SULFUR RECOVERY UNIT 2
COMPLIANCE STACK TESTING REPORT
UNITED REFINING COMPANY
WARREN FACILITY
WARREN, PENNSYLVANIA

PLAN APPROVAL No. 62-017O

Testing Date: April 10, 2008

Prepared for:

United Refining Company
P.O. Box 780
15 Bradley Street
Warren, Pennsylvania 16365

Prepared by:

Air/Compliance Consultants, Inc.
1050 William Pitt Way
Pittsburgh, Pennsylvania 15238
(412) 826-3636

Project Number 08-065

Air/Compliance Consultants, Inc.

SOURCE TEST REPORT STATEMENT

This statement signed by the on-site supervisor of the test team and the source owner/operator certifies that "to the best of their knowledge" the source test report has been checked for completeness, and that the results presented are accurate, error-free, legible, and representative of the actual emissions measured during testing.

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Eric S. White
Project Manager, QSTI
Air/Compliance Consultants, Inc.

Joey Roy
Environmental Manager
United Refining Company

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SULFUR RECOVERY UNIT 2
COMPLIANCE STACK TESTING REPORT
UNITED REFINING COMPANY
WARREN FACILITY
WARREN, PENNSYLVANIA

1 INTRODUCTION

United Refining Company (URC) contracted Air/Compliance Consultants, Inc. (ACCI) to perform a carbon monoxide (CO) and sulfur dioxide (SO_2) testing program on the Sulfur Recovery Unit 2 (SRU 2) stack at their facility located in Warren, Pennsylvania. Testing was performed to demonstrate compliance with URC's Plan Approval No. 62-017O. All testing followed methodology referenced in the United States Environmental Protection Agency (USEPA) Title 40, Code of Federal Regulations (CFR) Part 60, Appendix A. A copy of the testing protocol is located in Appendix A.

2 COMPANY AND TESTING FIRM INFORMATION

COMPANY	TESTING FIRM
Mr. Joey Roy United Refining Company 15 Bradley Street Warren, Pennsylvania 16365 (814) 723-1500 – Telephone (814) 726-4603 – Facsimile jroy@urc.com	Mr. Eric S. White Air/Compliance Consultants, Inc. 1050 William Pitt Way Pittsburgh, Pennsylvania 15238 (412) 826-3636 – Telephone (412) 826-3640 – Facsimile ewhite@air-comp.com

3 TESTING DATE AND PERSONNEL

Testing was performed April 10, 2008. The ACCI testing team consisted of Mr. Eric S. White, Project Manager, QSTI; Mr. Rich Williams, Project Scientist; and Mr. Michael Belfoure, Scientist. Mr. Joey Roy served as the URC liaison.

4 PROCESS OPERATING CONDITIONS

Testing was performed at the unit's maximum normal operating condition.

5 SAMPLING LOCATION DESCRIPTION

The SRU 2 extracts elemental sulfur from acid gas (gas containing hydrogen sulfide [H_2S]) using the Claus process. Tail gas from the Claus process contains residual H_2S and SO_2. It is sent to the Tail Gas Treating Unit (TGTU) where even more sulfur is stripped from the gas. At the TGTU, residual SO_2 is converted to H_2S and an amine scrubber removes the H_2S. The treated gas is sent to an incinerator where any residual sulfur compounds are converted to SO_2.

The SRU 2's incinerator stack is 70" in diameter at the sampling location and exhausts 175' above grade. A ladder provides access to the sampling platform, which is located approximately 79' above grade. The stack temperature of the SRU 2's incinerator is typically 1,200 to 1,220°F.

6 TESTING PROCEDURES

Testing was conducted in accordance with USEPA Title 40, CFR Part 60, Appendix A, Testing Methods 1, 2, 3A, 4, 6C, 10. Field and Computerized data sheets can be found in Appendix B.

6.1 Gas Flow and Temperature Measurements

The principles of USEPA Method 1, *Sample and Velocity Traverses for Stationary Sources*, were utilized to determine the number and location of the traverse points for the SRU 2 Stack Outlet.

The gas flow rate and temperature profiles for the gas stream were measured by conducting simultaneous velocity and temperature traverses during each sampling run. Gas velocity head was measured using a calibrated S-type Pitot tube that was connected to a manometer. The static pressure was measured using the same Pitot tube and manometer. A Chrome-Alumel thermocouple attached to a digital indicator was used to measure the gas temperature at each of the traverse points. The gas flow and temperature measurements followed the principles of USEPA Method 2, *Determination of Stack Gas Velocity and Volumetric Flow Rate (S-Type Pitot Tube)*. Cyclonic checks can be found on the Run 1 field data sheet, in Appendix B.

6.2 CO_2 and O_2 Determination

The principles of USEPA Method 3A were utilized for the determination of oxygen (O_2) and carbon dioxide (CO_2) for the test program. A Servomex 1440 Analyzer was used. A gas sample was continuously extracted from the SRU 2 stack and a portion of the sample was conveyed to a paramagnetic O_2 and a single beam, single wavelength CO_2 analyzer through a heated line.

6.3 Moisture Content Sampling

Moisture content sampling was conducted concurrently with each sampling run using the principles and sampling apparatus presented in USEPA Method 4, *Determination of Moisture Content in Stack Gases.* The parameters evaluated to determine the gas-stream moisture content were: sample gas volume, temperature and pressure, and impinger and silica gel moisture gain.

6.4 Determination of Carbon Monoxide Emissions

The principles of USEPA Method 10, *Determination of Carbon Monoxide Emissions from Stationary Sources (Instrument Analyzer Procedure),* were used for this test program. A gas sample was continuously extracted from the stack, passed through a heated line, into a gas conditioner, and then a portion of the sample was conveyed to a TECO Gas Filter Correlation analyzer. USEPA Protocol gases were used for USEPA Method 10 instrument calibrations. Three 60-minute sampling runs were performed.

6.5 Determination of Sulfur Dioxide Emissions

The principles of USEPA Method 6C, *Determination of Sulfur Dioxide Emissions from Stationary Sources (Instrument Analyzer Procedure),* were used for this test program. A gas sample was continuously extracted from the stack, passed through a heated line, into a gas conditioner, and then a portion of the sample was conveyed to a Western Research Series 921 AX-921-9746-1 ultraviolet analyzer. USEPA protocol gases were used for USEPA Method 6C instrument calibrations. Three 60-minute sampling runs were performed the average of the three sampling runs constituted the tests. The 1-minute average and CEM bias sheets for the test program are located in Appendix D.

7 DEVIATIONS FROM THE PROTOCOL

The only deviation from the URC submitted protocol is the revised stack figure for the SRU 2. The stack diameters referenced were incorrect against the verified measurements in the field. A corrected stack sampling schematic is enclosed in the figure section of this report.

8 QUALITY ASSURANCE/QUALITY CONTROL

The following reference method calibration sheets can be found in Appendix E.

- Analyzer interference checks
- Stratification Check
- USEPA Protocol Calibration Gas Certifications
- Thermocouple calibration
- Pitot Calibration
- Dry Gas Meter Calibration

9 TESTING RESULTS

Table 1 contains the emission results for the SRU 2 stack. CO and SO_2 emissions concentrations are presented in terms of parts per million, dry volume basis (ppm_{dv}) and emission rates are presented in terms of lb/hr.

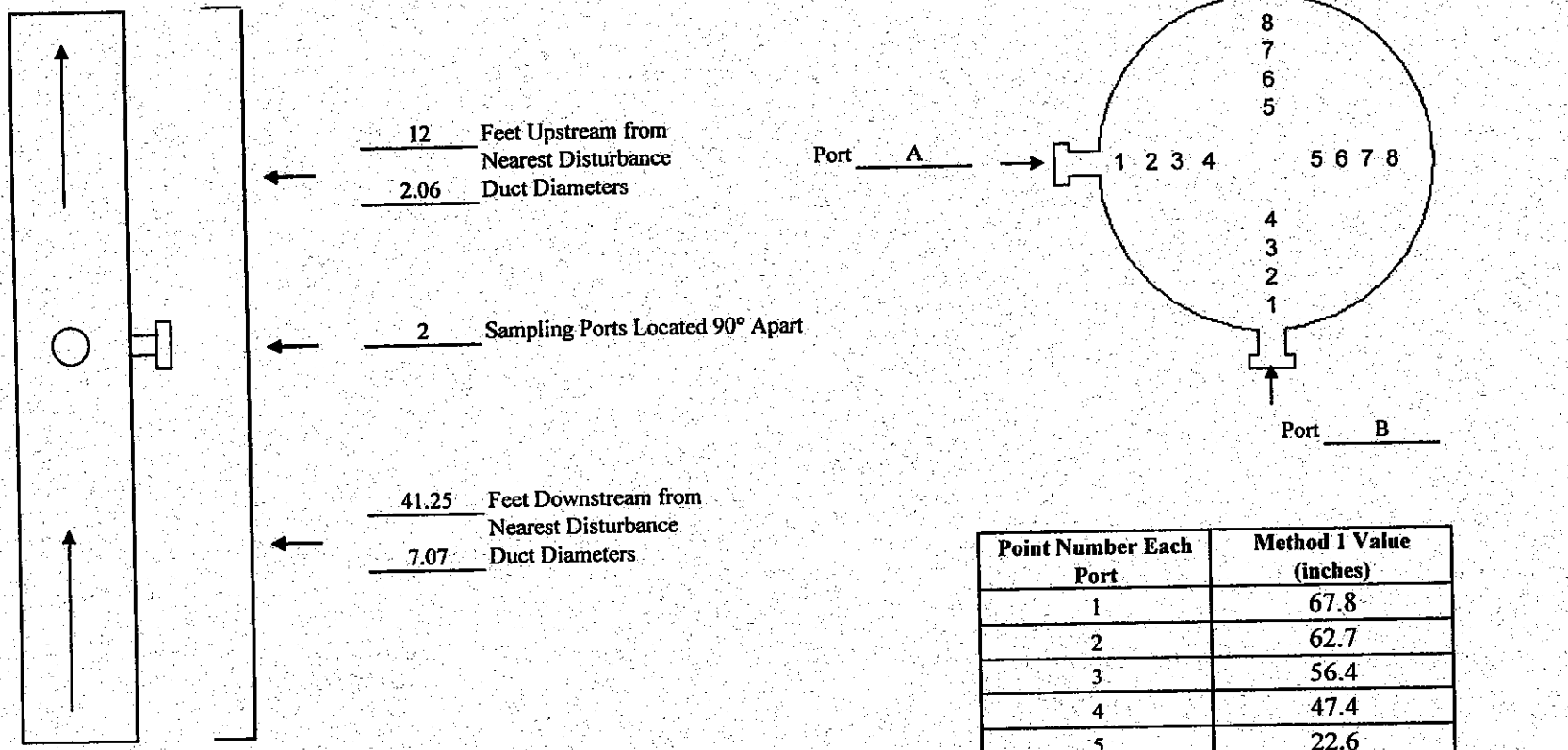
Field and computerized datasheets are contained in Appendix B. URC supplied process data can be found in Appendix C. One-minute averages and continuous emission monitoring (CEM) bias sheets are contained in Appendix D. Reference method QA/QC data is located in Appendix E, and sample calculations are located in Appendix F.

10 CONCLUSIONS

ACCI conducted a compliance testing program on April 10, 2008 for United Refining Company located in Warren, Pennsylvania. Testing was performed on the Sulfur Recovery Unit 2 Stack for CO, and SO_2 emission concentrations and emission rates. Test results represent data that is considered to be representative of the emission rates at the prevailing operating conditions.

FIGURES

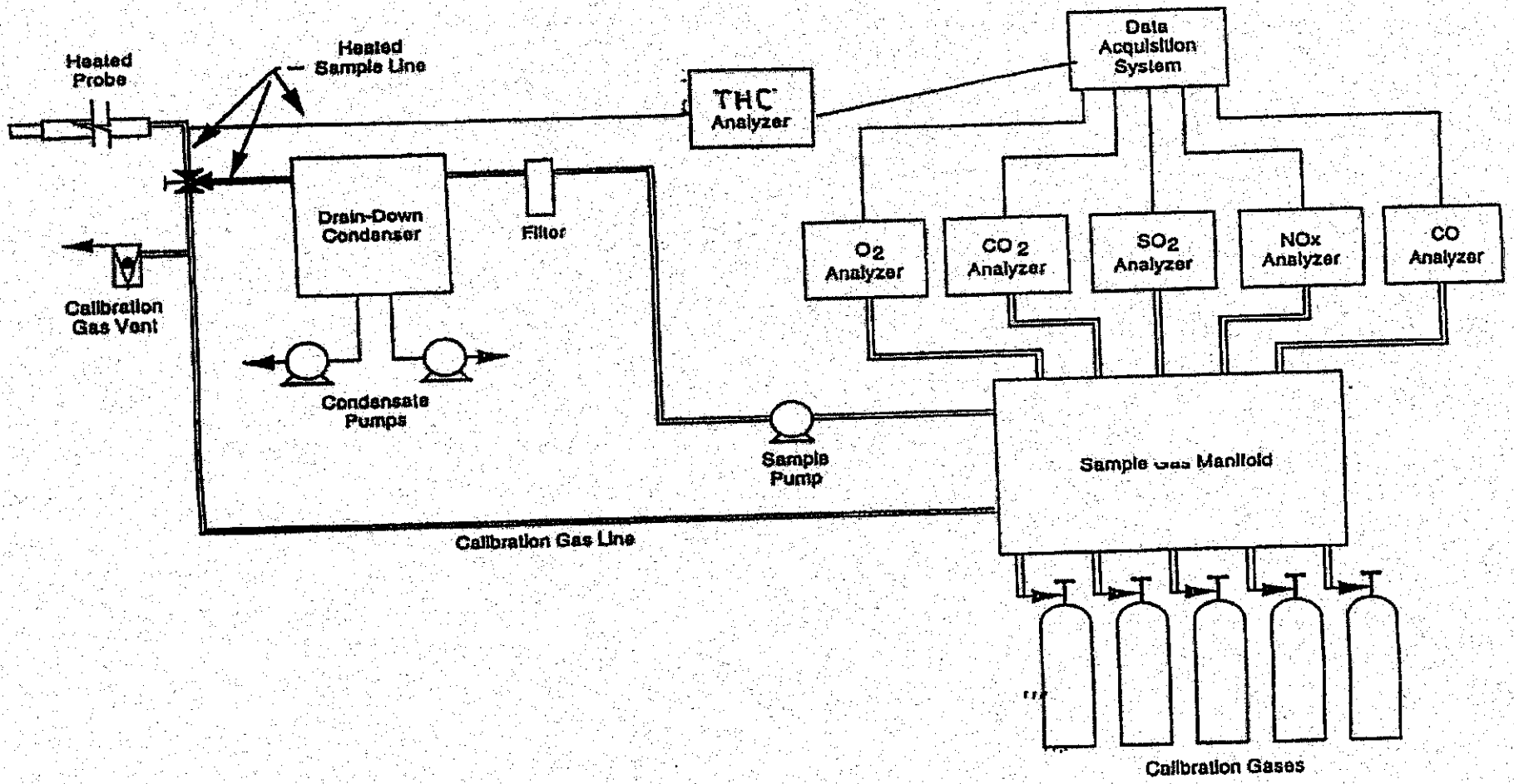
AIR/COMPLIANCE CONSULTANTS, INC.
USEPA METHOD 1 DATA SHEET



Point Number Each Port	Method 1 Value (inches)
1	67.8
2	62.7
3	56.4
4	47.4
5	22.6
6	13.6
7	7.4
8	2.2

Air/Compliance Consultants, Inc.

Sampling Schematic and sample point location for the SRU 2	Figure 1



Air/Compliance Consultants, Inc.

ACCI CEM's Sample Flow and Calibration System Schematic	Figure 2

TABLE

Table 1. Emissions Test Results, Sulfur Recovery Unit 2
United Refining Company, Warren, Pennsylvania

Test Data		Run 1	Run 2	Run 3	Average	
Date		4/10/2008	4/10/2008	4/10/2008		
Start Time		9:30 AM	10:40 AM	11:50 AM		
End Time		10:30 AM	11:40 AM	12:50 PM		
Flow Rate	(ACFM)	16,461	17,246	16,831	16,846	
Flow Rate	(SCFM)	5,282	5,565	5,446	5,431	
Flow Rate	(DSCFM)	4,946	5,202	5,070	5,073	
Flow Rate	(DSCM/min)	140	147	144	144	
Sample Volume	(DSCF)	22.958	22.831	22.990	22.926	
Sample Volume	(DSCM)	0.65	0.65	0.65	0.65	
Carbon Dioxide (CO_2)	(dry volume %)	4.97	5.04	5.27	5.09	
Oxygen (O_2)	(dry volume %)	5.77	5.66	3.95	5.13	
Water Vapor (H_2O)	(volume %)	6.36	6.53	6.90	6.60	
Stack Temperature	(°F)	1149.9	1140.9	1147.8	1146.2	
Results						Limits
Carbon Monoxide (CO)						
Emission Concentration	(ppm_{dv})	282.4	282.1	258.6	274.4	
Emission Rate	(lb/hr)	6.1	6.4	5.7	6.1	8.7
Sulfur Dioxide (SO_2)						
Emission Concentration	(ppm_{dv})	91.1	77.6	72.3	80.3	
Emission Rate	(lb/hr)	4.5	4.0	3.7	4.1	12

CEM results have been bias calibration corrected.
Values that are less than 0 are reported as 0 in the Table and are included in the Average as 0.

ACFM	Actual cubic feet per minute
DSCF	Dry standard cubic feet
DSCFM	Dry standard cubic feet per minute
DSCM	Dry standard cubic meter
°F	Degrees Fahrenheit
lb/hr	Pounds per Hour
ppm_{dv}	Parts per million dry volume
SCFM	Standard cubic feet per minute

APPENDIX A

Testing Protocol

West Reformer Heater, Pretreater Heater, and SRU 2
Compliance Testing Protocol
Warren Facility
United Refining Company
Warren, Pennsylvania

August 31, 2007

Prepared for:
United Refining Company
P.O. Box 780
15 Bradley Street
Warren, Pennsylvania 16365

Prepared by:

United Refining Company
P.O. Box 780
15 Bradley Street
Warren, Pennsylvania 16365
814-723-1500

Test Method Certification

United Refining Company has conducted a review of the state and federal regulations that apply to the Warren, PA Facility in order to develop the test methods described in this protocol. We certify, to the best of our knowledge, that the test methods that have been incorporated into the attached protocol meet the testing requirements of the applicable regulations.

William J. Roy
Environmental Manager of Air Quality

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1. Introduction

United Refining Company will contract a testing firm to perform an evaluation of Sulfur Dioxides (SOX), Carbon Monoxide (CO) emissions, and Nitrogen Oxides (NOX) for the Pretreater heater; Carbon Monoxide (CO) emissions for the West Reformer Heater, and Sulfur Dioxides (SOX) and Carbon Monoxide (CO) emissions for the Sulfur Recover Unit No. 2 (SRU 2).

2. Company and Testing Firm Information

Company Representative:

William J. Roy
United Refining Company
15 Bradley St.
Warren, Pa 16365
PH 814-723-1500
Fax 814-726-7398

Testing Firm:

To be determined

3. Analytical Laboratory Information

Refinery fuel gas (RFG) samples will be collected and analyzed for each test run by gas chromatography for btu content. A certified Pa Laboratory will perform analysis.

4. Scope and Objective

The scope of this project is to determine the NOX, SOX and CO emissions of the Pretreater Heater using the United States Environmental Protection Agency Methods 1,2,3A, 4, 6C, 7E, and 10; to determine the SOX and CO emissions for the SRU 2 using EPA Methods 1,2,3A, 6C and 10; and to determine CO emissions using Method 1,2,3A, 4, and 10 for the Pretreater Heater. The procedures described in the Pennsylvania Department of Environmental Protection (PADEP) "*SOURCE TESTING MANUAL.*" will be followed. The test results are intended to determine compliance with URC's Plan Approval Number 62-00170 (Source ID 052, 051, and 108). A copy of the Plan Approval applicable pages is included in Appendix A.

5. Testing Methods

Testing will be performed in accordance with PADEP requirements and EPA, Title 40 Code of Federal Regulations (CFR), Part 60. The following is a list of the test methods that will be used.

EPA Method 1 "Sample and Velocity Traverses for Stationary Sources"

EPA Method 2 "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)

EPA Method 3A "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources"

EPA Method 4 "Determination of Moisture Content in Stack Gases"

EPA Method 7E "Determination of Nitrogen Oxides Emissions from stationary Sources"

EPA Method 6C "Determination of Sulfur Dioxide Emissions from stationary sources (instrumental Analyzer Procedure)

EPA Method 10 "Determination of Carbon Monoxide Emissions from Stationary Sources"

6. Sampling System

The sampling system will consist of a heated stainless-steel sampling probe, a heated filter holder with a glass-fiber filter, a tee or valve arrangement that will introduce calibration gas into the system for bias check, and a data acquisition system that will store the data and record all system bias checks.

Sample Location setup and source dimensions are demonstrated in Figure 1 thru 3. All method sampling apparatus will follow the method diagrams that are found in Appendix B.

All calibration gas that will be used to calibrate the system will be USEPA Protocol 1 calibration gas.

7. Process Description

The Pretreater Heater (Source ID 51 transfers heat to the Naptha Hydrotreater Unit feed. The feed is Naptha from both the Crude tower and heavy Naptha from the FCC unit. The Pretreater Heater uses refinery fuel gas and refinery fuel oil to heat the Naptha before entering the NHT reactors.

The West Reformer Heater transfers heat to the Reformer feed before entering the Reformer reactors. The heater also has a deltek on top of the heater that recovers waste heat to produce steam.

The Sulfur Recover Unit No. 2 accepts all the sour gas, H2S laden off gas and gas from the sour water stripper. The sulfur is removed from the gas and converted to molton sulfur. The remaining gas is combusted in an incinerator before being emitted. The SRU 2 incinerator and the hot oil heater will be tested.

8.0 Procedures

8.1 Traverse Locations

The sampling station for the collection of gas-flow data is located at the outlet stack of the boiler. The inside diameter (ID) of the Vacuum Heater stack, at the sampling location, is 54". The nearest upstream disturbance is at a minimum 108" from the sampling ports. The nearest downstream disturbance is at a minimum 168" from the sampling ports. USEPA Method 1, "*Sample and Velocity Traverse for Stationary Sources,*" was utilized to determine the number and location of the traverse points. A total of 16 traverse points were chosen with 8 points sampled in each of 2 test ports (figure 4). All measurements will be verified prior to the start of the test program. A copy of the cyclonic flow check data will be included with the field data sheets in the final report. NOX sampling will be conducted at a single centrally located point at this location.

8.2 Volumetric Flow Rate and Temperature

Simultaneous velocity and temperature traverses will be taken during each run. Velocity will be measured with a calibrated S-type Pitot tube that will be connected to a manometer. A thermocouple will be used to measure temperature at each traverse point. EPA Method 2 procedures will be followed.

8.3 Gas Composition and Molecular Weight

EPA method 3A procedures will be followed for determination of Oxygen and Carbon Dioxide. A paramagnetic analyzer will be used to monitor Oxygen. A single wavelength analyzer will be used to measure Carbon Dioxide. Analyzer interference data will be provided in the final report.

8.4 Moisture Content

Moisture content will be monitored by evaluating parameters including sample gas volume, temperature pressure, impingers, and silica gel moisture gain. A minimum sample volume of 21 dry standard cubic feet will be collected for each run. EPA Method 4 procedures will be followed. Each moisture sample will be taken concurrently with each NOX sample run.

8.5 NO_X Concentration

EPA Method 7E will be followed for this project. A gas sample will be continuously extracted from the exhaust stack and a portion of the sample will be conveyed to a chemiluminescent analyzer through a heated sample line. EPA Method 205 utilizing EPA Protocol gases may be used for EPA Method 7E calibrations. Analyzer interference data and converter efficiency results will be provided in the final report.

8.6 CO Concentration

EPA Method 10 will be used to measure Carbon Monoxide concentration. A non-dispersive infrared analyzer will be used to monitor an extractive gas sample. EPA Method 205 utilizing EPA Protocol 1 gases will be used for Method 10 instrument calibrations. Analyzer interference data and converter efficiency results will be provided in the final report.

8.7 SO2 Concentration

EPA Method 6C will be used to measure Sulfur Dioxide concentration. An ultraviolet adsorption analyzer will be used to monitor an extractive gas sample. EPA Protocol 1 gases will be used for the required instrument calibration.

8.8 Process Data

United Refining Personnel will record the following process information at least every 15 minutes during each testing period for inclusion in the final report and for the use of calculating firing rate of the heater.

Fuel Gas being combusted in the burner in mmscf/day
Feed Rate going thru the heater in bbls/day

8.9 Calculations

Emission calculations will be completed by using a computer spreadsheet format. The results of each pertinent parameter will be detailed on a spreadsheet for each sample run and provided in the final report. A sample calculation for one complete test run will be included in the final report.

8.10 Calibrations

The following field equipment calibrations will be contained in the final report:

- Thermocouple
- Dry gas meter and orifice
- Pitot Tube
- NOX and CO Analyzer calibration data
- NOX analyzer converter efficiency and interference data

9.0 Formulas to be used in Data Reduction

See Appendix B

10.0 Examples of Field Data Sheets

See Appendix C

11.0 Testing Schedule

The tentative test date is scheduled during the last week in June. URC will notify PADEP at least 14 days prior to actual test dates.

12.0 Reporting

At the conclusion of the field evaluation program, a test report summarizing the emissions results will be prepared in accordance with PADEP requirements.

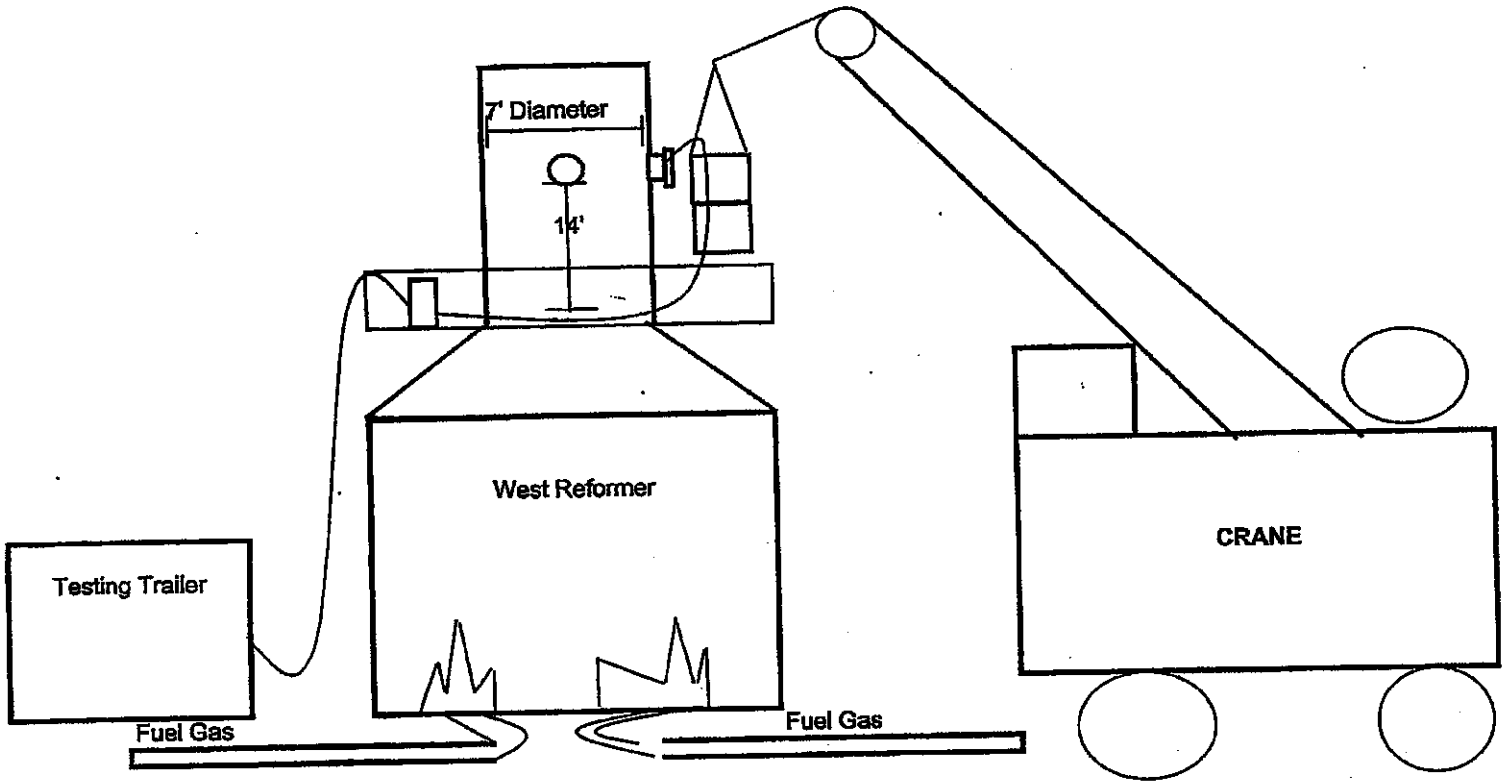


FIGURE 1 - SAMPLE LOCATION AND DIMENSIONS

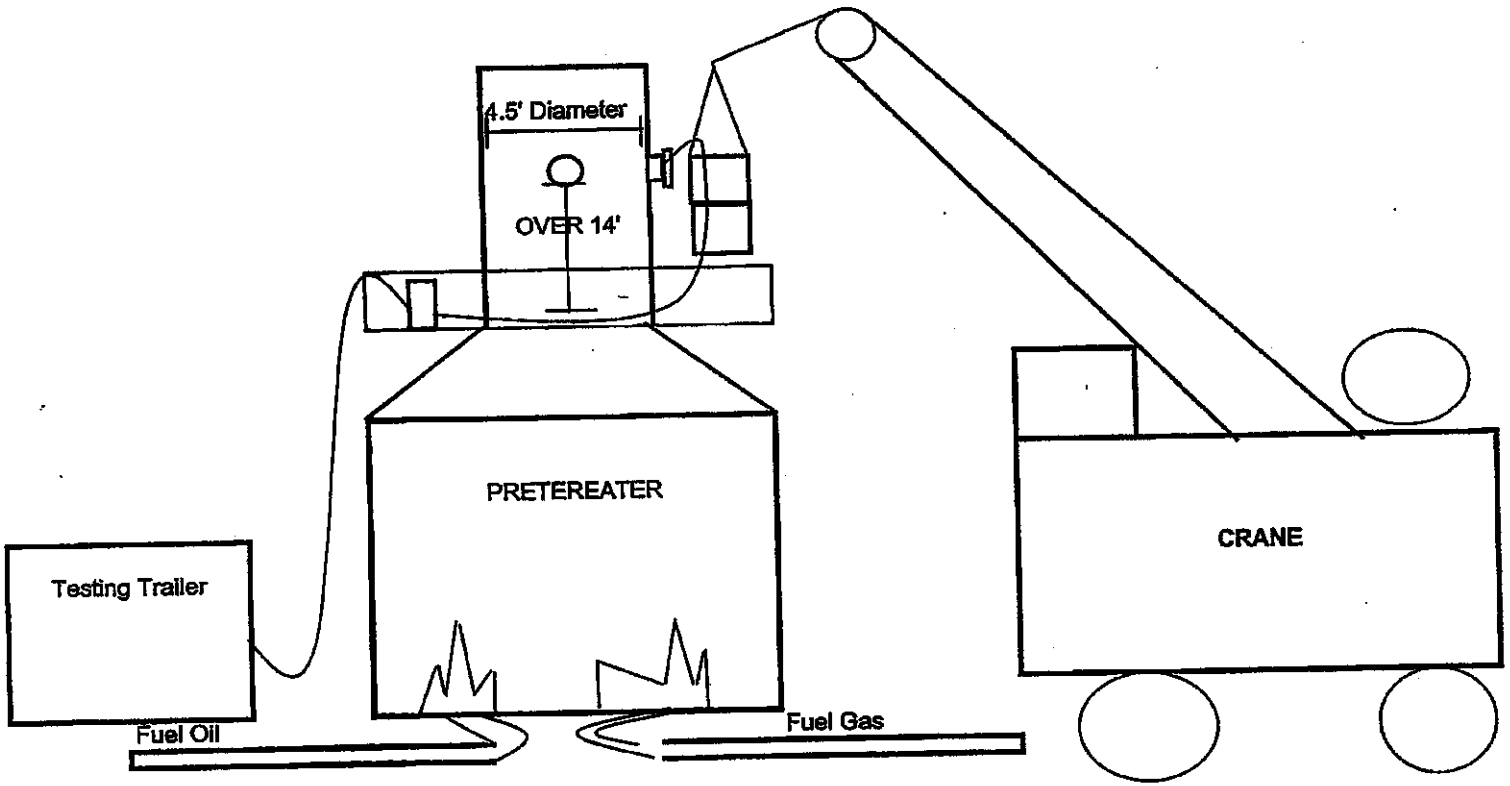


FIGURE 2 - SAMPLE LOCATION AND DIMENSIONS

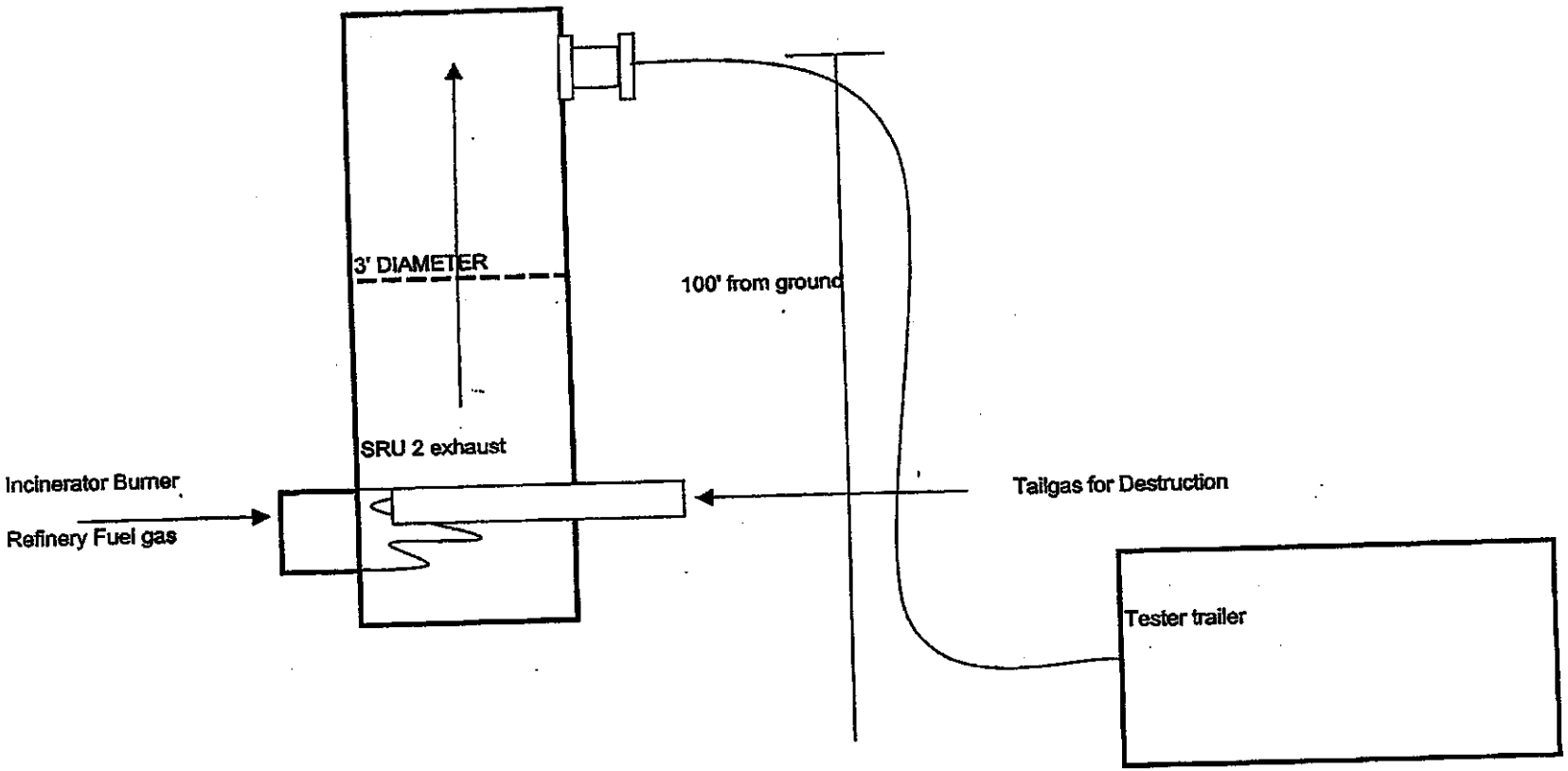
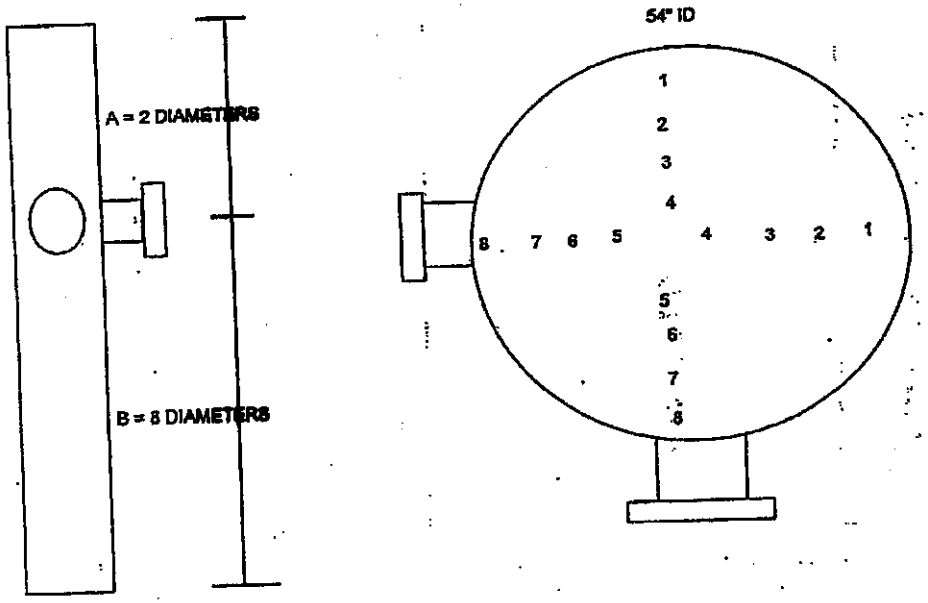


FIGURE 3 - SRU 2 STACK DIMENSIONS

USEPA METHOD 1 DATA SHEET FOR UNITED REFINING CO.
VACUUM HEATER



PORT NUMBER	Method 1 Value (inches)
1	52.3
2	48 3
3	43.5
4	36.6
5	17 4
6	10.5
7	5.7
8	1.7

Figure 4- Traverse Points

APPENDIX A

Plan Approval

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
AIR QUALITY PROGRAM

PLAN APPROVAL

Issue Date: March 13, 2007 Effective Date: March 13, 2007

Expiration Date: September 30, 2008

In accordance with the provisions of the Air Pollution Control Act, the Act of January 8, 1960, P.L. 2119, as amended, and 25 Pa. Code Chapter 127, the Owner, [and Operator if noted] (hereinafter referred to as permittee) identified below is authorized by the Department of Environmental Protection (Department) to construct, install, modify or reactivate the air emission source(s) more fully described in the site inventory list. This Facility is subject to all terms and conditions specified in this plan approval. Nothing in this plan approval relieves the permittee from its obligations to comply with all applicable Federal, State and Local laws and regulations.

The regulatory or statutory authority for each plan approval condition is set forth in brackets. All terms and conditions in this permit are federally enforceable unless otherwise designated as "State-Only" requirements.

Plan Approval No. 62-017O

Federal Tax Id - Plant Code: 25-1411751-1

Plan Approval Description

The plan approval is for modification of the Naphtha Hydrotreater (NHT) unit, addition of heat exchangers, modifications to heat exchangers, modifications to the NHT stripper tower, and adding an additional NHT reactor. The changes are being made to achieve compliance with the EPA low sulfur gasoline standards of 30 ppm (annual average) and 80 ppm (per gallon maximum).

Owner Information

Name: UNITED REF CO
Mailing Address: PO BOX 780
WARREN, PA 16365-0780

Plant Information

Plant: UNITED REFINING CO/WARREN PLT
Location: 62 Warren County 62001 Warren City
SIC Code: 2911 Manufacturing - Petroleum Refining

Responsible Official

Name: DAVID GALLOGLY
Title: ASST V.P., ENVIRONMENT CO
Phone: (814) 726 - 8020

Plan Approval Contact Person

Name: WILLIAM J ROY
Title: ENVIRONMENTAL ENGINEER
Phone: (814) 723 - 1500

[Signature] John F. Guth
JOHN F GUTH, NORTHWEST REGION AIR PROGRAM MANAGER

SECTION H. Source Group Plan Approval Restrictions.

Group Name: TESTING REQUIREMENTS

Group Description: Requirements for emission testing of sources subject to the ULSG Plan Approval

Sources included in this group:

ID	Name
049	EAST REFORMER HEATER
051	PRETREATER HEATER
052	WEST REFORMER HEATER
056	PREFACTIONATOR REBOILER 2
108	CLAUS SULFUR PLANT 2
108A	SULFUR PLANT 2 HOT OIL HEATER

I. RESTRICTIONS.

No additional requirements exist except as provided in other sections of this plan approval including Section B (Plan Approval General Requirements).

II. TESTING REQUIREMENTS.

001 [25 Pa. Code §127.12b]

Plan approval terms and conditions.

a) Within 30 days of completion of the ULSG Project modifications, a test procedure and a sketch with dimensions indicating the location of sampling ports and other data to ensure the collection of representative samples of NOx, CO, SOx, emissions from the West Reformer Heater, the Pretreater Heater, and the SRU2 shall be submitted to the Department.

b) Within 180 days after completion of the ULSG Project modifications, the owner or operator of the source shall conduct performance tests as follows:

1) West Reformer Heater for CO emissions,
2) Pretreater Heater for SOx, CO, and NOx emissions, and
3) SRU2 for SOx, and CO emissions.

c) The stack test shall be conducted in accordance with the provisions of 25 Pa Code Chapter 139. During the stack test the source shall be operating at maximum normal operating capacity.

d) At least two weeks prior to the test, the Department shall be informed of the date and time of the test.

e) Within 30 days after completion of the test, two copies of the complete test report, including all operating conditions, shall be submitted to the Department for approval.

f) If the results of a stack test, performed as required by this approval, exceed the level specified in any condition of this approval, the Permitee shall take appropriate corrective actions. Within 30 days of the Permitee receiving the stack test results, a written description of the corrective actions shall be submitted to the Department. The Permitee shall take appropriate action to minimize emissions from the affected facility while the corrective actions are being implemented. The Department shall notify the Permitee within 30 days, if the corrective actions taken are deficient. Within 30 days of receipt of the notice of deficiency, the Permitee shall submit a description of additional corrective actions to the Department. The Department reserves the authority to use enforcement activities to resolve noncompliant stack tests.

g) If the results of the required stack test exceed any limit defined in this plan approval, the test was not performed in accordance with the stack test protocol or the source and/or air cleaning device was not operated in accordance with the plan approval, then another stack test shall be performed to determine compliance. Within 120 days of the Permitee receiving the original stack test results, a retest shall be performed. The Department may extend the retesting deadline if the Permitee demonstrates, to the Department's satisfaction, that retesting within 120 days is not practicable. Failure of the second test to demonstrate compliance with the limits in the plan approval, not performing the test in accordance with the stack test protocol or not operating the source and/or air cleaning device in accordance with the plan approval may be grounds for immediate revocation of the plan approval to operate the affected source.

III. MONITORING REQUIREMENTS.

No additional monitoring requirements exist except as provided in other sections of this plan approval including Section B (Plan Approval General Requirements).

IV. RECORDKEEPING REQUIREMENTS.

No additional record keeping requirements exist except as provided in other sections of this plan approval including Section B (Plan Approval General Requirements).

V. REPORTING REQUIREMENTS.

No additional reporting requirements exist except as provided in other sections of this plan approval including Section B (Plan Approval General Requirements).

VI. WORK PRACTICE REQUIREMENTS.

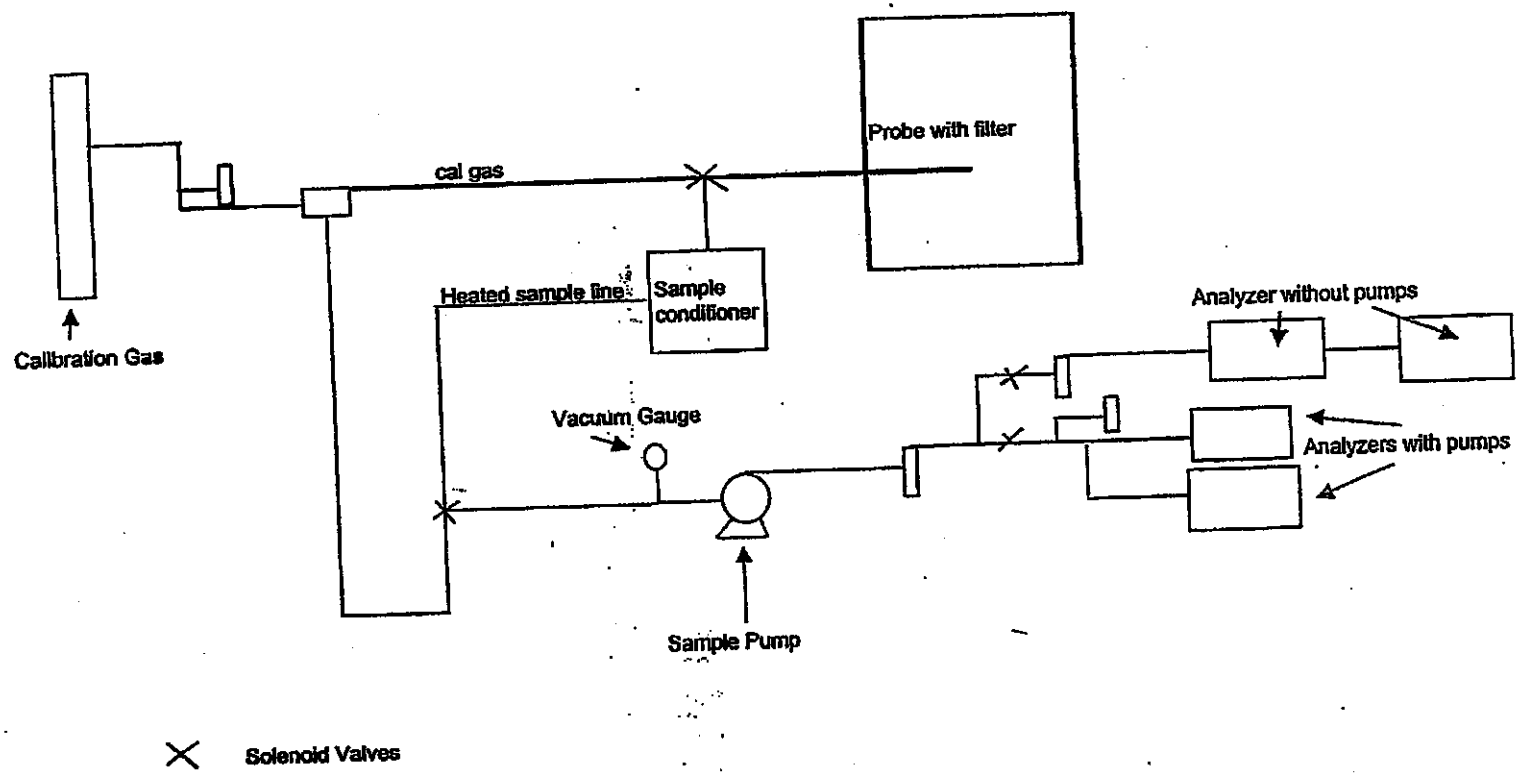
No additional work practice requirements exist except as provided in other sections of this plan approval including Section B (Plan Approval General Requirements).

VII. ADDITIONAL REQUIREMENTS.

No additional requirements exist except as provided in other sections of this plan approval including Section B (Plan Approval General Requirements).

APPENDIX B

Method Diagrams and Formulas



SAMPLE FLOW AND CALIBRATION SYSTEM SCHEMATIC

Vf	ml		Tstandard	68	F
Vi	ml		Pstandard	760	mm Hg
Wf	g		K1method 4	0.04707	scf/ml
Wi	g		K2method 4	0.04715	scf/g
Vm	dacf		K1method 5	17.64	R/in. Hg
Vm	dry actual liters		K4method 5	0.0945	
Yd			$Vh_{standard}$	385.3	ft3/lb-mole
Pbar	in. Hg		Kp	85.49	
dHavg	in. H2O				
Tm	F		π	3.141593	
O2	% dv		Ds (or L)		inches
CO2	% dv		Stack Width (W)	NA	inches
Pg	in. H2O		Tsavg		F
Cp			Product rate	NA	ton/hr
$(dP)^{1/2}$avg	in. H2O^1/2				
Process Data					
RFG Heating Value	btu/scf		RFG		mscf/hr
Oil Heating Value	btu/gal		Oil fired		bbls/hr
CEMS DATA					
			Oxides of Nitrogen (NOX)		
			$Caverage_{NOx}$		ppmdv
			C_{cmNOx}		ppmdv
			Cms_{NOx}		ppmdv
			Cm_{NOx}		ppmdv
			MW NO2	46.0	lb/lb-mole

1. Volume of Water Vapor Condensed (Vwc)

Vwc(std) = K1method 4 * (Vf - Vi) (USEPA Method 4, Eq. 4-1)

K1method 4= 0.04707 scf/ml
Vf= 0.0 ml
Vi= 0.0 ml
Vwc(std)= 0.000 scf

2. Volume of Water Vapor Collected in Silica Gel (Vwsg)

Vwsg(std) = K2method 4 * (Wf - Wi) (USEPA Method 4, Eq. 4-2)

K2method 4= 0.04715 scf/g
Wf= 0.0 g
Wi= 0.0 g
Vwsg(std)= 0.000 scf

3. Total Volume of Water Vapor in Gas Sample (Vw)

Vw(std) = Vwc(std) + Vwsg(std)

Vwc(std)= 0.000 scf
Vwsg(std)= 0.000 scf
Vw(std)= 0.000 scf

4. Volume of Gas Metered

Vm = Volume metered in dacf + Volume metred in dry actual liters * (1 cf / 28.317 liters)

Volume metered in dacf= 0.000 dacf
Volume metered in dry actual liters= 0.000 dry actual liters
Vm= 0.000 dacf

$Vm(m^3)$ = Vm * (1 m^3 / 35.3145 cf)

Vm= 0.000 dacf
$Vm(m^3)$= 0.000 dacm

5. Volume of Gas Metered , dry basis, STD (USEPA Method 5, Eq. 5-1)

Vm(std) = (K1method 5 * Vm * Yd * (Pbar + (dHavg/13.6))) / (Tm + 460)

K1method 5=	17.64	R/in. Hg
Vm=	0.000	dscf
Yd=	0.0000	
Pbar=	0.00	in. Hg
dHavg=	0.00	in. H2O
Tm=	0.0	F
Vm(std)=	0.000	dscf

$Vm(std)m^3 = Vm(std) * (1\ m^3 / 35.3145\ cf)$

Vm(std)=	0.000	dscf
$Vm(std)m^3$=	0.000	dscm

6. Water Vapor in the Gas Stream (USEPA Method 5, Eq. 5-3 and NOTE:)

Bws used = the lower of $SP_{H2O@Tsavg} / Ps$ and Vw(std) / (Vm(std) + Vw(std))

Bws = $SP_{H2O@Tsavg} / Ps$ With a maximum allowable value of 1.0

$SP_{H2O@Tsavg}$ = The saturation pressure of water at stack temperature
1997 ASHRAE Handbook page 6.2 Eq. (6)
EXP(C8/T + C9 +C10*T +C11*T^2 + C12*T^3 + C13*ln(T)) * (29.921/14.696)

T = Tsavg + 459.67

Tsavg=	0.0	F
T=	459.7	R
C8=	-1.044040E+04	
C9=	-1.1294650E+01	
C10=	-2.702236E-02	
C11=	1.289036E-05	
C12=	-2.478068E-09	
C13=	6.545967E+00	
$SP_{H2O@Tsavg}$=	0.04	in. Hg
Ps=	0.00	in. Hg
Bws=	1.0000	vol. fraction

Bws = Vw(std) / (Vm(std) + Vw(std))

Vw(std)=	0.000	scf
Vm(std)=	0.000	dscf
Bws=	#DIV/0!	vol. fraction
Bws used=	#DIV/0!	vol. fraction

7. Carbon Monoxide and Nitrogen in gas

CO + N2 = 100 - (CO2 + O2)

CO2=	0.00	% dv
O2=	0.00	% dv
CO + N2=	100.00	% dv

8. Molecular weight of dry gas stream (USEPA Method 3, Eq. 3-1)

Md = 0.44 * CO2 %dv + 0.32 * O2 %dv + 0.28 * (CO + N2 %dv)

CO2=	0.00	% dv
O2=	0.00	% dv
CO + N2=	100.00	% dv
Md=	28.00	lb/lb-mole

9. Molecular weight of wet gas stream (USEPA Method 2, Eq. 2-5)

Ms = Md * (1 - Bws) + 18 * Bws

Md=	28.00	lb/lb-mole
Bws=	#DIV/0!	vol. fraction
Ms=	#DIV/0!	lb/lb-mole

10. Stack Pressure (USEPA Method 2, Eq. 2-6)

Ps = Pbar + Pg/13.6

Pbar=	0.00	in. Hg
Pg=	0.00	in. H2O
Ps=	0.00	in. Hg

11. Average Stack Gas Velocity (USEPA Method 2, Eq. 2-9)

Vs = Kp * Cp * $(dP)^{1/2}$avg * ((Tsavg + 460) / (Ps * Ms))^1/2

Kp=	85.49	
Cp=	0	
$(dP)^{1/2}$avg=	0.0000	in. H2O^1/2
Tsavg=	0.0	F
Ps=	0.00	in. Hg
Ms=	#DIV/0!	lb/lb-mole
Vs=	#DIV/0!	ft/s

12. Area of the Stack

If W = 0, the stack is circular.

Circular

As = PI * (Ds)^2 / 4 * (1 ft / 12 in.)^2

PI=	3.141593	
Ds=	0.00	inches
As=	0.00	ft2

Rectangular

As = L * W * (1 ft / 12 in.)^2

L=	0.00	inches
W=	NA	inches
As=	#VALUE!	ft2

13. Stack Gas Flow Rate, Actual (USEPA Method 2, Eq. 2-10)

Qacfm = Vs * As * 60

Vs=	#DIV/0!	ft/s
As=	#VALUE!	ft2
Qacfm=	#DIV/0!	acfm

Qacm/min = Qacfm * (1 m^3 / 35.3145 cf)

Qacfm=	#DIV/0!	acfm
Qacm/min=	#DIV/0!	acm/min

14. Stack Gas Flow Rate, Standard (USEPA Method 2, Eq. 2-10)

Qscfm = Qacfm * ((Tstandard + 460) / (Tsavg + 460)) * (Ps / Pstandard)

Qacfm=	#DIV/0!	acfm
Tstandard=	68	F
Tsavg=	0.0	F
Ps=	0.00	in. Hg
Pstandard=	29.92	in. Hg
Qscfm=	#DIV/0!	scfm

Qscm/min = Qscfm * (1 m^3 / 35.3145 cf)

Qscfm=	#DIV/0!	scfm
Qscm/min=	#DIV/0!	scm/min

15. Stack Gas Flow Rate, Dry Standard (USEPA Method 2, Eq. 2-10)

Qdscfm = Qscfm * (1 - Bws)

Qscfm=	#DIV/0!	scfm
Bws=	#DIV/0!	vol. fraction
Qdscfm=	#DIV/0!	dscfm

Qdscm/min = Qdscfm * (1 m^3 / 35.3145 cf)

Qdscfm=	#DIV/0!	dscfm
Qdscm/min=	#DIV/0!	dscm/min

16. Heat Input Refinery Gas (HI) (MMBtu/hr)

HI=(mscf/hr*rfg btu/scf*1000scf/1mscf)/1000000

RFG=	0.00	mscf/hr
Heating Value=	0.0000	btu/scf
HI=	0.00	MMBtu/hr

17. Heat Input Fuel Oil (HI) (MMBtu/hr)

HI=(fuel oil barrels/hour* 42 gallons/barrel*heating value btu/gal)/1000000

Fuel Oil fired=	0.00	bbls/hr
Heating Value=	0.0000	btu/gal
HI=	0.00	MMBtu/hr

18. Oxides of Nitrogen concentration (ppmdv) (USEPA Method 6C, Eq. 6C-1)

$C_{NOx} = (Caverage_{NOx} - C_{oNOx}) * Cma_{NOx} / (Cm_{NOx} - C_{oNOx})$

$Caverage_{NOx}$=	0.00	ppmdv
C_{oNOx}=	0.00	ppmdv
Cma_{NOx}=	0.00	ppmdv
Cm_{NOx}=	0.00	ppmdv
C_{NOx}=	#DIV/0!	ppmdv

19. Oxides of Nitrogen concentration @ #REF! % O2

$NO2corrected = C_{NO2} * (20.9 - O2_{NO2correction}) / (20.9 - O_2)$

C_{NO2}=	#DIV/0!	ppmdv
$O2_{NO2correction}$=	#REF!	% dv.
O2=	0.00	% dv
NO2corrected=	#DIV/0!	ppmdv

20. Oxides of Nitrogen emission rate (lb/hr)

$NOx(lb/hr) = C_{NOx} / 1{,}000{,}000 * Qdscfm * (60 min / 1 hour) / V/n_{standard} * NOx_{MW}$

C_{NOx}=	#DIV/0!	ppmdv
Qdscfm=	#DIV/0!	dscfm
$V/n_{standard}$=	385.3	ft3/lb-mole
NOx_{MW}=	46.0	lb/lb-mole
NOx(lb/hr)=	#DIV/0!	lb/hr

21. Oxides of Nitrogen emission rate (lb/MM Btu)

NOx(lb/MM Btu) = NOx(lb/hr) / heat input (MM Btu/hr)

NOx(lb/hr)=	#DIV/0!	lb/hr
Total Heat input=	0	MMBtu/hr
NOx(lb/MM Btu)=	#DIV/0!	lb/MM Btu

O2		% dv	Tstandard	68	F
CO2		% dv	Pstandard	760	mm Hg
p_s	0	0	K1method 4	0.04707	scf/ml
π	3.141593		K2method 4	0.04715	scf/g
Combined F_d		dscf/MMBtu	K1method 5	17.64	R/in. Hg
ppm Nox conversion	1.194E-07	lb/scf	K4method 5	0.0945	
			$V/h_{standard}$	385.3	ft3/lb-mole

CEMS DATA

Oxides of Nitrogen (NOX)

$Caverage_{NO2}$		ppmdv
C_{0MO2}		ppmdv
Cma_{NO2}		ppmdv
Cm_{NO2}		ppmdv
MW NO2	46.0	lb/lb-mole

1. Carbon Monoxide and Nitrogen in gas

CO + N2 = 100 - (CO2 + O2)

CO2=	0.00 % dv
O2=	0.00 % dv
CO + N2=	100.00 % dv

2. Molecular weight of dry gas stream (USEPA Method 3, Eq. 3-1)

Md = 0.44 * CO2 %dv + 0.32 * O2 %dv + 0.28 * (CO + N2 %dv)

CO2=	0.00 % dv
O2=	0.00 % dv
CO + N2=	100.00 % dv
Md=	28.00 lb/lb-mole

3. Oxides of Nitrogen concentration (ppmdv) (USEPA Method 6C, Eq. 6C-1)

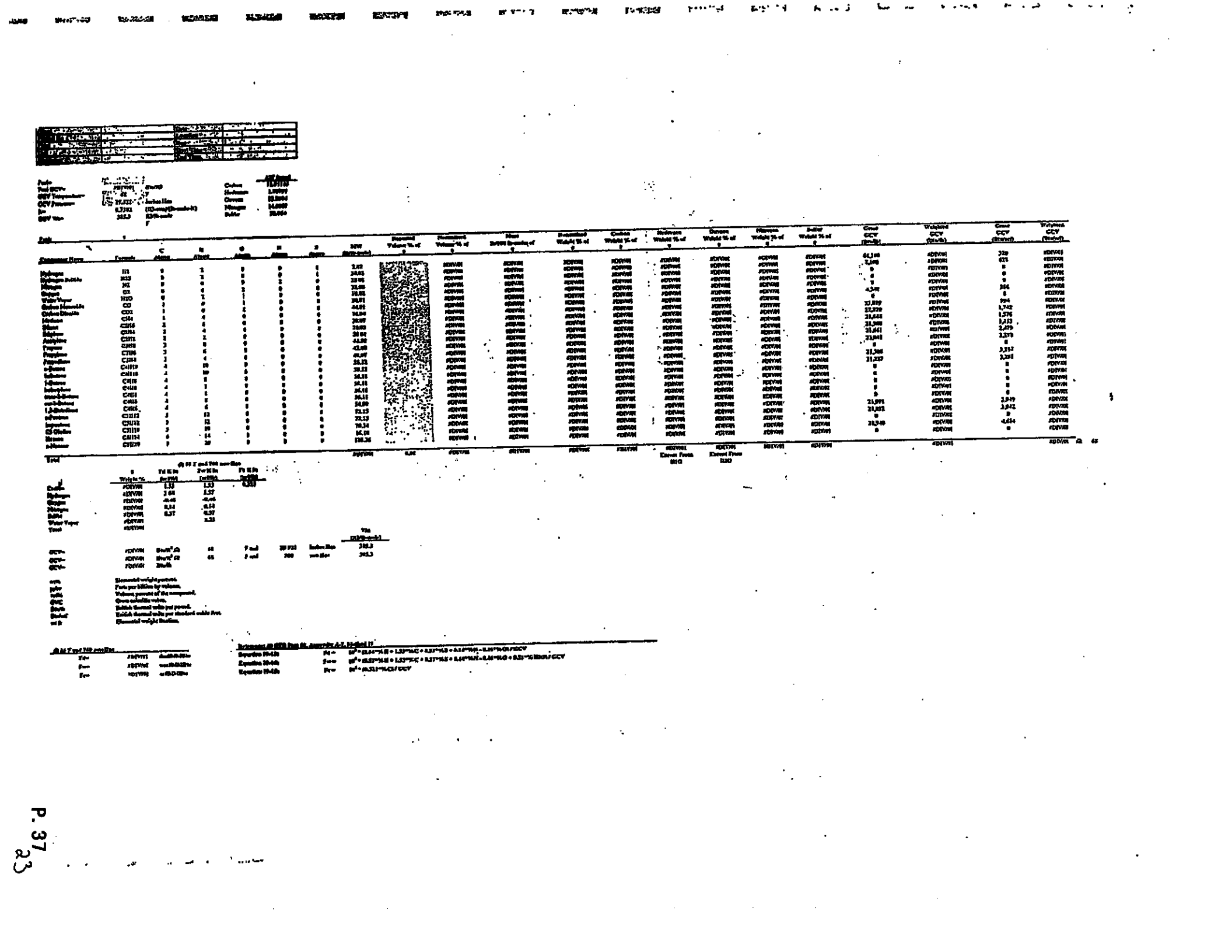
$C_{NOx} = (Caverage_{NOx} - C_{0NOx}) * Cma_{NOx} / (Cm_{NOx} - C_{0NOx})$

$Caverage_{NOx}$=	0.00	ppmdv
C_{0NOx}=	0.00	ppmdv
Cma_{NOx}=	0.00	ppmdv
Cm_{NOx}=	0.00	ppmdv
C_{NOx}=	#DIV/0!	ppmdv

4. Oxides of Nitrogen emission rate (lb/MM Btu)

NOx(lb/MM Btu) = NCdFd[20.9/(20.9-%O2)]

NOx(lb/MM Btu)= #DIV/0! lb/MM Btu



NOMENCLATURE

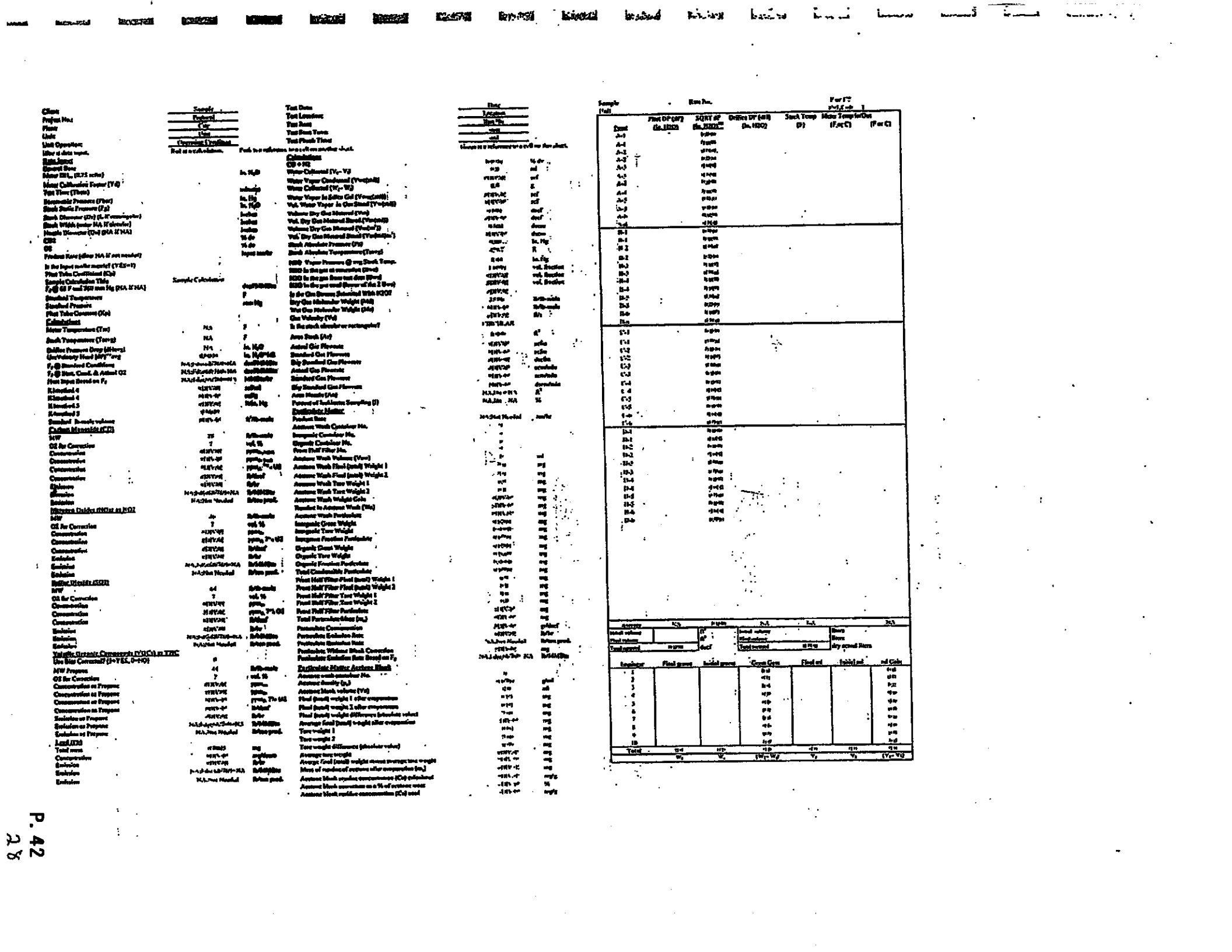
SYMBOL		DESCRIPTION
ACFM	-	Actual cubic feet per minute
A_s	-	Stack Area
AB	-	Acetone Blank
AB1	-	Acetone Blank Tare Weight 1
AB2	-	Acetone Blank Tare Weight 2
ABF1	-	Acetone Blank Final Weight 1
ABF2	-	Acetone Blank Final Weight 2
AT1	-	Acetone Rinse Tare Weight 1
AT2	-	Acetone Rinse Tare Weight 2
A_n	-	Nozzle Area
B_{wo}	-	Moisture content of sample gas, measured impinger collection
B_{ws}	-	Moisture content of sample gas, wet saturated
STO	-	British Thermal Units
Ca	-	Acetone Blank Correction
C_M	-	Average of initial and final system calibration bias check responses for the upscale gas, ppm
cf	-	Cubic foot
C_{MA}	-	Actual concentration of the upscale calibration gas, ppm
C_d	-	Concentration of Particulate Emissions
C_O	-	Average of initial and final system calibration bias check responses for the zero gas, ppm
CO	-	Carbon monoxide
CO_2	-	Carbon dioxide
C_p	-	Pitot co-efficient, 0.84 for S-type, 0.99 for standard (English units)
E_{NOX}	-	Emission rate of Oxides of nitrogen as NO2, lb/hr
DACF	-	Dry actual cubic feet
DSCF	-	Dry standard cubic feet
DACM	-	Dry actual cubic meters
DSCFM	-	Dry standard cubic feet per minute
D_S	-	Stack diameter
D_N	-	Nozzle diameter
°F	-	Degrees Fahrenheit
ft	-	foot
F1	-	Filter Final Weight 1
F2	-	Filter Final Weight 2
FT1	-	Filter Tare Weight 1
FT2	-	Filter Tare Weight 2
F_a	-	CO2 based F-Factor for natural gas (1,040 SCF/MMBtu)
F_d	-	F-factor
Ft^2	-	Square feet
Ft^3	-	Cubic feet
ft^3/lb-mole	-	Cubic feet per pound mole
ft/sec	-	Feet per second
g	-	Grams
g/mL	-	Gram per milliliter
gr/DSCF	-	Grains per dry standard cubic feet
HI	-	Heat Input
ΔH_{avg}	-	Average pressure drop across the meter box during test run, inches H2O
H_2O	-	Water
Hg	-	Mercury

hr	-	Hour
in Hg	-	Inches of Mercury
in H_2O	-	Inches of Water
$\sqrt{inH_2O}$	-	Square root of Inches of Water
I	-	Isokinetic Sampling
K1 method 5	-	Conversion to standard conditions, 17.64 °R/inches Hg
K1 method 4	-	Conversion to standard conditions, 0.04707 f3/ml
K2 method 4	-	Conversion to standard conditions, 0.04715 ft3/g
K4 method 5	-	Conversion to standard conditions, 0.0945
K_p	-	Pitot tube constant, 85.49 for English units
Kg	-	Kilograms
L	-	Length of Stack if Rectangular
lb	-	Pound
lb/lb-mole	-	Pound per pound mole
lb-mole	-	Pound mole
lb/hr	-	Pound per hour
lb/MMBTU	-	Pound per million British thermal units
ma	-	Average Final (total) weight after evaporation - Average Tare Weigth of Acetone Blank
m^3	-	Cubic meters.
mg	-	Milligrams
mg/g	-	Milligrams per gram
mL	-	Milliliter
M_d	-	Molecular weight of stack gas mixture, dry basis
MMBTU	-	Million British Thermal Units
MMBtu/hr	-	Million British Thermal Units per hour
mm HG	-	Millimeters of Mercury
M_n	-	Mass of particulate matter, g
M_s	-	Molecular weight of stack gas mixture, wet basis
M_{SAT}	-	Ratio of vapor pressure of water at stack conditions to stack pressure
M_w	-	Molecular weight of a specific compound or element
N_2	-	Nitrogen
O_2	-	Oxygen
ng	-	Nanograms
NO_x	-	Oxides of Nitrogen
NO_2	-	Nitrous Oxide
%	-	Percent
% Volume	-	Percent by volume
% dv	-	Percent by volume, dry basis
ΔP	-	Gas velocity pressure, in H2O
P_a	-	Density of Acetone
P_{BAR}	-	Barometric pressure, in H2O
P_s	-	Static Pressure, in H2O
P_g	-	Total pressure of gas at stack conditions
P_{STD}	-	Standard pressure, 760 mmHG
$\sqrt{(P)_{av}}$	-	Averag of the square root of gas velocity pressure, in H2O
ppm_{dv}	-	Parts per million, volume and dry basis
ppb_{dv}	-	Parts per billion, volume and dry basis
Q_{ACFM}	-	Flow rate of stack gas, actual cubic feet per minute
Q_{SCFM}	-	Flow rate of stack gas, standard cubic feet per minute
Q_{DSCFM}	-	Flow rate of stack gas, dry standard cubic feet per minute
°R	-	Degrees Rankin
°R/in. Hg	-	Degrees Rankin per inches of Mercury
scf/ml	-	Standard cubic feet per milliliter
scf/g	-	Standard cubic feet per gram
SCFM	-	Standard cubic feet per minute

SCM	-	Standard cubic meters
SCF	-	Standard cubic feet
$SP_{H2O@Tavx}$	-	Saturation pressure of water at average stack temperature
STD	-	Standard
s	-	Second
T	-	Stack Temperature
tph	-	Tons per hour
T_M	-	Temperature of the dry gas meter
T_s	-	Temperature of the stack
T_{STD}	-	Standard temperature, 68 °F
ug	-	Micrograms
Va	-	Volume of Acetone Blank, in mL
Vaw	-	Volume of Acetone Rinse, in mL
vol.	-	Volume
V/n_{std}	-	Volume mole in standard conditions, in cubic feet per pound mole
V_{lc}	-	Total volume of water vapor condensed, at STP
V_m	-	Volume of sample gas measured by the dry gas meter
V_{MSTD}	-	Volume of sample gas measured by the dry gas meter, corrrected to standard conditions
V_s	-	Velocity of stack gas, ft/s
$V_{Wc(std)}$	-	Volume of water condensed, corrected to standard conditions
$V_{Wsg(std)}$	-	Volume of water collected in silica gel, corrected to standard conditions
$V_{W(std)}$	-	Volume of water vapor in gas stream, corrected to standard conditions
Y_d	-	Dry gas meter calibration factor
V_f	-	Final volume of water
V_i	-	Initial volume of water
W1	-	Acetone Rinse Final Weight 1
W2	-	Acetone Rinse Final Weight 2
W	-	Width of Stack if Rectangular
Wa	-	Weight of Acetone
W_f	-	Final weight
W_i	-	Initial weight

APPENDIX C

Field Data Sheets



USEPA METHOD 2 AND METHOD 4 DATA SHEET

Client		Date	
Project #		Run #	
Plant Location		Meter Box #	
Stack ID		Yd	
Stack Diameter		Delta H	
Pitot ID		Test Crew:	
Pitot Cp		Pre-Test Leak Check	
B. P. (in. Hg)		Impingers	
Ps (in. H_2O)		Pitot (+/-)	
Start Time:		Post-Test Leak Check	
Stop Time:		Impingers	
		Pitot (+/-)	

DIAGRAM

MOISTURE DATA

Clock	Elapsed	Meter Volume	Meter Temp	Delta H	Vacuum/ Pressure	Impinger Temp.
	Initial					
	5 Min					
	10 Min					
	15 Min					
	20 Min					
	25 Min					
	30 Min					
	35 Min					
	Final					

IMPINGER WEIGHTS

Impinger	Initial	Final
1		
2		
3		
4		

O_2%	CO_2%	N_2%

start: stop:

TRAVERSE PORT/POINT	Delta P	Stack Temp °F	Cyclonic ° from Hor.

start: stop:

TRAVERSE PORT/POINT	Delta P	Stack Temp °F	Cyclonic ° from Hor.

[illegible]	Sample	[illegible]	Date
[illegible]	Protocol	[illegible]	Location
[illegible]	Cfs	[illegible]	Run No.
[illegible]	Units	[illegible]	Start
[illegible]	Operating Condition	[illegible]	[VALUE]
[illegible]			

[illegible] Calibration Gas	LOW		MID		HIGH		Task ID			Span	Conc. Units
	Conc.	(% of Span)	Conc.	(% of Span)	Conc.	(% of Span)	LOW	MID	HIGH		
O2	N/A	N/A		#DIV/0!		#DIV/0!	N/A				d. vol. %
CO2	N/A	N/A		#DIV/0!		#DIV/0!	N/A				d. vol. %
CO		#DIV/0!		#DIV/0!		#DIV/0!	N/A				ppmdv
NOx	N/A	N/A		#DIV/0!		#DIV/0!	N/A				ppmdv
SO2	N/A	N/A		#DIV/0!		#DIV/0!	N/A				ppmdv
CH4 (THC)		#DIV/0!		#DIV/0!		#DIV/0!	N/A				ppmwv
[illegible] LIMITS		[illegible]		40 % to 60 %		80 % to 100 %					
[illegible] LIMITS		25 % to 35 %		45 % to 55 %		90 % to 90 %					

[illegible] Gas	Operator Enter "Low" "Mid" or "High" below "Zero"	[illegible] Gas Conc.	[illegible] Response	[illegible] Cal. Error (% of Span)	[illegible] System Cal. Conc. Response	[illegible] Cal. Bias (% of Span)	[illegible] Drift (% of Span)	Average of Initial and Final System Response		Average Uncorrected Gas Conc.	Corrected Gas Conc.	Conc. Units
O2	Zero		0.0	#DIV/0!		#DIV/0!	#DIV/0!	0	0			
	Mid	0	0.0	#DIV/0!		#DIV/0!	#DIV/0!	0	0	#DIV/0!	#DIV/0!	d. vol. %
CO2	Zero		0.0	#DIV/0!		#DIV/0!	#DIV/0!	0	0			
	High	0	0.0	#DIV/0!		#DIV/0!	#DIV/0!	0	0	#DIV/0!	#DIV/0!	d. vol. %
CO	Zero		0.0	#DIV/0!		#DIV/0!	#DIV/0!	0	0			
	Mid	0	0.0	#DIV/0!		#DIV/0!	#DIV/0!	0	0	#DIV/0!	#DIV/0!	ppmdv
NOx	Zero		0.0	#DIV/0!		#DIV/0!	#DIV/0!	0	0			
	Mid	0	0.0	#DIV/0!		#DIV/0!	#DIV/0!	0	0	#DIV/0!	#DIV/0!	ppmdv
SO2	Zero		0.0	#DIV/0!		#DIV/0!	#DIV/0!	0	0			
	Mid	0	0.0	#DIV/0!		#DIV/0!	#DIV/0!	0	0	#DIV/0!	#DIV/0!	ppmdv
CH4 (THC)	Zero				0.0			0	0			
#	Mid	0			0.0			0	0	#DIV/0!	#DIV/0!	ppmwv
	LIMITS					+/- 5 %	+/- 3 %					

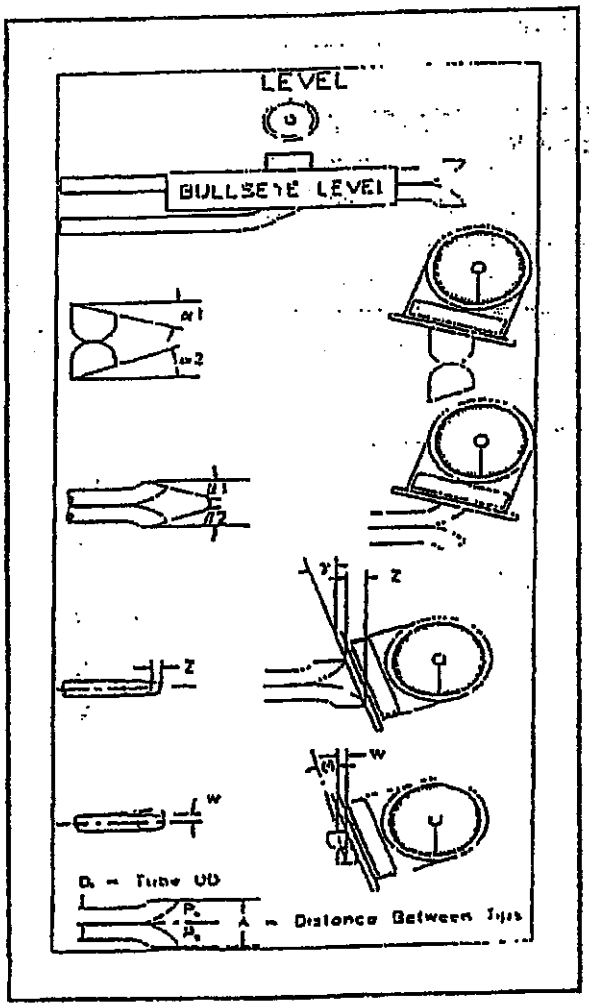
Gas	ZERO Analyzer Response (System for THC)	ZERO Analyzer Cal. Error (% of Span)	LOW Actual Conc.	LOW Analyzer Response (System for THC)	LOW Analyzer Cal. Error (% of Span)	LOW System Cal. Error (% of Actual)	MID Actual Conc.	MID Analyzer Response (System for THC)	MID Analyzer Cal. Error (% of Span)	MID System Cal. Error (% of Actual)	HIGH Actual Conc.	HIGH Analyzer Response (System for THC)	HIGH Analyzer Cal. Error (% of Span)	HIGH System Calibration Error (% of Actual)	Span	Conc. Units
O2		#DIV/0!					0		#DIV/0!		0		#DIV/0!		0	d. vol. %
CO2		#DIV/0!					0		#DIV/0!		0		#DIV/0!		0	d. vol. %
CO		#DIV/0!	0		#DIV/0!		0		#DIV/0!		0		#DIV/0!		0	ppmdv
NOx		#DIV/0!					0		#DIV/0!		0		#DIV/0!		0	ppmdv
SO2		#DIV/0!					0		#DIV/0!		0		#DIV/0!		0	ppmdv
CH4 (THC)			0			#DIV/0!	0			#DIV/0!	0			#DIV/0!	0	ppmwv
LIMITS		+/- 2 %			+/- 2 %	+/- 5 %			+/- 2 %	+/- 5 %			+/- 2 %	+/- 5 %		

Turnaround Time _____ Send Results to _____

Project Number					Analysis Requested					Remarks
Project Name										
Test Location										
Analytical Laboratory										
Lab Contact and Phone										
Sample Identification Number	Sample Collection Date	Start Time	Stop Time	Number/Type of Containers						

Relinquished by (signature)	Date	Time	Received by (signature)	Date	Time	

TYPE S PITOT TUBE INSPECTION DATA SHEET



Parameter	Value	Allowable Range
Assembly Level?		Yes
Holes Damaged?		No
Obstructed?		No
α1		-10° < α1 < +10°
α2		-10° < α2 < +10°
β1		-5° < β1 < +5°
β2		-5° < β2 < +5°
γ		
θ		
A		for 1/4" OD, 0.526 to 0.750 for 3/8" OD, 0.788 to 1.125
$Z = A \sin \gamma$		$Z = \leq 0.125$"
$W = A \sin \theta$		$W = \leq 0.031$"
P_A		for 1/4" OD, 0.263 to 0.375 for 3/8" OD, 0.394 to 0.563
P_B		for 1/4" OD, 0.263 to 0.375 for 3/8" OD, 0.394 to 0.563
$P_A - P_B$		-0.063 to 0.063"
D_T		0.188 to 0.375"

Certification

I certify that the Type S pitot tube/probe ID # _____ meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube calibration factor C_p of 0.84

Certified by: _____

Signature / Date

Thermocouple Calibration

Probe I.D.: _____ Dry Gas Meter I.D.: _____

Standard Used: Mercury Thermometer Temperature Scale: _____

Temperature Range	Reference Thermometer (°F)	Probe Thermometer (°F)	Absolute Temperature Difference
Ice Bath			
Room Temp.			
Hot Bath			

Calibrated By: _____ Date Calibrated: _____

APPENDIX B

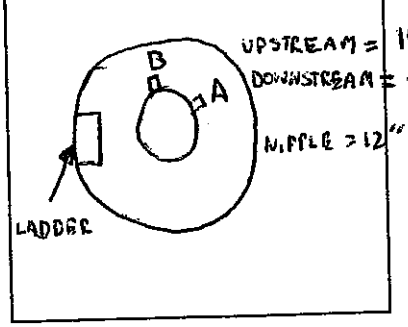
Field and Computerized Data Sheets

AIR/COMPLIANCE CONSULTANTS, INC.
USEPA METHOD 2 AND METHOD 4 DATA SHEET

Client	United Refining	Date	4.10.8
ACCI Project #	08-065	Run #	1
Plant Location	Warren, Pa	Meter Box #	1618
Stack ID	SRU 2	Yd	1.005
Stack Diameter	70"	Delta H	1.816
Pitot ID	8P-1	Test Crew:	EW,RW,MB
Pitot Cp	0.84	Pre-Test Leak Check	
B. P. (in. Hg)	29.3	Impingers	0.000 @ 10"
Ps (in. H_2O)	-.37	Pitot (+/-)	✓ ✓
Start Time:	9:30	Post-Test Leak Check	
Stop Time:	10:00	Impingers	0.000 @ 7"
		Pitot (+/-)	✓ ✓

Stack Dia. Measured? yes 70"

DIAGRAM



MOISTURE DATA

Clock	Elapsed	Meter Volume	Meter Temp	Delta H	Vacuum/ Pressure	Impinger Temp.
9:36	Initial	590.340				
	5 Min	594.104	51 / 47	1.8	1.0	43
	10 Min	597.852	53 / 47	1.8	1.0	45
	15 Min	601.603	54 / 48	1.8	1.0	47
	20 Min	605.356	55 / 49	1.8	1.0	49
	25 Min	609.103	57 / 49	1.8	1.0	50
10:00	30 Min	612.842	57 / 50	1.8	1.0	51
	35 Min					
	Final					

IMPINGER WEIGHTS

Impinger	Initial	Final
1	100	116
2	100	110
3	0	0
4	250.6	257.7
WET bulb		
DRY Bulb		

O_2%	CO_2%	N_2%

start: 9:36 stop: 9:45

TRAVERSE PORT/POINT	Delta P	Stack Temp ° F	Cyclonic ° from Hor.
A-1	.01	1156	0
A-2	.01	1152	0
A-3	.01	1150	1
A-4	.01	1148	0
A-5	.01	1152	0
A-6	.02	1147	1
A-7	.01	1146	0
A-8	.01	1144	1
B-1	.01	1150	0
B-2	.01	1154	0
B-3	.01	1150	1
B-4	.01	1150	0
B-5	.01	1150	0
B-6	.01	1149	0
B-7	.01	1152	0
B-8	.01	1146	0

start: stop:

TRAVERSE PORT/POINT	Delta P	Stack Temp ° F	Cyclonic ° from Hor.

AIR/COMPLIANCE CONSULTANTS, INC.
USEPA METHOD 2 AND METHOD 4 DATA SHEET

Client	United Refining	Date	4/10/8
ACCI Project #	08-065	Run #	2
Plant Location	Warren, Pa	Meter Box #	1618
Stack ID	SRU 2	Yd	1.005
Stack Diameter	70"	Delta H	1.916
Pitot ID	BP-1	Test Crew:	EW,RW,MB
Pitot Cp	0.84	Pre-Test Leak Check	
B. P. (in. Hg)	29.3	Impingers	0.002 @ 11"
Ps (in. H_2O)	-.35	Pitot (+/-)	✓ ✓
Start Time:	10:40	Post-Test Leak Check	
Stop Time:	11:10	Impingers	0.002 @ 8"
		Pitot (+/-)	✓ ✓

Stack Dia. Measured? _____

DIAGRAM

MOISTURE DATA

Clock	Elapsed	Meter Volume	Meter Temp	Delta H	Vacuum/ Pressure	Impinger Temp.
	Initial	612.941				
	5 Min	616.685	51/52	1.8	1.0	58
	10 Min	620.436	53/52	1.8	1.0	57
	15 Min	624.180	55/53	1.8	1.0	55
	20 Min	627.939	56/53	1.8	1.0	53
	25 Min	631.695	58/54	1.8	1.0	52
	30 Min	635.446	60/55	1.8	1.0	50
	35 Min					
	Final					

IMPINGER WEIGHTS

Impinger	Initial	Final
1	100	123
2	100	104
3	0	0
4	247.2	254.1
WET bulb		
DRY Bulb		

O_2%	CO_2%	N_2%

start: 10:46 stop: 10:55

TRAVERSE PORT/POINT	Delta P_s	Stack Temp °F	Cyclonic ° from Hor.
A-1	.01	1142	
A-2	.02	1144	
A-3	.01	1146	
A-4	.01	1147	
A-5	.01	1143	
A-6	.01	1142	
A-7	.02	1140	
A-8	.01	1137	
B-1	.01	1140	
B-2	.01	1142	
B-3	.01	1143	
B-4	.01	1142	
B-5	.01	1140	
B-6	.01	1137	
B-7	.02	1137	
B-8	.01	1135	

start: stop:

TRAVERSE PORT/POINT	Delta P	Stack Temp °F	Cyclonic ° from Hor.

AIR/COMPLIANCE CONSULTANTS, INC.
USEPA METHOD 2 AND METHOD 4 DATA SHEET

Client	United Refining	Date	4.10.08
ACCI Project #	08-065	Run #	3
Plant Location	Warren, Pa	Meter Box #	1618
Stack ID	SRU 2	Yd	1.005
Stack Diameter	70	Delta H	1.816
Pitot ID	SP-1	Test Crew:	EW,RW,MB
Pitot Cp	0.84	Pre-Test Leak Check	
B. P. (in. Hg)	29.5	Impingers	7@ 0.000
Ps (in. H_2O)	-.31	Pitot (+/-)	✓ / ✓
Start Time:	11:50	Post-Test Leak Check	
Stop Time:	12:20	Impingers	4@ 0.000
		Pitot (+/-)	✓ / ✓

Stack Dia. Measured? ____

DIAGRAM

MOISTURE DATA

Clock	Elapsed	Meter Volume	Meter Temp	Delta H	Vacuum/ Pressure	Impinger Temp.
	Initial	635.778				
	5 Min	640.072	63/61	1.8	1.0	54
	10 Min	643.745	66/61	1.8	1.0	56
	15 Min	647.408	70/62	1.8	1.0	55
	20 Min	651.235	73/63	1.8	1.0	56
	25 Min	655.000	75/64	1.8	1.0	55
	30 Min	658.827	77/65	1.8	1.0	57
	35 Min					
	Final					

IMPINGER WEIGHTS

Impinger	Initial	Final
1	100	124
2	100	106
3	0	0
4	237.6	243.8
WET bulb		
DRY Bulb		

O_2%	CO_2%	N_2%

start: 11:52 stop: 12:03

TRAVERSE PORT/POINT	Delta P	Stack Temp °F	Cyclonic ° from Hor.
A-1	.01	1150	
A-2	.02	1151	
A-3	.01	1152	
A-4	.01	1150	
A-5	.01	1148	
A-6	.01	1146	
A-7	.01	1146	
A-8	.01	1140	
B-1	.01	1152	
B-2	.01	1154	
B-3	.02	1153	
B-4	.01	1146	
B-5	.01	1144	
B-6	.01	1144	
B-7	.01	1143	
B-8	.01	1141	

start: stop:

TRAVERSE PORT/POINT	Delta P	Stack Temp °F	Cyclonic ° from Hor.

Client:	URC		Test Date:	April 10, 2008	
Project No.:	08-065		Test Location:	Exhaust	
Plant:	Warren, PA		Test Run:	Run 1	
Unit:	SRU -2		Test Start Time:	9:30 AM	
Unit Operation:	none		Test Finish Time:	10:30 AM	
Blue is data input.	Red is a calculation.	Pink is a reference to a cell on another sheet.		Green is a reference to a cell on this sheet.	
Data Input			**Calculations**		
Control Box:	1618		CO + N2	89.26	% dv
Meter $DH_@$ (0.75 scfm)	1.816	in. H_2O	Water Collected (V_f - V_i)	26.0	ml
Meter Calibration Factor (Yd)	1.0050		Water Vapor Condensed (Vwc(std))	1.224	scf
Barometric Pressure (Pbar)	29.30	in. Hg	Water Collected (W_f - W_i)	7.1	g
Stack Static Pressure (Pg)	-0.37	in. H_2O	Water Vapor in Silica Gel (Vwsg(std))	0.335	scf
Stack Diameter (Ds) (L if rectangular)	70.0	inches	Vol. Water Vapor in Gas Stand.(Vw(std))	1.558	scf
Stack Width (enter NA if circular)	NA	inches	Volume Dry Gas Metered (Vm)	22.502	dacf
CO2	4.97	% dv	Vol. Dry Gas Metered Stand.(Vm(std))	22.958	dscf
O2	5.77	% dv	Volume Dry Gas Metered (Vm(m^3))	0.637	dacm
Product Rate (enter NA if not needed)	NA	ton/hr	Vol. Dry Gas Metered Stand.(Vm(std)m^3)	0.650	dscm
Is the input ton/hr metric? (YES=1)	0		Stack Absolute Pressure (Ps)	29.27	in. Hg
Pitot Tube Coefficient (Cp)	0.84		Stack Absolute Temperature (Tsavg)	1609.5	R
Sample Calculation Title	Flow, Moisture, CEMS		H2O Vapor Pressure @ avg Stack Temp.	50559.21	in. Hg
F_d @ 68 F and 760 mm Hg (NA if NA)	na	dscf/MMBtu	H2O in the gas at saturation (Bws)	1.0000	vol. fraction
Standard Temperature	68	F	H2O in the gas from test data (Bws)	0.0636	vol. fraction
Standard Pressure	760	mm Hg	H2O in the gas used (lower of the 2 Bws)	0.0636	vol. fraction
Pitot Tube Constant (Kp)	85.49		Is the Gas Stream Saturated With H2O?	NO	
Calculations			Dry Gas Molecular Weight (Md)	29.03	lb/lb-mole
Meter Temperature (Tm)	51.4	F	Wet Gas Molecular Weight (Ms)	28.33	lb/lb-mole
Stack Temperature (Tsavg)	1149.9	F	Gas Velocity (Vs)	10.27	ft/s
Orifice Pressure Drop (dHavg)	1.800	in. H_2O	Is the stack circular or rectangular?	CIRCULAR	
GasVelocity Head $(dP)^{1/2}$avg	0.1026	in. H_2O^1/2	Area Stack (As)	26.725	ft^2
F_d @ Standard Conditions	NA	dscf/MMBtu	Actual Gas Flowrate	16,461	acfm
F_d @ Stan. Cond. & Actual O2	NA	dscf/MMBtu	Standard Gas Flowrate	5,282	scfm
Heat Input Based on F_d	NA	MMBtu/hr	Dry Standard Gas Flowrate	4,946	dscfm
K1method 4	0.04706	scf/ml	Actual Gas Flowrate	466	acm/min
K2method 4	0.04715	scf/g	Standard Gas Flowrate	150	scm/min
K1method 5	17.64	R/in. Hg	Dry Standard Gas Flowrate	140	dscm/min
K4method 5	0.0945				
Standard lb-mole volume	385.3	ft^3/lb-mole			
Carbon Monoxide (CO)					
MW	28	lb/lb-mole			
O2 for Correction	0	vol. %			
Concentration	282.41	ppm_{dv}			
Concentration	390.04	ppm_{dv} 7% O2			
Concentration	0.0000205	lb/dscf			
Emission	6.09	lb/hr			
Emission	NA	lb/MMBtu			
Emission	NA;Not Needed	lb/ton prod.			
Sulfur Dioxide (SO2)					
MW	64	lb/lb-mole			
O2 for Correction	0	vol. %			
Concentration	91.10	ppm_{dv}			
Concentration	125.82	ppm_{dv} 7% O2			
Concentration	0.0000151	lb/dscf			
Emission	4.49	lb/hr			
Emission	NA	lb/MMBtu			
Emission	NA;Not Needed	lb/ton prod.			

URC — Run 1 — F or C7

SRU -2 — F=1,C=0 — 1

Point	Pitot DP (dP) (in. H2O)	SQRT dP (in. $H2O)^{1/2}$	Orifice DP (dH) (in. H2O)	Stack Temp (F)	Meter Temp In/Out (F or C)	(F or C)
A-1	0.01	0.100	1.8	1158	51	47
A-2	0.01	0.100	1.8	1152	53	47
A-3	0.01	0.100	1.8	1150	54	48
A-4	0.01	0.100	1.8	1148	55	49
A-5	0.01	0.100	1.8	1152	57	49
A-6	0.02	0.141	1.8	1147	57	50
A-7	0.01	0.100		1146		
A-8	0.01	0.100		1144		
B-1	0.01	0.100		1150		
B-2	0.01	0.100		1154		
B-3	0.01	0.100		1150		
B-4	0.01	0.100		1150		
B-5	0.01	0.100		1150		
B-6	0.01	0.100		1149		
B-7	0.01	0.100		1152		
B-8	0.01	0.100		1146		
Average	0.01	0.103	1.80	1149.9		51.4

Initial volume	590.340	ft^3	Initial volume	0.000	liters
Final volume	612.842	ft^3	Final volume	0.000	liters
Total metered	22.502	dacf	Total metered	0.000	dry actual liters

Impinger	Final grams	Initial grams	Gram Gain	Final ml	Initial ml	ml Gain
1			0.0	116.0	100.0	16.0
2			0.0	110.0	100.0	10.0
3			0.0	0.0	0.0	0.0
4	257.7	250.6	7.1			0.0
5			0.0			0.0
6			0.0			0.0
7			0.0			0.0
8			0.0			0.0
9			0.0			0.0
10			0.0			0.0
Total	257.7	250.6	7.1	226.0	200.0	26.0
	W_f	W_i	(W_f - W_i)	V_f	V_i	(V_f - V_i)

Client:	URC		Test Date:	April 10, 2008
Project No.:	08-065		Test Location:	Exhaust
Plant:	Warren, PA		Test Run:	Run 2
Unit:	SRU -2		Test Start Time:	10:40 AM
Unit Operation:	mmcc		Test Finish Time:	11:40 AM
Blue is data input.	Red is a calculation.	Pink is a reference to a cell on another sheet.		Green is a reference to a cell on this sheet.
Data Input			**Calculations**	
Control Box:	1618		CO + N2	89.30 % dv
Meter $DH_@$ (0.75 scfm)	1.816	in. H_2O	Water Collected (V_f - V_i)	27.0 ml
Meter Calibration Factor (Yd)	1.005		Water Vapor Condensed (Vwc(std))	1.271 scf
Barometric Pressure (Pbar)	29.30	in. Hg	Water Collected (W_f - W_i)	6.9 g
Stack Static Pressure (Pg)	-0.35	in. H_2O	Water Vapor in Silica Gel (Vwsg(std))	0.325 scf
Stack Diameter (Ds) (L if rectangular)	70.0	inches	Vol. Water Vapor in Gas Stand.(Vw(std))	1.596 scf
Stack Width (enter NA if circular)	NA	inches	Volume Dry Gas Metered (Vm)	22.505 dscf
CO2	5.04	% dv	Vol. Dry Gas Metered Stand.(Vm(std))	22.831 dscf
O2	5.66	% dv	Volume Dry Gas Metered ($Vm(m^3)$)	0.637 dscm
Product Rate (enter NA if not needed)	NA	ton/hr	Vol. Dry Gas Metered Stand.($Vm(std)m^3$)	0.647 dscm
Is the input ton/hr metric? (YES=1)	0		Stack Absolute Pressure (Ps)	29.27 in. Hg
Pitot Tube Coefficient (Cp)	0.84		Stack Absolute Temperature (Tsavg)	1600.5 R
Sample Calculation Title	Flow, Moisture, CEMS		H2O Vapor Pressure @ avg Stack Temp.	49063.73 in. Hg
F_d @ 68 F and 760 mm Hg (NA if NA)	na	dscf/MMBtu	H2O in the gas at saturation (Bws)	1.0000 vol. fraction
Standard Temperature	68	F	H2O in the gas from test data (Bws)	0.0653 vol. fraction
Standard Pressure	760	mm Hg	H2O in the gas used (lower of the 2 Bws)	0.0653 vol. fraction
Pitot Tube Constant (Kp)	85.49		Is the Gas Stream Saturated With H2O?	NO
Calculations			Dry Gas Molecular Weight (Md)	29.03 lb/lb-mole
Meter Temperature (Tm)	54.3	F	Wet Gas Molecular Weight (Ms)	28.31 lb/lb-mole
Stack Temperature (Tsavg)	1140.9	F	Gas Velocity (Vs)	10.76 ft/s
Orifice Pressure Drop (dHavg)	1.800	in. H_2O	Is the stack circular or rectangular?	CIRCULAR
GasVelocity Head $(dP)^{1/2}$avg	0.1078	in. H_2O^1/2	Area Stack (As)	26.725 ft^2
F_d @ Standard Conditions	NA	dscf/MMBtu	Actual Gas Flowrate	17,246 acfm
F_d @ Stan. Cond. & Actual O2	NA	dscf/MMBtu	Standard Gas Flowrate	5.565 scfm
Heat Input Based on F_d	NA	MMBtu/hr	Dry Standard Gas Flowrate	5.202 dscfm
K1method 4	0.04706	scf/ml	Actual Gas Flowrate	488 acm/min
K2method 4	0.04715	scf/g	Standard Gas Flowrate	158 scm/min
K1method 5	17.64	R/in. Hg	Dry Standard Gas Flowrate	147 dscm/min
K4method 5	0.0945			
Standard lb-mole volume	385.3	ft^3/lb-mole		
Carbon Monoxide (CO)				
MW	28	lb/lb-mole		
O2 for Correction	7	vol. %		
Concentration	282.12	$ppm_{dv, NDIR}$		
Concentration	257.27	ppm_{dv} 7% O2		
Concentration	0.0000205	lb/dscf		
Emission	6.40	lb/hr		
Emission	NA	lb/MMBtu		
Emission	NA;Not Needed	lb/ton prod.		
Sulfur Dioxide (SO2)				
MW	64	lb/lb-mole		
O2 for Correction	7	vol. %		
Concentration	77.57	ppm_{dv}		
Concentration	70.74	ppm_{dv} 7% O2		
Concentration	0.0000129	lb/dscf		
Emission	4.02	lb/hr		
Emission	NA	lb/MMBtu		
Emission	NA;Not Needed	lb/ton prod.		

URC
SRU -2

Run 2

F or C?
F=1,C=0 1

Point	Pitot DP (dP) (in. H2O)	SQRT dP (in. H2O)$^{1/2}$	Orifice DP (dH) (in. H2O)	Stack Temp (F)	Meter Temp In/Out (F or C)	(F or C)
A-1	0.01	0.100	1.8	1142	51	52
A-2	0.02	0.141	1.8	1144	53	52
A-3	0.01	0.100	1.8	1146	55	53
A-4	0.01	0.100	1.8	1144	56	53
A-5	0.01	0.100	1.8	1143	58	54
A-6	0.01	0.100	1.8	1142	60	55
A-7	0.02	0.141		1140		
A-8	0.01	0.100		1137		
B-1	0.01	0.100		1140		
B-2	0.01	0.100		1142		
B-3	0.01	0.100		1143		
B-4	0.01	0.100		1142		
B-5	0.01	0.100		1140		
B-6	0.01	0.100		1137		
B-7	0.02	0.141		1137		
B-8	0.01	0.100		1135		
Average	0.01	0.108	1.80	1140.9		54.3

Initial volume	612.941	ft^3	Initial volume	0.000	liters
Final volume	635.446	ft^3	Final volume	0.000	liters
Total metered	22.505	dscf	Total metered	0.000	dry actual liters

Impinger	Final grams	Initial grams	Gram Gain	Final ml	Initial ml	ml Gain
1			0.0	123.0	100.0	23.0
2			0.0	104.0	100.0	4.0
3			0.0	0.0	0.0	0.0
4	254.1	247.2	6.9			0.0
5			0.0			0.0
6			0.0			0.0
7			0.0			0.0
8			0.0			0.0
9			0.0			0.0
10			0.0			0.0
Total	254.1	247.2	6.9	227.0	200.0	27.0
	W_f	W_i	(W_f - W_i)	V_f	V_i	(V_f - V_i)

Client:	URC		Test Date:	April 10, 2008	
Project No.:	08-065		Test Location:	Exhaust	
Plant:	Warren, PA		Test Run:	Run 3	
Unit:	SRU -2		Test Start Time:	11:50 AM	
Unit Operation:	smoe		Test Finish Time:	12:50 PM	
Blue is data input.	Red is a calculation.	Pink is a reference to a cell on another sheet.		Green is a reference to a cell on this sheet.	
Data Input			**Calculations**		
Control Box:	1618		CO + N2	90.78	% dv
Meter $DH_@$ (0.75 scfm)	1.816	in. H_2O	Water Collected (V_f- V_i)	30.0	ml
Meter Calibration Factor (Yd)	1.005		Water Vapor Condensed (Vwc(std))	1.412	scf
Barometric Pressure (Pbar)	29.50	in. Hg	Water Collected (W_f- W_i)	6.2	g
Stack Static Pressure (Pg)	-0.31	in. H_2O	Water Vapor in Silica Gel (Vwsg(std))	0.292	scf
Stack Diameter (Ds) (L if rectangular)	70.0	inches	Vol. Water Vapor in Gas Stand.(Vw(std))	1.704	scf
Stack Width (enter NA if circular)	NA	inches	Volume Dry Gas Metered (Vm)	23.049	dacf
CO2	5.27	% dv	Vol. Dry Gas Metered Stand.(Vm(std))	22.990	dscf
O2	3.95	% dv	Volume Dry Gas Metered (Vm(m^3))	0.653	dacm
Product Rate (enter NA if not needed)	NA	ton/hr	Vol. Dry Gas Metered Stand.(Vm(std)m^3)	0.651	dscm
Is the input ton/hr metric? (YES=1)	0		Stack Absolute Pressure (Ps)	29.48	in. Hg
Pitot Tube Coefficient (Cp)	0.84		Stack Absolute Temperature (Tsavg)	1607.5	R
Sample Calculation Title	Flow, Moisture, CEMS		H2O Vapor Pressure @ avg Stack Temp.	50214.56	in. Hg
F_d @ 68 F and 760 mm Hg (NA if NA)	na	dscf/MMBtu	H2O in the gas at saturation (Bws)	1.0000	vol. fraction
Standard Temperature	68	F	H2O in the gas from test data (Bws)	0.0690	vol. fraction
Standard Pressure	760	mm Hg	H2O in the gas used (lower of the 2 Bws)	0.0690	vol. fraction
Pitot Tube Constant (Kp)	85.49		Is the Gas Stream Saturated With H2O?	NO	
Calculations			Dry Gas Molecular Weight (Md)	29.00	lb/lb-mole
Meter Temperature (Tm)	66.7	F	Wet Gas Molecular Weight (Ms)	28.24	lb/lb-mole
Stack Temperature (Tsavg)	1147.8	F	Gas Velocity (Vs)	10.50	ft/s
Orifice Pressure Drop (dHavg)	1.800	in. H_2O	Is the stack circular or rectangular?	CIRCULAR	
GasVelocity Head $(dP)^{1/2}$avg	0.1052	in. H_2O^1/2	Area Stack (As)	26.725	ft^2
F_d @ Standard Conditions	NA	dscf/MMBtu	Actual Gas Flowrate	16,831	acfm
F_d @ Stan. Cond. & Actual O2	NA	dscf/MMBtu	Standard Gas Flowrate	5,446	scfm
Heat Input Based on F_d	NA	MMBtu/hr	Dry Standard Gas Flowrate	5,070	dscfm
K1method 4	0.04706	scf/ml	Actual Gas Flowrate	477	acm/min
K2method 4	0.04715	scf/g	Standard Gas Flowrate	154	scm/min
K1method 5	17.64	R/in. Hg	Dry Standard Gas Flowrate	144	dscm/min
K4method 5	0.0945				
Standard lb-mole volume	385.3	ft^3/lb-mole			
Carbon Monoxide (CO)					
MW	28	lb/lb-mole			
O2 for Correction	7	vol. %			
Concentration	258.57	$ppm_{dv, NDIR}$			
Concentration	212.07	ppm_{dv}, 7% O2			
Concentration	0.0000188	lb/dscf			
Emission	5.72	lb/hr			
Emission	NA	lb/MMBtu			
Emission	NA;Not Needed	lb/ton prod.			
Sulfur Dioxide (SO2)					
MW	64	lb/lb-mole			
O2 for Correction	7	vol. %			
Concentration	72.29	ppm_{dv}			
Concentration	59.28	ppm_{dv}, 7% O2			
Concentration	0.0000120	lb/dscf			
Emission	3.65	lb/hr			
Emission	NA	lb/MMBtu			
Emission	NA;Not Needed	lb/ton prod.			

URC
SRU -2

Run 3

F or C?
F=1,C=0 1

Point	Pitot DP (dP) (in. H2O)	SQRT dP (in. H2O)$^{1/2}$	Orifice DP (dH) (in. H2O)	Stack Temp (F)	Meter Temp In/Out (F or C)	(F or C)
A-1	0.01	0.100	1.8	1150	63	61
A-2	0.02	0.141	1.8	1151	66	61
A-3	0.01	0.100	1.8	1152	70	62
A-4	0.01	0.100	1.8	1150	73	63
A-5	0.01	0.100	1.8	1148	75	64
A-6	0.01	0.100	1.8	1146	77	65
A-7	0.01	0.100		1146		
A-8	0.01	0.100		1140		
B-1	0.01	0.100		1152		
B-2	0.01	0.100		1154		
B-3	0.02	0.141		1158		
B-4	0.01	0.100		1146		
B-5	0.01	0.100		1144		
B-6	0.01	0.100		1144		
B-7	0.01	0.100		1143		
B-8	0.01	0.100		1141		
Average	0.01	0.105	1.80	1147.8		66.7

Initial volume	635.778	ft^3	Initial volume	0.000	liters
Final volume	658.827	ft^3	Final volume	0.000	liters
Total metered	23.049	dacf	Total metered	0.000	dry actual liters

Impinger	Final grams	Initial grams	Gram Gain	Final ml	Initial ml	ml Gain
1			0.0	124.0	100.0	24.0
2			0.0	106.0	100.0	6.0
3			0.0	0.0	0.0	0.0
4	243.8	237.6	6.2			0.0
5			0.0			0.0
6			0.0			0.0
7			0.0			0.0
8			0.0			0.0
9			0.0			0.0
10			0.0			0.0
Total	243.8	237.6	6.2	230.0	200.0	30.0
	W_f	W_i	(W_f- W_i)	V_f	V_i	(V_f- V_i)

APPENDIX C

URC Process Data

	4/1		4/3	4/4	4/6	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30	AVG
Process Stream:																															
C3 STREAM	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.2	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1
- C3=	94.2	93.4	93.3	94.6		96.4	92.5	92.4	94.0	94.1	93.8	94.2	93.7	92.5	93.9	94.4	94.2	93.7	94.1	94.0	93.5	91.2	93.8	92.4	91.3	90.0	92.0	91.5	91.1	91.1	93.1
- C3H8	4.8	6.2	5.2	4.3		2.8	6.2	6.2	4.7	4.8	5.2	4.8	5.2	6.4	5.3	4.8	4.3	5.4	4.7	4.5	5.0	8.0	4.8	7.6	8.4	9.7	7.7	8.2	8.6	8.7	5.9
- IC4	0.7	1.2	1.2	0.8		1.4	1.1	1.2	1.1	1.1	0.8	0.8	0.8	0.7	0.8	0.7	1.2	0.8	0.9	1.2	1.1	0.4	1.0	0.0	0.1	0.1	0.2	0.1	0.2	0.2	0.7
- NC4	0.2	0.3	0.3	0.2		0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.2	0.3	0.2	0.3	0.3	0.3	0.0	0.3	0.0	0.1	0.1	0.1	0.2	0.1	0.1	0.2
Absorber Lean Oil:																															
Abs. lean oil STAGE	924	888	906			1089	973	1005	1071	1081			922	986	984	1075	1011			1059	901	903	920	1115			942				987
Abs. lean oil MW	18.2	18.5	18.7			18.1	18.1	18.1	18.5	18.1			18.3	18.8	18.2	18.9	18.8			11.8	18.3	18.5	18.5	15.1			15.7				15.9
- N2	14.6	15.3	13.5			9.6	12.9	10.0	8.9	5.3			14.2	11.6	10.7	5.3	9.8			11.1	16.5	17.0	12.3	8.2			14.4				11.5
- CO2	1.1	1.1	1.1			1.4	1.4	1.3	1.2	1.4			1.0	1.3	1.3	1.3	1.3			1.3	1.1	0.9	0.8	1.2			1.0				1.2
- CH4	34.9	36.1	37.7			33.9	31.8	32.4	31.8	34.2			35.3	32.7	32.8	33.6	31.7			33.9	36.4	35.6	45.8	32.8			36.7				34.7
- C2H6	9.0	9.0	8.9			11.9	11.2	11.1	11.0	11.9			9.4	11.5	11.3	12.0	11.3			11.9	9.2	8.2	6.5	10.4			8.3				10.2
- C2H4	9.6	9.7	9.5			13.1	12.1	12.1	11.8	12.3			10.0	12.2	12.1	12.5	12.1			12.7	9.6	9.0	7.3	11.8			9.5				11.0
- C3H8	1.5	1.1	1.3			1.8	1.5	1.7	3.6	2.0			1.3	1.5	1.6	2.1	1.9			1.9	1.4	1.4	1.3	2.3			1.4				1.7
- C3H6	5.6	4.5	4.9			6.9	5.9	6.4	7.5	7.4			5.3	6.2	6.4	7.6	6.8			7.1	5.1	6.8	6.5	11.6			7.2				6.6
- IC4	0.8	0.8	0.7			1.0	0.9	0.9	1.0	1.0			0.8	0.9	0.8	1.0	0.9			1.0	0.8	0.8	0.7	1.2			0.8				0.9
- NC4	0.7	0.8	0.8			0.9	0.8	0.8	0.9	0.9			0.7	0.6	0.6	0.8	0.7			0.9	0.7	0.7	0.5	0.8			0.6				0.7
- C4=	0.0	0.0	0.0			0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0	0.0	0.0			0.0				0.0
- H2S	4.7	4.3	4.4			5.2	4.4	6.1	5.6	6.2			4.6	4.8	5.4	5.7	5.6			5.2	1.9	2.4	2.1	3.2			3.3				4.5
-IC5	0.4	0.3	0.3			0.5	0.4	0.4	0.5	0.5			0.3	0.3	0.4	0.4	0.4			0.6	0.4	0.3	0.3	0.5			0.4				0.4
-NC5	0.1	0.1	0.1			0.1	0.1	0.1	0.1	0.1			0.1	0.0	0.1	0.1	0.1			0.1	0.1	0.0	0.0	0.1			0.1				0.1
Olefin Feed:																															
Olefin Feed - Perc	1.7	1.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	2.1	2.1	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Olefin feed/FCC %																															
OL FD/LPG TO TR	5.2	5.2	5.1	5.1	5.1	5.1	5.1	5.0	5.1	5.0	5.1	5.2	5.1	5.0	5.0	5.0	5.0	5.0	5.1	5.0	4.6	4.7	4.7	4.6	4.7	4.8	4.8	4.8	4.9	4.8	5.0
LPG to TRTM/FCC	32%	32%	32%	32%	32%	32%	32%	33%	33%	33%	33%	34%	34%	33%	33%	34%	34%	34%	33%	34%	41%	42%	42%	42%	42%	43%	43%	44%	44%	43%	36%
Olefin feed : C2H6	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
- C3H8	13.2	11.9	16.0	13.1		14.6	18.7	15.4	16.8	17.2	12.9	16.5	16.6	14.6	12.3	11.9	13.4	14.9	10.6	13.9	14.7	10.1	9.3	13.2	11.7	10.8	9.8	12.0	13.3	12.6	13.5
- C3H6	27.6	27.9	39.0	28.5		39.4	42.8	38.0	34.9	43.5	29.0	43.6	42.3	31.2	27.9	26.7	29.0	33.1	23.7	31.3	29.9	26.4	23.6	36.0	32.2	29.3	25.4	33.9	37.9	35.4	32.5
- IC4	24.4	24.9	21.4	24.5		23.8	19.2	20.3	21.8	18.0	24.5	19.2	18.5	23.3	23.9	24.2	23.7	22.5	24.8	23.8	25.5	26.7	25.4	22.9	23.1	25.0	24.9	23.0	21.4	21.8	23.0
- NC4	5.7	6.0	3.7	5.4		4.5	3.5	3.8	4.3	3.3	5.3	3.3	3.6	5.0	5.6	6.0	5.5	4.7	6.7	5.1	5.0	6.3	6.0	4.4	5.0	5.7	6.2	4.8	4.2	4.4	4.9
- IC4=	7.1	7.3	5.4	6.9		9.3	4.7	5.2	5.8	4.7	7.1	4.7	4.9	6.5	7.3	7.4	6.9	6.4	8.0	6.6	6.7	7.4	6.9	5.6	6.0	6.7	7.0	5.9	5.3	5.4	6.3
- C4-1=	7.4	7.2	5.7	7.1		6.6	4.7	5.3	6.2	5.2	7.3	4.9	5.2	6.9	7.6	7.5	7.0	6.5	8.0	6.6	6.6	6.6	6.6	5.4	6.0	6.5	6.6	5.6	5.1	5.1	6.3
- T-C4-2=	8.5	9.0	5.4	8.0		6.6	4.9	5.5	6.2	4.8	8.2	4.7	5.3	7.4	8.6	9.3	8.4	7.0	10.4	7.5	7.1	9.1	8.5	6.3	7.3	8.1	8.8	6.9	5.9	6.1	7.2
- C-C4-2=	5.7	6.3	3.2	5.2		4.1	3.2	3.6	3.8	3.1	5.4	3.0	3.4	4.9	6.1	6.7	5.9	4.5	7.3	4.9	4.3	8.4	6.3	4.2	5.1	6.0	6.7	4.7	4.0	4.1	4.8
- IC5	0.1	0.2	0.1	0.1		0.1	0.3	2.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.0	0.5	5.5	1.6	2.7	1.5	3.9	2.3	2.4	3.9	1.0
- NC5	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
- C5=	0.0	0.0	0.0	0.0		0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.3	0.2	0.6	0.0	0.0	0.5	0.2
- 1-3BUT=	0.2	0.1	0.1	0.2		0.0	0.1	0.2	0.1	0.1	0.2	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.0	0.2	0.2	0.5	0.3	0.4	0.4	0.4	0.4	0.3	0.4	0.2
DHT I:																															
Inlet sulfur Wt%	0.58	0.48				0.47		0.54						0.55		0.56															0.53
Outlet sulfur Wt%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01													0.00
Desulfurization %	100%	99%				100%		100%						100%		98%															99%
DHT II:																															
Inlet sulfur Wt%	8421	8921	9362	8504	8583	8229	8897	8587					8900	8862	7967	7683	7338														8482
Outlet sulfur Wt%	10.22	9.90	9.82	12.13	10.41	10.05	10.32	10.44		9.36	11.62		11.58	11.10	9.49	7.35	9.95														10.22
Desulfurization %	100%	100%	100%	100%	100%	100%	100%	100%					100%	100%	100%	100%	100%														100%
DHT Outlet Temp F	45.36	41.55	42.41	43.94	42.27	45.09	43.01	42.00	40.73	44.00	44.02	42.01	22.47	40.56	40.18	40.15	42.37	36.40	23.79	22.46	15.30	10.62	18.05	10.62	15.29	12.05	15.76	11.01	15.61	11.54	30.69

APPENDIX D

1-Minute Averages and CEM Bias Sheets

ACCI 1 Minute Average Data Sheet: O2, CO2, CO, SO2			
Client	URC	Unit	SRU -2
Project No	08-065	Operation	nmoc
Plant	Warren, PA	Location	Exhaust

MINUTE	DATE	TIME	O2 (DV %)	CO2 (DV %)	CO (PPMdv)	SO_2 (PPMdv)
RUN 1						
1	2008/04/10	09:30:46	5.7	4.9	324.9	98.9
2	2008/04/10	09:31:46	5.7	4.9	264.1	98.8
3	2008/04/10	09:32:46	5.7	5.0	222.4	98.2
4	2008/04/10	09:33:46	5.7	5.1	190.1	97.6
5	2008/04/10	09:34:46	5.7	5.0	205.5	98.0
6	2008/04/10	09:35:46	5.6	5.0	171.4	96.8
7	2008/04/10	09:36:46	5.6	5.0	163.2	95.4
8	2008/04/10	09:37:46	5.6	5.1	142.3	95.6
9	2008/04/10	09:38:46	5.6	5.1	119.9	94.8
10	2008/04/10	09:39:46	5.7	5.0	144.8	95.4
11	2008/04/10	09:40:46	5.7	4.9	344.1	94.5
12	2008/04/10	09:41:46	5.8	4.8	324.4	94.3
13	2008/04/10	09:42:46	5.8	4.9	284.7	94.5
14	2008/04/10	09:43:46	5.9	5.0	342.0	93.6
15	2008/04/10	09:44:46	5.6	5.0	331.8	93.5
16	2008/04/10	09:45:46	5.7	4.9	252.4	92.2
17	2008/04/10	09:46:46	5.8	4.9	263.4	90.5
18	2008/04/10	09:47:46	5.9	4.9	284.8	90.9
19	2008/04/10	09:48:46	5.8	5.0	341.8	89.0
20	2008/04/10	09:49:46	5.7	4.8	399.8	88.8
21	2008/04/10	09:50:46	5.7	4.9	424.7	88.8
22	2008/04/10	09:51:46	5.7	5.0	387.2	88.4
23	2008/04/10	09:52:46	5.9	5.0	380.3	89.3
24	2008/04/10	09:53:46	5.7	5.0	394.2	89.3
25	2008/04/10	09:54:46	5.8	4.9	417.1	86.8
26	2008/04/10	09:55:46	5.8	4.9	463.4	86.2
27	2008/04/10	09:56:46	5.8	4.9	425.8	86.1
28	2008/04/10	09:57:46	5.6	5.1	278.5	84.9
29	2008/04/10	09:58:46	5.5	5.1	197.9	84.5
30	2008/04/10	09:59:46	5.6	5.0	197.4	84.6
31	2008/04/10	10:00:46	5.6	5.1	155.9	83.9
32	2008/04/10	10:01:46	5.7	5.1	139.6	83.4
33	2008/04/10	10:02:46	5.7	5.0	140.7	83.7
34	2008/04/10	10:03:46	5.7	5.0	250.2	84.4
35	2008/04/10	10:04:46	5.8	4.9	325.3	83.4
36	2008/04/10	10:05:46	5.8	5.0	330.5	83.1
37	2008/04/10	10:06:46	5.8	4.9	361.8	82.6
38	2008/04/10	10:07:46	5.7	4.9	340.3	83.7
39	2008/04/10	10:08:46	5.6	5.0	342.5	84.2
40	2008/04/10	10:09:46	5.7	4.9	315.7	83.8
41	2008/04/10	10:10:46	5.7	5.0	262.5	83.7
42	2008/04/10	10:11:46	5.9	4.9	349.3	83.8
43	2008/04/10	10:12:46	5.7	4.9	357.2	84.5
44	2008/04/10	10:13:46	5.7	4.9	345.9	84.2
45	2008/04/10	10:14:46	5.7	4.9	341.7	85.0
46	2008/04/10	10:15:46	5.9	4.9	298.6	84.1
47	2008/04/10	10:16:46	5.8	5.0	304.5	83.9
48	2008/04/10	10:17:46	5.7	4.9	282.0	83.8
49	2008/04/10	10:18:46	5.8	4.8	310.0	83.5
50	2008/04/10	10:19:46	5.8	4.9	278.0	83.7
51	2008/04/10	10:20:46	5.8	4.9	352.4	84.2
52	2008/04/10	10:21:46	5.7	4.9	345.7	84.5
53	2008/04/10	10:22:46	5.6	4.9	303.8	84.2
54	2008/04/10	10:23:46	5.7	4.9	242.0	83.1
55	2008/04/10	10:24:46	5.8	4.9	222.0	81.9
56	2008/04/10	10:25:46	5.9	4.9	316.0	82.8
57	2008/04/10	10:26:46	5.6	5.0	267.5	83.1
58	2008/04/10	10:27:46	5.6	4.9	284.9	83.2
59	2008/04/10	10:28:46	5.7	4.9	282.3	81.5
60	2008/04/10	10:29:46	5.7	5.0	275.1	81.8
RUN 1 AVERAGES			**5.7**	**5.0**	**290.1**	**87.8**

ACCI 1 Minute Average Data Sheet: O2, CO2, CO, SO2			
Client	URC	Unit	SRU -2
Project No	08-065	Operation	nmoc
Plant	Warren, PA	Location	Exhaust

MINUTE	DATE	TIME	O2 (DV %)	CO2 (DV %)	CO (PPMdv)	SO_2 (PPMdv)
RUN 2						
1	2008/04/10	10:40:46	5.4	5.0	134.6	76.0
2	2008/04/10	10:41:46	5.7	4.9	245.8	76.7
3	2008/04/10	10:42:46	5.6	5.0	304.0	75.6
4	2008/04/10	10:43:46	5.7	5.0	293.2	75.2
5	2008/04/10	10:44:46	5.7	4.9	345.2	75.1
6	2008/04/10	10:45:46	5.6	5.0	338.3	75.5
7	2008/04/10	10:46:46	5.6	4.9	367.0	76.1
8	2008/04/10	10:47:46	5.7	4.9	332.4	75.7
9	2008/04/10	10:48:46	5.8	4.9	429.0	75.2
10	2008/04/10	10:49:46	5.5	5.1	359.3	74.5
11	2008/04/10	10:50:46	5.5	5.0	190.4	73.4
12	2008/04/10	10:51:46	5.4	5.0	150.1	73.9
13	2008/04/10	10:52:46	5.6	5.1	129.5	74.6
14	2008/04/10	10:53:46	5.6	5.0	160.6	74.6
15	2008/04/10	10:54:46	5.5	5.0	154.3	73.4
16	2008/04/10	10:55:46	5.5	5.0	156.8	72.8
17	2008/04/10	10:56:46	5.7	5.0	187.1	74.0
18	2008/04/10	10:57:46	5.7	4.9	292.4	73.8
19	2008/04/10	10:58:46	5.7	4.9	333.5	74.2
20	2008/04/10	10:59:46	5.6	4.9	349.5	75.1
21	2008/04/10	11:00:46	5.7	4.9	396.1	74.6
22	2008/04/10	11:01:46	5.8	5.0	382.0	74.4
23	2008/04/10	11:02:46	5.7	5.0	497.9	72.4
24	2008/04/10	11:03:46	5.5	5.0	472.1	71.6
25	2008/04/10	11:04:46	5.3	5.0	205.4	71.7
26	2008/04/10	11:05:46	5.5	5.0	209.0	71.4
27	2008/04/10	11:06:46	5.5	5.1	198.7	71.2
28	2008/04/10	11:07:46	5.5	5.0	200.6	72.3
29	2008/04/10	11:08:46	5.6	5.0	154.3	71.6
30	2008/04/10	11:09:46	5.7	4.9	120.9	71.7
31	2008/04/10	11:10:46	5.6	5.0	198.1	72.3
32	2008/04/10	11:11:46	5.7	5.0	190.7	72.0
33	2008/04/10	11:12:46	5.6	4.9	218.5	71.9
34	2008/04/10	11:13:46	5.7	4.9	214.3	71.9
35	2008/04/10	11:14:46	5.6	5.0	196.1	72.7
36	2008/04/10	11:15:46	5.6	5.1	232.7	73.6
37	2008/04/10	11:16:46	5.6	5.0	295.8	73.6
38	2008/04/10	11:17:46	5.7	5.0	312.6	73.6
39	2008/04/10	11:18:46	5.5	5.0	297.5	74.1
40	2008/04/10	11:19:46	5.7	5.0	263.3	73.8
41	2008/04/10	11:20:46	5.6	5.0	271.1	73.7
42	2008/04/10	11:21:46	5.5	5.0	279.9	73.3
43	2008/04/10	11:22:46	5.6	4.9	316.0	72.8
44	2008/04/10	11:23:46	5.6	4.9	258.7	71.1
45	2008/04/10	11:24:46	5.7	5.0	216.8	70.8
46	2008/04/10	11:25:46	5.6	5.0	302.4	72.7
47	2008/04/10	11:26:46	5.6	5.0	355.0	72.7
48	2008/04/10	11:27:46	5.6	4.9	341.2	72.6
49	2008/04/10	11:28:46	5.6	5.0	273.4	72.7
50	2008/04/10	11:29:46	5.6	5.0	338.9	72.3
51	2008/04/10	11:30:46	5.7	4.9	392.9	72.0
52	2008/04/10	11:31:46	5.6	4.9	380.6	70.6
53	2008/04/10	11:32:46	5.6	4.9	400.8	71.2
54	2008/04/10	11:33:46	5.6	5.0	384.6	71.1
55	2008/04/10	11:34:46	5.7	4.9	400.5	72.5
56	2008/04/10	11:35:46	5.6	5.0	350.8	72.4
57	2008/04/10	11:36:46	5.7	4.9	391.9	72.2
58	2008/04/10	11:37:46	5.7	5.0	334.2	72.7
59	2008/04/10	11:38:46	5.6	5.0	406.2	72.8
60	2008/04/10	11:39:46	5.6	5.0	399.1	72.7
RUN 2 AVERAGES			**5.6**	**5.0**	**288.4**	**73.2**

ACCI 1 Minute Average Data Sheet: O2, CO2, CO, SO2			
Client	URC	Unit	SRU -2
Project No	08-065	Operation	nmoc
Plant	Warren, PA	Location	Exhaust

MINUTE	DATE	TIME	O2 (DV %)	CO2 (DV %)	CO (PPMdv)	SO_2 (PPMdv)
RUN 3						
1	2008/04/10	11:50:46	5.6	5.0	386.0	54.8
2	2008/04/10	11:51:46	5.6	5.1	340.3	54.2
3	2008/04/10	11:52:46	5.5	5.2	334.9	53.4
4	2008/04/10	11:53:46	5.3	5.2	163.5	53.6
5	2008/04/10	11:54:46	5.4	5.1	140.1	53.5
6	2008/04/10	11:55:46	5.6	5.0	161.1	53.8
7	2008/04/10	11:56:46	5.6	5.1	251.8	53.1
8	2008/04/10	11:57:46	5.6	5.0	313.4	52.8
9	2008/04/10	11:58:46	5.5	5.1	241.7	53.6
10	2008/04/10	11:59:46	5.6	5.0	282.0	55.2
11	2008/04/10	12:00:46	5.6	5.1	327.8	69.1
12	2008/04/10	12:01:46	5.7	5.0	377.3	70.3
13	2008/04/10	12:02:46	5.6	5.0	396.2	70.6
14	2008/04/10	12:03:46	5.6	5.0	443.0	70.6
15	2008/04/10	12:04:46	5.5	5.0	391.9	70.8
16	2008/04/10	12:05:46	5.5	5.1	343.9	70.7
17	2008/04/10	12:06:46	5.4	5.2	234.7	70.1
18	2008/04/10	12:07:46	5.3	5.2	185.8	70.1
19	2008/04/10	12:08:46	5.4	5.1	175.3	70.1
20	2008/04/10	12:09:46	5.3	5.2	140.2	70.6
21	2008/04/10	12:10:46	5.4	5.1	174.7	70.0
22	2008/04/10	12:11:46	5.5	4.9	316.7	70.8
23	2008/04/10	12:12:46	5.5	5.1	258.6	70.6
24	2008/04/10	12:13:46	5.5	5.0	325.2	71.1
25	2008/04/10	12:14:46	5.6	5.0	291.7	71.6
26	2008/04/10	12:15:46	5.6	5.0	340.1	71.7
27	2008/04/10	12:16:46	5.5	5.0	406.6	72.1
28	2008/04/10	12:17:46	5.6	5.0	379.4	72.7
29	2008/04/10	12:18:46	5.7	5.0	327.9	71.9
30	2008/04/10	12:19:46	5.6	5.0	386.3	71.9
31	2008/04/10	12:20:46	5.6	5.0	364.8	72.1
32	2008/04/10	12:21:46	5.6	5.0	335.6	72.1
33	2008/04/10	12:22:46	5.6	5.0	302.0	72.1
34	2008/04/10	12:23:46	5.3	5.2	194.2	72.2
35	2008/04/10	12:24:46	5.4	5.2	108.4	72.2
36	2008/04/10	12:25:46	5.4	5.1	97.4	71.8
37	2008/04/10	12:26:46	5.4	5.0	199.0	72.7
38	2008/04/10	12:27:46	5.4	5.1	198.6	71.8
39	2008/04/10	12:28:46	5.5	5.1	251.0	71.1
40	2008/04/10	12:29:46	5.4	5.1	274.7	72.0
41	2008/04/10	12:30:46	5.5	5.1	254.3	71.0
42	2008/04/10	12:31:46	5.5	5.0	275.3	71.2
43	2008/04/10	12:32:46	5.5	5.1	237.5	71.5
44	2008/04/10	12:33:46	5.7	5.0	277.8	71.3
45	2008/04/10	12:34:46	5.5	5.1	261.6	70.3
46	2008/04/10	12:35:46	5.6	5.0	273.1	70.1
47	2008/04/10	12:36:46	5.4	5.1	194.7	70.9
48	2008/04/10	12:37:46	5.4	5.1	184.2	71.7
49	2008/04/10	12:38:46	5.5	5.1	224.5	71.9
50	2008/04/10	12:39:46	5.4	5.1	250.0	71.5
51	2008/04/10	12:40:46	5.4	5.0	263.6	69.1
52	2008/04/10	12:41:46	5.4	5.1	193.4	67.8
53	2008/04/10	12:42:46	5.5	5.1	203.4	70.6
54	2008/04/10	12:43:46	5.4	5.1	188.1	70.6
55	2008/04/10	12:44:46	5.5	5.0	226.5	70.7
56	2008/04/10	12:45:46	5.4	5.1	191.9	70.4
57	2008/04/10	12:46:46	5.5	5.1	236.4	70.1
58	2008/04/10	12:47:46	5.5	5.0	296.9	69.1
59	2008/04/10	12:48:46	5.3	5.1	242.2	70.3
60	2008/04/10	12:49:46	5.5	5.1	240.4	71.7
RUN 3 AVERAGES			**5.5**	**5.1**	**264.7**	**68.1**

ACCI CEM Calibration, Bias and Drift Data Sheet
Based on 40 CFR Part 60, Appendix A-4, Method 6C

Client	URC	Date	April 10, 2008
Project No	08-065	Location	Exhaust
Plant	Warren, PA	Run	Run 1
Unit	SRU -2	Start Time	9:30
Operation	nmoc	End Time	10:30
Tester(s)	EW,RW,MB		

Cal. Gas	LOW Conc.	LOW (% of Span)	MID Conc.	MID (% of Span)	HIGH Conc.	HIGH (% of Span)	Tank ID LOW	Tank ID MID	Tank ID HIGH	Span	Conc. Units	Response Time	Response Time
O2	N/A	N/A	11.9	54.1	22	100.0	N/A	CC130116	CC209107	22	d. vol. %	30	28
CO2	N/A	N/A	9.84	55.6	17.7	100.0	N/A	CC209107	CC130116	17.7	d. vol. %	30	28
CO	N/A	N/A	302	49.9	605.5	100.0	N/A	CC73683B	CC266639	605.5	ppmdv	62	60
SO2	N/A	N/A	51.6	40.3	128.1	100.0	N/A	CC231139	CC185180	128.1	ppmdv	59	57
LIMITS				40 % to 60 %		100%							

Gas	Upscale: Enter "Low" "Mid" or "High" below "Zero"	Actual Upscale Conc.	Analyzer Cal. Response	Initial Values: System Cal. Response	Initial Values: System Cal. Bias (% of Span)	Final Values: System Cal. Response	Final Values: System Cal. Bias (% of Span)	Drift (% of Span)	Span	Average of Initial and Final System Responses	Average Indicated Gas Conc.	Corrected Gas Conc.	Conc. Units
O2	Zero		0.0	0.0	0.00	0.0	0.00	0.00	22	0			
	Mid	11.9	11.9	11.8	-0.45	11.8	-0.45	0.00	22	11.8	5.72	5.77	d. vol. %
CO2	Zero		0.0	0.0	0.00	0.0	0.00	0.00	17.7	0			
	Mid	9.84	9.9	9.9	0.00	9.7	-1.13	-1.13	17.7	9.8	4.95	4.97	d. vol. %
CO	Zero		-0.1	-0.1	0.00	-1.1	-0.17	-0.17	605.5	-0.6			
	Mid	302	313.1	311.8	-0.21	308.8	-0.71	-0.50	605.5	310.3	290.13	282.41	ppmdv
SO2	Zero		0.1	0.1	0.00	1.2	0.86	0.86	128.1	0.65			
	Mid	51.6	51.7	50.9	-0.62	49.1	-2.03	-1.41	128.1	50	87.78	91.10	ppmdv
LIMITS					+/- 5 %		+/- 5 %	+/- 3 %					

Gas	ZERO Analyzer Response (System for THC)	ZERO Analyzer Cal. Error (% of Span)	LOW Actual Conc.	LOW Analyzer Response (System for THC)	LOW Analyzer Cal. Error (% of Span)	LOW System Cal. Error (% of Actual)	MID Actual Conc.	MID Analyzer Response (System for THC)	MID Analyzer Cal. Error (% of Span)	MID System Cal. Error (% of Actual)	HIGH Actual Conc.	HIGH Analyzer Response (System for THC)	HIGH Analyzer Cal. Error (% of Span)	HIGH System Calibration Error (% of Actual)	Span	Conc. Units
O2	0.0	0.00					11.9	11.9	0.00		22	22.0	0.00		22	d. vol. %
CO2	0.0	0.00					9.84	9.9	0.34		17.7	17.7	0.00		17.7	d. vol. %
CO	-0.1	-0.02					302	313.1	1.83		605.5	605.7	0.03		605.5	ppmdv
SO2	0.1	0.00					51.6	51.7	0.08		128.1	128.4	0.23		128.1	ppmdv
LIMITS		+/- 2 %			+/- 2 %	+/- 5 %			+/- 2 %	+/- 5 %			+/- 2 %	+/- 5 %		

ACCI CEM Calibration, Bias and Drift Data Sheet

Based on 40 CFR Part 60, Appendix A-4, Method 6C

Client	URC	**Date**	April 10, 2008
Project No	08-065	**Location**	Exhaust
Plant	Warren, PA	**Run**	Run 2
Unit	SRU -2	**Start Time**	12:25
Operation	nmoc	**End Time**	13:25
Tester(s)	EW,RW,MB		

Cal. Gas	LOW Conc.	LOW (% of Span)	MID Conc.	MID (% of Span)	HIGH Conc.	HIGH (% of Span)	Tank ID LOW	Tank ID MID	Tank ID HIGH	Span	Conc. Units
O2	N/A	N/A	11.9	54.1	22	100.0	N/A	CC130116	CC209107	22	d. vol. %
CO2	N/A	N/A	9.84	55.6	17.7	100.0	N/A	CC209107	CC130116	17.7	d. vol. %
CO	N/A	N/A	302	49.9	605.5	100.0	N/A	CC73683B	CC266639	605.5	ppmdv
SO2	N/A	N/A	51.6	40.3	128.1	100.0	N/A	CC231139	CC185180	128.1	ppmdv
LIMITS				40 % to 60 %		100%					

Gas	Upscale: Enter "Low" "Mid" or "High" below "Zero"	Actual Upscale Conc.	Analyzer Cal. Response	Initial Values: System Cal. Response	Initial Values: System Cal. Bias (% of Span)	Final Values: System Cal. Response	Final Values: System Cal. Bias (% of Span)	Drift (% of Span)	Span	Average of Initial and Final System Responses	Average Indicated Gas Conc.	Corrected Gas Conc.	Conc. Units
O2	Zero		0.0	0.0	0.00	0.0	0.00	0.00	22	0			
	Mid	11.9	11.9	11.8	-0.45	11.8	-0.45	0.00	22	11.8	5.61	5.66	d. vol. %
CO2	Zero		0.0	0.0	0.00	0.0	0.00	0.00	17.7	0			
	Mid	9.84	9.9	9.7	-1.13	9.7	-1.13	0.00	17.7	9.7	4.97	5.04	d. vol. %
CO	Zero		-0.1	-1.1	-0.17	-1.1	-0.17	0.00	605.5	-1.1			
	Mid	302	313.1	308.8	-0.71	308.8	-0.71	0.00	605.5	308.8	288.40	282.12	ppmdv
SO2	Zero		0.1	1.2	0.86	1.8	1.33	0.47	128.1	1.5			
	Mid	51.6	51.7	49.1	-2.03	49.3	-1.87	0.16	128.1	49.2	73.21	77.57	ppmdv
LIMITS					+/- 5 %		+/- 5 %	+/- 3 %					

Gas	ZERO Analyzer Response (System for THC)	ZERO Analyzer Cal. Error (% of Span)	LOW Actual Conc.	LOW Analyzer Response (System for THC)	LOW Analyzer Cal. Error (% of Span)	LOW System Cal. Error (% of Actual)	MID Actual Conc.	MID Analyzer Response (System for THC)	MID Analyzer Cal. Error (% of Span)	MID System Cal. Error (% of Actual)	HIGH Actual Conc.	HIGH Analyzer Response (System for THC)	HIGH Analyzer Cal. Error (% of Span)	HIGH System Calibration Error (% of Actual)	Span	Conc. Units
O2	0.0	0.00					11.9	11.9	0.00		22	22.0	0.00		22	d. vol. %
CO2	0.0	0.00					9.84	9.9	0.34		17.7	17.7	0.00		17.7	d. vol. %
CO	-0.1	-0.02					302	313.1	1.83		605.5	605.7	0.03		605.5	ppmdv
SO2	0.1	0.00					51.6	51.7	0.08		128.1	128.4	0.23		128.1	ppmdv
LIMITS		+/- 2 %			+/- 2 %	+/- 5 %			+/- 2 %	+/- 5 %			+/- 2 %	+/- 5 %		

ACCI CEM Calibration, Bias and Drift Data Sheet
Based on 40 CFR Part 60, Appendix A-4, Method 6C

Client	URC	Date	April 10, 2008
Project No	08-065	Location	Exhaust
Plant	Warren, PA	Run	Run 3
Unit	SRU -2	Start Time	13:43
Operation	nmoc	End Time	14:43
Tester(s)	EW,RW,MB		

Cal.	LOW		MID		HIGH		Tank ID			Span	Conc.
Gas	Conc.	(% of Span)	Conc.	(% of Span)	Conc.	(% of Span)	LOW	MID	HIGH		Units
O2	N/A	N/A	11.9	54.1	22	100.0	N/A	CC130116	CC209107	22	d. vol. %
CO2	N/A	N/A	9.84	55.6	17.7	100.0	N/A	CC209107	CC130116	17.7	d. vol. %
CO	N/A	N/A	302	49.9	605.5	100.0	N/A	CC73683B	CC266639	605.5	ppmdv
SO2	N/A	N/A	51.6	40.3	128.1	100.0	N/A	CC231139	CC185180	128.1	ppmdv
LIMITS				40 % to 60 %		100%					

Gas	Upscale: Enter "Low" "Mid" or "High" below "Zero"	Actual Upscale Conc.	Analyzer Cal. Response	Initial Values: System Cal. Response	Initial Values: System Cal. Bias (% of Span)	Final Values: System Cal. Response	Final Values: System Cal. Bias (% of Span)	Drift (% of Span)	Span	Average of Initial and Final System Responses	Average Indicated Gas Conc.	Corrected Gas Conc.	Conc. Units
O2	Zero		0.0	0.0	0.00	0.0	0.00	0.00	22	0			
	Mid	11.9	11.9	11.8	-0.45	21.3	42.73	43.18	22	16.55	5.50	3.95	d. vol. %
CO2	Zero		0.0	0.0	0.00	0.0	0.00	0.00	17.7	0			
	Mid	9.84	9.9	9.7	-1.13	9.2	-3.95	-2.82	17.7	9.45	5.06	5.27	d. vol. %
CO	Zero		-0.1	-1.1	-0.17	-1.1	-0.17	0.00	605.5	-1.1			
	Mid	302	313.1	308.8	-0.71	309.8	-0.55	0.17	605.5	309.3	264.67	258.57	ppmdv
SO2	Zero		0.1	1.8	1.33	1.5	1.09	-0.23	128.1	1.65			
	Mid	51.6	51.7	49.3	-1.87	48.9	-2.19	-0.31	128.1	49.1	68.12	72.29	ppmdv
LIMITS					+/- 5 %		+/- 5 %	+/- 3 %					

Gas	ZERO Analyzer Response (System for THC)	ZERO Analyzer Cal. Error (% of Span)	LOW Actual Conc.	LOW Analyzer Response (System for THC)	LOW Analyzer Cal. Error (% of Span)	LOW System Cal. Error (% of Actual)	MID Actual Conc.	MID Analyzer Response (System for THC)	MID Analyzer Cal. Error (% of Span)	MID System Cal. Error (% of Actual)	HIGH Actual Conc.	HIGH Analyzer Response (System for THC)	HIGH Analyzer Cal. Error (% of Span)	HIGH System Calibration Error (% of Actual)	Span	Conc. Units
O2	0.0	0.00					11.9	11.9	0.00		22	22.0	0.00		22	d. vol. %
CO2	0.0	0.00					9.84	9.9	0.34		17.7	17.7	0.00		17.7	d. vol. %
CO	-0.1	-0.02					302	313.1	1.83		605.5	605.7	0.03		605.5	ppmdv
SO2	0.1	0.00					51.6	51.7	0.08		128.1	128.4	0.23		128.1	ppmdv
LIMITS		+/- 2 %			+/- 2 %	+/- 5 %			+/- 2 %	+/- 5 %			+/- 2 %	+/- 5 %		

APPENDIX E

Reference Method QA/QC Data

SO2 Interference Test for Sulfur Dioxide Analyzer,

Trailer:	Western Research
Date:	18-Mar-08
Analyzer Range:	0-3000
Serial Number:	AX-921-9746-1

Test Gas	Gas Cylinder Concentration (ppm_v)	SO2 Analyzer Response (ppm_v)	Difference Percent of Span	Suggested Concentration (ppm_v)
Nitric Oxide	226	0.6	0.06%	200 +/- 20 ppm
Carbon Dioxide	9.84	0.6	0.06%	10.0 +/- 1%
Oxygen	22	0.6	0.06%	20.9 +/- 1%
	Total Difference Response		0.2%	

Notes: Acceptance criteria is the sum of analyzer response must be less than 2 percent. Performed in accordance with 40 CFR, Part 60, USEPA Method 7E, Section 6.2 and Method 20, Section 5.4

NO_X Oxides of nitrogen.
ppm_v Parts per million by volume.
USEPA U.S. Environmental Protection Agency.

Carbon Monoxide Interference Test.

Trailer	TECO Model 48C Gas Filter Correlation CO Analyzer
Date	23-Dec-06
Analyzer Range	0-100 ppm
Serial #	48CHL-64485-344

Test Gas	Concentration (%)	Allowable Interference (ppm)	CO Analyzer Response (ppm)
Carbon dioxide	17.90	2	-0.7
Carbon dioxide	9.85	2	-0.5
Carbon dioxide	0	2	0

Allowable Interference is indicated if the CO analyzer response to each of the gases is less than 1 percent of the applicable measurement range of the analyzer.

CO	Carbon monoxide.
ppmv	Parts per million by volume.
ppm	Parts per million.
USEPA	U.S. Environmental Protection Agency.

O_2 Interference Test.

Analyzer:	Servomex
Date:	12/19/05
Analyzer Range:	0 to 25 percent
Serial #:	3858

Test Gas	Gas Cylinder Concentration (ppm_v)	O_2 Analyzer Response (%)	Difference Percent of Span
Nitric Oxide	25.3	0.0	0.00%
Sulfur Dioxide	51.4	0.0	0.00%
Carbon Monoxide	62.2	0.0	0.00%
Carbon Dioxide			
	Total Difference Response		0.00%

Notes: CO_2 interference is not evaluated due to O_2 / CO_2 cylinder mixture.
Servomex instrument specifications indicate no interferences with paramagnetic analysis.
Acceptance criteria is the sum of analyzer response must be less than 2 percent.
Performed in accordance with 40 CFR, Part 60, Appendix A, USEPA Method 3A,Section 6.2 and Method 20, Section 5.4

CO_2	Carbon Dioxide
O_2	Oxygen.
%	Percent.
ppm_v	Parts per million by volume.
USEPA	U.S. Environmental Protection Agency.

CO_2 Interference Test.

Analyzer:	Servomex
Date:	12/19/05
Analyzer Range:	0 to 25 percent
Serial #:	3858

Test Gas	Gas Cylinder Concentration (ppm_v)	O_2 Analyzer Response (%)	Difference Percent of Span
Nitric Oxide	25.3	0.0	0.00%
Sulfur Dioxide	51.4	0.0	0.00%
Carbon Monoxide	62.2	0.0	0.00%
Oxygen			
	Total Difference Response		0.00%

Notes: O_2 interference is not evaluated due to O_2 / CO_2 cylinder mixture.
Servomex instrument specifications indicate no interferences with infrared analysis.
Acceptance criteria is the sum of analyzer response must be less than 2 percent.
Performed in accordance with 40 CFR, Part 60, Appendix A, USEPA Method 3A,Section 6.2 and Method 20, Section 5.4

CO_2	Carbon Dioxide
O_2	Oxygen.
%	Percent.
ppm_v	Parts per million by volume.
USEPA	U.S. Environmental Protection Agency.

Stratification Check

Air/Compliance Consultants, Inc.

Client: United Refining Company
Facility: Warren, Pa
Source ID: SRU-2
Project Number: 08-065
Date: 04/10/08

Test conducted in accordance with section 8.1.2 of Method 7E

yellow=calculation
blue=data entry

Requirements:

3 Point sampling across centroidal area (alternately 12 points)
Sampling must be done for 2x response time
Record average at each point and mean of traverse

Stack Diameter 70 inches
Response Time 62 seconds

Point	Probe Marking (inches)	O2 reading (ppm_v)	Diff. vs. Mean (% of mean)	Diff. from Mean (%)
1	11.7	7.0	0.47%	0.0
2	35.0	7.1	-0.25%	0.0
3	58.3	7.1	-0.22%	0.0
	Mean of All Points	7.05	ppm_v	

Point	Probe Marking (inches)	CO_2 reading (ppm_v)	Diff. vs. Mean (% of mean)	Diff. from Mean (ppm_v)
1	11.7	4.6	0.10%	0.0
2	35.0	4.6	0.42%	0.0
3	58.3	4.7	-0.52%	0.0
	Mean of All Points	4.64	ppm_v	

Point	Probe Marking (inches)	CO reading (ppm_v)	Diff. vs. Mean (% of mean)	Diff. from Mean (ppm_v)
1	11.7	443.4	4.35%	20.2
2	35.0	472.8	-1.97%	-9.2
3	58.3	474.6	-2.38%	-11.0
	Mean of All Points	463.61	ppm_v	

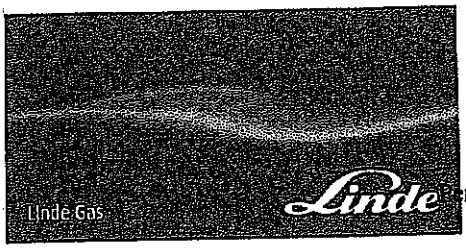
Point	Probe Marking (inches)	SO_2 reading (ppm_v)	Diff. vs. Mean (% of mean)	Diff. from Mean (ppm_v)
1	11.7	99.6	2.31%	2.4
2	35.0	100.7	1.30%	1.3
3	58.3	105.6	-3.61%	-3.7
	Mean of All Points	101.97	ppm_v	

a) if concentration differs at each point by +/- 5% or +/-.5 ppm (whichever less restrictive) (.3% for O2 and CO2)
single point sampling at point closest to mean

b) if concentration differs at each point by +/- 10% or +/- 1.0 ppm (whichever less restrictive) (.5% for O2 and CO2)
tri point sampling at 16.7, 50 and 83.3 % of diameter

c) if conditions a) and b) fail, then 12 point sampling is required

This test shows sampling may be conducted at centroidally located point (meets condition a)



Certificate of Analysis

EPA Protocol

HiQ® Certificate

Performed according to EPA-600/R-97/121, Procedure G1

Notice: This Cylinder is not to be used when pressure is under 150 psig.

Manufactured and certified at:

Linde Gas USA LLC
Maumee Specialty Gas Plant
6421 Monclova Road
MAUMEE OH 43537
419-893-7226

Produced for customer

LINDE GAS
LINDE PITTSBURGH INTERBRANCH
4349 WILLIAM PENN HWY
MURRYSVILLE PA 15668
724-327-1480

Material:	6655	**Blend Tolerance:**	5 % Relative
EPA SO2/N2 15-99 PPM	A31	**Blend Type:**	EPA Protocol
Production #:	100136155	**Cyl. Pressure:**	2000 psig
Lot #:	02499E7040JA	**Balance Gas:**	Nitrogen
Cylinder #:	CC231139	**CGA:**	660
Expiration Date:	5/9/2009	**Analytical Accuracy:**	1.00 % Relative
Shelf Life:	24 months	**Confidence:**	95 %

CAS #	Certified Component	Requested Concentration	Concentration and Uncertainty	Date of Certification
7446-09-5	Sulfur Dioxide	50	51.6 +/- 0.5 ppm	05/09/2007
7727-37-9	Nitrogen		Balance	05/09/2007

CAS #	Reference Standard	Cylinder/Standard #	Concentration	Expire Date
7446-09-5	Sulfur Dioxide	CC99186 , GMIS	50.77 ppm	03/15/2008

Instrument	Serial #	Analytical Principle	Calibration Date
Horiba VIA-510	4131546004	Non-Dispersive Infrared	04/05/2007

All analyses are performed under controlled environmental conditions.This product is manufactured using equipment which has been calibrated with NIST traceable, or equivalent, standards, weights, or equipment.

Analytical report approved by Roy Yoder

Roy Yoder

HiQ certificate

Airgas

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E02NI99E15A0005	Reference Number:	113-124107567-1
Cylinder Number:	CC185180	Cylinder Volume:	144 Cu.Ft
Laboratory:	ASG - Maumee - OH	Cylinder Pressure:	2015 PSIG
Analysis Date:	Sep 20, 2007	Valve Outlet:	660

Expiration Date: Sep 20, 2009

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 n. 1 Mega Pascal

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
SULFUR DIOXIDE	125.0 PPM	126.1 PPM	G1	+/- 1% NIST Traceable
NITROGEN	Balance			

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Expiration Date
NTRM	1030	CC240079	100.7PPM SULFUR DIOXIDE/NITROGEN	Mar 15, 2008
NTRM	D6070SD	CC240079	100.7PPM SULFUR DIOXIDE/NITROGEN	May 01, 2011

ANALYTICAL EQUIPMENT

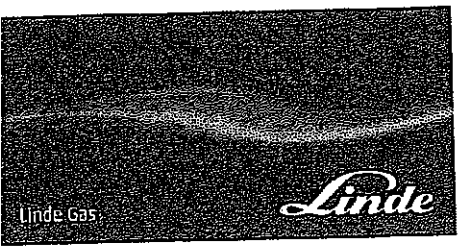
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
048-Nicolet Magna 550	FTIR	Sep 14, 2007

Triad Data Available Upon Request

Notes:

Signature on file

QA Approval



HiQ® Certificate.

EPA Protocol

Performed according to EPA-600/R-97/121, Procedure G1

Notice: This Cylinder is not to be used when pressure is under 150 psig.

Manufactured and certified at:

Linde Gas USA LLC
Maumee Specialty Gas Plant
6421 Monclova Road
MAUMEE OH 43537
419-893-7226

Produced for customer:

LINDE GAS
LINDE PITTSBURGH INTERBRANCH
4349 WILLIAM PENN HWY
MURRYSVILLE PA 15668
724-327-1480

Material:	6198 EPA CO/N2 100-999 PPM A31	**Blend Tolerance:**	5 % Relative
Production #:	100135835	**Blend Type:**	EPA Protocol
Lot #:	02499D7300ZA	**Cyl. Pressure:**	2000 psig
Cylinder #:	CC73683B	**Balance Gas:**	Nitrogen
Expiration Date:	5/14/2010	**CGA:**	350
Shelf Life:	36 months	**Analytical Accuracy:**	1.00 % Relative
		Confidence:	95 %

CAS #	Certified Component	Requested Concentration	Concentration and Uncertainty	Date of Certification
630-08-0	Carbon Monoxide	300	302 +/- 3 ppm	05/14/2007
7727-37-9	Nitrogen		Balance	05/14/2007

CAS #	Reference Standard	Cylinder/Standard #	Concentration	Expire Date
630-08-0	Carbon Monoxide	CC179999 , NTRM	495.8 ppm	02/02/2009

Instrument	Serial #	Analytical Principle	Calibration Date
Horiba VIA-510	569466011	Non-Dispersive Infrared	04/05/2007

All analyses are performed under controlled environmental conditions. This product is manufactured using equipment which has been calibrated with NIST traceable, or equivalent, standards, weights, or equipment.

Analytical report approved by Roy Yoder

Roy Yoder

HiQ certificate

Airgas

Airgas Specialty Gases
6421 Monclova Road
Maumee, OH 43537-9760
(419) 893-7226
Fax (419) 893-2963
www.airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E02NI99E15A0928	Reference Number:	113-124122084-2
Cylinder Number:	CC266639	Cylinder Volume:	144 Cu.Ft.
Laboratory:	ASG - Maumee - OH	Cylinder Pressure:	2015 PSIG
Analysis Date:	Jan 23, 2008	Valve Outlet:	350

Expiration Date: Jan 23, 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 MONOXIDE	600.0 PPM	605.5 PPM	G1	+/- 1% NIST Traceable
NITROGEN	Balance			

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Expiration Date
NTRM	051207	CC180329	2453PPM CARBON MONOXIDE/NITROGEN	Feb 02, 2009
NTRM	051205	CC180694	495 8PPM CARBON MONOXIDE/NITROGEN	Feb 02, 2009

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
023-Horiba VIA-510	NDIR	Jan 08, 2008

Triad Data Available Upon Request

Notes:

QA Approval

AGA
Member of the Linde Gas Group

Linde

Certificate of Analysis

EPA Protocol

Performed according to EPA-600/R-97/121, Procedure G1

Notice: This Cylinder is not to be used when pressure is under 150 psig.

Manufactured and certified at:

Linde Gas LLC
Maumee Specialty Gas Plant
6421 Monclova Road
MAUMEE OH 43537
419-893-7226

Produced for customer:

LINDE GAS
LINDE PITTSBURGH INTERBRANCH
4349 WILLIAM PENN HWY
MURRYSVILLE PA 15668
724-327-1480

Material:	2179		**Blend Tolerance:**	5 % Relative
MISC 3 COMPONENT EPA		A31	**Blend Type:**	EPA Protocol
Production #:	100105201		**Cyl. Pressure:**	2000 psig
Lot #:	02499H5160ZB		**Balance Gas:**	Nitrogen
Cylinder #:	CC130116		**CGA:**	590
Expiration Date:	8/23/2008		**Analytical Accuracy:**	1.00 % Relative
Shelf Life:	36 months		**Confidence:**	95 %

CAS #	Certified Component	Requested Concentration	Concentration and Uncertainty	Date of Certification
7782-44-7	Oxygen	12	11.9 +/- 0.1 %	08/23/2005
124-38-9	Carbon Dioxide	18	17.7 +/- 0.2 %	08/23/2005
7727-37-9	Nitrogen		Balance	08/23/2005

CAS #	Reference Standard	Cylinder/Standard #	Concentration	Expire Date
7782-44-7	Oxygen	CC73283 , NTRM	20.89 %	10/02/2008
124-38-9	Carbon Dioxide	CC59228 , NTRM	19.91 %	08/01/2007

Instrument	Serial #	Analytical Principle	Calibration Date
Horiba VIA-510	568849043	Non-Dispersive Infrared	07/05/2005
Rosemount 755R	1000559	Paramagnetic	07/05/2005

All analyses are performed under controlled environmental conditions.This product is manufactured using equipment which has been calibrated with NIST traceable, or equivalent, standards, weights, or equipment.

Analytical report approved by Jennifer Carney

Jennifer Carney

EHQ Analysis Certificate

Certificate of Analysis

EPA Protocol

Performed according to EPA-600/R-97/121, Procedure G1

Notice: This Cylinder is not to be used when pressure is under 150 psig.

Manufactured and certified at:

Linde Gas LLC
Maumee Specialty Gas Plant
6421 Monclova Road
MAUMEE OH 43537
419-893-7226

Produced for customer:

LINDE GAS
LINDE PITTSBURGH INTERBRANCH
4349 WILLIAM PENN HWY
MURRYSVILLE PA 15668
724-327-1480

Material:	2179		**Blend Tolerance:**	5 % Relative
MISC 3 COMPONENT EPA		A31	**Blend Type:**	EPA Protocol
Production #:	100131977		**Cyl. Pressure:**	2000 psig
Lot #:	02499B7090ZD		**Balance Gas:**	Nitrogen
Cylinder #:	CC209107		**CGA:**	590
Expiration Date:	2/15/2010		**Analytical Accuracy:**	1.00 % Relative
Shelf Life:	36 months		**Confidence:**	95 %

CAS #	Certified Component	Requested Concentration	Concentration and Uncertainty	Date of Certification
124-38-9	Carbon Dioxide	10	9.84 +/- 0.10 %	02/15/2007
7782-44-7	Oxygen	22	22.0 +/- 0.2 %	02/15/2007
7727-37-9	Nitrogen		Balance	02/15/2007

CAS #	Reference Standard	Cylinder/Standard #	Concentration	Expire Date
124-38-9	Carbon Dioxide	CC59188 , NTRM 81674	6.900 %	10/02/2008
7782-44-7	Oxygen	CC73619 , NTRM	14.84 %	10/02/2008
7782-44-7	Oxygen	CC195913 , NTRM	20.90 %	01/01/2010
124-38-9	Carbon Dioxide	CC184889 , NTRM	19.66 %	05/01/2010

Instrument	Serial #	Analytical Principle	Calibration Date
Horiba VIA-510	568849043	Non-Dispersive Infrared	02/08/2007
Rosemount 755R	1000559	Paramagnetic	02/06/2007

All analyses are performed under controlled environmental conditions.This product is manufactured using equipment which has been calibrated with NIST traceable, or equivalent, standards, weights, or equipment.

Analytical report approved by Roy Yoder

Roy Yoder

Air/Compliance Consultants, Inc. (ACCI)
Thermocouple Calibration Data Sheet

Probe I.D.: 8P-1 ***Dry Gas Meter I.D.:*** 1618

Standard Used: Mercury Thermometer ***Temperature Scale:*** °F

Converted to: °R (Equation= 460 + °F result)

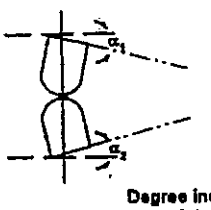
Post Test

Temperature Range	Reference Thermometer (°R)	Probe Thermometer (°R)	Absolute Temperature Difference
Ice Bath	492	493	.20%
Room Temp.	533	534	.18%
Hot Bath	1590	1587	.19%

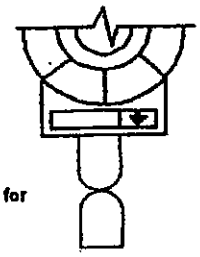
Criteria are:
Hot Bath Value within 10% of the average stack temperature measured.
The absolute temperature Difference within 1.5% of Reference Standard used.
Section 10.3.1 of USEPA Method 2

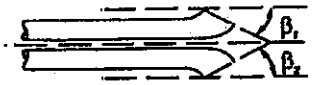
Checked by: _____ 4-11-08
(Signature / Date)

Air/Compliance Consultants, Inc. (ACCI)
Type S Pitot Tube Inspection Data Sheet

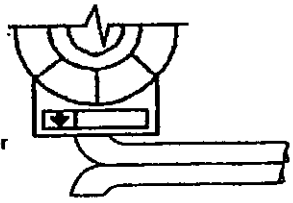


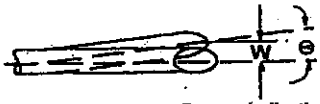
Degree indicating level position for determining α_1 and α_2.



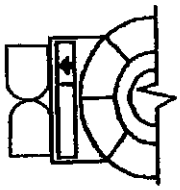


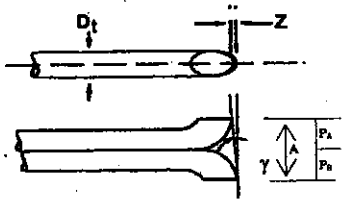
Degree indicating level position for determining β_1 and β_2.



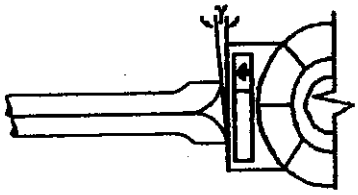


Degree indicating level position for determining Θ.





Degree indicating level position for determining γ then calculate Z.



Allowable Range/Parameter		*Value*
Level and perpendicular?		Y☒ N☐
Obstruction?		Y☐ N☒
Damaged?		Y☐ N☒
$\alpha 1$	$(-10° < \alpha 1 < +10°)$	0
$\alpha 2$	$(-10° < \alpha 2 < +10°)$	0
$\beta 1$	$(-5° < \beta 1 < +5°)$	0
$\beta 2$	$(-5° < \beta 2 < +5°)$	0
γ	$(-2° < \alpha 1 < +2°)$	0
θ	$(-1° < \alpha 1 < +1°)$	0
A	(for 1/4 " OD, 0.526 to 0.750 for 3/8" OD, 0.788 to 1.125)	1.005
Z =	A sin γ ($\leq$ 0.125")	0
W =	A sin θ ($\leq$ 0.03125")	0
P_A	(for 1/4 " OD, 0.263 to 0.375 for 3/8" OD, 0.394 to 0.563)	.510
P_B	(for 1/4 " OD, 0.263 to 0.375 for 3/8" OD, 0.394 to 0.563)	.505
$P_A - P_B$	(-0.063 to 0.063")	.005
D_T	(3/16" $\leq D_t \leq$ 3/8")	.375

Certification:

I certify that the Type S Pitot Tube/Probe ID# 8P-1 meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a Pitot tube calibration factor C_P of 0.84.

Checked by: Richard Willen 4.10.09
(Signature / Date)

Air Compliance Consultants, Inc.
EPA Method 5
Meter Box Calibration
Pre-Test Orifice Method
English Meter Box Units, English K' Factor

Model #: C-5000
Serial #: 1618

Date: ----------> 02/12/08 60.00
Barometric Pressure: ----------> 29.23 (in. Hg)
Theoretical Critical Vacuum:--> 13.79 (in. Hg)

!!!!!!!!!
IMPORTANT For valid test results, the Actual Vacuum should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above.
IMPORTANT The Critical Orifice Coefficient, K', must be entered in English units, (ft)^3*(deg R)^0.5/((in.Hg)*(min)).
!!!!!!!!!

DRY GAS METER READINGS									-CRITICAL ORIFICE READINGS-					
					Initial Temps.		Final Temps.					– Ambient Temperature –		
dH (in H2O)	Time (min)	Volume Initial (cu ft)	Volume Final (cu ft)	Volume Total (cu ft)	Inlet (deg F)	Outlet (deg F)	Inlet (deg F)	Outlet (deg F)	Orifice Serial# (number)	K' Orifice Coefficient (see above)	Actual Vacuum (in Hg)	Initial (deg F)	Final (deg F)	Average (deg F)
0.54	15.00	469.510	475.705	6.195	64.0	62.0	64.0	62.0	47	0.3219	22.5	62.0	62.0	62.0
1.00	10.00	488.254	493.911	5.657	68.0	63.0	64.0	63.0	55	0.4366	21.0	62.0	61.0	61.5
1.70	20.00	454.857	469.462	14.605	62.0	61.0	64.0	62.0	63	0.5687	20.0	61.0	61.0	61.0
3.20	10.00	494.025	504.086	10.061	64.0	63.0	64.0	62.0	73	0.7813	17.0	61.0	61.0	61.0
4.65	10.00	476.108	486.204	12.096	64.0	62.0	69.0	63.0	81	0.9438	15.0	62.0	62.0	62.0

********** RESULTS **********

-- DRY GAS METER -- VOLUME CORRECTED	
Vm(std) (cu ft)	Vm(std) (liters)
6.116	173.2
5.575	157.9
14.481	410.1
9.994	283.0
12.030	340.7

------ ORIFICE ------		
VOLUME CORRECTED		VOLUME NOMINAL
Vcr(std) (cu ft)	Vcr(std) (liters)	Vcr (cu ft)
6.177	174.9	6.254
5.588	158.3	5.652
14.565	412.5	14.717
10.005	283.3	10.110
12.075	342.0	12.224

-- DRY GAS METER -- CALIBRATION FACTOR	
Y Value (number)	Variation (number)
1.010	0.005
1.002	-0.002
1.006	0.001
1.001	-0.003
1.004	-0.001
Avg Y--> 1.005	

------- ORIFICE ------- CALIBRATION FACTOR		
dH@		
Value (in H2O)	Value (mm H2O)	Variation (in H2O)
1.814	46.07	-0.002
1.817	46.16	0.001
1.821	46.25	0.005
1.812	46.03	-0.003
1.815	46.11	-0.001
Avg dH@--> 1.816	46.12	

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

For Orifice Calibration Factor dH@, the orifice differential pressure in inches of H20 that equates to 0.75 cfm of air at 68 F and 29.92 inches of Hg, acceptable tolerance of individual values from the average is +-0.2.

SIGNED: _____ Date: 2/12/08

C:\Documents and Settings\Todd Haas\Desktop\Meterbox Calibrations\2008\1618\02-12-08

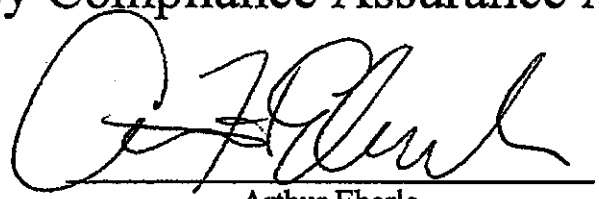
Compliance Assurance Associates, Inc.

Helping Industry Comply with Environmental Regulations

This is to acknowledge that

MATTHEW PALLADINO
PIT080320-2041

successfully participated in Visible Emissions Evaluation field training on March 20, 2008, and is qualified pursuant to US EPA 40 CFR 60 Appendix A, Reference Method 9 as amended to evaluate Visible Emissions for a period of six (6) months from the date of this certification, by Compliance Assurance Associates, Inc.



March 20, 2008	Arthur Eberle	Pittsburgh, PA
Date	President	Location

APPENDIX F

Sample Calculations

ACCI SAMPLE CALCULATIONS
Flow, Moisture, CEMS
URC
08-065
Warren, PA
SRU -2
nmoc
April 10, 2008
Exhaust
Run 1

Vf	226.0	ml	Tstandard	68	F
Vi	200.0	ml	Pstandard	760	mm Hg
Wf	257.7	g	K1method 4	0.04706	scf/ml
Wi	250.6	g	K2method 4	0.04715	scf/g
Vm	22.502	dacf	K1method 5	17.64	R/in. Hg
Vm	0.000	dry actual liters	K4method 5	0.0945	
Yd	1.0050		$V/n_{standard}$	385.3	ft3/lb-mole
Pbar	29.30	in. Hg	Kp	85.49	
dHavg	1.80	in. H2O	π	3.141593	
Tm	51.4	F	Ds (or L)	70.00	inches
O2	5.77	% dv	Stack Width (W)	NA	inches
CO2	4.97	% dv	Tsavg	1149.9	F
Pg	-0.37	in. H2O	Product rate	NA	ton/hr
Cp	0.84		F_d	na	dscf/MMBtu
$(dP)^{1/2}avg$	0.103	in. H2O^1/2			

CEMS DATA					
Sulfur Dioxide			Carbon Monoxide		
$Caverage_{SO2}$	87.78	ppmdv	$Caverage_{CO}$	290.1	ppmdv
C_{0SO2}	0.65	ppmdv	C_{0CO}	-0.6	ppmdv
Cma_{SO2}	51.60	ppmdv	Cma_{CO}	302.0	ppmdv
Cm_{SO2}	50.00	ppmdv	Cm_{CO}	310.3	ppmdv
MW SO2	64.0	lb/lb-mole	MW CO	28.0	lb/lb-mole

1. Volume of Water Vapor Condensed (Vwc) (USEPA Method 4, Eq. 4-1)

Vwc(std) = K1method 4 * (Vf - Vi)

K1method 4=	0.04706 scf/ml
Vf=	226.0 ml
Vi=	200.0 ml
Vwc(std)=	1.224 scf

2. Volume of Water Vapor Collected in Silica Gel (Vwsg) (USEPA Method 4, Eq. 4-2)

Vwsg(std) = K2method 4 * (Wf - Wi)

K2method 4=	0.04715 scf/g
Wf=	257.7 g
Wi=	250.6 g
Vwsg(std)=	0.335 scf

3. Total Volume of Water Vapor in Gas Sample (Vw)

Vw(std) = Vwc(std) + Vwsg(std)

Vwc(std)=	1.224 scf
Vwsg(std)=	0.335 scf
Vw(std)=	1.558 scf

4. Volume of Gas Metered

Vm = Volume metered in dacf + Volume metred in dry actual liters * (1 cf / 28.317 liters)

Volume metered in dacf=		22.502 dacf
Volume metered in dry actual liters=		0.000 dry actual liters
Vm=	22.502 dacf	

$Vm(m^3)$ = Vm * (1 m^3 / 35.3145 cf)

Vm=	22.502 dacf
$Vm(m^3)$=	0.637 dacm

5. Volume of Gas Metered , dry basis, STD (USEPA Method 5, Eq. 5-1)

Vm(std) = (K1method 5 * Vm * Yd * (Pbar + (dHavg/13.6))) / (Tm + 460)

K1method 5=	17.64 R/in. Hg
Vm=	22.502 dacf
Yd=	1.0050
Pbar=	29.30 in. Hg
dHavg=	1.80 in. H2O
Tm=	51.4 F
Vm(std)=	22.958 dscf

$Vm(std)m^3$ = Vm(std) * (1 m^3 / 35.3145 cf)

Vm(std)=	22.958 dscf
$Vm(std)m^3$=	0.650 dscm

6. Water Vapor in the Gas Stream (USEPA Method 5, Eq. 5-3 and NOTE:)

Bws used = the lower of $SP_{H2O@Tsavg}$ / Ps
and Vw(std) / (Vm(std) + Vw(std))

Bws = $SP_{H2O@Tsavg}$ / Ps With a maximum allowable value of 1.0

$SP_{H2O@Tsavg}$ = The saturation pressure of water at stack temperature
1997 ASHRAE Handbook page 6.2 Eq. (6)
EXP(C8/T + C9 +C10*T + C11*T^2 + C12*T^3 + C13*ln(T)) * (29.921/14.696)

T = Tsavg + 459.67

Tsavg=	1149.9 F
T=	1609.5 R
C8=	-1.044040E+04
C9=	-1.1294650E+01
C10=	-2.702236E-02
C11=	1.289036E-05
C12=	-2.478068E-09
C13=	6.545967E+00
$SP_{H2O@Tsavg}$=	50559.21 in. Hg
Ps=	29.27 in. Hg
Bws=	1.0000 vol. fraction

Bws = Vw(std) / (Vm(std) + Vw(std))

Vw(std)=	1.558 scf
Vm(std)=	22.958 dscf
Bws=	0.0636 vol. fraction
Bws used=	0.0636 vol. fraction

7. Carbon Monoxide and Nitrogen in gas

CO + N2 = 100 - (CO2 + O2)

CO2=	4.97 % dv
O2=	5.77 % dv
CO + N2=	89.26 % dv

8. Molecular weight of dry gas stream (USEPA Method 3, Eq. 3-1)

Md = 0.44 * CO2 %dv + 0.32 * O2 %dv + 0.28 * (CO + N2 %dv)

CO2=	4.97	% dv
O2=	5.77	% dv
CO + N2=	89.26	% dv
Md=	29.03	lb/lb-mole

9. Molecular weight of wet gas stream (USEPA Method 2, Eq. 2-5)

Ms = Md * (1 - Bws) + 18 * Bws

Md=	29.03	lb/lb-mole
Bws=	0.0636	vol. fraction
Ms=	28.33	lb/lb-mole

10. Stack Pressure (USEPA Method 2, Eq. 2-6)

Ps = Pbar + Pg/13.6

Pbar=	29.30	in. Hg
Pg=	-0.37	in. H2O
Ps=	29.27	in. Hg

11. Average Stack Gas Velocity (USEPA Method 2, Eq. 2-9)

Vs = Kp * Cp * $(dP)^{1/2}$avg * ((Tsavg + 460) / (Ps * Ms))^1/2

Kp=	85.49	
Cp=	0.84	
$(dP)^{1/2}$avg=	0.1026	in. H2O^1/2
Tsavg=	1149.9	F
Ps=	29.27	in. Hg
Ms=	28.33	lb/lb-mole
Vs=	10.27	ft/s

12. Area of the Stack

If W = 0, the stack is circular.

Circular

As = PI * (Ds)^2 / 4 * (1 ft / 12 in.)^2

PI=	3.141593	
Ds=	70.00	inches
As=	26.73	ft2

Rectangular

As = L * W * (1 ft / 12 in.)^2

L=	0.00	inches
W=	NA	inches
As=	0.00	ft2

13. Stack Gas Flow Rate, Actual (USEPA Method 2, Eq. 2-10)

Qacfm = Vs * As * 60

Vs=	10.27	ft/s
As=	26.73	ft2
Qacfm=	16,461	acfm

Qacm/min = Qacfm * (1 m^3 / 35.3145 cf)

Qacfm=	16,461	acfm
Qacm/min=	466	acm/min

14. Stack Gas Flow Rate, Standard (USEPA Method 2, Eq. 2-10)

Qscfm = Qacfm * ((Tstandard + 460) / (Tsavg + 460)) * (Ps / Pstandard)

Qacfm=	16,461	acfm
Tstandard=	68	F
Tsavg=	1149.9	F
Ps=	29.27	in. Hg
Pstandard=	29.92	in. Hg
Qscfm=	5,282	scfm

Qscm/min = Qscfm * (1 m^3 / 35.3145 cf)

Qscfm=	5,282	scfm
Qscm/min=	150	scm/min

15. Stack Gas Flow Rate, Dry Standard (USEPA Method 2, Eq. 2-10)

Qdscfm = Qscfm * (1 - Bws)

Qscfm=	5,282	scfm
Bws=	0.0636	vol. fraction
Qdscfm=	4,946	dscfm

Qdscm/min = Qdscfm * (1 m^3 / 35.3145 cf)

Qdscfm=	4,946	dscfm
Qdscm/min=	140	dscm/min

16. Heat Input (HI) (MMBtu/hr)

HI = Qscfm * 60 * ((100 - Bws) / F_d) * ((20.9 - O2) / 20.9) (USEPA Part 75, Appendix F, Eq. F-18)

Qscfm=	5,282	scfm
Bws=	0.0636	vol. fraction
F_d=	na	dscf/MMBtu
O2=	5.77	% dv
HI=	NA	MMBtu/hr

17. Sulfur dioxide concentration (ppmdv) (USEPA Method 6C, Eq. 6C-1)

C_{SO2} = ($Caverage_{SO2}$ - C_{0SO2}) * Cma_{SO2} / (Cm_{SO2} - C_{0SO2})

$Caverage_{SO2}$=	87.78	ppmdv
C_{0SO2}=	0.65	ppmdv
Cma_{SO2}=	51.60	ppmdv
Cm_{SO2}=	50.00	ppmdv
C_{SO2}=	91.10	ppmdv

18. Sulfur dioxide concentration @ 0.0 % O2

SO2corrected = C_{SO2} * (20.9 - $O2_{SO2correction}$) / (20.9 - O2)

C_{SO2}=	91.10	ppmdv
$O2_{SO2correction}$=	0.0	0.0
O2=	5.77	% dv
SO2corrected=	125.82	ppmdv

19. Sulfur dioxide emission rate (lb/hr)

SO2(lb/hr) = C_{SO2} / 1,000,000 * Qdscfm * (60 min / 1 hour) / $V/n_{standard}$ * $SO2_{MW}$

C_{SO2}=	91.10	ppmdv
Qdscfm=	4,946	dscfm
$V/n_{standard}$=	385.3	ft3/lb-mole
$SO2_{MW}$=	64.0	lb/lb-mole
SO2(lb/hr)=	4.49	lb/hr

20. Sulfur dioxide emission rate (lb/MM Btu)

SO2(lb/MM Btu) = SO2(lb/hr) / heat input (MM Btu/hr)

SO2(lb/hr)=	4.49	lb/hr
Heat input=	NA	MMBtu/hr
SO2(lb/MM Btu)=	na	lb/MM Btu

21. Sulfur Dioxide Emission Rate (lb/ton of product)

SO2(lb/ton) = SO2(lb/hr) / Product(tph)

SO2(lb/hr)=	4.49	lb/hr
Product(tph)=	NA	ton/hr
SO2(lb/ton)=	NA	lb/ton

27. Carbon Monoxide concentration (ppmdv) (USEPA Method 6C, Eq. 6C-1)

$C_{CO} = (Caverage_{CO} - C0_{CO}) * Cma_{CO} / (Cm_{CO} - C0_{CO})$

$Caverage_{CO}$=	290.13	ppmdv
$C0_{CO}$=	-0.60	ppmdv
Cma_{CO}=	302.00	ppmdv
Cm_{CO}=	310.30	ppmdv
C_{CO}=	282.41	ppmdv

28. Carbon Monoxide Concentration @ 0.0 % O2

$CO = C_{CO} * (20.9 - O2_{COcorrection}) / (20.9 - O_2)$

C_{CO}=	282.41	ppmdv
$O2_{COcorrection}$=	0.0	% O2
O2=	5.77	% dv
COcorrected=	390.04	ppmdv

29. Carbon Monoxide emission rate (lb/hr)

$CO(lb/hr) = C_{CO} / 1{,}000{,}000 * Qdscfm * (60 \text{ min} / 1 \text{ hour}) / V/n_{standard} * CO_{MW}$

C_{CO}=	282.41	ppmdv
Qdscfm=	4,946	dscfm
$V/n_{standard}$=	385.3	ft3/lb-mole
COMW=	28.0	lb/lb-mole
CO(lb/hr)=	6.09	lb/hr

30. Carbon Monoxide emission rate (lb/MM Btu)

CO(lb/MM Btu) = CO(lb/hr) / heat input (MM Btu/hr)

CO(lb/hr)=	6.09	lb/hr
Heat input=	NA	MMBtu/hr
CO(lb/MM Btu)=	na	lb/MM Btu

31. Carbon Monoxide Emission Rate (lb/ton of product)

CO(lb/ton) = CO(lb/hr) / Product(tph)

CO(lb/hr)=	6.09	lb/hr
Product(tph)=	NA	ton/hr
CO(lb/ton)=	NA	lb/ton

Nomenclature

NOMENCLATURE

SYMBOL		DESCRIPTION
ACFM	-	Actual cubic feet per minute
A_s	-	Stack Area
AB	-	Acetone Blank
AB1	-	Acetone Blank Tare Weight 1
AB2	-	Acetone Blank Tare Weight 2
ABF1	-	Acetone Blank Final Weight 1
ABF2	-	Acetone Blank Final Weight 2
AT1	-	Acetone Rinse Tare Weight 1
AT2	-	Acetone Rinse Tare Weight 2
A_n	-	Nozzle Area
B_{wo}	-	Moisture content of sample gas, measured impinger collection
B_{ws}	-	Moisture content of sample gas, wet saturated
BTU	-	British Thermal Units
C	-	Carbon
C_3H_8	-	Propane
Ca	-	Acetone Blank Correction
C_M	-	Average of initial and final system calibration bias check responses for the upscale gas, ppm
cf	-	Cubic foot
C_{MA}	-	Actual concentration of the upscale calibration gas, ppm
C_d	-	Concentration of Particulate Emissions
C_O	-	Average of initial and final system calibration bias check responses for the zero gas, ppm
CO	-	Carbon monoxide
CO_2	-	Carbon dioxide
C_p	-	Pitot co-efficient, 0.84 for S-type, 0.99 for standard (English units)
E_{NOX}	-	Emission rate of Oxides of nitrogen as NO2, lb/hr
DACF	-	Dry actual cubic feet
DSCF	-	Dry standard cubic feet
DACM	-	Dry actual cubic meters
DSCFM	-	Dry standard cubic feet per minute
dscf/MMBtu	-	Dry standard cubic feet per Million British Thermal Units (units for Fd)
D_S	-	Stack diameter
D_N	-	Nozzle diameter
°F	-	Degrees Fahrenheit
ft	-	foot
F1	-	Filter Final Weight 1
F2	-	Filter Final Weight 2
FT1	-	Filter Tare Weight 1
FT2	-	Filter Tare Weight 2
F_c	-	CO2 based F-Factor for natural gas (1,040 SCF/MMBtu)
F_d	-	F-factor
Ft^2	-	Square feet
Ft^3	-	Cubic feet
FTIR	-	Fourier Transform Infrared
ft^3/lb-mole	-	Cubic feet per pound mole
ft/sec	-	Feet per second
g	-	Grams
g/mL	-	Gram per milliliter
gr/DSCF	-	Grains per dry standard cubic feet

HI	-	Heat Input
ΔH_{avg}	-	Average pressure drop across the meter box during test run, inches H2O
H_2O	-	Water
Hg	-	Mercury
hr	-	Hour
in Hg	-	Inches of Mercury
in H_2O	-	Inches of Water
$\sqrt{inH_2O}$	-	Square root of Inches of Water
I	-	Isokinetic Sampling
K1 method 5	-	Conversion to standard conditions, 17.64 °R/inches Hg
K1 method 4	-	Conversion to standard conditions, 0.04707 f3/ml
K2 method 4	-	Conversion to standard conditions, 0.04715 ft3/g
K4 method 5	-	Conversion to standard conditions, 0.0945
K_p	-	Pitot tube constant, 85.49 for English units
Kg	-	Killograms
L	-	Length of Stack if Rectangular
lb	-	Pound
lb/lb-mole	-	Pound per pound mole
lb-mole	-	Pound mole
lb/hr	-	Pound per hour
lb/MMBTU	-	Pound per million British thermal units
ma	-	Average Final (total) weight after evaporation - Average Tare Weigth of Acetone Blank
m^3	-	Cubic meters
mg	-	Milligrams
mg/g	-	Milligrams per gram
mL	-	Milliliter
M_d	-	Molecular weight of stack gas mixture, dry basis
MMBTU	-	Million British Thermal Units
MMBtu/hr	-	Million British Thermal Units per hour
mm HG	-	Millimeters of Mercury
M_n	-	Mass of particulate matter, g
M_s	-	Molecular weight of stack gas mixture, wet basis
M_{SAT}	-	Ratio of vapor pressure of water at stack conditions to stack pressure
M_W	-	Molecular weight of a specific compound or element
N_2	-	Nitrogen
O_2	-	Oxygen
ng	-	Nanograms
NMNEVOC	-	Non-Methane, Non-Ethane Volatile Organic Compounds
NO_x	-	Oxides of Nitrogen
NO_2	-	Nitrous Oxide
%	-	Percent
% Volume	-	Percent by volume
% dv	-	Percent by volume, dry basis
ΔP	-	Gas velocity pressure, in H2O
P_a	-	Density of Acetone
P_{BAR}	-	Barometric pressure, in H2O
P_S	-	Static Pressure, in H2O
P_g	-	Total pressure of gas at stack conditions
P_{STD}	-	Standard pressure, 760 mmHG
$\sqrt{(P)_{avg}}$	-	Averag of the square root of gas velocity pressure, in H2O
ppm_{dv}	-	Parts per million, volume and dry basis
ppb_{dv}	-	Parts per billion, volume and dry basis
Q_{ACFM}	-	Flow rate of stack gas, actual cubic feet per minute
Q_{SCFM}	-	Flow rate of stack gas, standard cubic feet per minute
Q_{DSCFM}	-	Flow rate of stack gas, dry standard cubic feet per minute

°R	-	Degrees Rankin
°R/in. Hg	-	Degrees Rankin per inches of Mercury
scf/ml	-	Standard cubic feet per milliliter
scf/g	-	Standard cubic feet per gram
SCFM	-	Standard cubic feet per minute
SCM	-	Standard cubic meters
SCF	-	Standard cubic feet
$SP_{H2O@Tavg}$	-	Saturation pressure of water at average stack temperature
STD	-	Standard
s	-	Second
T	-	Stack Temperature
tph	-	Tons per hour
ton/yr	-	Tons per year
T_M	-	Temperature of the dry gas meter
T_S	-	Temperature of the stack
T_{STD}	-	Standard temperature, 68 °F
THC	-	Total Hydrocarbons
ug	-	Micrograms
Va	-	Volume of Acetone Blank, in mL
Vaw	-	Volume of Acetone Rinse, in mL
vol.	-	Volume
V/n_{std}	-	Volume mole in standard conditions, in cubic feet per pound mole
V_{lc}	-	Total volume of water vapor condensed, at STP
V_m	-	Volume of sample gas measured by the dry gas meter
V_{MSTD}	-	Volume of sample gas measured by the dry gas meter, corrrected to standard conditions
VOC	-	Volatile Organic Compounds
V_S	-	Velocity of stack gas, ft/s
$V_{Wc(std)}$	-	Volume of water condensed, corrected to standard conditions
$V_{Wsg(std)}$	-	Volume of water collected in silica gel, corrected to standard conditions
$V_{W(std)}$	-	Volume of water vapor in gas stream, corrected to standard conditions
Y_d	-	Dry gas meter calibration factor
V_f	-	Final volume of water
V_i	-	Initial volume of water
W1	-	Acetone Rinse Final Weight 1
W2	-	Acetone Rinse Final Weight 2
W	-	Width of Stack if Rectangular
Wa	-	Weight of Acetone
W_f	-	Final weight
W_i	-	Initial weight