Prepared for:

Shell Oil Products US
17 Junction Drive
PMB#299
Glen Carbon, Illinois 62034

Regenerative Thermal Oxidizer Performance Testing Work Plan

Roxana, Illinois

Prepared by:

Geosyntec consultants

engineers | scientists | innovators

924 Anacapa Street, Suite 4A
Santa Barbara, CA 93101

Project Number: SB0659

June 14, 2013

SVE Regenerative Thermal Oxidizer Performance Testing Work Plan

Roxana, Illinois

Prepared for:

Shell Oil Products US

Kate Graf
Senior Consultant

Robert Ettinger
Principal

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1.0 INTRODUCTION

Geosyntec Consultants (Geosyntec) has been retained by Shell Oil Products US (SOPUS) to arrange for and oversee stack testing required by the Illinois Environmental Protection Agency (IEPA). SOPUS operates a soil vapor extraction (SVE) system at a corrective action site located in the Village of Roxana, in Madison County, Illinois. The SVE system uses a blower to extract soil gas from the ground where it is passed through a knockout tank which extracts the condensate from the gas stream. The gas stream is then conveyed to a natural gas fired regenerative thermal oxidizer (RTO) to destroy hydrocarbon constituents prior to emissions. The RTO operates under an IEPA permit number 11060036 issued on July 14, 2011.

In a letter dated April 12, 2013, the IEPA requested SOPUS conduct emission testing to measure benzene and volatile organic matter (VOM) emissions at the inlet and outlet of the RTO during operation of the SVE. The testing will be conducted at a range of combustion chamber temperatures based on minimum, normal, and maximum combustion chamber temperatures for the RTO since operation began. The testing will include operating the RTO at three (3) set points to vary the combustion chamber temperatures. The set points to be tested include 1500°F, 1550°F, and 1650°F. Per IEPA, the testing is being conducted to establish the minimum acceptable temperature for the combustion chamber that will ensure compliance with the permitted emission limits, applicable emission standards, and regulatory requirements.

2.0 RTO DESCRIPTION

The RTO is located on the southwestern boundary of the Phillips 66 Wood River Refinery North Property, near the corner of Chaffer Street and 8th Street in the Village of Roxana. The RTO is an Anguil Environmental system designed to treat 10,000 standard cubic feet per minute (SCFM). The hydrocarbon mass loading rate for the inlet to the RTO is expected to be 75 to 100 lb/hr, with an outlet hydrocarbon emission rate of 2 to 5 lb/hr. The general arrangement drawing for the RTO is provided in the Attachment A.

3.0 PERFORMANCE TEST PROCEDURES

The testing will include three (3) operating scenarios (maximum temperature, normal operating temperature, and minimum temperature). During testing the SVE system will be operating. The testing shall be conducted at the inlet and outlet locations simultaneously. During testing parametric monitoring will be conducted to monitor inlet and outlet temperature. Testing at each location will be conducted in accordance with the following United States Environmental Protection Agency (USEPA) Reference Methods:

Parameter	**Test Method**	**Procedure**	**Number of Runs**
Traverse Points	USEPA Method 1	Linear Measurements	1
Volumetric Airflow	USEPA Method 2	Pitot Tube	3
Gas Composition O_2 and CO_2	USEPA Method 3A	Instrumental Analyzer	3
Moisture Content	USEPA Method 4	Impinger Condensate	3
Benzene	USEPA Method 18	Tedlar Bag and GC/MS	3
Total Hydrocarbons	USEPA Method 25A	Instrumental Analyzer - FID	3

Stack testing will be performed by Pace Analytical Field Services Division (Pace). Pace adheres to the ASTM D7036-04 Standard Practice for Competence of Air Emission Testing Bodies and has an interim accreditation with the Source Testing Accreditation Council. The attached test protocol from Pace provides additional information on Pace's experience and details of the planned stack testing.

4.0 REPORTING

Within 60 days of completion of the RTO performance test, Geosyntec will submit a test report to IEPA. The test report will include a summary table of test results and the identification, location, and description of the emission units tested, as well as the names of the testing firm, personnel performing testing, and agency personnel observing testing. The report will provide a description of test procedures utilized in testing, description of the sampling locations, map of sample points, and details of the testing and analysis equipment used. The SVE operating conditions, RTO operating conditions, raw data sheets, laboratory analysis, calculations, equipment calibration information, quality control evaluation data, and an explanation of any discrepancies or anomalies in the test data will be included in the test report.

5.0 SCHEDULE

The proposed schedule for the testing and submittal of a test report to the IEPA is as follows:

- Five (5) Days Prior to Testing: Confirm the exact date and time of the testing with IEPA to enable IEPA representatives to witness the test.
- Week of June 17, 2013: Conduct Emission Testing (within 90 days from receipt of letter requesting testing). We anticipate 2 – 3 days are necessary to conduct the field activities associated with the emission testing.
- Within 30 Days of the Test Date: Obtain test results from stack testing firm
- Within 60 Days of the Test Date: Submit test results to IEPA

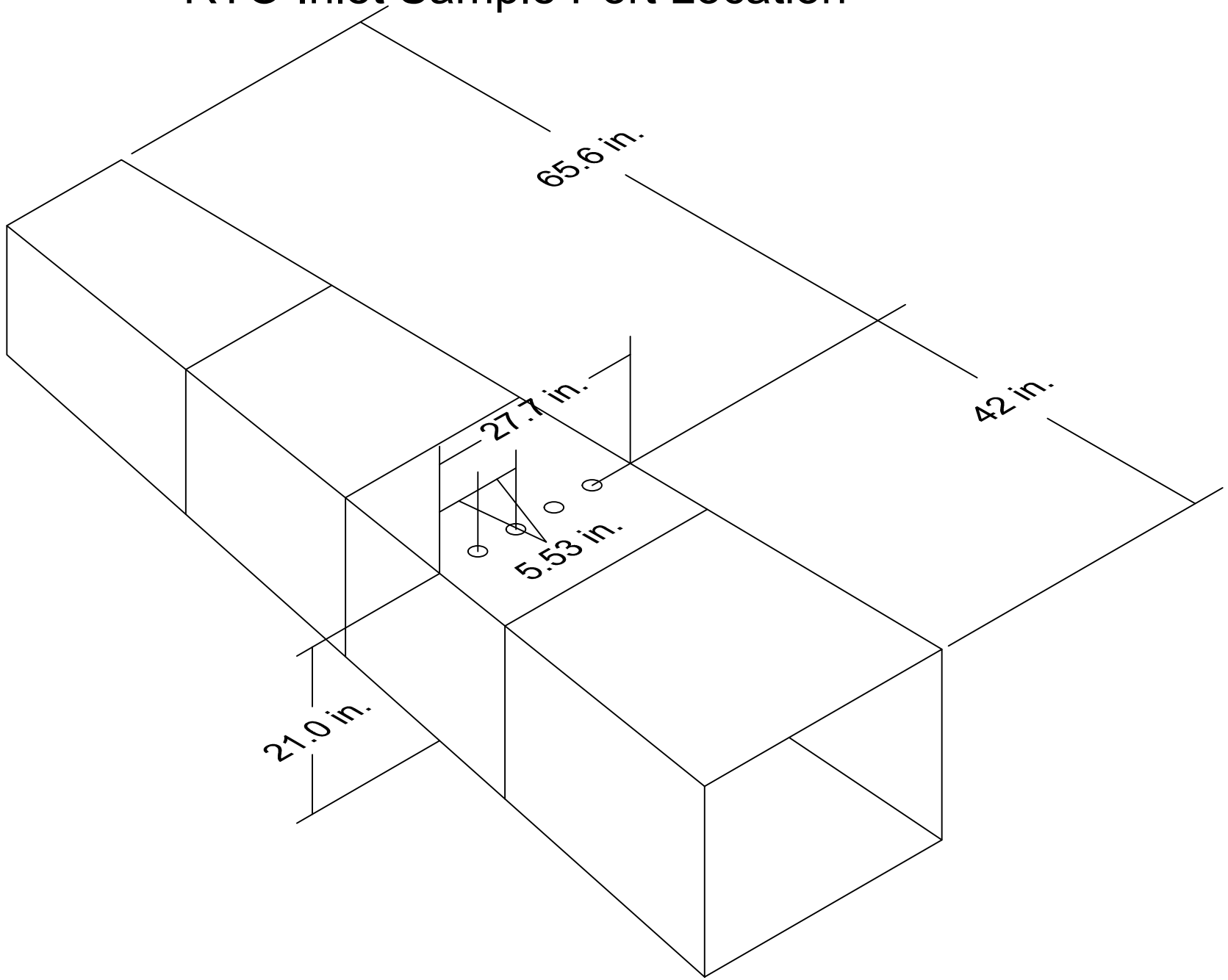
Geosyntec would like to conduct the performance test the week of 24 June 2013. The testing dates are dependent on (i) written approval from the Compliance Section Manager (ii) coordination with Phillips 66 refinery, and (iii) confirmation of availability with the stack testing firm.

APPENDIX A

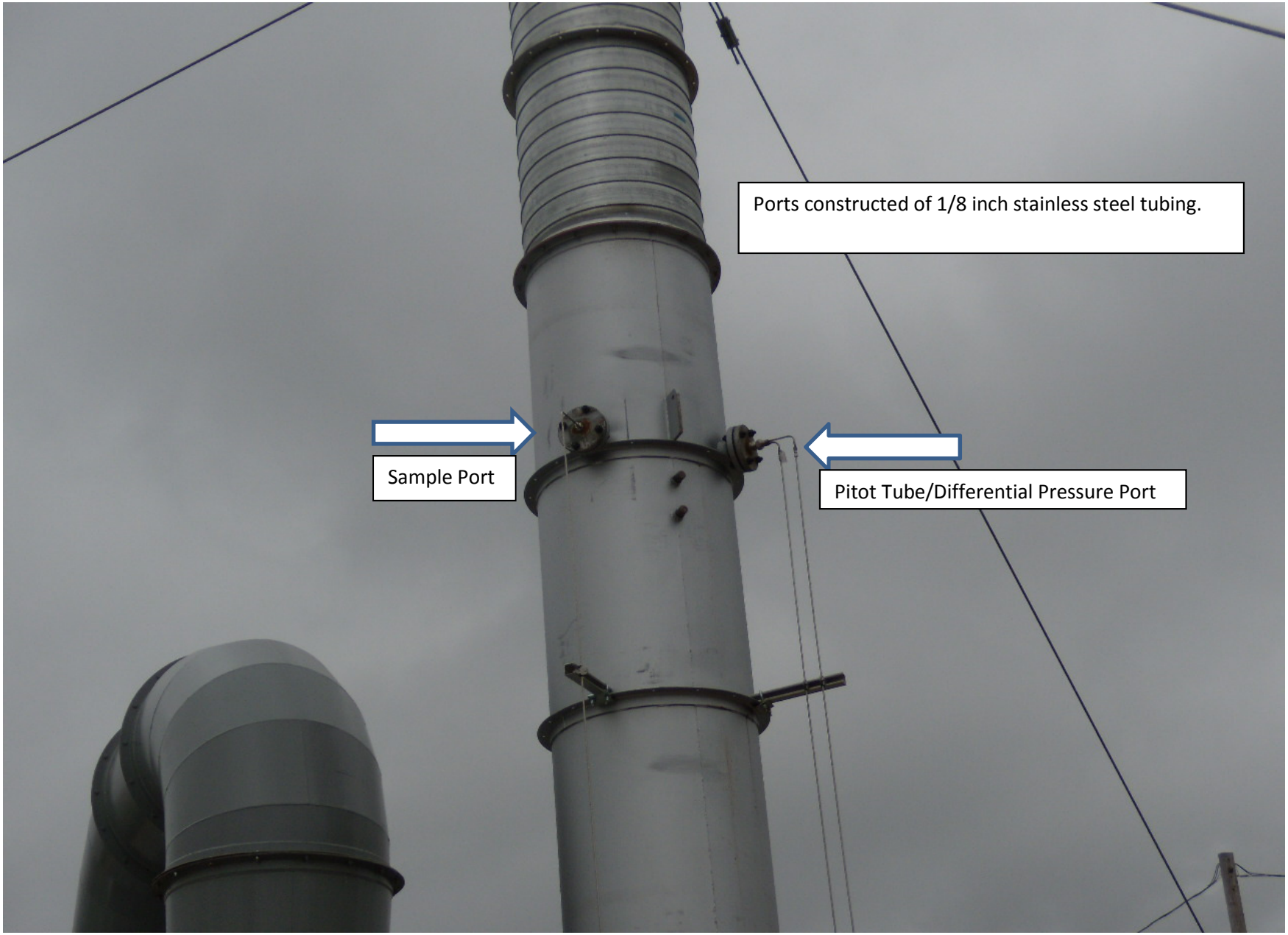
INLET AND OUTLET SAMPLING LOCATION DETAILS

Inlet Sampling Location

RTO Inlet Sample Port Location



Outlet Sampling Location



APPENDIX B

PACE TEST PROTOCOL

Pace Analytical Services, Inc.
1700 Elm Street
Minneapolis, MN 55414
Phone: 612.607.1700
Fax: 612.607.6388
www.pacelabs.com

Total Hydrocarbons and Benzene Emissions Testing Protocol

Plant Name: Conoco Phillips
Wood River Refinery
Protocol Date: May 31, 2013
Revision Date: June 14, 2013
Testing Dates: June 25-26, 2013

Subject Facility:
Conoco Phillips
Wood River Refinery
900 South Central Avenue
Roxana, IL 62084

Regulatory Permit No.:

Subject Emission Sources:
Vapor Extraction System

Test Locations:
RTO Inlet
RTO Outlet

Client Test Coordinator:

Kate Graf
Geosyntec Consultants
1787 Sentry Parkway West
Building 18, Suite 120
Blue Bell, PA 19422
Telephone No.: (267) 419-3103
Facsimile No.: (267) 401-1554
E-mail Address: kgraf@geosyntec.com

Testing Firm Coordinator:

Paul Robinson
Pace Analytical Services, Inc.
1700 Elm Street, Suite 200
Minneapolis, MN 55414
Telephone No.: (612) 607-6432
Facsimile No.: (612) 607-6388
E-mail Address: paul.robinson@pacelabs.com

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Plant/Source Information

Subject Facility:	Conoco Phillips Wood River Refinery 900 South Central Avenue Roxana, IL 62084
Plant Contact:	Kate Graf
Company Affiliation:	Geosyntec Consultants/Conoco Phillips
Office Address:	900 South Central Avenue Roxana, IL 62084
Telephone Number:	(267) 419-3103
Facsimile Number:	(267) 401-1554
E-mail Address:	kgraf@geosyntec.com
Reason for Test:	Emissions Permit Requirement

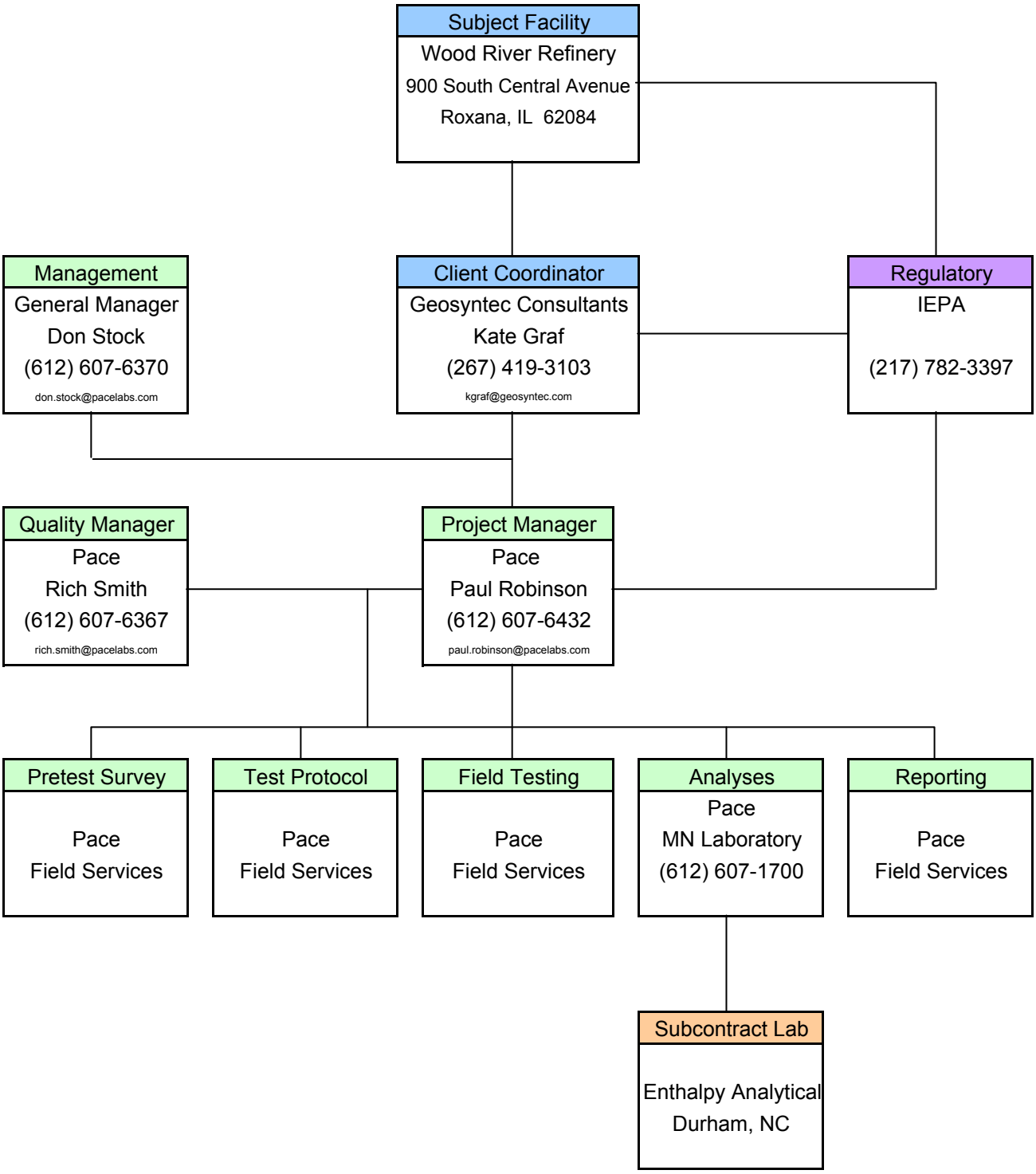
Testing Firm Information

Project Contact:	Paul Robinson
Testing Firm:	Pace Analytical Services, Inc.
Office Location:	1700 Elm Street, Suite 200 Minneapolis, MN 55414
Telephone Number:	(612) 607-6432
Facsimile Number:	(612) 607-6388
E-mail Address	paul.robinson@pacelabs.com
Subcontractors:	Enthalpy Analytical

Regulatory Contact Information

Regulatory Agency:	Illinois Environmental Protection Agency
Testing Contact:	
Office Location:	1021 North Grand Avenue East P.O. Box 19276 Springfield, IL 62794
Telephone Number:	(217) 782-3397
Facsimile Number:	
E-mail Address	

Project Organization



Note: Chart based on anticipated participants at the time of protocol development and is subject to change.

Facility and Process Description

Target Operating Conditions:Minimum, Normal, Maximum Temperature Conditions

The confidential client operates a soil vapor extraction system (SVE) which uses a blower to extract soil gas from the ground where it is passed through a knockout tank to extracts the condensate from the gas stream. The gas stream is conveyed to a natural gas fired regenerative thermal oxidizer (RTO) to destroy hydrocarbon constituents. The RTO manufacturer is Anguil Environmental and designed to treat 10,000 standard cubic feet per minute (SCFM). The hydrocarbon emission rate on the inlet to the RTO is expected to be 75 to 100 lb/hr, with an outlet hydrocarbon emission rate of 2 to 5 lb/hr.

For this test event three (3) operating scenarios (maximum temperature, normal operating temperature, and minimum temperature) will be set on the RTO to establish the minimum acceptable temperature for the RTO. The RTO combustion temperature set points for this test event will be:

- Test 1 – 1500F
- Test 2 – 1550F
- Test 3 – 1650F

Operation data will be collected during the test event and included in the test report.

Testing Schedule

Plant operations will begin preparing the process for the target operating conditions in the early morning of Tuesday, June 25th, 2013. At approximately 0800 hours, the test team will contact the plant coordinator to verify operation at target conditions. If the plant processes and test equipment are ready, sampling will commence shortly thereafter.

Testing is presently planned for the following schedule:

Monday	Tuesday	Wednesday	Thursday	Friday
6/24/13	6/25/13	6/26/13	6/27/13	
Travel	Set up/Test	Test	Contingency	

The final test report will be submitted to the Illinois Environmental Protection Agency within 60 days of the completion of testing. In cases where multiple sources are tested during a single mobilization, the last day of testing will dictate the start of the 60 days. All sources evaluated during a mobilization will be summarized in a single report.

RTO Inlet
Testing Requirements

Emissions Testing Constituents				
Source No.	**Source Identification**	**Regulated Constituents**	**Applicable Rules or Regulations**	**Emission Limits**
	RTO Inlet	Total Hydrocarbons	NA	To be determined
		Benzene	NA	To be determined

Process Monitoring Parameters			
Source No.	**Process Parameter**	**Monitoring Method**	**Target Range**
	Temperature	Continous monitoring	To be determined

Emissions Testing Methods						
Parameter	**Test Method**	**No. of Runs**	**Length of Run**	**Sample Vol/Rate**	**Report Units**	**Detection Limit**
Locate Test Ports & Trvs Point	EPA Method 1 (details below)	1	NA	NA	NA	NA
Volumetric Airflow	EPA Method 2	3	NA	NA	ACFM DSCFM	4 Ft./Sec.
Gas Composition Instrumental	EPA Method 3A	3	1 Hour	1 LPM	% v/v	0.1 % v/v
Moisture Content	EPA Method 4	3	1 Hour	0.5 CFM	% v/v Mole. Wt.	0.3 % v/v
Benzene	EPA Method 18	3	1 Hour	6 Liters	PPM v/v LB/HR	1 PPB v/v
Total Gaseous Organic Compounds	EPA Method 25A	3	1 Hour	1 LPM	PPM v/v LB/HR	2 PPM v/v

Test Location Details: Test site details are not currently available. All airflow measaurements will be conducted at test locations that meet Method 1 requirements and documented in the final report.

Special Considerations: 1) Absence of cyclonic flow will be verified at all airflow test locations per procedures outlined in Section 11.4 of EPA Method 1.
2) Airflow measurements will be conducted twice during each test run per EPA Method 2 requirements.

RTO Outlet
Testing Requirements

Emissions Testing Constituents				
Source No.	**Source Identification**	**Regulated Constituents**	**Applicable Rules or Regulations**	**Emission Limits**
	RTO Outlet	Total Hydrocarbons	Permit Condition 3a	To be determined
		Benzene	Permit Condition 3b	To be determined

Process Monitoring Parameters			
Source No.	**Process Parameter**	**Monitoring Method**	**Target Range**
	Temperature	Continous monitoring	To be determined
	Total Maximum Firing Rate	To be determined	As stipulated in Permit Condition 3c

Emissions Testing Methods						
Parameter	**Test Method**	**No. of Runs**	**Length of Run**	**Sample Vol/Rate**	**Report Units**	**Detection Limit**
Locate Test Ports & Trvs Point	EPA Method 1 (details below)	1	NA	NA	NA	NA
Volumetric Airflow	EPA Method 2	3	NA	NA	ACFM DSCFM	4 Ft./Sec.
Gas Composition Instrumental	EPA Method 3A	3	1 Hour	1 LPM	% v/v	0.1 % v/v
Moisture Content	EPA Method 4	3	1 Hour	0.5 CFM	% v/v Mole. Wt.	0.3 % v/v
Benzene	EPA Method 18	3	1 Hour	6 Liters	PPM v/v LB/HR	1 PPB v/v
Total Gaseous Organic Compounds	EPA Method 25A	3	1 Hour	1 LPM	PPM v/v LB/HR	2 PPM v/v

Test Location Details: Test site details are not currently available. All airflow measaurements will be conducted at test locations that meet Method 1 requirements and documented in the final report.

Special Considerations: 1) Absence of cyclonic flow will be verified at all airflow test locations per procedures outlined in Section 11.4 of EPA Method 1.
2) Airflow measurements will be conducted twice during each test run per EPA Method 2 requirements.

Test Report

A final test report will be compiled by Pace Analytical at the completion of testing. The report will be submitted to the client within 30 days of the last day of sampling. The client will be responsible for submitting report copies as required by regulatory agencies. Two electronic copies of the test report on CD-ROM will be included with hardbound copies of the report. The final test report will include the following information:

- Name and location of emission facility.
- Identification of emission unit.
- Date of tests.
- Name and address of testing company.
- Certification of project information (client signatures also required).
- Reasons and constituents for test.
- Names of observers and witnesses
- Emission results expressed in the units of the emission limitation criteria.
- Process descriptions as provided by the client.
- Process rate information as provided by the client.
- Descriptions of maintenance activities as provided by the client.
- Discussions of problems or errors encountered.
- Sampling and analytical procedures.
- Analytical results of fuels or process samples as appropriate.
- Dimensioned drawing of sampling location.
- Copies of raw field data.
- Copies of laboratory analytical reports.
- Calculation equations.
- Sampling train calibration data
- Laboratory quality assurance information as appropriate
- Copy of this test plan and other pertinent pretest correspondence.

Safety Considerations

Safety is an important aspect of sampling programs, especially when test teams and observers are in unfamiliar plant surroundings. Plants are required to provide test ports, safe test platforms and access routes. The test firm is required to follow plant safety protocols and rules as well as their own safety program. Attention must be given to special considerations related to testing such as overhead work, solvent usage, compressed gases, flammable materials, open ports and electrical appliances. Observers and regulatory witnesses must comply with both plant and test firm safety protocols. Pace cannot provide PPE for visitors and observers. The following protocols and Personal Protection Equipment (PPE) will be required for this site.

Safety Requirements	Pace Protocol	Plant Protocol
No Smoking	X	X
Safety Shoes	X	X
Metatarsal Guards		
ESD Shoes or Strap		
Hard Hat	X	X
Safety Glasses	X	X
Full-Face Shield		
Chemical Resistant Gloves		
Abrasion Resistant Gloves	X	
Temperature Insulating Gloves	X	
Full Length Trousers (Waist to Ankle)	X	X
Long-Sleeved Shirt		
Fire Retardant Clothing		X
Chemical Resistant Suit/Clothing		
No Facial Hair		X
Dust Respirator		
Half-Face Air Purifying Respirator		
Full-Face Air Purifying Respirator		
Self Contained Breathing Apparatus		
Supplied Air Respirator		
Plant Security Log In		X
Plant Safety Training		X
Plant Escort		
Spark Permit/Protocols		X
Electronic Device Restrictions		X
Designated Break/Smoking Areas		X
Safety Climb System		
Fall Protection (Harness/Tie-off)		X

Attachments

Attachment 1	Test Location Schematic(s)
Attachment 2	Abbreivations, Symbols, and Nomenclature
Attachment 3	Calculation Equations
Attachment 4	Method Summaries
Attachment 5	Quality Statement

Attachment 1
Test Location Schematic(s)

To be included in test report.

Attachment 2
Abbreviations, Symbols, and Nomenclature

“Hg	Inches of Mercury (pressure)
“WC	Inches Water Column (pressure)
°C	Degrees Centigrade or Celsius
°F	Degrees Fahrenheit
°K	Degrees Kelvin (absolute)
°R	Degrees Rankin (absolute)
% v/v	Percent by volume
% w/w	Percent by weight
ACFM	Actual Cubic Feet per Minute
AP-42	Compilation of Air Pollutant Emission Factors, Volume I, Stationary Point and Area Sources.
BACT	Best Available Control Technology
BH	Baghouse
BHP	Brake Horsepower
BTU	British Thermal Unit
c	Centimeter
c^3	Cubic Centimeter
cc	Cubic Centimeter
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CE	Control Equipment (in Reg. ID Nos.)
CE	Control Efficiency
CEM	Continuous Emissions Monitor
CEMS	Continuous Emissions Monitoring System
CF	Cubic Feet
CFR	Code of Federal Regulations
C_1	Carbon (as carbon)
CH_4	Methane
C_3H_8	Propane
cm	Cubic Meter
CO	Carbon Monoxide
CO_2	Carbon Dioxide
DGS	Distiller’s Grains with Solubles
DDGS	Dry Distiller’s Grains with Solubles
DRE	Destruction/Reduction Efficiency
DSCF	Dry Standard Cubic Feet
DSCFM	Dry Standard Cubic Feet per Minute
dscm	Dry Standard Cubic Meter
dscmm	Dry Standard Cubic Meter per Minute
dsl	Dry Standard Liter
EPA	Environmental Protection Agency
EP	Emission Point
ESP	Electrostatic Precipitator
EU	Emission Unit
FID	Flame Ionization Detector
FGR	Flue Gas Recirculation
FPM	Feet Per Minute
FPS	Feet Per Second
FR	Federal Register
FT or ft	Foot or Feet
FT^3	Cubic Feet
FTIR	Fourier Transform Infrared
g	Gram
GC	Gas Chromatograph(y)
GPD	Gallons Per Day
GPH	Gallons Per Hour
GR	Grains
H_2O	Water
H_2S	Hydrogen Sulfide
HAP	Hazardous Air Pollutant
HAPs	Hazardous Air Pollutants
Hg	Mercury
HP	Horsepower
HR	Hour
In.	Inch or Inches
KLB	Thousand Pounds
kW	Kilowatt
kWH	Kilowatt Hour
l	liter
LB	Pound or Pounds
LDAR	Leak Detection and Repair
m	Meter
m^3	Cubic Meter
MACT	Maximum Achievable Control Technology
MC	Moisture Content
µg	Microgram
µl	Microliter
µm	Micrometer (micron)
mg	Milligram
MGAL	Thousand Gallons
Min.	Minute or Minutes
ml	Milliliter
mm	Millimeter
MMBTU	Million British Thermal Units
MMSCF	Million Standard Cubic Feet
MS	Mass Spectrometry
MSDS	Material Safety Data Sheet
mW	Megawatt
MW	Molecular Weight
N_2	Nitrogen
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides (quantified as NO_2)
NSPS	New Source Performance Standard
O_2	Oxygen
PEMS	Parametric (or Predictive) Emissions Monitoring System
PM	Particulate Matter
PM_{10}	Particulate Matter with and aerodynamic diameter equal to or less than 10 microns

PM-10	PM_{10}
$PM_{2.5}$	Particulate Matter with an aerodynamic diameter equal to or less than 2.5 microns
PM-2.5	$PM_{2.5}$
PPB	Parts Per Billion (see variation below)
PPM	Parts Per Million
PPMv	Part Per Million by volume
PPMv-dry	Parts Per Million by volume, dry basis
PPMv-wet	Parts Per Million by volume, wet basis
PPMw	Parts Per Million by Weight (mg/l)
PSIA	Pounds per Square Inch, Absolute
PSIG	Pounds per Square Inch, Gauge
PTE	Permanent Total Enclosure
RA	Relative Accuracy
RATA	Relative Accuracy Test Audit
rH	Relative Humidity
RTO	Regenerative Thermal Oxidizer or Recuperative Thermal Oxidizer
SCF	Standard Cubic Feet
SCFM	Standard Cubic Feet per Minute
scm	Standard Cubic Meter
scmm	Standard Cubic Meter per Minute
Scr.	Scrubber
SIC	Standard Industrial Classification
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
Sq. Ft.	Square Feet
TCD	Thermal Conductivity Detector
TO	Thermal Oxidizer
TPD	Tons Per Day
TPH	Tons Per Hour
TPY	Tons per year
TRS	Total Reduced Sulfur
TSP	Total Suspended Particulate Matter
TTE	Temporary Total Enclosure
USEPA	United States Environmental Protection Agency
VHAP	Volatile Hazardous Air Pollutant
VOC	Volatile Organic Compound
VOCs	Volatile Organic Compounds
WC	Water Column
WDGS	Wet Distiller's Grains with Solubles

State Environmental Agency Acronyms

ADEM	Alabama Department of Environmental Management
ADEC	Alaska Department of Environmental Conservation
ADEQ	Arizona Department of Environmental Quality
ADEQ	Arkansas Department of Environmental Quality
CARB	California Air Resources Board
CDPHE	Colorado Department of Public Health & Environment
CDEP	Connecticut Department of Environmental Protection
DNREC	Delaware Natural Resources & Environmental Control
FDEP	Florida Department of Environmental Protection
GEPD	Georgia Environmental Protection Division
IDEQ	Idaho Department of Environmental Quality
IEPA	Illinois Environmental Protection Agency
IDEM	Indiana Department of Environmental Management
IDNR	Iowa Department of Natural Resources
KDHE	Kansas Department of Health & Environment
KDEP	Kentucky Department for Environmental Protection
LDEQ	Louisiana Department of Environmental Quality
MDEP	Maine Department of Environmental Protection
MDE	Maryland Department of the Environment
MDEP	Massachusetts Department of Environmental Protection
MDEQ	Michigan Department of Environmental Quality
MPCA	Minnesota Pollution Control Agency
MDEQ	Mississippi Department of Environmental Quality
MDNR	Missouri Department of Natural Resources
MDEQ	Montana Department of Environmental Quality
NDEQ	Nebraska Department of Environmental Quality
NDEP	Nevada Division of Environmental Protection
NHDES	New Hampshire Department of Environmental Services
NJDEP	New Jersey Department of Environmental Protection
NMED	New Mexico Environment Department
NYSDEC	New York State Department of Environmental Conservation
NCDENR	North Carolina Department of Environment & Natural Resources
NDDH	North Dakota Department of Health
OEPA	Ohio Environmental Protection Agency
ODEQ	Oklahoma Department of Environmental Quality
ODEQ	Oregon Department of Environmental Quality
PDEP	Pennsylvania Department of Environmental Protection
RIDEM	Rhode Island Department of Environmental Management
SCDHEC	South Carolina Department of Health & Environmental Control
SDDENR	South Dakota Department of Environment & Natural Resources
TDEC	Tennessee Department of Environment & Conservation
TCEQ	Texas Commission on Environmental Quality
UDEQ	Utah Department of Environmental Quality
VANR	Vermont Agency of Natural Resources
VDEQ	Virginia Department of Environmental Quality
WSDNR	Washington State Department of Natural Resources
WVDEP	West Virginia Division of Environmental Protection
WYDEQ	Wyoming Department of Environmental Quality
WDNR	Wisconsin Department of Natural Resources

Attachment 3
Calculation Equations

EPA Method 2 Calculations

Flue Gas Linear Velocity

$$V_s = 85.49 \times C_p \times \overline{\sqrt{\Delta P}} \times \sqrt{\frac{\overline{T_s}}{P_s \times M_s}}$$

Volumetric Flow Rates - ACFM, SCFM & DSCFM

$$Q = 60 \times v_s \times A$$

$$Q_s = Q \times \left(\frac{528}{T_s}\right) \times \left(\frac{P_s}{29.92}\right) = Q \times 17.647 \times \left(\frac{P_s}{T_s}\right)$$

$$Q_{sd} = Q_s \times (1 - B_{ws})$$

Mass Flow Rate of Wet Flue Gas

$$m_g = \frac{4.995 \times Q_{sd} \times G_d}{1 - B_{ws}}$$

Actual Gas Density

$$\rho = \frac{0.04585 \times P_s \times M_s}{\overline{T_s}}$$

Where:

A	=	Cross-sectional area of duct at sample point (sq. ft.).
B_{ws}	=	Water vapor in gas stream (proportion by volume).
C_p	=	Pitot tube calibration coefficient.
G_d	=	Flue gas specific gravity relative to air, dimensionless.
m_g	=	Mass flow rate of wet flue gas (LB/HR).
M_s	=	Molecular weight of wet flue gas (LB/LB-mole).
P_s	=	Absolute gas pressure of duct (Inches Hg).
ΔP	=	Velocity pressure measured by pitot tube (Inches WC).
Q	=	Actual flue gas volumetric flow rate (ACFM).
Q_s	=	Volumetric gas flow at standard conditions (SCFM).
Q_{sd}	=	Dry standard volumetric gas flow rate (DSCFM).
T_s	=	Flue gas temperature (°R).
V_s	=	Flue gas linear velocity (feet per second).
ρ	=	Actual flue gas density (LB/CF).

EPA Method 3 Calculations

Dry Molecular Weight of Flue Gas

$$M_d = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times (\%N_2 + \%CO))$$

Wet Molecular Weight of Flue Gas

$$M_s = M_d \times (1 - B_{ws}) + (18 \times B_{ws})$$

Percent Excess Air

$$\%EA = 100 \times \left(\frac{\%O_2 - (0.05 \times \%CO)}{(0.264 \times \%N_2) - \%O_2 + (0.5 \times \%CO)} \right)$$

Fuel F-factor (for comparison)

$$F_o = \frac{20.9 - \%O_2}{\%CO_2}$$

Where:

B_{ws}	=	Water vapor in gas stream (proportion by volume).
%CO	=	Carbon monoxide in gas stream (percent).
$\%CO_2$	=	Carbon dioxide in gas stream (percent).
%EA	=	Excess air for combustion (percent).
F_o	=	Fuel F-factor for results comparison.
M_d	=	Molecular weight of dry flue gas (LB/LB-mole).
M_s	=	Molecular weight of wet flue gas (LB/LB-mole).
$\%N_2$	=	Nitrogen in gas stream (percent).
$\%O_2$	=	Oxygen in gas stream (percent).

EPA Method 4 Calculations

Sample Volume, Standard Conditions

$$V_{std} = 17.647 \times V_m \times Y \times \left(\frac{P_b + \frac{\overline{\Delta H}}{13.6}}{\overline{T_m}} \right)$$

Volume of Water Vapor Sampled

$$V_w = 0.047070 \times V_{lc}$$

Proportion of Water Vapor in Sampled Gas

$$B_{ws} = \frac{V_w}{V_w + V_{std}}$$

Moisture Content of Sampled Gas

$$MC = B_{ws} \times 100$$

Where:

B_{ws}	=	Water vapor in gas stream (proportion by volume).
ΔH	=	Orifice meter differential pressure (Inches WC).
MC	=	Moisture Content, % v/v
P_b	=	Barometric pressure (Inches Hg).
T_m	=	Sampling train meter temperature (°R).
V_{lc}	=	Total volume of liquid collected in sampling train (mls).
V_m	=	Volume of gas sample measured by gas meter (CF).
V_{std}	=	Gas volume corrected to standard conditions (DSCF).
V_w	=	Volume of water vapor in gas sample (SCF).
Y	=	Dry gas meter calibration coefficient.

Psychometric Moisture Content

Saturated Water Vapor Pressure

VP_s = Value indexed from Vapor Pressure of Water Table (29.92" Hg)

Source Gas Water Vapor Pressure

$VP_a = VP_s - (0.000367 \times P_s \times (T_{db} - T_{wb}) \times (1+((T_{wb}-32) \div 1571)))$

Moisture Content

$MC\% = 100 \times VP_a \div P_s$

Where:

MC% = Moisture content of stack gas, percent by volume.
P_s = Absolute pressure of stack gas, inches Hg.
T_{db} = Dry bulb temperature measurement, °F.
T_{wb} = Wet bulb temperature measurement, °F.
VP_a = Vapor pressure of stack gas, inches Hg.
VP_s = Saturated vapor pressure at wet bulb temperature and 29.92 inches Hg.

VAPOR PRESSURE OF WATER ("Hg)

	0	1	2	3	4	5	6	7	8	9
0	0.0376	0.0398	0.0417	0.0441	0.0463	0.0489	0.0517	0.0541	0.0571	0.0598
10	0.0631	0.0660	0.0696	0.0728	0.0768	0.0810	0.0846	0.0892	0.0932	0.0982
20	0.1025	0.1080	0.1127	0.1186	0.1248	0.1302	0.1370	0.1429	0.1502	0.1567
30	0.1647	0.1716	0.1803	0.1878	0.1955	0.2035	0.2118	0.2203	0.2292	0.2383
40	0.2478	0.2576	0.2677	0.2782	0.2891	0.3004	0.3120	0.3240	0.3364	0.3493
50	0.3626	0.3764	0.3906	0.4052	0.4203	0.4359	0.4520	0.4686	0.4858	0.5035
60	0.5218	0.5407	0.5601	0.5802	0.6009	0.6222	0.6442	0.6669	0.6903	0.7144
70	0.7392	0.7648	0.7912	0.8183	0.8462	0.8750	0.9046	0.9352	0.9666	0.9989
80	1.032	1.066	1.102	1.138	1.175	1.213	1.253	1.293	1.335	1.378
90	1.422	1.467	1.513	1.561	1.610	1.660	1.712	1.765	1.819	1.875
100	1.932	1.992	2.052	2.114	2.178	2.243	2.310	2.379	2.449	2.521
110	2.596	2.672	2.749	2.829	2.911	2.995	3.081	3.169	3.259	3.351
120	3.446	3.543	3.642	3.744	3.848	3.954	4.063	4.174	4.289	4.406
130	4.525	4.647	4.772	4.900	5.031	5.165	5.302	5.442	5.585	5.732
140	5.881	6.034	6.190	6.350	6.513	6.680	6.850	7.024	7.202	7.384
150	7.569	7.759	7.952	8.150	8.351	8.557	8.767	8.981	9.200	9.424
160	9.652	9.885	10.12	10.36	10.61	10.86	11.12	11.38	11.65	11.92
170	12.20	12.48	12.77	13.07	13.37	13.67	13.98	14.30	14.62	14.96
180	15.29	15.63	15.98	16.34	16.70	17.07	17.44	17.82	18.20	18.61
190	19.01	19.42	19.84	20.27	20.70	21.14	21.59	22.05	22.52	22.99
200	23.47	23.96	24.46	24.97	25.48	26.00	26.53	27.07	27.62	28.18
210	28.75	29.33	29.92	30.52	31.13	31.75	32.38	33.02	33.67	34.33
220	35.00	35.68	36.37	37.07	37.78	38.50	39.24	39.99	40.75	41.52
230	42.31	43.11	43.92	44.74	45.57	46.41	47.27	48.14	49.03	49.93
240	50.84	51.76	52.70	53.65	54.62	55.60	56.60	57.61	58.63	59.67
250	60.72	61.79	62.88	63.98	65.10	66.23	67.38	68.54	69.72	70.92
260	72.13	74.36	74.61	75.88	77.16	78.46	79.78	81.11	82.46	83.83
270	85.22	86.63	88.06	89.51	90.97	92.45	93.96	95.49	97.03	98.61
280	100.2	101.8	103.4	105.0	106.7	108.4	110.1	111.8	113.6	115.4
290	117.2	119.0	120.8	122.7	124.6	126.5	128.4	130.4	132.4	134.4
300	136.4	138.5	140.6	142.7	144.8	147.0	149.2	151.4	153.6	155.9
310	158.2	160.5	162.8	165.2	167.6	170.0	172.5	175.0	177.5	180.0
320	182.6	185.2	187.8	190.4	193.1	195.8	198.5	201.3	204.1	206.9
330	209.8	212.7	215.6	218.6	221.3	224.6	227.7	230.8	233.9	237.1
340	240.3	243.5	246.8	250.1	253.4	256.7	260.1	263.6	267.1	270.6
350	274.1	277.7	281.3	284.9	288.6	292.3	296.1	299.9	303.8	307.7
360	311.6	315.5	319.5	323.5	327.6	331.7	335.9	340.1	344.4	348.7
370	353.0	357.4	361.8	366.2	370.7	375.2	379.8	384.4	389.1	393.8
380	398.6	403.4	408.2	413.1	418.1	423.1	428.1	433.1	438.2	443.4
390	446.6	453.9	459.2	464.6	470.0	475.5	481.0	486.6	492.2	497.9
400	503.6	509.3	515.1	521.0	526.9	532.9	538.9	545.0	551.1	557.3

Volatile Organic Compound Calculations

Weight/Volume Concentration

$$C_{VOC} = \frac{m_{VOC}}{V_{std}}$$

Volume/Volume Concentration

$$C_{PPM} = \frac{C_{voc} \times 24.04}{MW_{VOC}}$$

VOC Emission Rate

$$E_{VOC} = (6.242 \times 10^{-8}) \times 60 \times C_{VOC} \times DSCFM$$

Where:

C_{VOC}	=	Volatile organic compound (VOC) concentration, mg/dscm
C_{PPM}	=	Volatile organic compound (VOC) concentration, PPM v/v
DSCFM	=	Volumetric airflow, Dry Standard Cubic Feet per Minute
E_{VOC}	=	Volatile organic compound (VOC) emission rate, LB/HR
M_{VOC}	=	Mass of volatile organic compound collected, µg
MW_{VOC}	=	Molecular weight of volatile organic compound
V_{std}	=	Standard volume of air sample, liters
(6.242×10^{-8})	=	Conversion from mg/dscm to LB/DSCF
60	=	Conversion from minutes to hours

Control Efficiency Calculations

Capture Efficiency of Volatile Organic Compounds

$$E_C = \frac{MR_{VOC_{In}}}{MR_{VOC_{Rls}}} \times 100$$

Destruction/Reduction Efficiency of Volatile Organic Compounds

$$E_{DR} = \frac{MR_{VOC_{In}} - \mathrm{MR}_{\mathrm{VOC_{Out}}}}{MR_{VOC_{In}}} \times 100$$

Control Efficiency of Volatile Organic Compounds

$$E_T = \frac{E_C \times E_{DR}}{100}$$

Where:

E_C = Capture Efficiency, percentage of VOC captured by exhaust versus VOC released based on carbon (percent).

E_{DR} = Destruction/Removal Efficiency of pollution control device (percent).

E_T = Total control or reduction efficiency based capture and destruction/removal efficiencies (percent).

$MR_{VOC_{Rls}}$ = Mass Rate of VOC released from process based on VOC usage and volatile carbon analyses of formulations (LB/HR_{carbon}).

$MR_{VOC_{In}}$ = Mass Rate of VOC measured at pollution control device inlet (LB/HR_{carbon}).

$MR_{VOC_{Out}}$ = Mass Rate of VOC measured at pollution control device outlet (LB/HR_{carbon}).

Instrumental Analyzer Calculations
EPA Methods 3A, 6C, 7E and 10

Analyzer Calibration Error

$$A_E = \frac{C_{AR} - C_{Cyl}}{S_{FS}} \times 100$$

System Calibration Bias

$$B_{Sys} = \frac{C_{SR} - C_{AR}}{S_{FS}} \times 100$$

System Drift

$$D_{Sys} = \frac{C_{SR_F} - C_{SR_I}}{S_{FS}} \times 100$$

Gas Concentration Corrected for System Bias

$$C_{PPM} = \left(\overline{C} - C_{0_{SR}}\right) \frac{C_{Cyl}}{\left(\frac{C_{SR_I} + C_{SR_F}}{2}\right) - C_{0_{SR}}}$$

Conversion to Weight/Volume Units

$$C_{mg/dscm} = C_{PPM} \times \frac{M_{Gas}}{24.04}$$

Emission Rate Calculation

$$E_R = 6.243 \times 10^{-8} \times C_{mg/dscm} \times DSCFM \times 60$$

Where:

A_E	=	Analyzer calibration error, percent of span.
B_{Sys}	=	System calibration bias, percent of span.
D_{Sys}	=	System calibration drift, percent of span.
$\overline{C}$	=	Average gas concentration response from analyzer, PPM (or %).
C_{0SR}	=	Average of initial and final system calibration bias check responses for the zero gas, PPM (or %).
C_{AR}	=	Analyzer direct calibration response, PPM (or %).
C_{Cyl}	=	Actual concentration of calibration gas, PPM (or %).
C_{SR}	=	System calibration response, PPM (or %).
C_{SRF}	=	Final system calibration response, PPM (or %).
C_{SRI}	=	Initial system calibration response, PPM (or %).
C_{PPM}	=	Concentration adjusted for system bias, PPM (or %).
$C_{mg/dscm}$	=	Constituent concentration converted to mg/dscm.
M_{Gas}	=	Molecular weight of target constituent, lb/lb-mole.
E_R	=	Emission rate of constituent, LB/HR.
S_{FS}	=	System measurement span, full scale.
DSCFM	=	Dry standard cubic feet per minute.
6.243×10^{-8}	=	Conversion factor, mg/cm to LB/CF.
60	=	Conversion factor, minutes to hours.

Gas Concentration Calculations

Weight/Volume Concentration

$$C_{mg/cm} = \frac{m}{V_{std}}$$

Volume/Volume Concentration

$$C_{ppm} = \frac{C_{mg/cm} \; x \; 24.04}{MW}$$

Emission Rate

$$E_{Gas} = \left(6.242 \; x \; 10^{-8}\right) x \; 60 \; x \; C_{mg/cm} \; x \; DSCFM$$

Where:

$C_{mg/cm}$	=	Compound Concentration, mg/cubic meter.
C_{ppm}	=	Compound Concentration, PPM v/v.
DSCFM	=	Volumetric Airflow, dry standard cubic feet per minute.
E_{Gas}	=	Compound Emission Rate, LB/HR.
m	=	Mass of Compound Collected, µg.
MW	=	Molecular Weight of Compound.
V_{std}	=	Standard Volume of Air Sample, liters.
(6.242×10^{-8})	=	Conversion From mg/dscm To LB/CF.
60	=	Conversion From Minutes to Hours.

Moisture Correction Calculations

Wet to Dry Concentration Correction

$$C_{dry} = \frac{C_{wet}}{\left(1 - \frac{MC_{source}}{100}\right)}$$

Dry to Wet Concentration Correction

$$C_{wet} = C_{dry} \times \left(1 - \frac{MC_{source}}{100}\right)$$

Wet Analytical Basis to Wet Stack Basis

$$C_{wet-s} = \frac{C_{wet-a}}{\left(1 - \frac{MC_{analyses}}{100}\right)} \times \left(1 - \frac{MC_{source}}{100}\right)$$

Note: Changes in temperature and pressure from the source to analysis affect the moisture capacity of the gas sample. 100% rH at laboratory conditions, or 2.5% v/v, is assumed for the analysis moisture content. If another value is used, it will be noted in the Results Summary. Care must be taken to ensure that analytes of interest are not soluble in the resulting condensate.

Where:

C_{dry}	=	Compound Concentration,dry basis, not unit specfic.
C_{wet}	=	Compound Concentration,wet basis, not unit specfic.
C_{wet-a}	=	Compound Concentration,wet basis, at analysis.
C_{wet-s}	=	Compound Concentration,wet basis, in source gas.
$MC_{analysis}$	=	Moisture content of gas at analytical conditions.
MC_{source}	=	Moisture content of gas at source conditions.

Volatile Organic Compound Calculations
EPA Method 25A

Convert Analyzer Response to Carbon Basis

$$C_{ppm-C1} = C_{propane}\ x\ 3$$

Methane Corrected Concentration (as carbon)

$$C_{ppm-(C1-CH4)} = C_{ppm-C1} - C_{ppm-CH4}$$

Weight/Volume Concentration (as carbon)

$$C_{VOC-C1} = \frac{C_{ppm-C1}\ x\ 12.01}{24.04} = C_{ppm-C1}\ x\ 0.5 \quad or \quad C_{ppm-(C1-CH4)}\ x\ 0.5$$

Emission Rate (as carbon)

$$E_{VOC-C1} = (6.242\ x\ 10-8)\ x\ 60\ x\ C_{VOC-C1}\ x\ SCFM$$

Where:

C_{voc-C1}	=	VOC Concentration as Carbon, mg/scm.
C_{ppm-C1}	=	VOC Concentration as Carbon, PPM v/v.
$C_{ppm-(C1-CH4)}$	=	Methane Corrected Concentration as Carbon, PPM v/v.
$C_{ppm-CH4}$	=	Methane Concentration, PPM v/v.
$C_{propane}$	=	Average THC Analyzer Concentration, PPM as propane.
SCFM	=	Volumetric Airflow, Standard Cubic Feet Per Minute.
E_{voc-C1}	=	VOC Emission Rate as Carbon, LB/HR.
12.01	=	Molecular Weight of Carbon.
(6.242×10^{-8})	=	Conversion From mg/scm To LB/SCF.
60	=	Conversion from Minutes to Hours.

Attachment 4
Method Summaries

EPA Method 1 specifies test location acceptability criteria and defines the minimum number of traverse points for representative sampling. Linear measurements from upstream and downstream flow disturbances and the duct equivalent diameter are compared and the distances related to number of diameters. A flow disturbance can be defined as anything that changes or upsets the direction of flow within the duct including bends, dampers, fans, shape or size transitions, and open flames. Method 1 stipulates that test ports should be located at least eight diameters downstream and two diameters upstream of any flow disturbance. The minimum acceptable criteria are two diameters downstream and 0.5 diameters upstream of flow disturbances. The test location must also be free of cyclonic or multidirectional flow. Once the distances have been determined, the values are used to select the minimum number of traverse points for representative sampling. Shorter distances require a greater number of traverse points. The test site configuration and measurement details will be included in test report

Pace FSD conducts the method as written with no routine deviations. Project situational deviations are fully documented at the time of the test.

EPA Method 2 defines procedures used to measure linear velocity and volumetric flow rate of a confined gas stream. Using traverse points determined by EPA Method 1, multiple differential pressure measurements (pitot impact opening versus static pressure) are made using a pitot tube and differential pressure gauge. The individual measurements are averaged and combined with the gas density to calculate the average gas velocity. The velocity and duct cross-sectional area are used to calculate the volumetric flow rate. The volumetric flow rate is expressed as actual cubic feet per minute (ACFM), standard cubic feet per minute (SCFM), and dry standard cubic feet per minute (DSCFM). The technician maintains comprehensive test records on EPA Method 2 Field Data Sheet. Details of the equipment used to measure gas velocity include:

Pitot Tube:	S-Type
Differential Pressure Gauge:	Oil or Electronic Digital Manometer
Temperature Device:	Type K Thermocouple
Barometer Type:	Electronic Digital Barometer
Gas Density Determination:	EPA Method 3
Gas Moisture Determination:	EPA Method 4

Quality Control: Sampling equipment calibrations ensure accurate measurement of stack gas flow-rate and sample volume.

Pace FSD conducts the method as written with no routine deviations. Project situational deviations are fully documented at the time of the test.

EPA Method 3A defines procedures to measure carbon dioxide (CO2) and oxygen (O2) concentrations from stationary sources. A stainless steel sampling probe and a sampling line draw a sample of the gas stream from the duct to a thermo-electric gas conditioner to remove moisture. The conditioned gas stream is delivered to an infrared gas analyzer to quantify CO2 concentrations and paramagnetic gas analyzer quantifies O2 concentrations. Zero grade cylinder air or a zero gas generator provides zero gas.

Span gases include varying concentrations of EPA Protocol 1 CO2/O2 mixed standards specific to the target calibration range. A computerized data acquisition system logs CO2/O2 concentrations for one-minute averages. The logged results are integrated to test periods and tabulated with standardized spreadsheets in Microsoft Excel. The operator also maintains comprehensive test records on the Gas Monitoring Field Data Sheet. Equipment used for CO2/O2 testing includes:

Probe Material:	Stainless Steel
Moisture Removal:	Thermo-electric
Transfer Line:	Teflon™
Analytical Technique:	Non-dispersive Infrared Detector (CO2) Paramagnetic Detector (O2)
Calibration Gas:	EPA Protocol 1

Quality control procedures are defined in Section 9.0 of EPA Method 7E, which include:

- NO2-NO Conversion Efficiency is ≥ 90% of certified gas concentration
- Gases have traceability protocol (G1, G2)
- High-level gas is equal to the calibration span
- Mid-level gas is 40-60% of calibration span
- Low-level gas is 20% of calibration span
- Analyzer is documented to show interference effects are ≤ 2.5% of the calibration span
- Analyzer and calibration gas performance equals the analyzer calibration error or the 3-point system calibration error for dilution system and within ±2.0% of calibration span of the analyzer for low, mid, and high level calibration gases (with alternative specifications equaling 0.5 ppmv absolute difference)
- System response time determines minimum sampling time per point
- Drift equals 3.0% of calibration span for low, mid, high level gases (with alternate specifications at 0.5 ppmv absolute difference)
- Purge time equals ≥ 2 times the sytem response time; stratification test is used for sample point selelction

Pace FSD conducts the method as written with no routine deviations. Project situational deviations are fully documented at the time of testing.

EPA Method 4 defines procedures to measure the moisture content of emission gas streams from stationary sources. A stainless steel sampling probe draws a sample of the gas stream from the duct to a series of impingers to condense the water vapor. The first two impingers initially contain deionized water and a third impinger is dry. A desiccant packed drying column follows the impingers to quantitatively collect the remaining moisture. An ice bath maintains the impinger train temperature (outlet) at 68°F or less. Collected water condensate is measured and discarded. Method 4 equations convert the condensed liquid volume to a gas volume. The water vapor volume compared with the dry standard gas volume collected through the isokinetic train determines the moisture content of the emissions gas stream and is reported in percent by volume. The operator

maintains comprehensive test records on EPA Method 4 Field Data Sheet, Constant Rate Moisture Sampling.

Probe Material:	Stainless Steel
Impinger Train Material:	Borosilicate Glass
Desiccant:	Drierite
Condensate Measure:	Graduated Cylinder or Electronic Scale
Desiccant Measure:	Electronic Scale

Pace FSD conducted this method as written with no deviations.

EPA Method 18 defines procedures to measure gaseous organics emitted from industrial sources. Depending on flame hazards and source conditions, samples are collected using one of five procedures: Integrated Bag Sampling, Impinger, Sorbent Tube Sampling, Direct Interface Sampling, Dilution Interface Sampling. Through pretest screening or previous information on the source gas, the identity and approximate concentration of the compounds are determined in order to prepare the required spikes and calibration standards.

Integrated Bag Sampling: a gas sample is collected into a flexible bag made of Tedlar™, Teflon™, or Mylar™. An inert sampling probe and Teflon™ transfer line extract a sample of the gas stream at a constant rate and deliver it to the bag. An evacuation vessel or inert pump facilitates sample flow. The flow rate is set so the final volume of the sample is approximately 80% of the bag capacity. The collected sample is protected from sunlight and steep temperature gradients. A test protocol document outlines target parameters, sampling handling protocols, and analytical strategies.

The major components of the sample are separated by gas chromatography (GC) and individually quantified with flame ionization. Prior to analysis, the system is calibrated with appropriate zero and span gases. After sampling, recovery studies and response factors are performed and must meet method requirements. The train operator maintains comprehensive test records on the Midget Train Sampling Field Data Sheet. Details of testing are outlined below:

Probe:	Stainless Steel
Sample Lines:	Teflon™
Collection Procedure:	Tedlar™ Bags, Evacuation Chamber

Quality Control: Recovery study for bag sampling demonstrates that proper sampling/analysis procedures were selected. Calibration gas standards for each target compound to be analyzed are commercial cylinder gases certified by the manufacturer to be accurate to 1% or 2% of the certified label value are allowed.

Pace FSD conducts the method as written with no routine deviations. Project situational deviations are fully documented at the time of testing.

EPA Method 25A defines procedures used to measure total hydrocarbons from stationary sources. A stainless steel sampling probe and heat-traced Teflon™ sampling line draw a sample of the gas stream from the duct directly to the analytical system. A total hydrocarbon monitor utilizing a flame ionization detector (FID) quantifies total hydrocarbon concentrations. Zero grade cylinder air or a zero gas generator provides zero gas. Span gases include varying concentrations of EPA Protocol propane (C3H8) standards specific to the target calibration range. A computerized data acquisition system logs THC concentrations for one-minute averages. The logged results are integrated to test periods and tabulated with standardized spreadsheets in Microsoft Excel. The analyzer results are multiplied by 3 to report results as carbon (C1). The operator also maintains comprehensive test records on the Gas Monitoring Field Data Sheet. Equipment used for THC testing includes:

Probe Material:	Stainless Steel
Transfer Line:	Teflon™, (heated)
Analytical Technique:	Flame Ionization Detector (FID)
Calibration Gas:	EPA Protocol 1

Quality Control: Zero and calibration drift tests ensure bias introduced by drift in the measurement system output during the run is ≤3% of span. Zero Drift is less than ±3% of the span value. Calibration Drift is less than ±3% of span value. Calibration Error is less than ±5% of the calibration gas value.

Pace FSD conducts the method as written with no routine deviations. Project situational deviations are fully documented at the time of testing.

Attachment 5
Quality Statement

Quality Assurance/Quality Control

Pace Analytical strives to produce data that are complete, representative, and of known precision and accuracy. To meet these objectives, Pace Analytical uses method specific data sheets and forms which clearly identify the process tested, the date, time, test location, and sampling personnel. Observations are recorded in indelible ink unless conditions do not allow. If any corrections are needed, the old data is lined out and new data is initialed and dated. All data is checked for completeness and accuracy. Our use of proper equipment, rigorous maintenance, and timely calibrations are extremely important to stack testing integrity and client service. We design and build much of our own test equipment and employ full time staff dedicated to implementing maintenance and calibration schedules. Equipment is calibrated on a schedule that meets or exceeds the method requirements. High quality traceable standards and reagents are used and are positively identified and tracked with a unique number. Any samples collected are securedm and properly preserved to prevent degradation and tampering. Chain of custody is maintained from sample collection through laboratory analysis.

To ensure testing integrity and data quality, Pace Analytical observes the USEPA Quality Assurance Handbook for Air Pollution Measurement Systems for the development of training programs, Standard Operating Procedures and Procedure Manuals. Pace Analytical has implemented a rigorous Quality Program documented in a Field Services specific Quality Assurance Manual that outlines our quality policies. Pace Analytical uses a custom, computerized Learning Management System to facilitate and track employee training. Controlled copies of all relevant procedures are available to personnel where work is being performed. Equipment is maintained and calibrated by trained personnel on a frequency that meets or exceeds method requirements. Any equipment found to not meet the required specifications is removed from service until it can be repaired and verified to be functioning properly. Pace Analytical uses matrix spikes, duplicate analysis, internal standards, blanks, and linearity and drift checks where required and appropriate. Procedures are in place to assure the accurate transfer of raw data and accuracy of calculations. The Pace Analytical Quality Assurance Program includes procedures for preventative action, corrective action, internal audits and management reviews. Pace Analytical has an internal proficiency testing program and participates in third party proficiency testing programs where available. Pace Analytical field team leaders are certified Qualified Source Testing Individuals (QSTI). The Pace quality program complies with *ASTM D7036 - 04 Standard Practice for Competence of Air Emission Testing Bodies.*

By this test protocol, the regulatory agency is notified of the testing event and invited to observe any and all testing activities. Documentation of the Pace Analytical Quality Assurance Program will be available on-site.