4
2-Feb-10	15:22:00	20.2
2-Feb-10	15:23:00	20.1
2-Feb-10	15:24:00	20.1
2-Feb-10	15:25:00	20.1
2-Feb-10	15:26:00	20.1
2-Feb-10	15:27:00	20.1
2-Feb-10	15:28:00	20.2
2-Feb-10	15:29:00	20.3
2-Feb-10	15:30:00	20.4
2-Feb-10	15:31:00	20.4
2-Feb-10	15:32:00	20.4
2-Feb-10	15:33:00	20.1
2-Feb-10	15:34:00	20
2-Feb-10	15:35:00	20
2-Feb-10	15:36:00	20.2
2-Feb-10	15:37:00	20.5
2-Feb-10	15:38:00	20.4
2-Feb-10	15:39:00	20.4
2-Feb-10	15:40:00	20.3
2-Feb-10	15:41:00	20.1
2-Feb-10	15:42:00	19.9
2-Feb-10	15:43:00	19.9
2-Feb-10	15:44:00	20
2-Feb-10	15:45:00	20.4
2-Feb-10	15:46:00	20.4
2-Feb-10	15:47:00	20.1
2-Feb-10	15:48:00	20.1
2-Feb-10	15:49:00	20
2-Feb-10	15:50:00	19.8
2-Feb-10	15:51:00	19.9
2-Feb-10	15:52:00	20
2-Feb-10	15:53:00	20.3
2-Feb-10	15:54:00	20.2
2-Feb-10	15:55:00	20.1
2-Feb-10	15:56:00	20
2-Feb-10	15:57:00	19.9
2-Feb-10	15:58:00	19.9
2-Feb-10	15:59:00	19.9
2-Feb-10	16:00:00	19.8
2-Feb-10	16:01:00	20
2-Feb-10	16:02:00	20.1
2-Feb-10	16:03:00	20.1
2-Feb-10	16:04:00	20.2
2-Feb-10	16:05:00	20.2
2-Feb-10	16:06:00	20.1
2-Feb-10	16:07:00	19.9
2-Feb-10	16:08:00	19.9
2-Feb-10	16:09:00	19.9
2-Feb-10	16:10:00	20.3
2-Feb-10	16:11:00	20.2
2-Feb-10	16:12:00	20.2
2-Feb-10	16:13:00	20.1
2-Feb-10	16:14:00	19.9
2-Feb-10	16:15:00	19.7

2-Feb-10	16:16:00	19.6
2-Feb-10	16:17:00	19.6
2-Feb-10	16:18:00	19.8

ConocoPhillips - Ferndale Refinery

File Name: SRU2 Flow Balance 020210.xls
File Location: S:\Departments\HSE\Environmental\NWCAA\Stack Tests & RATAs

SRU No. 2 Flow Balance Summary during Feb 2, 2010 Compliance Tests

Run No.	Start Time	End Time	dscf/min
1	12:50	13:50	2921
2	14:21	15:21	2931
3	15:50	16:50	2958

Calculations for the flow balance on the #2 Incinerator.
RATA stack tests completed on February 02, 2010.

MCFD to SCFH

$$SCFH = MCFD \times \frac{1000}{24}$$

Standard Cubic Feet per Hour

$$Vol_{standard} = \left(\frac{P_{actual}}{R * T_{actual}}\right)\left(\frac{R * T_{standard}}{P_{standard}}\right)V_{actual}$$

P_{actual} = 14.896
V_{actual} = 88625.00
T_{actual} = 550.37
$P_{standard}$ = 14.7
$T_{standard}$ = 519.67
R = 10.73

$$84{,}797\,scfh = \left(\frac{14.896\,psia}{10.73 * 550.37°R}\right)\left(\frac{10.73 * 519.67°R}{14.7\,psia}\right) \times 88{,}625\,cfh$$

Partial pressure exerted by water in the Quench Column overhead.

Antoine Coefficients for Water

$$P_{SAT} = e^{A - \frac{B}{T + C}}$$

A = 16.262
B = 3799.89
C = 226.35
T = 32.61

$$4.90\,kPa = e^{16.262 - \frac{3799.89}{32.61 + 226.35}}$$

Convert kPa to psia

$$psia = kPa * 0.145$$

$$0.71 = 4.90 * 0.145$$

Volume of Water Vapor

$$V_{water} = V_{total} \times \frac{Partial\ Pressure_{water}}{Total\ Pressure_{QCOH}}$$

V_{total} = 88625.00
Partial P_{water} = 0.71
Total $P_{quenchOH}$ = 14.896

$$4{,}224\,cfh = 88{,}625\,cfh \times \frac{0.71\,psia}{14.896\,psia}$$

Dry Standard Cubic Feet per Hour

$$V_{dry} = V_{total} - V_{water}$$

Total Incinerator Stack Flow Rate

$$OxygenConsumed = 2 \times NaturalGasFlow$$

$$CO_2\ Produced = 1 \times NaturalGasFlow$$

Quench Column Overhead = 80,756
Incinerator Combustion Air = 100,483
Oxygen Consumed = 12,617
CO2 Produced = 6,308

$$Flowrate_{total} = QuenchColumnOH + IncineratorCombustionAir - O_2Consumed + CO_2produced$$

$$174{,}931\,dscf = 80{,}756\,dscfh + 100{,}483\,scfh - 12{,}617\,scfh + 6{,}308\,scfh$$

Total Incinerator Stack Flow Rate in Dry Standard Cubic Feet per Minute

$$dscfm = \frac{dscfh}{60}$$

$$2{,}916\,dscfm = \frac{174{,}931\,dscfh}{60}$$

ENVIRONMENTAL TECHNICAL SERVICES, LLC.

4848 Airway Drive
Central Point, Oregon 97502
Phone: (541) 779-2646
FAX: (541) 734-5537

January 6, 2010

Northwest Clean Air Agency
1600 South Second Street
Mount Vernon, Washington 98273-1620
Attention: Ms. Annie Naismith
CC: Mr. Axel Franzman

Source Test Plan For: ConocoPhillips Ferndale Refinery
- SRU2 Incinerator Sulfur Dioxide (SO_2) CEMS RATA
- SRU2 Incinerator Carbon Monoxide (CO), Nitrogen Oxides (NO_x), and Sulfur Dioxide (SO_2) Compliance Determination Testing

Ecology Final Permit Number: PSD-05-01
Order of Approval to Construct (OAC): #908A

Revised Testing Dates February 2nd and/or 3rd, 2010

Dear Ms. Naismith

Environmental Technical Services, Inc. is notifying the Northwest Clean Air Agency (NWCAA) of a pending Relative Accuracy Test Audit (RATA) and compliance determination test(s) scheduled for the week of January 31st, 2010 at the ConocoPhillips Refinery, located in Ferndale, Washington. The emissions unit to be evaluated and tested is the sulfur recovery unit #2 (SRU2). The purpose of testing is to satisfy two requirements, the CEMs annual O_2/SO_2 RATA and the second to demonstrate OAC permit #908a compliance. The annual RATA will verify the performance of the oxygen (O_2) and sulfur dioxide (SO_2) continuous emission monitoring systems (CEMS) as outlined in CFR 40, part 60, Appendices B and F, NWCAA Regulation Section 367, and Appendix A. The second testing requirement is to demonstrate compliance with OAC Permit #908A, Approval Conditions 1, 2, 3c, 5, & 6; CO, NOx and SO_2 emission rates.

1.) ***Name and Location of Source:***
ConocoPhillips Ferndale Refinery
3901 Unick Rd.
P.O. Box 8
Ferndale, Washington 98248

2.) ***Facility Site Personnel:***

Mr. Steve Burton
Construction Manager
ConocoPhillips Ferndale Refinery
3901 Unick Road
Ferndale, Washington 98248
Phone: (360) 384 - 8325

3.) ***Source Test Personnel:***

Environmental Technical Services, Inc.
4848 Airway Drive
Central Point, Oregon 97502
Phone: (541) 779 - 2646

Mr. James DeHoog - Environmental Engineer
Mr. Andy Winkler - Senior Project Manager
Mr. Jacob Buss - Air Quality Tech. / Report Development

4.) ***Date and Time of Emission Test:***

Date and Time of Emission Test:

February 1st, 2010: Travel, Test equipment set-up
February 2nd, 2010: Conduct CO, NO_x, and SO_2 compliance determination source tests. Start conducting CEMS audits.
February 3rd, 2010: Finish conducting CEMS audits, if needed.
February 4th, 2010: Extra day for unforeseen circumstances or additional testing.

5.) ***Description of the Process:***

Emission Source Process Units

Sulfur Recovery Unit #2 (SRU 2)
Supplemental Fuel: *Purchased Natural Gas*

Emission Unit Control Device: SCOT Tail Gas Treating (TGU2) Unit
Compliance Demonstration Point: Exhaust duct for: O_2, CO, NO_x, SO_2, and Opacity.

6.) ***Pollutant Parameters to be Determined:***

The emission parameters to be measured include:
Sulfur Recovery Unit #2 (SRU 2), Exhaust Duct:

Oxygen (O_2)
Carbon Monoxide (CO)
Nitrogen Oxides (NO_x)
Sulfur Dioxide (SO_2)
Opacity Via Source Test Method 9A

7.) ***Test Methods to be Followed, Number of Replicates:***

Annual Compliance Demonstration
Emission Measurement Location: Sulfur Recovery Unit #2 (SRU #2) Exhaust Duct

Parameter	Test Method	Sample Replicates & Time	Reporting Units
Volume Flow Rates	EPA 1-4	Three Runs up to 60 minutes each.	acfm, scfm, sdcfm
Visible Emissions	EPA Method 9, Source Test Method 9A	Three Runs 6 minutes each. 24 Readings	%, Opacity
Sulfur Dioxide	EPA Method 6c	Three Runs 60 minutes each.	ppm ppm @ 7% O_2 lbs/hour
Nitrogen Oxides	EPA Method 7e	Three Runs 60 minutes each.	ppm ppm @ 7% O_2 lbs/hour
Carbon Monoxide	EPA Method 10	Three Runs 60 minutes each.	ppm ppm @ 7% O_2 lbs/hour

Relative Accuracy Test Audit (RATA)
Emission Measurement Location: Sulfur Recovery Unit #2 (SRU #2) Exhaust Duct

Parameter	Test Method	Sample Replicates & Time	Reporting Units
Oxygen	EPA Method 3a Performance Spec. 3	Twelve runs, 12 qty. 21 minute.	Percent (%) by Volume
Sulfur Dioxide	EPA Method 6c Performance Spec. 2	Twelve runs, 12 qty. 21 minute.	ppm, dry volume, ppm@0% O_2

Notes: Twelve audit test runs will be performed comparing the reference method (RM) data to the corresponding CEMS data to determine relative accuracy (RA). The audit test runs will be composed of twelve (12 qty.) twenty-one minute RATA test runs.

8.) ***Applicable Process Information - Operating Load During Emission Testing:***

Sulfur Recovery Unit #2 (SRU #2) Exhaust Duct
During the emission testing of the SRU #2, ConocoPhillips personnel will document operating parameters and applicable process information to be included in the source test reports.

Acid Gas and Sour Gas feed rates (SCF) into Sulfur Recovery Unit #2 will be documented for each test run and included in the final report.

9.) ***General Approach:***

The following EPA reference methods will be used during the performance test. The respective summaries outline each method and any deviations proposed.

9.1 Volume Flow, EPA Methods 1 and 2

EPA Methods 1 and 2 are used to measure volumetric flow rates. EPA Method 1 is used to locate the representative sample points within the stack area. The cross-sectional area of the stack is divided into a number of equal areas. Sample traverse points are then located within each of these equal areas. EPA Method 2 is used to measure average stack gas velocity using a calibrated type "S" pitot tube connected to an incline oil manometer. Stack temperature is measured simultaneously using a calibrated type "K" thermocouple.

In addition, the measured volumetric flow rates will be compared to the volumetric flow rates calculated from operating parameters measured during each compliance test run performed.

9.2 Molecular Weight, EPA Method 3a

A gas analysis for oxygen and carbon dioxide is performed by an instrumental gas analyzer and used to calculate the molecular weight of the stack gas.

9.3 Stack Gas Moisture Content, EPA Method 4

A sample of the gas stream is extracted, dried, and gas volume metered using an EPA Method 4 sample train. The weight gain of condensed moisture is then measured by volume. The percentage of moisture is used to calculate the dry molecular weight of the stack gas and correct wet volume measurements to a dry volume basis.

9.4 Continuous Emission Monitoring EPA Methods 3a, 6c, 7e, and 10:

The gaseous parameters, O_2, CO_2, CO, NO_x, and SO_2 are determined using continuous instrumentation methodology. A gas sample is extracted from the stack through a heated (250° ± 5° F) Teflon probe/filter assembly that is approximately 2 meters in length. A calibration-gas purge tee is fitted upstream of the filter assembly and is used during system bias calibrations.

The sample gas is transported from the outlet of the control device to the mobile CEMS through a heated (250° ± 5° F) Teflon flex line that measures 100 feet in length. At the CEMS van the sample is drawn through a moisture removal system. This system consists of two chilled knockout traps (250 cubic centimeters (cc) each) connected in series and maintained at 38° ± 3° F. Condensate is continuously removed from the moisture traps with a dual-head, peristaltic pump at 50 cc per minute.

A finish filter removes particulate matter to less than 0.2 microns in diameter. The gas manifold consists of a leak-free sample pump constructed of a stainless-steel head and Teflon diaphragm. The sample gas is then divided simultaneously to each analyzer through a series of stainless-steel metering valves and glass flow meters.

The following instrumentation is used to analyze the gaseous pollutant parameters:

Parameter	Manufacturer	Model	Technology
O_2	Siemens	Oxymat 5E	Paramagnetic
CO_2	Siemens	Ultramat 5E	NDIR
CO	Siemens	Ultramat 5E	NDIR
NOx	Eco-Physic	70CLD	Chemilumunesence
SO_2	Bovar	Model 721M	UV

The data recorder consists of a Parametric Systems digital data acquisition system. The Parametric Systems package is a fully automated reference test method data recording and report generating software/hardware package.

Calibration gases used are blended following EPA Method 205, with an Environics Series 4000 precision gas divider. All sample system bias checks, pre and post zero checks, and calibration–drift checks will be performed via EPA Methodology for each method, 3A, 6C, 7E, and 10, respectively. The test run is started after twice the response time has elapsed.

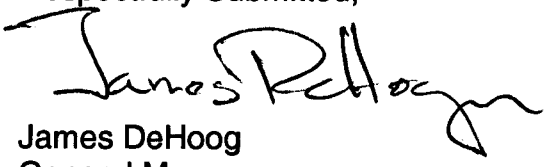
10.) General

Method-specific quality assurance / quality control procedures will be performed to ensure that the data is valid for determining source compliance. Documentation of the procedures and results will be presented in the final source test report for review. NWCAA will be notified of any change in the source test plan prior to testing.

Source test reports will be submitted to the Agency within sixty (60) days of the test completion. ConocoPhillips Ferndale Refinery will send one (1) copy of the completed source test report to Northwest Clean Air Agency.

If you have any questions please feel free to contact us at (541) 779 - 2646 or via e-mail at ETSLLC@msn.com. Please return Agency written approval to proceed with the aforementioned Source Test Protocol (STP) at your earliest convenience.

Respectfully Submitted,



James DeHoog
General Manager
Environmental Technical Services, Inc.

Northwest Clean Air Agency
Emission Test Summary

Please fill out the pertinent information and submit the form with your test plan **and** with the final test report! Submit separate sheets for each emission unit.

Source Name:	ConocoPhillips Ferndale Refinery
Test performed by:	Environmental Technical Services, Inc. (541) 779-2646
Emission/Process Unit:	1) Sulfur Recovery Unit #2 (SRU #2)
List Operational Parameters recorded during testing:	NOx, CO, SO_2 concentration (ppm) in exhaust gas stream
Regulation requiring test: --- Required frequency of test:	EPA NSPS, WDOE Permit # PSD-05-01 --- Annual Compliance demonstration
Proposed Test Date(s): --- Actual Test Date(s)	February 2, 2010 --- February 2, 2010
Test Method(s): --- Modifications (if any):	EPA Method 3a, 4, 6c, 7e and 10 --- None
Pollutant(s), units: --- Emission or concentration limit:	NO_xppm@7%O_2, NO_x ppm lbs/hr COppm@7%O_2 COppm lbs/hr SO_2ppm @0%O_2 --- 42.2ppm NO_x @7% O_2 2.3lbs/hr NOx 57.1ppm CO @7% O_2 1.9lbs/hr CO 250ppm SO_2 @ 0%O_2 22.3 Tons SO_2/year
Average Emission/Concentration: (include averaging time, correction if applicable)	24.7ppm NO_x @7% O_2 0.0ppm CO @7% O_2 29.7ppm SO_2@0%O_2 0.87lbs/hr NOx 0.00lbs/hr CO 4.17Tons SO_2/yr
In Compliance (Y/N)	1) SRU#2 – In Compliance
Comments:	
For Official Use Only:	