TETRA TECH

STATE-ONLY OPERATING PERMIT APPLICATION

FOR

CORNWALL STATION

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DEP SOUTHCENTRAL REGION
AIR QUALITY PROGRAM

Performed for:

SUNOCO PIPELINE, L.P.

Prepared by:

Tetra Tech, Inc.
Foster Plaza 7
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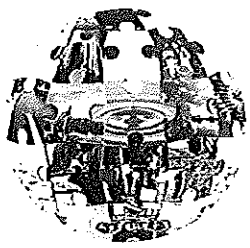
May 20, 2014



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STATE-ONLY OPERATING PERMIT APPLICATION FOR CORNWALL STATION

Submitted to:

Pennsylvania Department of Environmental Protection
South-central Regional Office
909 Elmerton Avenue
Harrisburg, Pennsylvania 17110

Submitted by:

Tetra Tech, Inc.
Foster Plaza 7
661 Andersen Drive
Pittsburgh, Pennsylvania 15220

On Behalf of:

Sunoco Pipeline, L.P.

MAY 2014

PREPARED UNDER THE DIRECTION OF:

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SECTION 1

REGULATORY ANALYSIS

Regulatory Analysis

Following is a summary of state and federal rules and regulations that were reviewed to determine applicability to the sources (enclosed flare combusting natural gas and fugitive natural gas emissions from seal leaks) included this state-only operating permit application.

State Regulatory Analysis

Pennsylvania Code Title 25 Environmental Protection Part I. Department of Environmental Protection Subpart C. Protection of Land Resources; Article II Air Resources

Chapter 122. National Standards of Performance for New Stationary Sources

Does not apply - The Department determined that under Title 25 PA Code §127.14(a)(8) the source emissions are of minor significance (Appendix A).

Chapter 123. Standards for contaminants

25 § 123.1. Prohibition of certain fugitive emissions.

Does not apply - The Department determined that under Title 25 PA Code §127.14(a)(8) the source emissions are of minor significance (Appendix A).

25 § 123.2. Fugitive Particulate Matter.

The flare is designed to produce no visible emissions and therefore visible emissions should not occur beyond the property boundary.

Particulate Matter Emissions

25 § 123.11. Combustion Units.

Particulate matter emissions from the flare are considered 0 micrograms per liter (µg/L) because the flare is smokeless (i.e., no visible emissions) and via AP-42 Table 13.5-1[1] the soot concentration of nonsmoking flares is 0 micrograms per liter (µg/L).

Sulfur Compound Emissions

25 § 123.22. Combustion Units.

Does not apply — Sulfur compound emissions will not occur because sulfur compounds will not be within the product stream that will be flared.

Odor Emissions

25 § 123.31. Limitations.

[1] United States Environmental Protection Agency (EPA), 1995. Compilation of Air Pollutant Emission Factors Volume 1: Stationary Point and Area Sources, Fifth Edition.

Does not apply — Control of malodors will not be necessary because malodorous air contaminants from the flare will not be detectable outside of the property where the flare is being operated. No malodorous compounds (e.g. mercaptan) will be contained in the product stream being flared.

Visible Emissions

25 § 123.41. Limitations.

The flare is designed to produce no visible emissions and therefore the opacity of emissions will not exceed the limitations.

Nitrogen Compound Emissions

25 § 123.51. Monitoring requirements.

Does not apply — The maximum heat input of the flare is 10 million BTUs per hour and this regulation only applies to combustion units with a rated heat input of 250 mill BTUs per hour or greater with annual average capacity factor of greater than 30%.

Chapter 124. National Emission Standards for Hazardous Air Pollutants

Does not apply — Emissions from sources included in this application do not include hazardous air pollutants.

Chapter 127. Construction, Modification, Reactivation, and Operation of Sources

25 § 127.11 → 25 § 127.52

Does not apply — The Department determined that the sources in this application are exempt from plan approval (Appendix A).

25 § 127.81 → 25 § 127.83

Does not apply - The Department determined for that under Title 25 PA Code §127.14(a)(8) the source emissions are of minor significance (Appendix A) and therefore would not trigger the requirements of the Prevention of Significant Deterioration promulgated by the United States Environmental Protection Agency under the Clean Air Act.

Subchapter E. NEW SOURCE REVIEW

25 § 127.201 → 25 § 127.18

The Department determined that this project will not trigger the requirements of 25 PA Code Subchapter E or 40 CFR Part 52 (Appendix A).

An Applicability determination was conducted per 25 § 127.2013a and was included in the request for determination of minor significance and exemption from Plan Approval/Operating Permit under code 25 § 127.14 or 25 § 127.449. The conclusion of the applicability determination is that no New Source Review (NSR) pollutants emitted by the proposed source will cause a significant emissions increase or a significant net emissions increase (Appendix B).

Subchapter F. OPERATING PERMIT REQUIRMENTS

25 § 127.401

Based upon review of a request for determination of minor significance and exemption from Plan Approval/Operating Permit under code 25 § 127.14 or 25 § 127.449 the Department determined that this project is not exempt from the operating permit requirements (Appendix A).

25 § 127.411

All required contents of the application are included except for those specified in a(6), a(7), a(8), and a(10) because those requirements were not requested by the Department (Appendix A).

25 § 127.412

Compliance review forms signed by a corporate officer are included in this State Only Operating Permit application.

25 § 127.413

A municipal notification was mailed that clearly describes the source and states there is a 30-day comment period which begins upon receipt of the notice (Appendix C). Proof of receipt will be forwarded to the Department.

25 § 127.414

If necessary, supplemental information will be submitted to the Department in accordance with 25 §127.414.

Subchapter G. TITLE V OPERATING PERMITS

25 § 127.501 → 25 § 127.543

Does not apply - The Department determined that under Title 25 PA Code §127.14(a)(8) the source emissions are of minor significance (Appendix A).

Subchapter H. GENERAL PLAN APPROVALS AND OPERATING PERMITS

25 § 127.601 → 25 § 127.642

Does not apply – This is project is not applicable for a general operating permit.

Subchapter I. PLAN APPROVAL AND OPERATING PERMIT FEES

25 § 127.703

All operating permits fees were submitted to the Department prior to submittal of this application.

Chapter 128. Alternative Emission Reduction Limitations

Does not apply – No proposal for an alternative emission reduction plan is included in this application.

Chapter 129. Standards for Sources

Does not apply – The source in this application is not listed in this chapter. For example, this project is not for a petroleum refinery, bulk gasoline terminal, bulk gasoline plant, or an ethylene production plant.

Chapter 135. Reporting of Sources

25 § 135.2(6)

Does not apply - The Department determined that under Title 25 PA Code §127.14(a)(8) the source emissions are of minor significance (Appendix A).

Chapter 139. Sampling and Testing

25 § 139.1 → 25 § 139.33

Annual emissions performance testing will occur per the flare manufacturers recommended maintenance (Appendix B). Additionally, performance testing results were previously provided to the Department and are included in this application (Appendix B).

Federal Regulatory Analysis

40 CFR Part 60 – Standards of Performance for New Stationary Sources

Subpart Kb - Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced after July 23, 1984

Does not apply – Volatile organic compounds (VOCs) will not be stored in vessels on-site.

Subpart XX - Standards of Performance for Bulk Gasoline Terminals

Does not apply – The property on which the source is located is not a bulk gasoline terminal.

Subpart IIII - Standards of Performance for Stationary Compression Ignition Internal Combustion Engine

Does not apply – All pumping devices used to transport material will utilize electricity supplied by a public utility.

Subpart JJJJ - Standards of Performance for Stationary Compression Ignition Internal Combustion Engine

Does not apply – All pumping devices used to transport material will utilize electricity supplied by a public utility.

Subpart OOOO - Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution

Does not apply – The source is located at a pump station and pumping stations are not listed as a source affected by this subpart 40 CFR 60 § 60.5365.

SECTION 2

STATE-ONLY APPLICATION FORM

2700-PM-AQ0013 Rev. 8/2009

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

STATE-ONLY PERMIT APPLICATION

FOR OFFICIAL USE ONLY
State-Only OP Number:
Reviewed by:
Date:
Comments:

RECEIVED
MAY 22 2014
DEP SOUTHCENTRAL REGION
AIR QUALITY PROGRAM

Section 1 - General Information

1.1 Application Type

Type of permit for which application is made: (Check one)

- ☒ Initial
- ☐ Renewal Operating Permit No. _____
- ☐ Application Revision

1.2 Plant Information

Federal Tax ID: 23-3102656 Firm Name: Sunoco Pipeline L.P.

Plant Code: _____ Plant Name: Cornwall Station

NAICS Code: 486990 SIC Code: 4619

Description of NAICS Code: All Other Pipeline Transportation

Description of SIC Code: Pipelines, Not Elsewhere Classified

County: Lebanon Municipality West Cornwall Township

Latitude: 40.282642 Longitude: -76.465692

Horizontal Reference Datum: NAD 1983 Horizontal Collection Method: NTDEP Reference Point: CNTAR

1.3 Contact Information

Name: Matt Gordon Title: Project Manager

Address: 525 Fritztown Road
Sinking Spring, PA 19608

Telephone Number: (610) 670-3284

Email Address: mlgordon@sunocologistics.com

1.4 Certification of Truth, Accuracy and Completeness

Note: This certification must be signed by a responsible official. Applications without a signed certification will be returned as incomplete.

I certify under penalty of law that, based on information and belief formed after reasonable inquiry, the statements and information contained in this application are true, accurate, and complete.

(Signed) _____ Date: 5/16/2014

Name (Typed): Matt Gordon Title: Project Manager

Section 2 - Site Information

2.1 Potential Emission Estimates for the Site

Provide the estimated potential emission for the site BEFORE and AFTER utilizing the proposed restriction(s) and/or limitation(s).

Pollutant or CAS No.	Potential Emission BEFORE taking Limitations (TPY)	Potential Emission AFTER taking Limitations (TPY)
CO2e	0.00E+00	6.72E-02
CO2	0.00E+00	6.69E-02
N2O	0.00E+00	6.16E-07
CH4	0.00E+00	3.08E-06
CO	0.00E+00	1.72E-04
Total VOCs	2.42E+01	2.48E-01
Butane	2.42E+01	2.48E-01
Total HAPs	0.00E+00	0.00E+00

*** Provide all supporting calculation methods as an attachment at the end of this application.**

2.2 Facility Type

Is this facility a Synthetic Minor Facility? Yes ☐ No ☒

If yes, go to Section 2.3, "Synthetic Minor Facility".

If no, go to Section 3, "Site Inventory".

IMPORTANT: Note that all Synthetic Minor Facilities must be able to meet the proposed restriction(s) and/or limitation(s) immediately upon the submission of this application. By signing the Certification of Compliance in Section 13 of this application, the facility for which a Synthetic Minor Status is proposed will be deemed a Synthetic Minor Facility according to the restriction(s) and/or limitation(s) proposed upon receipt of the application by the Department, unless the Department determines that the facility is unable to meet the Synthetic Minor requirements at a later date.

Please read instructions carefully before completing this application.

2.3 Synthetic Minor Facility Information (to be completed by all facilities seeking Synthetic Minor Status)

Synthetic Minor Status for this facility can be taken at the: Source Level ☐ AND/OR Site Level ☐

If limitation(s) and/or restriction(s) can be taken at the site level (for all sources within this facility), complete the following questions, otherwise please go on to Section 3, "Site Inventory".

Synthetic Minor Status for the Entire Site is achievable through the following restrictions: (Please check all that apply and describe in detail what is/are proposed):

☐	Hours of Operation	
☐	Production/Throughput Rate	
☐	Type of Fuel	
☐	Fuel Usage	
☐	Control Devices	
☐	Emissions Limitiations	
☐	Other	

Describe how the elected restriction(s) will allow the facility to become a Synthetic Minor

Note: If Section 2.3 is completed and there are no additional restrictions proposed at the source level, the applicant can omit Subsections 5, 6, and 7 in Sections 5, 6, and 7 for all sources in this permit application.

2.4 Compliance Method for the Site (for Synthetic Minor Facilities only)

Complete this section only if limitation(s) and/or restriction(s) were proposed in Section 2.3.

a. Explain how you would demonstrate compliance with the restriction(s) and/or limitation(s) listed in Section 2.3:

b. Describe what is to be reported in the compliance report:

c. Reporting start date:

d. Indicate the frequency for submitting compliance report as explained above:

Please read instructions carefully before completing this application.

Section 3 - Site Inventory

List all air pollution sources, control equipment, emission points and fuel material locations at this site. Duplicate this page as necessary. For renewals, only list sources not included in current permit.

Unit ID No.	Company Designation	Unit Type
101	*John Zink Enclosed Flare*	*4' by 30' Enclosed ZTOF Production Flare*
102	*Fugitive Emissions from seal leaks*	*pump seals*
103	*Maintenance (Pigging) Operations*	*pipe line*

Section 4 - Source Group (Optional)

4.1 Source Group Definition

This section applies to new State-Only Operating Permit applications only.

Define groups of source(s) that are subject to one or more applicable requirements that apply to all source(s) in the group.

Group No.	Source ID (for source(s) in this group)

4.2 Applicable Requirements for Source Groups

For renewals, only list group level requirements not included in the current State-Only Operating Permit. If there are no changes, check the box to the right.

☐ No changes from current State-Only Operating Permit.

Describe and cite all applicable requirements pertaining to all source groups.

Note: A Method of Compliance Worksheet (Addendum 1) must be completed for each requirement listed.

Group Number	Citation Number	Citation Limitation	Limitation Used

Section 5 - Combustion Operational Inventory

(Complete this section for each combustion source in this site. Duplicate this section as needed).

For renewals, review and correct any pre-printed information and add additional sections for any new combustion unit listed in Section 3 of this application.

5.1 General Source Information

a. Unit ID No.: _____ b. Company Designation: _____

c. Plan Approval or Operating Permit Number: _____

d. Manufacturer: _____ e. Model Number: _____

f. Source Description: _____

g. Rated Heat Input/Thruput: _____ h. Installation Date: _____

i. Exhaust Temperature: _____ Units: _____ j. Exhaust % Moisture: _____ k. Exhaust Flow Volume: _____ SCFM

5.2 Exhaust System Components

Explain how the exhaust components are configured:

From Unit	Unit Description	To Unit	Unit Description	Percent Flow

5.3 Source Classification Code (SCC) Listing for Standard Operation

Fuel/Material	Associated SCC	Max Throughput Rate	Firing Sequence

5.4 Maximum Fuel Physical Characteristics

If taking limitations on Fuel Physical Characteristics, see instructions.

SCC/Fuel Burned	FML*	% Sulfer	% Ash	BTU Content (Units)

*FML = Fuel Material Loction

5.5 Limitations on Source Operation (optional)

Maximum amount of hours of source operation per year: _____

☐	Hours of Operation	
☐	Production Throughput Rate	
☐	Type of Fuel	
☐	Fuel Usage	
☐	Control Devices	
☐	Emissions Limitations	
☐	Other	

Describe how the elected restriction(s) will allow the facility to become a Synthetic Minor?

5.6 Compliance Method for this source (for Synthetic Minor Sources only)

Complete this section only if limitation(s) and/or restriction(s) were proposed in Section 5.5.

a. Explain how you would demonstrate compliance with the restriction(s) and/or limitation(s):

b. Describe what is to be reported in the compliance report:

c. Reporting start date: _____

d. Indicate the frequency for submitting compliance report as explained above: _____

5.7 Source Potential to Emit (for Synthetic Minor Sources only)

Give Potential Emission estimate for all air pollutants emitted at this source. Calculations for the Potential Emissions Estimate here should have included the restriction(s) and/or proposed in Section 5.5, if applicable.

Pollutant or CAS Number	Fuel/SCC	Emissions/Activity Allowable per Unit	Calc. Method	Max. Capacity	Total Hours	Emission in TPY

5.8 Source Applicable Requirements

Describe and cite all applicable requirements pertaining to this source.

Note: A Method of Compliance Worksheet (Addendum 1) must be completed for each requirement listed.

For renewals, only list group level requirements not included in the current State Only Operating Permit. If there are no changes, check the box to the right.

☐ No changes from current State Only Operating Permit.

Fuel/SCC	Citation Number	Citation Limitation	Limitation Used

Section 6 - Incinerator Operational Inventory

(Complete this section for each incinerator at this site. Duplicate this section as needed).

For renewals, review and correct any pre-printed information and add additional sections for any new incinerator listed in Section 3 of this application.

6.1 General Source Information

a. Unit ID: _____ b. Company Designation: _____

c. Plan Approval or Operating Permit Number: _____

d. Manufacturer: _____ e. Model Number: _____

f. Source Description: _____

g. Rated Heat Input/Thruput: _____ h. Installation Date: _____

i. Exhaust Temperature: _____ Units: _____ j. Exhaust % Moisture: _____ k. Exhaust Flow Volume: _____ SCFM

l. Inc. Capacity: _____ Lbs/Hr m. Primary Burner Heat Input: Units:

n. Exhaust % CO_2: _____ o. Secondary Burner Heat Input: _____ Units: _____

p. Incinerator Class: _____

q. Waste Type: _____ r. Waste BTU/lb: _____

6.2 Exhaust System Components

Explain how the exhaust components are configured:

From Unit	Unit Description	To Unit	Unit Description	Percent Flow

6.3 Source Classification Code (SCC) Listing for Standard Operation

Fuel/Material	Associated SCC	Max. Throughput Rate	Firing Sequence

6.4 Maximum Fuel Physical Characteristics

If taking limitations on Fuel Physical Characteristics, see instructions.

SCC/Fuel Burned	FML*	% Sulfur	% Ash	BTU Content (Units)

*FML = Fuel Material Location

6.5 Limitations on Source Operation (optional) (for Synthetic Minor Sources only)

Maximum amount of hours of source operation per year: _____

☐	Hours of Operation	
☐	Production Throughput Rate	
☐	Type of Fuel	
☐	Fuel Usage	
☐	Control Devices	
☐	Emissions Limitations	
☐	Other	

Describe how the elected restriction(s) will allow the facility to become a Synthetic Minor?

6.6 Compliance Method for this source (for Synthetic Minor Sources only)

Complete this section only if limitation(s) and/or restriction(s) were proposed in Section 6.5.

a. Explain how you would demonstrate compliance with the restriction(s) and/or limitation(s):

b. Describe what is to be reported in the compliance report:

c. Reporting start date: _____

d. Indicate the frequency for submitting compliance report as explained above: _____

6.7 Source Potential to Emit (for Synthetic Minor Sources only)

Give Potential Emission estimate for all air pollutants emitted at this source. Calculations for the Potential Emissions Estimate here should have included the restriction(s) and/or limitation(s) proposed in Section 6.5, if applicable.

Pollutant or CAS Number	Fuel/SCC	Emissions/Activity Allowable per Unit	Calc. Method	Max. Capacity	Total Hours	Emission in TPY

6.8 Source Applicable Requirements

Describe and cite all applicable requirements pertaining to this source.

Note: A Method of Compliance Worksheet (Addendum 1) must be completed for each requirement listed.

For renewals, only list group level requirements not included in the current State Only Operating Permit. If there are no changes, check the box to the right.

☐ No changes from current State Only Operating Permit.

Fuel/SCC	Citation Number	Citation Limitation	Limitation Used

Section 7 – Process Operational Inventory

(Complete this section for each process at this site. Duplicate this section as needed).

For renewals, review and correct any pre-printed information and add additional sections for any new incinerator listed in Section 3 of this application.

7.1 General Source Information

a. Unit ID: 101 b. Company Designation: John Zink - Enclosed Flare

c. Plan Approval or Operating Permit Number: TBD

d. Manufacturer: John Zink e. Model Number: ZTOF04X30PF

f. Source Description: Enclosed Flare

g. Rated Heat Input/Thruput: 10,000,000 BTU/Hour - Max h. Installation Date: TBD - Tenative August 2014

i. Exhaust Temperature: 1660 Units: F j. Exhaust % Moisture: 6.1 k. Exhaust Flow Volume: 4,848 SCFM

7.2 Exhaust System Components

Explain how the exhaust components are configured:

From Unit	Unit Description	To Unit	Unit Description	Percent Flow
101	pump station seal leaks	CD101	John Zink - Enclosed Flare	
102	fugitive emissions from pump seal leaks	atmosphere		
103	maintenance (pigging) operations	CD101	John Zink - Enclosed Flare	

7.3 Source Classification Code (SCC) Listing for Standard Operation

Fuel/Material	Associated SCC	Max. Throughput Rate	Firing Sequence

7.4 Maximum Fuel Physical Characteristics

If taking limitations on Fuel Physical Characteristics, see instructions.

SCC/Fuel Burned	FML*	% Sulfur	% Ash	BTU Content (Units)
Butane		0	0	2,980 (BTU/scf)
Propane		0	0	2,370 (BTU/scf)
Ethane		0	0	1,630 (BTU/scf)

*FML = Fuel Material Location

7.5 Limitations on Source Operation (optional) (for Synthetic Minor Sources only)

Maximum amount of hours of source operation per year: _____

☐	Hours of Operation	
☐	Production Throughput Rate	
☐	Type of Fuel	
☐	Fuel Usage	
☐	Control Devices	
☐	Emissions Limitations	
☐	Other	

Describe how the elected restriction(s) will allow the facility to become a Synthetic Minor?

7.6 Compliance Method for this source (for Synthetic Minor Sources only)

Complete this section only if limitation(s) and/or restriction(s) were proposed in Section 7.6.

a. Explain how you would demonstrate compliance with the restriction(s) and/or limitation(s):

b. Describe what is to be reported in the compliance report:

c. Reporting start date: _____

d. Indicate the frequency for submitting compliance report as explained above: _____

7.7 Source Potential to Emit (for Synthetic Minor Sources only)

Give Potential Emission estimate for all air pollutants emitted at this source. Calculations for the Potential Emissions Estimate here should have included the restriction(s) and/or limitation(s) proposed in Section 7.5, if applicable.

Pollutant or CAS Number	Fuel/SCC	Emissions/Activity Allowable per Unit	Calc. Method	Max. Capacity	Total Hours	Emission in TPY

7.8 Source Applicable Requirements

Describe and cite all applicable requirements pertaining to this source.

Note: A Method of Compliance Worksheet (Addendum 1) must be completed for each requirement listed.

For renewals, only list group level requirements not included in the current State Only Operating Permit. If there are no changes, check the box to the right.

☐ No changes from current State Only Operating Permit.

Fuel/SCC	Citation Number	Citation Limitation	Limitation Used

Section 8 – Control Device Information (duplicate this section as needed)

For renewals, review and correct any pre-printed information and add additional sections for any new control device listed in Section 3 of this application.

8.1 General Control Device Information

a. Unit ID: CD101 b. Company Designation: John Zink - Enclosed Flare

c. Used by Sources: Mariner East Pipeline

d. Type: Enclosed Flare

e. Pressure Drop in H_2O: ~ 10 psig at max flow rate f. Capture Efficiency: 99.9

g. Scrubber Flow Rate (GPM): Not Applicable

h. Manufacturer: John Zink Company LLC i. Model Number: ZTOF04X30PF

j. Installation Date: TBD - Tenative August 2014

8.2 Control Device Efficiencies for this Control Device:

Pollutant Name	CAS Number	Estimated Control Efficiency	Basis for Efficiency Estimate
Butane (VOC)	106-97-8	99.9	EPA 40 CFR Part 60 Subpart OOOO Stack Emission Study. Performance criteria of the Emission Control Device was assessed as per 40 CFR Part 60, specifically paragraph §60.5413(d)(11) from the September 23rd, 2013 publication of the new NSPS for the Oil and Natural Gas Sector.
Propane (VOC)	74-98-6	99.9	see above

Section 9 – Stack/Flue Information (duplicate this section as needed)

For renewals, review and correct any pre-printed information and add additional sections for any new stack/flue listed in Section 3 of this application.

9.1 General Stack/Vent Information

a. Unit ID: S101 b. Company Designation: John Zink Company LLC Enclosed Flare

c. Discharge Type: Enclosed Flare

d. Diameter (ft): 4 Height (ft): 30 Base Elevation (ft): 4

e. Exhaust Temperature: 1,660 F Exhaust % Moisture: 6.1 Exhaust Velocity: 27.3 ft/sec

f. Exhaust Volume: 20,583 ACFM Exhaust Volume: 4,848 SCFM

g. Distance to Nearest Property Line (ft): ~83 feet

h. Weather Cap?: ☒ Yes ☐ No

i. Used by Sources:

j. Latitude: 40.282642 Longitude: -76.465692
Horizontal Reference Datum: NAD 1983 Horizontal Collection Method: NTDEP Reference Point: CNTAR

a. Unit ID: b. Company Designation:

c. Discharge Type:

d. Diameter (ft): Height (ft): Base Elevation (ft):

e. Exhaust Temperature: Exhaust % Moisture: Exhaust Velocity:

f. Exhaust Volume: ACFM Exhaust Volume: SCFM

g. Distance to Nearest Property Line (ft):

h. Weather Cap?: ☐ Yes ☐ No

i. Used by Sources:

j. Latitude: Longitude:
Horizontal Reference Datum: Horizontal Collection Method: Reference Point:

Section 10 – Fuel Material Location (FML) Information (Optional)

For renewals, review and correct any pre-printed information and add additional sections for any new FML listed in Section 3 of this application.

10.1 Fuel Material Location Information

a. FML ID Number: _____ b. Name: _____

c. Capacity: _____ Units: _____ d. Fuel: _____

e. Maximum Fuel Characteristics: If fuel is coal, what is the moisture content? _____

% Ash: % Sulfur: BTU Content: Units:

f. Used by Source:

_____

a. FML ID Number: _____ b. Name: _____

c. Capacity: _____ Units: _____ d. Fuel: _____

e. Maximum Fuel Characteristics: If fuel is coal, what is the moisture content? _____

% Ash: _____ % Sulfur: _____ BTU Content: _____ Units: _____

f. Used by Source:

_____

a. FML ID Number: _____ b. Name: _____

c. Capacity: _____ Units: _____ d. Fuel: _____

e. Maximum Fuel Characteristics: If fuel is coal, what is the moisture content? _____

% Ash: _____ % Sulfur: _____ BTU Content: _____ Units: _____

f. Used by Source:

_____

Section 11 – Alternative Operating Scenario (optional)

(Duplicate this section for each source participated in this alternative scenarios)

11.1 General Information

a. Alternative Operating Scenario Name or ID No.: _____

b. Source ID No.: _____ c. Source Name: _____

d. Source Type (check one): ☐ Combustion ☐ Incinerator ☐ Process

e. Give a brief description of this alternative scenario stating how it is different from the standard operation:

11.2 Operational Flexibility Request

Check all that apply.

☐ Alternative exhaust system component configuration.
If this box is checked, complete Sections 11.3 and 11.7

☐ Alternative type of fuel replacing or in addition to an existing fuel in standard operation.
If this box is checked, complete Sections 11.4 and/or 11.5 and 11.7

☐ Alternative process method replacing or in addition to a process SCC existing in standard operation.
If this box is checked, complete Sections 11.6 and 11.7

☐ Alternative lower limitations.

11.3 Exhaust System Components

Specify the complete exhaust system component configuration for this alternative operating scenario.

From Component Type	From Component Number	To Component Type	To Component Number	Percent Flow	Begin Date	End Date

11.4 Source Classification Code (SCC) Listing for Alternative Operation

Give a complete listing of all fuels burned, products produced by a process or waste incinerated for this alternative operating scenario.

Fuel	Associated SCC	Max. Throughput Rate	Firing Sequence

11.5 Alternative Fuel Physical Characteristics

Give a complete listing of all fuels physical characteristics for this alternative operating scenario.

SCC/Fuel Burned	FML	% Sulfur	% Ash	BTU Content (Units)

11.6 Alternative Process/Product Description

a. Briefly describe the change(s) in raw materials and/or process methods used in this operating scenario, if applicable:

b. Provide and briefly describe the process SCC associated with this alternative operating scenario:

Process SCC:		SCC Description:	

c. Alternative Product(s):

Please read instructions carefully before completing this application.

11.7 Source Potential to Emit

Give Potential Emission estimate for all air pollutants emitted at this source for this operating scenario.

Pollutant or CAS Number	Fuel	Emissions/Activity Allowable per Unit	Calc. Method	Max. Capacity	Total Hours	Emission in TPY

Section 12 – Compliance Plan for the Facility

		Yes	No
12.1	Will your facility be in compliance with all applicable requirements at the time of permit issuance and continue to comply with these requirements during the permit duration?	☒	☐
12.2	Will your facility be in compliance with all applicable requirements presently scheduled to take effect during the term of the permit?	☒	☐
12.3	Will these requirements be met by the regulatory required dates?	☒	☐

If you checked "NO" in part 12.1, 12.2 or 12.3, answer the following questions:

12.4 Identify applicable requirement(s) for which compliance is not or will not be achieved:

Source ID Number	Citation Number

12.4.1 Briefly describe how compliance with this/these applicable requirement(s) will be achieved:

12.4.2. Provide a detailed schedule of compliance for the non-complying sources or activities identified in this section of the application. Include an enforceable sequence of corrective actions with milestone and projected compliance dates.

Date	Action/Milestone

12.4.3. Indicate the submittal frequency for the progress report(s): _____

12.4.4. Starting date for the submittal of the progress report(s): _____

Section 13 – Certification of Compliance for Synthetic Minor Source

In order for this Synthetic Minor facility to avoid the State-Only Operating Permit requirements, the applicant must agree to be bound by the emissions limitation(s) and/or restriction(s) contained in this application. In addition, the applicant must agree that these emission limitation(s) are enforceable by the Department, the Environmental Protection Agency and the citizens.

13.1 Schedule for Compliance Certification Submission

a. Frequency of submittal: _____

b. Beginning date: _____

13.2 Certification of Compliance (for Synthetic Minor Facility only)

I certify under the penalty of 18 Pa. CS 4904 (b) (2) that the sources covered by this application will comply with the emission limitations and other requirements contained in this application and all previously issued plan approvals and operating permits. I further certify that, based on information and belief formed after reasonable inquiry, the statements and information in this application are true, accurate, and complete.

(Signed) _____ Date _____

Name (Typed) _____

Title: _____

SECTION 3

COMPLIANCE REVIEW FORM

2700-PM-AQ0004 Rev. 6/2006

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

RECEIVED
MAY 22 2014
DEP SOUTHCENTRAL REGION
PROGRAM

AIR POLLUTION CONTROL ACT COMPLIANCE REVIEW FORM

Fully and accurately provide the following information, as specified. Attach additional sheets as necessary.

Type of Compliance Review Form Submittal (check all that apply)

☒ Original Filing
☐ Amended Filing

Date of Last Compliance Review Form Filing: ____/____/____

Type of Submittal

☐ New Plan Approval ☒ New Operating Permit ☐ Renewal of Operating Permit
☐ Extension of Plan Approval ☐ Change of Ownership ☐ Periodic Submission (@ 6 mos)
☐ Other: _____

SECTION A. GENERAL APPLICATION INFORMATION

Name of Applicant/Permittee/("applicant")
(non-corporations-attach documentation of legal name)
Sunoco Pipeline, L.P.

Address 525 Fritztown Road
Sinking Spring, PA 19608

Telephone 610-670-3284 **Taxpayer ID#** 23-310-2656

Permit, Plan Approval or Application ID#

Identify the form of management under which the applicant conducts its business (check appropriate box)

☐ Individual ☐ Syndicate ☐ Government Agency
☐ Municipality ☐ Municipal Authority ☐ Joint Venture
☐ Proprietorship ☐ Fictitious Name ☐ Association
☐ Public Corporation ☐ Partnership ☐ Other Type of Business, specify below:
☐ Private Corporation ☒ Limited Partnership

Describe below the type(s) of business activities performed.
SIC Code: 4619 - Pipelines, Not Elsewhere Classified

SECTION B. GENERAL INFORMATION REGARDING "APPLICANT"

If applicant is a corporation or a division or other unit of a corporation, provide the names, principal places of business, state of incorporation, and taxpayer ID numbers of all domestic and foreign parent corporations (including the ultimate parent corporation), and all domestic and foreign subsidiary corporations of the ultimate parent corporation with operations in Pennsylvania. Please include all corporate divisions or units, (whether incorporated or unincorporated) and privately held corporations. (A diagram of corporate relationships may be provided to illustrate corporate relationships.) Attach additional sheets as necessary.

Unit Name	Principal Places of Business	State of Incorporation	Taxpayer ID	Relationship to Applicant
N/A				

SECTION C. SPECIFIC INFORMATION REGARDING APPLICANT AND ITS "RELATED PARTIES"

Pennsylvania Facilities. List the name and location (mailing address, municipality, county), telephone number, and relationship to applicant (parent, subsidiary or general partner) of applicant and all Related Parties' places of business, and facilities in Pennsylvania. Attach additional sheets as necessary.

Unit Name	Street Address	County and Municipality	Telephone No.	Relationship to Applicant
see attachment #1				

Provide the names and business addresses of all general partners of the applicant and parent and subsidiary corporations, if any.

Name	Business Address
Sunoco Logistics Partners Operations GP, LLC	1818 Market Street, Philadelphia, PA 19103-3615

List the names and business address of persons with overall management responsibility for the process being permitted (i.e. plant manager).

Name	Business Address
see attachment #1	

Plan Approvals or Operating Permits. List all plan approvals or operating permits issued by the Department or an approved local air pollution control agency under the APCA to the applicant or related parties that are currently in effect or have been in effect at any time 5 years prior to the date on which this form is notarized. This list shall include the plan approval and operating permit numbers, locations, issuance and expiration dates. Attach additional sheets as necessary.

Air Contamination Source	Plan Approval/ Operating Permit#	Location	Issuance Date	Expiration Date
see attachment #2				

Compliance Background. (Note: Copies of specific documents, if applicable, must be made available to the Department upon its request.) List all documented conduct of violations or enforcement actions identified by the Department pursuant to the APCA, regulations, terms and conditions of an operating permit or plan approval or order by applicant or any related party, using the following format grouped by source and location in reverse chronological order. Attach additional sheets as necessary. See the definition of "documented conduct" for further clarification. Unless specifically directed by the Department, deviations which have been previously reported to the Department in writing, relating to monitoring and reporting, need not be reported.

Date	Location	Plan Approval/ Operating Permit#	Nature of Documented Conduct	Type of Department Action	Status: Litigation Existing/Continuing or Corrected/Date	Dollar Amount Penalty
07/27/02	No. 2 Tank Farm	23-00044	The VOC RACT fugitive emissions monitoring did not occur during the 2nd qtr. Of 2002. Failure to monitor	NOV	Monitoring was performed for 2nd qtr. 2002 and the Department was notified.	$ 0
05/20/04	Ft. Mifflin Terminal	23-00037	Product discovered on roof of a tank, as well as open hatch	NOV	Corrected within 30 days.	$ 0
03/06/06	Twin Oaks Terminal	23-00045	Failure to submit 05/01/05-10/31/05 semiannual monitoring report	NOV	Confusion with reporting dates in new permit issued on 10/05/05 resulted in semiannual report being submitted late. Report was issued to the Department on 02/21/06.	$ 0
03/06/06	Twin Oaks Terminal	23-00045	Failure to complete stack test in a timely manner.	NOV	New permit required stack test to be completed by 2/15/06. Stack test completed on 03/01/06.	$ 0
06/12/07	Darby Creek Tank Farm	23-00011	Product on tank roofs, in oil/water boxes, around roof drain outlets, on ground below crude mixers, open vacuum breakers, open roof drain cover, absence of required records, absence of required seal gap notifications, lack of records of annual PRV checks.	NOV/CACP	Response to PADEP submitted on 6/29/07, challenging all findings of NOV and requesting NOV to be rescinded. Awaiting response. CACP issued May 2008. A review of the findings is pending.	$37,730
03/01/07	Fort Mifflin Terminal	23-00037	Failure to submit semi-annual compliance certification/deviation report in a timely manner.	NOV	Response to PADEP, submitted on 4/4/07, requesting NOV to be rescinded. NOV issued before the due date of report. Awaiting response.	$0
07/20/07	Fort Mifflin Terminal	23-00037	Observed seal gaps, observed torn seals, vapor pressure exceedances.	NOV/CACP	Response to PADEP submitted on 7/24/07, challenging all findings of NOV and requesting NOV to be rescinded. CACP issued May 2008. Entered into agreement to settle in order to avoid time and expense of challenging the findings.	$2,700
07/20/07	No. 2 Tank Farm	23-00044	Failure to submit semiannual deviation report in a timely manner, absence of required records, absence of required seal gap notifications.	NOV/CACP	Response to PADEP submitted on 7/31/07, challenging two of three findings of NOV. CACP issued May 2008. Entered into agreement to settle in order to avoid time and expense of challenging the findings.	$2,200

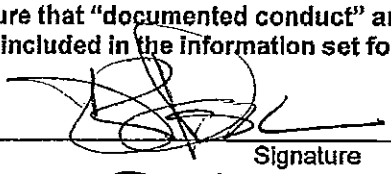
10/02/07	Willow Grove Terminal	46-00091	Failure to obtain required approval prior to installing a control device and operating a source without a permit.	NOV/CACP	Response to PADEP in July 2008 agreeing to violations and penalty	$5,000
10/28/09	Montello Terminal	06-05064B	Construction of a Vapor Recovery Unit prior to approval from the department	NOV	Response to PADEP submitted 11/03/09 explaining problems associated with obtaining plan approval. Plan approval issued 11/19/09.	$1,500
02/09/11	Mechanicsburg Terminal	Plan Approval 21-05029B	Failure to submit an administrative amendment application to roll plan approval conditions into operating permit at least 15 days prior to the end of the initial 180-day shakedown period	NOV	Administrative amendment submitted to Department 12/10/2010.	$0
02/09/11	Montello Terminal	Plan Approval 06-05064B	Failure to submit an administrative amendment application to roll plan approval conditions into operating permit at least 15 days prior to the end of the initial 180-day shakedown period	NOV	Administrative amendment submitted to Department 12/10/2010.	$0
12/28/11	Willow Grove Terminal	46-0091	Failure to notify PADEP 30 days prior to conducting a stack test	NOV/CACP	Corrective Action submitted Jan 10,2012. CACP pending.	$0
8/12/13	Delmont Terminal	65-00354	Exceedances of tank 701 and 702 annual VOC limitation	NOV	Correspondence with PADEP to revise permit.	$0

List all incidents of deviations of the APCA, regulations, terms and conditions of an operating permit or plan approval or order by applicant or any related party, using the following format grouped by source and location in reverse chronological order. This list must include items both currently known and unknown to the Department. Attach additional sheets as necessary. See the definition of "deviations" for further clarification.

Date	Location	Plan Approval/ Operating Permit#	Nature of Deviation	Incident Status: Litigation Existing/Continuing Or Corrected/Date

CONTINUING OBLIGATION. Applicant is under a continuing obligation to update this form using the Compliance Review Supplemental Form if any additional deviations occur between the date of submission and Department action on the application.

2700-PM-AQ0004 Rev. 6/2006

VERIFICATION STATEMENT
Subject to the penalties of Title 18 Pa.C.S. Section 4904 and 35 P.S. Section 4009(b)(2), I verify under penalty of law that I am authorized to make this verification on behalf of the Applicant/Permittee. I further verify that the information contained in this Compliance Review Form is true and complete to the best of my belief formed after reasonable inquiry. I further verify that reasonable procedures are in place to ensure that "documented conduct" and "deviations" as defined in 25 Pa Code Section 121.1 are identified and included in the information set forth in this Compliance Review Form.
 Signature — 5/13/14 Date
D.R. CHALSON Name (Print or Type)
V.P. OPERATIONS Title

Attachment #1: Names, Locations and Facility Managers for all Sunoco Partners Marketing & Terminals L.P. Related Parties in PA.

Facility Name	Owner/Operator	Federal Tax ID #	SIC Code	Facility Address	City	Zip Code	County	Facility Manager	Office Number
Beaver Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	State Road, Box 49	Beaver	15009	Beaver	Mark Whalen	724-774-9440
Belmont Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	2700 West Passyunk Ave	Philadelphia	19145	Philadelphia	Robert Gray	215-339-2550
Blawnox Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	Freeport Road & Boyd	Pittsburgh	15238	Allegheny	Mark Whalen	412-828-7500
Darby Creek Tank Farm	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4612	Calcon Hook Road	Sharon Hill	19079	Delaware	Fred Ammons	610-586-6240
Delmont Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	Route 66	North Delmont	15626	Westmoreland	Mark Whalen	724-468-4072
Eldorado (Altoona) Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	Rt. 764 N. & Sugar Run Road	Altoona	16601	Blair	Mark Whalen	814-944-8153
Exton Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	601 E. Lincoln Highway	Exton	19134	Chester	Robert Gray	610-859-5793
Ft. Mifflin	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	Hog Island Road	Essington	19029	Delaware	Fred Ammons	215-365-6688
Fullerton Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	2480 Main Street	Fullerton	18052	Lehigh	Terry Wolfe	610-264-0526
Hog Island Warf	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	4 Atlantic Avenue	Essington	19029	Delaware	Fred Ammons	215-492-9161
Kingston Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	Rt. 11, Box 1479	Kingston	18704-3102	Luzerne	Terry Wolfe	570-288-2555
Malvern Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	41 Malin Road	Malvern	10355	Chester	Robert Gray	610-296-4517
Marcus Hook Industrial Complex	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	100 Green Street	Marcus Hook	19061	Chester	Jonathan Hunt	610-859-1043
Mechanicsburg Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	5145 Simpson Ferry Road	Mechanicsburg	17055	Cumberland	Terry Wolfe	717-766-2526
Montello Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	PO Box 2089, Fritztown Road	Montello	19608	Berks	Terry Wolfe	610-927-2090
Northumberland Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	Rd#1, Box 285 E	Northumberland	17857	Northumberland	Terry Wolfe	570-473-3575
Pittsburgh Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	5733 Butler Street	Pittsburgh	15210	Allegheny	Mark Whalen	412-784-3460
Tamaqua Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	Tuscarara Street And Park	Tamaqua	18252	Schuylkill	Terry Wolfe	570-668-0430
Twin Oaks Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	4041 Market Street	Aston	19014	Delaware	Robert Gray	610-859-5742
#2 Tank Farm	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4613	7 Commerce Drive	Aston	19014	Delaware	Fred Ammons	610-859-1421
Willow Grove Term.	Sunoco Partners Marketing & Terminals L.P.	23-3102655	4226	3290 Sunset Lane	Hatboro	19040	Montgomery	Robert Gray	215-442-1694
Twin Oaks Term.	Sunoco Partners Marketing & Terminals L.P	23-3102655	4226	4041 Market Street	Aston	19014-3197	Delaware	D.R. Chalson	610-859-5754

Attachment #2: Plan Approvals & Operating Permits

Facility	Owner / Operator	State	Permit Type	Permit #	Effective	Expiration
Beaver (Brighton/ Vanport)	Sunoco Partners Marketing & Terminals L.P.	PA	Operating Permit	04-00489	03/26/2006	03/27/2011
Belmont	Sunoco Partners Marketing & Terminals L.P.	PA	Title V Permit	V04-004	08/01/2010	08/01/2015
Blawnox	Sunoco Partners Marketing & Terminals L.P.	PA	Synthetic Minor	0011	06/28/2011	06/27/2016
Darby Creek	Sunoco Partners Marketing & Terminals L.P.	PA	General Permit	GP2-23-0225	02/11/2010	02/11/2015
Darby Creek	Sunoco Partners Marketing & Terminals L.P.	PA	Title V Permit	23-00011	10/06/2011	10/06/2016
Delmont	Sunoco Partners Marketing & Terminals, L.P.	PA	Title V Permit	65-00354	01/31/2012	01/31/2017
Eldorado	Sunoco Partners Marketing & Terminals L.P.	PA	Synthetic Minor	07-05025	10/01/2008	9/30/2013 (renewal submitted 2/26/13)
Exton	Sunoco Partners Marketing & Terminals L.P.	PA	Synthetic Minor	15-00044	05/01/2010	04/30/2015
Fort Mifflin	Sunoco Partners Marketing & Terminals L.P.	PA	Title V Permit	23-00037	11/01/2010	10/31/2015
Fullerton	Sunoco Partners Marketing & Terminals L.P.	PA	Synthetic Minor	39-00022	04/07/2009	04/07/2014
Hog Island Wharf	Sunoco Partners Marketing & Terminals L.P.	PA	Title V Permit	23-00043	11/15/2011	11/14/2016
Kingston	Sunoco Partners Marketing & Terminals L.P.	PA	Synthetic Minor	40-00025	07/21/2009	07/21/2014
Marcus Hook Industrial Complex	Sunoco Partners Marketing & Terminals L.P.	PA	Title V Permit	23-0001	Facility purchased 4/1/2013	Major permit modification in process
Marcus Hook Industrial Complex	Sunoco Partners Marketing & Terminals L.P.	PA	Plan Approval	23-0119	02/05/2013	08/5/2014
Malvern	Sunoco Partners Marketing & Terminals L.P.	PA	Title V Permit	15-00043	04/30/2009	04/30/3014

Mechanicsburg	Sunoco Partners Marketing & Terminals L.P.	PA	Title V Permit	21-05029	04/01/2009 (revised 02/09/2011)	04/31/2014
Montello	Sunoco Partners Marketing & Terminals L.P.	PA	Title V Permit	06-05064	05/01/2009 (revised 2/8/2011)	04/30/2014
Northumberland	Sunoco Partners Marketing & Terminals L.P.	PA	Synthetic Minor	49-00019	5/27/2009	5/26/2014
#2 Tank Farm	Sunoco Partners Marketing & Terminals L.P.	PA	Title V Permit	23-00044	10/01/2010	09/30/2015
Pittsburgh	Sunoco Partners Marketing & Terminals L.P.	PA	Title V Permit	0007	06/30/2011	06/29/2016
Tamaqua	Sunoco Partners Marketing & Terminals L.P.	PA	Synthetic Minor	54-00015	8/31/2009	8/31/2014
Twin Oaks	Sunoco Partners Marketing & Terminals L.P.	PA	Title V Permit	23-00045	10/21/2010	10/21/2015
Willow Grove	Sunoco Partners Marketing & Terminals L.P.	PA	Title V Permit	46-00091	6/23/2011	6/23/2016

SECTION 4

GENERAL INFORMATION FORM

1300-PM-BIT0001 5/2012
Form

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

RECEIVED
MAY 22 2014
SOUTHCENTRAL REGION
AIR QUALITY PROGRAM

GENERAL INFORMATION FORM – AUTHORIZATION APPLICATION

Before completing this General Information Form (GIF), read the step-by-step instructions provided in this application package. This version of the General Information Form (GIF) must be completed and returned with any program-specific application being submitted to the Department.

Related ID#s (If Known)		DEP USE ONLY
Client ID#	APS ID#	Date Received & General Notes
Site ID#	Auth ID#	
Facility ID#		

CLIENT INFORMATION

DEP Client ID#	Client Type / Code
	PARTL

Organization Name or Registered Fictitious Name	Employer ID# (EIN)	Dun & Bradstreet ID#
Sunoco Pipeline L.P.	23-3102656	

Individual Last Name	First Name	MI	Suffix	SSN
Gordon	Matthew	L		

Additional Individual Last Name	First Name	MI	Suffix	SSN

Mailing Address Line 1	Mailing Address Line 2
525 Fritztown Road	

Address Last Line – City	State	ZIP+4	Country
Sinking Spring	PA	19608	

Client Contact Last Name	First Name	MI	Suffix
Gordon	Matt		

Client Contact Title	Phone	Ext
Project Manager	(610) 670-3284	

Email Address	FAX
mlgordon@sunocologistics.com	

SITE INFORMATION

DEP Site ID#	Site Name
	Cornwall Station

EPA ID#	Estimated Number of Employees to be Present at Site	
		Unmanned - weekly inspections

Description of Site
Natural Gas Liquid Pumping Station

County Name	Municipality	City	Boro	Twp	State
Lebanon	West Cornwall	☐	☐	☒	PA
County Name	**Municipality**	**City**	**Boro**	**Twp**	**State**
		☐	☐	☐	

Site Location Line 1	Site Location Line 2

Site Location Last Line – City	State	ZIP+4
Lebanon	PA	17042

Detailed Written Directions to Site
909 Elmerton Avenue, Harrisburg, PA to Cornwall pump staion. Head southwest on Elmerton Ave. Take the 1st right onto US-22 W (signs for I-81/US-322/Carlisle 22/Lewistowz 55/Hazleton 80). Merge onto I-81 N/US-322 E via the ramp to I-78/Hazleton/Allentown. Keep left to continue on I-81 N, follow signs for I-78/Hazleton/Allentown. Take exit 85A to merge onto PA-934 S toward Annville. Turn left onto PA-241 N/US-322 E, Continue to follow US-322 E. Arrive at pump station along US-322 E.

Site Contact Last Name	First Name	MI	Suffix
Gordon	Matt		

Site Contact Title	Site Contact Firm
Project Manager	Sunoco Pipeline L.P.
Mailing Address Line 1	**Mailing Address Line 2**
525 Fritztown Road	
Mailing Address Last Line – City	**State** **ZIP+4**
Sinking Spring, PA	**PA** **19608**
Phone **Ext** **FAX**	**Email Address**
(610) 670-3284	mlgordon@sunocologistics.com
NAICS Codes (Two- & Three-Digit Codes – List All That Apply)	**6-Digit Code** (Optional)
486990	
Client to Site Relationship	
OWNOP	

FACILITY INFORMATION

Modification of Existing Facility **Yes** **No**

1. **Will this project modify an existing facility, system, or activity?** ☐ ☒
2. **Will this project involve an addition to an existing facility, system, or activity?** ☐ ☒

If "Yes", check all relevant facility types and provide DEP facility identification numbers below.

	Facility Type	DEP Fac ID#		Facility Type	DEP Fac ID#
☐	Air Emission Plant		☐	Industrial Minerals Mining Operation	
☐	Beneficial Use (water)		☐	Laboratory Location	
☐	Blasting Operation		☐	Land Recycling Cleanup Location	
☐	Captive Hazardous Waste Operation		☐	MineDrainageTrmt/LandRecyProjLocation	
☐	Coal Ash Beneficial Use Operation		☐	Municipal Waste Operation	
☐	Coal Mining Operation		☐	Oil & Gas Encroachment Location	
☐	Coal Pillar Location		☐	Oil & Gas Location	
☐	Commercial Hazardous Waste Operation		☐	Oil & Gas Water Poll Control Facility	
☐	Dam Location		☐	Public Water Supply System	
☐	Deep Mine Safety Operation -Anthracite		☐	Radiation Facility	
☐	Deep Mine Safety Operation -Bituminous		☐	Residual Waste Operation	
☐	Deep Mine Safety Operation -Ind Minerals		☐	Storage Tank Location	
☐	Encroachment Location (water, wetland)		☐	Water Pollution Control Facility	
☐	Erosion & Sediment Control Facility		☐	Water Resource	
☐	Explosive Storage Location		☐	Other:	

Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
	40	16	57.51	-76	27	56.49

Horizontal Accuracy Measure Feet --or-- Meters

Horizontal Reference Datum Code
- ☐ North American Datum of 1927
- ☒ North American Datum of 1983
- ☐ World Geodetic System of 1984

Horizontal Collection Method Code NTDEP

Reference Point Code CNTAR

Altitude Feet 582 --or-- Meters

Altitude Datum Name
- ☐ The National Geodetic Vertical Datum of 1929
- ☒ The North American Vertical Datum of 1988 (NAVD88)

Altitude (Vertical) Location Datum Collection Method Code NTDEP

Geometric Type Code POINT

Data Collection Date 5/14/14

Source Map Scale Number 1 Inch(es) = 500 Feet

--or-- Centimeter(s) = Meters

PROJECT INFORMATION

Project Name
Mariner East Pipeline (Cornwall Station)

Project Description
Natural Gas Liquid Pumping Station

Project Consultant Last Name	First Name	MI	Suffix
Kraus	Matt		

Project Consultant Title			Consulting Firm	
Project Manager/Environmental Scientist			Tetra Tech, Inc.	
Mailing Address Line 1			**Mailing Address Line 2**	
661 Andersen Dr. Foster Plaza 7				
Address Last Line – City			**State**	**ZIP+4**
Pittsburgh			PA	15220
Phone	**Ext**	**FAX**	**Email Address**	
(412) 921-8729			matthew.kraus@tetratech.com	

Time Schedules	Project Milestone (Optional)
Tentative - Late Summer/Fall 2014	

1. **Have you informed the surrounding community and addressed any concerns prior to submitting the application to the Department?** ☐ Yes ☒ No

2. **Is your project funded by state or federal grants?** ☐ Yes ☒ No
   Note: If "Yes", specify what aspect of the project is related to the grant and provide the grant source, contact person and grant expiration date.
   Aspect of Project Related to Grant
   Grant Source: _____
   Grant Contact Person: _____
   Grant Expiration Date: _____

3. **Is this application for an authorization on Appendix A of the Land Use Policy? (For referenced list, see Appendix A of the Land Use Policy attached to GIF instructions)** ☐ Yes ☒ No
   Note: If "No" to Question 3, the application is not subject to the Land Use Policy.
   If "Yes" to Question 3, the application is subject to this policy and the Applicant should answer the additional questions in the **Land Use Information** section.

LAND USE INFORMATION

Note: Applicants are encouraged to submit copies of local land use approvals or other evidence of compliance with local comprehensive plans and zoning ordinances.

1. **Is there an adopted county or multi-county comprehensive plan?** ☒ Yes ☐ No
2. **Is there an adopted municipal or multi-municipal comprehensive plan?** ☐ Yes ☒ No
3. **Is there an adopted county-wide zoning ordinance, municipal zoning ordinance or joint municipal zoning ordinance?** ☒ Yes ☐ No
   Note: If the Applicant answers "No" to either Questions 1, 2 or 3, the provisions of the PA MPC are not applicable and the Applicant does not need to respond to questions 4 and 5 below.
   If the Applicant answers "Yes" to questions 1, 2 and 3, the Applicant should respond to questions 4 and 5 below.
4. **Does the proposed project meet the provisions of the zoning ordinance or does the proposed project have zoning approval?** If zoning approval has been received, attach documentation. ☐ Yes ☐ No
5. **Have you attached Municipal and County Land Use Letters for the project?** ☐ Yes ☐ No

COORDINATION INFORMATION

Note: The PA Historical and Museum Commission must be notified of proposed projects in accordance with DEP Technical Guidance Document 012-0700-001 and the accompanying Cultural Resource Notice Form.

If the activity will be a mining project (i.e., mining of coal or industrial minerals, coal refuse disposal and/or the operation of a coal or industrial minerals preparation/processing facility), respond to questions 1.0 through 2.5 below.

If the activity will not be a mining project, skip questions 1.0 through 2.5 and begin with question 3.0.

1.0	**Is this a coal mining project?** If "Yes", respond to 1.1-1.6. If "No", skip to Question 2.0.	☐	Yes	☒	No
1.1	**Will this coal mining project involve coal preparation/ processing activities in which the total amount of coal prepared/processed will be equal to or greater than 200 tons/day?**	☐	Yes	☐	No
1.2	**Will this coal mining project involve coal preparation/ processing activities in which the total amount of coal prepared/processed will be greater than 50,000 tons/year?**	☐	Yes	☐	No
1.3	**Will this coal mining project involve coal preparation/ processing activities in which thermal coal dryers or pneumatic coal cleaners will be used?**	☐	Yes	☐	No
1.4	**For this coal mining project, will sewage treatment facilities be constructed and treated waste water discharged to surface waters?**	☐	Yes	☐	No
1.5	**Will this coal mining project involve the construction of a permanent impoundment meeting one or more of the following criteria: (1) a contributory drainage area exceeding 100 acres; (2) a depth of water measured by the upstream toe of the dam at maximum storage elevation exceeding 15 feet; (3) an impounding capacity at maximum storage elevation exceeding 50 acre-feet?**	☐	Yes	☐	No
1.6	**Will this coal mining project involve underground coal mining to be conducted within 500 feet of an oil or gas well?**	☐	Yes	☐	No
2.0	**Is this a non-coal (industrial minerals) mining project?** If "Yes", respond to 2.1-2.6. If "No", skip to Question 3.0.	☐	Yes	☒	No
2.1	**Will this non-coal (industrial minerals) mining project involve the crushing and screening of non-coal minerals other than sand and gravel?**	☐	Yes	☐	No
2.2	**Will this non-coal (industrial minerals) mining project involve the crushing and/or screening of sand and gravel with the exception of wet sand and gravel operations (screening only) and dry sand and gravel operations with a capacity of less than 150 tons/hour of unconsolidated materials?**	☐	Yes	☐	No
2.3	**Will this non-coal (industrial minerals) mining project involve the construction, operation and/or modification of a portable non-metallic (i.e., non-coal) minerals processing plant under the authority of the General Permit for Portable Non-metallic Mineral Processing Plants (i.e., BAQ-PGPA/GP-3)?**	☐	Yes	☐	No
2.4	**For this non-coal (industrial minerals) mining project, will sewage treatment facilities be constructed and treated waste water discharged to surface waters?**	☐	Yes	☐	No
2.5	**Will this non-coal (industrial minerals) mining project involve the construction of a permanent impoundment meeting one or more of the following criteria: (1) a contributory drainage area exceeding 100 acres; (2) a depth of water measured by the upstream toe of the dam at maximum storage elevation exceeding 15 feet; (3) an impounding capacity at maximum storage elevation exceeding 50 acre-feet?**	☐	Yes	☐	No

3.0	**Will your project, activity, or authorization have anything to do with a well related to oil or gas production, have construction within 200 feet of, affect an oil or gas well, involve the waste from such a well, or string power lines above an oil or gas well?** If "Yes", respond to 3.1-3.3. If "No", skip to Question 4.0.	☐	Yes	☒	No
3.1	**Does the oil- or gas-related project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a watercourse, floodway or body of water (including wetlands)?**	☐	Yes	☐	No
3.2	**Will the oil- or gas-related project involve discharge of industrial wastewater or stormwater to a dry swale, surface water, ground water or an existing sanitary sewer system or storm water system?** If "Yes", discuss in *Project Description*.	☐	Yes	☐	No
3.3	**Will the oil- or gas-related project involve the construction and operation of industrial waste treatment facilities?**	☐	Yes	☐	No
4.0	**Will the project involve a construction activity that results in earth disturbance?** If "Yes", specify the total disturbed acreage. **4.0.1 Total Disturbed Acreage** 3.02	☒	Yes	☐	No
5.0	**Does the project involve any of the following?** If "Yes", respond to 5.1-5.3. If "No", skip to Question 6.0.	☐	Yes	☒	No
5.1	**Water Obstruction and Encroachment Projects – Does the project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a watercourse, floodway or body of water?**	☐	Yes	☐	No
5.2	**Wetland Impacts – Does the project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a wetland?**	☐	Yes	☐	No
5.3	**Floodplain Projects by the commonwealth, a Political Subdivision of the commonwealth or a Public Utility – Does the project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a floodplain?**	☐	Yes	☐	No
6.0	**Will the project involve discharge of stormwater or wastewater from an industrial activity to a dry swale, surface water, ground water or an existing sanitary sewer system or separate storm water system?**	☐	Yes	☒	No
7.0	**Will the project involve the construction and operation of industrial waste treatment facilities?**	☐	Yes	☒	No
8.0	**Will the project involve construction of sewage treatment facilities, sanitary sewers, or sewage pumping stations?** If "Yes", indicate estimated proposed flow (gal/day). Also, discuss the sanitary sewer pipe sizes and the number of pumping stations/treatment facilities/name of downstream sewage facilities in the *Project Description*, where applicable. **8.0.1 Estimated Proposed Flow (gal/day)**	☐	Yes	☒	No
9.0	**Will the project involve the subdivision of land, or the generation of 800 gpd or more of sewage on an existing parcel of land or the generation of an additional 400 gpd of sewage on an already-developed parcel, or the generation of 800 gpd or more of industrial wastewater that would be discharged to an existing sanitary sewer system?**	☐	Yes	☒	No
	9.0.1 Was Act 537 sewage facilities planning submitted and approved by DEP? If "Yes" attach the approval letter. Approval required prior to 105/NPDES approval.	☐	Yes	☐	No
10.0	**Is this project for the beneficial use of biosolids for land application within Pennsylvania?** If "Yes" indicate how much (i.e. gallons or dry tons per year). **10.0.1 Gallons Per Year (residential septage)** _____ **10.0.2 Dry Tons Per Year (biosolids)**	☐	Yes	☒	No
11.0	**Does the project involve construction, modification or removal of a dam?** If "Yes", identify the dam. **11.0.1 Dam Name**	☐	Yes	☒	No

12.0	**Will the project interfere with the flow from, or otherwise impact, a dam?** If "Yes", identify the dam.	☐	Yes	☒	No
	12.0.1 Dam Name				
13.0	**Will the project involve operations (excluding during the construction period) that produce air emissions (i.e., NOX, VOC, etc.)?** If "Yes", identify each type of emission followed by the amount of that emission.	☒	Yes	☐	No
	13.0.1 Enter all types & amounts of emissions; separate each set with semicolons. In tons/year: CO2e = 6.72E-02; CO2 = 6.69E-02; N2O = 6.16E-07; CH4 = 3.08E-06; CO = 1.72E-04; Total VOCs = 2.48E-01; Butane = 2.48E-01; Total HAPs = 0.00+00.				
14.0	**Does the project include the construction or modification of a drinking water supply to serve 15 or more connections or 25 or more people, at least 60 days out of the year?** If "Yes", check all proposed sub-facilities.	☐	Yes	☒	No
	14.0.1 Number of Persons Served _____				
	14.0.2 Number of Employee/Guests _____				
	14.0.3 Number of Connections _____				
	14.0.4 Sub-Fac: Distribution System	☐	Yes	☐	No
	14.0.5 Sub-Fac: Water Treatment Plant	☐	Yes	☐	No
	14.0.6 Sub-Fac: Source	☐	Yes	☐	No
	14.0.7 Sub-Fac: Pump Station	☐	Yes	☐	No
	14.0.8 Sub Fac: Transmission Main	☐	Yes	☐	No
	14.0.9 Sub-Fac: Storage Facility	☐	Yes	☐	No
15.0	**Will your project include infiltration of storm water or waste water to ground water within one-half mile of a public water supply well, spring or infiltration gallery?**	☐	Yes	☒	No
16.0	**Is your project to be served by an existing public water supply?** If "Yes", indicate name of supplier and attach letter from supplier stating that it will serve the project.	☐	Yes	☒	No
	16.0.1 Supplier's Name				
	16.0.2 Letter of Approval from Supplier is Attached	☐	Yes	☐	No
17.0	**Will this project involve a new or increased drinking water withdrawal from a stream or other water body?** If "Yes", should reference both Water Supply and Watershed Management.	☐	Yes	☒	No
	17.0.1 Stream Name				
18.0	**Will the construction or operation of this project involve treatment, storage, reuse, or disposal of waste?** If "Yes", indicate what type (i.e., hazardous, municipal (including infectious & chemotherapeutic), residual) and the amount to be treated, stored, re-used or disposed.	☐	Yes	☒	No
	18.0.1 Type & Amount				
19.0	**Will your project involve the removal of coal, minerals, etc. as part of any earth disturbance activities?**	☐	Yes	☒	No
20.0	**Does your project involve installation of a field constructed underground storage tank?** If "Yes", list each Substance & its Capacity. **Note:** Applicant may need a Storage Tank Site Specific Installation Permit.	☐	Yes	☒	No
	20.0.1 Enter all substances & capacity of each; separate each set with semicolons.				
21.0	**Does your project involve installation of an aboveground storage tank greater than 21,000 gallons capacity at an existing facility?** If "Yes", list each Substance & its Capacity. **Note:** Applicant may need a Storage Tank Site Specific Installation Permit.	☐	Yes	☒	No
	21.0.1 Enter all substances & capacity of each; separate each set with semicolons.				

22.0	**Does your project involve installation of a tank greater than 1,100 gallons which will contain a highly hazardous substance as defined in DEP's Regulated Substances List, 2570-BK-DEP2724?** If "Yes", list each Substance & its Capacity. **Note:** Applicant may need a Storage Tank Site Specific Installation Permit. **22.0.1 Enter all substances & capacity of each; separate each set with semicolons.**	☐	Yes	☒	No
23.0	**Does your project involve installation of a storage tank at a new facility with a total AST capacity greater than 21,000 gallons?** If "Yes", list each Substance & its Capacity. **Note:** Applicant may need a Storage Tank Site Specific Installation Permit. **23.0.1 Enter all substances & capacity of each; separate each set with semicolons.**	☐	Yes	☒	No
24.0	**Will the intended activity involve the use of a radiation source?**	☐	Yes	☒	No

CERTIFICATION

I certify that I have the authority to submit this application on behalf of the applicant named herein and that the information provided in this application is true and correct to the best of my knowledge and information.

Type or Print Name Matthew Gordon

Signature	Title	Date
	Principal Engineer	5/14/14

APPENDIX A

PADEP DETERMATION ON RFD

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

Request for Determination of Requirement For Plan Approval/Operating Permit (RFD)

OFFICIAL USE ONLY

Facility Name:	Sunoco Pipeline L.P. Cornwall Station	**RFD Facility ID:**	1886
RFD Application ID:	3699	**Date Received:**	04/03/2014
Reviewed BY:	Thomas J Hanlon	**Approved Date:**	04/03/2014
Approved By:	Thomas J Hanlon		

☑ **A plan approval is not required for this source (See 25 Pa. Code Section 127.14(a)(1)-(9)**

☐ **An operating permit is not required for this source (See 25 Pa. Code Section 127.443(a))**

☐ **The source(s) do(es) not qualify for exemption. Applicant is required to submit a plan approval application.**

☑ **The source(s) do(es) not qualify for exemption. Applicant is required to submit an operating permit application.**

Remarks

After review, the Department of Environmental Protection has determined that the installation and operation of a John Zink 4'X30' Enclosed ZTOF Flare to control emissions at the above referenced facility is exempt from the Plan Approval requirements per 25 PA Code §127.14(d) listed as No. 44 in the Department's Plan Approval and Operating Permit Exemptions list under Title 25 PA Code §127.14(a)(8). It is the Department's understanding that potential to emit including emissions from equipment leaks from the project will not exceed 0.25 tpy VOC, 0.01 tpy NOx, and 0.2 tpy CO based on the worst case of flaring a maximum of 312,800 scf of pure butane per year; that all compression for the project will be electrically powered as supplied by a public utility; that the flare will be operated by the manufacturer's specification and maintained by the manufacturer's recommended maintenance schedule; that, while the facility is not subject to the Subpart, the applicant will utilize a flare model that meets the requirements of 40 CFR Part 60 Subpart OOOO Section 60.5413(d); that the Cornwall Station is not considered to be adjacent or contiguous with any facilities under common control; and that this project will not trigger the requirements of 25 PA Code Subchapter E or 40 CFR Part 52. The Department has also determined that this project is not exempt from the operating permit requirements. Please submit an application for a State Only Operating Permit application which includes the conditions of this authorization prior to commencement of operation of this facility. This exemption does not affect your obligation to meet all applicable Pennsylvania Air Quality Regulations for this source. All air contamination sources and air pollution control devices must be operated in a manner consistent with the manufacturer's specifications and good engineering practice. Please be advised that this exemption is only valid for the equipment, throughput, and emission levels proposed in this request for determination (RFD). A revised RFD or plan approval application may be required prior to any future expansions or changes which increase atmospheric emissions.

Conditions

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

Request for Determination of Requirement For Plan Approval/Operating Permit (RFD)

OFFICIAL USE ONLY

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Remarks

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Conditions

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

Request for Determination of Requirement For Plan Approval/Operating Permit (RFD)

OFFICIAL USE ONLY

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☐ **The source(s) do(es) not qualify for exemption. Applicant is required to submit a plan approval application.**

☑ **The source(s) do(es) not qualify for exemption. Applicant is required to submit an operating permit application.**

Remarks

After review, the Department of Environmental Protection has determined that the installation and operation of a John Zink 4'X30' Enclosed ZTOF Flare to control emissions at the above referenced facility is exempt from the Plan Approval requirements per 25 PA Code §127.14(d) listed as No. 44 in the Department's Plan Approval and Operating Permit Exemptions list under Title 25 PA Code §127.14(a)(8). It is the Department's understanding that potential to emit including emissions from equipment leaks from the project will not exceed 0.25 tpy VOC, 0.01 tpy NOx, and 0.2 tpy CO based on the worst case of flaring a maximum of 312,800 scf of pure butane per year; that all compression for the project will be electrically powered as supplied by a public utility; that the flare will be operated by the manufacturer's specification and maintained by the manufacturer's recommended maintenance schedule; that, while the facility is not subject to the Subpart, the applicant will utilize a flare model that meets the requirements of 40 CFR Part 60 Subpart OOOO Section 60.5413(d); that the Cornwall Station is not considered to be adjacent or contiguous with any facilities under common control; and that this project will not trigger the requirements of 25 PA Code Subchapter E or 40 CFR Part 52. The Department has also determined that this project is not exempt from the operating permit requirements. Please submit an application for a State Only Operating Permit application which includes the conditions of this authorization prior to commencement of operation of this facility. This exemption does not affect your obligation to meet all applicable Pennsylvania Air Quality Regulations for this source. All air contamination sources and air pollution control devices must be operated in a manner consistent with the manufacturer's specifications and good engineering practice. Please be advised that this exemption is only valid for the equipment, throughput, and emission levels proposed in this request for determination (RFD). A revised RFD or plan approval application may be required prior to any future expansions or changes which increase atmospheric emissions.

Conditions

APPENDIX B

CORNWALL STATION RFD SUBMITTAL

This Request for Determination (RFD) of changes of minor significance and exemption from plan approval/operating permit under Pa Code § 127.14 or § 127.449 is for an enclosed flare that will be constructed by Sunoco Pipeline L.P in West Cornwall Township, Cornwall, Pennsylvania (referred to hereafter as Cornwall Station) on the Mariner East pipeline. Mariner East is a pipeline project that will deliver butane, propane, and ethane from the liquid-rich Marcellus Shale areas in Western Pennsylvania to Marcus Hook, Pennsylvania, where it will be processed, stored, and distributed, to various domestic and waterborne markets. The pipeline will run from southwestern Pennsylvania to southeastern Pennsylvania and will traverse through Pennsylvania Department of Environmental Protection (PADEP) Southwest, South-Central, and Southeast regions. Pumping stations along the pipeline will use electric driven split case multistage centrifugal pumps to transport product through the pipeline. All pumping devices used to transport material will utilize electricity supplied by a public utility. The pipeline will transport the natural gas liquids butane, ethane, and propane. From August 2014 to July 2015 the pipeline will transport batches of a minimum 95% butane or 95% propane product. From July 2015 on the line is slated for pure liquid ethane.

A portion of emissions from seal leaks will be disposed of safely through a permanently installed, enclosed flare and another portion of seal leaks will be vented directly to the atmosphere. The maximum volume of product (i.e., butane, ethane, or propane) that leaks through the seals and is captured and combusted will be 0.5 standard cubic feet (SCF) per minute totaling 262,800 SCF per year. Fugitive seals leaks that vent directly to the atmosphere are estimated to be 0.224 tons per year of volatile organic compounds (VOCs) when butane or propane is the product being transferred. Additionally, once per year, the pipeline will require maintenance operations known as pigging, which involves cleaning the pipeline. During this maintenance period, it will be necessary to dispose of an amount of the natural gas liquids safely through each enclosed flare. The estimated maximum volume of gas to be flared at each station is 25,000 SCF during maintenance operations. The estimated annual volume of gas that will be flared at each station is 287,800 SCF. Once every 5 years, Smart Tools pigging operations will send the same amount (25,000 SCF) of gas to the flare. As a result, the worst case annual volume of pipeline gas flared will be 312,800 SCF once every 5 years. No hazardous air pollutant (HAP) emissions are expected to result from the Mariner East Pipeline operations described in this RFD. Emissions calculations and all corresponding assumptions due to maintenance operations, seal leaks, and fugitive emissions are included in this RFD as Attachment 1.

An Aggregation Analysis was completed on the basis of the facility definition contained in 25 PA Code Section 121.1, Guidance for Performing Single Stationary Source Determinations for Oil and Gas Industries (PADEP 270-0810-006). The Aggregation Analysis is included as Attachment 2 to this RFD. Additionally, in accordance with, 25 PA Code § 127.203a, Applicability Determination, this RFD provides the required applicability determination emissions increase calculations for regulated New Source Review (NSR) pollutants associated with the installation of an enclosed flare at Cornwall Station as part of the Sunoco Pipeline L.P. Mariner East pipeline construction project. The Applicability Determination is included as Attachment 3 to this RFD.

The enclosed flares that will be constructed at pumping stations along the Mariner East pipeline are John Zink Company LLC 4' by 30' Enclosed ZTOF Production Flares. A process and instrument diagram, specification sheets, detail diagram, manufacturer recommended maintenance forms, and a wiring diagram for the 4' by 30' Enclosed ZTOF Production Flare are included in Attachment 4. These flares were designed to comply with United States Environmental Protection Agency (EPA) 40 Code of Federal Regulations (CFR) Part 60 Subpart OOOO. In order to comply with that regulation a performance test must be conducted and a report must be submitted to and approved by the EPA to verify that the performance criteria listed per 40 CFR Part 60 Subpart OOOO, specifically paragraph §60.5413(d)(11) are met. Attachment 5 to this RFD is an EPA 40 CFR Part 60 Subpart OOOO Stack Emission Study for the ZTOP 025X15PF Unit. The flare studied in that report uses the same burner as the flares that will be installed along the Mariner East Pipeline and similar results (e.g. VOC destruction efficiencies) are expected for the 4' by 30' Enclosed ZTOP Production Flares, which are scheduled for a stack test study in March 2014.

Each flare constructed will be monitored 24 hours a day seven days a week via a supervisory control and data acquisition (SCADA) system and a physical inspection will occur at a minimum of once per week. Each observation will evaluate and document visible emissions, fugitive emissions, and malodors using the appropriate monitoring equipment. Sunoco Pipeline L.P. personnel will receive training and certification from the (PADEP) "Smoke School" subcontractor to determine the plume opacity. All daily and periodic observations will be documented. The proposed flare system is designed to be fully smokeless through the full range of flows. The flare will operate 24 hours a day seven days a week.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

Request for Determination of Changes of Minor Significance and Exemption from Plan Approval/Operating Permit Under Pa Code §127.14 or §127.449

A. Request for:

Exemption from Plan Approval

- ☐ Physical changes to sources of minor significance, pursuant to 25 Pa. Code Section 127.14(a)(9)
- ☐ Additional physical changes of minor significance that do not add new equipment, pursuant to 25 Pa. Code Section 127.14(c)(1)
- ☑ Other sources and classes of sources of minor significance, pursuant to 25 Pa. Code Section 127.14(a)(8)
- ☐ Additional physical changes of minor significance that add new equipment, pursuant to 25 Pa. Code Section 127.14(c)(2)
- ☑ Minor Sources or classes of sources, pursuant to 25 Pa. Code Section 127.14(a)(1)-(7)

Exemption from Operating Permit

- ☑ Other sources and classes of sources of minor significance, pursuant to 25 Pa. Code Section 127.14(a)(8)
- ☐ Physical changes to sources of minor significance, pursuant to 25 Pa. Code Section 127.14(a)(9)
- ☑ Changes due to De Minimis increases in emissions, pursuant to 25 Pa. Code Section 127.449
- ☐ Additional physical changes of minor significance that add new equipment, pursuant to 25 Pa. Code Section 127.14(c)(2)
- ☐ Additional physical changes of minor significance that do not add new equipment, pursuant to 25 Pa. Code Section 127.14(c)(1)

B. Company/Facility Information

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Company/Facility Name: Sunoco Pipeline L.P.	**Plant Name:**
Site Address: Latitude: 40.443298; Longitude: -79.254204 Blairsville PA 15717	
Mailing Address: 535 Fritztown Road Sinking Spring PA 19608	
Federal Employer Identification Number (EIN): 23-3102656	
Current Operating Permit No:	**NAICS Code:** 493190
Name of Person Completing Form: Matthew Kraus	**Title:** Tetra Tech
Address	**Telephone:** (412) 921-8729
661 Andersen Drive	**Fax:** (412) 921-4040
Pittsburgh PA 15220	**EMail:** matthew.kraus@tetratech.com
Name of Company/Facility Contact Person: Matt Gordon	**Title:** Sunoco Pipeline
Address	**Telephone:** (610) 670-6284
535 Fritztown Road	**Fax:**
Sinking Spring PA 19608	**EMail:** mlgordon@sunocologistics.com

C. Project Description

Project Type: ☐ Other ☐ Remediation ☐ Modification ☑ New Construction

Total number of sources in project: 1

Description of project: The project description is included as an attachment to this RFD.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

Request for Determination of Changes of Minor Significance and Exemption from Plan Approval/Operating Permit Under Pa Code §127.14 or §127.449

D. Source Description

Source Name: EF-4' by 30' Enclosed ZTOP Production Flare

Source Category: INTERNAL COMBUSTION -- Natural Gas

Source Location: Latitude: 40.443298, Longitude: -79.254204

Source Type: ☑ Stationary ☐ Portable

Is equipment existing or proposed? ☐ Existing ☑ Proposed

Actual or Planned Date of Installation: 07/01/2014

Municipality: Black Lick **County:** Indiana

Source Description: The emission source will consist of an enclosed flare that will be used to combust gas during pipeline maintenance operations. The gas enters an inlet manifold at the base of the unit and is then diverted to flow controlled burner trains. The burners premix the gas, controlled naturally aspirated air, and make-up gas when required. The combustion efficiency has been assumed to be 99.9 percent based on the Stack Emission Study presented in Attachment 5 for a similar flare that uses the same burner. The enclosed flares that will be constructed at pumping stations along the Mariner East pipeline are John Zink Company LLC 4# by 30# Enclosed ZTOF Production Flares. A process and instrument diagram, specification sheets, detail diagram, manufacturer recommended maintenance forms, and a wiring diagram for the 4# by 30# Enclosed ZTOF Production Flare are included in Attachment 4. These flares were designed to comply with United States Environmental Protection Agency (EPA) 40 Code of Federal Regulations (CFR) Part 60 Subpart OOOO. In order to comply with that regulation a performance test must be conducted and a report must be submitted to and approved by the EPA to verify that the performance criteria listed per 40 CFR Part 60 Subpart OOOO specifically paragraph §60.5413(d)(11) are met. Attachment 5 to this RFD is an EPA 40 CFR Part 60 Subpart OOOO Stack Emission Study for the ZTOP 025X15PF Unit. The flare studied in that report uses the same burner as the flares that will be installed along the Mariner East Pipeline and similar results (e.g. VOC destruction efficiencies) are expected for the 4# by 30# Enclosed ZTOP Production Flares, which are scheduled for a stack test study in March 2014. Each flare constructed will be monitored 24 hours a day seven days a week via a supervisory control and data acquisition (SCADA) system and a physical inspection will occur at a minimum of once per week. Daily inspections will be conducted at all manned locations such as the Delmont Station. Each observation will evaluate and document visible emissions, fugitive emissions, and malodors using the appropriate monitoring equipment. Sunoco Pipeline L.P. personnel will receive training and certification from the (PADEP) #Smoke School# subcontractor to determine the plume opacity. All daily and periodic observations will be documented. The proposed flare system is designed to be fully smokeless through the full range of flows. The flare will operate 24 hours a day seven days a week.

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Pollutant	Calculation Method	Emissions (lbs/hr)	Emissions (tons/year)
Particulate	SEE COMMENT	0.0000	0.0000
PM10	SEE COMMENT	0.0000	0.0000
PM2.5	SEE COMMENT	0.0000	0.0000
SOX	SEE COMMENT	0.0000	0.0000
CO	SEE COMMENT	0.0000	0.0002
NOX	SEE COMMENT	0.0000	0.0000
VOC	SEE COMMENT	0.0567	0.2480
Hazardous Air Pollutants	SEE COMMENT	0.0000	0.0000

Will the construction of this source increase emissions from other sources at this facility?

☐ Yes ☑ No

Is the construction or modification of the source subject to 25 Pa. Code, Subchapter E, New Source Review (NSR)

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DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

Request for Determination of Changes of Minor Significance and Exemption from Plan Approval/Operating Permit Under Pa Code §127.14 or §127.449

requirements or prevention of Significant Deterioration (PSD) of Air Quality regulations at Subchapter D?

☐ Yes ☑ No

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D. Source Description

Source Name: EF-4' by 30' Enclosed ZTOP Production Flare

Source Category: INTERNAL COMBUSTION -- Natural Gas

Source Location: Latitude: 40.443298, Longitude: -79.254204

Source Type: ☑ Stationary ☐ Portable

Is equipment existing or proposed? ☐ Existing ☑ Proposed

Actual or Planned Date of Installation: 07/01/2014

Municipality: Black Lick **County:** Indiana

Source Description: The emission source will consist of an enclosed flare that will be used to combust gas during pipeline maintenance operations. The gas enters an inlet manifold at the base of the unit and is then diverted to flow controlled burner trains. The burners premix the gas, controlled naturally aspirated air, and make-up gas when required. The combustion efficiency has been assumed to be 99.9 percent based on the Stack Emission Study presented in Attachment 5 for a similar flare that uses the same burner. The enclosed flares that will be constructed at pumping stations along the Mariner East pipeline are John Zink Company LLC 4# by 30# Enclosed ZTOF Production Flares. A process and instrument diagram, specification sheets, detail diagram, manufacturer recommended maintenance forms, and a wiring diagram for the 4# by 30# Enclosed ZTOF Production Flare are included in Attachment 4. These flares were designed to comply with United States Environmental Protection Agency (EPA) 40 Code of Federal Regulations (CFR) Part 60 Subpart OOOO. In order to comply with that regulation a performance test must be conducted and a report must be submitted to and approved by the EPA to verify that the performance criteria listed per 40 CFR Part 60 Subpart OOOO specifically paragraph §60.5413(d)(11) are met. Attachment 5 to this RFD is an EPA 40 CFR Part 60 Subpart OOOO Stack Emission Study for the ZTOP 025X15PF Unit. The flare studied in that report uses the same burner as the flares that will be installed along the Mariner East Pipeline and similar results (e.g. VOC destruction efficiencies) are expected for the 4# by 30# Enclosed ZTOP Production Flares, which are scheduled for a stack test study in March 2014. Each flare constructed will be monitored 24 hours a day seven days a week via a supervisory control and data acquisition (SCADA) system and a physical inspection will occur at a minimum of once per week. Daily inspections will be conducted at all manned locations such as the Delmont Station. Each observation will evaluate and document visible emissions, fugitive emissions, and malodors using the appropriate monitoring equipment. Sunoco Pipeline L.P. personnel will receive training and certification from the (PADEP) #Smoke School# subcontractor to determine the plume opacity. All daily and periodic observations will be documented. The proposed flare system is designed to be fully smokeless through the full range of flows. The flare will operate 24 hours a day seven days a week.

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Pollutant	Calculation Method	Emissions (lbs/hr)	Emissions (tons/year)
Particulate	SEE COMMENT	0.0000	0.0000
PM10	SEE COMMENT	0.0000	0.0000
PM2.5	SEE COMMENT	0.0000	0.0000
SOX	SEE COMMENT	0.0000	0.0000
CO	SEE COMMENT	0.0000	0.0002
NOX	SEE COMMENT	0.0000	0.0000
VOC	SEE COMMENT	0.0567	0.2480
Hazardous Air Pollutants	SEE COMMENT	0.0000	0.0000

Will the construction of this source increase emissions from other sources at this facility?

☐ Yes ☑ No

Is the construction or modification of the source subject to 25 Pa. Code, Subchapter E, New Source Review (NSR)

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DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

Request for Determination of Changes of Minor Significance and Exemption from Plan Approval/Operating Permit Under Pa Code §127.14 or §127.449

requirements or prevention of Significant Deterioration (PSD) of Air Quality regulations at Subchapter D?

☐ Yes ☑ No

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BUREAU OF AIR QUALITY

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E. Exemption History

Source Name	Date of Installation	Reason for Exemption		
		RFD	Exemption List	De Minimis

F. List of Attached Documents

Description of Attachment	Confidential?
Attachment 5 - Stack Emission Study. Will be sent via Tetra Tech file transfer site.	N
Flare Design Specs, Inspection, and Maintenance Forms	Y
Emission calculations for the proposed enclosed flare.	N
Applicability Determination for enclosed flare at New Station #1	N
Project Description for New Station #1.	N
Aggregation Analysis for New Station #1	N

G. Signature of Responsible Official or Authorized Representative

I, ,certify under penalty of law as provided in 18 Pa. C.S.A. § 4904 and 35 P.S. § 4009(b)(2) that based on information and belief formed after reasonable inquiry, the statements and information contained in this form are true, accurate, and complete.

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Name	Date	Telephone
Address		Email Address

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

Request for Determination of Changes of Minor Significance and Exemption from Plan Approval/Operating Permit Under Pa Code §127.14 or §127.449

NOTES

From: MARK GOROG **Date:** 01/15/2014

Subject: The Application is rejected by reviewer.

Message:
Applicant will revise application as discussed.

From: Fer Padilla **Date:** 05/14/2013

Subject: Exemption Request

Message:
§ 127.14. Exemptions

(a) Plan approval is not required for the construction, modification, reactivation or installation of the following:

(3) Combustion units with a rated capacity of less than 10 million Btu per hour of heat input fueled by natural gas supplied by a public utility, liquified petroleum gas or by commercial fuel oils which are No. 2 or lighter#viscosity less than or equal to 5.82 C St#and which meet the sulfur content requirements of § 123.22 (relating to combustion units). Combustion units converting to fuel oils which are No. 3 or heavier#viscosity greater than 5.82 C St#or contain sulfur in excess of the requirements of § 123.22 require approval. For the purpose of this section, commercial fuel oil shall be virgin oil which has no reprocessed, recycled or waste material added.

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ATTACHMENT 1 - EMISSIONS CALCULATIONS

1-1 FLOW SERVE EMISSIONS SEAL LEAKS SUPPORT INFORMATION

Thomas Schullik
District Manager

OEM & Project Sales
Seals and Support Systems

August 30, 2013

Mr. Trey Maxwell
Best PumpWorks
8885 Monroe Rd.
Houston, TX 77061

SUBJECT: Sunoco Mariner East Project.
Estimated Seal Performance Data.

Below are answers to a series of questions posed to Flowserve's Seal Engineering Team. Answers are based on the customer conditions of service at time of quoting.

- Best PumpWorks610 – PMW Model – 6x8x12H Size – BB3 style pump – Running at 1800-3600 RPM
- Light Hydrocarbon – NGL Mix of Ethane and Propane @ 100F (Max)
- Specific Gravity of 0.26/0.52 – Viscosity of 0.13cP
- Suction Pressure = 579 PSIG, Discharge = 1435 PSIG, Product Vapor Pressure of 531 PSIA
- Seals Designed for Max Potential Box Pressure of 1480 PSIG.
- Seal Model – UHTW/GSL

a. The expected leakage of Primary Liquid Wavy Face seal that would be directed to Flare?
   i. For 100% Ethane and 100% Propane conditions:
   Flowserve would estimate the leakage range in testing is .15-.5 scfm on 100% ethane and is predicted very similar by FEA for 100% propane. This is not a guaranteed rate, just an estimate based on similar testing.
   ii. Normal Operation seal chamber pressures:
   Same answer as above. Flowserve would estimate the leakage range in testing is .15-.5 scfm on 100% ethane and is predicted very similar by FEA for 100% propane. This is not a guaranteed rate, just an estimate based on similar testing.
   iii. Max pump discharge pressure:
   Test data for ethane only goes up to 1100 psig and is in the .15-.5 scfm range as well. Again, this not a guaranteed rate.

b. The expected leakage to atmospheric side of the GSLW for 100% Propane and 100% Ethane operation?
   i. Under normal seal chamber pressure operation conditions:
   The GSL will operate at the cracking pressure of the check valve we require in the flare line. All the testing has been done with a 10 psi cracking valve. Testing done recently has not captured GSL leakage to the atmosphere. Original testing on the GSL measured leakage on a 2,375 seal at ~175 ppm at 10 psi (GSL Seal Profile, Page 7, and Section 1111-0200-05-G). Visually, there has been no noticeable leakage from the GSL under normal operating conditions.

Flowserve Corporation
www.flowserve.com
14219 Westfair West Road
Houston, TX 77041
Phone: 281-671-9233
Fax: 281-671-9267
Cell Phone: 610-662-5482

Thomas Schullik
District Manager

OEM & Project Sales
Seals and Support Systems

Based on historical leakage rate lab testing on Propane for low emission seals we estimate leakage to be close to zero. Leakage would be approximately 0.01 SCFH. GSL seals measured seal emissions to be less than 200 ppm.

ii. Under normal operation conditions seal chamber pressure operation (as if the primary seal vanished):
The same comment as above about capturing GSL leakage. Using the same GSL Seal Profile, the seal was run at 300 psi nitrogen pressure and produced ~550 ml/min of external leakage. We have also run the GSL on CO2 at 2200 psig and ethylene at 1150 psig and the seals hold the pressure with minimal leakage. The seal will prevent a major release to atmosphere.

iii. Under Max Pump discharge pressure (as if the primary seal vanished):
The Same comment as above about capturing GSL leakage. Using the same GSL Seal Profile, the seal was run at 300 psi nitrogen pressure and produced ~550 ml/min of external leakage. We have also run the GSL on CO2 at 2200 psig and ethylene at 1150 psig and the seals hold the pressure with minimal leakage. The seal will prevent a major release to atmosphere.

c. The expected flow to the Flare through Plan 76 in the case of catastrophic inboard seal failure (as if the primary seal vanished)?

The flow rate to the flare when the inner seal vanishes is a function of the GSL leakage and the restrictions in the flare connection. The flare connection to the seal would become a direct tap into the seal chamber of the pump with whatever restrictions there are in the line acting as orifices. Estimating this rate is an orifice calculation based on the components in the P76 system. Since we don't want a lot of restriction in the flare line under normal conditions, the flow rate when the inner seal disappears is going to be very high. The answers to the specific cases depend on the design of the P76 system. Designing for 10x normal leak rate is a good starting point.

If you have additional questions or any concern please let us know and we will be happy to address the issue. We are confident that our proposed seal design will meet the needs of these application conditions. Of course we will conduct an FEA of the seal design for optimization of design and construction should we be given the opportunity to provide our seals for this project.

Thank you again for this opportunity to provide additional detail.

Kind Regards,

Tom Schullik
District Manager – Gulf Coast
Flowserve Corporation
14219 Westfair West Road
Houston, TX 77041

1-2 MAXIMUM FLOW RATE CALCULATION SUPPORT INFORMATION

Mariner East Project
Rooney Engineering, Inc.
2/3/2014

Calculations for Pump Station Flare Design Basis

Flowserve will be providing the pump seals on the pumps being ordered from BestPump Works. Due to the nature of the seal design and the selected seal flush plan, there will be a constant (small) flow of product from the pump seals through the API 12/75 flush plan. The estimated flowrate from the vendor is as follows:

Constant Flow During Normal Operation = 0.5 SCFM (720 SCFD) (Estimated)

Additionally, the flares at the pump stations may be used to blow down portions of the pump station piping for maintenance purposes. This would occur only during operational upsets or for DOT direct assessment of piping, or during maintenance pigging operations. The sizing basis for this scenario will be based on the total volume of product to be exhausted through the flare and the desired duration of the flare event.

94.5	actual ft3 (volume of 120 feet of 12" Station Pipe, Pump Discharge to Pig Launcher)
7.0	hours for blowdown
10,000,000	BTU/hr (Max for flare design)

Ethane

25.6	lbm/ft3 (density at 1480 psig & 60°F)
2,419	lbm (total mass to be flared)
1.04	SG @ STP (Air = 1.0)
0.08	lbm/ft3 (density at STP)
28,825	ft3 (total volume to be flared @STP)
98,828	scfd
1,641	BTU/ft3 (Heat of Combustion - Lower)
6,757,335	BTU/hr
OK	Design Check

Propane

33.1	lbm/ft3 (density at 1480 psig & 60°F)
3,128	lbm (total mass to be flared)
1.6	SG @ STP (Air = 1.0)
0.13	lbm/ft3 (density at STP)
24,225	ft3 (total volume to be flared @STP)
83,058	scfd
2,385	BTU/ft3 (Heat of Combustion - Lower)
8,253,851	BTU/hr
OK	Design Check

Butane

37.3	lbm/ft3 (density at 1480 psig & 60°F)
3,525	lbm (total mass to be flared)
2.0	SG @ STP (Air = 1.0)
0.16	lbm/ft3 (density at STP)
21,763	ft3 (total volume to be flared @STP)
74,616	scfd
3,113	BTU/ft3 (Heat of Combustion - Lower)
9,678,339	BTU/hr
OK	Design Check

1-3 POTENTIAL EMISSIONS RATE CALCULATIONS

1-3.1 Potential Emissions Rate Summary

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Annual Potential Emissions Rate Summary - Butane		
BASED ON:	Client information and other reference materials as noted in each calculation worksheet.		

	Pigging Operations Emissions Directed to the Flare						Seal Leak Emissions Directed to the Flare			Seal Leak Emissions To the Atmosphere			Total Emissions - Butane Scenario 1[4]			Total Emissions - Butane Scenario 2[5]		
	Butane - Scenario 1[1]			Butane - Scenario 2[2]			100% Butane			Fugitive Emissions[3]								
	Emissions			Emissions			Emissions						Emissions			Emissions		
Pollutants	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year
CO_2e	1.23E+00	1.07E+04	5.37E+00	2.45E+00	2.15E+04	1.07E+01	1.29E+01	1.13E+05	5.64E+01	--	--	--	1.41E+01	1.24E+05	6.18E+01	1.53E+01	1.34E+05	6.72E+01
CO_2	1.22E+00	1.07E+04	5.35E+00	2.44E+00	2.14E+04	1.07E+01	1.28E+01	1.12E+05	5.62E+01	--	--	--	1.41E+01	1.23E+05	6.16E+01	1.53E+01	1.34E+05	6.69E+01
N_2O	1.12E-05	9.85E-02	4.93E-05	2.25E-05	1.97E-01	9.85E-05	1.18E-04	1.04E+00	5.18E-04	--	--	--	1.29E-04	1.13E+00	5.67E-04	1.41E-04	1.23E+00	6.16E-04
CH_4	5.62E-05	4.93E-01	2.46E-04	1.12E-04	9.85E-01	4.93E-04	5.91E-04	5.18E+00	2.59E-03	--	--	--	6.47E-04	5.67E+00	2.84E-03	7.04E-04	6.16E+00	3.08E-03
CO	3.15E-03	2.76E+01	1.38E-02	6.29E-03	5.51E+01	2.76E-02	3.31E-02	2.90E+02	1.45E-01	--	--	--	3.62E-02	3.17E+02	1.59E-01	3.94E-02	3.45E+02	1.72E-01
Total VOCs	4.38E-01	3.83E+03	1.92E+00	8.75E-01	7.67E+03	3.83E+00	4.60E+00	4.03E+04	2.02E+01	5.12E-02	4.48E+02	2.24E-01	5.09E+00	4.46E+04	2.23E+01	5.53E+00	4.84E+04	2.42E+01
Propane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Butane	4.38E-01	3.83E+03	1.92E+00	8.75E-01	7.67E+03	3.83E+00	4.60E+00	4.03E+04	2.02E+01	--	--	--	5.09E+00	4.46E+04	2.23E+01	5.53E+00	4.84E+04	2.42E+01
Total HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	--	--	--	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

(1) - Scenario 1 assumes that the volume of gas flared during pigging operations is 25,000 scf/year.

(2) - Scenario 2 assumes that the volume of gas flared during pigging operations is 50,000 scf/year.

(3) - The emission factors used to calculate the fugitive emissions are for total organic compounds (including non-VOCs such as methane and ethane) (USEPA, 1995). Because propane, ethane, and butane use the same emission factor, the fugitive emissions were not divided into multiple scenarios and can be applied to both propane and butane for potential emissions rate calculations.

(4) - Totals presented are the sum of the pigging operations emissions (Scenario 1), seal leak emissions directed to the flare, and seal leak emissions to the atmosphere (for total VOCs only).

(5) - Totals presented are the sum of the pigging operations emissions (Scenario 2), seal leak emissions directed to the flare, and seal leak emissions to the atmosphere (for total VOCs only).

CH_4 = Methane

CO = Carbon Monoxide

CO_2 = Carbon Dioxide

CO_2e = Greenhouse Gas emissions in Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results

N_2O = Nitrous Oxide

Total HAPs = Hazardous Air Pollutants

Total VOCs = Volatile Organic Compounds

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Annual Potential Emissions Rate Summary - Propane		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

	Pigging Operations Emissions Directed to the Flare						Seal Leak Emissions Directed to the Flare			Seal Leak Emissions To the Atmosphere			Total Emissions - Propane Scenario 1[4]			Total Emissions - Propane Scenario 2[5]		
	Propane - Scenario 1[1]			Propane - Scenario 2[2]			100% Propane			Fugitive Emissions[3]								
	Emissions			Emissions			Emissions						Emissions			Emissions		
Pollutants	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year
CO_2e	9.20E-01	8.06E+03	4.03E+00	1.84E+00	1.61E+04	8.06E+00	9.67E+00	8.47E+04	4.24E+01	--	--	--	1.06E+01	9.28E+04	4.64E+01	1.15E+01	1.01E+05	5.04E+01
CO_2	9.16E-01	8.03E+03	4.01E+00	1.83E+00	1.61E+04	8.03E+00	9.63E+00	8.44E+04	4.22E+01	--	--	--	1.05E+01	9.24E+04	4.62E+01	1.15E+01	1.00E+05	5.02E+01
N_2O	8.94E-06	7.84E-02	3.92E-05	1.79E-05	1.57E-01	7.84E-05	9.40E-05	8.24E-01	4.12E-04	--	--	--	1.03E-04	9.02E-01	4.51E-04	1.12E-04	9.80E-01	4.90E-04
CH_4	4.47E-05	3.92E-01	1.96E-04	8.94E-05	7.84E-01	3.92E-04	4.70E-04	4.12E+00	2.06E-03	--	--	--	5.15E-04	4.51E+00	2.25E-03	5.60E-04	4.90E+00	2.45E-03
CO	2.50E-03	2.19E+01	1.10E-02	5.01E-03	4.38E+01	2.19E-02	2.63E-02	2.30E+02	1.15E-01	--	--	--	2.88E-02	2.52E+02	1.26E-01	3.13E-02	2.74E+02	1.37E-01
Total VOCs	3.31E-01	2.90E+03	1.45E+00	6.63E-01	5.80E+03	2.90E+00	3.49E+00	3.06E+04	1.53E+01	5.12E-02	4.48E+02	2.24E-01	3.87E+00	3.39E+04	1.70E+01	4.20E+00	3.68E+04	1.84E+01
Propane	3.31E-01	2.90E+03	1.45E+00	6.63E-01	5.80E+03	2.90E+00	3.49E+00	3.06E+04	1.53E+01	--	--	--	3.87E+00	3.39E+04	1.70E+01	4.20E+00	3.68E+04	1.84E+01
Ethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Butane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	--	--	--	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

(1) - Scenario 1 assumes that the volume of gas flared during pigging operations is 25,000 scf/year.

(2) - Scenario 2 assumes that the volume of gas flared during pigging operations is 50,000 scf/year.

(3) - The emission factors used to calculate the fugitive emissions are for total organic compounds (including non-VOCs such as methane and ethane) (USEPA, 1995). Because propane, ethane, and butane use the same emission factor, the fugitive emissions were not divided into multiple scenarios and can be applied to both propane and butane for potential emissions rate calculations.

(4) - Totals presented are the sum of the pigging operations emissions (Scenario 1), seal leak emissions directed to the flare, and seal leak emissions to the atmosphere (for VOCs only).

(5) - Totals presented are the sum of the pigging operations emissions (Scenario 2), seal leak emissions directed to the flare, and seal leak emissions to the atmosphere (for VOCs only).

CH_4 = Methane

CO = Carbon Monoxide

CO_2 = Carbon Dioxide

CO_2e = Greenhouse Gas emissions in Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results

N_2O = Nitrous Oxide

Total HAPs = Hazardous Air Pollutants

Total VOCs = Volatile Organic Compounds

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Annual Potential Emissions Rate Summary - Ethane		
BASED ON:	Client information and other reference materials as noted in each calculation worksheet.		

	Pigging Operations Emissions Directed to the Flare						Seal Leak Emissions Directed to the Flare			Seal Leak Emissions To the Atmosphere			Total Emissions - Ethane Scenario 1[4]			Total Emissions - Ethane Scenario 2[5]		
	Ethane - Scenario 1[1]			Ethane - Scenario 2[2]			100% Ethane			Fugitive Emissions[3]								
	Emissions			Emissions			Emissions						Emissions			Emissions		
Pollutants	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year
CO_2e	6.45E-01	5.65E+03	2.82E+00	1.29E+00	1.13E+04	5.65E+00	6.78E+00	5.94E+04	2.97E+01	--	--	--	7.42E+00	6.50E+04	3.25E+01	8.07E+00	7.07E+04	3.53E+01
CO_2	6.42E-01	5.63E+03	2.81E+00	1.28E+00	1.13E+04	5.63E+00	6.75E+00	5.91E+04	2.96E+01	--	--	--	7.39E+00	6.48E+04	3.24E+01	8.04E+00	7.04E+04	3.52E+01
N_2O	6.15E-06	5.39E-02	2.69E-05	1.23E-05	1.08E-01	5.39E-05	6.47E-05	5.66E-01	2.83E-04	--	--	--	7.08E-05	6.20E-01	3.10E-04	7.70E-05	6.74E-01	3.37E-04
CH_4	3.08E-05	2.69E-01	1.35E-04	6.15E-05	5.39E-01	2.69E-04	3.23E-04	3.23E-04	3.23E-04	--	--	--	3.54E-04	2.70E-01	4.58E-04	3.85E-04	5.39E-01	5.93E-04
CO	1.72E-03	1.51E+01	7.54E-03	3.44E-03	3.02E+01	1.51E-02	2.63E-02	2.30E+02	7.92E-02	--	--	--	2.80E-02	2.46E+02	8.68E-02	2.97E-02	2.61E+02	9.43E-02
Total VOCs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.12E-02	4.48E+02	2.24E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Propane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethane	2.26E-01	1.98E+03	9.92E-01	4.53E-01	3.97E+03	1.98E+00	2.38E+00	2.09E+04	1.04E+01	--	--	--	2.61E+00	2.28E+04	1.14E+01	2.83E+00	2.48E+04	1.24E+01
Butane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	--	--	--	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

(1) - Scenario 1 assumes that the volume of gas flared during pigging operations is 25,000 scf/year.

(2) - Scenario 2 assumes that the volume of gas flared during pigging operations is 50,000 scf/year.

(3) - The emission factors used to calculate the fugitive emissions are for total organic compounds (including non-VOCs such as methane and ethane) (USEPA, 1995). Because propane, ethane, and butane use the same emission factor, the fugitive emissions were not divided into multiple scenarios and can be applied to both propane and butane for potential emissions rate calculations.

(4) - Totals presented are the sum of the pigging operations emissions (Scenario 1) and seal leak emissions directed to the flare. Seal leak emissions to the atmosphere (for VOCs only) are not included because ethane is not considered a VOC.

(5) - Totals presented are the sum of the pigging operations emissions (Scenario 2) and seal leak emissions directed to the flare Seal leak emissions to the atmosphere (for VOCs only) are not included because ethane is not considered a VOC.

CH_4 = Methane

CO = Carbon Monoxide

CO_2 = Carbon Dioxide

CO_2e = Greenhouse Gas emissions in Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results

N_2O = Nitrous Oxide

Total HAPs = Hazardous Air Pollutants

Total VOCs = Volatile Organic Compounds

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Maximum Hourly Potential Emissions Rate Summary - Butane		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

	Pigging Operations Emissions Directed to the Flare		Seal Leak Emissions Directed to the Flare		Seal Leak Emissions To the Atmosphere		Total Emissions - Butane - Maximum Hourly Basis[4]	
	Butane - Maximum Hourly Basis[1]		100% Butane[2]		Fugitive Emissions[2][3]			
	Emissions		Emissions				Emissions	
Pollutants	lbs./hour	tons/hour	lbs./hour	tons/hour	lbs/hour	tons/hour	lbs/hour	tons/hour
CO_2e	1.34E+03	6.68E-01	1.29E+01	6.44E-03	--	--	1.35E+03	6.74E-01
CO_2	1.33E+03	6.65E-01	1.28E+01	6.42E-03	--	--	1.34E+03	6.72E-01
N_2O	1.23E-02	6.13E-06	1.18E-04	5.91E-08	--	--	1.24E-02	6.19E-06
CH_4	6.13E-02	3.06E-05	5.91E-04	2.96E-07	--	--	6.19E-02	3.09E-05
CO	3.43E+00	1.71E-03	3.31E-02	1.65E-05	--	--	3.46E+00	1.73E-03
Total VOCs	4.77E+02	2.38E-01	4.60E+00	2.30E-03	5.12E-02	2.56E-05	4.81E+02	2.41E-01
Propane	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--
Butane	4.77E+02	2.38E-01	4.60E+00	2.30E-03	--	--	4.81E+02	2.41E-01
Total HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	--	--	0.00E+00	0.00E+00

(1) - The maximum hourly basis calculation assumes that the volume of gas flared during pigging operations is 3,109 scf/hour.

(2) - Seal leaks directed to the flare and fugitive emissions are assumed to be the same as those calculated for an annual basis.

(3) - The emission factors used to calculate the fugitive emissions are for total organic compounds (including non-VOCs such as methane and ethane) (USEPA, 1995). Because propane, ethane, and butane use the same emission factor, the fugitive emissions were not divided into multiple scenarios and can be applied to both propane and butane for potential to emit calculations.

(4) - Totals presented are the sum of the pigging operations emissions (hourly basis), seal leak emissions directed to the flare (same as for an annual basis), and seal leak emissions to the atmosphere (for VOCs only).

CH_4 = Methane

CO = Carbon Monoxide

CO_2 = Carbon Dioxide

CO_2e = Greenhouse Gas emissions in Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results

N_2O = Nitrous Oxide

Total HAPs = Hazardous Air Pollutants

Total VOCs = Volatile Organic Compounds

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Maximum Hourly Potential Emissions Rate Summary - **Propane**		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

	Pigging Operations Emissions Directed to the Flare		**Seal Leak Emissions Directed to the Flare**		**Seal Leak Emissions To the Atmosphere**		**Total Emissions - Propane - Maximum Hourly Basis[4]**	
	Propane - Maximum Hourly Basis[1]		**100% Propane[2]**		**Fugitive Emissions[2][3]**			
	Emissions		**Emissions**				**Emissions**	
Pollutants	**lbs./hour**	**tons/hour**	**lbs./hour**	**tons/hour**	**lbs/hour**	**tons/hour**	**lbs/hour**	**tons/hour**
CO_2e	1.12E+03	5.58E-01	9.67E+00	4.84E-03	--	--	1.13E+03	5.63E-01
CO_2	1.11E+03	5.56E-01	9.63E+00	4.82E-03	--	--	1.12E+03	5.60E-01
N_2O	1.08E-02	5.42E-06	9.40E-05	4.70E-08	--	--	1.09E-02	5.47E-06
CH_4	5.42E-02	2.71E-05	4.70E-04	2.35E-07	--	--	5.47E-02	2.74E-05
CO	3.03E+00	1.52E-03	2.63E-02	1.32E-05	--	--	3.06E+00	1.53E-03
Total VOCs	4.02E+02	2.01E-01	3.49E+00	1.75E-03	5.12E-02	2.56E-05	4.05E+02	2.03E-01
Propane	4.02E+02	2.01E-01	3.49E+00	1.75E-03	--	--	4.05E+02	2.03E-01
Ethane	--	--	--	--	--	--	--	--
Butane	--	--	--	--	--	--	--	--
Total HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	--	--	0.00E+00	0.00E+00

(1) - The maximum hourly basis calculation assumes that the volume of gas flared during pigging operations is 3,461 scf/hour.

(2) - Seal leaks directed to the flare and fugitive emissions are assumed to be the same as those calculated for an annual basis.

(3) - The emission factors used to calculate the fugitive emissions are for total organic compounds (including non-VOCs such as methane and ethane) (USEPA, 1995). Because propane, ethane, and butane use the same emission factor, the fugitive emissions were not divided into multiple scenarios and can be applied to both propane and butane for potential to emit calculations.

(4) - Totals presented are the sum of the pigging operations emissions (hourly basis), seal leak emissions directed to the flare (same as for an annual basis), and seal leak emissions to the atmosphere (for VOCs only).

CH_4 = Methane

CO = Carbon Monoxide

CO_2 = Carbon Dioxide

CO_2e = Greenhouse Gas emissions in Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results

N_2O = Nitrous Oxide

Total HAPs = Hazardous Air Pollutants

Total VOCs = Volatile Organic Compounds

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Maximum Hourly Potential Emissions Rate Summary - **Ethane**		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

	Pigging Operations Emissions Directed to the Flare		Seal Leak Emissions Directed to the Flare		Seal Leak Emissions To the Atmosphere		Total Emissions - Ethane - Maximum Hourly Basis[4]	
	Ethane - Maximum Hourly Basis 1[1]		100% Ethane[2]		Fugitive Emissions[2][3]			
	Emissions		Emissions				Emissions	
Pollutants	lbs./hour	tons/hour	lbs./hour	tons/hour	lbs/hour	tons/hour	lbs/hour	tons/hour
CO_2e	9.30E+02	4.65E-01	6.78E+00	3.39E-03	--	--	9.37E+02	4.69E-01
CO_2	9.27E+02	4.63E-01	6.75E+00	3.38E-03	--	--	9.33E+02	4.67E-01
N_2O	8.88E-03	4.44E-06	6.47E-05	3.23E-08	--	--	8.94E-03	4.47E-06
CH_4	4.44E-02	2.22E-05	3.23E-04	1.62E-07	--	--	4.47E-02	2.24E-05
CO	2.48E+00	1.24E-03	2.63E-02	1.32E-05	--	--	2.51E+00	1.25E-03
Total VOCs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.12E-02	2.56E-05	0.00E+00	0.00E+00
Propane	--	--	--	--	--	--	--	--
Ethane	3.27E+02	1.63E-01	2.38E+00	1.19E-03	--	--	3.29E+02	1.65E-01
Butane	--	--	--	--	--	--	--	--
Total HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	--	--	0.00E+00	0.00E+00

(1) - The maximum hourly basis calculation assumes that the volume of gas flared during pigging operations is 4,118 scf/hour.
(2) - Seal leaks directed to the flare and fugitive emissions are assumed to be the same as those calculated for an annual basis.
(3) - The emission factors used to calculate the fugitive emissions are for total organic compounds (including non-VOCs such as methane and ethane) (USEPA, 1995). Because propane, ethane, and butane use the same emission factor, the fugitive emissions were not divided into multiple scenarios and can be applied to both propane and butane for potential to emit calculations.
(4) - Totals presented are the sum of the pigging operations emissions (hourly basis), seal leak emissions directed to the flare (same as for an annual basis), and seal leak emissions to the atmosphere (for VOCs only).

CH_4 = Methane
CO = Carbon Monoxide
CO_2 = Carbon Dioxide
CO_2e = Greenhouse Gas emissions in Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results
N_2O = Nitrous Oxide
Total HAPs = Hazardous Air Pollutants
Total VOCs = Volatile Organic Compounds

1-3.2 Pigging Operations Directed to the Flare

1-3.2.1 Butane Emissions from Pigging Operations

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Annual Potential Emissions Rate Summary - **Butane**		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

	Scenario 1			Scenario 2		
	Emissions			Emissions		
Pollutants	**lbs./hour[1]**	**lbs./year**	**tons/year**	**lbs./hour[1]**	**lbs./year**	**tons/year**
CO_2e	1.23E+00	1.07E+04	5.37E+00	2.45E+00	2.15E+04	1.07E+01
CO_2	1.22E+00	1.07E+04	5.35E+00	2.44E+00	2.14E+04	1.07E+01
N_2O	1.12E-05	9.85E-02	4.93E-05	2.25E-05	1.97E-01	9.85E-05
CH_4	5.62E-05	4.93E-01	2.46E-04	1.12E-04	9.85E-01	4.93E-04
CO	3.15E-03	2.76E+01	1.38E-02	6.29E-03	5.51E+01	2.76E-02
Total VOCs	4.38E-01	3.83E+03	1.92E+00	8.75E-01	7.67E+03	3.83E+00
Butane	4.38E-01	3.83E+03	1.92E+00	8.75E-01	7.67E+03	3.83E+00
HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

	Maximum Hourly Rate Emissions	
Pollutants	**lbs./hour[2]**	**tons/hour[2]**
CO_2e	1.34E+03	6.68E-01
CO_2	1.33E+03	6.65E-01
N_2O	1.23E-02	6.13E-06
CH_4	6.13E-02	3.06E-05
CO	3.43E+00	1.71E-03
Total VOCs	4.77E+02	2.38E-01
Butane	4.77E+02	2.38E-01
Total HAPs	0.00E+00	0.00E+00

1 - Average rate based on annual emissions.
2 - Maximum hourly rate.

CH_4 = Methane
CO = Carbon Monoxide
CO_2e = Greenhouse Gas emissions in Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#result
CO_2 = Carbon Dioxide
HAPs = Hazardous Air Pollutants
N_2O = Nitrous Oxide
Total VOCs = Volatile Organic Compounds

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01/27/14
SUBJECT:	Source Information and Assumptions for Potential Emissions Rate Calculations - Butane		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

Scenario 1	Volume of gas flared	25,000	scf/year	The enclosed flare will only be used during maintenance operations. Maintenance operations (pigging) will occur once per year. Gas volume flared includes 25,000 scf directed to the flare during maintenance.
Scenario 2	Volume of gas flared	50,000	scf/year	The enclosed flare will only be used during maintenance operations. Maintenance operations (pigging) will occur once per year. Gas volume flared includes 25,000 scf directed to the flare during maintenance. Once every 5 years, Smart Tools pigging operations will also occur and send the same amount (25,000 scf) of gas to the flare.
Lower Heating Value (BTU/scf)		2,980		
Flare Control Efficiency [1]		0%		

Gas Composition	
Gas	Percent
Butane	0-100%

Flare Manufacturer: John Zinc, Inc. LLC
Estimated Flare Height: 30 feet

Expected Emissions

Flare emissions will include products of combustion and uncombusted flared gas compound (butane). The flared gas will consist of butane and will not contain sulfur-bearing compounds or any HAPs. Fugitive emissions from seal leaks will be directed to the flare for combustion. There will be some leakage (fugitive emissions) to the atmospheric side of the seal. The potential emissions rate for atmospheric side seal leaks for VOCs (i.e., butane) are estimated to be 2.24E-01 tons/year.

Products of Combustion

The products of combustion from flaring of butane will include VOCs, NOx consisting of N_2O, and carbon dioxide, carbon monoxide, and methane.

Compounds from Uncombusted Flared Gas

The flare's estimated destruction efficiency determines what fraction of the flared gas remains uncombusted. The uncombusted flared gas compounds will include butane. These calculations are based on the potential emissions rate, which does not include a destruction efficiency (i.e, destruction efficiency = 0-percent).

1. PER calculations do not include a control efficiency.

BTU = British Thermal Units
HAP = hazardous air pollutants
NOx = nitrogen oxides
N_20= nitrous oxide
PER = potential emissions rate
scf = standard cubic feet
VOCs = volatile organic compounds

TETRATECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01/27/14
SUBJECT:	VOC emissions - Butane - Scenario 1		
BASED ON:	Client Information and Potential Emissions Rate		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per year
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 0 percent (No control efficiency for PER calculations)
Volume of Gas Uncombusted = 25,000 scf/year

VOC Calculation		
Inputs		
Gas Volume uncombusted (100%) =	25,000	scf/year
Flare Gas Molecular Weight =	58.12000	lb./lb-mol
Weight Fraction: Total VOCs =	1.00000	
Weight Fraction: Butane =	1.00000	
Efficiency =	0%	
Conversion Factors:		
1 MMBTU =	1,000,000	BTU
1 ton=	2,000	lb.
1 scf =	379	scf / lb.-mole
Results		
Total VOC Emissions =	3.83E+03	lb./year
	1.92E+00	ton/year
Butane Emissions =	3.83E+03	lb./year
	1.92E+00	ton/year

TETRATECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	VOC emissions - Butane - Scenario 2		
BASED ON:	Client Information and Potential Emissions Rate		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per year
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 0 percent (No control efficiency for PER calculations)
Volume of Gas Uncombusted = 50,000 scf/year

VOC Calculation		
Inputs		
Gas Volume uncombusted (100%) =	50,000	scf/year
Flare Gas Molecular Weight =	58.12000	lb/lb-mol
Weight Fraction: Total VOCs =	1.00000	
Weight Fraction: Butane =	1.00000	
Efficiency =	0%	
Conversion Factors:		
1 MMBTU =	1,000,000	BTU
1 ton=	2,000	lb.
1 scf =	379	scf / lb-mole
Results		
Total VOC Emissions =	7.67E+03	lb./year
	3.83E+00	ton/year
Butane Emissions =	7.67E+03	lb./year
	3.83E+00	ton/year

TETRATECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01/27/14
SUBJECT:	VOC emissions - Butane - Maximum Hourly Basis		
BASED ON:	Client Information and Potential Emissions Rate		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per year
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 0 percent (No control efficiency for PER calculations)
Volume of Gas Uncombusted = 3,109 scf/year(1)

VOC Calculation		
Inputs		
Gas Volume uncombusted (100%) =	3,109	scf/hour(1)
Flare Gas Molecular Weight =	58.12000	lb./lb-mol
Weight Fraction: Total VOCs =	1.00000	
Weight Fraction: Butane =	1.00000	
Efficiency =	0%	
Conversion Factors:		
1 MMBTU =	1,000,000	BTU
1 ton=	2,000	lb.
1 scf =	379	scf / lb.-mole
Results		
Total VOC Emissions =	4.77E+02	lb./hour
	2.38E-01	ton/hour
Butane Emissions =	4.77E+02	lb./hour
	2.38E-01	ton/hour

(1) - Maximum hourly rate calculated in maximum flow rate calculation (Attachment 1).

TETRATECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Butane - Scenario 1		
BASED ON:	Potential emissions rate, client information and references for emission factors, including: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor(EF) *Lower Heating Value (LHV)

Where:

Gas Volume uncombusted (100%) = 25,000 scf/year

LHV = 2,980 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	65.15	143.59
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./year	Tons/year
Emissions	1.07E+04	5.35E+00

N_2O Calculation	lbs./year	Tons/year
Emissions	9.85E-02	4.93E-05

CH_4 Calculation	lbs./year	Tons/year
Emissions	4.93E-01	2.46E-04

1kg = 2.204 lbs.

TETRATECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/2014
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Butane - Scenario 2		
BASED ON:	Potential emissions rate, client information and references for emission factors, including: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor(EF) * Lower Heating Value (LHV)

Where:

Gas Volume uncombusted (100%) = 50,000 scf/year

LHV = 2,980 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	65.15	143.59
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./year	Tons/year
Emissions	2.14E+04	1.07E+01

N_2O Calculation	lbs./year	Tons/year
Emissions	1.97E-01	9.85E-05

CH_4 Calculation	lbs./year	Tons/year
Emissions	9.85E-01	4.93E-04

1kg = 2.204 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Butane - Maximum Hourly Basis		
BASED ON:	Potential emissions rate, client information and references for emission factors, including: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor(EF) *Lower Heating Value (LHV)

Where:

Gas Volume uncombusted (100%) = 3,109 scf/hour(1)

LHV = 2,980 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	65.15	143.59
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./hour	Tons/hour
Emissions	1.33E+03	6.65E-01

N_2O Calculation	lbs./hour	Tons/hour
Emissions	1.23E-02	6.13E-06

CH_4 Calculation	lbs./hour	Tons/hour
Emissions	6.13E-02	3.06E-05

(1) - Maximum hourly rate calculated in maximum flow rate calculation (Attachment 1).

1kg = 2.204 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Carbon monoxide emissions - Butane - Scenario 1		
BASED ON:	Potential emissions rate, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor(EF) *conversation factor (CF)

Where:

Flare Gas Volume uncombusted (100%) =	25,000	scf/year
LHV =	2,980	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation		
	lbs/year	Tons/year
Emissions	2.76E+01	1.38E-02

1 ton = 2000 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Carbon monoxide emissions - Butane - Scenario 2		
BASED ON:	Potential emissions rate, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor(EF) *conversation factor (CF)

Where:

Flare Gas Volume uncombusted (100%) =	50,000	scf/year
LHV =	2,980	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation	lbs/year	Tons/year
Emissions	5.51E+01	2.76E-02

1 ton = 2000 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Carbon monoxide emissions - Butane - Maximum Hourly Basis		
BASED ON:	Potential emissions rate, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor(EF) *conversation factor (CF)

Where:

Flare Gas Volume uncombusted (100%) =	3,109	scf/hour(1)
LHV =	2,980	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation	lbs/hour	Tons/hour
Emissions	3.43E+00	1.71E-03

(1) - Maximum hourly rate calculated in maximum flow rate calculation (Attachment 1).

1 ton = 2000 lbs.

1-3.2.2 Propane Emissions from Pigging Operations

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01/27/14
SUBJECT:	Source Information and Assumptions for Potential Emissions Rate Calculations - Propane		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

Scenario 1	Volume of gas flared	25,000	scf/year	The enclosed flare will only be used during maintenance operations. Maintenance operations (pigging) will occur once per year. Gas volume flared includes 25,000 scf directed to the flare during maintenance.
Scenario 2	Volume of gas flared	50,000	scf/year	The enclosed flare will only be used during maintenance operations. Maintenance operations (pigging) will occur once per year. Gas volume flared includes 25,000 scf directed to the flare during maintenance. Once every 5 years, Smart Tools pigging operations will also occur and send the same amount (25,000 scf) of gas to the flare.
Lower Heating Value (BTU/scf)		2,370		
Flare Control Efficiency [1]		0%		

Gas Composition	
Gas	Percent
Propane	0-100%

Flare Manufacturer: John Zinc Inc., LLC
Estimated Flare Height: 30 feet

Expected Emissions
Flare emissions will include products of combustion and uncombusted flared gas compound (propane). The flared gas will consist of propane and will not contain sulfur-bearing compounds or any HAPs. Fugitive emissions from seal leaks will be directed to the flare for combustion. There will be some leakage (fugitive emissions) to the atmospheric side of the seal. The potential emissions rate for atmospheric side seal leaks for VOCs (i.e., propane) are estimated to be 2.24E-01 tons/year.

Products of Combustion
The products of combustion from flaring of propane will include VOCs, NOx consisting of N_2O, and carbon dioxide, carbon monoxide, and methane.

Compounds from Uncombusted Flared Gas
The flare's estimated destruction efficiency determines what fraction of the flared gas remains uncombusted. The uncombusted flared gas compounds will include propane. These calculations are based on the potential emissions rate, which does not include a destruction efficiency (i.e, destruction efficiency = 0-percent).

1. PER calculations do not include a control efficiency.

BTU = British Thermal Units
HAP = hazardous air pollutants
NOx = nitrogen oxides
N_20= nitrous oxide
PER = potential emissions rate
scf = standard cubic feet
VOCs = volatile organic compounds

TETRATECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01/27/14
SUBJECT:	VOC emissions - Propane - Maximum Hourly Basis		
BASED ON:	Client Information and Potential Emissions Rate		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per year
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 0 percent (No control efficiency for PER calculations)
Volume of Gas Uncombusted = 3,461 scf/year(1)

VOC Calculation		
Inputs		
Gas Volume uncombusted (100%) =	3,461	scf/hour(1)
Flare Gas Molecular Weight =	44.00000	lb./lb-mol
Weight Fraction: Total VOCs =	1.00000	
Weight Fraction : Propane =	1.00000	
Efficiency =	0%	
Conversion Factors:		
1 MMBTU =	1,000,000	BTU
1 ton=	2,000	lb.
1 scf =	379	scf / lb.-mole
Results		
Total VOC Emissions =	4.02E+02	lb./hour
	2.01E-01	ton/hour
Propane Emissions =	4.02E+02	lb./hour
	2.01E-01	ton/hour

(1) - Maximum hourly rate calculated in maximum flow rate calculation (Attachment 1).

TETRATECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Propane - Scenario 1		
BASED ON:	Potential emissions rate, client information and references for emission factors, including: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor(EF) * Lower Heating Value

Where:

Gas Volume uncombusted (100%) = 25,000 scf/year

LHV = 2,370 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	61.46	135.46
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./year	Tons/year
Emissions	8.03E+03	4.01E+00

N_2O Calculation	lbs./year	Tons/year
Emissions	7.84E-02	3.92E-05

CH_4 Calculation	lbs./year	Tons/year
Emissions	3.92E-01	1.96E-04

1kg = 2.204 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/2014
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Propane - Scenario 2		
BASED ON:	Potential emissions rate, client information and references for emission factors, including: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor(EF) * Lower Heating Value

Where:

Gas Volume uncombusted (100%) = 50,000 scf/year

LHV = 2,370 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	61.46	135.46
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation		
	lbs./year	Tons/year
Emissions	1.61E+04	8.03E+00

N_2O Calculation		
	lbs./year	Tons/year
Emissions	1.57E-01	7.84E-05

CH_4 Calculation		
	lbs./year	Tons/year
Emissions	7.84E-01	3.92E-04

1kg = 2.204 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Propane - Scenario 1		
BASED ON:	Potential emissions rate, client information and references for emission factors, including: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor(EF) * Lower Heating Value

Where:

Gas Volume uncombusted (100%) = 25,000 scf/year

LHV = 2,370 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	61.46	135.46
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./year	Tons/year
Emissions	8.03E+03	4.01E+00

N_2O Calculation	lbs./year	Tons/year
Emissions	7.84E-02	3.92E-05

CH_4 Calculation	lbs./year	Tons/year
Emissions	3.92E-01	1.96E-04

1kg = 2.204 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/2014
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Propane - Scenario 2		
BASED ON:	Potential emissions rate, client information and references for emission factors, including: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor(EF) * Lower Heating Value

Where:

Gas Volume uncombusted (100%) = 50,000 scf/year

LHV = 2,370 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	61.46	135.46
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./year	Tons/year
Emissions	1.61E+04	8.03E+00

N_2O Calculation	lbs./year	Tons/year
Emissions	1.57E-01	7.84E-05

CH_4 Calculation	lbs./year	Tons/year
Emissions	7.84E-01	3.92E-04

1kg = 2.204 lbs.

TETRATECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Propane - Maximum Hourly Basis		
BASED ON:	Potential emissions rate, client information and references for emission factors, including: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor(EF) * Lower Heating Value

Where:

Gas Volume uncombusted (100%) = 3,461 scf/hour[(1)]

LHV = 2,370 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	61.46	135.46
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./hour	Tons/hour
Emissions	1.11E+03	5.56E-01

N_2O Calculation	lbs./hour	Tons/hour
Emissions	1.08E-02	5.42E-06

CH_4 Calculation	lbs./hour	Tons/hour
Emissions	5.42E-02	2.71E-05

(1) - Maximum hourly rate calculated in maximum flow rate calculation (Attachment 1).

1kg = 2.204 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Carbon monoxide emissions - Propane - Scenario 1		
BASED ON:	Potential emissions rate, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor(EF) *conversation factor (CF)

Where:

Flare Gas Volume uncombusted (100%) =	25,000	scf/year
LHV =	2,370	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation		
	lbs/year	Tons/year
Emissions	2.19E+01	1.10E-02

1 ton = 2000 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Carbon monoxide emissions - Propane - Scenario 2		
BASED ON:	Potential emissions rate, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor(EF) *conversation factor (CF)

Where:

Flare Gas Volume uncombusted (100%) =	50,000	scf/year
LHV =	2,370	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation		
	lbs/year	Tons/year
Emissions	4.38E+01	2.19E-02

1 ton = 2000 lbs.

TETRATECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Carbon monoxide emissions - Propane - Maximum Hourly Basis		
BASED ON:	Potential emissions rate, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor(EF) *conversation factor (CF)

Where:

Flare Gas Volume uncombusted (100%) =	3,461	scf/hour(1)
LHV =	2,370	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation		
	lbs/hour	Tons/hour
Emissions	3.03E+00	1.52E-03

(1) - Maximum hourly rate calculated in maximum flow rate calculation (Attachment 1).

1 ton = 2000 lbs.

1-3.2.3 Ethane Emissions from Pigging Operations

TETRA TECH

CLIENT: Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
	100-NRS-T29725	01/27/14
SUBJECT: Annual Potential Emissions Rate Summary - Ethane		
BASED ON: Client Information and other reference materials as noted in each calculation worksheet.		

	Scenario 1			Scenario 2		
	Emissions			Emissions		
Pollutants	lbs./hour[1]	lbs./year	tons/year	lbs./hour[1]	lbs./year	tons/year
CO_2e	6.45E-01	5.65E+03	2.82E+00	1.29E+00	1.13E+04	5.65E+00
CO_2	6.42E-01	5.63E+03	2.81E+00	1.28E+00	1.13E+04	5.63E+00
N_2O	6.15E-06	5.39E-02	2.69E-05	1.23E-05	1.08E-01	5.39E-05
CH_4	3.08E-05	2.69E-01	1.35E-04	6.15E-05	5.39E-01	2.69E-04
CO	1.72E-03	1.51E+01	7.54E-03	3.44E-03	3.02E+01	1.51E-02
Total VOCs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ethane	2.26E-01	1.98E+03	9.92E-01	4.53E-01	3.97E+03	1.98E+00
HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

	Maximum Hourly Rate Emissions	
Pollutants	lbs./hour[2]	tons/hour[2]
CO_2e	9.30E+02	4.65E-01
CO_2	9.27E+02	4.63E-01
N_2O	8.88E-03	4.44E-06
CH_4	4.44E-02	2.22E-05
CO	2.48E+00	1.24E-03
Total VOCs	0.00E+00	0.00E+00
Ethane	3.27E+02	1.63E-01
Total HAPs	0.00E+00	0.00E+00

1 - Average rate based on annual emissions.
2 - Maximum hourly rate.

CH_4 = Methane
CO = Carbon Monoxide
CO_2e = Greenhouse Gas emissions in Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results
CO_2 = Carbon Dioxide
HAPs = Hazardous Air Pollutants
N_2O = Nitrous Oxide
Total VOCs = Volatile Organic Compounds

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01/27/14
SUBJECT:	Source Information and Assumptions for Potential Emissions Rate Calculations - Ethane		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

Scenario 1	Volume of gas flared	25,000	scf/year	The enclosed flare will only be used during maintenance operations. Maintenance operations (pigging) will occur once per year. Gas volume flared includes 25,000 scf directed to the flare during maintenance.
Scenario 2	Volume of gas flared	50,000	scf/year	The enclosed flare will only be used during maintenance operations. Maintenance operations (pigging) will occur once per year. Gas volume flared includes 25,000 scf directed to the flare during maintenance. Once every 5 years, Smart Tools pigging operations will also occur and send the same amount (25,000 scf) of gas to the flare.
Lower Heating Value (BTU/scf)		1,630		
Flare Control Efficiency [1]		0%		

Gas Composition	
Gas	Percent
Ethane	0-100%

Flare Manufacturer: John Zinc Inc., LLC
Estimated Flare Height: 30 feet

Expected Emissions

Flare emissions will include products of combustion and uncombusted flared gas compound (ethane). The flared gas will consist of ethane and will not contain sulfur-bearing compounds, VOCs or any HAPs. Fugitive emissions from seal leaks will be directed to the flare for combustion. There will be some leakage (fugitive emissions) to the atmospheric side of the seal. The potential emissions rate for atmospheric side seal leaks for ethane are estimated to be 2.24E-01 tons/year.

Products of Combustion

The products of combustion from flaring of ethane will include VOCs, NOx consisting of N_2O, and carbon dioxide, carbon monoxide, and methane.

Compounds from Uncombusted Flared Gas

The flare's estimated destruction efficiency determines what fraction of the flared gas remains uncombusted. The uncombusted flared gas compounds will include ethane. These calculations are based on the potential emissions rate, which does not include a destruction efficiency (i.e, destruction efficiency = 0-percent).

1. PER calculations do not include a control efficiency.

BTU = British Thermal Units
HAP = hazardous air pollutants
NOx = nitrogen oxides
N_2O= nitrous oxide
PER = potential emissions rate
scf = standard cubic feet
VOCs = volatile organic compounds

TETRATECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01/27/14
SUBJECT:	VOC emissions - Ethane - Scenario 1		
BASED ON:	Client Information and Potential Emissions Rate		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per year
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 0 percent (No control efficiency for PER calculations)
Volume of Gas Uncombusted = 25,000 scf/year

VOC Calculation		
Inputs		
Gas Volume uncombusted (100%) =	25,000	scf/year
Flare Gas Molecular Weight =	30.07000	lb./lb-mol
Weight Fraction: Total VOCs =	0.00000	
Weight Fraction : Ethane =	1.00000	
Efficiency =	0%	
Conversion Factors:		
1 MMBTU =	1,000,000	BTU
1 ton=	2,000	lb.
1 scf =	379	scf / lb.-mole
Results		
Total VOC Emissions =	0.00E+00	lb./year
	0.00E+00	ton/year
Ethane Emissions =	1.98E+03	lb./year
	9.92E-01	ton/year

TETRATECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01/27/14
SUBJECT:	VOC emissions - Ethane - Scenario 2		
BASED ON:	Client Information and Potential Emissions Rate		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per year
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 0 percent (No control efficiency for PER calculations)
Volume of Gas Uncombusted = 50,000 scf/year

VOC Calculation		
Inputs		
Gas Volume uncombusted (100%) =	50,000	scf/year
Flare Gas Molecular Weight =	30.07000	lb/lb-mol
Weight Fraction: Total VOCs =	0.00000	
Weight Fraction : Ethane =	1.00000	
Efficiency =	0%	
Conversion Factors:		
1 MMBTU =	1,000,000	BTU
1 ton=	2,000	lb.
1 scf =	379	scf / lb-mole
Results		
Total VOC Emissions =	0.00E+00	lb./year
	0.00E+00	ton/year
Ethane Emissions =	3.97E+03	lb./year
	1.98E+00	ton/year

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01/27/14
SUBJECT:	VOC emissions - Ethane - Maximum Hourly Rate		
BASED ON:	Client Information and Potential Emissions Rate		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per year
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 0 percent (No control efficiency for PER calculations)
Volume of Gas Uncombusted = 4,118 scf/year[(1)]

VOC Calculation		
Inputs		
Gas Volume uncombusted (100%) =	4,118	scf/hour[(1)]
Flare Gas Molecular Weight =	30.07000	lb./lb-mol
Weight Fraction: Total VOCs =	0.00000	
Weight Fraction : Ethane =	1.00000	
Efficiency =	0%	
Conversion Factors:		
1 MMBTU =	1,000,000	BTU
1 ton=	2,000	lb.
1 scf =	379	scf / lb.-mole
Results		
Total VOC Emissions =	0.00E+00	lb./hour
	0.00E+00	ton/hour
Ethane Emissions =	3.27E+02	lb./hour
	1.63E-01	ton/hour

(1) - Maximum hourly rate calculated in maximum flow rate calculation (Attachment 1).

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Ethane - Scenario 1		
BASED ON:	Potential emissions rate, client information and references for emission factors, including: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor(EF) * Lower Heating Value (LHV)

Where:

Gas Volume uncombusted (100%) = 25,000 scf/year

LHV = 1,630 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	62.64	138.06
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./year	Tons/year
Emissions	5.63E+03	2.81E+00

N_2O Calculation	lbs./year	Tons/year
Emissions	5.39E-02	2.69E-05

CH_4 Calculation	lbs./year	Tons/year
Emissions	2.69E-01	1.35E-04

1kg = 2.204 lbs.

TETRATECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/2014
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Ethane - Scenario 2		
BASED ON:	Potential emissions rate, client information and references for emission factors, including: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor(EF) *Lower Heating Value(LHV)

Where:

Gas Volume uncombusted (100%) = 50,000 scf/year

LHV = 1,630 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	62.64	138.06
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./year	Tons/year
Emissions	1.13E+04	5.63E+00

N_2O Calculation	lbs./year	Tons/year
Emissions	1.08E-01	5.39E-05

CH_4 Calculation	lbs./year	Tons/year
Emissions	5.39E-01	2.69E-04

1kg = 2.204 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01/27/14
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Ethane - Maximum Hourly Basis		
BASED ON:	Potential emissions rate, client information and references for emission factors, including: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor(EF) * Lower Heating Value (LHV)

Where:

Gas Volume uncombusted (100%) = 4,118 scf/hour(1)

LHV = 1,630 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	62.64	138.06
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation		
	lbs./hour	Tons/hour
Emissions	9.27E+02	4.63E-01

N_2O Calculation		
	lbs./hour	Tons/hour
Emissions	8.88E-03	4.44E-06

CH_4 Calculation		
	lbs./hour	Tons/hour
Emissions	4.44E-02	2.22E-05

(1) - Maximum hourly rate calculated in maximum flow rate calculation (Attachment 1).

1kg = 2.204 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Carbon monoxide emissions - Ethane - Scenario 1		
BASED ON:	Potential emissions rate, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor(EF) *conversation factor (CF)

Where:

Flare Gas Volume uncombusted (100%) =	25,000	scf/year
LHV =	1,630	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation		
	lbs/year	Tons/year
Emissions	1.51E+01	7.54E-03

1 ton = 2000 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Carbon monoxide emissions - Ethane - Scenario 2		
BASED ON:	Potential emissions rate, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor(EF) *conversation factor (CF)

Where:

Flare Gas Volume uncombusted (100%) =	50,000	scf/year
LHV =	1,630	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation		
	lbs/year	Tons/year
Emissions	3.02E+01	1.51E-02

1 ton = 2000 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	Carbon monoxide emissions - Ethane - Maximum Hourly Basis		
BASED ON:	Potential emissions rate, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor(EF) *conversation factor (CF)

Where:

Flare Gas Volume uncombusted (100%) =	4,118	scf/hour(1)
LHV =	1,630	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation	lbs/hour	Tons/hour
Emissions	2.48E+00	1.24E-03

(1) - Maximum hourly rate calculated in maximum flow rate calculation (Attachment 1).

1 ton = 2000 lbs.

1-3.3 Seal Leak Emissions

1-3.3.1 Seal Leak Potential Emissions Rate Summary

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	100-NRS-T29725
PREPARED BY:	CR	DATE:	01/29/14
SUBJECT:	Annual Potential Emissions Rate Calculation Summary Due to Seal Leaks		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

	Seal Leak Emissions Directed to the Flare									Seal Leak Emissions To the Atmosphere		
	Scenario 1			Scenario 2			Scenario 3			Fugitive Emissions [1]		
	Emissions			Emissions			Emissions					
Pollutants	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year
CO_2e	6.78E+00	5.94E+04	2.97E+01	9.67E+00	8.47E+04	4.24E+01	1.29E+01	1.13E+05	5.64E+01	--	--	--
CO_2	6.75E+00	5.91E+04	2.96E+01	9.63E+00	8.44E+04	4.22E+01	1.28E+01	1.12E+05	5.62E+01	--	--	--
N_2O	6.47E-05	5.66E-01	2.83E-04	9.40E-05	8.24E-01	4.12E-04	1.18E-04	1.04E+00	5.18E-04	--	--	--
CH_4	3.23E-04	2.83E+00	1.42E-03	4.70E-04	4.12E+00	2.06E-03	5.91E-04	5.18E+00	2.59E-03	--	--	--
CO	2.63E-02	2.30E+02	7.92E-02	2.63E-02	2.30E+02	1.15E-01	3.31E-02	2.90E+02	1.45E-01	--	--	--
Total VOCs	0.00E+00	0.00E+00	0.00E+00	3.49E+00	3.06E+04	1.53E+01	4.60E+00	4.03E+04	2.02E+01	5.12E-02	4.48E+02	2.24E-01
Propane	0.00E+00	0.00E+00	0.00E+00	3.49E+00	3.06E+04	1.53E+01	0.00E+00	0.00E+00	0.00E+00	--	--	--
Ethane	2.38E+00	2.09E+04	1.04E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	--	--	--
Butane	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.60E+00	4.03E+04	2.02E+01	--	--	--
HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	--	--	--

(1) - The emission factors used to calculate the fugitive emissions are for total organic compounds (including non-VOCs such as methane and ethane) (USEPA, 1995). Because propane, ethane and butane use the same emission factor, the fugitive emissions were not divided into multiple scenarios and can be applied to Scenarios 1, 2 and 3 for potential emissions rate calculations.

CH_4 = Methane

CO_2e = Greenhouse Gas emissions in Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results

CO_2 = Carbon Dioxide

HAPs = Hazardous Air Pollutants

N_2O = Nitrous Oxide

Total VOCs = Volatile Organic Compounds

1-3.3.2 Seal Leaks Directed to the Flare

TETRA TECH

CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY:	CR	DATE:	01/29/14
SUBJECT:	Source Information and Assumptions - Seal Leaks Directed to Flare		
BASED ON:	Client Information, potential emissions rate, and other reference materials as noted in each calculation worksheet.		

Seal Leak Scenario 1	Leaks directed to flare	262,800	scf/year	Potential emission rate calculations for seal leaks that are directed to the flare. Estimated leakage has a range from 0.15 to 0.5 scfm. A leakage of 0.5 scfm was assumed as the most conservative estimate. Seal Leak Scenario 1 is based off a gas composition of 100% ethane.
Seal Leak Scenario 2	Leaks directed to flare	262,800	scf/year	Potential emission rate calculations for seal leaks that are directed to flare. Estimated leakage has a range from 0.15 to 0.5 scfm. A leakage of 0.5 scfm was assumed as the most conservative estimate. Seal Leak Scenario 2 is based off a gas composition of 100% propane.
Seal Leak Scenario 3	Leaks directed to flare	262,800	scf/year	Potential emission rate calculations for seal leaks that are directed to flare. Estimated leakage has a range from 0.15 to 0.5 scfm. A leakage of 0.5 scfm was assumed as the most conservative estimate. Seal Leak Scenario 3 is based off a gas composition of 100% butane.

Ethane Lower Heating Value (BTU/scf)	1,630
Propane Lower Heating Value (BTU/scf)	2,370
Butane Lower Heating Value (BTU/scf)	2,980
Flare Control Efficiency	0%

Gas Composition

Gas	Percent		
	Seal Leak Scenario 1	Seal Leak Scenario 2	Seal Leak Scenario 3
Ethane	100%	0%	0%
Propane	0%	100%	0%
Butane	0%	0%	100%

Flare Manufacturer: John Zinc Co. LLC
Estimated Flare Height: 30 feet

Expected Emissions

Flare emissions will include products of combustion and uncombusted flared gas compounds (propane, ethane or butane). The flared gas will consist of a mixture of propane, ethane or butane and will not contain sulfur-bearing compounds or any hazardous air pollutants (HAPs). Fugitive emissions from seal leaks will be directed to the flare for combustion. There will be some leakage (fugitive emissions) to the atmospheric side of the seal. The potential emissions rate (PER) for atmospheric side seal leaks for VOCs are estimated to be 2.24E-01 tons/year.

Products of Combustion

The products of combustion from flaring propane, ethane or butane will include volatile organic compounds (VOCs), nitrogen oxides (NOx) consisting of nitrous oxide (N_2O), carbon dioxide, carbon monoxide, and methane.

Compounds from Uncombusted Flared Gas

The flare's estimated destruction efficiency determines what fraction of the flared gas remains uncombusted. The uncombusted flared gas compounds will include propane, ethane or butane. These calculations are based on the PER, which does not include an destruction efficiency (i.e., flare control efficiency = 0-percent).

BTU = British Thermal Units
HAPs = hazardous air pollutants
N_2O= nitrous oxide
NOx = nitrogen oxides
PER= potential emissions rate
scf = standard cubic feet
VOCs = volatile organic compounds

TETRA TECH		
CLIENT: Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY: CR	DATE:	01/29/14
SUBJECT: VOC emissions - Ethane - Seal Leak Scenario 1 - Leaks directed to flare		
BASED ON: Client Information and Potential Emissions Rate		

VOC Flare Emissions Calculations

Emissions (lb/event) = Seal leak gas volume * coversion factor (CF) * Molecular Weight * Weight Fraction

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per event
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 0 percent (No control efficiency for PER calculations)
Volume of Gas Uncombusted = 262,800 scf/year

VOC Calculation		
Inputs		
Gas Volume leaked (100%) =	262,800	scf/year
Flare Gas Molecular Weight =	30.07	lb./lb-mol
Weight Fraction: Total VOCs [1] =	0.00000	
Weight Fraction: Ethane =	1.00000	
Efficiency =	0%	
Conversion Factors:		
1 MMBTU =	1,000,000	BTU
1 ton =	2,000	lb.
1 scf =	379	scf / lb.-mole
Results		
Total VOC[1] Emissions =	0.00E+00	lb./year
	0.00E+00	ton/year
Ethane Emissions =	2.09E+04	lb./year
	1.04E+01	ton/year

1. Ethane is considered to have negligible photochemical activity per 40CFR51.100 and is not a VOC.

TETRA TECH		
CLIENT: Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY: CR	DATE:	01/29/14
SUBJECT: VOC emissions - Propane - Seal Leak Scenario 2 - Leaks directed to flare		
BASED ON: Client Information and Potential Emissions Rate		

VOC Flare Emissions Calculations

Emissions (lb/event) = Seal leak gas volume * coversion factor (CF) * Molecular Weight * Weight Fraction

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per event
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 0 percent (No control efficiency for PER calculations)
Volume of Gas Uncombusted = 262,800 scf/year

VOC Calculation

Inputs

Gas Volume leaked (100%) =	262,800	scf/year
Flare Gas Molecular Weight =	44.10	lb./lb-mol
Weight Fraction: Total VOCs =	1.00000	
Weight Fraction: Propane =	1.00000	
Efficiency =	0%	

Conversion Factors:

1 MMBTU =	1,000,000	BTU
1 ton =	2,000	lb.
1 scf =	379	scf / lb.-mole

Results

Total VOC Emissions =	3.06E+04	lb./year
	1.53E+01	ton/year
Propane Emissions =	3.06E+04	lb./year
	1.53E+01	ton/year

TETRATECH			
CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY: CR		DATE:	01/29/14
SUBJECT:	VOC emissions - Butane - Seal Leak Scenario 3 - Leaks directed to flare		
BASED ON:	Client Information and Potential Emissions Rate		

VOC Flare Emissions Calculations

Emissions (lb/event) = Seal leak gas volume * coversion factor (CF) * Molecular Weight * Weight Fraction

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per event
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 0 percent (No control efficiency for PER calculations)
Volume of Gas Uncombusted = 262,800 scf/year

VOC Calculation

Inputs

Gas Volume leaked (100%) =	262,800	scf/year
Flare Gas Molecular Weight =	58.12	lb./lb-mol
Weight Fraction: Total VOCs =	1.00000	
Weight Fraction: Butane =	1.00000	
Efficiency =	0%	

Conversion Factors:

1 MMBTU =	1,000,000	BTU
1 ton =	2,000	lb.
1 scf =	379	scf / lb.-mole

Results

Total VOC Emissions =	4.03E+04	lb./year
	2.02E+01	ton/year
Butane Emissions =	4.03E+04	lb./year
	2.02E+01	ton/year

TETRATECH			
CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY:	CR	DATE:	01/29/14
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Ethane - Scenario 1 - Leaks directed to flare.		
BASED ON:	Potential emissions rate, client information and references for Emission Factors, including : Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp. Global warming potential factors are selected for a 100-year horizon, which are consistent with all climate change programs via the Intergovernmental Panel on Climate Change.		

Emissions = Seal leak gas volume * Emission Factor(EF) *Lower Heating Value (LHV)

Where:

Seal leak gas volume = 262,800 scf/year

LHV (ethane)= 1,630 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)	Global Warming Potential (GWP)
CO_2	62.64	138.06	1
N_2O	0.0006	0.0013	310
CH_4	0.003	0.0066	21

CO_2 Calculation	lbs./year	Tons/year
Emissions	5.91E+04	2.96E+01

N_2O Calculation			CO_2 Equivalent (CO2e)	
	lbs./year	Tons/year	lbs./year	Tons/year
Emissions	5.66E-01	2.83E-04	1.76E+02	8.78E-02

CH_4 Calculation			CO_2 Equivalent (CO2e)	
	lbs./year	Tons/year	lbs./year	Tons/year
Emissions	2.83E+00	1.42E-03	5.95E+01	2.97E-02

1kg = 2.204 lbs.

1 ton = 2,000 lbs.

TETRA TECH

CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY:	CR	DATE:	01/29/14
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Propane - Scenario 2 - Leaks directed to flare.		
BASED ON:	Potential Emissions Rate, client information and Reference for Emission Factors including: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp. Global warming potential factors are selected for a 100-year horizon, which are consistent with all climate change programs via the Intergovernmental Panel on Climate Change.		

Emissions = Seal leak gas volume * Emission Factor(EF) *Lower Heating Value (LHV)

Where:

Seal leak gas volume = 262,800 scf/year

LHV (propane) = 2,370 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)	Global Warming Potential (GWP)
CO_2	61.46	135.46	1
N_2O	0.0006	0.0013	310
CH_4	0.003	0.0066	21

CO_2 Calculation	lbs./year	Tons/year
Emissions	8.44E+04	4.22E+01

N_2O Calculation			CO_2 Equivalent (CO2e)	
	lbs./year	Tons/year	lbs./year	Tons/year
Emissions	8.24E-01	4.12E-04	2.55E+02	1.28E-01

CH_4 Calculation			CO_2 Equivalent (CO2e)	
	lbs./year	Tons/year	lbs./year	Tons/year
Emissions	4.12E+00	2.06E-03	8.65E+01	4.32E-02

1 kg = 2.204 lbs.

1 ton = 2,000 lbs.

TETRA TECH

CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY:	CR	DATE:	01/29/14
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Butane - Scenario 3 - Leaks directed to flare.		
BASED ON:	Potential Emissions Rate, client information and Reference for Emission Factors including: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp. Global warming potential factors are selected for a 100-year horizon, which are consistent with all climate change programs via the Intergovernmental Panel on Climate Change.		

Emissions = Seal leak gas volume * Emission Factor(EF) *Lower Heating Value (LHV)

Where:

Seal leak gas volume = 262,800 scf/year

LHV (butane) = 2,980 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)	Global Warming Potential (GWP)
CO_2	65.15	143.59	1
N_2O	0.0006	0.0013	310
CH_4	0.003	0.0066	21

CO_2 Calculation	lbs./year	Tons/year
Emissions	1.12E+05	5.62E+01

N_2O Calculation			CO_2 Equivalent (CO2e)	
	lbs./year	Tons/year	lbs./year	Tons/year
Emissions	1.04E+00	5.18E-04	3.21E+02	1.61E-01

CH_4 Calculation			CO_2 Equivalent (CO2e)	
	lbs./year	Tons/year	lbs./year	Tons/year
Emissions	5.18E+00	2.59E-03	1.09E+02	5.44E-02

1 kg = 2.204 lbs.

1 ton = 2,000 lbs.

TETRATECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/29/14
SUBJECT:	Carbon monoxide emissions - Ethane - Scenario 1		
BASED ON:	Potential emissions rate, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Seal leak gas volume * Lower Heating Value (LHV) * Emission Factor(EF) *conversion factor (CF)

Where:

Seal leak gas volume =	262,800	scf/year
LHV(ethane)=	1,630	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation		
	lbs/year	Tons/year
Emissions	1.58E+02	7.92E-02

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/29/14
SUBJECT:	Carbon monoxide emissions - Propane - Scenario 2		
BASED ON:	Potential emissions rate, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Seal leak gas volume * Lower Heating Value (LHV) * Emission Factor(EF) *conversion factor (CF)

Where:

Seal leak gas volume =	262,800	scf/year
LHV(propane)=	2,370	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation	lbs/year	Tons/year
Emissions	2.30E+02	1.15E-01

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/29/14
SUBJECT:	Carbon monoxide emissions - Butane - Scenario 3		
BASED ON:	Potential emissions rate, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Seal leak gas volume * Lower Heating Value (LHV) * Emission Factor(EF) *conversion factor (CF)

Where:

Seal leak gas volume =	262,800	scf/year
LHV(butane)=	2,980	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation	lbs/year	Tons/year
Emissions	2.90E+02	1.45E-01

1-3.3.3 Seal Leaks Directed to the Atmosphere

TETRA TECH

CLIENT:	Sunoco Pipeline L.P.	NUMBER:	100-NRS-T29725
PREPARED BY: CR		DATE:	01/29/14
SUBJECT:	VOC emissions - Delmont Facility - Fugitive Emissions - Leaks directed to atmosphere		
BASED ON:	Client Information and Potential Emissions Rate		

Fugitive Emissions Calculations

Where:
Fugitive VOC Emissions (TPY) = # of Sources x Emission Factor (lbs./hr.-source) x 8,760 hrs./year x (1 ton/2,000 pounds)

Source Category	Service	Emission Factor (lb./hr./source)	Total Number of Sources	Fugitive VOC Emissions (TPY)
Valves	Light Liquid	0.0000946	150	0.062
Fittings	Light Liquid	0.0000176	410	0.032
Pumps	Light Liquid	0.001188	1	0.005
Other	Light Liquid	0.000286	100	0.125
			Total	**0.224**

1-4 POTENTIAL TO EMIT CALCULATIONS

1-4.1 Potential to Emit Summary

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	02-03-2014
SUBJECT:	Annual Potential to Emit Summary - Butane		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

	Pigging Operations Emissions Directed to the Flare						Seal Leak Emissions Directed to the Flare			Seal Leak Emissions To the Atmosphere			Total Emissions - Butane Scenario 1[4]			Total Emissions - Butane Scenario 2[5]		
	Butane - Scenario 1[1]			Butane - Scenario 2[2]			100% Butane			Fugitive Emissions[3]								
	Emissions			Emissions			Emissions						Emissions			Emissions		
Pollutants	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year
CO_2e	1.23E-03	1.07E+01	5.37E-03	2.45E-03	2.15E+01	1.07E-02	1.29E-02	1.13E+02	5.64E-02	--	--	--	1.41E-02	1.24E+02	6.18E-02	1.53E-02	1.34E+02	6.72E-02
CO_2	1.22E-03	1.07E+01	5.35E-03	2.44E-03	2.14E+01	1.07E-02	1.28E-02	1.12E+02	5.62E-02	--	--	--	1.41E-02	1.23E+02	6.16E-02	1.53E-02	1.34E+02	6.69E-02
N_2O	1.12E-08	9.85E-05	4.93E-08	2.25E-08	1.97E-04	9.85E-08	1.18E-07	1.04E-03	5.18E-07	--	--	--	1.29E-07	1.13E-03	5.67E-07	1.41E-07	1.23E-03	6.16E-07
CH_4	5.62E-08	4.93E-04	2.46E-07	1.12E-07	9.85E-04	4.93E-07	5.91E-07	5.18E-03	2.59E-06	--	--	--	6.47E-07	5.67E-03	2.84E-06	7.04E-07	6.16E-03	3.08E-06
CO	3.15E-06	2.76E-02	1.38E-05	6.29E-06	5.51E-02	2.76E-05	3.31E-05	2.90E-01	1.45E-04	--	--	--	3.62E-05	3.17E-01	1.59E-04	3.94E-05	3.45E-01	1.72E-04
Total VOCs	4.38E-04	3.83E+00	1.92E-03	8.75E-04	7.67E+00	3.83E-03	4.60E-03	4.03E+01	2.02E-02	5.12E-02	4.48E+02	2.24E-01	5.62E-02	4.93E+02	2.46E-01	5.67E-02	4.96E+02	2.48E-01
Propane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Butane	4.38E-04	3.83E+00	1.92E-03	8.75E-04	7.67E+00	3.83E-03	4.60E-03	4.03E+01	2.02E-02	--	--	--	5.62E-02	4.93E+02	2.46E-01	5.67E-02	4.96E+02	2.48E-01
Total HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	--	--	--	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

(1) - Scenario 1 assumes that the volume of gas flared during pigging operations is 25,000 scf/year.

(2) - Scenario 2 assumes that the volume of gas flared during pigging operations is 50,000 scf/year.

(3) - The emission factors used to calculate the fugitive emissions are for total organic compounds (including non-VOCs such as methane and ethane) (USEPA, 1995). Because propane, ethane, and butane use the same emission factor, the fugitive emissions were not divided into multiple scenarios and can be applied to both propane and butane for potential to emit calculations.

(4) - Totals presented are the sum of the pigging operations emissions (Scenario 1), seal leak emissions directed to the flare, and seal leak emissions to the atmosphere (for total VOCs only).

(5) - Totals presented are the sum of the pigging operations emissions (Scenario 2), seal leak emissions directed to the flare, and seal leak emissions to the atmosphere (for total VOCs only).

CH_4 = Methane

CO = Carbon Monoxide

CO_2 = Carbon Dioxide

CO_2e = Greenhouse Gas emissions In Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results

N_2O = Nitrous Oxide

Total HAPs = Hazardous Air Pollutants

Total VOCs = Volatile Organic Compounds

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	02-03-2014
SUBJECT:	Annual Potential to Emit Summary - Propane		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

	Pigging Operations Emissions Directed to the Flare						Seal Leak Emissions Directed to the Flare			Seal Leak Emissions To the Atmosphere			Total Emissions - Propane Scenario 1[4]			Total Emissions - Propane Scenario 2[5]		
	Propane - Scenario 1[1]			Propane - Scenario 2[2]			100% Propane			Fugitive Emissions[3]								
	Emissions			Emissions			Emissions						Emissions			Emissions		
Pollutants	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year
CO_2e	9.20E-04	8.06E+00	4.03E-03	1.84E-03	1.61E+01	8.06E-03	9.67E-03	8.47E+01	4.24E-02	--	--	--	1.06E-02	9.28E+01	4.64E-02	1.15E-02	1.01E+02	5.04E-02
CO_2	9.16E-04	8.03E+00	4.01E-03	1.83E-03	1.61E+01	8.03E-03	9.63E-03	8.44E+01	4.22E-02	--	--	--	1.05E-02	9.24E+01	4.62E-02	1.15E-02	1.00E+02	5.02E-02
N_2O	8.94E-09	7.84E-05	3.92E-08	1.79E-08	1.57E-04	7.84E-08	9.40E-08	8.24E-04	4.12E-07	--	--	--	1.03E-07	9.02E-04	4.51E-07	1.12E-07	9.80E-04	4.90E-07
CH_4	4.47E-08	3.92E-04	1.96E-07	8.94E-08	7.84E-04	3.92E-07	4.70E-07	4.12E-03	2.06E-06	--	--	--	5.15E-07	4.51E-03	2.25E-06	5.60E-07	4.90E-03	2.45E-06
CO	2.50E-06	2.19E-02	1.10E-05	5.01E-06	4.38E-02	2.19E-05	2.63E-05	2.30E-01	1.15E-04	--	--	--	2.88E-05	2.52E-01	1.26E-04	3.13E-05	2.74E-01	1.37E-04
Total VOCs	3.31E-04	2.90E+00	1.45E-03	6.63E-04	5.80E+00	2.90E-03	3.49E-03	3.06E+01	1.53E-02	5.12E-02	4.48E+02	2.24E-01	5.50E-02	4.82E+02	2.41E-01	5.54E-02	4.85E+02	2.42E-01
Propane	3.31E-04	2.90E+00	1.45E-03	6.63E-04	5.80E+00	2.90E-03	3.49E-03	3.06E+01	1.53E-02	--	--	--	5.50E-02	4.82E+02	2.41E-01	5.54E-02	4.85E+02	2.42E-01
Ethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Butane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	--	--	--	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

(1) - Scenario 1 assumes that the volume of gas flared during pigging operations is 25,000 scf/year.
(2) - Scenario 2 assumes that the volume of gas flared during pigging operations is 50,000 scf/year.
(3) - The emission factors used to calculate the fugitive emissions are for total organic compounds (including non-VOCs such as methane and ethane) (USEPA, 1995). Because propane, ethane, and butane use the same emission factor, the fugitive emissions were not divided into multiple scenarios and can be applied to both propane and butane for potential to emit calculations.
(4) - Totals presented are the sum of the pigging operations emissions (Scenario 1), seal leak emissions directed to the flare, and seal leak emissions to the atmosphere (for VOCs only).
(5) - Totals presented are the sum of the pigging operations emissions (Scenario 2), seal leak emissions directed to the flare, and seal leak emissions to the atmosphere (for VOCs only).

CH_4 = Methane
CO = Carbon Monoxide
CO_2 = Carbon Dioxide
CO_2e = Greenhouse Gas emissions in Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results
N_2O = Nitrous Oxide
Total HAPs = Hazardous Air Pollutants
Total VOCs = Volatile Organic Compounds

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	02-03-2014
SUBJECT:	Annual Potential to Emit Summary - Ethane		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

	Pigging Operations Emissions Directed to the Flare						Seal Leak Emissions Directed to the Flare			Seal Leak Emissions To the Atmosphere			Total Emissions - Ethane Scenario 1[4]			Total Emissions - Ethane Scenario 2[5]		
	Ethane - Scenario 1[1]			Ethane - Scenario 2[2]			100% Ethane			Fugitive Emissions[3]								
	Emissions			Emissions			Emissions						Emissions			Emissions		
Pollutants	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year
CO_2e	6.45E-04	5.65E+00	2.82E-03	1.29E-03	1.13E+01	5.65E-03	6.78E-03	5.94E+01	2.97E-02	--	--	--	7.42E-03	6.50E+01	3.25E-02	8.07E-03	7.07E+01	3.53E-02
CO_2	6.42E-04	5.63E+00	2.81E-03	1.28E-03	1.13E+01	5.63E-03	6.75E-03	5.91E+01	2.96E-02	--	--	--	7.39E-03	6.48E+01	3.24E-02	8.04E-03	7.04E+01	3.52E-02
N_2O	6.15E-09	5.39E-05	2.69E-08	1.23E-08	1.08E-04	5.39E-08	6.47E-08	5.66E-04	2.83E-07	--	--	--	7.08E-08	6.20E-04	3.10E-07	7.70E-08	6.74E-04	3.37E-07
CH_4	3.08E-08	2.69E-04	1.35E-07	6.15E-08	5.39E-04	2.69E-07	3.23E-07	2.83E-03	1.42E-06	--	--	--	3.54E-07	3.10E-03	1.55E-06	3.85E-07	3.37E-03	1.69E-06
CO	1.72E-06	1.51E-02	7.54E-06	3.44E-06	3.02E-02	1.51E-05	1.81E-05	1.58E-01	7.92E-05	--	--	--	1.98E-05	1.74E-01	8.68E-05	2.15E-05	1.89E-01	9.43E-05
Total VOCs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.12E-02	4.48E+02	2.24E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Propane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethane	2.26E-04	1.98E+00	9.92E-04	4.53E-04	3.97E+00	1.98E-03	2.38E-03	2.09E+01	1.04E-02	--	--	--	2.61E-03	2.29E+01	1.14E-02	2.83E-03	2.48E+01	1.24E-02
Butane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	--	--	--	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

(1) - Scenario 1 assumes that the volume of gas flared during pigging operations is 25,000 scf/year.

(2) - Scenario 2 assumes that the volume of gas flared during pigging operations is 50,000 scf/year.

(3) - The emission factors used to calculate the fugitive emissions are for total organic compounds (including non-VOCs such as methane and ethane) (USEPA, 1995). Because propane, ethane, and butane use the same emission factor, the fugitive emissions were not divided into multiple scenarios and can be applied to both propane and butane for potential to emit calculations.

(4) - Totals presented are the sum of the pigging operations emissions (Scenario 1) and seal leak emissions directed to the flare. Seal leak emissions to the atmosphere (for VOCs only) are not included because ethane is not considered a VOC.

(5) - Totals presented are the sum of the pigging operations emissions (Scenario 2) and seal leak emissions directed to the flare Seal leak emissions to the atmosphere (for VOCs only) are not included because ethane is not considered a VOC.

CH_4 = Methane

CO = Carbon Monoxide

CO_2 = Carbon Dioxide

CO_2e = Greenhouse Gas emissions in Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results

N_2O = Nitrous Oxide

Total HAPs = Hazardous Air Pollutants

Total VOCs = Volatile Organic Compounds

1-4.2 Pigging Operations Directed to the Flare

1-4.2.1 Butane Emissions from Pigging Operations

TETRA TECH

CLIENT: Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
	100-NRS-T29725	01-27-2014
SUBJECT: Annual Potential to Emit Summary - **Butane**		
BASED ON: Client Information and other reference materials as noted in each calculation worksheet.		

	Scenario 1			Scenario 2		
	Emissions			Emissions		
Pollutants	lbs./hour[1]	lbs./year	tons/year	lbs./hour[1]	lbs./year	tons/year
CO_2e	1.23E-03	1.07E+01	5.37E-03	2.45E-03	2.15E+01	1.07E-02
CO_2	1.22E-03	1.07E+01	5.35E-03	2.44E-03	2.14E+01	1.07E-02
N_2O	1.12E-08	9.85E-05	4.93E-08	2.25E-08	1.97E-04	9.85E-08
CH_4	5.62E-08	4.93E-04	2.46E-07	1.12E-07	9.85E-04	4.93E-07
CO	3.15E-06	2.76E-02	1.38E-05	6.29E-06	5.51E-02	2.76E-05
Total VOCs	4.38E-04	3.83E+00	1.92E-03	8.75E-04	7.67E+00	3.83E-03
Butane	4.38E-04	3.83E+00	1.92E-03	8.75E-04	7.67E+00	3.83E-03
Total HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

	Maximum Hourly Rate	
	Emissions	
Pollutants	lbs./hour[2]	tons/hour[2]
CO_2e	1.34E+00	6.68E-04
CO_2	1.33E+00	6.65E-04
N_2O	1.23E-05	6.13E-09
CH_4	6.13E-05	3.06E-08
CO	3.43E-03	1.71E-06
Total VOCs	4.77E-01	2.38E-04
Butane	4.77E-01	2.38E-04
Total HAPs	0.00E+00	0.00E+00

1 - Average rate based on annual emissions.
2 - Maximum hourly rate.

CH_4 = Methane
CO = Carbon Monoxide
CO_2 = Carbon Dioxide
CO_2e = Greenhouse Gas emissions in Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results
N_2O = Nitrous Oxide
Total HAPs = Hazardous Air Pollutants
Total VOCs = Volatile Organic Compounds

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01-27-2014
SUBJECT:	Source Information and Assumptions - Butane		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

Scenario 1	Volume of gas flared	25,000	scf/year	The enclosed flare will only be used during maintenance operations. Maintenance operations (pigging) will occur once per year. Gas volume flared includes 25,000 scf directed to the flare during maintenance.
Scenario 2	Volume of gas flared	50,000	scf/year	The enclosed flare will only be used during maintenance operations. Maintenance operations (pigging) will occur once per year. Gas volume flared includes 25,000 scf directed to the flare during maintenance. Once every 5 years, Smart Tools pigging operations will also occur and send the same amount (25,000 scf) of gas to the flare.
Lower Heating Value (BTU/scf)		2,980		
Flare Control Efficiency [1]		99.9%		

Gas Composition	
Gas	Percent
Butane	0-100%

Flare Manufacturer: John Zink Co. LLC
Estimated Flare Height: 30 feet

Expected Emissions

Flare emissions will include products of combustion and uncombusted flared gas compounds (butane). The flared gas will consist of butane and will not contain sulfur-bearing compounds or any hazardous air pollutants (HAPs). Fugitive emissions from seal leaks will be directed to the flare for combustion. There will be some leakage (fugitive emissions) to the atmospheric side of the seal. The potential to emit (PTE) for atmospheric side seal leaks for volatile organic compounds (VOCs) are estimated to be 2.24E-01 tons/year.

Products of Combustion

The products of combustion from flaring the butane will include VOCs, nitrogen oxides (NOx) consisting of nitrous oxide (N_2O), carbon dioxide, carbon monoxide, and methane.

Compounds from Uncombusted Flared Gas

The flare's estimated destruction efficiency (99.9 percent) determines what fraction of the flared gas remains uncombusted. The uncombusted flared gas compounds will include butane. These calculations are based on PTE, which does include the destruction efficiency.

1. A 99.9% destruction efficiency is based on the stack emission study found in Attachment 5.

BTU = British Thermal Units
HAP = hazardous air pollutant
N_2O = nitrous oxide
NOx = nitrogen oxides
PTE = potential to emit

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01-27-2014
SUBJECT:	VOC emissions - Butane - Scenario 1		
BASED ON:	Client Information and Potential to Emit		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per year
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 99.9 percent[1]
Volume of Gas Uncombusted = 25 scf/year

VOC Calculation		
Inputs		
Gas Volume uncombusted (0.1%) =	25	scf/year
Flare Gas Molecular Weight =	58.12000	lb./lb-mol
Weight Fraction: Total VOCs =	1.00000	
Weight Fraction: Butane =	1.00000	
Efficiency =	99.9% [1]	
Conversion Factors:		
1 MMBTU =	1,000,000	BTU
1 ton =	2,000	lb.
1 scf =	379	scf / lb.-mole
Results		
Total VOC Emissions =	3.83E+00	lb./year
	1.92E-03	ton/year
Butane Emissions =	3.83E+00	lb./year
	1.92E-03	ton/year

1. A 99.9% destruction efficiency is based on the stack emission study found in Attachment 5.

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01-27-2014
SUBJECT:	VOC emissions - Butane - Scenario 2		
BASED ON:	Client Information and Potential to Emit		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per year
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 99.9 percent(1)
Volume of Gas Uncombusted = 50 scf/year

VOC Calculation		
Inputs		
Gas Volume uncombusted (0.1%) =	50	scf/year
Flare Gas Molecular Weight =	58.12000	lb/lb-mol
Weight Fraction: Total VOCs =	1.00000	
Weight Fraction : Butane =	1.00000	
Efficiency =	99.9%	(1)
Conversion Factors:		
1 MMBTU =	1,000,000	BTU
1 ton=	2,000	lb.
1 scf =	379	scf / lb-mole
Results		
Total VOC Emissions =	7.67E+00	lb./year
	3.83E-03	ton/year
Butane Emissions =	7.67E+00	lb./year
	3.83E-03	ton/year

1. A 99.9% destruction efficiency is based on the stack emission study found in Attachment 5.

TETRATECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01-27-2014
SUBJECT:	VOC emissions - Butane - Maximum Hourly Basis		
BASED ON:	Client Information and Potential to Emit		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per hour
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 99.9 percent(1)
Volume of Gas Uncombusted = 3.1 scf/hour(2)

VOC Calculation		
Inputs		
Gas Volume uncombusted (0.1%) =	3.1	scf/hour(2)
Flare Gas Molecular Weight =	58.12000	lb./lb-mol
Weight Fraction: Total VOCs =	1.00000	
Weight Fraction: Butane =	1.00000	
Efficiency =	99.9%	(1)
Conversion Factors:		
1 MMBTU =	1,000,000	BTU
1 ton =	2,000	lb.
1 scf =	379	scf / lb.-mole
Results		
Total VOC Emissions =	4.77E-01	lb./hour
	2.38E-04	ton/hour
Butane Emissions =	4.77E-01	lb./hour
	2.38E-04	ton/hour

1. A 99.9% destruction efficiency is based on the stack emission study found in Attachment 5.
2. Maximum hourly rate calculated in maximum flow rate calculation (Attachment 1).

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon dioxide, nitrous oxide, and methane emissions - Butane - Scenario 1		
BASED ON:	Potential to emit, client information and Reference for Emission Factors: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor (EF) * Lower Heating Value (LHV)

Where:

Gas Volume uncombusted (0.1%) = 25 scf/year

LHV = 2,980 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	65.15	143.59
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./year	Tons/year
Emissions	1.07E+01	5.35E-03

N_2O Calculation	lbs./year	Tons/year
Emissions	9.85E-05	4.93E-08

CH_4 Calculation	lbs./year	Tons/year
Emissions	4.93E-04	2.46E-07

1kg = 2.204 lbs.
1 ton = 2000 lbs.

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01-27-2014
SUBJECT:	Carbon dioxide, nitrous oxide, and methane emissions - Butane - Scenario 2		
BASED ON:	Potential to emit, client information and Reference for Emission Factors: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor (EF) * Lower Heating Value (LHV)

Where:

Gas Volume uncombusted (0.1%) = 50 scf/year

LHV = 2,980 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	65.15	143.59
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./year	Tons/year
Emissions	2.14E+01	1.07E-02

N_2O Calculation	lbs./year	Tons/year
Emissions	1.97E-04	9.85E-08

CH_4 Calculation	lbs./year	Tons/year
Emissions	9.85E-04	4.93E-07

1kg = 2.204 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon dioxide, nitrous oxide, and methane emissions - Butane - Maximum Hourly Basis		
BASED ON:	Potential to emit, client information and Reference for Emission Factors: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor (EF) * Lower Heating Value (LHV)

Where:

Gas Volume uncombusted (0.1%) = 3.1 scf/hour[1]

LHV = 2,980 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	65.15	143.59
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./hour	Tons/hour
Emissions	1.33E+00	6.65E-04

N_2O Calculation	lbs./hour	Tons/hour
Emissions	1.23E-05	6.13E-09

CH_4 Calculation	lbs./hour	Tons/hour
Emissions	6.13E-05	3.06E-08

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon monoxide emissions - Butane - Scenario 1		
BASED ON:	Potential to emit, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor (EF) *coversion factor (CF)

Where:

Flare Gas Volume uncombusted (0.1%) =	25	scf/year
LHV =	2,980	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation	lbs./year	Tons/year
Emissions	2.76E-02	1.38E-05

1 ton = 2000 lbs.

TETRATECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon monoxide emissions - Butane - Scenario 2		
BASED ON:	Potential to emit, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor (EF) *coversion factor (CF)

Where:

Flare Gas Volume uncombusted (0.1%) =	50	scf/year
LHV =	2,980	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation		
	lbs./year	Tons/year
Emissions	5.51E-02	2.76E-05

1 ton = 2000 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon monoxide emissions - Butane - Maximum Hourly Basis		
BASED ON:	Potential to emit, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor (EF) *coversion factor (CF)

Where:

Flare Gas Volume uncombusted (0.1%) =	3.1	scf/hour[1]
LHV =	2,980	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation		
	lbs./hour	Tons/hour
Emissions	3.43E-03	1.71E-06

1. Maximum hourly rate calculated in maximum flow rate calculation (Attachment 1).

1 ton = 2000 lbs.

1-4.2.2 Propane Emissions from Pigging Operations

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Annual Potential to Emit Summary - Propane		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

	Scenario 1			Scenario 2		
	Emissions			Emissions		
Pollutants	lbs./hour[1]	lbs./year	tons/year	lbs./hour[1]	lbs./year	tons/year
CO_2e	9.20E-04	8.06E+00	4.03E-03	1.84E-03	1.61E+01	8.06E-03
CO_2	9.16E-04	8.03E+00	4.01E-03	1.83E-03	1.61E+01	8.03E-03
N_2O	8.94E-09	7.84E-05	3.92E-08	1.79E-08	1.57E-04	7.84E-08
CH_4	4.47E-08	3.92E-04	1.96E-07	8.94E-08	7.84E-04	3.92E-07
CO	2.50E-06	2.19E-02	1.10E-05	5.01E-06	4.38E-02	2.19E-05
Total VOCs	3.31E-04	2.90E+00	1.45E-03	6.63E-04	5.80E+00	2.90E-03
Propane	3.31E-04	2.90E+00	1.45E-03	6.63E-04	5.80E+00	2.90E-03
TOTAL HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

	Maximum Hourly Rate Emissions	
Pollutants	lbs./hour[2]	tons/hour[2]
CO_2e	1.12E+00	5.58E-04
CO_2	1.11E+00	5.56E-04
N_2O	1.08E-05	5.42E-09
CH_4	5.42E-05	2.71E-08
CO	3.03E-03	1.52E-06
Total VOCs	4.02E-01	2.01E-04
Propane	4.02E-01	2.01E-04
Total HAPs	0.00E+00	0.00E+00

1 - Average rate based on annual emissions.
2 - Maximum hourly rate.

CH_4 = Methane
CO = Carbon Monoxide
CO_2 = Carbon Dioxide
CO_2e = Greenhouse Gas emissions in Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results
N_2O = Nitrous Oxide
Total HAPs = Hazardous Air Pollutants
Total VOCs = Volatile Organic Compounds

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01-27-2014
SUBJECT:	Source Information and Assumptions - Propane		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

Scenario 1	Volume of gas flared	25,000	scf/year	The enclosed flare will only be used during maintenance operations. Maintenance operations (pigging) will occur once per year. Gas volume flared includes 25,000 scf directed to the flare during maintenance.
Scenario 2	Volume of gas flared	50,000	scf/year	The enclosed flare will only be used during maintenance operations. Maintenance operations (pigging) will occur once per year. Gas volume flared includes 25,000 scf directed to the flare during maintenance. Once every 5 years, Smart Tools pigging operations will also occur and send the same amount (25,000 scf) of gas to the flare.
Lower Heating Value (BTU/scf)		2,370		
Flare Control Efficiency [1]		99.9%		

Gas Composition	
Gas	Percent
Propane	0-100%

Flare Manufacturer: John Zink Co. LLC
Estimated Flare Height: 30 feet

Expected Emissions

Flare emissions will include products of combustion and uncombusted flared gas compounds (propane). The flared gas will consist of propane and will not contain sulfur-bearing compounds or any hazardous air pollutants (HAPs). Fugitive emissions from seal leaks will be directed to the flare for combustion. There will be some leakage (fugitive emissions) to the atmospheric side of the seal. The potential to emit (PTE) for atmospheric side seal leaks for VOCs are estimated to be 2.24E-01 tons/year.

Products of Combustion

The products of combustion from flaring the propane will include volatile organic compounds (VOCs), nitrogen oxides (NOx) consisting of nitrous oxide (N_2O), carbon dioxide, carbon monoxide, and methane.

Compounds from Uncombusted Flared Gas

The flare's estimated destruction efficiency (99.9 percent) determines what fraction of the flared gas remains uncombusted. The uncombusted flared gas compounds will include propane. These calculations are based on PTE, which does include the destruction efficiency.

1. A 99.9% destruction efficiency is based on the stack emission study found in Attachment 5.

BTU = British Thermal Units
HAP = hazardous air pollutant
N_2O = nitrous oxide

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01-27-2014
SUBJECT:	VOC emissions - Propane - Scenario 1		
BASED ON:	Client Information and Potential to Emit		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per year
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 99.9 percent(1)
Volume of Gas Uncombusted = 25 scf/year

VOC Calculation

Inputs

Gas Volume uncombusted (0.1%) =	25	scf/year
Flare Gas Molecular Weight =	44.00000	lb./lb-mol
Weight Fraction: Total VOCs =	1.00000	
Weight Fraction: Propane =	1.00000	
Efficiency =	99.9% (1)	

Conversion Factors:

1 MMBTU =	1,000,000	BTU
1 ton =	2,000	lb.
1 scf =	379	scf / lb.-mole

Results

Total VOC Emissions =	2.90E+00	lb./year
	1.45E-03	ton/year
Propane Emissions =	2.90E+00	lb./year
	1.45E-03	ton/year

1. A 99.9% destruction efficiency is based on the stack emission study found in Attachment 5.

TETRATECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01-27-2014
SUBJECT:	VOC emissions - Propane - Scenario 2		
BASED ON:	Client Information and Potential to Emit		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per year
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 99.9 percent[1]
Volume of Gas Uncombusted = 50 scf/year

VOC Calculation		
Inputs		
Gas Volume uncombusted (0.1%) =	50	scf/year
Flare Gas Molecular Weight =	44.00000	lb/lb-mol
Weight Fraction: Total VOCs =	1.00000	
Weight Fraction: Propane =	1.00000	
Efficiency =	99.9% [1]	
Conversion Factors:		
1 MMBTU =	1,000,000	BTU
1 ton =	2,000	lb.
1 scf =	379	scf / lb-mole
Results		
Total VOC Emissions =	5.80E+00	lb./year
	2.90E-03	ton/year
Propane Emissions =	5.80E+00	lb./year
	2.90E-03	ton/year

1. A 99.9% destruction efficiency is based on the stack emission study found in Attachment 5.

TETRATECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01-27-2014
SUBJECT:	VOC emissions - Propane - Maximum Hourly Basis		
BASED ON:	Client Information and Potential to Emit		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per year
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 99.9 percent[1]
Volume of Gas Uncombusted = 3.5 scf/hour[2]

VOC Calculation		
Inputs		
Gas Volume uncombusted (0.1%) =	3.5	scf/hour[2]
Flare Gas Molecular Weight =	44.00000	lb./lb-mol
Weight Fraction: Total VOCs =	1.00000	
Weight Fraction : Propane =	1.00000	
Efficiency =	99.9%	[1]
Conversion Factors:		
1 MMBTU =	1,000,000	BTU
1 ton =	2,000	lb.
1 scf =	379	scf / lb.-mole
Results		
Total VOC Emissions =	4.02E-01	lb./hour
	2.01E-04	ton/hour
Propane Emissions =	4.02E-01	lb./hour
	2.01E-04	ton/hour

1. A 99.9% destruction efficiency is based on the stack emission study found in Attachment 5.
2. Maximum hourly rate calculated in maximum flow rate calculation (Attachment 1).

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon dioxide, nitrous oxide, and methane emissions - Propane - Scenario 1		
BASED ON:	Potential to emit, client information and Reference for Emission Factors: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor (EF) * Lower Heating Value (LHV)

Where:

Gas Volume uncombusted (0.1%) = 25 scf/year

LHV = 2,370 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	61.46	135.46
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./year	Tons/year
Emissions	8.03E+00	4.01E-03

N_2O Calculation	lbs./year	Tons/year
Emissions	7.84E-05	3.92E-08

CH_4 Calculation	lbs./year	Tons/year
Emissions	3.92E-04	1.96E-07

1kg = 2.204 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon dioxide, nitrous oxide, and methane emissions - Propane - Scenario 2		
BASED ON:	Potential to emit, client information and Reference for Emission Factors: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor (EF) * Lower Heating Value (LHV)

Where:

Gas Volume uncombusted (0.1%) = 50 scf/year

LHV = 2,370 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	61.46	135.46
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./year	Tons/year
Emissions	1.61E+01	8.03E-03

N_2O Calculation	lbs./year	Tons/year
Emissions	1.57E-04	7.84E-08

CH_4 Calculation	lbs./year	Tons/year
Emissions	7.84E-04	3.92E-07

1kg = 2.204 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon dioxide, nitrous oxide, and methane emissions - Propane - Maximum Hourly Basis		
BASED ON:	Potential to emit, client information and Reference for Emission Factors: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor (EF) * Lower Heating Value (LHV)

Where:

Gas Volume uncombusted (0.1%) = 3.5 scf/hour[1]

LHV = 2,370 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	61.46	135.46
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./hour	Tons/hour
Emissions	1.11E+00	5.56E-04

N_2O Calculation	lbs./hour	Tons/hour
Emissions	1.08E-05	5.42E-09

CH_4 Calculation	lbs./hour	Tons/hour
Emissions	5.42E-05	2.71E-08

1. Maximum hourly rate calculated in maximum flow rate calculation (Attachment 1).

1kg = 2.204 lbs.

TETRATECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon monoxide emissions - Propane - Scenario 1		
BASED ON:	Potential to emit, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor (EF) *conversion factor (CF)

Where:

Flare Gas Volume uncombusted (0.1%) =	25	scf/year
LHV =	2,370	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation		
	lbs./year	Tons/year
Emissions	2.19E-02	1.10E-05

1 ton = 2000 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon monoxide emissions - Propane - Scenario 2		
BASED ON:	Potential to emit, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor (EF) *conversion factor (CF)

Where:

Flare Gas Volume uncombusted (0.1%) =	50	scf/year
LHV =	2,370	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation	lbs./year	Tons/year
Emissions	4.38E-02	2.19E-05

1 ton = 2000 lbs.

TETRATECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon monoxide emissions - Propane - Maximum Hourly Basis		
BASED ON:	Potential to emit, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor (EF) *conversion factor (CF)

Where:

Flare Gas Volume uncombusted (0.1%) =	3.5	scf/hour[(1)]
LHV =	2,370	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation		
	lbs./hour	Tons/hour
Emissions	3.03E-03	1.52E-06

1-4.2.3 Ethane Emissions from Pigging Operations

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Annual Potential to Emit Summary - **Ethane**		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

	Scenario 1			Scenario 2		
	Emissions			Emissions		
Pollutants	lbs./hour[1]	lbs./year	tons/year	lbs./hour[1]	lbs./year	tons/year
CO_2e	6.45E-04	5.65E+00	2.82E-03	1.29E-03	1.13E+01	5.65E-03
CO_2	6.42E-04	5.63E+00	2.81E-03	1.28E-03	1.13E+01	5.63E-03
N_2O	6.15E-09	5.39E-05	2.69E-08	1.23E-08	1.08E-04	5.39E-08
CH_4	3.08E-08	2.69E-04	1.35E-07	6.15E-08	5.39E-04	2.69E-07
CO	1.72E-06	1.51E-02	7.54E-06	3.44E-06	3.02E-02	1.51E-05
Total VOCs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ethane	2.26E-04	1.98E+00	9.92E-04	4.53E-04	3.97E+00	1.98E-03
TOTAL HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

	Maximum Hourly Rate Emissions	
Pollutants	lbs./hour[2]	tons/hour[2]
CO_2e	9.30E-01	4.65E-04
CO_2	9.27E-01	4.63E-04
N_2O	8.88E-06	4.44E-09
CH_4	4.44E-05	2.22E-08
CO	2.48E-03	1.24E-06
Total VOCs	0.00E+00	0.00E+00
Ethane	1.63E-04	1.63E-04
Total HAPs	0.00E+00	0.00E+00

1 - Average rate based on annual emissions.
2 - Maximum hourly rate.

CH_4 = Methane
CO = Carbon Monoxide
CO_2 = Carbon Dioxide
CO_2e = Greenhouse Gas emissions in Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#resu
N_2O = Nitrous Oxide
Total HAPs = Hazardous Air Pollutants
Total VOCs = Volatile Organic Compounds

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01-27-14
SUBJECT:	Source Information and Assumptions - Ethane		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

Scenario 1	Volume of gas flared	25,000	scf/year	The enclosed flare will only be used during maintenance operations. Maintenance operations (pigging) will occur once per year. Gas volume flared includes 25,000 scf directed to the flare during maintenance.
Scenario 2	Volume of gas flared	50,000	scf/year	The enclosed flare will only be used during maintenance operations. Maintenance operations (pigging) will occur once per year. Gas volume flared includes 25,000 scf directed to the flare during maintenance. Once every 5 years, Smart Tools pigging operations will also occur and send the same amount (25,000 scf) of gas to the flare.
Lower Heating Value (BTU/scf)		1,630		
Flare Control Efficiency [1]		99.9%		

Gas Composition	
Gas	Percent
Ethane	0-100%

Flare Manufacturer: John Zink Co. LLC
Estimated Flare Height: 30 feet

Expected Emissions

Flare emissions will include products of combustion and uncombusted flared gas compounds (ethane). The flared gas will consist of ethane and will not contain sulfur-bearing compounds or any hazardous air pollutants (HAPs). Fugitive emissions from seal leaks will be directed to the flare for combustion. There will be some leakage (fugitive emissions) to the atmospheric side of the seal. The potential to emit (PTE) for atmospheric side seal leaks for ethane is estimated to be 2.24E-01 tons/year.

Products of Combustion

The products of combustion from flaring the ethane will include nitrogen oxides (NOx) consisting of nitrous oxide (N_2O), carbon dioxide, carbon monoxide, and methane.

Compounds from Uncombusted Flared Gas

The flare's estimated destruction efficiency (99.9 percent) determines what fraction of the flared gas remains uncombusted. The uncombusted flared gas compounds will include ethane. These calculations are based on PTE, which does include the destruction efficiency.

1. A 99.9% destruction efficiency is based on the stack emission study found in Attachment 5.

BTU = British Thermal Units
HAP = hazardous air pollutant
N_2O = nitrous oxide

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01-27-2014
SUBJECT:	VOC emissions - Ethane - Scenario 1		
BASED ON:	Client Information and Potential to Emit		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per year
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 99.9 percent[1]
Volume of Gas Uncombusted = 25 scf/year

VOC Calculation

Inputs

Gas Volume uncombusted (0.1%) =	25	scf/year
Flare Gas Molecular Weight =	30.07000	lb./lb-mol
Weight Fraction: Total VOCs =	0.00000	
Ethane =	1.00000	
Efficiency =	99.9% [1]	

Conversion Factors:

1 MMBTU =	1,000,000	BTU
1 ton =	2,000	lb.
1 scf =	379	scf / lb.-mole

Results

Total VOC Emissions =	0.00E+00	lb./year
	0.00E+00	ton/year
	1.98E+00	lb./year
Ethane Emissions =	9.92E-04	ton/year

1. A 99.9% destruction efficiency is based on the stack emission study found in Attachment 5.

TETRATECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	VOC emissions - Ethane - Scenario 2		
BASED ON:	Client Information and Potential to Emit		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per year
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 99.9 percent[1]
Volume of Gas Uncombusted = 50 scf/year

VOC Calculation			
Inputs			
Gas Volume uncombusted (0.1%) =		50	scf/year
Flare Gas Molecular Weight =		30.07000	lb/lb-mol
Weight Fraction: Total VOCs =		0.00000	
	Ethane	1.00000	
	Efficiency =	99.9% [1]	
Conversion Factors:			
	1 MMBTU =	1,000,000	BTU
	1 ton =	2,000	lb.
	1 scf =	379	scf / lb-mole
Results			
	Total VOC Emissions =	0.00E+00	lb./year
		0.00E+00	ton/year
	Ethane Emissions =	3.97E+00	lb./year
		1.98E-03	ton/year

1. A 99.9% destruction efficiency is based on the stack emission study found in Attachment 5.

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01-27-2014
SUBJECT:	VOC emissions - Ethane - Maximum Hourly Basis		
BASED ON:	Client Information and Potential to Emit		

VOC Flare Emissions Calculations

Emissions = Uncombusted Flare gas volume * Flare Gas Molecular Weight * Weight Fraction of VOCs

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per year
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 99.9 percent[1]
Volume of Gas Uncombusted = 4.1 scf/hour[2]

VOC Calculation		
Inputs		
Gas Volume uncombusted (0.1%) =	4.1	scf/hour[2]
Flare Gas Molecular Weight =	30.07000	lb./lb-mol
Weight Fraction: Total VOCs =	0.00000	
Ethane =	1.00000	
Efficiency =	99.9%	[1]
Conversion Factors:		
1 MMBTU =	1,000,000	BTU
1 ton =	2,000	lb.
1 scf =	379	scf / lb.-mole
Results		
Total VOC Emissions =	0.00E+00	lb./hour
	0.00E+00	ton/hour
Ethane Emissions =	3.27E-01	lb./hour
	1.63E-04	ton/hour

1. A 99.9% destruction efficiency is based on the stack emission study found in Attachment 5.
2. Maximum hourly rate calculated in maximum flow rate calculation (Attachment 1).

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon dioxide, nitrous oxide, and methane emissions - Ethane - Scenario 1		
BASED ON:	Potential to emit, client information and Reference for Emission Factors: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor (EF) * Lower Heating Value (LHV)

Where:

Gas Volume uncombusted (0.1%) = 25 scf/year

LHV = 1,630 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	62.64	138.06
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./year	Tons/year
Emissions	5.63E+00	2.81E-03

N_2O Calculation	lbs./year	Tons/year
Emissions	5.39E-05	2.69E-08

CH_4 Calculation	lbs./year	Tons/year
Emissions	2.69E-04	1.35E-07

1kg = 2.204 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon dioxide, nitrous oxide, and methane emissions - Ethane - Scenario 2		
BASED ON:	Potential to emit, client information and Reference for Emission Factors: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor (EF) * Lower Heating Value (LHV)

Where:

Gas Volume uncombusted (0.1%) = 50 scf/year

LHV = 1,630 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	62.64	138.06
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./year	Tons/year
Emissions	1.13E+01	5.63E-03

N_2O Calculation	lbs./year	Tons/year
Emissions	1.08E-04	5.39E-08

CH_4 Calculation	lbs./year	Tons/year
Emissions	5.39E-04	2.69E-07

1kg = 2.204 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon dioxide, nitrous oxide, and methane emissions - Ethane - Maximum Hourly Basis		
BASED ON:	Potential to emit, client information and Reference for Emission Factors: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp.		

Emissions = Flare gas volume * Emission Factor (EF) * Lower Heating Value (LHV)

Where:

Gas Volume uncombusted (0.1%) = 4.1 scf/hour[(1)]

LHV = 1,630 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)
CO_2	62.64	138.06
N_2O	6.00E-04	1.32E-03
CH_4	3.00E-03	0.01

CO_2 Calculation	lbs./hour	Tons/hour
Emissions	9.27E-01	4.63E-04

N_2O Calculation	lbs./hour	Tons/hour
Emissions	8.88E-06	4.44E-09

CH_4 Calculation	lbs./hour	Tons/hour
Emissions	4.44E-05	2.22E-08

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER: 100-NRS-T29725	DATE 01-27-2014
SUBJECT:	Carbon monoxide emissions - Ethane - Scenario 1		
BASED ON:	Potential to emit, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor (EF) *conversion factor (CF)

Where:

Flare Gas Volume uncombusted (0.1%) =	25	scf/year
LHV =	1,630	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation	lbs./year	Tons/year
Emissions	1.51E-02	7.54E-06

1 ton = 2000 lbs.

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon monoxide emissions - Ethane - Scenario 2		
BASED ON:	Potential to emit, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor (EF) *conversion factor (CF)

Where:

Flare Gas Volume uncombusted (0.1%) =	50	scf/year
LHV =	1,630	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation		
	lbs./year	Tons/year
Emissions	3.02E-02	1.51E-05

1 ton = 2000 lbs.

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-27-2014
SUBJECT:	Carbon monoxide emissions - Ethane - Maximum Hourly Basis		
BASED ON:	Potential to emit, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Flare gas volume * Lower Heating Value (LHV) * Emission Factor (EF) *conversion factor (CF)

Where:

Flare Gas Volume uncombusted (0.1%) =	4.1	scf/hour[1]
LHV =	1,630	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation		
	lbs./hour	Tons/hour
Emissions	2.48E-03	1.24E-06

1-4.3 Seal Leak Emissions

1-4.3.1 Seal Leak Potential to Emit Summary

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	100-NRS-T29725
PREPARED BY:	MK	DATE:	02/04/14
SUBJECT:	Annual Potential to Emit Summary Due to Seal Leaks		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

	Seal Leak Emissions Directed to the Flare									Seal Leak Emissions To the Atmosphere		
	Scenario 1 Emissions			Scenario 2 Emissions			Scenario 3 Emissions			Fugitive Emissions[1]		
Pollutants	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs./hour	lbs./year	tons/year	lbs/hour	lbs./year	tons/year
CO_2e	6.78E-03	5.94E+01	2.97E-02	9.67E-03	8.47E+01	4.24E-02	1.29E-02	1.13E+02	5.64E-02	--	--	--
CO_2	6.75E-03	5.91E+01	2.96E-02	9.63E-03	8.44E+01	4.22E-02	1.28E-02	1.12E+02	5.62E-02	--	--	--
N_2O	6.47E-08	5.66E-04	2.83E-07	9.40E-08	8.24E-04	4.12E-07	1.18E-07	1.04E-03	5.18E-07	--	--	--
CH_4	3.23E-07	2.83E-03	1.42E-06	4.70E-07	4.12E-03	2.06E-06	5.91E-07	5.18E-03	2.59E-06	--	--	--
CO	1.81E-05	1.58E-01	7.92E-05	2.63E-05	2.30E-01	1.15E-04	3.31E-05	2.90E-01	1.45E-04	--	--	--
Total VOCs	0.00E+00	0.00E+00	0.00E+00	3.49E-03	3.06E+01	1.53E-02	4.60E-03	4.03E+01	2.02E-02	5.12E-02	4.48E+02	2.24E-01
Propane	0.00E+00	0.00E+00	0.00E+00	3.49E-03	3.06E+01	1.53E-02	0.00E+00	0.00E+00	0.00E+00	--	--	--
Ethane	2.38E-03	2.09E+01	1.04E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	--	--	--
Butane	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.60E-03	4.03E+01	2.02E-02			
Total HAPs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	--	--	--

Footnote

(1) - The emission factors used to calculate the fugitive emissions are for total organic compounds (including non-VOCs such as methane and ethane) (USEPA, 1995). Because propane, ethane, and butane use the same emission factor, the fugitive emissions were not divided into multiple scenarios and can be applied to both Scenario 1, 2, and 3 for PTE.

Acronyms

CH_4 = Methane

CO = Carbon Monoxide

CO_2 = Carbon Dioxide

CO_2e = Greenhouse Gas emissions in Carbon Dioxide Equivalent. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results

HAPs = Hazardous Air Pollutants

N_2O = Nitrous Oxide

VOCs = Volatile Organic Compounds

1-4.3.2 Seal Leaks Directed to the Flare

TETRA TECH			
CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY:	MK	DATE:	01/29/14
SUBJECT:	Source Information and Assumptions - Seal Leaks Directed to Flare		
BASED ON:	Client Information and other reference materials as noted in each calculation worksheet.		

Seal Leak Scenario 1	Leaks directed to flare	262,800	scf/year	Potential to emit calculations for seal leaks that are directed to the flare. Estimated leakage has a range from 0.15 to 0.5 scfm. A leakage of 0.5 scfm was assumed as the most conservative estimate. Seal Leak Scenario 1 is based off a gas composition of 100% ethane.
Seal Leak Scenario 2	Leaks directed to flare	262,800	scf/year	Potential to emit calculations for seal leaks that are directed to flare. Estimated leakage has a range from 0.15 to 0.5 scfm. A leakage of 0.5 scfm was assumed as the most conservative estimate. Seal Leak Scenario 2 is based off a gas composition of 100% propane.
Seal Leak Scenario 3	Leaks directed to flare	262,800	scf/year	Potential to emit calculations for seal leaks that are directed to flare. Estimated leakage has a range from 0.15 to 0.5 scfm. A leakage of 0.5 scfm was assumed as the most conservative estimate. Seal Leak Scenario 3 is based off a gas composition of 100% butane.

Ethane Heating Value (BTU/scf)	1,630
Propane Heating Value (BTU/scf)	2,370
Butane Heating Value (BTU/scf)	2,980
Flare Control Efficiency[1]	99.9%

Gas Composition			
Gas	Percent		
	Seal Leak Scenario 1	Seal Leak Scenario 2	Seal Leak Scenario 3
Ethane	100%	0%	0%
Propane	0%	100%	0%
Butane	0%	0%	100%

Flare Manufacturer: John Zink, Co LLC
Estimated Flare Height: 30 feet

Expected Emissions

Flare emissions will include products of combustion and uncombusted flared gas compounds (propane, ethane, and butane). The flared gas will consist of a mixture of propane, ethane, or butane and will not contain sulfur-bearing compounds or any hazardous air pollutants (HAPs). Fugitive emissions from seal leaks will be directed to the flare for combustion. There will be some leakage (fugitive emissions) to the atmospheric side of the seal. The potential to emit (PTE) for atmospheric side seal leaks for volatile organic compounds (VOCs) are estimated to be 2.24E-01 tons/year.

Products of Combustion

The products of combustion from flaring the mixture of propane, ethane, and butane will include VOCs, nitrogen oxides (NOx) consisting of nitric oxide (N_2O), carbon dioxide, carbon monoxide, and methane.

Compounds from Uncombusted Flared Gas

The flare's estimated destruction efficiency (99.9 percent) determines what fraction of the flared gas remains uncombusted. The uncombusted flared gas compounds will include propane, ethane, or butane dependant on which product is transported in the pipeline.

Footnotes

1. A 99.9% destruction efficiency is based on the stack emission study found in Attachment 5.

Acronyms

BTU = British Thermal Units
HAP = hazardous air pollutant
N_2O = nitrous oxide
NOx = nitrogen oxides
PTE = potential to emit
scf = standard cubic feet
VOCs = volatile organic compounds

TETRATECH			
CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY: MK		DATE:	02/04/14
SUBJECT:	VOC emissions - Ethane - Seal Leak Scenario 1 - Leaks directed to flare		
BASED ON:	Client Information and Potential to Emit		

VOC Flare Emissions Calculations

Emissions (lb/event) = Seal leak gas volume * coversion factor (CF) * Molecular Weight * Weight Fraction

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per event
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 99.9 percent (control efficiency for PTE calculations)
Volume of Gas Uncombusted = 263 scf/year

VOC Calculation			
Inputs			
	Gas Volume leaked (0.1%) =	263	scf/year
	Flare Gas Molecular Weight =	30.07	lb./lb-mol
	Weight Fraction: Total VOCs [1] =	0.00000	
	Weight Fraction: Ethane =	1.00000	
	Efficiency =	99.9%	
Conversion Factors:			
	1 MMBTU =	1,000,000	BTU
	1 ton =	2,000	lb.
	1 scf =	379	scf / lb.-mole
Results			
	Total VOC[1] Emissions =	0.00E+00	lb./year
		0.00E+00	ton/year
	Ethane Emissions =	2.09E+01	lb./year
		1.04E-02	ton/year

Footnote
1. Ethane is considered to have negligible photochemical activity per 40CFR51.100

TETRATECH		
CLIENT: Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY: MK	DATE:	02/04/14
SUBJECT: VOC emissions - Propane - Seal Leak Scenario 2 - Leaks directed to flare		
BASED ON: Client Information and Potential to Emit		

VOC Flare Emissions Calculations

Emissions (lb/event) = Seal leak gas volume * coversion factor (CF) * Molecular Weight * Weight Fraction

Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per event
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 99.9 percent (control efficiency for PTE calculations)
Volume of Gas Uncombusted = 263 scf/year

VOC Calculation

Inputs

Gas Volume leaked (0.1%) =	263	scf/year
Flare Gas Molecular Weight =	44.10	lb./lb-mol
Weight Fraction: Total VOCs =	1.00000	
Weight Fraction: Propane =	1.00000	
Efficiency =	99.9%	

Conversion Factors:

1 MMBTU =	1,000,000	BTU
1 ton =	2,000	lb.
1 scf =	379	scf / lb.-mole

Results

Total VOC Emissions =	3.06E+01	lb./year
	1.53E-02	ton/year
Propane Emissions =	3.06E+01	lb./year
	1.53E-02	ton/year

TETRA TECH			
CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY: MK		DATE:	02/04/14
SUBJECT:	VOC emissions - Butane - Seal Leak Scenario 3 - Leaks directed to flare		
BASED ON:	Client Information and Potential to Emit		

Emissions (lb/event) = Seal leak gas volume * coversion factor (CF) * Molecular Weight * Weight Fraction

VOC Flare Emissions Calculations

Annual Basis
Where:
Emissions = Total Mass of Pollutant
Flare gas volume = Amount of gas flared per event
Flare Gas Molecular Weight = Molecular Weight based on Gas Composition
Weight Fraction of VOCs = Fraction of Weight of VOCs based on Gas Composition
Control Efficiency = 99.9 percent (control efficiency for PTE calculations)
Volume of Gas Uncombusted = 263 scf/year

VOC Calculation

Inputs

Gas Volume leaked (0.1%) =	263	scf/year
Flare Gas Molecular Weight =	58.12	lb./lb-mol
Weight Fraction: Total VOCs =	1.00000	
Weight Fraction: Butane =	1.00000	
Efficiency =	99.9%	

Conversion Factors:

1 MMBTU =	1,000,000	BTU
1 ton =	2,000	lb.
1 scf =	379	scf / lb.-mole

Results

Total VOC Emissions =	4.03E+01	lb./year
	2.02E-02	ton/year
Butane Emissions =	4.03E+01	lb./year
	2.02E-02	ton/year

TETRA TECH

CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY:	MK	DATE:	02/04/14
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Ethane - Scenario 1 - Leaks directed to flare.		
BASED ON:	Potential to emit, client information and reference for emission factors: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp. Global warming potential factors are selected for a 100-year horizon, which are consistent with all climate change programs via the Intergovernmental Panel on Climate Change.		

Emissions = Seal Leak gas volume * Emission Factor (EF) * Lower Heating Value (LHV)

Where:

Seal Leak gas volume (PTE) = 263 scf/year

Lower Heating Value (Ethane) = 1,630 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)	Global Warming Potential (GWP)
CO_2	62.64	138.06	1
N_2O	0.0006	0.0013	310
CH_4	0.003	0.0066	21

CO_2 Calculation	lbs./year	Tons/year
Emissions	5.91E+01	2.96E-02

N_2O Calculation			CO_2 Equivalent (CO2e)	
	lbs./year	Tons/year	lbs./year	Tons/year
Emissions	5.66E-04	2.83E-07	1.76E-01	8.78E-05

CH_4 Calculation			CO_2 Equivalent (CO2e)	
	lbs./year	Tons/year	lbs./year	Tons/year
Emissions	2.83E-03	1.42E-06	5.95E-02	2.97E-05

1kg = 2.204 lbs.
1 ton = 2,000 lbs.

TETRA TECH

CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY:	MK	DATE:	02/04/14
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Delmont Station - Propane - Leaks directed to flare.		
BASED ON:	Potential to emit, client information and Reference for Emission Factors: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp. Global warming potential factors are selected for a 100-year horizon, which are consistent with all climate change programs via the Intergovernmental Panel on Climate Change.		

Emissions = Seal Leak gas volume * Emission Factor (EF) * Lower Heating Value (LHV)

Where:

Seal Leak gas volume (PTE) = 263 scf/year

Lower Heating Value (Propane) = 2,370 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)	Global Warming Potential (GWP)
CO_2	61.46	135.46	1
N_2O	0.0006	0.0013	310
CH_4	0.003	0.0066	21

CO_2 Calculation	lbs./year	Tons/year
Emissions	8.44E+01	4.22E-02

N_2O Calculation			CO_2 Equivalent (CO2e)	
	lbs./year	Tons/year	lbs./year	Tons/year
Emissions	8.24E-04	4.12E-07	2.55E-01	1.28E-04

CH_4 Calculation			CO_2 Equivalent (CO2e)	
	lbs./year	Tons/year	lbs./year	Tons/year
Emissions	4.12E-03	2.06E-06	8.65E-02	4.32E-05

1 kg = 2.204 lbs.

1 ton = 2,000 lbs.

TETRA TECH			
CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY:	MK	DATE:	02/04/14
SUBJECT:	Carbon dioxide, nitrous oxide and methane emissions - Butane - Scenario 3 - Leaks directed to flare.		
BASED ON:	Potential to emit, client information and Reference for Emission Factors: Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp. Global warming potential factors are selected for a 100-year horizon, which are consistent with all climate change programs via the Intergovernmental Panel on Climate Change.		

Emissions = Seal Leak gas volume * Emission Factor (EF) * Lower Heating Value (LHV)

Annual Basis

Where:

Seal Leak gas volume (PTE) = 263 scf/year

Lower Heating Value (Butane) = 2,980 Btu/scf

Pollutant	EF (kg/mmBtu)	EF (lb./mmBtu)	Global Warming Potential (GWP)
CO_2	65.15	143.59	1
N_2O	0.0006	0.0013	310
CH_4	0.003	0.0066	21

CO_2 Calculation	lbs./year	Tons/year
Emissions	1.12E+02	5.62E-02

N_2O Calculation			CO_2 Equivalent (CO2e)	
	lbs./year	Tons/year	lbs./year	Tons/year
Emissions	1.04E-03	5.18E-07	3.21E-01	1.61E-04

CH_4 Calculation			CO_2 Equivalent (CO2e)	
	lbs./year	Tons/year	lbs./year	Tons/year
Emissions	5.18E-03	2.59E-06	1.09E-01	5.44E-05

1 kg = 2.204 lbs.

1 ton = 2,000 lbs.

TETRA TECH			
CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY:	MK	DATE:	02/04/14
SUBJECT:	Carbon monoxide emissions - Ethane - Leaks directed to flare.		
BASED ON:	Potential to emit, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Seal leak gas volume * Lower Heating Value (LHV) * Emission Factor (EF) *coversion factor (CF)

Where:

Seal Leak gas volume (PTE) =	263	scf/year
LHV =	1,630	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation		
	lbs./year	Tons/year
Emissions	1.58E-01	7.92E-05

1 ton = 2000 lbs.

TETRA TECH

CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY: MK		DATE:	02/04/14
SUBJECT:	Carbon monoxide (CO) emissions - Propane - Leaks directed to flare.		
BASED ON:	Potential to emit, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Seal leak gas volume * Lower Heating Value (LHV) * Emission Factor (EF) *coversion factor (CF)

Where:

Seal Leak gas volume (PTE) =	263	scf/year
LHV =	2,370	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation		
	lbs./year	Tons/year
Emissions	2.30E-01	1.15E-04

1 ton = 2000 lbs.

TETRA TECH			
CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY:	MK	DATE:	02/04/14
SUBJECT:	Carbon monoxide emissions - Butane - Leaks directed to flare.		
BASED ON:	Potential to emit, client information, and emission factor reference for flare operatons presented in Table 13.5-1 in Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42, US EPA, 1995.		

Emissions (lb/event) = Seal leak gas volume * Lower Heating Value (LHV) * Emission Factor (EF) *coversion factor (CF)

Annual Basis

Where:

Seal Leak gas volume (PTE) =	263	scf/year
LHV =	2,980	Btu/scf
EF =	0.37	lb/mmBtu
CF =	1 MMBtu/1,000,000 Btu	

CO Calculation	lbs./year	Tons/year
Emissions	2.90E-01	1.45E-04

1 ton = 2000 lbs.

1-4.3.3 Seal Leaks Directed to the Atmosphere

TETRA TECH

CLIENT:	Sunoco Pipeline L.P.	NUMBER:	100-NRS-T29725
PREPARED BY: MK		DATE:	02/04/14
SUBJECT:	VOC emissions - Fugitive Emissions - Leaks directed to atmosphere		
BASED ON:	Client Information and Potential to Emit		

Fugitive Emissions Calculations

Where:
Fugitive VOC Emissions (TPY) = # of Sources x Emission Factor (lbs./hr.-source) x 8,760 hrs./year x (1 ton/2,000 pounds)

Source Category	Service	Emission Factor (lb./hr./source)	Total Number of Sources	Fugitive VOC Emissions (TPY)
Valves	Light Liquid	0.0000946	150	0.062
Fittings	Light Liquid	0.0000176	410	0.032
Pumps	Light Liquid	0.001188	1	0.005
Other	Light Liquid	0.000286	100	0.125
			Total	**0.224**

ATTACHMENT 2

AGGREGATION ANALYSIS

Aggregation Analysis for Cornwall Station Enclosed Flare

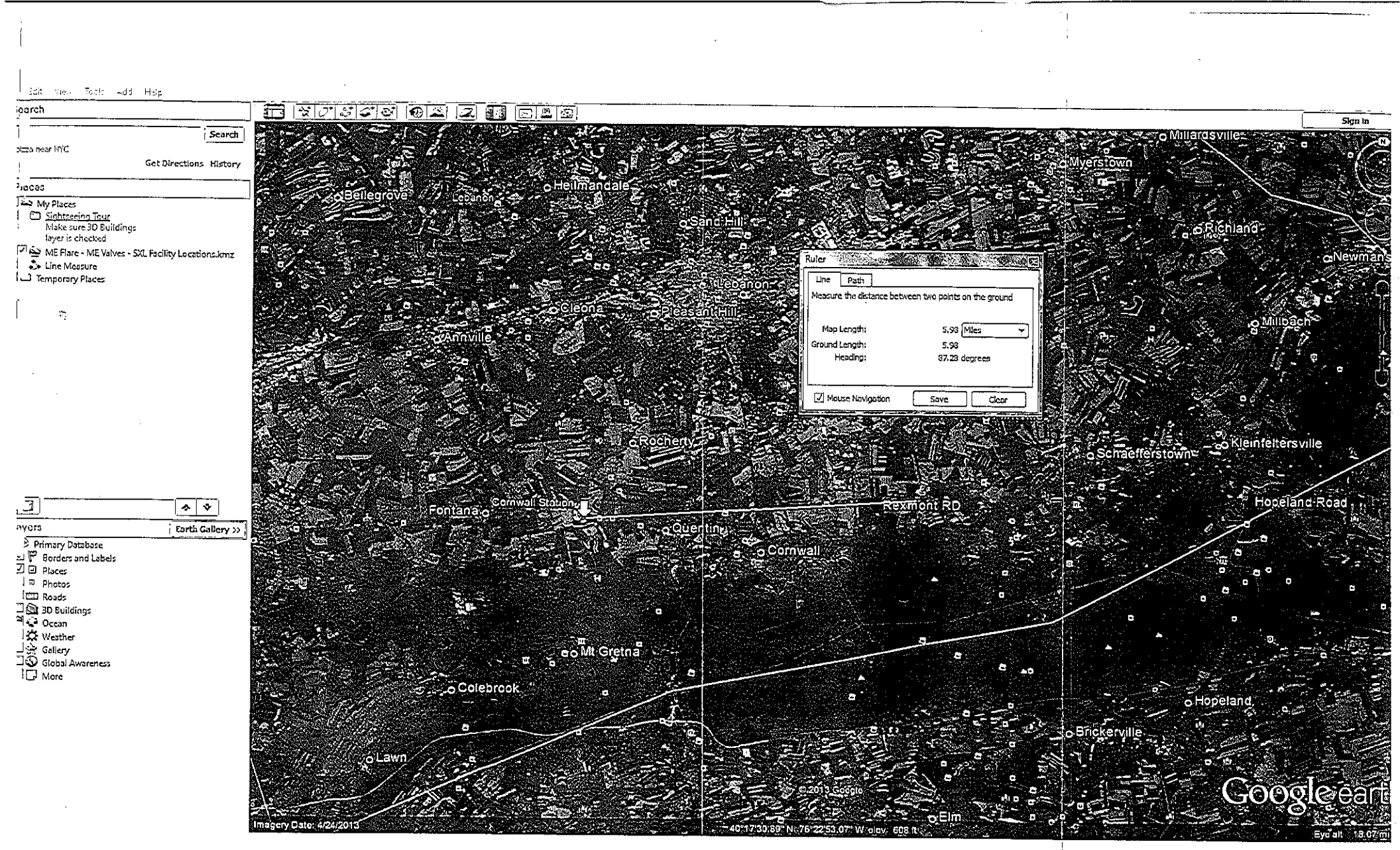
An Aggregation Analysis has been completed on the basis of the facility definition contained in 25 PA Code Section 121.1, Guidance for Performing Single Stationary Source Determinations for Oil and Gas Industries (PADEP 270-0810-006). The entire state of Pennsylvania is considered a "moderate" ozone nonattainment area for nitrogen oxides (NOx) and volatile organic compounds (VOCs) because Pennsylvania is a jurisdiction in the Ozone Transport Region (Section 184 of the Clean Air Act). For non-attainment New Source Review (NSR) purposes, Pennsylvania defines a "facility" to mean "an air contamination source or combination of air contamination sources located on one or more contiguous or adjacent properties and which is owned and operated by the same person under common control."

PADEP guidance (270-0810-006) states that if two or more air contamination sources are determined to be a single source with emissions, which collectively meet or exceed the major source thresholds and meet the nonattainment NSR criteria stated above, they should be treated as a single air contamination source for non-attainment NSR permitting purposes.

The closest property owned or operated by Sunoco Pipeline L.P. or by the same person under common control is approximately 6.0 miles from the Cornwall Station enclosed flare location. Attachment 2-1 illustrates the distance from the Cornwall Station flare (identified as Cornwall Station) to the closest common control facility (identified as Rexmont Rd). Aggregate emission calculations were not performed because these properties are greater than a quarter mile from each other and are not considered contiguous or adjacent.

2-1

MAP SHOWING CLOSEST COMMON CONTROL PROPERTY TO ENCLOSED FLARE LOCATION


Search
Get Directions History
My Places
Sightseeing Tour
Make sure 3D Buildings layer is checked
ME Flare - ME Valves - SXL Facility Locations.kmz
Line Measure
Temporary Places
Earth Gallery >>
Primary Database
Borders and Labels
Places
Photos
Roads
3D Buildings
Ocean
Weather
Gallery
Global Awareness
More
Sign In
Ruler
Line
Path
Measure the distance between two points on the ground
Map Length: 5.98 Miles
Ground Length: 5.98
Heading: 87.28 degrees
Mouse Navigation
Save
Clear
Millardsville
Myerstown
Richland
Newmanstown
Millbach
Kleinfeltersville
Schaefferstown
Hopeland Road
Hopeland
Brickerville
Bellegrove
Lebanon
Hellmandale
Sand Hill
Cleona
Pleasant Hill
Annville
Rocherty
Fontana
Cornwall Station
Rexmont RD
Quentin
Cornwall
Mt Gretna
Colebrook
Lawn
Elm
Imagery Date: 4/24/2013
40°17'30.89" N 76°22'53.07" W elev 608 ft
Eye alt 18.07 mi
Google earth

ATTACHMENT 3

APPLICABILITY DETERMINATION

Applicability Determination for Cornwall Station Enclosed Flare

In accordance with, 25 PA Code § 127.203a, Applicability Determination, this document provides the required applicability determination emissions increase calculations for regulated New Source Review (NSR) pollutants associated with the installation of an enclosed flare at Cornwall Station as part of the Sunoco Pipeline L.P. Mariner East pipeline construction project.

Potential emissions rate (PER) and potential to emit (PTE) for all pollutants expected to be emitted based on the composition of liquefied natural gas carried in the pipeline were calculated (see Attachment 1). From August 2014 to July 2015 the pipeline will transport batches of either 95% liquid butane or 95% liquid propane. From July 2015 on the pipeline is slated for pure liquid ethane. According to the definition of volatile organic compounds (VOCs) found in 25 PA Code § 121.1, Definitions, ethane is not considered a VOC because it is listed as having negligible photochemical reactivity in 40 CFR 51.100 relating to definitions. Therefore, emissions calculations based on pure liquid ethane do not result in any VOC emissions. Scenarios assuming that the liquefied natural gas stream consists of 100% propane or 100% butane do include VOC emissions in the PER and PTE calculations because both of those chemicals are considered VOCs. Pollutants emitted by the proposed new emission unit (enclosed flare) include carbon dioxide, nitrous oxide, methane, carbon monoxide, propane, ethane, butane, and total VOCs. Applicability determinations apply to regulated NSR pollutants. Total VOCs, nitrous oxide, and carbon monoxide are the only regulated NSR pollutants that will be emitted by the proposed new emission unit and therefore are the focus of this applicability determination.

The PER (i.e., assuming a flare control efficiency of 0 percent) for total VOCs is 18.4 tons per year if assuming a liquefied natural gas composition of 100% propane, and 24.2 tons per year assuming a liquefied natural gas composition of 100% butane. No VOC emissions would occur when transporting pure ethane. The PTE (i.e., assuming a flare control efficiency of 99.9 percent) for total VOCs is 0.24 tons per year assuming a liquefied natural gas composition of 100% propane and 0.25 tons per year assuming a liquefied natural gas composition of 100% butane. Calculations for the PER and PTE are presented in Attachment 1.

According to the definition of "significant" found at 25 PA Code § 121.1.Definitions, the PTE for total VOCs is not significant even though the entire Commonwealth of Pennsylvania is considered a "moderate" ozone nonattainment area, because the PTE for total VOCs is less than 25 tons per year. The emissions increase of total VOCs at Cornwall Station is the PTE from the new emissions unit (enclosed flare) as described in 25 PA Code § 127.203a (1)(i)(B). The total VOC net emissions increase in this case is also the PTE per 25 PA Code § 127.203a (1)(ii)(A). Based on the total VOC emissions increase and net emissions, the installation of the enclosed flare is not considered a major modification because it does not cause a significant emissions increase or a significant net emissions increase of total VOCs based on PTE [25 PA Code § 127.203a (1)].

The PER for nitrous oxide is 4.9×10^{-4} tons per year assuming a liquefied natural gas composition of 100% propane, 6.2×10^{-4} tons per year assuming a liquefied natural gas composition of 100% butane, and 3.4×10^{-4} tons per year assuming a liquefied natural gas composition of 100% ethane. The PTE for nitrous oxide is 4.9×10^{-7} tons per year assuming a liquefied natural gas composition of 100% propane, and 6.2×10^{-7} tons per year assuming a liquefied natural gas composition of 100% butane, and 3.4×10^{-7} tons per year assuming a liquefied natural gas composition of 100% ethane. According to the definition of "de minimis emissions increase" found at 25 PA Code § 121.1, Definitions, the PTE for nitrous oxide is de minimis. The emissions increase of nitrous oxide at the Cornwall Station is the PTE from the new emissions unit (enclosed flare) as described in 25 PA Code § 127.203a (4)(ii).

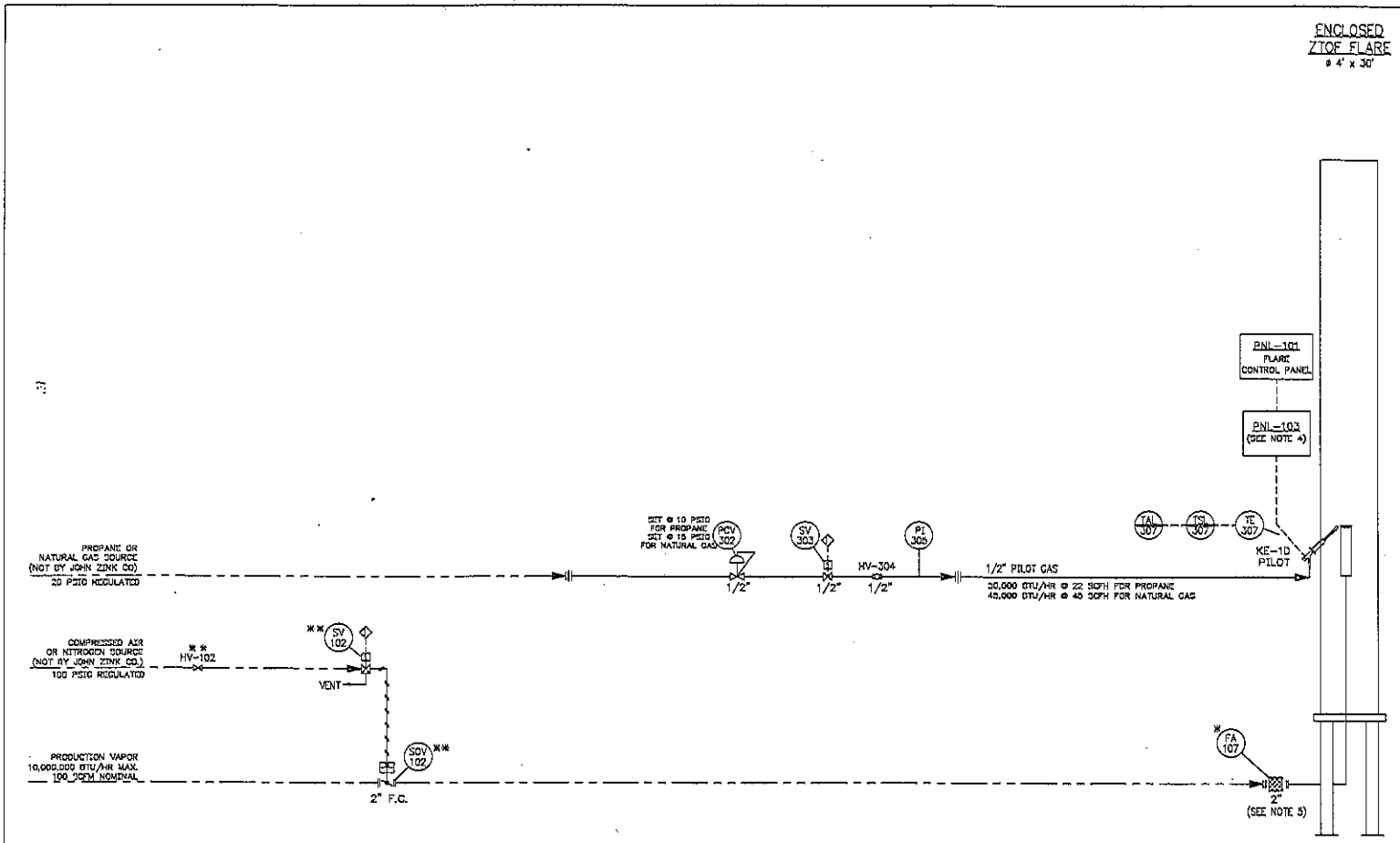
The PER for carbon monoxide is 1.4×10^{-1} tons per year assuming a liquefied natural gas composition of 100% propane, 1.7×10^{-1} tons per year assuming a liquefied natural gas composition of 100% butane, and 9.4×10^{-2} tons per year assuming a liquefied natural gas composition of 100% ethane. The PTE for carbon monoxide is 1.4×10^{-4} tons per year assuming a liquefied natural gas composition of 100% propane, and

$1.7x10^{-4}$ tons per year assuming a liquefied natural gas composition of 100% butane, and $9.4x10^{-5}$ tons per year assuming a liquefied natural gas composition of 100% ethane. According to the definition of "de minimis emissions increase" found at 25 PA Code § 121.1, Definitions, the PTE for carbon monoxide is de minimis. The emissions increase of carbon monoxide at the Cornwall Station is the PTE from the new emissions unit (enclosed flare) as described in 25 PA Code § 127.203a (4)(ii).

ATTACHMENT 4

FLARE DESIGN SPECIFICATIONS, INSPECTION, AND MAINTENANCE

Enclosed ZTOF Flare Process and Instrument Diagram



NOTES:

1. ✻ – SUPPLIED BY JOHN ZINK CO. AND SHIPPED LOOSE FOR FIELD INSTALLATION.
2. ✻✻ – SUPPLIED BY OTHERS (NOT BY JOHN ZINK CO.)
3. ELECTRICAL AREA CLASSIFICATION: NON-HAZARDOUS
4. IGNITION TRANSFORMER IS INSIDE PNL-103 AND MOUNTED ON FLARE.
5. LOCATE FLAME ARRESTOR WITH 5 DIAMETERS OF STRAIGHT UNDISTURBED FLOW UPSTREAM.

LEGEND

- FIELD MOUNTED INSTRUMENT
- REMOTE PANEL MOUNTED NORMALLY ACCESSIBLE TO OPERATOR
- LOCAL PANEL MOUNTED NORMALLY ACCESSIBLE TO OPERATOR
- REMOTE SUB-PANEL MOUNTED NORMALLY INACCESSIBLE TO OPERATOR
- LOCAL SUB-PANEL MOUNTED NORMALLY INACCESSIBLE TO OPERATOR
- LOCATED IN THE PLC
- INTERLOCK TO/FROM CONTROL PANEL
- PIPE & FITTINGS BY OTHERS (NOT BY JOHN ZINK CO.)
- ELECTRICAL INTERCONNECTIONS
- INSTRUMENT CONTROL AIR LINE
- PIPE & FITTINGS BY JOHN ZINK CO.

NO.	REVISION DESCRIPTION	BY	CK.	APP.	DATE

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FOR: SUNOCO LOGISTICS
USER: SUNOCO LOGISTICS
JOB/SITE: SINKING SPRINGS, PA
S.O. NO. DF-0144980
P.O. NO. 01109261-V2

DR. RPJ DATE: 12-17-13
CK. JPR DATE: 1-3-14
APP. JPR DATE: 1-3-14
DATE:

JOHN ZINK
JOHN ZINK COMPANY LLC
PARTS AND SERVICE, CALL 1-800-755-4752 FAX (918) 234-1068

PROCESS & INSTRUMENT DIAGRAM
FOR AN ENCLOSED ZTOF PRODUCTION FLARE

CERTIFIED

DRAWING NUMBER: D-F-0144980-150 REV. 0
SCALE: NONE 1 of 1

File Name: c:\cadd\p-wspc\0144980\dwg\0144980-150.dwg Plot Date: 11/25/2013 3:33 PM

Enclosed ZTOF Flare Specification Sheets

JOHN ZINK
JOHN ZINK COMPANY LLC

Project Spec Sheet List

Project #	9144980	**Project Site**	SUNOCO LOGISTICS
Description	4' X 30' ENCLOSED ZTOF FLARE		
Customer	SUNOCO LOGISTICS		
Location	PENNSYLVANIA		
Cust. PO #	D1109261-V2		

Spec	Page	Of	Revision	Description	Spec Name
1	1	4	0	PNL-101	FLARE CONTROL PANEL
1	2	4	0	PNL-101	FLARE CONTROL PANEL
1	3	4	0	PNL-101	FLARE CONTROL PANEL
1	4	4	0	PNL-101	RECEIVER INSTRUMENTS
2	1	1	0	PNL-103	IGNITION TRANSFORMER
3	1	4	0	PCV-302	PRESSURE CONTROL VALVES & REGULATORS
3	2	4	0	SV-303	SOLENOID VALVES
3	3	4	0	HV-304	MANUAL BALL VALVE
3	4	4	0	PI-305	PRESSURE GAGES
4	1	1	0	FA-107	FLASH - BACK ARRESTOR
5	1	1	0	-----	MISCELLANEOUS

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JOHN ZINK JOHN ZINK COMPANY LLC FOR JZ PARTS: (918)234-2751	***JZ SPECIFICATION SHEET*** ***FLARE CONTROL PANEL*** ***PNL-101***	Spec Rev. ***1*** ***0*** Page No. ***1*** of ***4*** Project ***9144980***

Project Name: ***4' X 30' ENCLOSED ZTOF FLARE***	Customer Name: ***SUNOCO LOGISTICS***
Project Site: ***SUNOCO LOGISTICS***	Customer P.O.: ***D1109261-V2***

	Item No.	Qty	Tag Number(s)	Description	JZ Part No.
1		1 EACH	CE-101	KILLARK #EXB-8106 N34SU2 ENCLOSURE, NEMA 7 HINGED	1083990
2				(10" H X 8" W X 6" D)	
3					
4		1 EACH	-----	KILLARK #7996-2 SUBPANEL	0303521
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

25 **Notes:**

ALL ITEMS REQUIRE UL LABEL

PANEL MOUNT, THEN FLARE MOUNT

	Revision Date	Initials	Revision Description		Date	Name
Δ				Prepared	12/16/2013	ROLFJ
Δ				Checked	01/03/2014	ROLFJ
Δ				Approved	01/03/2014	ROLFJ
Δ				Quote Attached: ☐ Yes	Copies of Vendor Literature Req'd:	1

JOHN ZINK JOHN ZINK COMPANY LLC FOR JZ PARTS: (918)234-2751	JZ SPECIFICATION SHEET FLARE CONTROL PANEL PNL-101	Spec | Rev: 1 | 0 Page No.: 2 of 4 Project: 9144980

Project Name: 4' X 30' ENCLOSED ZTOF FLARE	Customer Name: SUNOCO LOGISTICS
Project Site: SUNOCO LOGISTICS	Customer P.O.: D1109261-V2

	Item No.	Qty	Tag Number(s)	Description	JZ Part No.
1		1 EACH	L-1	KILLARK #GOB3-F23C N34 PILOT LIGHT, NEMA 7, 120 V	0550358
2				INCANDESCENT, WHITE LENS	
3		1 EACH	L-5	KILLARK #GOB3-G23C N34 PILOT LIGHT, NEMA 7, 120 V	0400672
4				INCANDESCENT, GREEN LENS	
5		1 EACH	L-6	KILLARK #GOB3-R23C N34 PILOT LIGHT, NEMA 7, 120 V	0023898
6				INCANDESCENT, RED LENS	
7					
8					
9					
10					
11					
12		1 EACH	S-1	KILLARK #GO5-2A3F N34 SELECTOR SWITCH, MAINTAINED	0026360
13				POSITION , NEMA 7, 1-N/O AND 1-N/C CONTACTS	
14					
15		1 EACH	PB-2	KILLARK #GO1-KX3C N34 PUSHBUTTON, MOMENTARY,	1037139
16				NEMA 7, 1-N/O AND 1-N/C CONTACTS	
17					
18					
19					
20					
21					
22					
23					
24					

25 **Notes:**

ALL ITEMS REQUIRE UL LABEL

PANEL MOUNT, THEN FLARE MOUNT

Revision Date	Initials	Revision Description		Date	Name
Δ			Prepared	12/16/2013	ROLFJ
Δ			Checked	01/03/2014	ROLFJ
Δ			Approved	01/03/2014	ROLFJ
Δ			Quote Attached: ☐ Yes	Copies of Vendor Literature Req'd:	1

JOHN ZINK JOHN ZINK COMPANY LLC FOR JZ PARTS: (918)234-2751	JZ SPECIFICATION SHEET FLARE CONTROL PANEL PNL-101	Spec	Rev	1	0
		Page No.		3 of 4	
		Project		9144980	

Project Name: 4' X 30' ENCLOSED ZTOF FLARE	Customer Name: SUNOCO LOGISTICS
Project Site: SUNOCO LOGISTICS	Customer P.O.: D1109261-V2

	Item No.	Qty	Tag Number(s)	Description	JZ Part No.
1		20 EACH	-----	ENTRELEC #M4/6 TERMINAL (P/N 115 116.07)	0020514
2		2 EACH	-----	ENTRELEC #FEM6 END SECTION (P/N 118 368.16)	0020515
3		2 EACH	-----	ENTRELEC #BAM END STOP (P/N 103 002.26)	0036813
4		1 EACH	-----	ENTRELEC #PR4 RAIL, DIN-3 MOUNT (P/N 101 598.26)	1012629
5		1 EACH	-----	ENTRELEC BLANK MARKING TAG (P/N 233 000.01)	1006764
6		1 EACH	-----	ENTRELEC #BJM6 JUMPER, 10 POINT (P/N 168 973.07)	1019660
7					
8		2 EACH	-----	ENTRELEC #MTC6 TERMINAL (P/N 115 206.22)	1070213
9					
10					
11					
12		1 EACH	CB-2	SQUARE D #60106 CIRCUIT BREAKER, 5 A, ONE POLE	1140428
13					
14		3 EACH	TR-10,14,15	IDEC #GT3A-2AF20 TIMER, 120 V, INSTANT SPDT,	0020413
15				DELAYED SPDT, 0.1 S TO 180 HR ADJUSTABLE RANGE	
16		3 EACH	-----	IDEC #SR2P-06 SOCKET	0030704
17					
18					
19					
20		1 EACH	CR-7	IDEC #RR3B-ULCAC120V RELAY, 3 PDT WITH INDICATING	0401314
21				LIGHT AND PUSH-TO-TEST BUTTON	
22		1 EACH	-----	IDEC #SR3B-05 SOCKET	0030703
23					
24					

25 **Notes:**

ALL ITEMS REQUIRE UL LABEL

PANEL MOUNT, THEN FLARE MOUNT

Revision Date	Initials	Revision Description		Date	Name
Δ			Prepared	12/16/2013	ROLFJ
Δ			Checked	01/03/2014	ROLFJ
Δ			Approved	01/03/2014	ROLFJ
Δ			Quote Attached: ☐ Yes	Copies of Vendor Literature Req'd:	1

JOHN ZINK JOHN ZINK COMPANY LLC FOR JZ PARTS: (918)234-2751	JZ SPECIFICATION SHEET RECEIVER INSTRUMENTS PNL-101	Spec | Rev: 1 | 0 Page No.: 4 of 4 Project: 9144980

Project Name: **4' X 30' ENCLOSED ZTOF FLARE**
Customer Name: **SUNOCO LOGISTICS**
Project Site: **SUNOCO LOGISTICS**
Customer P.O.: **D1109261-V2**

GENERAL	1	Service		TEMPERATURE
	2			
	3	Function		SWITCH
	4	Case	Color	
	5	Mounting		INTERNAL
	6			
	7	Enclosure Class		General Purpose
	8	Power Supply		117 V 60 Hz
	9	Chart		
	10			
	11	Chart Drive		
	12	Scales		
	13			
CONTROLLER	14	P=Prop(Gain), I=Integral(Auto Reset), D=Derivative(Rate), Sub: s=Slow, f=Fast		
	15	Control Modes		
	16	Action		
	17	Auto-Man Switch		
	18	Set Point Adj.		
	19	Manual Reg.		
	20	Output		
	21			
	22			
	23			
	24			

INPUTS	25	Input Signals		TYPE K THERMOCOUPLE
	26	No. of Inputs		1
	27	Power for XMTRS		External
	28	Transmitter Spec. No.		
	29	Burnout		UPSCALE
	30			
	31			
	32			
OPTIONS	33	Alarm Switches: Qty	Form	1 |
	34	Rating		3 A
	35	Function		Meas. Var.
	36	Contact	on Measurement	Open | Increase
	37			
	38			
	39			
	40			
	41			
	42			
ORDER	43	Manufacturer		OMRON
	44	Model No.		E5C2-R20K
	45	Tag No.		TSL-307
	46	Quantity		1 EACH
	47	Mount		PANEL
	48	JZ Part No.		0016484

49 ***Notes:***

ALSO SUPPLY OMRON #P2CF-08 BASE
JOHN ZINK PART NUMBER: 0034301
QUANTITY: ONE (1) EACH REQUIRED

ALL ITEMS REQUIRE UL LABEL

Revision Date	Initials	Revision Description		Date	Name
Δ			Prepared	12/16/2013	ROLFJ
Δ			Checked	01/03/2014	ROLFJ
Δ			Approved	01/03/2014	ROLFJ
Δ			Quote Attached: ☐ Yes	Copies of Vendor Literature Req'd:	1

JOHN ZINK JOHN ZINK COMPANY LLC FOR JZ PARTS: (918)234-2751	***JZ SPECIFICATION SHEET*** ***IGNITION TRANSFORMER*** ***PNL-103***	Spec | Rev: ***2*** | ***0*** Page No.: ***1*** of ***1*** Project: ***9144980***

Project Name: ***4' X 30' ENCLOSED ZTOF FLARE***
Customer Name: ***SUNOCO LOGISTICS***
Project Site: ***SUNOCO LOGISTICS***
Customer P.O.: ***D1109261-V2***

TRANSFORMER		
1	Manufacturer	DONGAN
2	Model	A06-SA6
3	Tag No.	IT-1
4	Primary	120 V, 60 HZ
5	Secondary	6000 V
6	JZ Part No.	0002558
7		
8		
9		
10		
11		
12		

ENCLOSURE		
13	Manufacturer	KILLARK
14	Model	EXB-8106 N34SU2
15	Enclosure	NEMA 7
16	Dimensions	10" H X 8" W X 6" D
17	JZ Part No.	1083990
18		
19	Sub-Panel Manufacturer	KILLARK
20	Sub-Panel Model No	7996-2
21	JZ Part No.	0303521
22		
23		
24	Mount	BELOW

25 ***Notes:***

QUANTITY: ONE (1) EACH ASSEMBLY REQUIRED

ALL ITEMS REQUIRE UL LABEL

PANEL MOUNT, THEN FLARE MOUNT

Revision Date	Initials	Revision Description		Date	Name
Δ			Prepared	12/16/2013	ROLFJ
Δ			Checked	01/03/2014	ROLFJ
Δ			Approved	01/03/2014	ROLFJ
Δ			Quote Attached: ☐ Yes	Copies of Vendor Literature Req'd:	1

JOHN ZINK JOHN ZINK COMPANY LLC FOR JZ PARTS: (918)234-2751	JZ SPECIFICATION SHEET PRESSURE CONTROL VALVES & REGULATORS PCV-302	Spec Rev: 3 0 Page No.: 1 of 4 Project: 9144980

Project Name: **4' X 30' ENCLOSED ZTOF FLARE**
Project Site: **SUNOCO LOGISTICS**

Customer Name: **SUNOCO LOGISTICS**
Customer P.O.: **D1109261-V2**

LINE	1	Service		PILOT GAS
	2	Line No./Vessel No.		
	3	Line Size/Sched. No.		1/2"
	4	Function		REGULATE
BODY	5	Type of Body		BOLTED
	6	Body Size	Port Size	1/2"
	7	Guiding	No. of Ports	2
	8	End Conn. & Rating		1/2" NPT
	9	Body Material		ALUMINUM
	10	Packing Material		
	11	Lubricator	Isolating Valve	
	12	Seal Type		
	13	Trim Form		
	14	Trim Material		
	15	Seat Material		NITRILE
	16	Required Seat Tightness		
	17	Max. Allow. Sound Level dBA		
ACTUATOR	18	Type of Actuator		SPRING DIAPHRAGM
	19	Pilot		
	20	Supply to Pilot		
	21	Self Cont.	Ext. Conn.	X
	22	Diaphragm Material		NITRILE
	23	Diaphragm Rating		
	24	Spring Range		0 TO 35 PSIG
	25	Set Point		15 PSIG
	26			
	27			

ACCESSORIES	28	Filt. Reg.	Supply Gage	NO	NO
	29	Line Strainer			
	30	Housing Vent			
	31	Internal Relief		NO	
	32				
	33				
	34				
SERVICE	35	Flow Units		SCFH	
	36	Fluid		PROPANE / NATURAL GAS	
	37	Quant. Max		25 / 50	
	38	Quant. Oper.		22 / 45	
	39	Valve Cv	Valve 1	1.33	35.02
	40	Norm. Inlet Press.	ΔP	20 PSIG	
	41	Max. Inlet Press.		400 PSIG	
	42	Max. Shut Off ΔP			
	43	Temp. Max.	Operating	180	60
	44	Oper. sp. gr.	Mol. Wt.	1.52 / 0.65	44 / 19
	45	Oper. Visc.	% Flash		
	46	% Superheat	% Solids		
	47	Vapor Press.	Crit. Press.		
	48	Predicted Sound Level dBA			
ORDER	49				
	50	Manufacturer		FISHER	
	51	Model No.		67D-27	
	52	Mount		PIPE	
	53	Tag No.		PCV-302	
	54	JZ Part No.		1260113	

55 **Notes:**

QUANTITY: ONE (1) EACH REQUIRED

	Revision Date	Initials	Revision Description
Δ			
Δ			
Δ			
Δ			

	Date	Name
Prepared	12/16/2013	ROLFJ
Checked	01/03/2014	ROLFJ
Approved	01/03/2014	ROLFJ

Quote Attached: ☐ Yes
Copies of Vendor Literature Req'd: 1

Project Name: **4' X 30' ENCLOSED ZTOF FLARE**
Project Site: **SUNOCO LOGISTICS**
Customer Name: **SUNOCO LOGISTICS**
Customer P.O.: **D1109261-V2**

GENERAL	1	Tag No.	SV-303		
	2	Service	PILOT GAS		
	3				
	4	Line No. / Vessel No.			
	5	Quantity	1 EACH		
VALVE BODY	6	Type			
	7	Size: Body / Port	1/2"	3/4"	
	8	Rating / Type Conn.		NPT	
	9	Material -- Body	ALUMINUM		
	10	Material – Seat	NITRILE		
	11	Material -- Diaphragm	NITRILE		
	12	Operation Direct/ Pilot	DIRECT		
	13	Packless or Type Packed	PACKLESS		
	14	Manual Re-Set	NO		
	15	Manual Operator	NO		
	16				
	17				
WHEN DE-ENERGIZED	18	2-Way Valve Opens/Close		CLOSES	
	19	3-Way			
	20	Vent Port Opens/Close			
	21	Press Port Opens/Clos			
	22	4-Way			
	23	Press to Cyl.1 / Cyl.2			
	24	Exh. from Cyl.1 / Cyl.2			
	25				
	26				
	27				

SOLENOID	28	Enclosure	NEMA 4,7		
	29	Voltage / HZ	120 V	60	
	30	Style of Coil	F		
	31	Single or Double Coil	SINGLE		
	32				
	33				
SERVICE COND.	34	Fluid	PROPANE		NATURAL GAS
	35	Qty. Maximum	25 SCFH		50 SCFH
	36	Oper. Diff. Min / Max	0	20 PSI	
	37	Allow. Diff. Min / Max	0	50 PSI	
	38	Temp. Norm / Max. F	60	125	
	39	Oper. sp. gr.	1.52		0.65
	40	Oper. Viscosity			
	41	Required Cv			
	42	Valve Cv	4.4		
	43				
	44				
	45				
	46				
	47				
	48				
	49				
	50				
	51	Manufacturer	ASCO		
	52	Model No.	EF8215G20		
	53	Mount	PIPE		
	54	JZ Part No.	0012004		

55 **Notes:**

Revision Date	Initials	Revision Description		Date	Name
Δ			Prepared	12/16/2013	ROLFJ
Δ			Checked	01/03/2014	ROLFJ
Δ			Approved	01/03/2014	ROLFJ
Δ			Quote Attached: ☐ Yes	Copies of Vendor Literature Req'd:	1

JOHN ZINK
JOHN ZINK COMPANY LLC
FOR JZ PARTS: (918)234-2751

JZ SPECIFICATION SHEET
MANUAL BALL VALVE
HV-304

Spec	Rev	3	0
Page No.		3 of 4	
Project		9144980	

Project Name: **4' X 30' ENCLOSED ZTOF FLARE**
Project Site: **SUNOCO LOGISTICS**

Customer Name: **SUNOCO LOGISTICS**
Customer P.O.: **D1109261-V2**

1	Manufacturer	KF CONTROMATICS
2	Model No.	1/2" S8000-SS-M3
3	Process Connections	THREADED
4	Body Material	STAINLESS STEEL
5	Ball Material	316 STAINLESS STEEL
6	Stem Material	316 STAINLESS STEEL
7	Seal/Seat Material	PTFE/PTFE
8	Packing Material	PTFE
9	Handle Type	LEVER
10		
11		
12		

34 **Notes:**

13	Qty	Tag No.	Size	Oper. Press. PSIG	Oper. Temp. ° F	Service	Mount	JZ Part No.
14	1 EA	HV-304	1/2"	15	60	PILOT GAS	PIPE	1138982
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								

Revision Date	Initials	Revision Description
Δ		
Δ		
Δ		
Δ		

	Date	Name
Prepared	12/16/2013	ROLFJ
Checked	01/03/2014	ROLFJ
Approved	01/03/2014	ROLFJ

Quote Attached: ☐ Yes
Copies of Vendor Literature Req'd: 1

JOHN ZINK
JOHN ZINK COMPANY LLC
FOR JZ PARTS: (918)234-2751

JZ SPECIFICATION SHEET
PRESSURE GAGES
PI-305

Spec Re	3 0
Page No.	4 of 4
Project	9144980

Project Name **4' X 30' ENCLOSED ZTOF FLARE**
Project Site **SUNOCO LOGISTICS**
Customer Name **SUNOCO LOGISTICS**
Customer P.O.: **D1109261-V2**

1	Type		Direct	13	Process Connection	1/2" BOTTOM
2	Mount Type		Local	14	Operating Temperature	60 °F
3	Dial Diamete	Color	4 1/2" WHITE	15	OPTIONS	
4	Case Material		Phenol	16		
5	Ring Type		Screwed	17		
6	Blow-Out Protection		Back	18		
7	Lens Material		Plastic	19		
8	Accuracy Required		+/- 0.5%	20		
9	Element Type		Bourdon	21		
10	Element Materia		SS	22		
11	Socket Material		Steel	23	Manufacturer	WIKA
12	Movement Material		SS	24	Model No.	222.34 4.5 30PSI 1/2L

	Quantity	Tag No	Range PSIG	Oper. Press. PSIG	Service	JZ Part No
25						
26	1 EACH	PI-305	0 TO 30	15	PILOT GAS	1209636
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						

45 **Notes:**

PIPE MOUNT

Revision Date	Initials	Revision Description		Date	Name
Δ			Prepare	12/16/2013	ROLFJ
Δ			Checked	01/03/2014	ROLFJ
Δ			Approved	01/03/2014	ROLFJ
Δ			Quote Attached: ☐ Yes	Copies of Vendor Literature Req'd:	1

JOHN ZINK JOHN ZINK COMPANY LLC FOR JZ PARTS: (918)234-2751	**JZ SPECIFICATION SHEET** **FLASH - BACK ARRESTOR** **FA-107**	Spec Rev: **4** **0** Page No: **1 of 1** Project: **9144980**

Project Name: ***4' X 30' ENCLOSED ZTOF FLARE***
Customer Name: ***SUNOCO LOGISTICS***
Project Site: ***SUNOCO LOGISTICS***
Customer P.O.: ***D1109261-V2***

1	Manufacturer	ENARDO
2	Model No.	E70802/D-AAF-13
3	Process Connections	125 LB FF
4	Body Material	ALUMINUM
5	Element Materia	ALUMINUM
6	Drain Connection	1/2" NPT WITH PLUG
7	Body Configuration	ECCENTRIC
8		
9		
10		
11		
12		

34 ***Notes:***

TWO (2) 1/2" FNPT TAPS WITH PLUG REQUIRED, ONE ON EACH SIDE OF ELEMENT.

13	Qty	Tag No.	Size	Oper. Press. H2O	Oper. Temp. ° F	Service	Mount	JZ Part No.
14	1 EA	FA-107	2"	15"	100	PRODUCTION VAPOR	FIELD	1164213
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								

Revision Date	Initials	Revision Description		Date	Name
Δ			Prepared	12/16/2013	ROLFJ
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Δ			Quote Attached: ☐ Yes	Copies of Vendor Literature Req'd:	1

JOHN ZINK JOHN ZINK COMPANY LLC FOR JZ PARTS: (918)234-2751	JZ SPECIFICATION SHEET MISCELLANEOUS —	Spec Rev: 5 0 Page No.: 1 of 1 Project: 9144980

Project Name: **4' X 30' ENCLOSED ZTOF FLARE**
Customer Name: **SUNOCO LOGISTICS**
Project Site: **SUNOCO LOGISTICS**
Customer P.O.: **D1109261-V2**

	Item No.	Qty	Tag Number(s)	Description	JZ Part No.
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11	1	10' EACH	-----	DELCO #440 IGNITION WIRE, HIGH VOLTAGE	0002167
12	2	10' EACH	-----	THERMO SENSORS #PPZS16KX THERMOCOUPLE WIRE,	0403529
13				16 GAGE SHIELDED, MOISTURE RESISTANT	
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

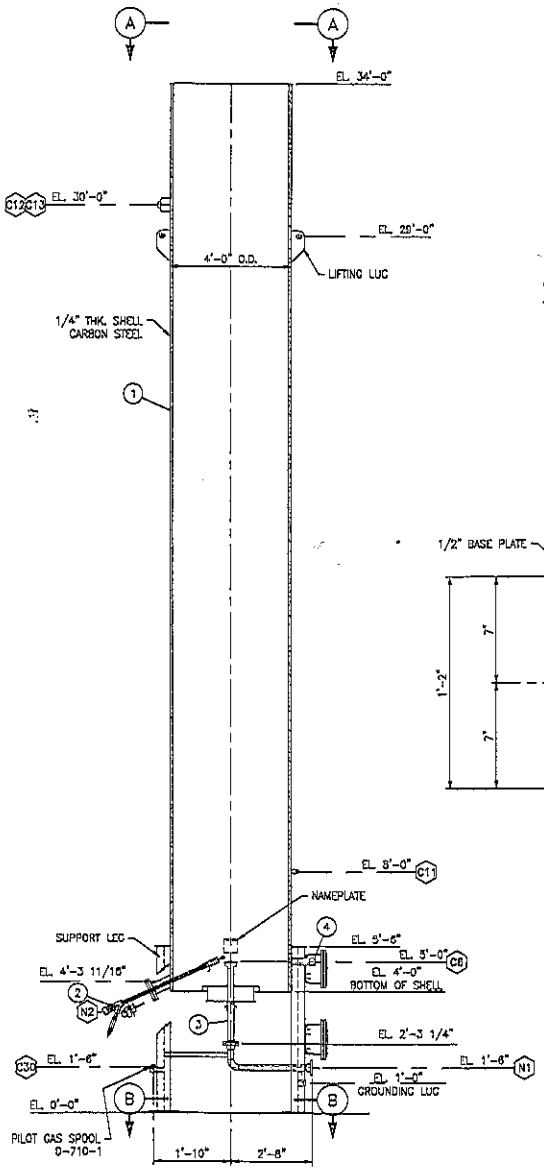
25 **Notes:**

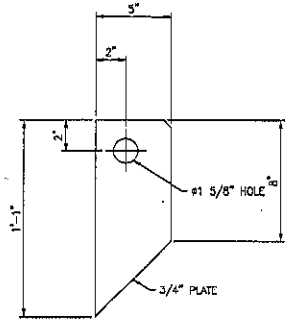
ALL ITEMS REQUIRE UL LABEL

FLARE MOUNT

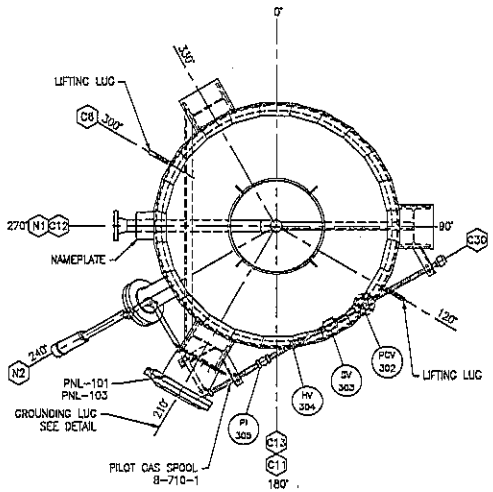
Revision Date	Initials	Revision Description		Date	Name
Δ			Prepared	01/03/2014	ROLFJ
Δ			Checked	01/03/2014	ROLFJ
Δ			Approved	01/03/2014	ROLFJ
Δ			Quote Attached: ☐ Yes	Copies of Vendor Literature Req'd:	1

Enclosed ZTOF Production Flare Detail

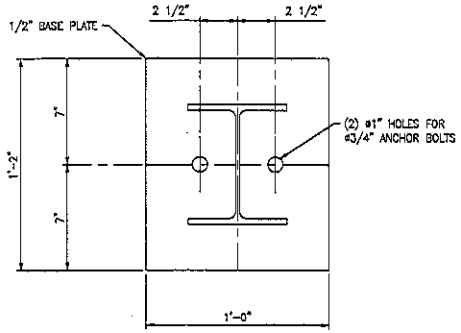




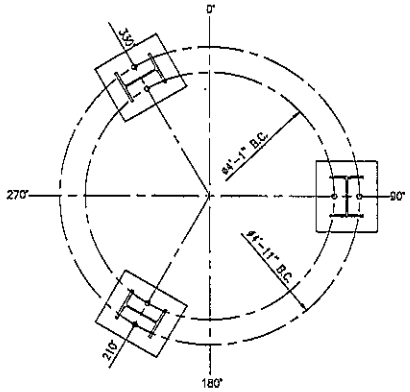
LIFTING LUG DETAIL
TYPICAL TWO PLACES @ 120° AND 300°



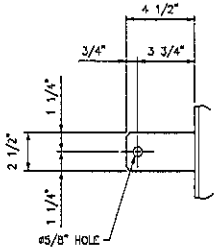
VIEW A-A
(TRUE ORIENTATION)



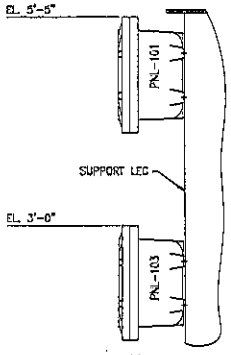
BASE PLATE DETAIL
(TYP 3 PLACES)



SECTION B-B
(TRUE ORIENTATION)



GROUND LUG DETAIL



PANEL DETAIL

PARTS LIST				
ITEM	QTY	DESCRIPTION	MK. NO	MATERIAL
1	1	ENCLOSED ZTOF FLARE	D-701-1	
2	1	KC-10 PILOT ASSEMBLY	D-302-1	
3	1	2" FLARE TIP	D-730-1	
4	1	2" SIGHT PORT	CA-ST-0600-1	

NOZZLE LEGEND		
MK	QTY	DESCRIPTION
N1	1	GAS CONNECTION: 2" 150# F.F.W.N.
N2	1	PILOT MTG CONN: 4" 150# R.F.S.O
C6	1	SIGHT PORT - 2" MNPT
C11	1	THERMOCOUPLE CONN - 1" FNPT WITH PLUG
C12-13	2	SAMPLE PORT 4" FNPT WITH PLUG
C30	1	PILOT GAS INLET: 1/2" NPT

DESIGN DATA

WINDLOAD (PER ASCE 7-10, EXP. C)	110 M.P.H.
SEISMIC (ASCE 7-05)	SITE CLASS E
SHEAR @ BASE	2,000 LB
MOMENT @ BASE	44,500 LB-FT
DEADLOAD	5,000 LB
SHELL DESIGN TEMPERATURE	500° F
CORROSION ALLOWANCE	0.0

INSULATION LEGEND

A: (1) OVERLAPPING LAYER OF 1" THICK 8 LB DENSITY, 2300° F.

LIFTING NOTES

A: MAIN CRANE AT TOP REQUIRES SPREADER BAR, (NOT SUPPLIED BY JOHN ZINK CO.)
B: LIFTING LUGS DESIGNED FOR 13 1/2 TON CROSBY ANCHOR SHACKLE AND VERTICAL SLINGS.

GENERAL NOTES

1. TAG NUMBERS TO BE PRECEDED BY JOHN ZINK SALES ORDER NUMBER.
2. FLARE ASSEMBLY IS NOT TO BE USED AS AN ANCHOR POINT FOR CUSTOMER PIPING.
3. PRE-TENSION ANCHOR BOLTS BY THE "TURN OF THE NUT" METHOD/AISC.
4. BOLT HOLES TO STRADDLE NORMAL CENTER LINES UNLESS NOTED.
5. FINISH EXTERIOR CARBON STEEL, SUPPORT LEGS, BOTTOM OF FLOOR PLATE, AND MANIFOLD EXTERIOR, SANDBLAST PER SSPC-SP-6 AND PRIME WITH SHERWIN WILLIAMS ZINC CLAD II PLUS #B69VZ12/B69VZ13/B69011 (3-4 MILS D.F.T.)

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FOR: SUNOCO LOGISTICS	
USER: SUNOCO LOGISTICS	
JOBSITE: SINKING SPRINGS, PA.	
S.O. NO. 19F-01144980	
P.O. NO. 01100281-V2	

JOHN ZINK
JOHN ZINK COMPANY LLC
PARTS AND SERVICE, CALL 1-800-752-4252 FAX (918) 234-1828

ENCLOSED ZTOF PRODUCTION FLARE
4'-0" O.D. x 30' H
(QUANTITY 17)

DR.	CFC	DATE: 12-17-13	
CK.	CFC	DATE: 12-17-13	
APP.	JPR	DATE: 1-3-14	

DRAWING NUMBER: D-F-01144980-301 REV. 0
SCALE: 1 of 1

NO.	REVISION DESCRIPTION	BY	CK.	APP.	DATE

File Name: d:\acad\projects\drawings\301\d-f-01144980-301.dwg Plot Date: 1/8/2014 11:44 AM

Manufacturer Recommended Maintenance

JOHN ZINK HAMWORTHY COMBUSTION

RECOMMENDED MAINTENANCE FORM
PRODUCTION FLARE

12/13

SYSTEM COMPONENT	INTERVAL	DATE	INITIALS	COMMENTS
General				
Confirm all covers are secure.	monthly			
Inspect enclosures for moisture.	monthly			
Confirm no gas or liquid leaks exist.	monthly			
Confirm all threaded connections are tight.	annually			
Replace all thermocouples.	annually			
Calibrate instruments and flow meter.	annually			
Flare				
Record flame arrester differential pressure.	monthly			
Inspect exterior paint.	monthly			
Conduct recommended System Testing.	quarterly			
Inspect internal insulation.	quarterly			
Inspect foundation and anchor bolts.	annually			
Clean sight port, flare tip, and flame arrester.	annually			
Conduct emissions performance test.	annually			
Pilot				
Record pilot gas pressure.	monthly			
Inspect mixer for debris or moisture.	monthly			
Clean mixer and orifice.	quarterly			
Clean solenoid.	annually			
Replace electrode.	annually			

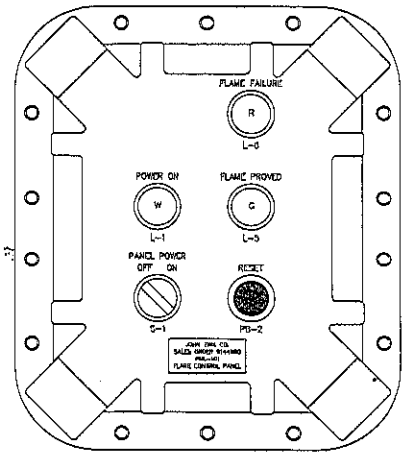
Technical Questions Clarifications

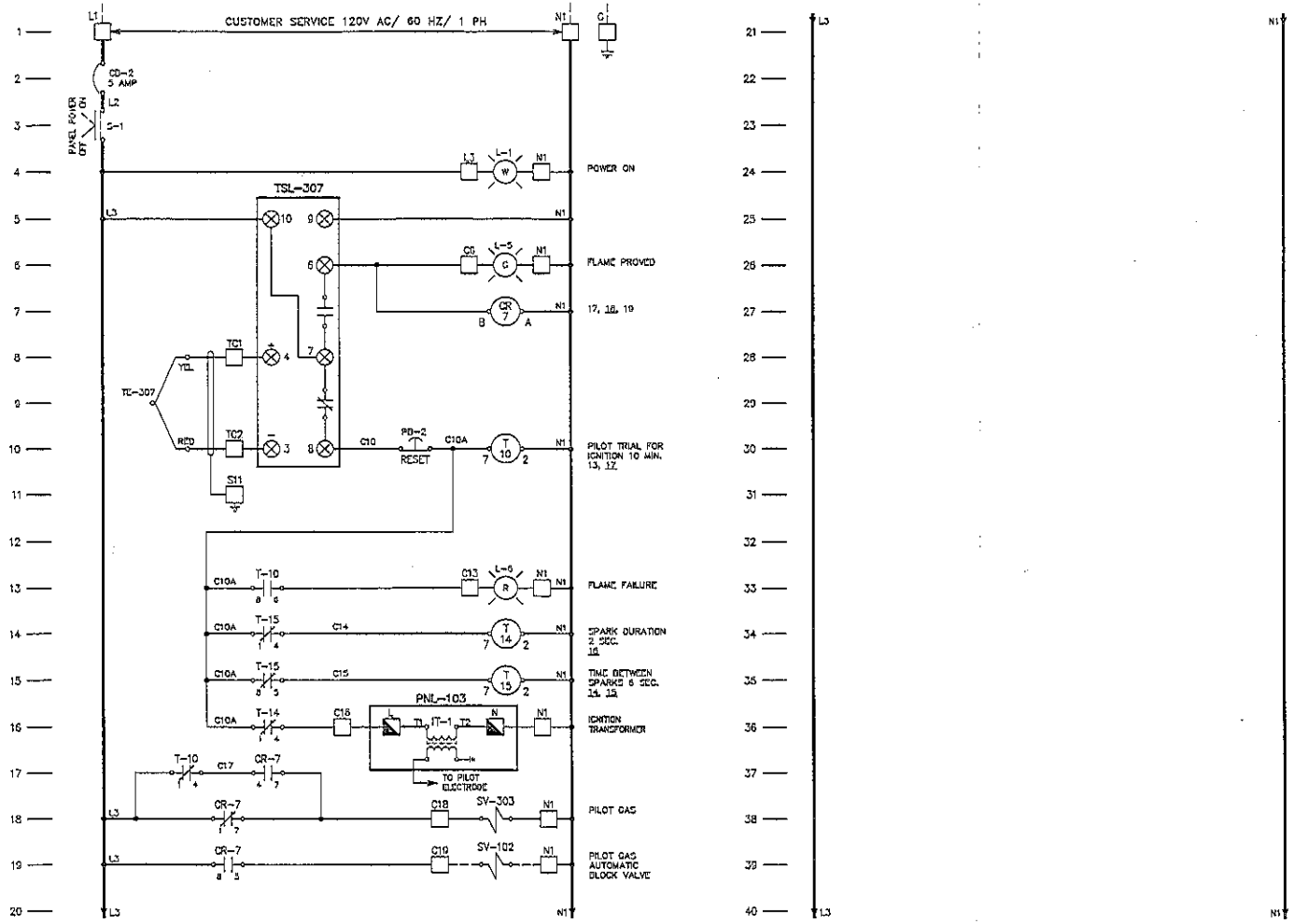
Vendor Proposal Technical and Commercial Questions, Clarifications, and Requests for Information 2

Sunoco Logistics Request for Proposal #:	02896-9001
Vendor:	John Zink
Vendor Proposal #:	BF-201307-37263
Vendor Proposal Date:	August 20, 2013

Technical Question/Clarifications	Vendor Response
1. Can we receive wiring diagrams for the flares? Then we will be able to design our PLC connections.	Drawing submittal is scheduled for January 3, 2014 which will include wiring diagrams of the Flare Control Panel and Ignition Panel.
2. Can we receive piping drawings to show the piping connections with the flares?	Drawing submittal is scheduled for January 3, 2014 which will include a Process and Instrument Diagram, along with general arrangement drawing.
3. We need clarification on the detailed drawing EF1-300-001. Based on the detail drawing it appears that the flare shell enclosure is supported by three support legs that lift the enclosed section 4' above the foundation. Please clarify if the bottom of the shell is closed off or open. If it is closed, we will need to account for uplift.	The bottom of the shell is partially closed, not entirely closed, so "uplift" is insignificant.
4. Can we please receive the manufacturer's recommending maintenance schedule, including tests?	Refer to the separate Recommended Maintenance Form.
5. Can we receive manufacturer's recommended operating specifications, (i.e., flame temperature)?	Pilot Gas Pressure: 10 psig for propane 15 psig for natural gas Pilot Gas Volume: 50,000 BTU/hr Pilot Flame Proved: 200 °F minimum Electricity: 120 V, single phase, 60 Hz

Wiring Diagram for Enclosed ZTOF Flare





NOTES:

1. ALL WIRING TO BE AS FOLLOWS UNLESS INDICATED OTHERWISE:
   WIRE SIZING PER NEC
   MIN. 18 GA./600 V/THHN OR THWN FOR CONTROL
   MIN. 18 GA./TWO CONDUCTOR SHIELDED FOR SIGNAL
2. MINIMUM FIELD CONDUIT REQUIRED:
   (1) THERMOCOUPLES
   (1) POWER – 120 V
3. TERMINAL BLOCKS TO BE ARRANGED IN NUMERICAL ORDER.
4. WIRING LEGEND:
   - ⊗ TERMINAL IN PANEL MOUNTED INSTRUMENTS.
   - ☐ TERMINAL IN FLARE CONTROL PANEL PNL-101
   - ◪ TERMINAL IN IGNITION PANEL PNL-103
   - ———— WIRING BY JOHN ZINK CO.
   - – – – – – WIRING BY OTHERS (NOT BY JOHN ZINK CO.)
5. ALL WIRING COLORS TO BE AS FOLLOWS UNLESS INDICATED OTHERWISE:

120 V POWER	BLACK
120 V NEUTRAL	WHITE
GROUND	GREEN
24 V DC POWER	BLUE
24 V DC COMMON	YELLOW
SHIELDED ANALOG SIGNAL	BLACK
SHIELDED ANALOG COMMON	WHITE

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NO.	REVISION DESCRIPTION	BY	CK.	APP.	DATE

FOR: SUNOCO LOGISTICS
USER: SUNOCO LOGISTICS
JOBSITE: SINKING SPRINGS, PA
S.O. NO. BF-9144980
P.O. NO. 01109281-V2
DR. RPJ DATE: 12-17-13
CK. JPR DATE: 1-3-14
APP. JPR DATE: 1-3-14
DATE:

JOHN ZINK.
JOHN ZINK COMPANY LLC
PARTS AND SERVICE, CALL 1-800-755-4257 FAX (918) 234-1998

WIRING DIAGRAM
FOR AN ENCLOSED ZTOF PRODUCTION FLARE
(QUANTITY 17)

CUSTOMER
DRAWING NUMBER: D-F-9144980-401
REV. 0
SCALE NONE
1 of 1

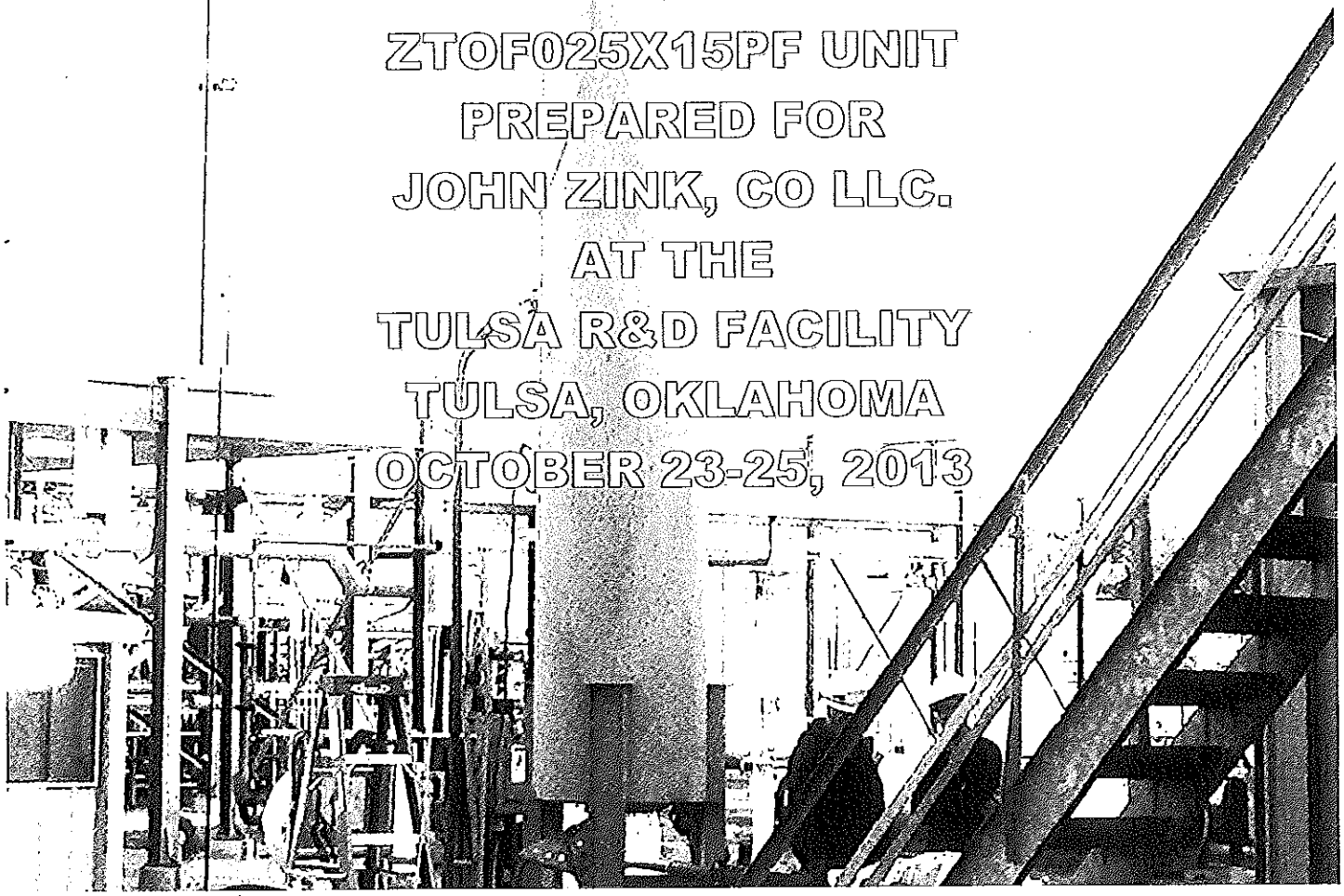
ATTACHMENT 5

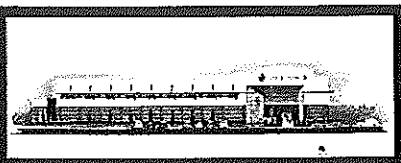
STACK EMISSIONS STUDY FOR ZTOF025X15PF

AIR HYGIENE, INC.

Testing Solutions for a Better World

STACK EMISSIONS STUDY
EPA 40 CFR PART 60 SUBPART OOOO
FOR THE
ZTOF025X15PF UNIT
PREPARED FOR
JOHN ZINK, CO LLC.
AT THE
TULSA R&D FACILITY
TULSA, OKLAHOMA
OCTOBER 23-25, 2013





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1600 W Tacoma Street
Broken Arrow, OK 74012

AIR HYGIENE, INC.

(918) 307-8865 or (888) 461-8778
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Humble, TX 77338
Shreveport, LA 71115
Miami, FL 33101
Philadelphia, PA 19136

STACK EMISSIONS STUDY
EPA 40 CFR PART 60 SUBPART OOOO
FOR THE
ZTOF025X15PF UNIT
PREPARED FOR
JOHN ZINK, CO LLC.
AT THE
TULSA R&D FACILITY
TULSA, OKLAHOMA
OCTOBER 23-25, 2013

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APPENDICES

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Stack Emissions Study
ZTOF025X15PF Unit
John Zink, Co LLC.
Tulsa R&D Facility
Tulsa, Oklahoma
October 23-25, 2013

1.0 INTRODUCTION

Air Hygiene International, Inc. (Air Hygiene) has completed the emissions testing study for carbon monoxide (CO), total hydrocarbons, flow, opacity, carbon dioxide (CO_2), and oxygen (O_2) from the exhaust of the ZTOF025X15PF Unit for John Zink, Co LLC. at the Tulsa R&D Facility near Tulsa, Oklahoma. This report details the background, results, process description, and the sampling/analysis methodology of the stack sampling survey conducted on October 23-25, 2013.

1.1 TEST PURPOSE AND OBJECTIVES

The purpose of the test was to conduct compliance emission test to document levels of selected pollutants at four test loads (0-30-0 percent, 30-70-30 percent, 70-100-70 percent, 90-100 percent). The information will be used to confirm compliance with 40CFR 60 Subpart OOOO. The specific objective was to determine the emission concentration of CO, THC, flow, opacity, H_2O, CO_2, and O_2 from the exhaust of John Zink, Co LLC.'s ZTOF025X15PF Unit .

1.2 SUMMARY OF TEST PROGRAM

The following list details pertinent information related to this specific project:

1.2.1 Participating Organizations
- Environment Protection Agency (EPA)
- John Zink, Co LLC.
- Air Hygiene

1.2.2 Industry
- Natural Gas Transport and Processing

1.2.3 Air Permit and Federal Requirements
- 40 CFR 60, Subpart OOOO

1.2.4 Plant Location
- Tulsa R&D Facility near Tulsa, Oklahoma

1.2.5 Equipment Tested
- ZTOF025X15PF Unit

1.2.6 Emission Points
- Exhaust from the ZTOF025X15PF Unit

1.2.7 Pollutants Measured
- CO
- THC
- Flow
- Opacity
- H_2O
- CO_2
- O_2

1.2.8 Dates of Emission Test

- October 23-25, 2013

1.3 KEY PERSONNEL

John Zink, Co LLC.:	Aron Katz	918-234-2791
John Zink, Co LLC.:	John Bellovich	918-234-5816
Air Hygiene:	Min Sum Lee	918-307-8865
Air Hygiene:	Shane Cantrell	918-307-8865
Air Hygiene:	Dana Albert	918-307-8865

2.0 SUMMARY OF TEST RESULTS

Results from the sampling conducted on John Zink, Co LLC.'s ZTOF025X15PF Unit located at the Tulsa R&D Facility on October 23-25, 2013 are summarized in the following table and relate only to the items tested.

TABLE 2.1
ZTOF025X15PF 0-30-0 LOAD DATA SUMMARY

Parameter	0-30-0 Load, Run - 2.5OD15 R1	0-30-0 Load, Run - 2.5OD15 R2	0-30-0 Load, Run - 2.5OD15 R3	Average
Date (mm/dd/yy)	10/23/13	10/23/13	10/24/13	--
Start Time (hh:mm:ss)	14:19:07	15:35:07	7:55:07	--
End Time (hh:mm:ss)	15:18:37	16:34:37	8:54:37	--
Run Duration (min / run)	60	60	60	60
Bar. Pressure (in. Hg)	30.04	30.02	30.27	30.11
Amb. Temp. (°F)	67	67	48	61
Rel. Humidity (%)	43	42	80	55
Spec. Humidity (lb water / lb air)	0.005998	0.005861	0.005581	0.005813
Wind Speed (mph)	4.0	3.0	5.0	4.0
Wind Direction (--)	SE	SSE	NNE	--
Stack Flow (M2) (SCFH)	68,349	67,693	67,995	68,012
Avg Stack Wet Std Flow Rate (ASCFH)	73,415	71,032	71,348	71,932
Stack Moisture (Method 4)	6.9	4.7	4.7	5.5
Gross Fuel Heating Value (Btu/ft^3)	2,549.8	2,549.8	2,549.8	2,549.80
Average Inlet Fuel Flowrate (SCFH)	203.5	196.7	203.6	201.27
Average Inlet Mass Fuel Flowrate (lb/hr)	23.6	22.8	23.7	23.38
% Excess Air	180.4	188.1	245.5	204.64
CO_2 (%) - Modified method 3C	6.03	5.94	5.08	5.68
O_2 (%) - Modified Method 3C	13.40	13.60	14.80	13.93
N_2 (%) - Modified Method 3C	80.50	80.50	80.10	80.37
CO (ppmvd)	17.66	14.36	8.58	13.54
CO (ppm@3%CO_2)	9.24	7.51	4.75	7.16
THC (ppmvw)	0.33	0.03	0.09	0.15
THC (ppm@3%CO_2)	0.18	0.02	0.06	0.09
THC (lb/hr)	0.00	0.00	0.00	0.00
VOC Destruction Efficiency (%)	99.989	99.999	99.991	99.993

*0% load referred to minimum operation rate

TABLE 2.2
ZTOF025X15PF 30-70-30 LOAD DATA SUMMARY

Parameter	30-70-30 Load, Run - 2.5OD15 R4	30-70-30 Load, Run - 2.5OD15 R5	30-70-30 Load, Run - 2.5OD15 R6	Average
Date (mm/dd/yy)	10/24/13	10/24/13	10/24/13	--
Start Time (hh:mm:ss)	9:16:07	13:04:07	14:18:07	--
End Time (hh:mm:ss)	10:15:37	14:03:37	15:17:37	--
Run Duration (min / run)	60	60	60	60
Bar. Pressure (in. Hg)	30.29	30.32	30.36	30.32
Amb. Temp. (°F)	46	55	57	53
Rel. Humidity (%)	72	50	48	57
Spec. Humidity (lb water / lb air)	0.004648	0.004503	0.004643	0.004598
Wind Speed (mph)	6.0	9.0	5.0	6.7
Wind Direction (--)	N	NNE	N	--
Stack Flow (M2) (SCFH)	177,398	201,888	219,690	199,659
Avg Stack Wet Std Flow Rate (ASCFH)	190,546	215,003	232,722	212,757
Stack Moisture (Method 4)	6.9	6.1	5.6	6.2
Gross Fuel Heating Value (Btu/ft^3)	2,540.1	2,540.1	2,540.1	2,540.10
Average Inlet Fuel Flowrate (SCFH)	449.2	438.2	450.7	446.00
Average Inlet Mass Fuel Flowrate (lb/hr)	52.2	50.9	52.3	51.80
% Excess Air	208.4	182.1	173.0	187.83
CO_2 (%) - Modified method 3C	5.55	5.95	6.12	5.87
O_2 (%) - Modified Method 3C	14.20	13.60	13.40	13.73
N_2 (%) - Modified Method 3C	80.3	80.4	80.5	80.40
CO (ppmvd)	11.84	1.38	3.16	5.46
CO (ppm@3%CO_2)	6.50	0.69	1.57	2.92
THC (ppmvw)	0.00	0.00	0.00	0.00
THC (ppm@3%CO_2)	0.00	0.00	0.00	0.00
THC (lb/hr)	0.00	0.00	0.00	0.00
VOC Destruction Efficiency (%)	99.998	99.999	99.999	99.999

TABLE 2.3
ZTOF025X15PF 70-100-70 LOAD DATA SUMMARY

Parameter	70-100-70 Load, Run - 2.5OD15 R7	70-100-70 Load, Run - 2.5OD15 R8	70-100-70 Load, Run - 2.5OD15 R9	Average
Date (mm/dd/yy)	10/24/13	10/24/13	10/25/13	--
Start Time (hh:mm:ss)	15:52:00	17:06:07	8:23:07	--
End Time (hh:mm:ss)	16:51:37	18:05:37	9:22:37	--
Run Duration (min / run)	60	60	60	60
Bar. Pressure (in. Hg)	30.30	30.30	30.43	30.34
Amb. Temp. (°F)	57	55	39	50
Rel. Humidity (%)	47	46	78	57
Spec. Humidity (lb water / lb air)	0.004555	0.004144	0.003823	0.004174
Wind Speed (mph)	4.0	7.0	1.0	10.7
Wind Direction (--)	NNE	NNE	NE	--
Stack Flow (M2) (SCFH)	384,934	386,645	430,583	400,721
Avg Stack Wet Std Flow Rate (ASCFH)	407,769	411,324	457,580	425,558
Stack Moisture (Method 4)	6.6	6.0	5.9	6.1
Gross Fuel Heating Value (Btu/ft^3)	2,510.0	2,510.0	2,510.0	2,510.00
Average Inlet Fuel Flowrate (SCFH)	716.0	739.2	727.7	727.65
Average Inlet Mass Fuel Flowrate (lb/hr)	82.8	85.9	77.3	81.99
% Excess Air	177.7	160.7	177.7	172.05
CO_2 (%) - Modified method 3C	5.96	6.35	5.98	6.10
O_2 (%) - Modified Method 3C	13.60	13.10	13.60	13.43
N_2 (%) - Modified Method 3C	80.40	80.50	80.42	80.44
CO (ppmvd)	3.20	3.38	1.72	2.77
CO (ppm@3%CO_2)	1.64	1.64	0.89	1.39
THC (ppmvw)	0.01	0.00	0.00	0.00
THC (ppm@3%CO_2)	0.01	0.00	0.00	0.00
THC (lb/hr)	0.00	0.00	0.00	0.00
VOC Destruction Efficiency (%)	99.999	99.999	99.999	99.999

TABLE 2.4
ZTOF025X15PF 90-100 LOAD DATA SUMMARY

Parameter	90-100 Load, Run - 2.5OD15 R10	90-100 Load, Run - 2.5OD15 R11	90-100 Load, Run - 2.5OD15 R12	Average
Date (mm/dd/yy)	10/25/13	10/25/13	10/25/13	10/25/13
Start Time (hh:mm:ss)	9:43:07	10:54:07	12:08:07	9:43:07
End Time (hh:mm:ss)	10:42:37	11:53:37	13:07:37	13:07:37
Run Duration (min / run)	60	60	60	60
Bar. Pressure (in. Hg)	30.44	30.43	30.42	30.43
Amb. Temp. (°F)	48	50	54	51
Rel. Humidity (%)	56	52	46	51
Spec. Humidity (lb water / lb air)	0.003874	0.003878	0.003978	0.003910
Wind Speed (mph)	2.0	6.0	3.0	3.7
Wind Direction (--)	SSE	SE	E	--
Stack Flow (M2) (SCFH)	462,413	508,750	508,371	493,178
Avg Stack Wet Std Flow Rate (ASCFH)	487,777	540,074	545,462	524,438
Stack Moisture (Method 4)	5.2	5.8	6.8	5.9
Gross Fuel Heating Value (Btu/ft^3)	2,560.4	2,560.4	2,560.4	2,560.40
Average Inlet Fuel Flowrate (SCFH)	824.0	823.5	826.3	824.61
Average Inlet Mass Fuel Flowrate (lb/hr)	95.7	95.1	96.0	95.59
% Excess Air	174.7	178.3	174.7	175.94
CO_2 (%) - Modified method 3C	6.05	5.98	6.03	6.02
O_2 (%) - Modified Method 3C	13.50	13.60	13.50	13.53
N_2 (%) - Modified Method 3C	80.4	80.4	80.5	80.43
CO (ppmvd)	2.52	4.63	1.53	2.89
CO (ppm@3%CO_2)	1.27	2.36	0.79	1.47
THC (ppmvw)	0.00	0.00	0.00	0.00
THC (ppm@3%CO_2)	0.00	0.00	0.00	0.00
THC (lb/hr)	0.00	0.00	0.00	0.00
VOC Destruction Efficiency (%)	99.999	99.999	99.999	99.999

2.1 ASSESSMENT OF PERFORMANCE CRITERIA

Performance criteria of the Emission Control Device was assessed as per 40 CFR Part 60, specifically paragraph §60.5413(d)(11) from the September 23rd, 2013 publication of the new NSPS for the Oil and Natural Gas Sector. The results of the performance criteria assessment are as follows:

1. No visible emissions were observed during the 90-100% fixed rate firing setting, the 70-100-70% ramped rate firing setting. Smoke was observed during the 30-70-30% ramped rate firing setting for 178seconds during Run 4, The substantial cause was burning residue at the burning chamber. A single smoking event did occur during Run 1 to 3 of the 0-30-0% ramped rate test for 432 seconds, 399 seconds and 189 seconds respectively. These events were due to improper operator adjustment as the unit was being ramped down.
2. Average THC as propane corrected to 3% CO_2 did not exceed 10.0 ppmvw for any of the 12 individual test runs. Real Time THC as propane corrected to 3% CO_2 did not exceed 10.0 ppmvw during the 90-100% fixed rate firing setting, the 70-100-70% ramped rate firing setting, the 30-70-30%, or the 0-30-0% ramped rate firing setting. THC levels were seen during the shutdown periods of the 0-30-0% ramped rate firing setting, as the fuel gas inlet rate was reduced to almost 0%. See the associated 0-30-0% graphical strip charts in Appendix B for a visualization of this effect.

3. Average CO corrected to 3% CO_2 did not exceed 10 ppmvd for any of the 12 individual test runs. Real time CO corrected to 3%CO_2 did intermittently exceed the 10ppmvd limit with the greatest spikes seen during the shutdown periods of the 0-30-0% ramped rate firing setting. As the fuel gas inlet rate was reduced to 0%, the CO spiked due to incomplete combustion during the shutdown period. The CO was reduced to acceptable levels again once the unit was restarted. The spikes in CO during the shutdown periods caused the average CO for the run to shift up, which does not accurately represent the CO destruction efficiency of the unit while in operation. See the associated 0-30-0% graphical strip charts in Appendix B for a visualization of this effect.
4. The inlet VOC mass flow rates were determined through the inlet Propylene fuel sample content analysis and the metered inlet fuel flow rates found in Appendices E and B respectively. The exhaust VOC emission was measured and determined via Method 25A as THC (propane equivalent). The VOC destruction efficiency was determined to be greater than 99.99%.
5. Quality assurance/quality control data, calibration gas values, and gas cylinders certifications are presented in Appendix D. Graphical presentations of data are presented in Appendix B.

Also, in accordance to Subpart OOOO requirements, this report also contains the following information:

1. Schematics of the control device and dimensions of the control device are presented in Section 4.2 of this report.
2. Maximum Design is based on total Heat release of 1.9 MMBTU/Hr. Typical net heating value ranges between 300 Btu/SCF to 3,500 Btu/SCF
3. The inlet gas fuel flow rate range for each of the load settings and associated charts are included in Appendix B. The Max flow rate is 6.3 MSCFH or 1.9 MMBTU/hr
4. Air/steam injection/assist ranges are not applicable to tested unit. If assist gas is used, the combined max heat release will not be exceed.
5. The test parameter ranges listed below, as applicable for the tested device:
    a. Fuel gas delivery pressure and temperature - see Appendix B.
    b. Fuel gas moisture content, gross and net heating values - see Fuel Analysis in Appendix F.
    c. Purge gas usage range - purge gas not used.
    d. Condensate liquid fuel separation range - no liquids in the gas.
    e. Combustion zone temperature range – 500 °F to 2000 °F.
    f. Excess combustion air range – See Table 2.1-2.4
    g. Flame arrestor - (std equipment) see BOM equipment configuration drawing in Section 4.2
    h. Burner manifold pressure – see Appendix B
    i. Pilot flame indicator - (std equipment) see BOM equipment configuration drawing in Section 4.2, pilot not used during testing
    j. Pilot flame fuel usage – measured usage 50 SCFH (previous testing), not used during testing
    k. Tip velocity range – Not applicable to tested unit
    l. Momentum flux ratio – see Appendix B
    m. Exit temperature range – see Appendix B.
    n. Exit flow rate – see Appendix B.
    o. Wind speed and direction – see Appendix B

3.0 SOURCE OPERATION

3.1 PROCESS DESCRIPTION

Headquartered in Tulsa, Oklahoma, John Zink Hamworthy Combustion is home to the best and brightest process engineers, researchers and scientists from all corners of the globe, and the combustion industry's largest research and development test center. John Zink is one of the biggest manufacturer of flare control unit across the globe.

3.2 SAMPLING LOCATION

The sample ports were located approximately 19 feet above grade level on the exhaust system. The stack measures 30 inches in outer diameter and has a 2 inches flange. The ports were 1.6 duct diameters downstream from the flare tip and 0.3 duct diameters upstream from the stack exit to the atmosphere. All exhaust samples for gaseous emissions were continuously drawn from the exhaust system at the sample ports. All opacity observations were made by viewing the point where the exhaust system exited to the atmosphere at the top of the exhaust stack. All fuel sampling was continuously drawn from the fuel supply system with Silonite-coated stainless steel evacuated canister.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 TEST METHODS

The emission test on the ZTOF025X15PF Unit at the Tulsa R&D Facility was performed following United States Environmental Protection Agency (EPA) methods described by the Code of Federal Regulations (CFR). Table 4.1 outlines the specific methods performed on October 23-25, 2013.

TABLE 4.1
SUMMARY OF SAMPLING METHODS

Pollutant or Parameter	Sampling Method	Analysis Method
Sample Point Location	EPA Method 1	Equal Area Method
Stack Flow Rate	EPA Method 2	S-Type Pitot Tube
Oxygen	EPA Method 3a	Paramagnetic Cell
Carbon Dioxide	EPA Method 3a	Nondispersive Infrared Analyzer
Stack Moisture Content	EPA Method 4	Gravimetric Analysis
Opacity	EPA Method 22	Visual Observation
Carbon Monoxide	EPA Method 10	Nondispersive Infrared Analyzer
Carbon Dioxide	EPA Method 3c	Gas Chromatograph
Oxygen	EPA Method 3c	Gas Chromatograph

Pollutant or Parameter	Sampling Method	Analysis Method
Total Hydrocarbons	EPA Method 25a	Flame Ionization Detector
Fuel Flow Rate	EPA Method 2a	Volume Displacement
Fuel Content Analysis	ASTM D 1945-03, ASTM D 3588-98	Fuel Gas Sample and Laboratory Analysis

4.2 INSTRUMENT CONFIGURATION AND OPERATIONS FOR GAS ANALYSIS

The sampling and analysis procedures used during these tests conform with the methods outlined in the Code of Federal Regulations (CFR), Title 40, Part 60, Appendix A, Methods 1, 2, 2a, 3b, 3c, 4, 10, 22, 25a, ASTM D1945-03, ASTM D5504-08, ASTM D3588-98.

Figure 4.1 depicts the sample system used for the CO, THC, CO_2, and O_2 tests. A heated stainless steel probe was inserted into the sample ports of the stack to extract gas measurements from the emission stream at three points located at 16.7, 50, and 83.3 percent across the stack diameter. The gas sample was continuously pulled through the probe and transported, via heat-traced Teflon® tubing, to a stainless steel minimum-contact condenser designed to dry the sample. Transportation of the sample, through Teflon® tubing, continued into the sample manifold within the mobile laboratory via a stainless steel/Teflon® diaphragm pump. From the manifold, the sample was partitioned to the CO, CO_2, and O_2 analyzers through rotameters that controlled the flow rate of the sample. Exhaust samples were routed to the THC analyzer prior to gas conditioning.

Figure 4.1 shows that the sample system was also equipped with a separate path through which a calibration gas could be delivered to the probe and back through the entire sampling system. This allowed for convenient performance of system bias checks as required by the testing methods.

All instruments were housed in an air-conditioned, trailer-mounted mobile laboratory. Gaseous calibration standards were provided in aluminum cylinders with the concentrations certified by the vendor. EPA Protocol No. 1 was used to determine the cylinder concentrations where applicable (i.e. NOx calibration gases).

Table 4.2 provides a description of the analyzers used for the instrument portion of the tests. All data from the continuous monitoring instruments were recorded on a Logic Beach Portable Data Logging System Hyperlogger which retrieves calibrated electronic data from each instrument every one second and reports an average of the collected data every 30 seconds. Data records can be found in Appendix A and B of this report.

Figure 4.2 represents the sample system used for the flow and moisture measurement. A stainless steel probe was inserted into the sample ports of the stack to extract gas measurements from the emission stream through a glass impinger train. Flow rates are monitored with oil filled manometers and total sample volumes are measured with a dry gas meter.

On each load settings, three test runs of approximately 60 minutes each were conducted on the ZTOF025X15PF Unit CO, THC, flow, CO_2, and O_2.

The stack gas analysis for O_2 and CO_2 concentrations was performed in accordance with procedures set forth in EPA Method 3c.

CO emission concentrations were quantified in accordance with procedures set forth in EPA Method 10. A continuous nondispersive infrared (NDIR) analyzer was used for this purpose.

THC emission concentrations were quantified in accordance with procedures set forth in EPA Method 25a. A continuous flame ionization (FID) analyzer was used for this purpose.

TABLE 4.2
ANALYTICAL INSTRUMENTATION

Parameter	Model and Manufacturer	Range	Sensitivity	Detection Principle
CO	THERMO 48i	User may select up to 10,000 ppm	0.1 ppm	Infrared absorption, gas filter correlation detector, microprocessor based linearization.
CO_2	SERVOMEX 1440	0-20%	0.1%	Nondispersive infrared
THC	VIG 210	User may select up to 10,000 ppm	0.1 ppm	Flame Ionization Detector
O_2	THERMO 42i-HL	0-25%	0.1%	Paramagnetic cell, inherently linear.

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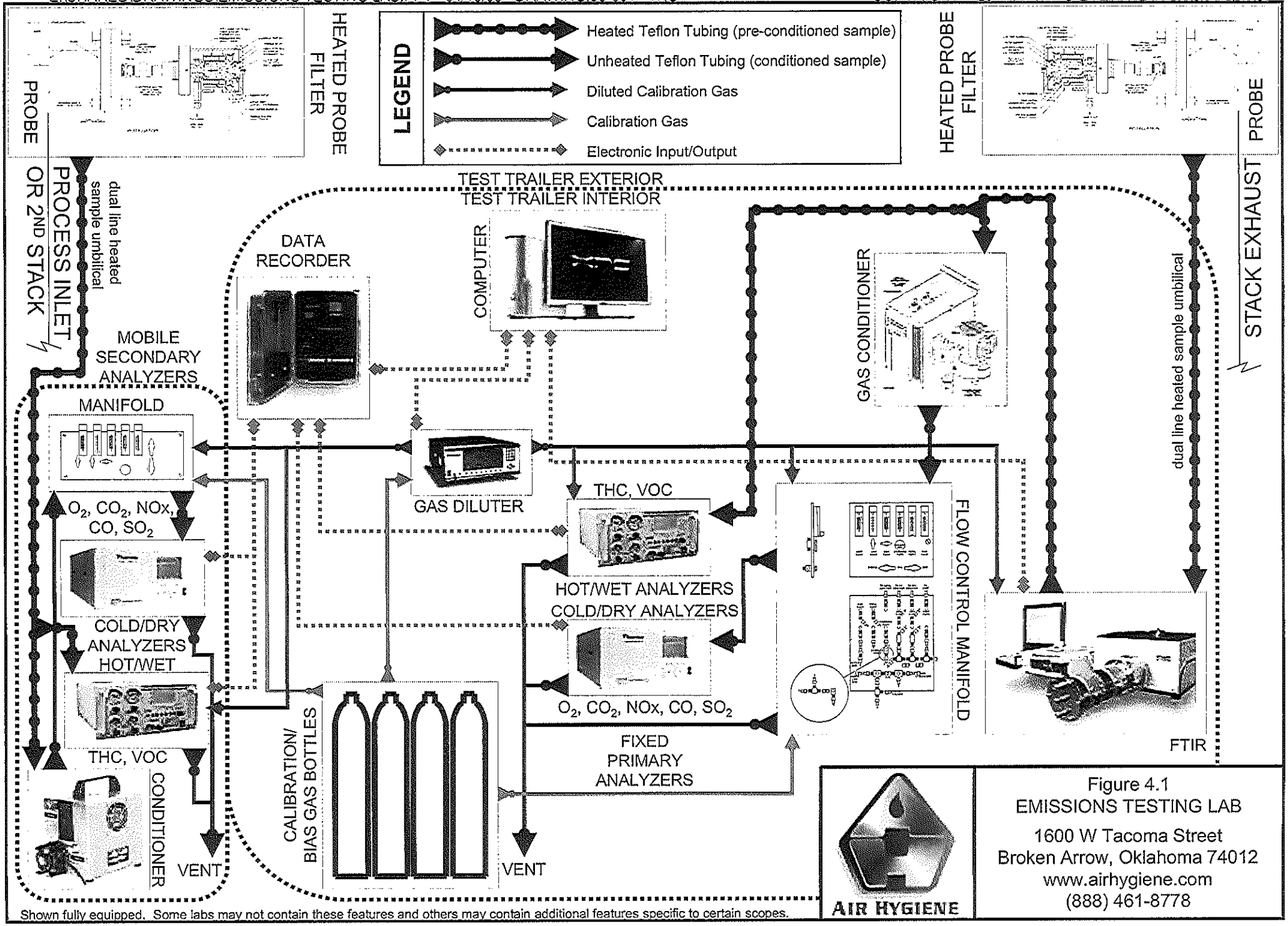

Shown fully equipped. Some labs may not contain these features and others may contain additional features specific to certain scopes.

AIR HYGIENE

Figure 4.1
EMISSIONS TESTING LAB

1600 W Tacoma Street
Broken Arrow, Oklahoma 74012
www.airhygiene.com
(888) 461-8778

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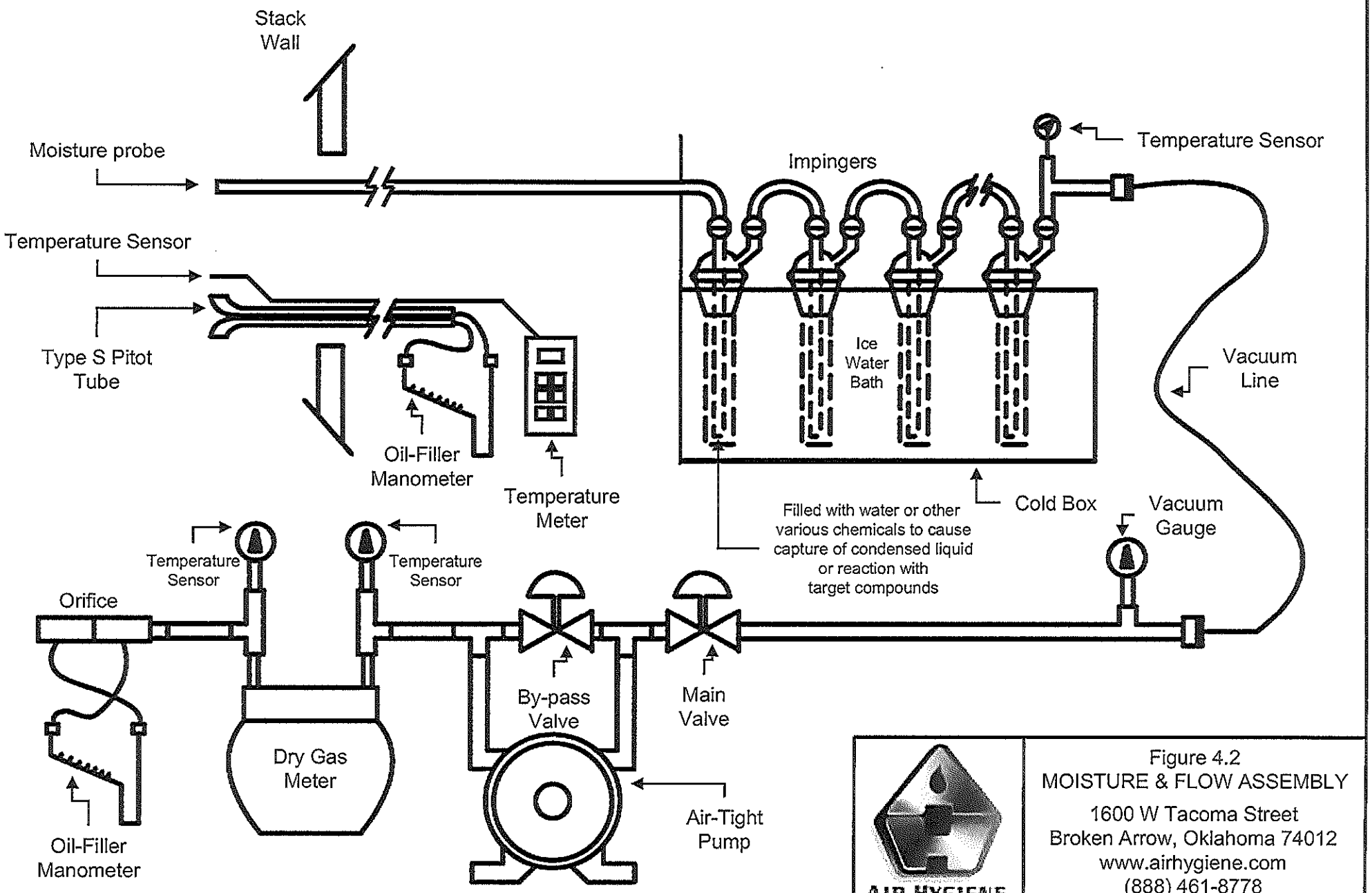

AIR HYGIENE

Figure 4.2
MOISTURE & FLOW ASSEMBLY

1600 W Tacoma Street
Broken Arrow, Oklahoma 74012
www.airhygiene.com
(888) 461-8778

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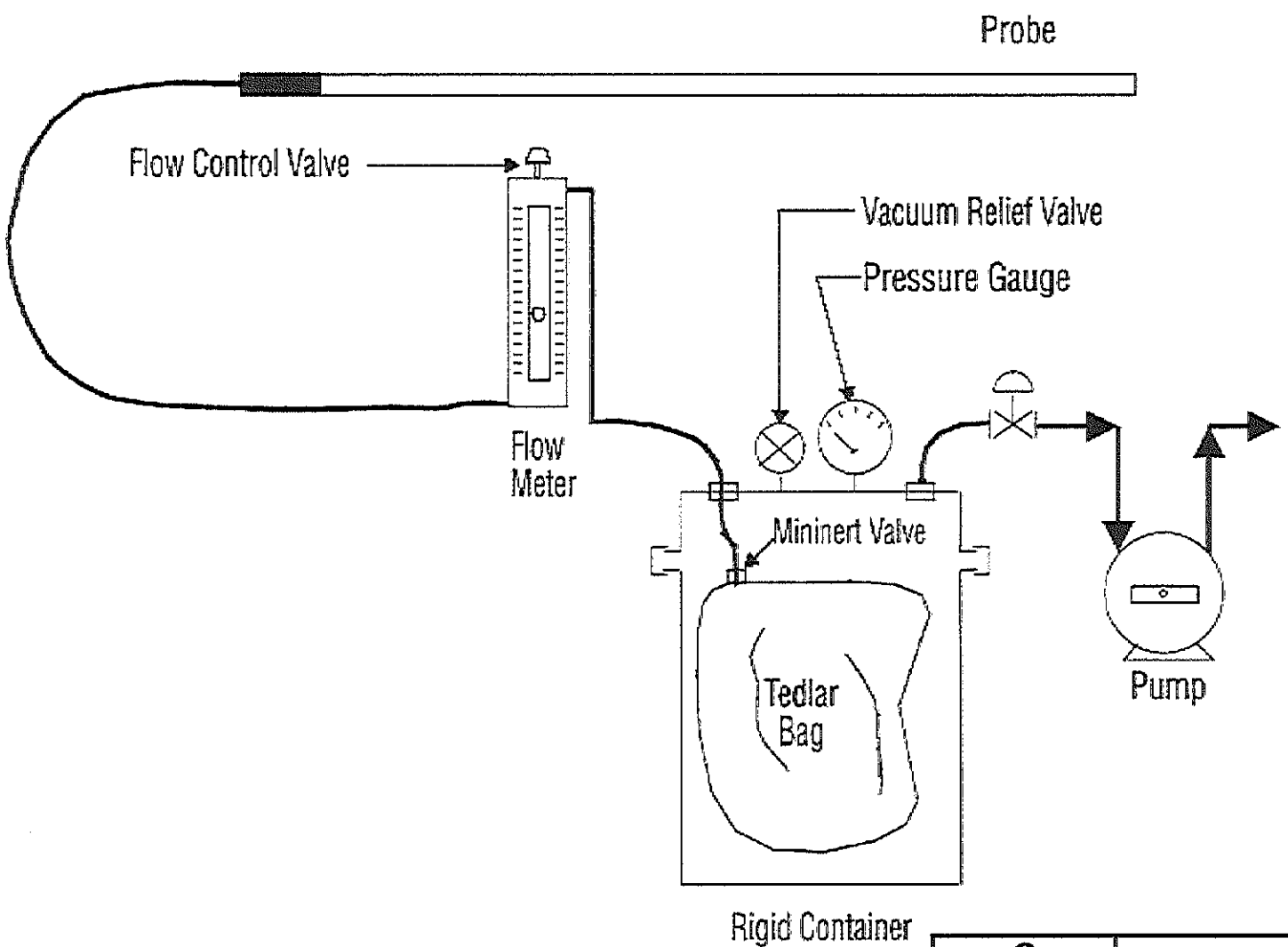

AIR HYGIENE

Figure 4.3
TEDLAR BAG SETUP

1600 W Tacoma Street
Broken Arrow, Oklahoma 74146
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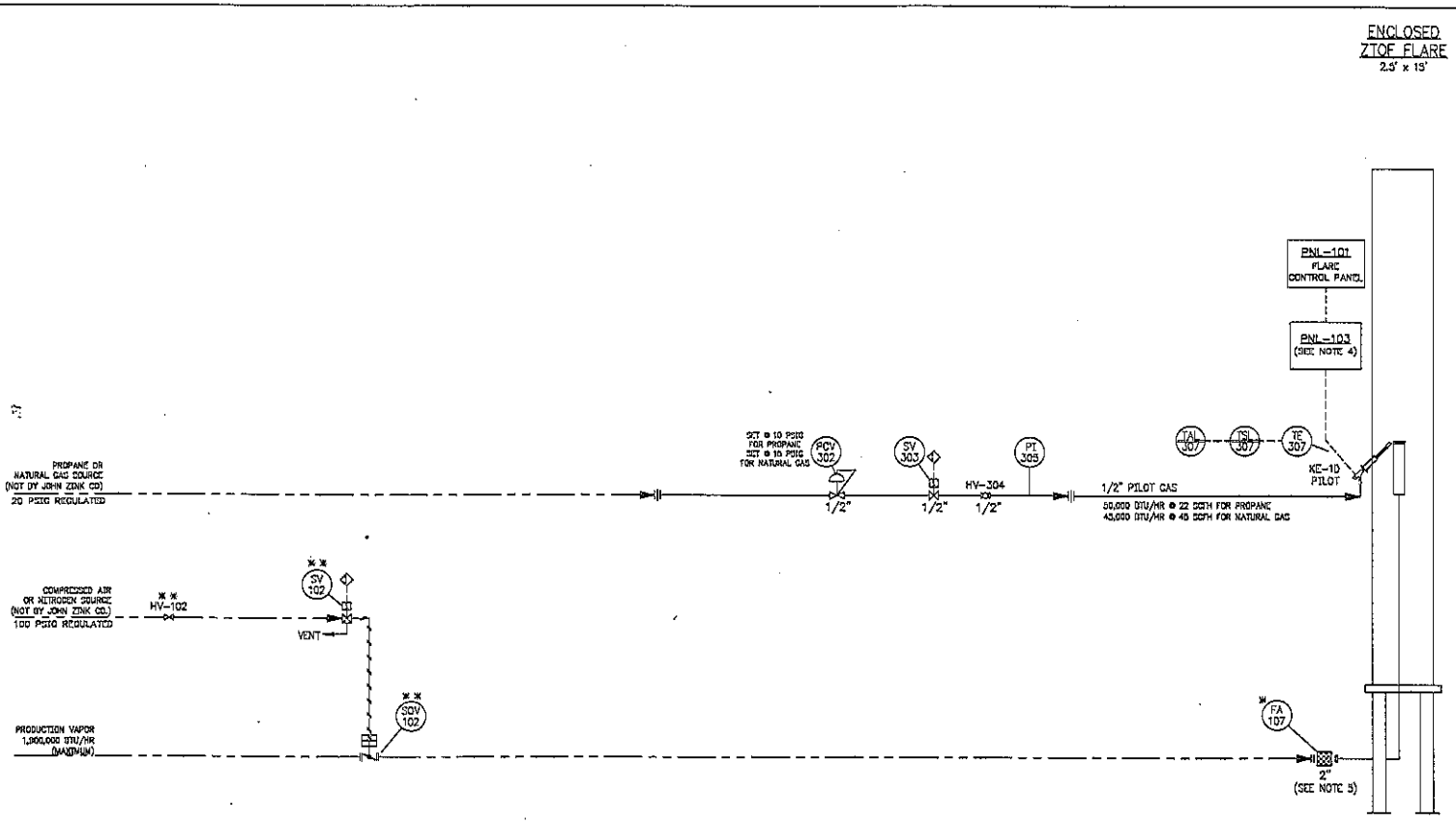
(888) 461-8778



NOTES:

1. ✱ – SUPPLIED BY JOHN ZINK CO. AND SHIPPED LOOSE FOR FIELD INSTALLATION.
2. ✱✱ – SUPPLIED BY OTHERS (NOT BY JOHN ZINK CO.)
3. ELECTRICAL AREA CLASSIFICATION: NON-HAZARDOUS
4. IGNITION TRANSFORMER IS INSIDE PNL-103 AND MOUNTED ON FLARE.
5. LOCATE FLAME ARRESTER WITH 5 DIAMETERS OF STRAIGHT UNDISTURBED FLOW UPSTREAM.

LEGEND

- FIELD MOUNTED INSTRUMENT
- REMOTE PANEL MOUNTED NORMALLY ACCESSIBLE TO OPERATOR
- LOCAL PANEL MOUNTED NORMALLY ACCESSIBLE TO OPERATOR
- REMOTE SUB-PANEL MOUNTED NORMALLY INACCESSIBLE TO OPERATOR
- LOCAL SUB-PANEL MOUNTED NORMALLY INACCESSIBLE TO OPERATOR
- LOCATED IN THE PLC
- INTERLOCK TO/FROM CONTROL PANEL
- PIPE & FITTINGS BY OTHERS (NOT BY JOHN ZINK CO.)
- ELECTRICAL INTERCONNECTIONS
- INSTRUMENT CONTROL AIR LINE
- PIPE & FITTINGS BY JOHN ZINK CO.

NO.	REVISION DESCRIPTION	BY	CK.	APP.	DATE

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P.O. NO.:
DR. DATE:
CK. DATE:
APP. DATE:

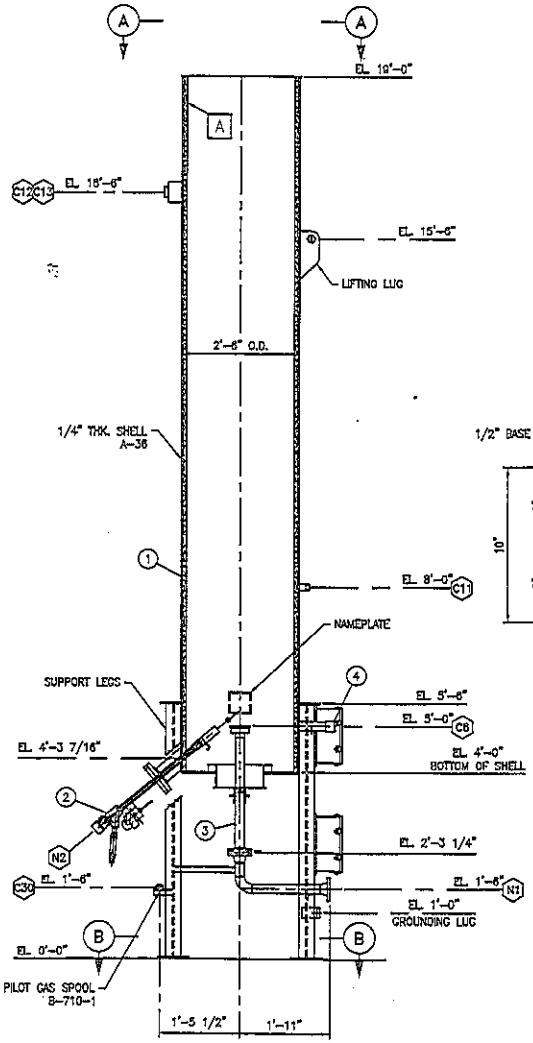
JOHN ZINK COMPANY LLC
PARTS AND SERVICE, CALL 1-800-705-4222 FAX (918) 234-1068

PROCESS & INSTRUMENT DIAGRAM
FOR AN ENCLOSED ZTOF PRODUCTION FLARE

CLASSIFIED
DATE:

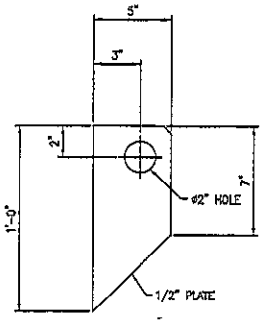
DRAWING NUMBER:
REV.
SCALE: NONE

File Name: c:\users\jzinkgis\documents\projects\1650\1650.dwg Plot Date: 11/21/2013 10:09 AM

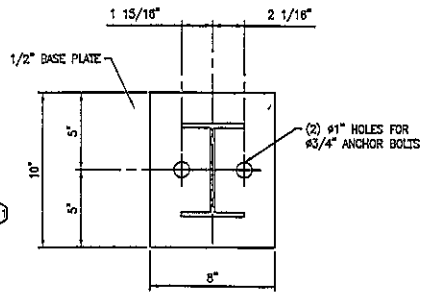


ELEVATION
(NOT TRUE ORIENTATION)

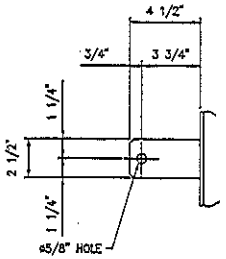
MK: D-701-1



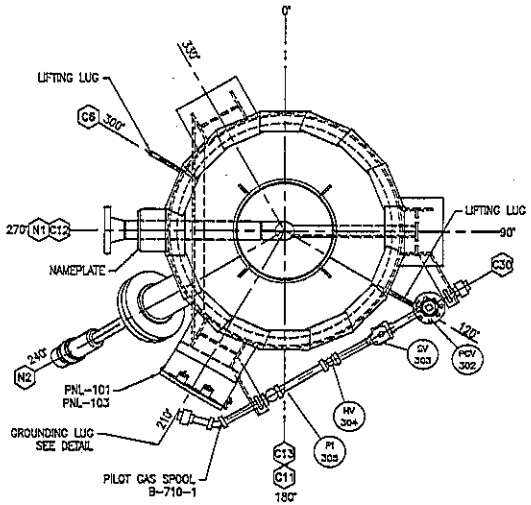
LIFTING LUG DETAIL
TYPICAL TWO PLACES @ 120° AND 300°



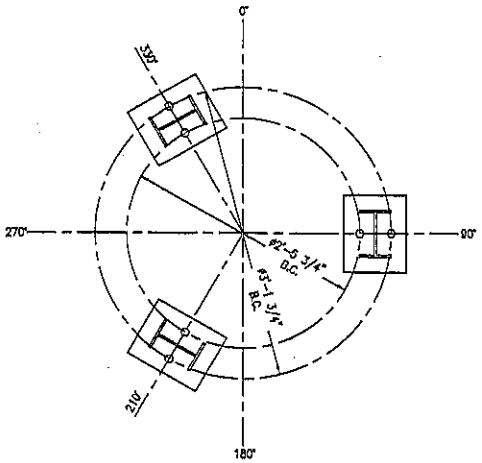
BASE PLATE DETAIL
(TYP 3 PLACES)



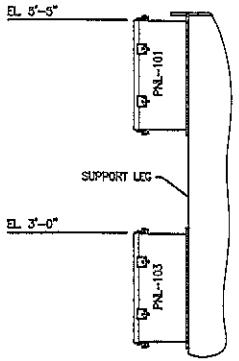
GROUND LUG DETAIL



VIEW A-A
(TRUE ORIENTATION)



SECTION B-B
(TRUE ORIENTATION)



PANEL DETAIL

PARTS LIST

ITEM	QTY	DESCRIPTION	MK. NO.	MATERIAL
1	1	ENCLOSED ZTOF FLARE	D-701-1	
2	1	KE-10 PILOT ASSEMBLY	D-302-1	
3	1	2" FLARE TIP	D-730-1	
4	1	2" SIGHT PORT	CA-ST-0800-1	

NOZZLE LEGEND

MK	QTY	DESCRIPTION
N1	1	GAS CONNECTION: 2" 150# R.F.W.N.
N2	1	PILOT MTG CONN: 4" 150# R.F.S.O
C5	1	SIGHT PORT - 2" MNPT
C11	1	THERMOCOUPLE CONN - 1" FNPT WITH PLUG
C12-13	2	SAMPLE PORT 4" FNPT WITH PLUG
C30	1	PILOT GAS INLET: 1/2" NPT

DESIGN DATA

WINDLOAD (PER ASCE 7-10, EXP. C)	110 M.P.H.
SEISMIC (PER IBC-2009)	CLASS E
SHEAR @ BASE	500 LB
MOMENT @ BASE	4000 LB-FT
DEADLOAD	3000 LB
SHELL DESIGN TEMPERATURE	500° F
CORROSION ALLOWANCE	0.0

INSULATION LEGEND

A: (1) OVERLAPPING LAYER OF 1" THICK 8 LB DENSITY, 2300° F.

GENERAL NOTES:

1. TAG NUMBERS TO BE PRECEDED BY JOHN ZINK SALES ORDER NUMBER.
2. FLARE ASSEMBLY IS NOT TO BE USED AS AN ANCHOR POINT FOR CUSTOMER PIPING.
3. PRE-TENSION ANCHOR BOLTS BY THE "TURN OF THE NUT" METHOD/AISC.
4. BOLT HOLES TO STRADDLE NORMAL CENTER LINES UNLESS NOTED.
5. FINISH EXTERIOR CARBON STEEL, SUPPORT LEGS, BOTTOM OF FLOOR PLATE, AND MANIFOLD EXTERIOR: SANDBLAST PER SSPC-SP-6 AND PRIME WITH SHERWIN WILLIAMS ZINC CLAD II PLUS #B69VZ12/B69VZ15/B69D11 (3-4 MILS D.F.T.)

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CK. DATE:
APP. DATE:

JOHN ZINK
JOHN ZINK COMPANY LLC
PARTS AND SERVICE, CALL 1-800-752-4252 FAX (918) 234-1968

ENCLOSED ZTOF PRODUCTION FLARE
30" O.D. x 15' H

CERTIFIED
DATE
DRAWING NUMBER
REV.
SCALE

APPENDIX A

TEST RESULTS AND CALCULATIONS

TABLE A.1:
EMISSIONS TESTING SCHEDULE

Unit	Load	Test Type	Run	Date	Start	Stop	Time Sync
48 ECD	0-30-0	Performance	2.5OD15 R1	10/23/13	14:19:07	15:18:37	CST
48 ECD	0-30-0	Performance	2.5OD15 R2	10/23/13	15:35:07	16:34:37	CST
48 ECD	0-30-0	Performance	2.5OD15 R3	10/24/13	7:55:07	8:54:37	CST
48 ECD	30-70-30	Performance	2.5OD15 R4	10/24/13	9:16:07	10:15:37	CST
48 ECD	30-70-30	Performance	2.5OD15 R5	10/24/13	13:04:07	14:03:37	CST
48 ECD	30-70-30	Performance	2.5OD15 R6	10/24/13	14:18:07	15:17:37	CST
48 ECD	70-100-70	Performance	2.5OD15 R7	10/24/13	15:52:00	16:51:37	CST
48 ECD	70-100-70	Performance	2.5OD15 R8	10/24/13	17:06:07	18:05:37	CST
48 ECD	70-100-70	Performance	2.5OD15 R9	10/25/13	8:23:07	9:22:37	CST
48 ECD	90-100	Performance	2.5OD15 R10	10/25/13	9:43:07	10:42:37	CST
48 ECD	90-100	Performance	2.5OD15 R11	10/25/13	10:54:07	11:53:37	CST
48 ECD	90-100	Performance	2.5OD15 R12	10/25/13	12:08:07	13:07:37	CST

EXAMPLE CALCULATIONS (INFORMATION)

Specific Humidity (RH_{sp})

Note: RHsp (gr/lb) calculated using temperature, relative humidity, and barometric pressure with psychrometric chart, psychrometric calculator, or built in psychrometric algorithm.

$$RH_{sp}(lb/lb) = \left[\left(\frac{gr}{lb}\right) \times \frac{lb}{7000\,gr}\right]$$

RH_{sp} = $\frac{41.98\ gr}{lb}$ x $\frac{1\ lb}{7000\ gr}$ = 0.005998 $\frac{lb\ H_2O}{lb\ Air}$

EXAMPLE CALCULATIONS (CALIBRATION)

Analyzer Calibration Error

RM 7E, (12-17-09), 12.2 Analyzer Calibration Error. For non-dilution systems, use Equation 7E-1 to calculate the analyzer calibration error for the low-, mid-, and high-level calibration gases. (calc for CO analyzer mid gas, if applicable)

$$ACE = \left(\frac{C_{Dir} - C_V}{CS}\right) \times 100$$ Eq. 7E-1

ACE = $\frac{9.13\ ppm - 9.07\ ppm}{18.00\ ppm}$ x 100 = 0.33 %

Calibration Error and Estimated Point, RM 25A, THC Analyzer

RM 25A, (12-17-09), 8.4 Calibration Error Test. Immediately prior to the test series (within 2 hours of the start of the test), introduce zero gas and high-level calibration gas at the calibration valve assembly. Adjust the analyzer output to the appropriate levels, if necessary. Calculate the predicted response for the low-level and mid-level gases based on a linear response line between the zero and high-level response. Then introduce low-level and mid-level calibration gases successively to the measurement system. ... These differences must be less than 5 percent of the respective calibration gas value. (calc for THC analyzer mid gas, if applicable)

$$E_p = \frac{C_{Dir(H)} - C_{Dir(Z)}}{C_{V(H)} - C_{V(Z)}} \times C_{Dir(M)} + C_{Dir(Z)}$$ Eq. of a line y=mx+b

E_p = $\frac{18.07\ ppm - 0.05\ ppm}{18.10\ ppm - 0.00\ ppm}$ x 8.48 ppm + 0.05 = 8.49 ppm

$$ACE = \left(\frac{C_{Dir} - C_V}{CS}\right) \times 100$$ Eq. 7E-1

ACE_{THC} = $\frac{8.35\ ppm - 8.49\ ppm}{8.48\ ppm}$ x 100 = -1.68 %

EXAMPLE CALCULATIONS (BIAS, DRIFT, AND CORRECTED RAW AVERAGE)

System Bias

RM 7E, (12-17-09), 12.3 System Bias. For non-dilution systems, use Equation 7E-2 to calculate the system bias separately for the low-level and upscale calibration gases. (calc for CO analyzer upscale gas, Run 1 initial bias, if applicable)

$$SB = \left(\frac{C_S - C_{Dir}}{CS}\right) \times 100$$ Eq. 7E-2

SB = $\frac{9.37\ ppm - 9.13\ ppm}{18.00\ ppm}$ x 100 = 1.33 %

Drift Assessment

RM 7E, (12-17-09), 12.5 Drift Assessment. Use Equation 7E-4 to separately calculate the low-level and upscale drift over each test run. (calc for CO analyzer upscale drift, Run 1, if applicable)

$$D = |SB_{final} - SB_i|$$ Eq. 7E-4

D = | 2.22 % - 1.33 % | = 0.89 %

Alternative Drift and Bias

RM 7E, (12-17-09), 13.2 / 13.3 System Bias and Drift. Alternatively, the results are acceptable if |Cs – Cdir| is ≤ 0.5 ppmv or if |Cs – Cv| is ≤ 0.5 ppmv (as applicable). (calc for CO analyzer initial upscale, Run 1, if applicable)

$$SB/D_{Alt} = |C_S - C_{Dir}|$$ Eq. Section 13.2 and 13.3

SB/D_{AR} = | 9.37 ppm - 9.13 ppm | = 0.24 ppm

Bias Adjusted Average

RM 7E, (12-17-09), 12.6 Effluent Gas Concentration. For each test run, calculate Cavg, the arithmetic average of all valid CO concentration values (e.g., 1-minute averages). Then adjust the value of Cavg for bias, using Equation 7E-5b. (calc for CO analyzer, Run 1, if applicable)

$$C_{Gas} = (C_{Avg} - C_O) \times \left(\frac{C_M}{C_M - C_O}\right)$$ Eq. 7E-5b

C_{Gas} = $\left(18.25\ ppm - 0.16\ ppm\right) \times \left(\frac{9.07\ ppm}{9.45\ ppm - 0.16\ ppm}\right)$ = 17.66 ppm

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

EXAMPLE CALCULATIONS (RUNS)

Moisture Correction

RM 7E, (12-17-09), 12.10 Moisture Correction. Use Equation 7E-10 if your measurements need to be corrected to a dry basis. (calc for CO analyzer, Run 1, if applicable) Note: Calculations may not match as Run 1 results are typically also bias adjusted

$$C_{w} = C_{D} \times (1 - B_{ws})$$

$$C_D = \frac{C_{w}}{1 - B_{ws}} \quad \text{Eq. 7E-10} \quad C_D = \frac{16.44 \text{ ppmvw}}{1 - 0.07} = 17.66 \text{ ppmvd} \quad \text{or inversely,} \quad C_W = 17.66 \text{ ppmvd} \times \left(1 - 0.07\right) = 16.44 \text{ ppmvw}$$

EXAMPLE CALCULATIONS (RUNS)

Emissions Rate (lb/hr)

Calculation for pound per hour emission rate. Calculate, as follows: (calc for CO gas Run 1, if applicable)

$$E_{lb/hr} = \frac{C_{Gas}}{10^6} \times \frac{Q_S \times MW}{G} \qquad E_{lb/hr} = \frac{17.66 \text{ ppm}}{10^6 \text{ ppm/part}} \times \frac{67{,}693 \text{ SCFH} \times 28.00 \text{ lb/lb-mol}}{385.23 \text{ SCF/lb-mol}} = \frac{0.09 \text{ lb}}{\text{hr}}$$

VOC Destruction Efficiency

Calculation for VOC destructtion Efficiency. Calculate, as follows: (calc for run 1, if applicable)

$$DE\% = \frac{23.633 - 0.003 \text{ lb/hr}}{23.633 \text{ lb/hr}} \times 100 = 99.989 \%$$

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

RM 7E, (08-15-06), 12.1 Nomenclature. The terms used in the equations are defined as follows:

ACE = Analyzer calibration error, percent of calibration span.
B_{ws} = Moisture content of sample gas as measured by Method 4 or other approved method, percent/100.
C_{Avg} = Average unadjusted gas concentration indicated by data recorder for the test run.
C_D = Pollutant concentration adjusted to dry conditions.
C_{Dir} = Measured concentration of a calibration gas (low, mid, or high) when introduced in direct calibration mode.
C_{Gas} = Average effluent gas concentration adjusted for bias.
C_M = Average of initial and final system calibration bias (or 2-point system calibration error) check responses for the upscale calibration gas.
C_{MA} = Actual concentration of the upscale calibration gas, ppmv.
C_O = Average of the initial and final system calibration bias (or 2-point system calibration error) check responses from the low-level (or zero) calibration gas.
C_S = Measured concentration of a calibration gas (low, mid, or high) when introduced in system calibration mode.
C_{SS} = Concentration of NOx measured in the spiked sample.
C_{Spike} = Concentration of NOx in the undiluted spike gas.
C_{Calc} = Calculated concentration of NOx in the spike gas diluted in the sample.
C_V = Manufacturer certified concentration of a calibration gas (low, mid, or high).
C_W = Pollutant concentration measured under moist sample conditions, wet basis.
CS = Calibration span.
D = Drift assessment, percent of calibration span.
E_p = The predicted response for the low-level and mid-level gases based on a linear response line between the zero and high-level response.
Eff_{NO2} = NO_2 to NO converter efficiency, percent.
H = High calibration gas, designator.
L = Low calibration gas, designator.
M = Mid calibration gas, designator.
NOFinal = The average NO concentration observed with the analyzer in the NO mode during the converter efficiency test in Section 16.2.2.
NOxCorr = The NOx concentration corrected for the converter efficiency.
NOxFinal = The final NOx concentration observed during the converter efficiency test in Section 16.2.2.
NOxPeak = The highest NOx concentration observed during the converter efficiency test in Section 16.2.2.
Q_{Spike} = Flow rate of spike gas introduced in system calibration mode, L/min.
Q_{Total} = Total sample flow rate during the spike test, L/min.
R = Spike recovery, percent.
SB = System bias, percent of calibration span.
SB_i = Pre-run system bias, percent of calibration span.
SB_f = Post-run system bias, percent of calibration span.
SB / D_{Alt} = Alternative absolute difference criteria to pass bias and/or drift checks.
SCE = System calibration error, percent of calibration span.
SCE_i = Pre-run system calibration error, percent of calibration span.
SCE_{final} = Post-run system calibration error, percent of calibration span.
Z = Zero calibration gas, designator.

40CFR60.355(b)(1), (09-20-06), Nomenclature. The terms used in the equations are defined as follows:

P_r = reference combustor inlet absolute pressure at 101.3 kilopascals ambient pressure, mm Hg
P_o = observed combustor inlet absolute pressure at test, mm Hg
H_o = observed humidity of ambient air, g H_2O/g air
e = transcendental constant, 2.718
T_a = ambient temperature, K

RM 19, (07-29-06), 12.1 Nomenclature. The terms used in the equations are defined as follows:

AdjFactor = Percent oxygen or carbon dioxide adjustment applied to a target pollutant
B_{ws} = Moisture fraction of ambient air, percent.
Btu = British thermal unit
$\%_C$ = Concentration of carbon from an ultimate analysis of fuel, weight percent.
$\%_{CO2d}$,$\%_{CO2w}$ = Concentration of carbon dioxide on a dry and wet basis, respectively, percent.
CIP / CDP = Combustor inlet pressure / compressor discharge pressure (mm Hg); note, some manufactures reference as PCD.
E = Pollutant emission rate, ng/J (lb/million Btu).
E_a = Average pollutant rate for the specified performance test period, ng/J (lb/million Btu).
E_{ao}, E_{ai} = Average pollutant rate of the control device, outlet and inlet, respectively, for the performance test period, ng/J (lb/million Btu).
E_{bi} = Pollutant rate from the steam generating unit, ng/J (lb/million Btu).
E_{bo} = Pollutant emission rate from the steam generating unit, ng/J (lb/million Btu).
E_{ci} = Pollutant rate in combined effluent, ng/J (lb/million Btu).
E_{co} = Pollutant emission rate in combined effluent, ng/J (lb/million Btu).
E_d = Average pollutant rate for each sampling period (e.g.,24-hr Method 6B sample or 24-hr fuel sample) or for each fuel lot (e.g., amount of fuel bunkered), ng/J (lb/million Btu)
E_{di} = Average inlet SO_2 rate for each sampling period d, ng/J (lb/million Btu).
E_g = Pollutant rate from gas turbine, ng/J (lb/million Btu).
E_{gs} = Daily geometric average pollutant rate, ng/J (lbs/million Btu) or ppm corrected to 7 percent O_2.
E_{jo},E_{ji} = Matched pair hourly arithmetic average pollutant rate, outlet and inlet, respectively, ng/J (lb/million Btu) or ppm corrected to 7 percent O_2.
E_h = Hourly average pollutant, ng/J (lb/million Btu).
E_{hj} = Hourly arithmetic average pollutant rate for hour "j," ng/J (lb/million Btu) or ppm corrected to 7 percent O_2.
EXP = Natural logarithmic base (2.718) raised to the value enclosed by brackets.
Fc = Ratio of the volume of carbon dioxide produced to the gross calorific value of the fuel from Method 19
F_d, F_w, F_c = Volumes of combustion components per unit of heat content, scm/J (scf/million Btu).
ft^3 = cubic feet
G = Ideal gas conversion factor
(385.23 SCF/lb-mol at 68 deg F & 14.696 psia)
GCM = gross Btu per SCF (constant, compound based)
GCV = Gross calorific value of the fuel consistent with the ultimate analysis, kJ/kg (Btu/lb).
GCV_p, GCV_r = Gross calorific value for the product and raw fuel lots, respectively, dry basis, kJ/kg (Btu/lb).
$\%_H$ = Concentration of hydrogen from an ultimate analysis of fuel, weight percent.
H_b = Heat input rate to the steam generating unit from fuels fired in the steam generating unit, J/hr (million Btu/hr).
H_g = Heat input rate to gas turbine from all fuels fired in the gas turbine, J/hr (million Btu/hr).
$\%_{H2O}$ = Concentration of water from an ultimate analysis of fuel, weight percent.
H_r = Total numbers of hours in the performance test period (e.g., 720 hours for 30-day performance test period).
K = volume of combustion component per pound of component (constant)
K = Conversion factor, 10^{-6} (kJ/J)/(%) [10^6 Btu/million Btu].
K_c = (9.57 scm/kg)/% [(1.53 scf/lb)/%].
K_{cc} = (2.0 scm/kg)/% [(0.321 scf/lb)/%].
K_{hd} = (22.7 scm/kg)/% [(3.64 scf/lb)/%].
K_{hw} = (34.74 scm/kg)/% [(5.57 scf/lb)/%].
K_n = (0.86 scm/kg)/% [(0.14 scf/lb)/%].
K_o = (2.85 scm/kg)/% [(0.46 scf/lb)/%].
K_s = (3.54 scm/kg)/% [(0.57 scf/lb)/%].
K_{sulfur} = $2x10^4$ Btu/wt%-MMBtu
K_w = (1.30 scm/kg)/% [(0.21 scf/lb)/%].
lb = pound
ln = Natural log of indicated value.
L_p,L_r = Weight of the product and raw fuel lots, respectively, metric ton (ton).
$\%_N$ = Concentration of nitrogen from an ultimate analysis of fuel, weight percent.
$M_\%$ = mole percent
mol = mole
MW = molecular weight (lb/lb-mol)
MW_{AIR} = molecular weight of air (28.9625 lb/lb-mole)[1]
NCM = net Btu per SCF (constant based on compound)
$\%_O$ = Concentration of oxygen from an ultimate analysis of fuel, weight percent.
$\%_{O2d}$, $\%_{O2w}$ = Concentration of oxygen on a dry and wet basis, respectively, percent.
P_B = barometirc pressure, in Hg
P_s = Potential SO2 emissions, percent.
$\%_S$ = Sulfur content of as-fired fuel lot, dry basis, weight percent.
S_e = Standard deviation of the hourly average pollutant rates for each performance test period, ng/J (lb/million Btu).
$\%_{Sf}$ = Concentration of sulfur from an ultimate analysis of fuel, weight percent.
S(wt%) = weight percent of sulfur, per lab analysis by appropriate ASTM standard
S_i = Standard deviation of the hourly average inlet pollutant rates for each performance test period, ng/J (lb/million Btu).
S_o = Standard deviation of the hourly average emission rates for each performance test period, ng/J (lb/million Btu).
$\%S_p$, $\%S_r$ = Sulfur content of the product and raw fuel lots respectively, dry basis, weight percent.
SCF = standard cubic feet
SH = specific humidity, pounds of water per pound of air
$t_{0.95}$ = Values shown in Table 19-3 for the indicated number of data points n.
T_{a-b} = ambient temperature, °F
W/D Factor = 1.0236 = conv. at 14.696 psia and
68 deg F (ref. Civil Eng. Ref. Manual, 7th Ed.)
X_{CO2}=CO_2 Correction factor, percent.
X_k = Fraction of total heat input from each type of fuel k.

Calculations, Formulas, and Constants

The following information supports the spreadsheets for this testing project.

Given Data:

Ideal Gas Conversion Factor = 385.23 SCF/lb-mol at 68 deg F & 14.696 psia

Fuel Heating Value is based upon Air Hygiene's fuel gas calculation sheet. All calculations are based upon a correction to 68 deg F & 14.696 psia

High Heating Values (HHV) are used for the Fuel Heating Value, F-Factor, and Fuel Flow Data per EPA requirements.

ASTM D 3588

Molecular Weight of NOx (lb/lb-mole) = 46.01
Molecular Weight of CO (lb/lb-mole) = 28.00
Molecular Weight of SO_2 (lb/lb-mole) = 64.00
Molecular Weight of THC (propane) (lb/lb-mole) = 44.00
Molecular Weight of VOC (methane) (lb/lb-mole) = 16.00
Molecular Weight of NH_3 (lb/lb-mole) = 17.03
Molecular Weight of HCHO (lb/lb-mole) = 30.03

40CFR60, App. A., RM 19, Table 19-1

Conversion Constant for NOx = 0.0000001194351
Conversion Constant for CO = 0.0000000726839
Conversion Constant for SO_2 = 0.0000001661345
Conversion Constant for THC = 0.0000001142175
Conversion Constant for VOC (methane) = 0.0000000415336
Conversion Constant for NH_3 = 0.0000000442074
Conversion Constant for HCHO = 0.0000000779534
NOTE: units are lb/ppm*ft^3

Formulas:

1. Corrected Raw Average (C_{Gas}), 40CFR60, App. A, RM 7E, Eq. 7E-5 (08/15/06)

$$C_{Gas} = (C_{Avg} - C_o) \times \left(\frac{C_{M1}}{C_M - C_o} \right)$$

2. Correction to % O_2, 40CFR60, App. A, RM 20, Eq. 20-5 (11/26/02)

$$C_{adj} = C_{Gas(Target)} \times \left(\frac{20.9\% - AdjFactor}{20.9\% - C_{Gas(O2)}} \right)$$

3. Correction to % O_2 and ISO Conditions

$$C_{ISO} = C_{Adj} \times \sqrt{\frac{P_r}{P_o}} \times e^{(19 \times (H_o - 0.00633))} \times \left(\frac{288}{T_a} \right)^{1.53}$$

4. Method 19 stack exhaust flow (scfh)

$$Q_S = \left(\frac{FFactor \times Q_f \times HHV}{1{,}000{,}000} \right) \times \left(\frac{20.9\%}{20.9\% - C_{Gas(O2)}} \right)$$

5. Emission Rate in lb/hr

$$E_{lb/hr} = \frac{C_{Gas}}{10^6} \times \frac{Q_S \times MW}{G}$$

6. Emission Rate in tons per year

$$E_{ton/yr} = \frac{E_{lb/hr} \times hr_{year}}{2000}$$

7. Emission Concentration in lb/MMBtu (O_2 based)

$$E_{lb/MMBtu} = \frac{C_{Gas} \times F_d Factor \times Conv_C \times 20.9\%}{20.9\% - C_{Gas(O2)}}$$

8. Emission Concentration in g/hp*hr

$$E_{g/hp \cdot hr} = \frac{E_{lb/hr} \times 453.6}{mw \times 1314.022} \text{ or } \frac{E_{lb/hr} \times 453.6}{hp}$$

APPENDIX B

EMISSION DATA RECORDS

John Zink Co, LLC

Air Permit # :	40 CFR 60 Sub Part OOOO
Plant Name or Location:	John Zink Testing and Research Facility
Project Number:	jz-13-tulsa,ok-comp#1
Manufacturer & Equipment:	ZTOF025X15PF
Test Load:	Multiple
Tester(s) / Test Unit(s):	MSL/DA/SC/MW/212

		RUN											
	UNITS	2.5OD15 R1	2.5OD15 R2	2.5OD15 R3	2.5OD15 R4	2.5OD15 R5	2.5OD15 R6	2.5OD15 R7	2.5OD15 R8	2.5OD15 R9	2.5OD15 R10	2.5OD15 R11	2.5OD15 R12
Start Time	hh:mm:ss	14:19:07	15:35:07	07:55:07	09:16:07	13:04:07	14:18:07	15:52:00	17:06:07	08:23:07	09:43:07	10:54:07	12:08:07
End Time	hh:mm:ss	15:18:37	16:34:37	08:54:37	10:15:37	14:03:37	15:17:37	16:51:37	18:05:37	09:22:37	10:42:37	11:53:37	13:07:37
Bar. Pressure	in. Hg	30.04	30.02	30.27	30.29	30.32	30.36	30.30	30.30	30.43	30.44	30.43	30.42
Amb. Temp.	°F	67	67	48	46	55	57	57	55	39	48	50	54
Rel. Humidity	%	43	42	80	72	50	48	47	46	78	56	52	46
Spec. Humidity	lb water / lb air	0.005998	0.005861	0.005581	0.004648	0.004503	0.004643	0.004555	0.004144	0.003823	0.003874	0.003878	0.003978
Date	mm/dd/yy	10/23/13	10/23/13	10/24/13	10/24/13	10/24/13	10/24/13	10/24/13	10/24/13	10/25/13	10/25/13	10/25/13	10/25/13
Unit Number		1	1	1	1	1	1	1	1	1	1	1	1
Load Designator		0-30-0	0-30-0	0-30-0	30-70-30	30-70-30	30-70-30	70-100-70	70-100-70	70-100-70	90-100	90-100	90-100
Stack Flow (M2)	SCFH	68,349	67,693	67,995	177,398	201,888	219,690	384,934	386,645	430,583	462,413	508,750	508,371
Stack Moisture	Method 4	6.9	4.7	4.7	6.9	6.1	5.6	6.6	6.0	5.9	5.2	5.8	6.8
Wind Speed	mph	4	3	5	6	9	5	4	7	1	2	6	3
Wind Direction	-	SE	SSE	NNE	N	NNE	N	NNE	NNE	NE	SSE	SE	E

EMISSION DATA RECORDS

CO, THC, Fuel Pressure, Temperature, and Fuel Flowrate Data

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.9	%
Stack Exhaust Flow (M2)	67,693	SCFH

Weather Data

Barometric Pressure	30.04	in. Hg
Relative Humidity	43	%
Ambient Temperature	67	°F
Specific Humidity	0.005998	lb H_2O / lb air

0-30-0 Load, Run - 2.5OD15 R1

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/23/13 14:08:07	23010	9.60	27.64	0.27	7.29	5.45	1,216.92	80.25
10/23/13 14:13:37	23340	12.55	44.57	0.16	5.55	39.93	1,327.11	238.51
10/23/13 14:16:07	23490	11.23	7.29	0.22	6.60	39.58	1,410.58	238.47
10/23/13 14:16:37	23520	11.23	4.50	0.19	6.66	39.23	1,423.38	237.95
10/23/13 14:17:07	23550	13.90	4.32	0.16	5.27	39.58	1,459.20	238.90
10/23/13 14:17:37	23580	15.19	24.81	0.30	3.56	38.88	1,497.40	238.77
10/23/13 14:18:07	23610	14.21	22.40	0.29	4.35	39.93	1,518.17	238.21
10/23/13 14:18:37	23640	13.80	5.18	0.28	4.74	39.23	1,516.92	237.78
10/23/13 14:19:07	23670	14.78	4.93	0.26	4.10	38.88	1,517.62	222.58
10/23/13 14:19:37	23700	13.55	6.33	0.16	4.79	5.45	1,517.78	80.02
10/23/13 14:20:07	23730	15.57	15.25	0.69	3.73	5.10	1,459.47	79.91
10/23/13 14:20:37	23760	13.64	8.95	0.14	4.36	4.75	1,367.21	79.80
10/23/13 14:21:07	23790	10.78	13.85	0.11	6.77	5.45	1,301.92	79.82
10/23/13 14:21:37	23820	9.26	42.84	0.11	7.92	4.75	1,265.69	80.17
10/23/13 14:22:07	23850	9.16	40.04	0.09	7.96	4.75	1,222.04	81.76
10/23/13 14:22:37	23880	8.69	29.27	0.17	8.36	15.66	1,222.90	159.73
10/23/13 14:23:07	23910	8.61	20.44	0.21	8.43	39.93	1,220.74	239.90
10/23/13 14:23:37	23940	9.29	17.70	0.22	8.19	39.23	1,267.89	239.21
10/23/13 14:24:07	23970	10.73	23.46	0.28	6.95	40.29	1,357.77	238.73
10/23/13 14:24:37	24000	11.41	19.86	0.26	6.66	40.29	1,440.84	239.17
10/23/13 14:25:07	24030	12.03	10.11	0.23	6.03	39.93	1,503.34	239.09
10/23/13 14:25:37	24060	12.06	4.15	0.24	5.99	40.29	1,546.60	239.17
10/23/13 14:26:07	24090	12.44	2.30	0.23	5.78	40.29	1,569.34	238.44
10/23/13 14:26:37	24120	12.03	2.18	0.17	5.97	40.64	1,585.81	239.73
10/23/13 14:27:07	24150	11.94	2.27	0.15	6.07	40.64	1,587.73	239.69
10/23/13 14:27:37	24180	11.98	1.83	0.16	6.08	40.29	1,573.10	239.12
10/23/13 14:28:07	24210	12.61	2.19	0.20	5.67	40.29	1,548.99	239.64
10/23/13 14:28:37	24240	12.86	2.79	0.28	5.45	40.29	1,540.24	239.56
10/23/13 14:29:07	24270	12.68	2.75	0.24	5.55	40.29	1,533.40	238.78
10/23/13 14:29:37	24300	12.58	2.71	0.22	5.64	40.29	1,524.99	238.69
10/23/13 14:30:07	24330	12.61	2.79	0.15	5.63	40.29	1,519.54	239.09
10/23/13 14:30:37	24360	12.75	2.81	0.18	5.55	40.99	1,520.05	239.60
10/23/13 14:31:07	24390	12.53	2.22	0.19	5.66	40.64	1,512.97	238.65
10/23/13 14:31:37	24420	12.47	2.19	0.17	5.72	40.64	1,503.89	239.82
10/23/13 14:32:07	24450	12.56	2.58	0.16	5.67	40.99	1,492.47	239.51
10/23/13 14:32:37	24480	12.56	2.63	0.22	5.63	39.93	1,486.96	238.09
10/23/13 14:33:07	24510	12.38	2.33	0.24	5.77	40.29	1,485.13	238.22
10/23/13 14:33:37	24540	12.55	2.97	0.24	5.67	40.29	1,485.46	239.51
10/23/13 14:34:07	24570	12.42	4.12	0.20	5.79	39.93	1,483.70	239.12
10/23/13 14:34:37	24600	12.63	5.10	0.15	5.62	40.64	1,477.58	239.08
10/23/13 14:35:07	24630	12.53	5.37	0.14	5.65	40.29	1,478.02	239.56
10/23/13 14:35:37	24660	12.62	5.33	0.12	5.63	39.93	1,479.07	238.32
10/23/13 14:36:07	24690	12.53	4.89	0.19	5.67	40.64	1,481.71	238.96
10/23/13 14:36:37	24720	12.44	5.80	0.15	5.76	40.64	1,482.19	238.66
10/23/13 14:37:07	24750	12.25	7.77	0.14	5.81	40.99	1,483.92	239.61
10/23/13 14:37:37	24780	13.55	7.88	0.16	5.39	40.29	1,484.37	239.01
10/23/13 14:38:07	24810	15.05	26.83	0.19	3.57	40.64	1,483.35	239.44
10/23/13 14:38:37	24840	13.48	32.41	0.24	4.92	40.99	1,482.91	238.57
10/23/13 14:39:07	24870	13.51	11.08	0.23	4.84	39.58	1,484.85	238.49
10/23/13 14:39:37	24900	13.56	9.11	0.26	4.92	40.29	1,487.45	239.18

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.9	%
Stack Exhaust Flow (M2)	67,693	SCFH

Weather Data

Barometric Pressure	30.04	in. Hg
Relative Humidity	43	%
Ambient Temperature	67	°F
Specific Humidity	0.005998	lb H_2O / lb air

0-30-0 Load, Run - 2.5OD15 R1

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/23/13 14:40:07	24930	13.50	10.10	0.31	4.88	5.81	1,486.46	83.00
10/23/13 14:40:37	24960	15.15	14.92	0.40	3.98	5.81	1,444.53	82.97
10/23/13 14:41:07	24990	12.27	7.34	0.17	5.39	5.81	1,353.58	82.91
10/23/13 14:41:37	25020	11.40	7.84	0.15	6.52	6.16	1,304.41	84.28
10/23/13 14:42:07	25050	11.56	23.73	0.15	6.31	5.45	1,279.42	82.76
10/23/13 14:42:37	25080	11.10	11.75	0.15	6.76	5.45	1,261.90	84.23
10/23/13 14:43:07	25110	11.97	10.20	0.17	6.07	29.38	1,249.24	228.72
10/23/13 14:43:37	25140	12.01	12.31	0.16	6.09	40.29	1,247.26	239.54
10/23/13 14:44:07	25170	11.92	15.94	0.14	6.07	40.64	1,310.02	238.33
10/23/13 14:44:37	25200	11.95	10.95	0.13	6.08	38.53	1,382.88	238.08
10/23/13 14:45:07	25230	12.13	7.56	0.14	5.90	39.93	1,427.65	237.86
10/23/13 14:45:37	25260	12.15	6.34	0.15	6.00	39.93	1,463.97	237.13
10/23/13 14:46:07	25290	12.40	6.20	0.15	5.79	39.93	1,484.96	237.31
10/23/13 14:46:37	25320	11.42	7.32	0.16	6.33	39.23	1,500.48	237.74
10/23/13 14:47:07	25350	11.09	6.76	0.11	6.73	39.93	1,499.87	238.69
10/23/13 14:47:37	25380	14.17	8.06	0.15	5.08	40.29	1,507.60	238.30
10/23/13 14:48:07	25410	14.06	30.58	0.14	4.15	39.93	1,512.42	237.74
10/23/13 14:48:37	25440	13.70	20.18	0.13	4.81	38.88	1,512.70	238.35
10/23/13 14:49:07	25470	13.67	7.06	0.09	4.76	39.93	1,516.14	238.35
10/23/13 14:49:37	25500	13.44	7.90	0.12	4.94	40.29	1,522.84	238.56
10/23/13 14:50:07	25530	13.47	9.15	0.11	4.88	4.40	1,526.83	79.87
10/23/13 14:50:37	25560	13.91	9.76	0.33	4.71	4.40	1,467.65	79.60
10/23/13 14:51:07	25590	15.83	28.64	1.30	3.29	5.10	1,386.36	79.84
10/23/13 14:51:37	25620	13.07	12.32	0.14	5.10	4.75	1,337.50	79.97
10/23/13 14:52:07	25650	12.92	8.99	0.08	5.44	5.45	1,306.07	79.56
10/23/13 14:52:37	25680	12.67	46.80	0.15	5.55	4.75	1,281.39	79.93
10/23/13 14:53:07	25710	12.96	30.94	0.10	5.37	5.45	1,264.91	79.62
10/23/13 14:53:37	25740	12.54	18.83	0.10	5.54	39.23	1,237.31	238.91
10/23/13 14:54:07	25770	12.14	10.48	0.15	5.98	40.64	1,237.51	238.35
10/23/13 14:54:37	25800	12.12	8.99	0.07	5.90	40.29	1,308.36	237.75
10/23/13 14:55:07	25830	12.01	9.80	0.07	6.03	40.99	1,367.41	239.30
10/23/13 14:55:37	25860	11.70	9.06	0.07	6.25	39.93	1,400.69	238.78
10/23/13 14:56:07	25890	11.85	7.11	0.06	6.10	39.58	1,417.72	239.17
10/23/13 14:56:37	25920	11.33	6.78	0.04	6.54	40.29	1,431.26	237.67
10/23/13 14:57:07	25950	11.92	8.14	0.03	6.11	39.58	1,448.22	239.30
10/23/13 14:57:37	25980	11.77	8.88	0.02	6.22	40.29	1,463.00	238.14
10/23/13 14:58:07	26010	12.06	6.89	0.07	6.04	40.99	1,471.95	238.53
10/23/13 14:58:37	26040	11.80	7.24	0.19	6.08	40.29	1,485.92	239.22
10/23/13 14:59:07	26070	11.53	5.23	0.19	6.40	40.29	1,495.76	238.91
10/23/13 14:59:37	26100	11.92	5.78	0.17	6.11	40.64	1,509.80	238.44
10/23/13 15:00:07	26130	11.59	9.76	0.14	6.30	40.64	1,514.54	237.62
10/23/13 15:00:37	26160	11.39	12.23	0.11	6.52	41.34	1,514.94	238.57
10/23/13 15:01:07	26190	11.78	8.59	0.13	6.17	42.05	1,519.66	237.88
10/23/13 15:01:37	26220	11.88	6.20	0.12	6.18	40.64	1,518.32	239.04
10/23/13 15:02:07	26250	11.83	6.12	0.11	6.14	41.34	1,527.35	239.13
10/23/13 15:02:37	26280	11.49	3.71	0.10	6.36	40.64	1,535.83	238.49
10/23/13 15:03:07	26310	11.39	2.73	0.11	6.46	42.40	1,540.52	238.79
10/23/13 15:03:37	26340	11.14	3.32	0.21	6.68	42.05	1,541.96	239.22
10/23/13 15:04:07	26370	11.58	4.09	0.15	6.35	40.99	1,537.81	237.67
10/23/13 15:04:37	26400	14.01	10.49	0.09	5.15	40.99	1,535.91	238.40

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.9	%
Stack Exhaust Flow (M2)	67,693	SCFH

Weather Data

Barometric Pressure	30.04	in. Hg
Relative Humidity	43	%
Ambient Temperature	67	°F
Specific Humidity	0.005998	lb H_2O / lb air

0-30-0 Load, Run - 2.5OD15 R1

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/23/13 15:05:07	26430	14.31	32.06	0.12	4.00	40.99	1,531.10	239.17
10/23/13 15:05:37	26460	13.91	25.55	0.14	4.72	41.34	1,522.28	238.61
10/23/13 15:06:07	26490	14.16	5.59	0.13	4.43	42.05	1,520.77	238.18
10/23/13 15:06:37	26520	13.35	4.39	0.07	4.94	42.40	1,532.28	238.96
10/23/13 15:07:07	26550	15.04	7.93	0.14	4.14	5.45	1,535.91	79.79
10/23/13 15:07:37	26580	12.39	60.60	0.09	5.12	5.45	1,490.32	79.62
RAW AVERAGE		**12.47**	**18.25**	**0.19**	**5.70**	**32.10**	**1,427.81**	**203.48**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	inst-22-0005	inst-co-0020	inst-vc-0003	inst-22-0005	F8_PRF1	F8_TE5	
		(%)	(ppmvd)	(ppmvw)	(%)	(in. H_2O)	(°F)	(SCFH)
Bias	Initial Zero	0.05	0.16	-0.34	0.04			
	Final Zero	0.02	0.15	0.05	0.05			
	Avg. Zero	0.04	0.16	-0.15	0.05			
	Initial UpScale	12.03	9.37	4.81	8.91			
	Final UpScale	11.76	9.53	5.07	8.84			
	Avg. UpScale	11.90	9.45	4.94	8.88			
Upscale Cal Gas		12.10	9.07	5.04	8.95			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.68	17.66	0.34	5.74
Corrected Raw Average (ppm/% wet basis)	11.80	16.43	0.33	5.34
Concentration (ppm@ 3%CO_2)	N/A	9.24	0.18	N/A
Emission Rate (lb/hr)	N/A	0.09	0.00	N/A

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	4.7	%
Stack Exhaust Flow (M2)	67,995	SCFH

Weather Data

Barometric Pressure	30.02	in. Hg
Relative Humidity	42	%
Ambient Temperature	67	°F
Specific Humidity	0.005861	lb H_2O / lb air

0-30-0 Load, Run - 2.5OD15 R2

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/23/13 15:35:07	28230	15.48	7.54	0.03	3.89	5.81	1,322.85	79.63
10/23/13 15:35:37	28260	13.41	24.87	0.03	4.81	6.16	1,301.17	82.76
10/23/13 15:36:07	28290	13.64	9.90	0.09	4.84	5.45	1,280.73	81.56
10/23/13 15:36:37	28320	13.35	3.86	0.06	4.99	5.81	1,275.24	81.53
10/23/13 15:37:07	28350	13.36	3.89	0.02	4.99	42.05	1,353.69	237.71
10/23/13 15:37:37	28380	13.62	3.86	0.03	4.76	42.40	1,353.69	237.71
10/23/13 15:38:07	28410	13.93	4.24	0.08	4.82	43.10	1,411.34	236.85
10/23/13 15:38:37	28440	15.38	24.41	0.16	3.31	41.34	1,456.10	236.72
10/23/13 15:39:07	28470	12.31	103.63	0.03	5.73	42.40	1,488.29	236.12
10/23/13 15:39:37	28500	11.92	68.42	0.03	6.02	42.05	1,509.47	237.50
10/23/13 15:40:07	28530	11.53	26.12	0.01	6.25	42.05	1,517.89	237.41
10/23/13 15:40:37	28560	11.28	11.38	0.01	6.53	42.05	1,525.38	236.16
10/23/13 15:41:07	28590	10.73	10.17	0.04	6.95	42.40	1,525.38	237.20
10/23/13 15:41:37	28620	11.34	8.00	0.05	6.61	41.69	1,526.19	237.11
10/23/13 15:42:07	28650	11.59	7.60	0.00	6.41	42.05	1,526.61	237.84
10/23/13 15:42:37	28680	11.83	10.28	0.00	6.26	42.05	1,533.24	236.81
10/23/13 15:43:07	28710	11.63	10.03	0.03	6.27	42.75	1,538.27	237.41
10/23/13 15:43:37	28740	11.84	5.72	0.02	6.24	42.05	1,548.77	237.37
10/23/13 15:44:07	28770	11.90	3.82	0.03	6.15	42.40	1,553.59	236.81
10/23/13 15:44:37	28800	11.62	2.67	0.09	6.35	42.05	1,556.35	237.20
10/23/13 15:45:07	28830	11.06	2.76	0.05	6.70	42.40	1,558.49	236.68
10/23/13 15:45:37	28860	11.46	3.56	0.04	6.53	42.05	1,557.78	238.49
10/23/13 15:46:07	28890	11.47	3.27	0.07	6.50	42.40	1,557.78	236.46
10/23/13 15:46:37	28920	11.41	3.88	0.07	6.52	43.10	1,557.49	238.01
10/23/13 15:47:07	28950	11.55	7.10	0.04	6.36	42.05	1,559.62	237.37
10/23/13 15:47:37	28980	11.57	8.33	0.03	6.39	5.81	1,520.45	82.76
10/23/13 15:48:07	29010	11.62	4.87	0.02	6.36	5.45	1,411.78	81.27
10/23/13 15:48:37	29040	11.39	4.68	0.02	6.52	5.81	1,345.95	82.77
10/23/13 15:49:07	29070	11.57	4.68	0.06	6.41	6.16	1,320.20	82.79
10/23/13 15:49:37	29100	13.23	5.32	0.04	5.67	5.45	1,320.20	81.41
10/23/13 15:50:07	29130	15.02	11.05	0.16	3.81	6.51	1,296.86	82.95
10/23/13 15:50:37	29160	14.06	10.98	0.15	4.47	5.45	1,266.23	81.60
10/23/13 15:51:07	29190	13.52	3.39	0.11	4.88	6.16	1,255.20	82.93
10/23/13 15:51:37	29220	13.80	3.42	0.16	4.75	37.47	1,261.49	240.02
10/23/13 15:52:07	29250	13.50	4.57	0.05	4.91	43.45	1,331.15	240.71
10/23/13 15:52:37	29280	13.63	5.42	0.07	4.93	43.10	1,401.44	241.27
10/23/13 15:53:07	29310	13.46	5.69	0.07	4.91	43.45	1,450.52	240.80
10/23/13 15:53:37	29340	14.65	7.32	0.16	4.43	42.75	1,498.99	240.23
10/23/13 15:54:07	29370	12.37	47.33	0.04	5.28	41.69	1,498.99	240.75
10/23/13 15:54:37	29400	11.52	51.12	0.04	6.40	42.75	1,509.93	240.10
10/23/13 15:55:07	29430	11.30	12.76	0.07	6.57	42.40	1,516.54	240.19
10/23/13 15:55:37	29460	11.67	6.79	0.17	6.44	43.10	1,523.31	241.70
10/23/13 15:56:07	29490	12.01	10.43	0.07	6.09	42.05	1,524.90	241.06
10/23/13 15:56:37	29520	12.09	18.17	0.04	5.95	42.75	1,520.44	241.06
10/23/13 15:57:07	29550	11.89	15.86	0.13	6.15	42.05	1,507.07	241.28
10/23/13 15:57:37	29580	11.69	12.61	0.06	6.28	42.05	1,507.07	241.35
10/23/13 15:58:07	29610	12.07	9.97	0.06	6.08	42.40	1,501.68	241.28
10/23/13 15:58:37	29640	12.20	7.09	0.12	5.93	42.75	1,497.33	240.15
10/23/13 15:59:07	29670	12.43	6.27	0.06	5.83	43.10	1,493.30	240.54
10/23/13 15:59:37	29700	12.71	6.00	0.05	5.57	42.05	1,497.59	241.61
10/23/13 16:00:07	29730	12.86	8.47	0.05	5.52	41.69	1,502.78	240.19
10/23/13 16:00:37	29760	12.84	10.71	0.08	5.50	42.75	1,503.26	240.89

John Zink Co, LLC
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Unit Data

Meas. Stack Moisture	4.7	%
Stack Exhaust Flow (M2)	67,995	SCFH

Weather Data

Barometric Pressure	30.02	in. Hg
Relative Humidity	42	%
Ambient Temperature	67	°F
Specific Humidity	0.005861	lb H_2O / lb air

0-30-0 Load, Run - 2.5OD15 R2

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/23/13 16:01:07	29790	12.83	8.01	0.04	5.51	41.69	1,502.03	241.19
10/23/13 16:01:37	29820	12.56	13.02	0.04	5.64	42.05	1,499.96	240.19
10/23/13 16:02:07	29850	12.46	9.28	0.08	5.73	6.16	1,492.39	73.22
10/23/13 16:02:37	29880	12.53	7.53	0.08	5.68	4.05	1,492.39	75.24
10/23/13 16:03:07	29910	12.66	7.92	0.10	5.67	4.05	1,402.48	75.21
10/23/13 16:03:37	29940	12.65	7.05	0.05	5.60	5.10	1,339.71	81.58
10/23/13 16:04:07	29970	12.54	7.52	0.01	5.72	5.81	1,280.79	81.47
10/23/13 16:04:37	30000	12.62	14.14	0.07	5.64	6.16	1,260.22	82.96
10/23/13 16:05:07	30030	16.05	16.63	0.16	3.50	5.45	1,247.32	81.57
10/23/13 16:05:37	30060	14.03	36.67	0.05	4.39	5.81	1,237.67	82.87
10/23/13 16:06:07	30090	13.78	13.70	0.03	4.83	42.40	1,225.35	243.86
10/23/13 16:06:37	30120	13.65	6.75	0.03	4.78	42.40	1,300.32	244.79
10/23/13 16:07:07	30150	13.75	7.16	0.09	4.78	43.45	1,368.23	244.22
10/23/13 16:07:37	30180	13.83	6.79	0.05	4.68	42.75	1,404.87	244.29
10/23/13 16:08:07	30210	13.59	7.51	0.28	4.96	42.05	1,426.48	244.29
10/23/13 16:08:37	30240	16.35	23.72	1.90	3.03	42.40	1,446.44	244.44
10/23/13 16:09:07	30270	12.96	104.74	0.06	5.12	42.40	1,457.42	243.82
10/23/13 16:09:37	30300	12.66	74.84	0.06	5.64	42.75	1,466.96	243.45
10/23/13 16:10:07	30330	12.66	39.75	0.04	5.63	41.69	1,469.15	243.41
10/23/13 16:10:37	30360	12.60	24.55	0.03	5.64	42.05	1,470.02	243.58
10/23/13 16:11:07	30390	12.41	18.53	0.03	5.78	42.40	1,477.53	245.10
10/23/13 16:11:37	30420	12.74	22.53	0.01	5.57	42.05	1,495.22	243.89
10/23/13 16:12:07	30450	12.43	25.86	0.03	5.73	42.40	1,511.46	243.41
10/23/13 16:12:37	30480	12.71	19.20	0.06	5.65	42.40	1,518.01	243.25
10/23/13 16:13:07	30510	12.81	13.74	0.06	5.51	43.10	1,524.72	244.57
10/23/13 16:13:37	30540	12.68	16.09	0.03	5.58	42.75	1,533.98	243.98
10/23/13 16:14:07	30570	12.11	22.34	0.03	5.90	43.80	1,540.22	244.39
10/23/13 16:14:37	30600	11.37	18.93	0.03	6.49	43.45	1,539.93	245.27
10/23/13 16:15:07	30630	11.88	13.94	0.07	6.22	43.80	1,544.10	243.73
10/23/13 16:15:37	30660	11.81	14.48	0.06	6.19	43.45	1,549.87	244.21
10/23/13 16:16:07	30690	11.76	15.49	0.02	6.24	44.16	1,551.77	244.67
10/23/13 16:16:37	30720	11.97	21.49	0.01	6.14	43.10	1,513.59	244.14
10/23/13 16:17:07	30750	11.54	23.05	0.05	6.34	44.16	1,459.98	244.30
10/23/13 16:17:37	30780	11.65	12.18	0.03	6.27	43.45	1,507.67	244.67
10/23/13 16:18:07	30810	11.43	8.29	0.02	6.53	44.16	1,537.58	244.54
10/23/13 16:18:37	30840	11.44	12.51	0.07	6.48	43.10	1,550.96	244.56
10/23/13 16:19:07	30870	11.37	13.28	0.10	6.52	6.16	1,502.32	83.35
10/23/13 16:19:37	30900	11.38	6.13	0.06	6.60	5.45	1,410.66	82.98
10/23/13 16:20:07	30930	11.50	3.43	0.09	6.42	5.81	1,366.74	83.03
10/23/13 16:20:37	30960	11.48	2.81	0.05	6.44	4.75	1,331.53	81.56
10/23/13 16:21:07	30990	11.73	3.37	0.08	6.32	4.75	1,304.19	81.65
10/23/13 16:21:37	31020	13.94	4.66	0.05	5.23	5.81	1,284.95	83.01
10/23/13 16:22:07	31050	14.81	30.51	0.07	3.82	5.45	1,270.69	83.28
10/23/13 16:22:37	31080	13.55	24.82	0.12	4.82	42.05	1,283.00	239.10
10/23/13 16:23:07	31110	13.62	5.79	0.06	4.93	41.69	1,367.94	239.31
10/23/13 16:23:37	31140	13.75	5.49	0.05	4.77	42.05	1,440.77	238.58
10/23/13 16:24:07	31170	13.67	5.43	0.05	4.80	42.05	1,492.27	239.31
10/23/13 16:24:37	31200	13.86	5.84	0.05	4.69	41.34	1,520.57	239.40
10/23/13 16:25:07	31230	14.85	12.66	0.03	4.00	42.40	1,529.59	239.14
10/23/13 16:25:37	31260	11.21	53.69	0.12	6.34	42.40	1,533.74	240.22
10/23/13 16:26:07	31290	10.41	37.31	0.01	7.20	42.40	1,529.40	239.87
10/23/13 16:26:37	31320	10.36	23.14	0.05	7.20	42.75	1,522.62	238.71

John Zink Co, LLC
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John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	4.7	%
Stack Exhaust Flow (M2)	67,995	SCFH

Weather Data

Barometric Pressure	30.02	in. Hg
Relative Humidity	42	%
Ambient Temperature	67	°F
Specific Humidity	0.005861	lb H_2O / lb air

0-30-0 Load, Run - 2.5OD15 R2

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/23/13 16:27:07	31350	11.04	14.94	0.01	6.94	42.75	1,523.56	239.49
10/23/13 16:27:37	31380	11.69	9.40	0.01	6.30	41.69	1,525.28	240.13
10/23/13 16:28:07	31410	11.66	7.86	0.01	6.33	42.05	1,525.23	238.71
10/23/13 16:28:37	31440	12.02	9.63	0.01	6.16	42.40	1,526.53	239.32
10/23/13 16:29:07	31470	12.34	9.30	0.08	5.79	41.34	1,526.85	240.22
10/23/13 16:29:37	31500	12.34	8.14	0.08	5.87	41.69	1,526.74	239.71
10/23/13 16:30:07	31530	12.12	10.01	0.05	5.99	42.05	1,526.04	239.50
10/23/13 16:30:37	31560	12.47	11.53	0.06	5.75	40.99	1,529.03	239.63
10/23/13 16:31:07	31590	12.13	10.52	0.07	5.95	39.23	1,525.34	239.46
10/23/13 16:31:37	31620	12.12	7.77	0.04	5.97	40.64	1,525.89	239.89
10/23/13 16:32:07	31650	12.30	6.92	0.04	5.88	4.75	1,509.86	78.32
10/23/13 16:32:37	31680	12.32	7.88	0.03	5.84	4.75	1,417.94	78.60
10/23/13 16:33:07	31710	12.26	9.24	0.04	5.92	4.75	1,306.45	78.38
10/23/13 16:33:37	31740	12.23	8.03	0.06	5.91	4.40	1,164.79	78.72
10/23/13 16:34:07	31770	12.47	7.61	0.09	5.73	4.75	1,063.15	78.64
10/23/13 16:34:37	31800	12.43	8.43	0.05	5.80	4.40	988.38	78.53
RAW AVERAGE		**12.54**	**14.80**	**0.07**	**5.68**	**32.19**	**1,443.57**	**196.70**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	inst-22-0005	inst-co-0020	inst-vc-0003	inst-22-0005	F8_PRF1 (in. H_2O)	F8_TE5 (°F)	(SCFH)
Bias	Initial Zero	0.02	0.15	0.05	0.05			
	Final Zero	0.03	0.18	0.03	0.06			
	Avg. Zero	0.03	0.17	0.04	0.06			
	Initial UpScale	11.76	9.53	5.07	8.84			
	Final UpScale	11.85	9.28	5.05	8.82			
	Avg. UpScale	11.81	9.41	5.06	8.83			
Upscale Cal Gas		12.10	9.07	5.04	8.95			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.85	14.36	0.03	5.74
Corrected Raw Average (ppm/% wet basis)	12.24	13.68	0.03	5.46
Concentration (ppm@ 3%CO_2)	N/A	7.51	0.02	N/A
Emission Rate (lb/hr)	N/A	0.07	0.00	N/A

John Zink Co, LLC
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John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	4.7	%
Stack Exhaust Flow (M2)	177,398	SCFH

Weather Data

Barometric Pressure	30.27	in. Hg
Relative Humidity	80	%
Ambient Temperature	48	°F
Specific Humidity	0.005581	lb H_2O / lb air

0-30-0 Load, Run - 2.5OD15 R3

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 7:55:07	87030	15.13	2.10	0.18	4.39	4.40	1,152.95	77.63
10/24/13 7:55:37	87060	15.48	17.52	0.25	3.54	4.75	1,114.23	77.57
10/24/13 7:56:07	87090	15.12	11.88	0.26	3.94	5.10	1,094.76	77.31
10/24/13 7:56:37	87120	15.50	6.99	0.31	3.65	40.64	1,080.69	239.66
10/24/13 7:57:07	87150	15.92	10.76	0.37	3.36	42.05	1,101.18	238.10
10/24/13 7:57:37	87180	15.55	14.44	0.34	3.50	42.75	1,216.09	237.97
10/24/13 7:58:07	87210	15.43	18.32	0.36	3.64	42.05	1,309.89	238.78
10/24/13 7:58:37	87240	16.36	27.03	0.50	2.93	42.05	1,371.09	238.74
10/24/13 7:59:07	87270	11.14	37.19	0.18	6.26	42.40	1,403.99	238.14
10/24/13 7:59:37	87300	9.86	11.36	0.16	7.68	42.05	1,429.51	238.79
10/24/13 8:00:07	87330	10.28	2.69	0.16	7.52	40.99	1,446.12	239.05
10/24/13 8:00:37	87360	11.28	1.75	0.15	6.70	42.05	1,454.57	238.96
10/24/13 8:01:07	87390	11.09	1.41	0.19	6.84	40.64	1,464.62	239.05
10/24/13 8:01:37	87420	10.96	1.53	0.20	6.93	40.64	1,467.81	238.48
10/24/13 8:02:07	87450	11.27	1.36	0.17	6.70	41.69	1,469.98	238.87
10/24/13 8:02:37	87480	11.25	0.84	0.16	6.71	42.05	1,471.63	238.57
10/24/13 8:03:07	87510	11.40	0.75	0.23	6.69	42.05	1,469.44	237.75
10/24/13 8:03:37	87540	11.59	0.87	0.20	6.46	41.69	1,470.32	237.36
10/24/13 8:04:07	87570	11.56	0.95	0.14	6.48	40.99	1,468.30	238.49
10/24/13 8:04:37	87600	11.57	0.85	0.16	6.48	40.64	1,466.56	238.10
10/24/13 8:05:07	87630	11.82	0.46	0.13	6.33	41.34	1,473.02	237.88
10/24/13 8:05:37	87660	11.81	0.33	0.16	6.31	41.69	1,477.10	238.14
10/24/13 8:06:07	87690	11.92	0.35	0.13	6.21	40.99	1,477.14	238.06
10/24/13 8:06:37	87720	11.73	0.30	0.16	6.34	40.64	1,475.50	237.49
10/24/13 8:07:07	87750	11.57	0.16	0.18	6.49	40.99	1,475.94	238.96
10/24/13 8:07:37	87780	11.80	0.25	0.15	6.30	40.64	1,475.21	238.61
10/24/13 8:08:07	87810	11.81	0.42	0.12	6.32	5.10	1,474.31	81.03
10/24/13 8:08:37	87840	11.86	0.39	0.08	6.27	4.75	1,418.20	81.19
10/24/13 8:09:07	87870	11.93	0.33	0.12	6.20	5.45	1,319.32	80.90
10/24/13 8:09:37	87900	11.93	0.34	0.15	6.20	4.75	1,269.97	81.28
10/24/13 8:10:07	87930	12.77	0.38	0.11	6.04	4.75	1,238.39	81.18
10/24/13 8:10:37	87960	15.99	6.08	0.19	3.19	5.10	1,201.25	80.86
10/24/13 8:11:07	87990	14.68	9.39	0.22	4.25	42.75	1,169.18	252.82
10/24/13 8:11:37	88020	14.60	4.37	0.20	4.14	44.51	1,165.20	244.54
10/24/13 8:12:07	88050	15.01	5.78	0.23	4.12	41.34	1,245.78	242.30
10/24/13 8:12:37	88080	15.68	7.78	0.29	3.48	42.40	1,311.36	242.83
10/24/13 8:13:07	88110	16.22	12.52	1.11	3.31	40.99	1,345.62	242.21
10/24/13 8:13:37	88140	13.73	41.14	0.20	4.41	41.69	1,368.55	242.87
10/24/13 8:14:07	88170	12.63	24.61	0.14	5.72	40.99	1,382.39	242.61
10/24/13 8:14:37	88200	12.82	4.80	0.12	5.59	42.05	1,389.67	241.89
10/24/13 8:15:07	88230	12.75	3.43	0.09	5.62	41.34	1,398.65	242.28
10/24/13 8:15:37	88260	12.71	3.02	0.08	5.67	42.05	1,404.09	242.24
10/24/13 8:16:07	88290	12.87	2.88	0.12	5.56	41.34	1,408.88	241.80
10/24/13 8:16:37	88320	12.75	2.76	0.12	5.62	40.64	1,411.96	242.38
10/24/13 8:17:07	88350	12.71	2.62	0.08	5.67	40.64	1,417.00	243.08
10/24/13 8:17:37	88380	12.70	2.64	0.07	5.65	40.99	1,416.89	242.33
10/24/13 8:18:07	88410	12.80	2.98	0.11	5.58	40.99	1,417.92	243.03
10/24/13 8:18:37	88440	12.50	3.29	0.12	5.79	41.34	1,419.03	242.33
10/24/13 8:19:07	88470	12.74	2.96	0.07	5.67	40.64	1,416.71	242.90
10/24/13 8:19:37	88500	12.79	3.22	0.09	5.58	42.05	1,419.35	242.38
10/24/13 8:20:07	88530	12.74	3.21	0.11	5.64	40.64	1,419.96	242.72
10/24/13 8:20:37	88560	12.75	3.07	0.10	5.63	41.69	1,418.13	241.89

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	4.7	%
Stack Exhaust Flow (M2)	177,398	SCFH

Weather Data

Barometric Pressure	30.27	in. Hg
Relative Humidity	80	%
Ambient Temperature	48	°F
Specific Humidity	0.005581	lb H_2O / lb air

0-30-0 Load, Run - 2.5OD15 R3

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 8:21:07	88590	12.70	3.43	0.09	5.65	42.40	1,422.24	242.59
10/24/13 8:21:37	88620	12.83	3.35	0.09	5.58	42.40	1,424.93	242.15
10/24/13 8:22:07	88650	12.94	3.72	0.11	5.53	41.34	1,427.98	242.33
10/24/13 8:22:37	88680	12.66	4.03	0.10	5.64	4.75	1,146.81	77.65
10/24/13 8:23:07	88710	12.60	3.66	0.08	5.72	4.75	1,134.04	92.13
10/24/13 8:23:37	88740	12.49	3.43	0.09	5.77	40.29	1,121.41	240.93
10/24/13 8:24:07	88770	12.48	3.38	0.05	5.81	39.93	1,173.42	240.49
10/24/13 8:24:37	88800	12.53	3.33	0.05	5.78	39.93	1,279.99	240.43
10/24/13 8:25:07	88830	16.44	7.86	0.30	3.45	39.93	1,352.06	240.97
10/24/13 8:25:37	88860	15.84	26.53	0.24	3.23	40.29	1,385.80	240.53
10/24/13 8:26:07	88890	15.35	16.99	0.17	3.67	39.93	1,403.38	240.62
10/24/13 8:26:37	88920	15.35	14.38	0.19	3.75	40.64	1,419.49	241.17
10/24/13 8:27:07	88950	15.15	19.02	0.20	3.87	40.64	1,429.65	240.58
10/24/13 8:27:37	88980	15.36	24.39	0.21	3.62	40.64	1,432.88	241.37
10/24/13 8:28:07	89010	15.35	27.91	0.25	3.77	40.64	1,444.80	240.29
10/24/13 8:28:37	89040	15.52	40.25	0.30	3.30	39.58	1,451.59	241.08
10/24/13 8:29:07	89070	11.29	48.52	0.08	6.50	39.58	1,452.26	241.17
10/24/13 8:29:37	89100	11.22	16.14	0.05	6.81	39.58	1,455.96	239.99
10/24/13 8:30:07	89130	11.99	6.39	0.04	6.22	40.29	1,458.48	240.69
10/24/13 8:30:37	89160	12.09	4.96	0.05	6.11	39.93	1,442.31	240.53
10/24/13 8:31:07	89190	12.14	3.85	0.07	6.01	39.58	1,443.17	240.76
10/24/13 8:31:37	89220	12.20	4.10	0.09	6.04	41.34	1,450.08	239.77
10/24/13 8:32:07	89250	12.46	3.53	0.04	5.82	40.64	1,450.04	240.87
10/24/13 8:32:37	89280	12.23	2.97	0.03	5.93	40.29	1,461.76	241.00
10/24/13 8:33:07	89310	12.07	2.74	0.04	6.11	41.34	1,470.71	240.63
10/24/13 8:33:37	89340	12.30	3.05	0.05	5.95	39.93	1,475.14	239.86
10/24/13 8:34:07	89370	12.37	2.81	0.03	5.90	39.93	1,476.90	240.54
10/24/13 8:34:37	89400	12.20	2.37	0.03	5.96	40.64	1,479.52	239.77
10/24/13 8:35:07	89430	12.38	2.40	0.06	5.91	40.29	1,477.73	239.90
10/24/13 8:35:37	89460	12.41	2.16	0.06	5.82	40.29	1,478.29	240.45
10/24/13 8:36:07	89490	12.40	2.39	0.03	5.93	39.58	1,475.11	240.12
10/24/13 8:36:37	89520	12.66	2.33	0.02	5.70	40.64	1,467.15	240.69
10/24/13 8:37:07	89550	12.41	1.75	0.02	5.84	39.93	1,471.69	223.70
10/24/13 8:37:37	89580	12.29	1.68	0.05	5.90	5.81	1,478.06	85.96
10/24/13 8:38:07	89610	12.47	1.93	0.03	5.83	4.40	1,425.16	79.44
10/24/13 8:38:37	89640	12.44	2.50	0.03	5.88	4.40	1,325.96	77.58
10/24/13 8:39:07	89670	12.22	2.71	0.02	6.01	4.75	1,264.66	77.36
10/24/13 8:39:37	89700	12.64	2.61	0.01	5.69	4.75	1,226.98	79.35
10/24/13 8:40:07	89730	12.40	3.18	0.01	5.86	4.40	1,202.84	77.60
10/24/13 8:40:37	89760	12.73	2.99	0.01	5.67	35.71	1,178.88	241.63
10/24/13 8:41:07	89790	12.75	2.93	0.02	5.70	39.93	1,169.67	243.05
10/24/13 8:41:37	89820	12.91	3.09	0.03	5.45	39.23	1,242.97	242.13
10/24/13 8:42:07	89850	12.34	3.16	0.04	5.91	40.29	1,310.80	242.71
10/24/13 8:42:37	89880	13.79	3.13	0.05	5.28	39.23	1,355.32	241.28
10/24/13 8:43:07	89910	16.46	19.19	0.12	2.92	39.23	1,381.60	241.60
10/24/13 8:43:37	89940	15.19	30.52	0.11	3.90	38.88	1,403.90	241.63
10/24/13 8:44:07	89970	15.36	8.57	0.13	3.70	38.88	1,420.95	241.11
10/24/13 8:44:37	90000	15.23	7.73	0.12	3.70	38.88	1,435.07	242.21
10/24/13 8:45:07	90030	15.19	11.88	0.18	4.00	39.93	1,445.11	241.02
10/24/13 8:45:37	90060	16.72	21.09	0.72	2.82	39.93	1,451.74	241.68
10/24/13 8:46:07	90090	14.09	63.61	0.10	4.21	40.29	1,456.39	241.11
10/24/13 8:46:37	90120	12.81	59.20	0.08	5.60	39.58	1,453.62	242.25

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	4.7	%
Stack Exhaust Flow (M2)	177,398	SCFH

Weather Data

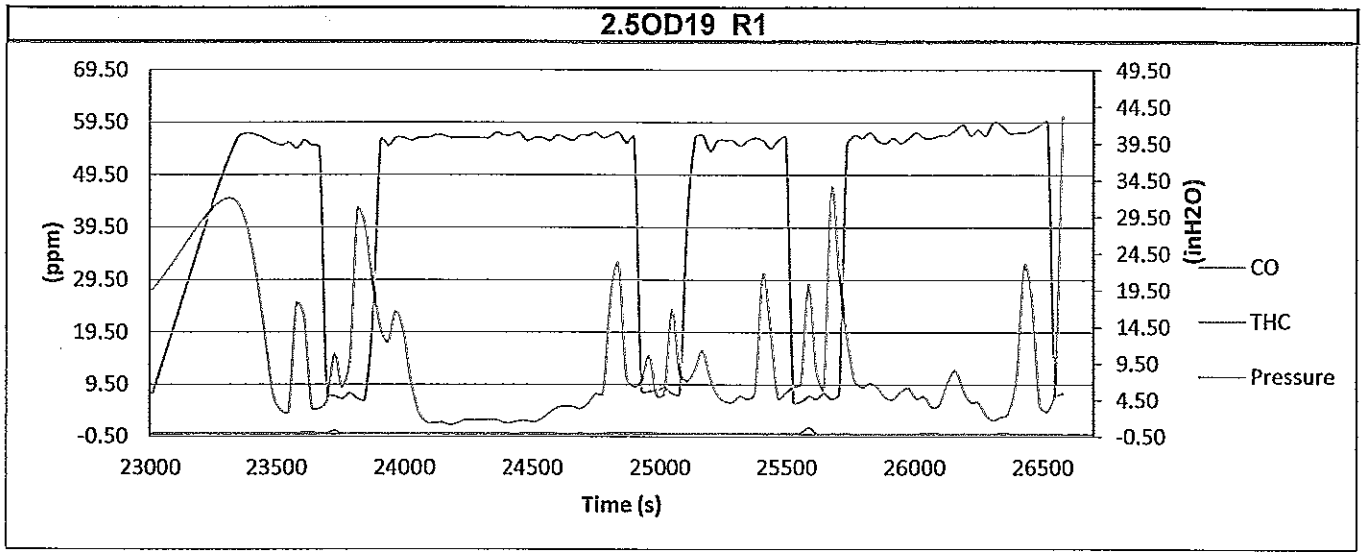
Barometric Pressure	30.27	in. Hg
Relative Humidity	80	%
Ambient Temperature	48	°F
Specific Humidity	0.005581	lb H_2O / lb air

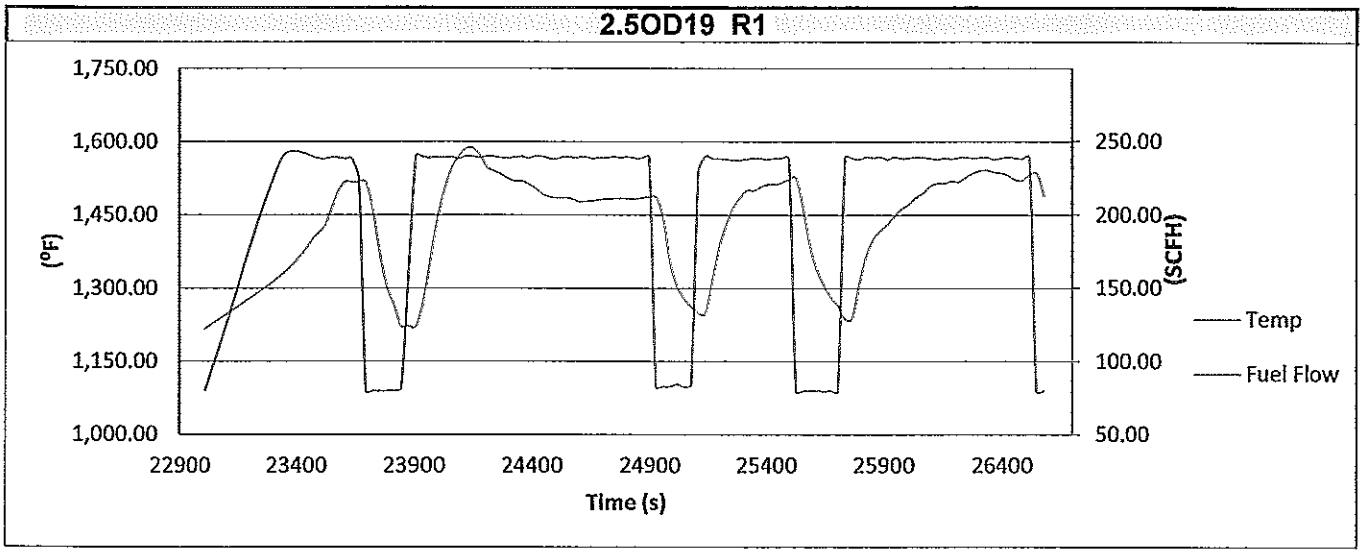
0-30-0 Load, Run - 2.5OD15 R3

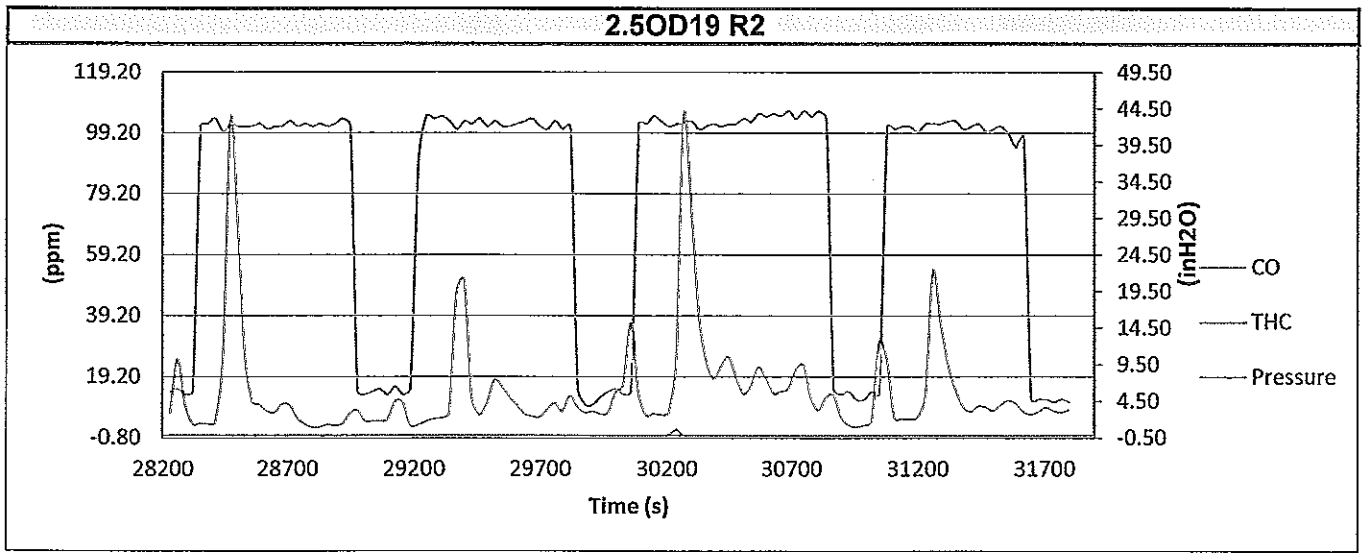
Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 8:47:07	90150	12.77	26.59	0.07	5.61	38.88	1,452.05	241.06
10/24/13 8:47:37	90180	12.98	15.66	0.08	5.51	39.23	1,457.58	242.12
10/24/13 8:48:07	90210	12.81	10.51	0.06	5.55	38.53	1,467.60	241.11
10/24/13 8:48:37	90240	12.80	9.10	0.06	5.55	40.29	1,471.17	241.41
10/24/13 8:49:07	90270	12.35	7.78	0.02	5.90	39.58	1,465.76	241.11
10/24/13 8:49:37	90300	12.28	5.06	0.03	5.94	4.75	1,464.02	84.29
10/24/13 8:50:07	90330	12.52	3.83	0.02	5.86	5.45	1,447.61	85.89
10/24/13 8:50:37	90360	12.44	3.69	0.02	5.83	5.10	1,360.52	84.26
10/24/13 8:51:07	90390	12.84	4.07	0.05	5.63	4.75	1,297.93	85.54
10/24/13 8:51:37	90420	12.87	3.56	0.05	5.55	5.45	1,255.25	83.88
10/24/13 8:52:07	90450	12.91	3.03	0.05	5.50	5.45	1,223.71	84.30
10/24/13 8:52:37	90480	12.76	2.96	0.06	5.64	4.75	1,207.02	83.88
10/24/13 8:53:07	90510	12.71	4.23	0.07	5.65	5.10	1,178.59	83.89
10/24/13 8:53:37	90540	12.82	4.85	0.07	5.61	5.45	1,160.45	83.88
10/24/13 8:54:07	90570	12.96	3.59	0.06	5.50	5.45	1,149.10	85.57
10/24/13 8:54:37	90600	13.00	3.54	0.01	5.49	4.75	1,136.20	84.14
RAW AVERAGE		**13.08**	**8.41**	**0.13**	**5.39**	**32.35**	**1,368.39**	**203.64**

		CO_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	inst-22-0005	inst-co-0020	inst-vc-0003	inst-22-0005	F8_PRF1	F8_TE5	
		(%)	(ppmvd)	(ppmvw)	(%)	(in. H_2O)	(°F)	(SCFH)
Bias	Initial Zero	0.17	0.29	0.03	0.09			
	Final Zero	0.13	0.30	0.04	0.05			
	Avg. Zero	0.15	0.30	0.04	0.07			
	Initial UpScale	11.88	8.78	5.04	8.82			
	Final UpScale	11.88	8.95	4.96	8.87			
	Avg. UpScale	11.88	8.87	5.00	8.85			
Upscale Cal Gas		12.10	9.07	5.04	8.95			

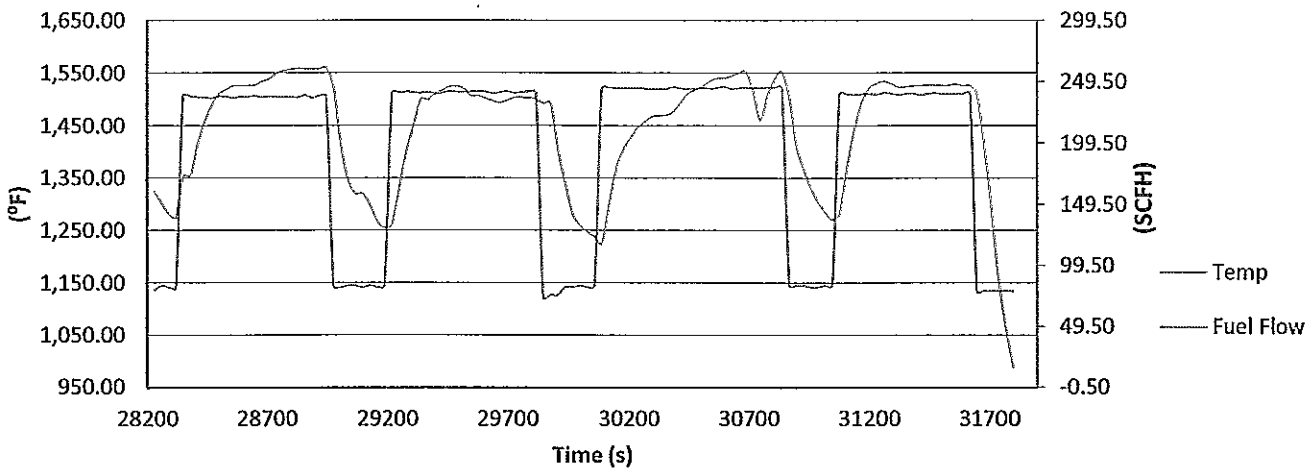
EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	13.33	8.58	0.11	5.42
Corrected Raw Average (ppm/% wet basis)	12.69	8.16	0.09	5.16
Concentration (ppm@ 3%CO_2)	N/A	4.75	0.06	N/A
Emission Rate (lb/hr)	N/A	0.11	0.00	N/A


2.5OD19 R1
69.50
59.50
49.50
39.50
29.50
19.50
9.50
-0.50
(ppm)
49.50
44.50
39.50
34.50
29.50
24.50
19.50
14.50
9.50
4.50
-0.50
(inH2O)
23000
23500
24000
24500
25000
25500
26000
26500
Time (s)
CO
THC
Pressure

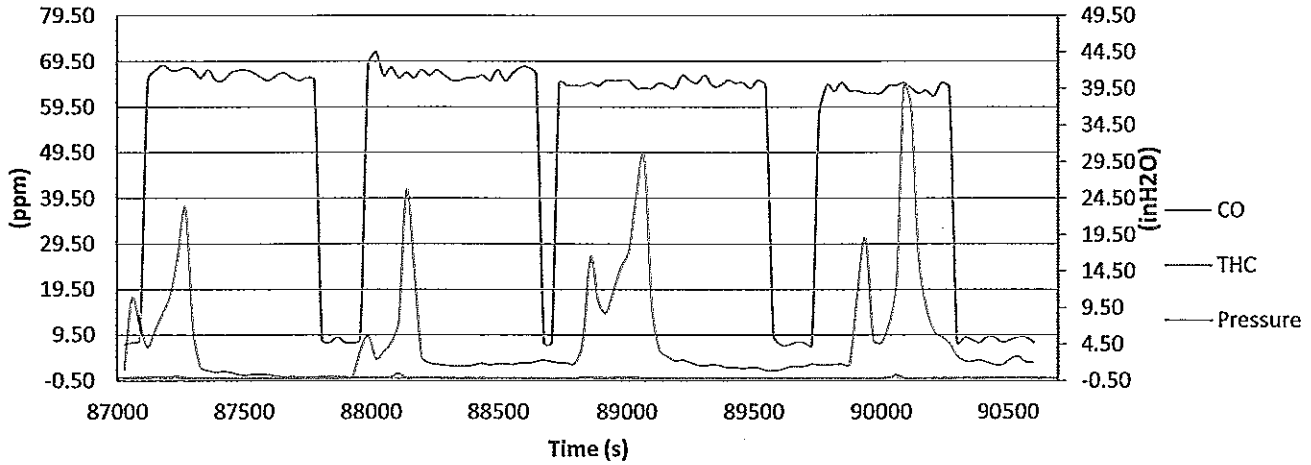

2.5OD19 R1
1,750.00
1,600.00
1,450.00
1,300.00
1,150.00
1,000.00
(°F)
250.00
200.00
150.00
100.00
50.00
(SCFH)
22900
23400
23900
24400
24900
25400
25900
26400
Time (s)
Temp
Fuel Flow


2.5OD19 R2
119.20
99.20
79.20
59.20
39.20
19.20
-0.80
(ppm)
49.50
44.50
39.50
34.50
29.50
24.50
19.50
14.50
9.50
4.50
-0.50
(inH2O)
28200
28700
29200
29700
30200
30700
31200
31700
Time (s)
CO
THC
Pressure

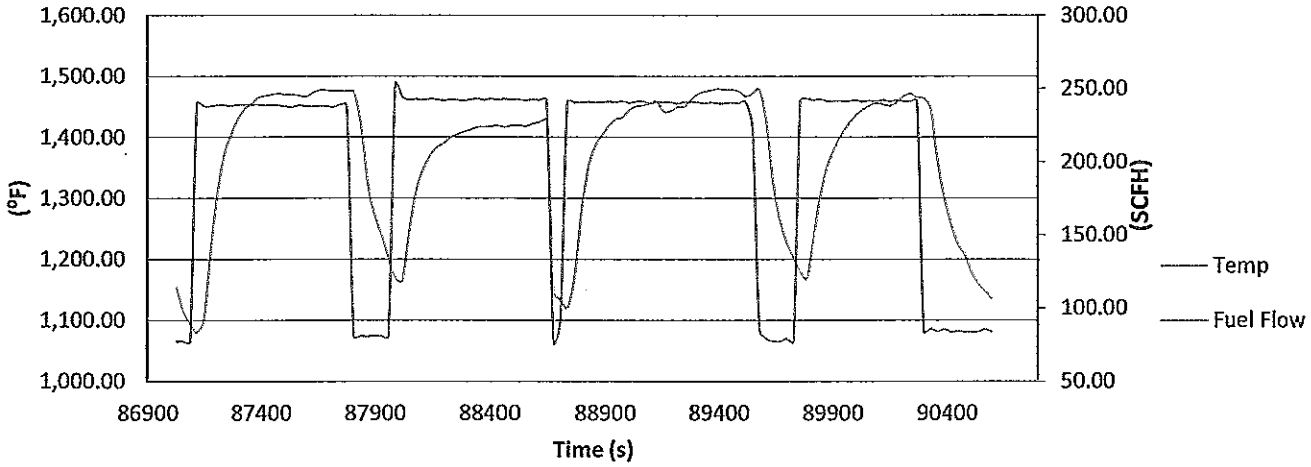
2.5OD19 R2



2.5OD19 R3



2.5OD19 R3



John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.9	%
Stack Exhaust Flow (M2)	177,398	SCFH

Weather Data

Barometric Pressure	30.29	in. Hg
Relative Humidity	72	%
Ambient Temperature	46	°F
Specific Humidity	0.004648	lb H_2O / lb air

30-70-30 Load, Run - 2.5OD15 R4

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 9:16:07	91890	12.70	5.05	0.05	5.68	49.79	1,488.58	246.76
10/24/13 9:16:37	91920	12.69	5.33	0.05	5.68	48.73	1,482.03	247.37
10/24/13 9:17:07	91950	12.70	5.17	0.03	5.70	63.51	1,478.11	343.72
10/24/13 9:17:37	91980	12.69	5.27	0.02	5.72	226.06	1,438.64	563.25
10/24/13 9:18:07	92010	12.86	5.25	0.05	5.58	255.97	1,436.21	564.85
10/24/13 9:18:37	92040	12.98	7.17	0.04	5.49	259.84	1,549.99	564.02
10/24/13 9:19:07	92070	13.43	8.77	0.26	5.41	257.02	1,610.40	562.44
10/24/13 9:19:37	92100	15.09	34.07	0.45	3.83	255.61	1,638.33	562.79
10/24/13 9:20:07	92130	12.35	61.76	0.04	5.78	251.04	1,646.28	560.57
10/24/13 9:20:37	92160	12.28	11.49	0.04	5.99	249.98	1,653.37	561.75
10/24/13 9:21:07	92190	12.25	2.55	0.06	6.04	252.80	1,665.00	561.33
10/24/13 9:21:37	92220	12.32	2.26	0.05	6.01	253.50	1,663.23	563.44
10/24/13 9:22:07	92250	12.39	2.16	0.03	5.89	251.39	1,669.55	561.03
10/24/13 9:22:37	92280	12.11	2.31	0.03	6.11	251.74	1,673.45	562.30
10/24/13 9:23:07	92310	12.25	2.09	0.03	6.06	254.21	1,670.26	560.43
10/24/13 9:23:37	92340	12.00	2.35	0.03	6.21	249.98	1,662.74	562.64
10/24/13 9:24:07	92370	12.11	1.56	0.02	6.10	253.50	1,667.55	562.25
10/24/13 9:24:37	92400	12.37	1.30	0.03	6.02	255.61	1,670.44	562.35
10/24/13 9:25:07	92430	12.83	1.29	0.01	5.62	256.67	1,672.75	561.78
10/24/13 9:25:37	92460	12.49	1.34	0.02	5.78	253.50	1,675.25	561.67
10/24/13 9:26:07	92490	12.38	1.56	0.06	5.98	254.21	1,677.06	559.07
10/24/13 9:26:37	92520	12.49	4.66	0.03	5.84	258.78	1,675.33	562.44
10/24/13 9:27:07	92550	12.35	9.45	0.04	5.95	201.43	1,678.43	343.13
10/24/13 9:27:37	92580	12.22	7.10	0.06	6.03	52.25	1,674.75	245.79
10/24/13 9:28:07	92610	12.63	2.75	0.04	5.82	48.73	1,560.78	246.35
10/24/13 9:28:37	92640	12.39	2.15	0.05	5.89	48.73	1,488.44	245.37
10/24/13 9:29:07	92670	12.38	1.81	0.05	5.94	49.43	1,480.94	245.84
10/24/13 9:29:37	92700	13.84	2.46	0.18	5.19	49.43	1,476.17	246.39
10/24/13 9:30:07	92730	15.07	30.24	0.30	3.82	50.14	1,478.13	246.48
10/24/13 9:30:37	92760	13.45	54.21	0.03	5.15	49.08	1,480.86	246.17
10/24/13 9:31:07	92790	13.44	15.24	0.05	5.14	49.43	1,481.71	246.48
10/24/13 9:31:37	92820	13.30	9.38	0.04	5.27	49.08	1,486.60	245.79
10/24/13 9:32:07	92850	13.18	5.72	0.06	5.30	49.43	1,495.64	246.24
10/24/13 9:32:37	92880	13.32	4.80	0.07	5.25	177.86	1,481.78	553.38
10/24/13 9:33:07	92910	12.97	7.51	0.06	5.44	251.04	1,399.35	557.93
10/24/13 9:33:37	92940	12.80	6.45	0.04	5.66	256.67	1,447.79	560.02
10/24/13 9:34:07	92970	13.15	5.13	0.05	5.40	255.61	1,526.58	559.84
10/24/13 9:34:37	93000	15.47	10.46	2.36	4.06	254.21	1,567.86	559.23
10/24/13 9:35:07	93030	14.69	81.87	0.61	3.98	259.13	1,594.29	558.61
10/24/13 9:35:37	93060	13.63	60.18	0.08	5.04	257.37	1,630.31	558.62
10/24/13 9:36:07	93090	13.48	14.61	0.04	5.20	259.13	1,642.60	556.86
10/24/13 9:36:37	93120	13.53	8.93	0.04	5.07	255.26	1,658.72	557.38
10/24/13 9:37:07	93150	12.79	11.44	0.02	5.59	259.84	1,662.94	557.00
10/24/13 9:37:37	93180	12.96	8.41	0.02	5.59	254.91	1,666.94	558.97
10/24/13 9:38:07	93210	12.74	8.13	0.02	5.67	258.43	1,674.08	556.58
10/24/13 9:38:37	93240	12.95	3.86	0.02	5.52	259.84	1,676.56	555.76
10/24/13 9:39:07	93270	12.81	1.88	0.05	5.62	255.61	1,675.22	558.47
10/24/13 9:39:37	93300	12.85	1.73	0.05	5.64	259.48	1,679.49	557.99
10/24/13 9:40:07	93330	12.88	1.33	0.04	5.59	254.91	1,679.64	557.87
10/24/13 9:40:37	93360	13.04	1.25	0.04	5.51	254.91	1,674.53	556.42
10/24/13 9:41:07	93390	13.13	1.28	0.01	5.43	256.67	1,674.53	556.94
10/24/13 9:41:37	93420	12.98	1.29	0.02	5.46	257.72	1,672.77	556.21

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.9	%
Stack Exhaust Flow (M2)	177,398	SCFH

Weather Data

Barometric Pressure	30.29	in. Hg
Relative Humidity	72	%
Ambient Temperature	46	°F
Specific Humidity	0.004648	lb H_2O / lb air

30-70-30 Load, Run - 2.5OD15 R4

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 9:42:07	93450	12.86	1.15	0.02	5.63	252.45	1,669.43	477.81
10/24/13 9:42:37	93480	13.07	1.07	0.02	5.47	58.93	1,674.62	249.91
10/24/13 9:43:07	93510	13.04	1.66	0.02	5.45	48.38	1,509.69	242.11
10/24/13 9:43:37	93540	13.13	1.89	0.03	5.46	49.08	1,514.57	241.58
10/24/13 9:44:07	93570	13.05	1.56	0.03	5.46	49.08	1,517.50	242.90
10/24/13 9:44:37	93600	13.86	1.81	0.09	5.18	47.32	1,519.14	242.15
10/24/13 9:45:07	93630	15.70	22.32	0.50	3.39	48.03	1,521.10	242.11
10/24/13 9:45:37	93660	13.90	61.49	0.06	4.80	49.08	1,522.26	241.93
10/24/13 9:46:07	93690	14.06	16.95	0.05	4.71	47.32	1,522.26	242.42
10/24/13 9:46:37	93720	13.81	11.46	0.04	4.87	48.03	1,518.36	243.02
10/24/13 9:47:07	93750	13.36	9.34	0.03	5.19	146.89	1,507.72	537.39
10/24/13 9:47:37	93780	13.61	7.44	0.02	5.11	253.85	1,421.13	568.83
10/24/13 9:48:07	93810	13.53	11.07	0.01	5.03	268.63	1,487.43	569.59
10/24/13 9:48:37	93840	13.64	14.30	0.02	5.05	265.82	1,583.23	568.85
10/24/13 9:49:07	93870	13.45	12.10	0.05	5.13	266.17	1,628.13	568.43
10/24/13 9:49:37	93900	15.41	15.57	0.96	4.05	269.69	1,650.23	566.53
10/24/13 9:50:07	93930	14.31	76.05	0.19	4.17	272.50	1,672.50	568.35
10/24/13 9:50:37	93960	12.33	56.50	0.05	5.96	272.50	1,672.50	566.01
10/24/13 9:51:07	93990	12.68	9.17	0.05	5.74	267.58	1,702.77	567.49
10/24/13 9:51:37	94020	13.24	5.96	0.08	5.42	270.39	1,718.66	569.10
10/24/13 9:52:07	94050	13.16	7.87	0.02	5.39	273.56	1,731.84	568.48
10/24/13 9:52:37	94080	13.29	9.32	0.03	5.26	272.85	1,743.34	567.85
10/24/13 9:53:07	94110	12.57	12.05	0.04	5.78	269.34	1,726.02	566.56
10/24/13 9:53:37	94140	12.58	13.55	0.02	5.79	271.80	1,733.22	568.27
10/24/13 9:54:07	94170	12.20	6.91	0.02	6.01	270.39	1,742.75	567.64
10/24/13 9:54:37	94200	11.88	2.56	0.02	6.31	274.61	1,758.11	566.92
10/24/13 9:55:07	94230	12.52	5.36	0.04	5.91	275.32	1,761.56	566.17
10/24/13 9:55:37	94260	12.89	8.46	0.05	5.59	271.80	1,761.56	566.08
10/24/13 9:56:07	94290	12.86	3.44	0.04	5.58	77.23	1,756.45	247.92
10/24/13 9:56:37	94320	12.46	1.66	0.04	5.86	49.79	1,591.85	244.59
10/24/13 9:57:07	94350	12.12	1.62	0.05	6.05	50.14	1,591.85	244.59
10/24/13 9:57:37	94380	11.92	1.68	0.04	6.33	49.43	1,580.75	244.07
10/24/13 9:58:07	94410	12.39	1.76	0.01	5.92	49.43	1,580.29	243.76
10/24/13 9:58:37	94440	13.03	2.63	0.02	5.70	50.84	1,576.38	245.39
10/24/13 9:59:07	94470	15.54	10.57	0.04	3.83	49.79	1,573.43	244.76
10/24/13 9:59:37	94500	13.76	45.56	0.02	4.73	51.19	1,570.19	245.61
10/24/13 10:00:07	94530	13.50	20.34	0.02	5.06	49.43	1,572.08	244.59
10/24/13 10:00:37	94560	13.44	8.71	0.01	5.20	49.43	1,572.08	244.76
10/24/13 10:01:07	94590	13.48	7.88	0.05	5.09	120.51	1,562.43	482.80
10/24/13 10:01:37	94620	13.40	9.68	0.05	5.21	247.17	1,475.07	556.85
10/24/13 10:02:07	94650	13.23	8.54	0.04	5.29	260.54	1,502.63	558.10
10/24/13 10:02:37	94680	12.75	5.93	0.04	5.62	257.72	1,502.63	558.21
10/24/13 10:03:07	94710	12.82	6.25	0.01	5.66	259.48	1,586.56	559.14
10/24/13 10:03:37	94740	14.73	7.07	0.47	4.58	260.89	1,662.54	556.77
10/24/13 10:04:07	94770	15.16	49.08	0.23	3.68	264.06	1,738.76	559.60
10/24/13 10:04:37	94800	12.48	84.58	0.05	5.65	265.82	1,753.94	556.57
10/24/13 10:05:07	94830	11.43	22.00	-0.01	6.57	268.28	1,767.89	559.28
10/24/13 10:05:37	94860	11.86	5.77	-0.01	6.41	264.76	1,772.93	558.27
10/24/13 10:06:07	94890	12.09	4.35	0.02	6.14	265.47	1,772.93	558.58
10/24/13 10:06:37	94920	12.04	4.62	0.02	6.20	265.47	1,779.34	557.22
10/24/13 10:07:07	94950	12.08	4.35	0.04	6.19	266.17	1,784.50	557.12
10/24/13 10:07:37	94980	12.48	3.86	0.03	5.84	267.22	1,787.47	557.53

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.9	%
Stack Exhaust Flow (M2)	177,398	SCFH

Weather Data

Barometric Pressure	30.29	in. Hg
Relative Humidity	72	%
Ambient Temperature	46	°F
Specific Humidity	0.004648	lb H_2O / lb air

30-70-30 Load, Run - 2.5OD15 R4

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 10:08:07	95010	12.61	2.55	0.06	5.88	272.50	1,794.66	556.28
10/24/13 10:08:37	95040	12.54	3.14	0.07	5.72	273.91	1,803.57	558.58
10/24/13 10:09:07	95070	12.63	3.88	0.03	5.81	270.04	1,806.27	558.51
10/24/13 10:09:37	95100	12.45	4.07	0.03	5.91	271.80	1,807.15	557.77
10/24/13 10:10:07	95130	12.77	4.29	0.05	5.69	271.09	1,815.15	555.79
10/24/13 10:10:37	95160	12.71	4.49	0.05	5.71	273.91	1,809.33	558.40
10/24/13 10:11:07	95190	13.22	7.12	0.02	5.38	270.74	1,814.17	558.20
10/24/13 10:11:37	95220	13.20	5.03	0.03	5.33	61.40	1,816.49	226.00
10/24/13 10:12:07	95250	13.27	2.10	0.02	5.34	44.51	1,771.55	226.51
10/24/13 10:12:37	95280	12.97	1.86	0.02	5.48	44.51	1,656.13	226.51
10/24/13 10:13:07	95310	12.90	2.87	0.02	5.54	43.10	1,634.40	227.03
10/24/13 10:13:37	95340	13.33	2.80	0.02	5.47	44.86	1,623.68	227.07
10/24/13 10:14:07	95370	15.25	7.01	0.04	3.83	43.45	1,614.70	225.93
10/24/13 10:14:37	95400	13.46	27.59	0.04	5.11	44.86	1,603.53	226.29
10/24/13 10:15:07	95430	13.48	9.80	0.05	5.17	43.80	1,595.49	226.70
10/24/13 10:15:37	95460	13.18	3.97	0.06	5.30	43.80	1,599.49	226.01
RAW AVERAGE		**13.07**	**11.46**	**0.09**	**5.44**	**185.58**	**1,628.38**	**449.15**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	inst-22-0005	inst-co-0020	inst-vc-0003	inst-22-0005	F8_PRF1 (in. H_2O)	F8_TE5 (°F)	(SCFH)
Bias	Initial Zero	0.13	0.30	0.04	0.05			
	Final Zero	0.14	0.29	0.03	0.04			
	Avg. Zero	0.14	0.30	0.04	0.05			
	Initial UpScale	11.88	8.95	4.96	8.87			
	Final UpScale	11.89	8.75	4.95	8.89			
	Avg. UpScale	11.89	8.85	4.96	8.88			
Upscale Cal Gas		12.10	9.07	5.04	8.95			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	13.32	11.84	0.05	5.47
Corrected Raw Average (ppm/% wet basis)	12.39	11.00	0.05	5.09
Concentration (ppm@ 3%CO_2)	N/A	6.50	0.03	N/A
Emission Rate (lb/hr)	N/A	0.15	0.00	N/A

John Zink Co, LLC

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John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.1	%
Stack Exhaust Flow (M2)	201,888	SCFH

Weather Data

Barometric Pressure	30.32	In. Hg
Relative Humidity	50	%
Ambient Temperature	55	°F
Specific Humidity	0.004503	lb H_2O / lb air

30-70-30 Load, Run - 2.5OD15 R5

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 13:04:07	105570	12.27	0.12	0.01	5.98	44.16	1,429.64	246.57
10/24/13 13:04:37	105600	12.66	0.11	0.02	5.74	45.92	1,434.22	245.63
10/24/13 13:05:07	105630	12.57	0.33	0.02	5.72	48.73	1,434.36	246.52
10/24/13 13:05:37	105660	12.06	0.18	0.02	6.12	55.42	1,438.68	338.08
10/24/13 13:06:07	105690	12.20	0.29	0.04	6.03	239.78	1,455.03	557.39
10/24/13 13:06:37	105720	12.35	0.35	0.04	5.93	261.95	1,544.59	557.16
10/24/13 13:07:07	105750	12.16	0.21	0.03	6.05	257.37	1,591.38	557.80
10/24/13 13:07:37	105780	11.72	0.16	0.04	6.36	258.08	1,566.30	558.19
10/24/13 13:08:07	105810	9.89	0.06	0.06	7.27	255.61	1,556.07	555.39
10/24/13 13:08:37	105840	11.31	0.17	0.06	7.17	251.39	1,557.73	558.30
10/24/13 13:09:07	105870	12.79	0.30	-0.01	5.78	248.93	1,568.30	556.72
10/24/13 13:09:37	105900	12.88	0.75	0.04	5.58	248.22	1,579.03	554.74
10/24/13 13:10:07	105930	12.81	1.45	0.08	5.60	247.87	1,582.11	555.58
10/24/13 13:10:37	105960	12.69	1.16	0.05	5.73	242.95	1,579.72	556.86
10/24/13 13:11:07	105990	12.46	0.51	0.03	5.86	245.06	1,581.29	555.84
10/24/13 13:11:37	106020	12.52	1.01	0.04	5.83	241.19	1,583.01	556.77
10/24/13 13:12:07	106050	12.64	1.65	0.05	5.76	240.84	1,592.92	556.94
10/24/13 13:12:37	106080	12.54	1.44	0.04	5.78	241.54	1,597.56	555.98
10/24/13 13:13:07	106110	12.59	3.53	0.07	5.78	240.84	1,603.35	555.29
10/24/13 13:13:37	106140	12.26	5.07	0.04	6.01	240.13	1,598.65	557.25
10/24/13 13:14:07	106170	12.26	1.86	0.04	6.00	78.99	1,593.13	246.85
10/24/13 13:14:37	106200	12.25	0.65	0.04	6.00	46.62	1,608.90	248.40
10/24/13 13:15:07	106230	12.40	0.62	0.06	5.95	46.62	1,574.25	248.49
10/24/13 13:15:37	106260	12.57	0.76	0.06	5.80	46.27	1,481.30	247.17
10/24/13 13:16:07	106290	12.33	0.60	0.02	5.90	47.32	1,438.79	248.54
10/24/13 13:16:37	106320	10.67	0.39	0.02	7.25	47.32	1,424.22	247.35
10/24/13 13:17:07	106350	13.73	0.81	0.06	5.14	47.67	1,407.21	247.76
10/24/13 13:17:37	106380	13.97	4.95	0.03	4.68	46.62	1,414.42	246.73
10/24/13 13:18:07	106410	13.26	5.90	0.04	5.24	47.67	1,428.36	248.14
10/24/13 13:18:37	106440	13.72	4.15	0.05	5.03	48.38	1,445.26	247.07
10/24/13 13:19:07	106470	13.21	5.13	0.06	5.22	48.03	1,471.83	246.42
10/24/13 13:19:37	106500	12.68	3.68	0.06	5.69	48.03	1,493.82	246.42
10/24/13 13:20:07	106530	12.63	1.50	0.01	5.66	233.45	1,505.67	568.58
10/24/13 13:20:37	106560	11.52	1.11	0.02	6.48	268.28	1,540.43	569.01
10/24/13 13:21:07	106590	11.23	0.35	0.04	6.73	267.93	1,615.54	569.03
10/24/13 13:21:37	106620	11.29	0.12	0.02	6.71	268.63	1,649.42	566.41
10/24/13 13:22:07	106650	11.47	0.16	0.04	6.70	266.17	1,661.23	566.10
10/24/13 13:22:37	106680	11.84	0.31	0.04	6.24	263.71	1,661.77	568.21
10/24/13 13:23:07	106710	11.97	0.50	0.04	6.27	261.24	1,653.78	568.02
10/24/13 13:23:37	106740	11.86	1.15	0.05	6.30	264.76	1,640.07	566.54
10/24/13 13:24:07	106770	11.76	1.57	0.01	6.42	259.84	1,630.27	568.47
10/24/13 13:24:37	106800	12.13	0.86	0.00	6.11	262.30	1,621.70	566.49
10/24/13 13:25:07	106830	12.11	0.59	0.05	6.20	256.32	1,615.48	565.75
10/24/13 13:25:37	106860	12.32	0.61	0.04	5.97	255.97	1,615.46	565.88
10/24/13 13:26:07	106890	12.59	0.56	0.04	5.79	260.19	1,612.71	567.04
10/24/13 13:26:37	106920	12.52	0.69	0.04	5.83	257.02	1,607.30	568.86
10/24/13 13:27:07	106950	12.52	0.68	0.04	5.84	256.32	1,613.63	566.56
10/24/13 13:27:37	106980	12.47	0.62	0.05	5.88	256.32	1,621.35	568.25
10/24/13 13:28:07	107010	12.50	0.56	0.03	5.85	257.37	1,617.86	566.59
10/24/13 13:28:37	107040	12.49	0.56	0.04	5.83	258.08	1,613.67	567.67
10/24/13 13:29:07	107070	12.39	0.62	0.04	5.93	253.50	1,611.45	566.51

John Zink Co, LLC

ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.1	%
Stack Exhaust Flow (M2)	201,888	SCFH

Weather Data

Barometric Pressure	30.32	in. Hg
Relative Humidity	50	%
Ambient Temperature	55	°F
Specific Humidity	0.004503	lb H_2O / lb air

30-70-30 Load, Run - 2.5OD15 R5

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 13:29:37	107100	12.50	1.15	0.04	5.85	253.85	1,615.62	568.22
10/24/13 13:30:07	107130	12.54	4.17	0.05	5.82	150.41	1,624.23	229.97
10/24/13 13:30:37	107160	12.54	9.18	0.03	5.83	42.75	1,616.09	240.03
10/24/13 13:31:07	107190	12.48	7.55	0.03	5.83	41.69	1,553.18	239.68
10/24/13 13:31:37	107220	12.36	4.61	0.02	5.93	42.75	1,520.39	239.30
10/24/13 13:32:07	107250	12.34	10.23	0.01	6.00	43.45	1,517.41	239.43
10/24/13 13:32:37	107280	13.04	14.05	0.02	5.46	42.75	1,508.31	241.03
10/24/13 13:33:07	107310	12.50	8.57	0.01	5.77	43.80	1,489.42	239.43
10/24/13 13:33:37	107340	11.72	3.32	0.01	6.33	44.16	1,482.61	240.86
10/24/13 13:34:07	107370	11.86	1.15	0.03	6.37	43.10	1,487.39	240.37
10/24/13 13:34:37	107400	12.87	1.08	0.04	5.59	44.16	1,494.24	239.70
10/24/13 13:35:07	107430	12.58	2.37	0.02	5.73	43.80	1,495.54	239.22
10/24/13 13:35:37	107460	12.20	2.07	0.00	5.99	216.91	1,495.08	557.23
10/24/13 13:36:07	107490	12.12	1.16	0.04	6.04	258.43	1,514.88	556.42
10/24/13 13:36:37	107520	12.05	0.76	0.04	6.14	260.19	1,593.07	556.45
10/24/13 13:37:07	107550	12.18	0.75	0.04	6.02	263.35	1,652.41	559.35
10/24/13 13:37:37	107580	12.13	0.94	0.04	6.13	257.72	1,653.88	556.81
10/24/13 13:38:07	107610	12.03	0.95	0.01	6.06	260.54	1,641.40	557.42
10/24/13 13:38:37	107640	11.46	0.49	0.01	6.62	258.78	1,631.97	557.55
10/24/13 13:39:07	107670	11.66	0.26	0.04	6.56	258.08	1,626.91	558.69
10/24/13 13:39:37	107700	12.29	0.39	0.04	6.01	258.43	1,639.35	558.19
10/24/13 13:40:07	107730	12.39	0.50	0.01	5.93	253.85	1,640.90	558.61
10/24/13 13:40:37	107760	12.57	0.57	0.02	5.81	253.15	1,630.08	557.22
10/24/13 13:41:07	107790	12.37	0.62	0.04	5.88	255.26	1,617.94	556.94
10/24/13 13:41:37	107820	12.29	0.64	0.05	6.04	253.15	1,613.01	556.96
10/24/13 13:42:07	107850	12.37	0.57	0.06	5.94	255.26	1,617.68	558.50
10/24/13 13:42:37	107880	12.70	0.78	0.05	5.71	254.91	1,619.45	556.57
10/24/13 13:43:07	107910	12.56	0.58	0.05	5.81	253.15	1,625.37	559.16
10/24/13 13:43:37	107940	12.70	0.52	0.05	5.71	252.45	1,632.95	559.27
10/24/13 13:44:07	107970	12.66	0.71	0.06	5.74	250.34	1,637.35	557.85
10/24/13 13:44:37	108000	12.55	0.77	0.05	5.78	57.88	1,638.86	246.53
10/24/13 13:45:07	108030	12.36	0.53	0.06	5.95	44.51	1,643.79	247.37
10/24/13 13:45:37	108060	12.44	0.51	0.04	5.86	44.86	1,601.80	247.45
10/24/13 13:46:07	108090	12.49	0.80	0.03	5.92	45.56	1,552.98	246.15
10/24/13 13:46:37	108120	12.37	0.94	0.04	5.83	44.86	1,529.64	246.90
10/24/13 13:47:07	108150	11.36	0.82	0.00	6.77	45.21	1,529.17	246.20
10/24/13 13:47:37	108180	12.95	0.95	0.01	5.53	46.62	1,530.07	245.80
10/24/13 13:48:07	108210	12.85	1.55	0.04	5.55	46.27	1,529.34	246.57
10/24/13 13:48:37	108240	12.35	1.53	0.03	5.86	46.27	1,531.21	246.24
10/24/13 13:49:07	108270	12.07	1.03	0.02	6.12	45.56	1,532.50	246.57
10/24/13 13:49:37	108300	12.26	0.74	0.02	5.97	233.10	1,532.53	566.36
10/24/13 13:50:07	108330	12.01	0.95	0.03	6.16	269.34	1,559.84	566.39
10/24/13 13:50:37	108360	12.01	0.87	0.03	6.16	271.80	1,641.83	565.27
10/24/13 13:51:07	108390	11.86	0.75	0.03	6.26	271.09	1,703.71	564.54
10/24/13 13:51:37	108420	11.75	0.74	0.03	6.39	266.87	1,718.89	565.71
10/24/13 13:52:07	108450	12.17	0.75	0.04	6.01	265.82	1,715.16	565.61
10/24/13 13:52:37	108480	11.35	0.55	0.04	6.66	265.11	1,715.20	566.06
10/24/13 13:53:07	108510	11.31	0.46	0.04	6.78	263.35	1,715.64	564.60
10/24/13 13:53:37	108540	11.76	0.65	0.05	6.39	262.30	1,715.97	563.39
10/24/13 13:54:07	108570	11.61	0.65	0.02	6.50	263.35	1,704.91	564.95
10/24/13 13:54:37	108600	11.70	0.60	0.02	6.45	263.35	1,699.64	564.67

John Zink Co, LLC

ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.1	%
Stack Exhaust Flow (M2)	201,888	SCFH

Weather Data

Barometric Pressure	30.32	in. Hg
Relative Humidity	50	%
Ambient Temperature	55	°F
Specific Humidity	0.004503	lb H_2O / lb air

30-70-30 Load, Run - 2.5OD15 R5

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 13:55:07	108630	11.68	0.56	0.03	6.47	264.41	1,697.43	565.18
10/24/13 13:55:37	108660	11.93	0.56	0.04	6.29	263.71	1,684.16	563.97
10/24/13 13:56:07	108690	12.08	0.61	0.05	6.14	261.24	1,681.55	562.76
10/24/13 13:56:37	108720	11.92	0.68	0.04	6.29	261.95	1,675.87	561.31
10/24/13 13:57:07	108750	12.18	0.78	0.03	6.11	258.78	1,681.91	561.62
10/24/13 13:57:37	108780	12.11	0.72	0.04	6.07	259.48	1,676.12	558.55
10/24/13 13:58:07	108810	12.06	0.76	0.03	6.23	255.26	1,664.54	556.16
10/24/13 13:58:37	108840	12.00	0.76	0.04	6.17	252.45	1,650.06	556.72
10/24/13 13:59:07	108870	11.97	0.76	0.04	6.22	94.82	1,650.06	246.06
10/24/13 13:59:37	108900	12.30	0.77	0.04	6.03	45.56	1,662.52	245.79
10/24/13 14:00:07	108930	12.47	0.79	0.04	5.89	45.56	1,622.66	245.73
10/24/13 14:00:37	108960	12.26	0.77	0.04	6.00	44.51	1,560.07	245.57
10/24/13 14:01:07	108990	12.10	0.79	0.02	6.10	44.86	1,529.85	245.17
10/24/13 14:01:37	109020	11.54	0.78	0.01	6.68	44.51	1,519.17	243.99
10/24/13 14:02:07	109050	13.50	2.05	0.03	5.14	44.86	1,510.60	244.54
10/24/13 14:02:37	109080	13.13	5.30	0.03	5.32	45.56	1,504.21	244.08
10/24/13 14:03:07	109110	12.83	6.32	0.04	5.60	45.56	1,502.05	243.10
10/24/13 14:03:37	109140	12.79	5.24	0.04	5.62	44.51	1,498.27	242.33
RAW AVERAGE		**12.27**	**1.57**	**0.03**	**6.00**	**175.29**	**1,582.22**	**438.21**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	inst-22-0005	inst-co-0020	inst-vc-0003	inst-22-0005	F8_PRF1	F8_TE5	
		(%)	(ppmvd)	(ppmvw)	(%)	(in. H_2O)	(°F)	(SCFH)
Bias	Initial Zero	0.14	0.29	0.03	0.04			
	Final Zero	0.13	0.26	0.04	0.03			
	Avg. Zero	0.14	0.28	0.04	0.04			
	Initial UpScale	11.89	8.75	4.95	8.89			
	Final UpScale	11.89	8.76	4.94	8.90			
	Avg. UpScale	11.89	8.76	4.95	8.90			
Upscale Cal Gas		12.10	9.07	5.04	8.95			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.49	1.38	0.00	6.03
Concentration (ppm@ 3%CO_2)	N/A	0.69	0.00	N/A
Emission Rate (lb/hr)	N/A	0.02	0.00	N/A

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	5.6	%
Stack Exhaust Flow (M2)	219,690	SCFH

Weather Data

Barometric Pressure	30.36	In. Hg
Relative Humidity	48	%
Ambient Temperature	57	°F
Specific Humidity	0.004643	lb H_2O / lb air

30-70-30 Load, Run - 2.5OD15 R6

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 14:18:07	110010	11.61	1.29	0.00	6.38	48.38	1,575.75	248.33
10/24/13 14:18:37	110040	11.62	1.32	-0.04	6.43	49.08	1,579.12	248.73
10/24/13 14:19:07	110070	11.43	1.43	0.04	6.56	229.23	1,579.72	560.57
10/24/13 14:19:37	110100	11.34	1.64	0.04	6.66	266.52	1,595.96	557.27
10/24/13 14:20:07	110130	11.47	1.79	0.03	6.59	267.93	1,616.28	559.33
10/24/13 14:20:37	110160	10.94	1.68	0.03	6.87	265.11	1,601.90	559.94
10/24/13 14:21:07	110190	12.97	1.80	0.02	5.74	265.47	1,617.15	560.15
10/24/13 14:21:37	110220	13.07	1.76	0.01	5.50	259.48	1,629.80	559.84
10/24/13 14:22:07	110250	12.99	1.49	0.03	5.43	258.08	1,630.00	558.80
10/24/13 14:22:37	110280	12.57	0.86	0.03	5.77	255.97	1,633.61	558.71
10/24/13 14:23:07	110310	12.29	0.49	0.03	5.96	257.37	1,630.86	559.42
10/24/13 14:23:37	110340	12.64	0.37	0.03	5.80	258.78	1,630.86	556.74
10/24/13 14:24:07	110370	12.72	0.78	0.03	5.67	254.91	1,632.53	556.85
10/24/13 14:24:37	110400	12.74	1.20	0.03	5.70	255.26	1,625.95	556.68
10/24/13 14:25:07	110430	12.78	1.21	0.04	5.62	253.85	1,625.95	556.16
10/24/13 14:25:37	110460	12.69	1.08	0.03	5.73	255.26	1,612.70	559.25
10/24/13 14:26:07	110490	12.80	1.12	0.00	5.65	256.32	1,613.13	558.33
10/24/13 14:26:37	110520	12.76	0.96	0.02	5.63	253.15	1,613.48	558.43
10/24/13 14:27:07	110550	12.72	0.83	0.00	5.68	254.21	1,616.67	556.37
10/24/13 14:27:37	110580	12.81	0.65	-0.08	5.60	252.45	1,614.55	559.56
10/24/13 14:28:07	110610	12.68	1.00	-0.01	5.68	250.69	1,623.92	556.30
10/24/13 14:28:37	110640	12.54	0.70	0.02	5.81	253.15	1,623.92	556.09
10/24/13 14:29:07	110670	12.50	0.58	0.04	5.83	230.63	1,622.90	364.35
10/24/13 14:29:37	110700	12.54	0.59	0.04	5.80	40.99	1,620.97	239.23
10/24/13 14:30:07	110730	12.65	0.69	0.03	5.73	41.34	1,619.60	239.49
10/24/13 14:30:37	110760	12.51	0.69	0.03	5.84	42.05	1,619.60	238.77
10/24/13 14:31:07	110790	11.45	0.59	0.03	6.37	42.05	1,572.91	240.44
10/24/13 14:31:37	110820	12.49	0.67	0.04	6.08	41.34	1,538.33	239.79
10/24/13 14:32:07	110850	12.74	1.95	0.03	5.62	42.75	1,527.22	240.30
10/24/13 14:32:37	110880	12.60	4.42	0.03	5.75	42.40	1,542.58	240.04
10/24/13 14:33:07	110910	11.85	5.21	0.01	6.11	43.45	1,552.92	239.96
10/24/13 14:33:37	110940	11.08	3.16	0.00	6.86	42.75	1,561.01	238.49
10/24/13 14:34:07	110970	11.13	1.01	0.01	6.82	42.40	1,561.01	240.04
10/24/13 14:34:37	111000	11.15	0.66	0.01	6.81	223.24	1,563.87	558.23
10/24/13 14:35:07	111030	11.16	0.55	0.02	6.79	264.41	1,578.13	557.13
10/24/13 14:35:37	111060	11.52	0.55	0.04	6.60	265.82	1,648.38	559.20
10/24/13 14:36:07	111090	11.73	1.52	0.03	6.30	267.22	1,685.77	559.09
10/24/13 14:36:37	111120	11.35	1.29	0.03	6.78	268.63	1,697.42	558.37
10/24/13 14:37:07	111150	11.54	0.45	0.01	6.53	266.87	1,697.23	557.96
10/24/13 14:37:37	111180	11.75	0.36	0.01	6.44	266.87	1,696.70	557.96
10/24/13 14:38:07	111210	11.93	0.35	0.03	6.25	266.17	1,693.62	560.33
10/24/13 14:38:37	111240	11.90	0.38	0.03	6.27	266.17	1,692.96	559.50
10/24/13 14:39:07	111270	11.80	0.42	0.04	6.34	262.30	1,689.36	557.58
10/24/13 14:39:37	111300	11.92	0.39	0.06	6.26	263.00	1,693.42	556.86
10/24/13 14:40:07	111330	11.68	0.37	0.02	6.45	263.35	1,698.78	558.20
10/24/13 14:40:37	111360	11.57	0.37	0.03	6.55	265.11	1,700.35	560.26
10/24/13 14:41:07	111390	11.78	0.43	0.03	6.37	265.82	1,701.39	558.51
10/24/13 14:41:37	111420	11.91	0.57	0.02	6.28	264.06	1,706.39	558.61
10/24/13 14:42:07	111450	11.84	0.76	0.03	6.33	267.22	1,711.63	557.41
10/24/13 14:42:37	111480	11.68	0.74	0.03	6.42	265.11	1,711.55	555.76
10/24/13 14:43:07	111510	11.74	1.04	0.04	6.42	264.06	1,697.89	556.17
10/24/13 14:43:37	111540	12.10	1.38	0.03	6.17	269.34	1,697.27	556.99

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	5.6	%
Stack Exhaust Flow (M2)	219,690	SCFH

Weather Data

Barometric Pressure	30.36	in. Hg
Relative Humidity	48	%
Ambient Temperature	57	°F
Specific Humidity	0.004643	lb H_2O / lb air

30-70-30 Load, Run - 2.5OD15 R6

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 14:44:07	111570	11.91	1.06	0.05	6.34	107.84	1,699.27	237.64
10/24/13 14:44:37	111600	11.71	0.63	0.04	6.52	44.51	1,694.34	237.62
10/24/13 14:45:07	111630	11.94	0.57	0.03	6.35	43.10	1,639.25	238.01
10/24/13 14:45:37	111660	12.16	0.66	0.03	6.29	40.99	1,577.05	238.73
10/24/13 14:46:07	111690	13.42	1.25	0.00	5.33	43.10	1,540.72	238.73
10/24/13 14:46:37	111720	13.60	3.06	0.01	5.17	44.16	1,535.91	238.51
10/24/13 14:47:07	111750	12.78	6.14	0.04	5.56	43.80	1,537.76	237.88
10/24/13 14:47:37	111780	12.58	3.79	0.03	5.85	44.16	1,538.57	238.39
10/24/13 14:48:07	111810	12.45	1.92	0.04	5.92	44.16	1,535.92	238.18
10/24/13 14:48:37	111840	12.35	1.67	0.03	6.01	43.80	1,532.79	237.74
10/24/13 14:49:07	111870	12.56	1.56	0.04	5.83	44.16	1,532.07	239.28
10/24/13 14:49:37	111900	12.26	1.72	0.04	6.01	251.39	1,532.82	580.42
10/24/13 14:50:07	111930	12.25	1.45	0.05	6.10	274.61	1,558.34	563.30
10/24/13 14:50:37	111960	11.48	1.65	0.05	6.46	278.48	1,600.78	562.05
10/24/13 14:51:07	111990	12.01	2.61	0.03	6.42	277.08	1,611.08	561.53
10/24/13 14:51:37	112020	12.26	2.76	0.01	6.20	280.24	1,613.64	564.23
10/24/13 14:52:07	112050	12.56	1.51	0.04	5.85	277.43	1,614.18	561.64
10/24/13 14:52:37	112080	12.51	2.14	0.04	5.94	279.19	1,610.02	563.92
10/24/13 14:53:07	112110	12.63	2.15	0.04	5.84	275.67	1,607.32	563.92
10/24/13 14:53:37	112140	12.49	2.43	0.03	5.88	279.54	1,607.08	561.25
10/24/13 14:54:07	112170	12.42	3.01	0.03	6.03	274.61	1,604.48	564.26
10/24/13 14:54:37	112200	12.62	3.51	0.03	5.83	279.89	1,606.90	563.54
10/24/13 14:55:07	112230	12.61	3.49	0.04	5.88	275.32	1,613.92	561.88
10/24/13 14:55:37	112260	12.65	3.47	0.05	5.83	280.24	1,609.05	562.82
10/24/13 14:56:07	112290	12.78	3.51	0.01	5.72	280.24	1,600.60	562.39
10/24/13 14:56:37	112320	12.77	3.56	0.03	5.78	274.96	1,592.33	563.54
10/24/13 14:57:07	112350	12.87	3.37	0.03	5.66	278.48	1,589.84	562.33
10/24/13 14:57:37	112380	12.85	4.09	0.04	5.63	275.32	1,603.03	561.91
10/24/13 14:58:07	112410	12.39	4.76	0.04	6.01	280.24	1,615.31	563.05
10/24/13 14:58:37	112440	12.56	4.09	0.03	5.84	275.67	1,614.25	561.08
10/24/13 14:59:07	112470	12.51	3.83	0.03	5.94	170.12	1,604.38	264.72
10/24/13 14:59:37	112500	12.79	4.41	0.05	5.76	46.62	1,606.09	244.36
10/24/13 15:00:07	112530	12.63	5.67	0.04	5.75	46.62	1,602.78	243.59
10/24/13 15:00:37	112560	11.81	5.97	0.05	6.49	46.27	1,541.03	244.62
10/24/13 15:01:07	112590	13.70	4.22	0.00	5.18	46.62	1,502.88	243.66
10/24/13 15:01:37	112620	13.72	11.25	0.01	5.02	45.92	1,491.06	244.32
10/24/13 15:02:07	112650	13.29	19.56	0.04	5.33	46.62	1,491.65	243.53
10/24/13 15:02:37	112680	13.03	16.65	0.04	5.45	47.32	1,499.21	243.88
10/24/13 15:03:07	112710	12.39	10.96	0.02	5.98	46.97	1,503.31	243.84
10/24/13 15:03:37	112740	12.42	6.00	0.04	5.93	46.97	1,506.06	244.19
10/24/13 15:04:07	112770	12.62	5.17	0.03	5.79	46.27	1,506.87	245.13
10/24/13 15:04:37	112800	12.43	4.89	0.03	5.94	214.45	1,505.07	570.71
10/24/13 15:05:07	112830	12.47	4.57	0.00	5.94	275.67	1,517.17	567.33
10/24/13 15:05:37	112860	12.33	4.17	0.01	5.94	285.17	1,549.02	568.15
10/24/13 15:06:07	112890	12.28	4.55	0.02	6.20	286.58	1,593.54	567.11
10/24/13 15:06:37	112920	11.97	6.43	0.03	6.17	287.28	1,621.84	565.84
10/24/13 15:07:07	112950	12.02	4.68	0.01	6.41	285.87	1,640.70	566.80
10/24/13 15:07:37	112980	12.15	2.96	0.02	6.13	283.06	1,649.98	565.33
10/24/13 15:08:07	113010	12.14	2.39	0.03	6.20	285.17	1,641.44	567.51
10/24/13 15:08:37	113040	12.24	3.25	0.03	6.17	287.98	1,636.91	567.52
10/24/13 15:09:07	113070	12.48	4.02	0.01	5.99	288.33	1,636.46	568.47
10/24/13 15:09:37	113100	12.66	3.67	0.01	5.80	282.35	1,633.60	567.94

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	5.6	%
Stack Exhaust Flow (M2)	219,690	SCFH

Weather Data

Barometric Pressure	30.36	in. Hg
Relative Humidity	48	%
Ambient Temperature	57	°F
Specific Humidity	0.004643	lb H_2O / lb air

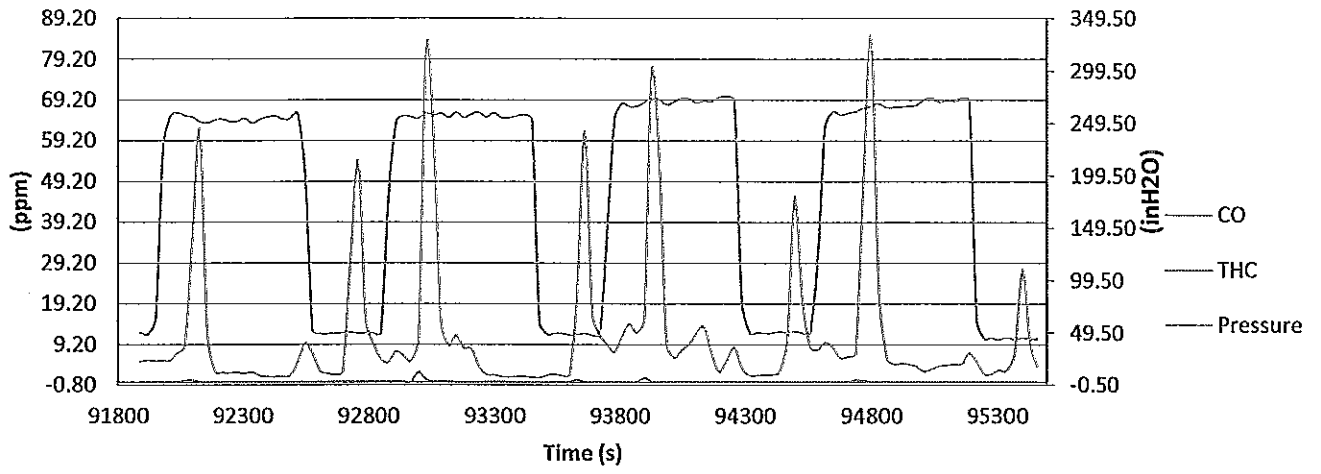
30-70-30 Load, Run - 2.5OD15 R6

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 15:10:07	113130	12.61	3.56	0.05	5.84	287.98	1,635.51	566.07
10/24/13 15:10:37	113160	12.47	3.18	0.03	5.95	285.87	1,635.75	565.54
10/24/13 15:11:07	113190	12.38	2.96	0.03	6.02	285.52	1,625.61	568.57
10/24/13 15:11:37	113220	12.64	3.32	0.03	5.83	288.33	1,618.51	567.99
10/24/13 15:12:07	113250	12.78	4.17	0.03	5.73	285.87	1,616.60	564.95
10/24/13 15:12:37	113280	12.65	5.56	0.03	5.83	288.33	1,615.39	566.94
10/24/13 15:13:07	113310	12.81	5.27	0.04	5.72	285.52	1,623.25	565.28
10/24/13 15:13:37	113340	12.66	4.72	0.04	5.77	286.58	1,623.19	568.29
10/24/13 15:14:07	113370	12.40	3.74	0.03	5.98	287.63	1,617.59	565.36
10/24/13 15:14:37	113400	12.39	3.27	0.02	6.02	53.66	1,622.98	238.93
10/24/13 15:15:07	113430	12.10	4.04	0.04	6.22	45.92	1,641.15	239.50
10/24/13 15:15:37	113460	11.57	4.06	0.03	6.31	44.86	1,588.70	239.52
10/24/13 15:16:07	113490	12.61	2.71	0.03	6.31	44.86	1,527.21	239.57
10/24/13 15:16:37	113520	14.15	7.26	0.02	4.77	45.92	1,501.32	239.75
10/24/13 15:17:07	113550	13.97	26.46	0.04	4.80	44.16	1,502.31	238.42
10/24/13 15:17:37	113580	13.18	30.13	0.04	5.29	45.21	1,511.49	238.67
RAW AVERAGE		**12.35**	**3.24**	**0.03**	**6.00**	**193.95**	**1,604.84**	**450.65**

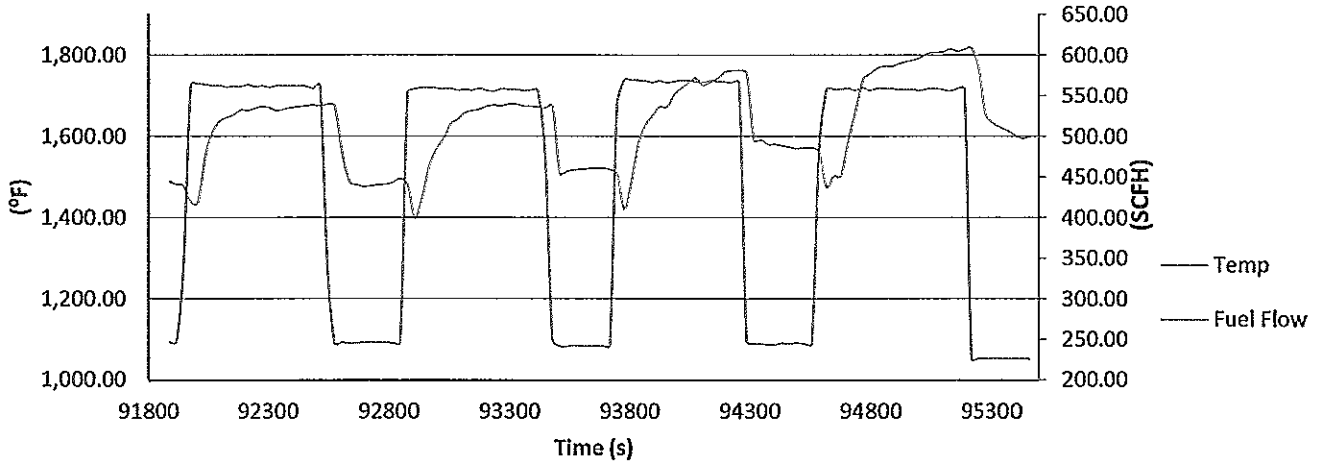
		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	inst-22-0005	inst-co-0020	inst-vc-0003	inst-22-0005	F8_PRF1	F8_TE5	
		(%)	(ppmvd)	(ppmvw)	(%)	(in. H_2O)	(°F)	(SCFH)
Bias	Initial Zero	0.13	0.26	0.04	0.03			
	Final Zero	0.14	0.29	0.02	0.07			
	Avg. Zero	0.14	0.28	0.03	0.05			
	Initial UpScale	11.89	8.76	4.94	8.90			
	Final UpScale	12.01	8.82	4.89	8.88			
	Avg. UpScale	11.95	8.79	4.92	8.89			
Upscale Cal Gas		12.10	9.07	5.04	8.95			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.51	3.16	0.00	6.02
Corrected Raw Average (ppm/% wet basis)	11.80	2.97	0.00	5.68
Concentration (ppm@ 3%CO_2)	N/A	1.57	0.00	N/A
Emission Rate (lb/hr)	N/A	0.05	0.00	N/A

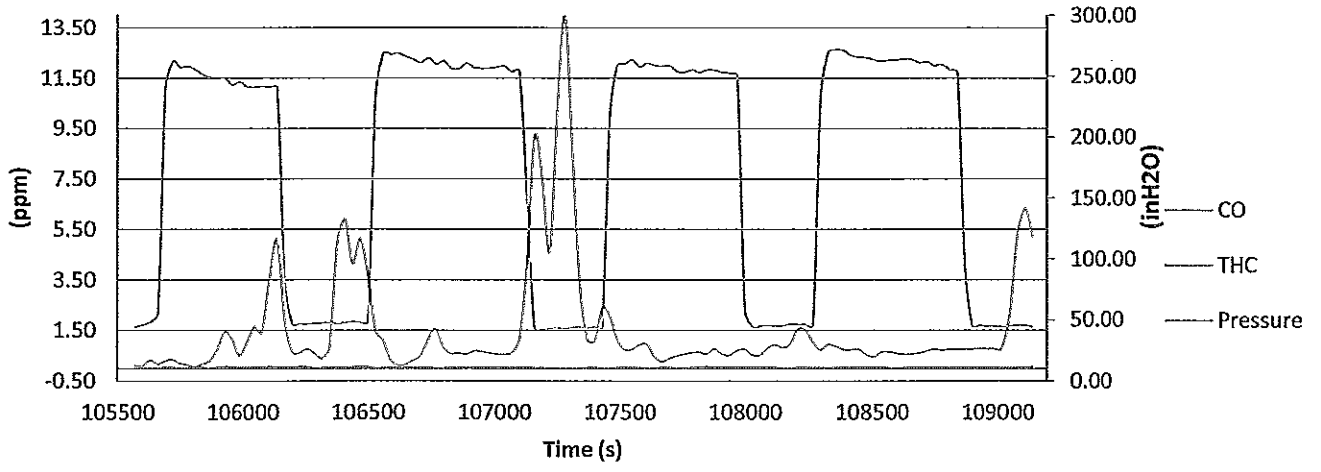
2.5OD19 R4

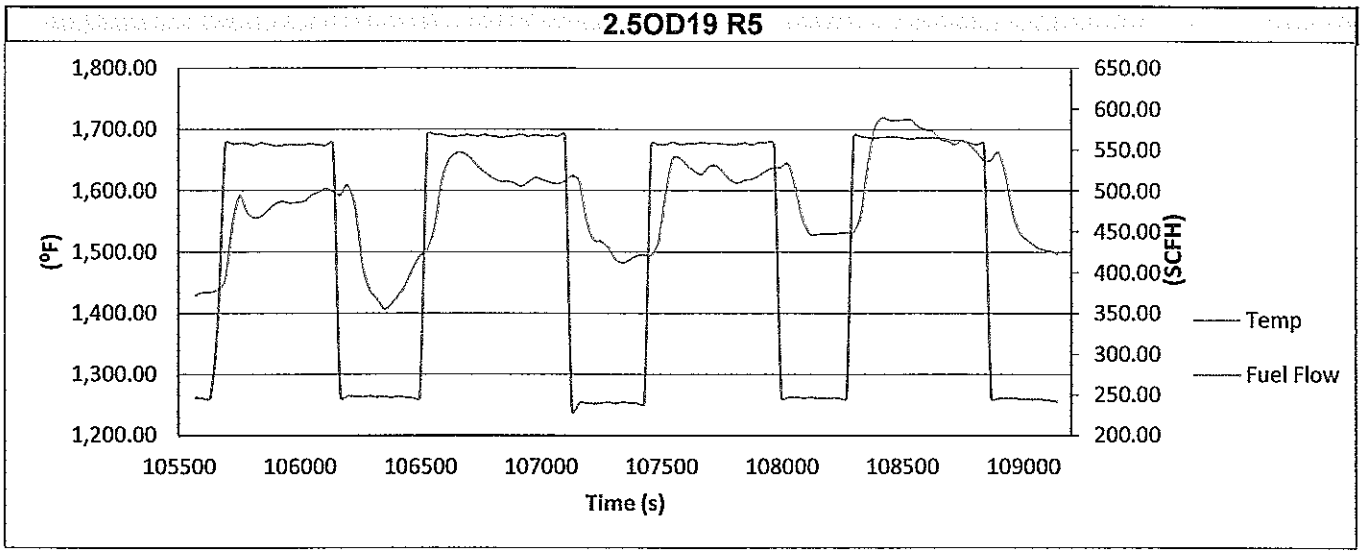


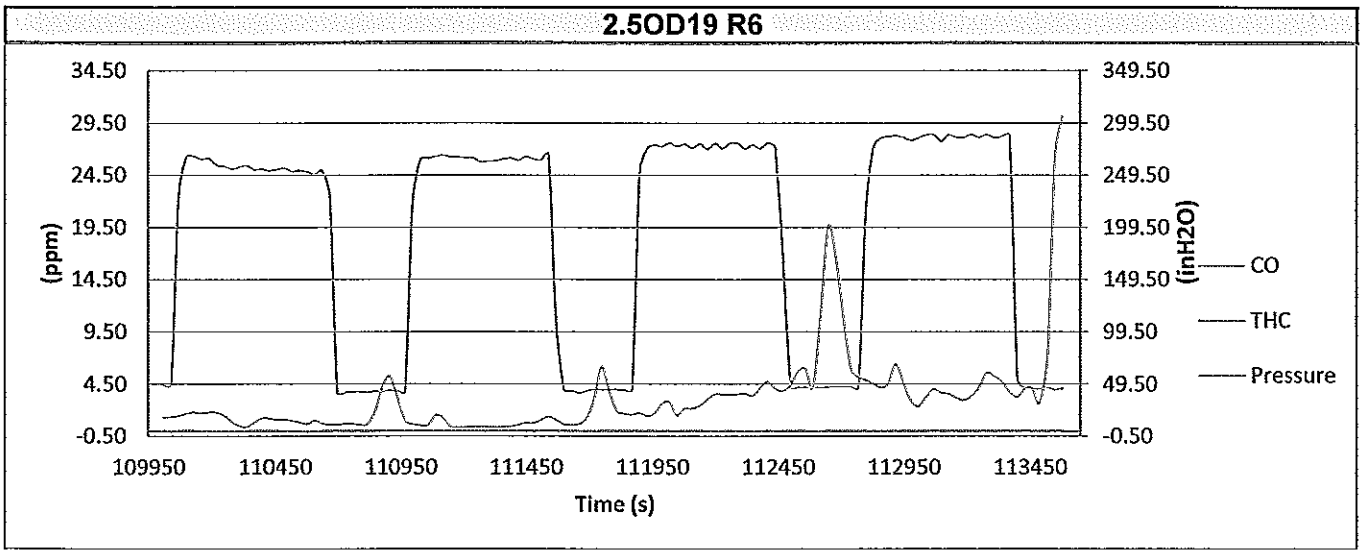
2.5OD19 R4

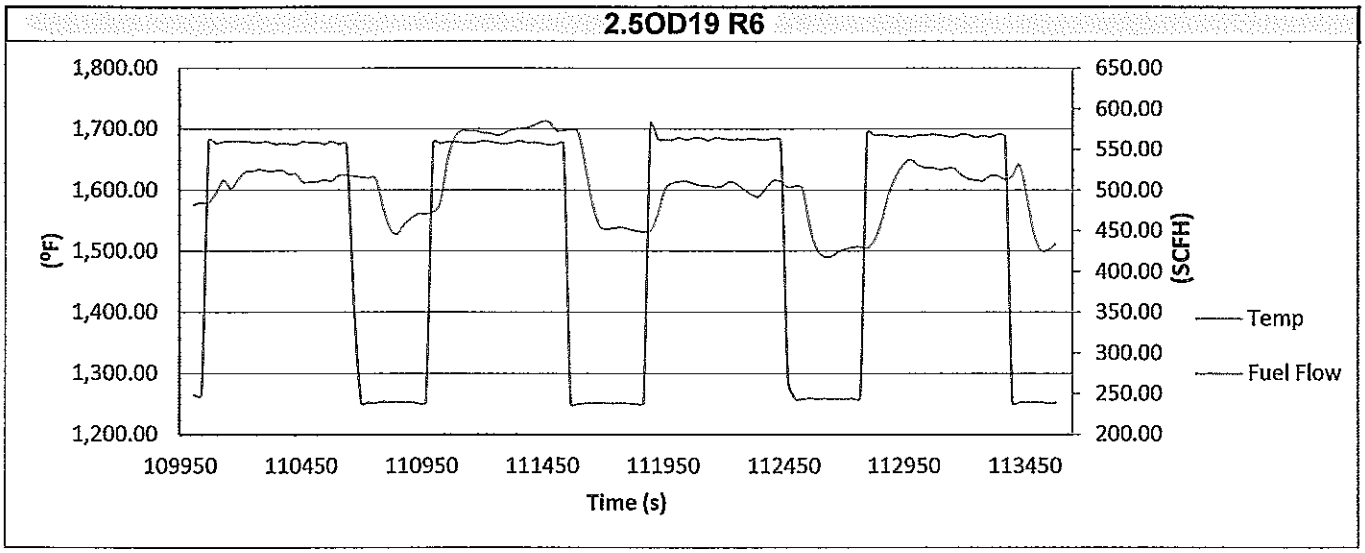


2.5OD19 R5




2.5OD19 R5
1,800.00
1,700.00
1,600.00
1,500.00
1,400.00
1,300.00
1,200.00
(°F)
650.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
200.00
(SCFH)
105500
106000
106500
107000
107500
108000
108500
109000
Time (s)
Temp
Fuel Flow


2.5OD19 R6
34.50
29.50
24.50
19.50
14.50
9.50
4.50
-0.50
(ppm)
349.50
299.50
249.50
199.50
149.50
99.50
49.50
-0.50
(inH2O)
109950
110450
110950
111450
111950
112450
112950
113450
Time (s)
CO
THC
Pressure


2.5OD19 R6
1,800.00
1,700.00
1,600.00
1,500.00
1,400.00
1,300.00
1,200.00
(°F)
650.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
200.00
(SCFH)
109950
110450
110950
111450
111950
112450
112950
113450
Time (s)
Temp
Fuel Flow

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.6	%
Stack Exhaust Flow (M2)	384,934	SCFH

Weather Data

Barometric Pressure	30.30	in. Hg
Relative Humidity	47	%
Ambient Temperature	57	°F
Specific Humidity	0.004555	lb H_2O / lb air

70-100-70 Load, Run - 2.5OD15 R7

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 15:52:07	115650	12.80	4.26	0.05	5.69	249.98	1,462.23	557.09
10/24/13 15:52:37	115680	12.67	1.84	-0.03	5.75	252.10	1,483.78	560.07
10/24/13 15:53:07	115710	12.86	1.59	0.02	5.71	249.98	1,496.19	558.12
10/24/13 15:53:37	115740	12.92	1.40	0.01	5.64	251.74	1,516.35	559.26
10/24/13 15:54:07	115770	13.00	1.18	0.04	5.57	250.34	1,534.70	557.50
10/24/13 15:54:37	115800	12.77	1.12	0.03	5.74	255.61	1,542.40	560.18
10/24/13 15:55:07	115830	12.69	1.02	0.03	5.79	255.26	1,545.11	560.05
10/24/13 15:55:37	115860	12.91	1.01	0.03	5.68	254.21	1,548.50	560.04
10/24/13 15:56:07	115890	12.92	0.74	0.04	5.63	375.94	1,552.77	816.51
10/24/13 15:56:37	115920	12.75	0.59	0.04	5.75	492.05	1,530.65	801.27
10/24/13 15:57:07	115950	12.86	0.78	0.02	5.69	508.94	1,494.69	803.01
10/24/13 15:57:37	115980	12.96	1.31	0.04	5.63	524.77	1,504.04	830.53
10/24/13 15:58:07	116010	14.43	6.02	0.07	4.69	539.90	1,529.94	826.25
10/24/13 15:58:37	116040	13.93	20.22	0.04	4.92	533.92	1,539.21	828.81
10/24/13 15:59:07	116070	13.67	18.51	0.05	5.05	538.14	1,555.57	830.28
10/24/13 15:59:37	116100	13.68	11.01	0.05	5.15	538.85	1,573.28	830.37
10/24/13 16:00:07	116130	13.38	10.04	0.01	5.29	537.44	1,571.41	828.27
10/24/13 16:00:37	116160	13.19	6.97	0.05	5.42	527.94	1,578.57	826.00
10/24/13 16:01:07	116190	13.34	3.92	0.03	5.39	531.46	1,590.98	827.34
10/24/13 16:01:37	116220	13.24	4.95	0.00	5.37	530.75	1,601.31	826.70
10/24/13 16:02:07	116250	13.04	4.20	0.04	5.59	533.57	1,589.90	829.13
10/24/13 16:02:37	116280	13.02	3.49	0.05	5.49	533.57	1,588.63	831.49
10/24/13 16:03:07	116310	13.31	3.80	0.03	5.44	532.16	1,585.29	826.77
10/24/13 16:03:37	116340	13.23	4.97	0.04	5.42	400.57	1,596.31	556.26
10/24/13 16:04:07	116370	13.18	4.68	0.06	5.48	253.15	1,623.63	556.87
10/24/13 16:04:37	116400	13.18	4.89	0.05	5.44	241.89	1,704.60	555.64
10/24/13 16:05:07	116430	13.11	4.75	0.03	5.53	243.65	1,702.55	555.54
10/24/13 16:05:37	116460	10.85	3.52	0.03	6.87	246.47	1,688.76	556.98
10/24/13 16:06:07	116490	11.38	1.42	0.04	6.87	244.71	1,677.37	556.47
10/24/13 16:06:37	116520	11.76	0.43	0.04	6.52	245.06	1,658.42	555.13
10/24/13 16:07:07	116550	11.92	0.26	-0.01	6.36	245.06	1,641.92	556.97
10/24/13 16:07:37	116580	12.17	0.35	0.02	6.24	249.63	1,630.30	555.27
10/24/13 16:08:07	116610	12.55	0.37	0.03	5.90	246.47	1,620.94	555.88
10/24/13 16:08:37	116640	12.71	0.38	0.03	5.82	249.98	1,620.21	555.99
10/24/13 16:09:07	116670	12.78	0.68	0.03	5.74	407.96	1,627.16	887.57
10/24/13 16:09:37	116700	12.73	1.62	0.03	5.72	531.11	1,580.84	835.50
10/24/13 16:10:07	116730	12.47	1.17	0.04	5.92	541.66	1,559.56	833.07
10/24/13 16:10:37	116760	12.74	0.60	0.03	5.92	542.72	1,600.98	835.00
10/24/13 16:11:07	116790	14.26	3.98	0.04	4.67	539.20	1,626.45	830.90
10/24/13 16:11:37	116820	13.23	10.93	0.07	5.39	545.53	1,643.57	834.91
10/24/13 16:12:07	116850	12.95	6.32	0.05	5.61	542.01	1,648.45	830.39
10/24/13 16:12:37	116880	12.54	3.68	0.04	5.86	536.03	1,654.70	831.23
10/24/13 16:13:07	116910	12.82	2.72	0.03	5.71	536.03	1,661.00	833.04
10/24/13 16:13:37	116940	12.74	2.38	0.03	5.80	539.90	1,679.67	834.96
10/24/13 16:14:07	116970	12.60	1.78	0.02	5.85	534.27	1,683.00	831.59
10/24/13 16:14:37	117000	12.34	1.40	0.04	6.01	538.14	1,669.32	834.91
10/24/13 16:15:07	117030	12.36	1.55	0.05	6.04	533.57	1,664.63	831.02
10/24/13 16:15:37	117060	12.64	1.97	0.03	5.89	539.90	1,664.23	829.63
10/24/13 16:16:07	117090	12.81	2.09	0.03	5.70	534.62	1,671.36	835.00
10/24/13 16:16:37	117120	12.83	2.04	0.02	5.69	538.50	1,666.66	830.05
10/24/13 16:17:07	117150	12.56	2.15	0.04	5.87	539.90	1,655.36	832.93
10/24/13 16:17:37	117180	12.66	1.51	0.04	5.85	533.22	1,666.45	833.73

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.6	%
Stack Exhaust Flow (M2)	384,934	SCFH

Weather Data

Barometric Pressure	30.30	in. Hg
Relative Humidity	47	%
Ambient Temperature	57	°F
Specific Humidity	0.004555	lb H_2O / lb air

70-100-70 Load, Run - 2.5OD15 R7

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 16:18:07	117210	12.89	1.88	0.04	5.67	487.48	1,670.26	555.34
10/24/13 16:18:37	117240	12.84	2.92	0.06	5.68	264.41	1,666.73	553.88
10/24/13 16:19:07	117270	12.67	3.11	0.03	5.82	244.35	1,687.31	556.19
10/24/13 16:19:37	117300	12.81	2.86	0.05	5.72	240.13	1,707.99	556.19
10/24/13 16:20:07	117330	12.66	3.16	0.05	5.70	244.71	1,690.68	555.98
10/24/13 16:20:37	117360	11.16	2.71	0.05	6.94	242.60	1,672.64	556.50
10/24/13 16:21:07	117390	11.86	0.88	0.01	6.45	248.58	1,658.71	556.30
10/24/13 16:21:37	117420	12.19	0.57	0.01	6.16	247.17	1,658.94	553.75
10/24/13 16:22:07	117450	12.45	0.53	0.05	6.00	248.58	1,653.57	554.98
10/24/13 16:22:37	117480	12.24	0.45	0.04	6.08	250.69	1,646.75	553.74
10/24/13 16:23:07	117510	12.34	0.39	0.03	6.06	248.58	1,644.76	555.98
10/24/13 16:23:37	117540	12.55	0.38	0.04	5.91	251.04	1,642.31	554.66
10/24/13 16:24:07	117570	12.44	0.31	0.02	5.95	337.24	1,644.93	763.80
10/24/13 16:24:37	117600	12.53	0.37	0.03	5.90	479.74	1,651.07	824.71
10/24/13 16:25:07	117630	12.52	0.33	0.04	5.90	546.59	1,632.99	832.89
10/24/13 16:25:37	117660	12.54	0.37	0.04	5.89	549.05	1,618.48	833.09
10/24/13 16:26:07	117690	12.56	0.62	0.01	6.10	543.07	1,659.22	832.70
10/24/13 16:26:37	117720	14.01	6.31	0.02	4.78	557.49	1,712.40	830.10
10/24/13 16:27:07	117750	12.98	11.10	0.04	5.54	556.79	1,739.04	831.26
10/24/13 16:27:37	117780	12.20	3.85	0.04	6.07	555.38	1,763.48	834.59
10/24/13 16:28:07	117810	12.10	1.36	0.02	6.26	549.75	1,776.99	832.27
10/24/13 16:28:37	117840	11.94	0.92	0.03	6.30	550.46	1,760.34	829.70
10/24/13 16:29:07	117870	11.59	0.81	0.04	6.59	557.14	1,757.86	829.99
10/24/13 16:29:37	117900	12.19	0.89	0.03	6.24	554.68	1,759.30	830.40
10/24/13 16:30:07	117930	12.36	1.88	0.04	6.03	556.44	1,763.26	831.35
10/24/13 16:30:37	117960	12.20	2.46	0.04	6.16	551.87	1,780.44	830.07
10/24/13 16:31:07	117990	12.42	2.17	0.04	5.97	559.96	1,795.42	833.15
10/24/13 16:31:37	118020	12.05	1.66	0.04	6.20	552.22	1,789.95	830.50
10/24/13 16:32:07	118050	11.80	1.38	0.04	6.44	553.27	1,771.32	829.99
10/24/13 16:32:37	118080	11.59	1.58	0.03	6.63	559.25	1,765.48	830.05
10/24/13 16:33:07	118110	12.45	1.80	0.05	6.10	399.87	1,751.83	552.78
10/24/13 16:33:37	118140	12.79	3.82	0.05	5.73	267.93	1,760.89	552.67
10/24/13 16:34:07	118170	13.65	4.91	0.05	5.24	252.10	1,791.71	553.90
10/24/13 16:34:37	118200	12.86	9.05	0.04	5.53	250.34	1,753.79	555.29
10/24/13 16:35:07	118230	11.08	5.04	0.06	6.83	255.26	1,726.02	553.55
10/24/13 16:35:37	118260	11.87	1.52	0.04	6.47	257.37	1,698.31	553.86
10/24/13 16:36:07	118290	12.02	1.00	0.01	6.30	256.67	1,678.15	553.15
10/24/13 16:36:37	118320	12.29	1.08	0.00	6.07	254.91	1,663.89	554.58
10/24/13 16:37:07	118350	12.53	1.19	0.02	5.92	257.72	1,655.80	552.94
10/24/13 16:37:37	118380	12.65	1.14	0.01	5.84	259.48	1,658.58	552.73
10/24/13 16:38:07	118410	12.67	0.97	0.03	5.81	261.59	1,660.38	585.87
10/24/13 16:38:37	118440	12.62	0.86	0.05	5.80	512.81	1,651.40	838.67
10/24/13 16:39:07	118470	12.25	0.75	0.03	6.08	562.42	1,594.06	833.07
10/24/13 16:39:37	118500	12.54	0.76	0.04	5.91	562.77	1,609.39	836.72
10/24/13 16:40:07	118530	13.67	1.42	0.09	5.40	564.53	1,659.28	833.58
10/24/13 16:40:37	118560	13.95	12.33	0.05	4.74	556.09	1,693.90	831.36
10/24/13 16:41:07	118590	12.86	14.27	0.04	5.60	551.51	1,689.46	835.51
10/24/13 16:41:37	118620	12.53	4.58	0.04	5.91	557.85	1,684.55	832.18
10/24/13 16:42:07	118650	12.96	2.94	0.00	5.64	551.87	1,684.84	830.99
10/24/13 16:42:37	118680	13.19	3.85	0.00	5.50	556.09	1,689.28	836.52
10/24/13 16:43:07	118710	12.84	6.54	0.05	5.66	553.27	1,701.20	836.38
10/24/13 16:43:37	118740	13.25	5.98	0.04	5.44	561.01	1,725.44	833.54

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.6	%
Stack Exhaust Flow (M2)	384,934	SCFH

Weather Data

Barometric Pressure	30.30	in. Hg
Relative Humidity	47	%
Ambient Temperature	57	°F
Specific Humidity	0.004555	lb H_2O / lb air

70-100-70 Load, Run - 2.5OD15 R7

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 16:44:07	118770	13.27	6.65	0.05	5.38	557.14	1,729.84	833.15
10/24/13 16:44:37	118800	12.63	6.98	0.05	5.75	552.57	1,733.02	834.32
10/24/13 16:45:07	118830	12.52	3.62	0.03	5.96	556.44	1,741.53	831.49
10/24/13 16:45:37	118860	12.74	2.71	0.06	5.77	560.66	1,733.70	836.41
10/24/13 16:46:07	118890	12.46	2.54	0.03	5.96	561.36	1,721.42	833.04
10/24/13 16:46:37	118920	12.43	2.07	0.03	5.96	562.42	1,714.29	830.26
10/24/13 16:47:07	118950	12.59	1.90	0.04	5.92	561.72	1,714.84	833.95
10/24/13 16:47:37	118980	13.29	2.89	0.04	5.46	557.85	1,725.87	834.56
10/24/13 16:48:07	119010	13.58	6.74	0.04	5.21	298.54	1,730.41	551.34
10/24/13 16:48:37	119040	13.25	11.33	0.03	5.40	255.61	1,794.31	551.65
10/24/13 16:49:07	119070	13.13	7.35	0.04	5.44	252.45	1,830.61	550.50
10/24/13 16:49:37	119100	12.12	4.75	0.04	5.79	255.26	1,805.64	550.08
10/24/13 16:50:07	119130	9.85	3.33	0.00	7.96	253.15	1,761.65	550.09
10/24/13 16:50:37	119160	10.47	1.20	0.02	7.46	255.26	1,734.76	551.29
10/24/13 16:51:07	119190	11.68	0.99	0.06	6.66	256.32	1,716.01	552.41
10/24/13 16:51:37	119220	11.81	0.85	0.02	6.43	258.43	1,686.20	549.67
RAW AVERAGE		**12.64**	**3.29**	**0.03**	**5.84**	**422.72**	**1,662.52**	**716.05**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	inst-22-0005	inst-co-0020	inst-vc-0003	inst-22-0005	F8_PRF1	F8_TE5	
		(%)	(ppmvd)	(ppmvw)	(%)	(in. H_2O)	(°F)	(SCFH)
Bias	Initial Zero	0.14	0.29	0.02	0.07			
	Final Zero	0.14	0.29	0.03	0.04			
	Avg. Zero	0.14	0.29	0.03	0.06			
	Initial UpScale	12.01	8.82	4.89	8.88			
	Final UpScale	12.00	8.74	4.92	8.89			
	Avg. UpScale	12.01	8.78	4.91	8.89			
Upscale Cal Gas		12.10	9.07	5.04	8.95			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.74	3.20	0.01	5.86
Corrected Raw Average (ppm/% wet basis)	11.90	2.97	0.01	5.48
Concentration (ppm@ 3%CO_2)	N/A	1.64	0.01	N/A
Emission Rate (lb/hr)	N/A	0.09	0.00	N/A

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.0	%
Stack Exhaust Flow (M2)	386,645	SCFH

Weather Data

Barometric Pressure	30.30	in. Hg
Relative Humidity	46	%
Ambient Temperature	55	°F
Specific Humidity	0.004144	lb H_2O / lb air

70-100-70 Load, Run - 2.5OD15 R8

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 17:06:07	120090	13.10	4.09	0.03	5.53	243.65	1,513.54	555.53
10/24/13 17:06:37	120120	13.29	5.24	0.04	5.41	246.47	1,525.77	557.27
10/24/13 17:07:07	120150	13.63	8.69	0.03	5.10	252.10	1,534.33	611.10
10/24/13 17:07:37	120180	13.54	11.29	0.03	5.28	502.26	1,553.15	827.41
10/24/13 17:08:07	120210	13.97	10.41	0.06	4.94	539.20	1,594.57	825.76
10/24/13 17:08:37	120240	13.64	14.86	0.02	4.98	548.70	1,679.01	827.51
10/24/13 17:09:07	120270	13.44	10.05	0.03	5.26	543.07	1,703.58	826.23
10/24/13 17:09:37	120300	12.53	4.84	0.03	5.74	544.48	1,726.66	826.16
10/24/13 17:10:07	120330	12.30	2.41	0.04	6.15	551.16	1,744.51	825.91
10/24/13 17:10:37	120360	12.18	0.88	0.04	6.09	551.87	1,734.78	825.31
10/24/13 17:11:07	120390	11.74	0.78	0.01	6.48	547.29	1,736.65	828.87
10/24/13 17:11:37	120420	12.16	0.76	0.00	6.28	556.44	1,746.43	825.15
10/24/13 17:12:07	120450	12.32	1.11	0.03	6.02	549.05	1,740.89	827.85
10/24/13 17:12:37	120480	12.17	1.06	0.03	6.17	550.46	1,735.05	828.20
10/24/13 17:13:07	120510	12.09	1.04	0.03	6.26	560.31	1,744.25	824.32
10/24/13 17:13:37	120540	12.31	1.21	0.04	6.08	552.92	1,759.23	824.04
10/24/13 17:14:07	120570	12.26	0.85	-0.07	6.01	559.96	1,769.31	826.37
10/24/13 17:14:37	120600	12.06	0.79	0.04	6.28	561.72	1,774.50	824.30
10/24/13 17:15:07	120630	11.83	0.91	0.05	6.41	556.09	1,786.15	826.55
10/24/13 17:15:37	120660	11.75	0.61	0.04	6.46	556.44	1,785.67	826.05
10/24/13 17:16:07	120690	11.74	0.66	0.05	6.47	563.48	1,795.79	823.15
10/24/13 17:16:37	120720	11.83	0.85	0.05	6.53	559.25	1,799.05	822.65
10/24/13 17:17:07	120750	11.71	1.12	0.03	6.47	449.83	1,799.76	553.44
10/24/13 17:17:37	120780	11.73	1.20	0.04	6.53	282.00	1,808.63	554.88
10/24/13 17:18:07	120810	11.86	1.23	0.03	6.45	260.54	1,822.38	555.19
10/24/13 17:18:37	120840	11.88	1.43	0.04	6.40	263.35	1,775.44	554.37
10/24/13 17:19:07	120870	11.29	1.00	0.01	6.76	262.30	1,730.78	555.17
10/24/13 17:19:37	120900	11.94	0.74	0.02	6.45	265.82	1,719.75	554.47
10/24/13 17:20:07	120930	12.98	0.77	0.01	5.73	264.41	1,731.21	554.15
10/24/13 17:20:37	120960	13.53	2.29	0.01	5.11	265.82	1,743.01	554.16
10/24/13 17:21:07	120990	12.56	3.47	0.03	5.77	263.71	1,745.82	553.23
10/24/13 17:21:37	121020	11.81	2.56	0.04	6.35	267.58	1,739.72	554.12
10/24/13 17:22:07	121050	11.10	1.06	0.00	6.94	349.56	1,716.16	860.77
10/24/13 17:22:37	121080	11.20	0.62	0.00	6.89	553.62	1,699.04	821.96
10/24/13 17:23:07	121110	11.83	0.87	0.03	6.53	572.62	1,730.53	822.90
10/24/13 17:23:37	121140	12.08	1.28	0.03	6.21	568.40	1,748.64	826.31
10/24/13 17:24:07	121170	12.06	1.41	0.04	6.26	571.57	1,742.59	824.44
10/24/13 17:24:37	121200	12.29	1.24	0.05	6.12	569.46	1,733.07	821.49
10/24/13 17:25:07	121230	12.36	1.39	0.02	6.07	560.66	1,729.44	821.39
10/24/13 17:25:37	121260	12.79	2.15	0.02	5.73	559.96	1,732.34	824.70
10/24/13 17:26:07	121290	12.67	2.89	0.00	5.78	563.83	1,726.11	827.18
10/24/13 17:26:37	121320	12.79	2.99	0.00	5.75	561.01	1,732.61	825.31
10/24/13 17:27:07	121350	12.67	2.75	0.04	5.77	562.07	1,744.61	824.55
10/24/13 17:27:37	121380	12.76	2.86	0.04	5.76	562.42	1,758.35	823.87
10/24/13 17:28:07	121410	11.86	2.54	0.03	6.28	565.24	1,773.69	825.60
10/24/13 17:28:37	121440	11.86	1.47	0.04	6.44	561.36	1,771.41	821.31
10/24/13 17:29:07	121470	11.93	0.98	0.03	6.33	566.64	1,781.58	821.72
10/24/13 17:29:37	121500	11.78	0.98	0.03	6.47	559.25	1,798.09	826.23
10/24/13 17:30:07	121530	11.85	1.04	0.03	6.37	560.66	1,800.33	824.65
10/24/13 17:30:37	121560	11.52	1.17	0.03	6.68	565.59	1,797.39	824.50
10/24/13 17:31:07	121590	11.55	1.10	0.00	6.65	557.49	1,799.45	826.11
10/24/13 17:31:37	121620	11.67	0.91	0.00	6.57	564.18	1,799.39	823.93

John Zink Co, LLC
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John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.0	%
Stack Exhaust Flow (M2)	386,645	SCFH

Weather Data

Barometric Pressure	30.30	in. Hg
Relative Humidity	46	%
Ambient Temperature	55	°F
Specific Humidity	0.004144	lb H_2O / lb air

70-100-70 Load, Run - 2.5OD15 R8

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 17:32:07	121650	11.77	0.94	0.00	6.48	493.46	1,792.39	555.19
10/24/13 17:32:37	121680	11.68	1.09	0.00	6.51	287.28	1,800.13	554.88
10/24/13 17:33:07	121710	12.15	1.13	0.03	6.29	261.95	1,786.68	553.00
10/24/13 17:33:37	121740	11.97	1.26	0.03	6.27	260.19	1,717.13	553.11
10/24/13 17:34:07	121770	11.53	1.26	0.04	6.64	258.08	1,712.35	554.95
10/24/13 17:34:37	121800	12.23	1.13	0.05	6.13	262.65	1,697.29	553.10
10/24/13 17:35:07	121830	11.36	1.70	0.04	6.71	261.95	1,669.29	552.69
10/24/13 17:35:37	121860	11.59	1.37	0.04	6.64	259.84	1,645.24	554.33
10/24/13 17:36:07	121890	11.98	1.50	0.02	6.40	262.30	1,625.35	554.34
10/24/13 17:36:37	121920	12.39	2.68	0.03	5.99	263.00	1,610.53	554.73
10/24/13 17:37:07	121950	13.00	4.70	0.04	5.65	374.89	1,607.52	805.93
10/24/13 17:37:37	121980	12.93	8.31	0.03	5.59	555.74	1,614.74	833.25
10/24/13 17:38:07	122010	12.70	10.18	0.02	5.73	578.96	1,672.30	834.16
10/24/13 17:38:37	122040	12.61	9.91	0.02	5.85	576.14	1,754.03	829.45
10/24/13 17:39:07	122070	12.70	8.15	0.03	5.83	575.09	1,793.32	834.64
10/24/13 17:39:37	122100	12.95	5.63	0.03	5.57	569.11	1,829.71	832.94
10/24/13 17:40:07	122130	12.87	4.64	0.06	5.63	568.75	1,849.75	833.17
10/24/13 17:40:37	122160	11.54	4.20	0.05	6.52	576.49	1,837.48	832.85
10/24/13 17:41:07	122190	11.09	1.69	0.00	6.85	575.79	1,825.98	832.45
10/24/13 17:41:37	122220	10.76	0.98	0.00	7.28	574.73	1,814.90	830.76
10/24/13 17:42:07	122250	10.95	0.85	0.04	7.09	572.27	1,807.62	829.25
10/24/13 17:42:37	122280	11.20	0.80	0.04	6.92	568.75	1,791.17	829.54
10/24/13 17:43:07	122310	11.26	0.79	0.04	6.85	569.11	1,776.51	834.82
10/24/13 17:43:37	122340	11.39	0.78	0.04	6.84	574.38	1,768.47	831.56
10/24/13 17:44:07	122370	12.86	1.23	0.03	5.80	575.09	1,770.29	835.32
10/24/13 17:44:37	122400	13.05	2.17	0.03	5.53	572.98	1,758.38	833.79
10/24/13 17:45:07	122430	12.15	2.51	0.04	6.03	568.40	1,726.71	830.80
10/24/13 17:45:37	122460	11.66	1.77	0.04	6.58	572.27	1,711.99	830.15
10/24/13 17:46:07	122490	12.42	1.37	0.04	6.10	568.75	1,700.44	833.20
10/24/13 17:46:37	122520	12.72	3.63	0.04	5.75	577.55	1,645.92	833.59
10/24/13 17:47:07	122550	13.37	6.37	0.04	5.46	576.85	1,662.01	833.50
10/24/13 17:47:37	122580	13.01	13.18	0.04	5.49	577.20	1,707.78	835.41
10/24/13 17:48:07	122610	13.44	12.02	0.01	5.31	310.50	1,738.19	556.57
10/24/13 17:48:37	122640	13.17	12.42	0.01	5.46	265.47	1,765.75	556.97
10/24/13 17:49:07	122670	13.30	11.31	0.04	5.27	264.06	1,728.75	554.83
10/24/13 17:49:37	122700	12.27	9.38	0.04	6.10	260.19	1,700.49	556.97
10/24/13 17:50:07	122730	12.32	2.19	0.04	5.99	261.24	1,681.11	555.44
10/24/13 17:50:37	122760	12.02	1.64	0.04	6.24	264.41	1,656.01	554.62
10/24/13 17:51:07	122790	11.89	2.71	0.04	6.38	264.06	1,633.34	555.95
10/24/13 17:51:37	122820	12.34	4.17	0.04	6.07	264.41	1,615.26	553.39
10/24/13 17:52:07	122850	12.51	6.77	0.03	5.92	461.79	1,592.76	817.42
10/24/13 17:52:37	122880	12.55	8.56	0.03	5.87	561.36	1,603.85	832.22
10/24/13 17:53:07	122910	12.97	10.75	0.03	5.61	577.20	1,681.50	833.21
10/24/13 17:53:37	122940	12.92	17.28	0.03	5.63	571.57	1,760.98	826.82
10/24/13 17:54:07	122970	13.15	14.96	0.03	5.51	571.92	1,820.34	829.39
10/24/13 17:54:37	123000	12.78	7.13	0.03	5.61	569.11	1,827.81	822.36
10/24/13 17:55:07	123030	11.39	4.33	0.01	6.62	562.42	1,821.36	821.75
10/24/13 17:55:37	123060	11.59	1.70	0.01	6.64	558.90	1,813.88	818.92
10/24/13 17:56:07	123090	11.51	1.25	0.01	6.63	558.20	1,816.07	814.43
10/24/13 17:56:37	123120	11.46	0.97	0.01	6.68	555.38	1,807.86	808.15
10/24/13 17:57:07	123150	10.92	0.99	0.04	7.03	553.27	1,790.62	800.17
10/24/13 17:57:37	123180	11.35	0.98	0.03	6.87	543.42	1,752.22	797.69

John Zink Co, LLC
ZTOF025X15PF
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Unit Data

Meas. Stack Moisture	6.0	%
Stack Exhaust Flow (M2)	386,645	SCFH

Weather Data

Barometric Pressure	30.30	in. Hg
Relative Humidity	46	%
Ambient Temperature	55	°F
Specific Humidity	0.004144	lb H_2O / lb air

70-100-70 Load, Run - 2.5OD15 R8

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/24/13 17:58:07	123210	11.59	1.46	0.01	6.68	555.74	1,735.87	826.48
10/24/13 17:58:37	123240	12.27	2.04	0.01	6.11	576.85	1,718.73	832.02
10/24/13 17:59:07	123270	12.65	2.47	0.04	5.90	572.27	1,719.41	831.10
10/24/13 17:59:37	123300	12.70	3.87	0.04	5.71	584.94	1,731.16	834.39
10/24/13 18:00:07	123330	12.43	4.36	0.03	5.92	580.36	1,732.99	835.10
10/24/13 18:00:37	123360	12.05	3.94	0.03	6.28	572.62	1,735.34	825.67
10/24/13 18:01:07	123390	12.37	2.63	0.03	6.04	583.88	1,730.45	835.60
10/24/13 18:01:37	123420	12.31	2.78	0.04	6.07	577.20	1,734.57	829.82
10/24/13 18:02:07	123450	12.26	3.04	0.03	6.03	380.87	1,740.03	594.60
10/24/13 18:02:37	123480	12.08	2.90	0.03	6.23	297.13	1,741.28	560.98
10/24/13 18:03:07	123510	11.81	2.96	0.04	6.40	271.80	1,774.92	560.25
10/24/13 18:03:37	123540	11.83	2.61	0.03	6.48	270.39	1,749.36	557.78
10/24/13 18:04:07	123570	11.80	2.52	0.01	6.33	266.52	1,714.84	554.11
10/24/13 18:04:37	123600	12.00	1.80	0.01	6.31	260.54	1,709.27	552.64
10/24/13 18:05:07	123630	11.98	1.65	0.04	6.36	258.43	1,697.37	549.67
10/24/13 18:05:37	123660	11.66	2.51	0.04	6.46	256.32	1,692.52	544.44
RAW AVERAGE		**12.21**	**3.45**	**0.03**	**6.14**	**466.93**	**1,733.03**	**739.17**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	inst-22-0005	inst-co-0020	inst-vc-0003	inst-22-0005	F8_PRF1	F8_TE5	
		(%)	(ppmvd)	(ppmvw)	(%)	(in. H_2O)	(°F)	(SCFH)
Bias	Initial Zero	0.14	0.29	0.03	0.04			
	Final Zero	0.15	0.30	0.05	0.06			
	Avg. Zero	0.15	0.30	0.04	0.05			
	Initial UpScale	12.00	8.74	4.92	8.89			
	Final UpScale	12.03	8.75	4.90	8.86			
	Avg. UpScale	12.02	8.75	4.91	8.88			
Upscale Cal Gas		12.10	9.07	5.04	8.95			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.30	3.38	0.00	6.18
Corrected Raw Average (ppm/% wet basis)	11.56	3.16	0.00	5.81
Concentration (ppm@ 3%CO_2)	N/A	1.64	0.00	N/A
Emission Rate (lb/hr)	N/A	0.10	0.00	N/A

John Zink Co, LLC

ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	5.9	%
Stack Exhaust Flow (M2)	430,583	SCFH

Weather Data

Barometric Pressure	30.43	in. Hg
Relative Humidity	78	%
Ambient Temperature	39	°F
Specific Humidity	0.003823	lb H_2O / lb air

70-100-70 Load, Run - 2.5OD15 R9

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/25/13 8:23:07	175110	13.05	2.14	0.00	5.49			
10/25/13 8:23:37	175140	13.01	2.10	-0.02	5.50			
10/25/13 8:24:07	175170	12.97	1.75	0.00	5.55			
10/25/13 8:24:37	175200	12.95	1.29	0.00	5.56			
10/25/13 8:25:07	175230	12.92	1.16	0.03	5.58			
10/25/13 8:25:37	175260	12.91	1.16	0.03	5.57			
10/25/13 8:26:07	175290	12.77	1.21	0.03	5.60			
10/25/13 8:26:37	175320	12.26	2.35	0.04	5.90			
10/25/13 8:27:07	175350	11.81	2.74	0.04	6.30			
10/25/13 8:27:37	175380	11.76	1.48	0.04	6.37			
10/25/13 8:28:07	175410	11.89	1.34	-0.02	6.27			
10/25/13 8:28:37	175440	11.95	1.48	0.01	6.22			
10/25/13 8:29:07	175470	12.04	1.19	0.03	6.15			
10/25/13 8:29:37	175500	11.95	1.29	0.02	6.20			
10/25/13 8:30:07	175530	12.20	1.36	0.03	6.05			
10/25/13 8:30:37	175560	12.18	1.44	0.03	6.04			
10/25/13 8:31:07	175590	12.33	2.24	0.05	5.94			
10/25/13 8:31:37	175620	12.42	3.06	0.05	5.86			
10/25/13 8:32:07	175650	12.46	1.96	0.06	5.84			
10/25/13 8:32:37	175680	12.48	1.85	0.06	5.82			
10/25/13 8:33:07	175710	12.49	2.12	0.05	5.80			
10/25/13 8:33:37	175740	12.36	1.66	0.07	5.90			
10/25/13 8:34:07	175770	12.35	1.29	0.07	5.90			
10/25/13 8:34:37	175800	12.51	2.10	0.06	5.82			
10/25/13 8:35:07	175830	12.49	2.59	0.06	5.84			
10/25/13 8:35:37	175860	12.53	2.85	0.07	5.78			
10/25/13 8:36:07	175890	12.29	2.05	0.15	5.93			
10/25/13 8:36:37	175920	12.81	0.86	0.10	5.66			
10/25/13 8:37:07	175950	12.91	0.89	0.10	5.52			
10/25/13 8:37:37	175980	12.98	0.91	0.07	5.48			
10/25/13 8:38:07	176010	13.05	0.95	0.05	5.42			
10/25/13 8:38:37	176040	13.03	0.96	0.04	5.45	240.13	1,546.70	559.14
10/25/13 8:39:07	176070	13.08	1.10	0.02	5.39	382.98	1,548.04	833.93
10/25/13 8:39:37	176100	13.02	1.26	0.03	5.44	511.05	1,607.77	833.45
10/25/13 8:40:07	176130	13.00	0.92	0.03	5.47	533.57	1,725.64	831.00
10/25/13 8:40:37	176160	12.92	1.01	0.02	5.51	540.25	1,779.20	827.40
10/25/13 8:41:07	176190	12.95	0.92	0.05	5.51	540.25	1,778.69	828.12
10/25/13 8:41:37	176220	12.44	0.90	0.08	5.66	540.96	1,766.48	826.02
10/25/13 8:42:07	176250	10.59	0.77	0.08	7.13	540.61	1,740.41	829.38
10/25/13 8:42:37	176280	10.27	0.54	0.05	7.47	537.44	1,729.28	828.76
10/25/13 8:43:07	176310	11.11	0.53	0.06	6.89	530.40	1,719.99	825.74
10/25/13 8:43:37	176340	11.24	0.53	0.06	6.79	535.68	1,710.83	825.55
10/25/13 8:44:07	176370	11.93	0.59	0.05	6.30	538.85	1,706.31	824.55
10/25/13 8:44:37	176400	11.91	0.73	0.04	6.24	538.85	1,706.93	827.53
10/25/13 8:45:07	176430	12.13	0.85	0.06	6.14	536.03	1,708.79	826.46
10/25/13 8:45:37	176460	12.32	1.09	0.05	5.91	537.09	1,700.28	826.08
10/25/13 8:46:07	176490	12.31	1.23	0.04	5.97	527.94	1,700.19	826.22
10/25/13 8:46:37	176520	12.43	3.21	0.03	5.84	532.51	1,699.91	826.56
10/25/13 8:47:07	176550	12.19	3.11	0.03	6.00	532.16	1,695.17	824.78
10/25/13 8:47:37	176580	12.05	2.04	0.04	6.17	532.87	1,699.30	823.06
10/25/13 8:48:07	176610	12.29	1.74	0.00	5.98	527.59	1,697.79	824.30

John Zink Co, LLC

ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	5.9	%
Stack Exhaust Flow (M2)	430,583	SCFH

Weather Data

Barometric Pressure	30.43	in. Hg
Relative Humidity	78	%
Ambient Temperature	39	°F
Specific Humidity	0.003823	lb H_2O / lb air

70-100-70 Load, Run - 2.5OD15 R9

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/25/13 8:48:37	176640	12.19	1.80	0.00	6.03	517.03	1,697.44	627.82
10/25/13 8:49:07	176670	12.05	1.32	0.02	6.12	270.39	1,692.55	555.26
10/25/13 8:49:37	176700	11.74	0.62	0.02	6.33	242.95	1,663.99	552.91
10/25/13 8:50:07	176730	12.33	0.53	0.03	6.03	240.84	1,610.79	556.10
10/25/13 8:50:37	176760	12.12	0.75	0.02	5.95	238.73	1,575.90	554.16
10/25/13 8:51:07	176790	12.79	1.23	0.00	5.79	238.02	1,557.95	552.21
10/25/13 8:51:37	176820	12.61	1.01	0.00	5.66	242.24	1,548.22	554.77
10/25/13 8:52:07	176850	13.20	0.55	0.03	5.41	239.08	1,544.41	554.54
10/25/13 8:52:37	176880	13.71	0.83	0.03	4.94	238.02	1,542.67	552.32
10/25/13 8:53:07	176910	13.73	1.38	0.03	4.95	240.84	1,540.10	553.25
10/25/13 8:53:37	176940	13.81	1.47	0.03	4.86	238.73	1,538.91	553.63
10/25/13 8:54:07	176970	13.76	1.51	0.02	4.88	241.89	1,538.96	554.27
10/25/13 8:54:37	177000	13.59	1.46	0.02	5.01	439.63	1,539.54	834.34
10/25/13 8:55:07	177030	13.58	1.23	0.04	5.05	532.51	1,587.98	833.07
10/25/13 8:55:37	177060	13.66	1.53	0.03	4.99	540.25	1,645.53	827.46
10/25/13 8:56:07	177090	13.45	1.61	0.02	5.10	547.29	1,666.93	831.71
10/25/13 8:56:37	177120	13.47	1.33	0.02	5.11	544.12	1,676.44	832.10
10/25/13 8:57:07	177150	12.95	1.52	0.02	5.33	543.42	1,680.36	832.04
10/25/13 8:57:37	177180	11.85	1.36	0.03	6.27	550.46	1,680.64	827.29
10/25/13 8:58:07	177210	11.93	1.05	0.03	6.22	548.70	1,681.03	830.08
10/25/13 8:58:37	177240	12.08	0.76	0.03	6.14	546.94	1,682.68	827.29
10/25/13 8:59:07	177270	11.93	0.54	0.03	6.24	549.75	1,680.92	829.40
10/25/13 8:59:37	177300	12.19	0.81	0.03	5.99	548.35	1,682.72	827.03
10/25/13 9:00:07	177330	11.99	1.06	0.02	6.22	544.48	1,683.26	830.02
10/25/13 9:00:37	177360	12.88	0.89	0.02	5.60	550.11	1,682.46	832.34
10/25/13 9:01:07	177390	12.16	1.04	0.02	5.97	553.27	1,684.08	826.58
10/25/13 9:01:37	177420	12.52	0.67	0.02	5.87	545.88	1,688.73	830.95
10/25/13 9:02:07	177450	12.86	1.18	0.03	5.58	555.74	1,688.01	828.38
10/25/13 9:02:37	177480	12.84	2.04	0.03	5.52	552.22	1,680.55	832.22
10/25/13 9:03:07	177510	12.24	2.17	0.02	5.97	552.92	1,689.93	828.34
10/25/13 9:03:37	177540	12.04	1.19	0.02	6.15	410.78	1,695.19	553.62
10/25/13 9:04:07	177570	12.80	0.73	0.02	5.66	268.28	1,693.16	552.66
10/25/13 9:04:37	177600	12.21	1.19	0.02	5.94	254.91	1,644.50	553.75
10/25/13 9:05:07	177630	12.03	1.06	0.02	6.10	252.45	1,591.24	555.08
10/25/13 9:05:37	177660	11.73	0.85	0.02	6.37	253.15	1,564.33	552.65
10/25/13 9:06:07	177690	11.41	0.77	0.02	6.56	251.04	1,547.56	554.97
10/25/13 9:06:37	177720	12.32	0.91	0.03	6.14	248.58	1,541.87	554.05
10/25/13 9:07:07	177750	13.17	1.13	0.03	5.38	246.47	1,534.92	552.85
10/25/13 9:07:37	177780	13.30	1.57	0.02	5.26	248.58	1,528.68	553.15
10/25/13 9:08:07	177810	13.38	2.02	0.04	5.20	245.76	1,527.43	553.29
10/25/13 9:08:37	177840	13.38	2.41	0.05	5.18	499.44	1,527.74	830.38
10/25/13 9:09:07	177870	13.28	2.67	0.03	5.26	546.94	1,583.42	829.38
10/25/13 9:09:37	177900	13.44	2.84	0.03	5.14	548.35	1,640.47	829.33
10/25/13 9:10:07	177930	13.46	3.40	0.03	5.12	556.44	1,684.53	828.95
10/25/13 9:10:37	177960	13.40	3.91	0.03	5.18	550.81	1,703.44	826.10
10/25/13 9:11:07	177990	13.16	4.08	0.02	5.26	551.51	1,711.35	828.08
10/25/13 9:11:37	178020	12.81	3.14	0.02	5.60	552.22	1,714.00	830.95
10/25/13 9:12:07	178050	12.40	4.07	0.02	5.80	553.27	1,711.43	827.08
10/25/13 9:12:37	178080	12.11	4.26	0.02	6.11	553.62	1,708.72	830.58
10/25/13 9:13:07	178110	12.40	3.12	0.03	5.87	543.42	1,705.88	830.11
10/25/13 9:13:37	178140	12.45	3.91	0.02	5.85	546.94	1,711.93	830.42

John Zink Co, LLC

ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	5.9	%
Stack Exhaust Flow (M2)	430,583	SCFH

Weather Data

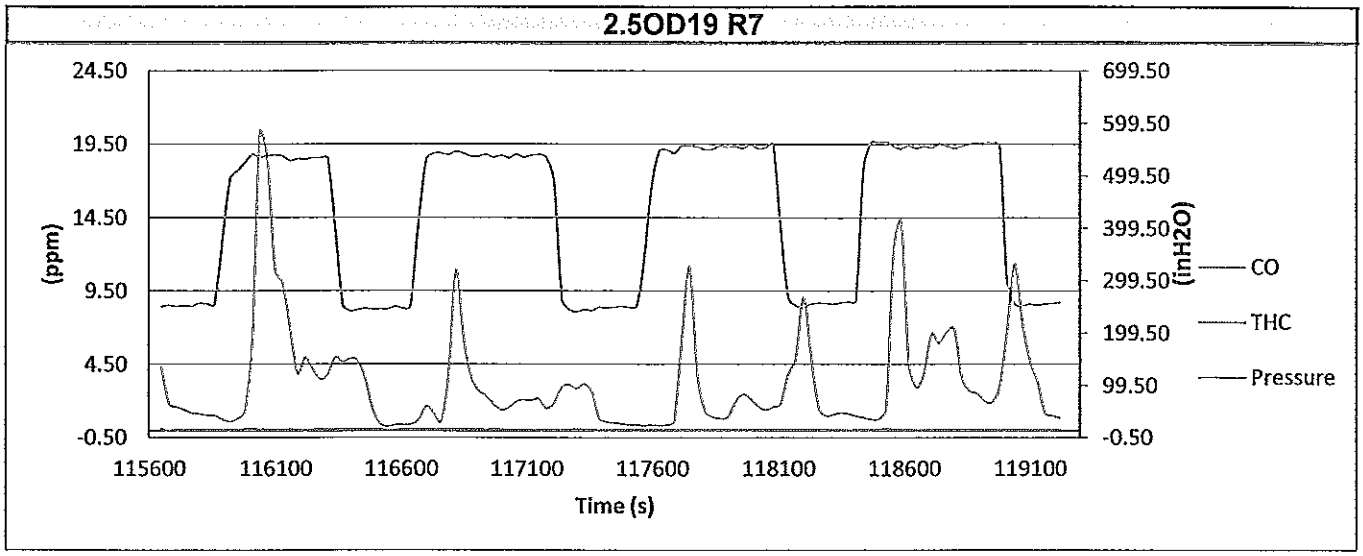
Barometric Pressure	30.43	in. Hg
Relative Humidity	78	%
Ambient Temperature	39	°F
Specific Humidity	0.003823	lb H_2O / lb air

70-100-70 Load, Run - 2.5OD15 R9

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/25/13 9:14:07	178170	12.57	3.65	0.03	5.77	544.12	1,717.25	828.98
10/25/13 9:14:37	178200	12.78	2.52	0.02	5.63	551.51	1,720.31	827.25
10/25/13 9:15:07	178230	12.54	1.54	0.02	5.75	546.59	1,726.70	828.94
10/25/13 9:15:37	178260	12.52	1.52	0.03	5.80	552.57	1,729.45	827.42
10/25/13 9:16:07	178290	12.55	1.63	0.03	5.76	552.22	1,730.36	826.27
10/25/13 9:16:37	178320	12.67	2.41	0.04	5.72	553.98	1,733.11	830.03
10/25/13 9:17:07	178350	12.82	4.94	0.03	5.58	546.24	1,741.73	827.26
10/25/13 9:17:37	178380	12.82	6.28	0.02	5.63	551.16	1,740.09	825.79
10/25/13 9:18:07	178410	12.92	5.54	0.02	5.51	428.02	1,740.83	550.71
10/25/13 9:18:37	178440	12.68	6.44	0.02	5.64	271.45	1,731.60	554.90
10/25/13 9:19:07	178470	12.63	4.86	0.03	5.69	250.69	1,674.37	554.53
10/25/13 9:19:37	178500	12.68	3.82	0.03	5.74	249.28	1,614.38	554.09
10/25/13 9:20:07	178530	12.43	4.68	0.03	5.83	248.58	1,580.20	556.26
10/25/13 9:20:37	178560	13.02	3.87	0.03	5.48	250.34	1,559.06	553.89
10/25/13 9:21:07	178590	12.91	3.61	0.02	5.56	250.34	1,559.06	553.89
10/25/13 9:21:37	178620	13.36	2.86	0.02	5.24	126.14	370.10	556.05
10/25/13 9:22:07	178650	13.80	3.35	0.02	4.89	124.73	609.08	557.60
10/25/13 9:22:37	178680	13.74	5.15	0.02	4.94	125.43	773.12	558.01
RAW AVERAGE		**12.59**	**1.92**	**0.03**	**5.75**	**433.46**	**1,621.84**	**727.74**

	Serial Number:	O_2 inst-22-0005 (%)	CO inst-co-0020 (ppmvd)	THC inst-vc-0003 (ppmvw)	CO_2 inst-22-0005 (%)	Press. Trans F8_PRF1 (in. H_2O)	Temp. Trans. F8_TE5 (°F)	F-Flow Trans. (SCFH)
Bias	Initial Zero	0.08	0.28	0.06	0.04			
	Final Zero	0.09	0.29	0.03	0.04			
	Avg. Zero	0.09	0.29	0.05	0.04			
	Initial UpScale	11.93	9.10	4.91	8.84			
	Final UpScale	11.87	8.72	4.88	8.86			
	Avg. UpScale	11.90	8.91	4.90	8.85			
Upscale Cal Gas		12.10	9.07	5.04	8.95			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.81	1.72	0.00	5.80
Corrected Raw Average (ppm/% wet basis)	12.05	1.60	0.00	5.46
Concentration (ppm@ 3%CO_2)	N/A	0.89	0.00	N/A
Emission Rate (lb/hr)	N/A	0.05	0.00	N/A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14.50
9.50
4.50
-0.50
(ppm)
699.50
599.50
499.50
399.50
299.50
199.50
99.50
-0.50
(inH2O)
CO
THC
Pressure
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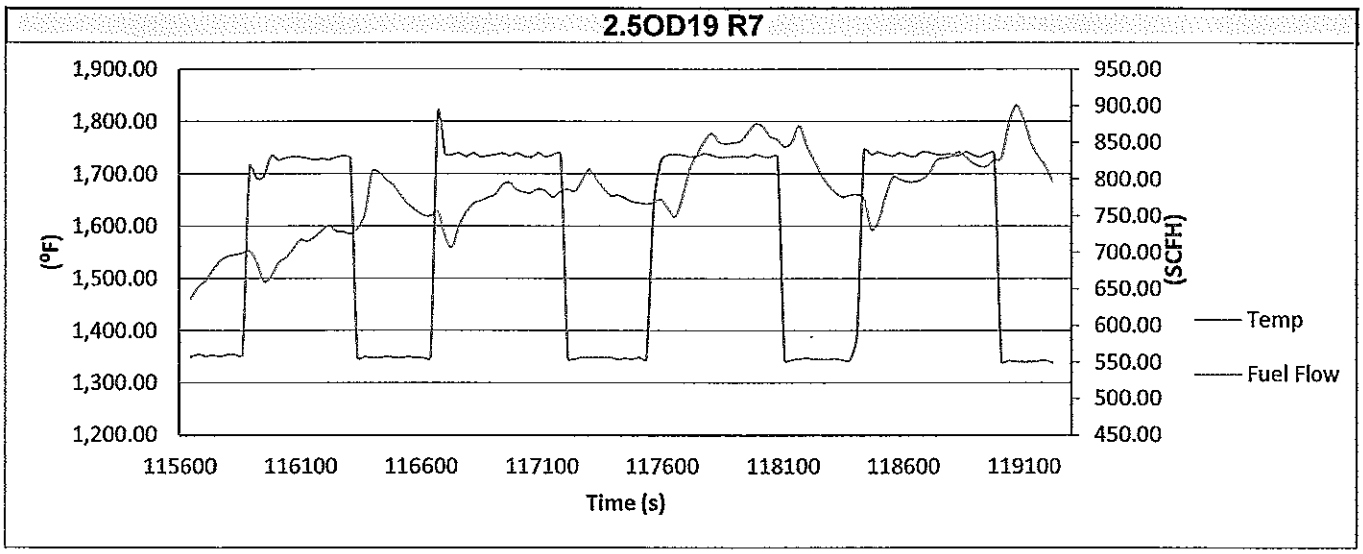
116100
116600
117100
117600
118100
118600
119100
Time (s)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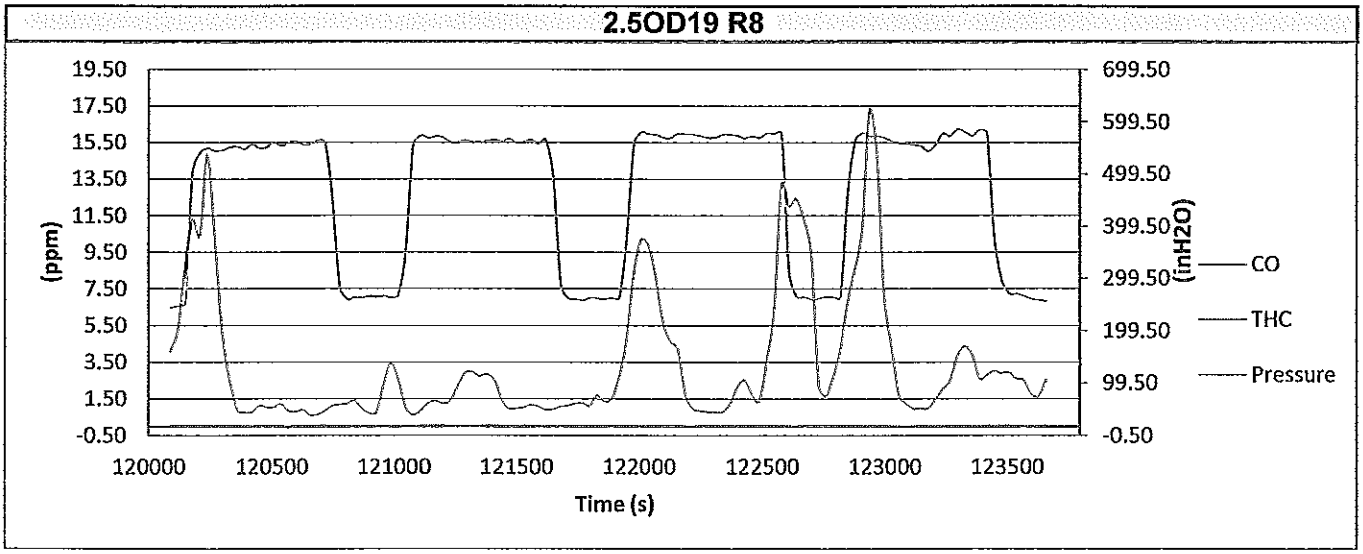
(°F)
950.00
900.00
850.00
800.00
750.00
700.00
650.00
600.00
550.00
500.00
450.00
(SCFH)
Temp
Fuel Flow
115600
116100
116600
117100
117600
118100
118600
119100
Time (s)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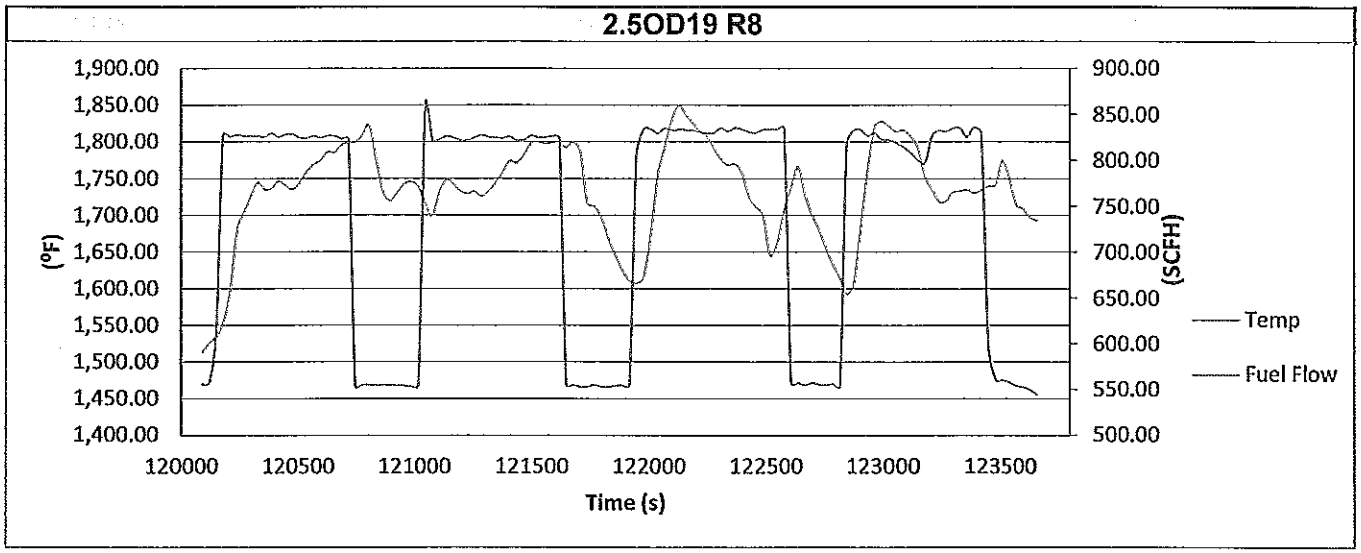
17.50
15.50
13.50
11.50
9.50
7.50
5.50
3.50
1.50
-0.50
(ppm)
699.50
599.50
499.50
399.50
299.50
199.50
99.50
-0.50
(inH2O)
CO
THC
Pressure
120000
120500
121000
121500
122000
122500
123000
123500
Time (s)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1,400.00
(°F)
900.00
850.00
800.00
750.00
700.00
650.00
600.00
550.00
500.00
(SCFH)
Temp
Fuel Flow
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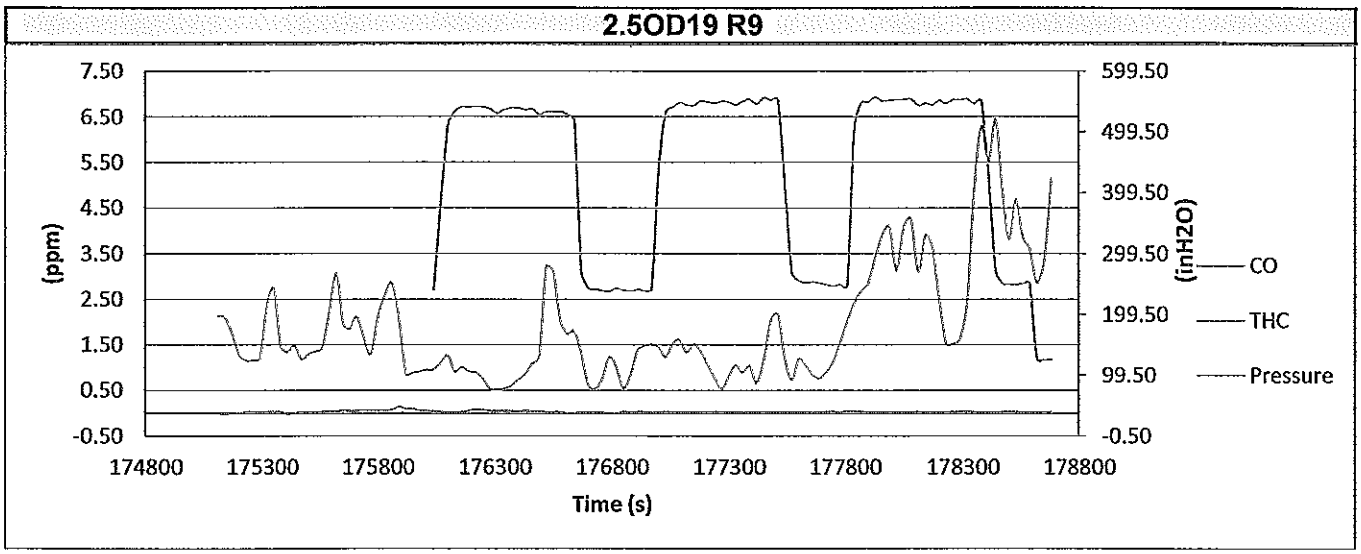
120500
121000
121500
122000
122500
123000
123500
Time (s)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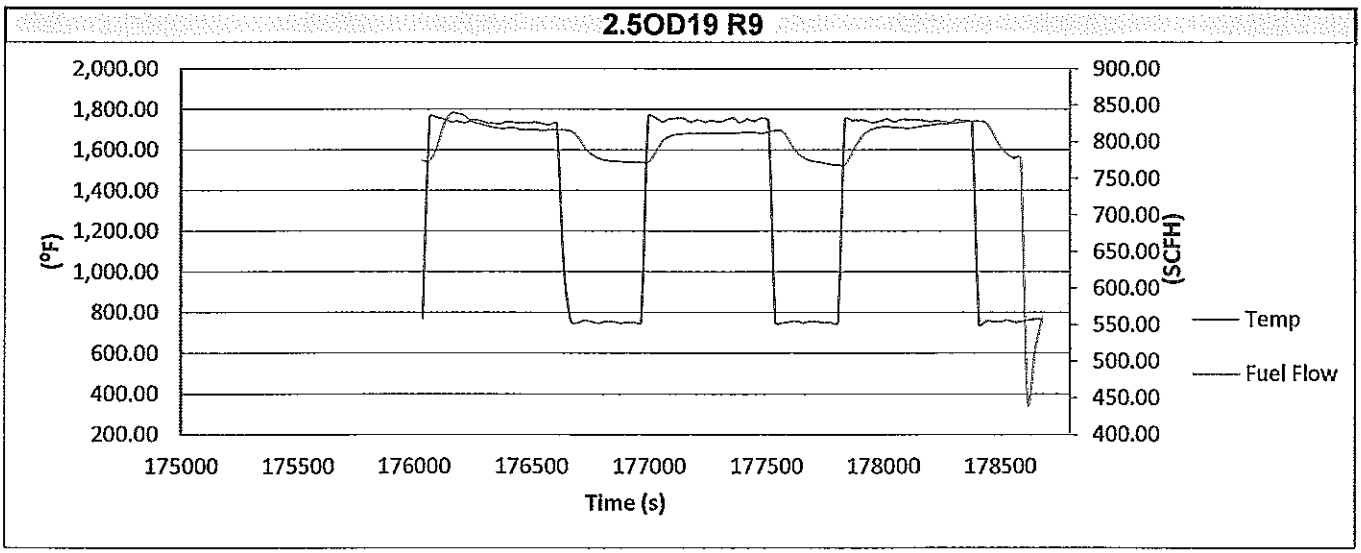
6.50
5.50
4.50
3.50
2.50
1.50
0.50
-0.50
(ppm)
599.50
499.50
399.50
299.50
199.50
99.50
-0.50
(inH2O)
CO
THC
Pressure
174800
175300
175800
176300
176800
177300
177800
178300
178800
Time (s)


2.5OD19 R9
2,000.00
1,800.00
1,600.00
1,400.00
1,200.00
1,000.00
800.00
600.00
400.00
200.00
(°F)
900.00
850.00
800.00
750.00
700.00
650.00
600.00
550.00
500.00
450.00
400.00
(SCFH)
Temp
Fuel Flow
175000
175500
176000
176500
177000
177500
178000
178500
Time (s)

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	5.2	%
Stack Exhaust Flow (M2)	462,413	SCFH

Weather Data

Barometric Pressure	30.44	in. Hg
Relative Humidity	56	%
Ambient Temperature	48	°F
Specific Humidity	0.003874	lb H_2O / lb air

90-100 Load, Run - 2.5OD15 R10

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/25/13 9:43:07	179910	12.52	0.95	0.03	5.78	464.26	1,586.94	827.05
10/25/13 9:43:37	179940	12.35	0.74	0.03	5.89	468.48	1,588.64	826.39
10/25/13 9:44:07	179970	12.33	0.67	0.02	5.95	469.53	1,592.19	827.88
10/25/13 9:44:37	180000	12.27	0.73	0.02	5.94	463.90	1,600.67	826.46
10/25/13 9:45:07	180030	12.32	0.91	0.02	5.94	466.02	1,601.45	827.60
10/25/13 9:45:37	180060	12.22	0.92	0.03	5.99	468.13	1,610.09	828.86
10/25/13 9:46:07	180090	12.26	1.11	0.02	6.00	467.42	1,610.56	826.80
10/25/13 9:46:37	180120	12.30	1.26	0.03	5.94	467.42	1,604.57	825.01
10/25/13 9:47:07	180150	12.17	1.07	0.04	6.06	466.37	1,596.22	823.62
10/25/13 9:47:37	180180	12.38	0.88	0.02	5.91	466.72	1,598.93	825.88
10/25/13 9:48:07	180210	12.36	0.78	0.03	5.90	469.53	1,599.89	823.21
10/25/13 9:48:37	180240	12.28	0.78	0.03	6.00	463.55	1,598.14	825.22
10/25/13 9:49:07	180270	12.40	0.59	0.03	5.86	470.94	1,602.10	823.06
10/25/13 9:49:37	180300	12.46	0.79	0.03	5.85	465.66	1,601.25	824.03
10/25/13 9:50:07	180330	12.36	0.91	0.03	5.88	468.48	1,607.64	823.12
10/25/13 9:50:37	180360	12.19	0.99	0.03	6.00	468.48	1,607.26	824.63
10/25/13 9:51:07	180390	12.16	1.04	0.01	6.08	462.15	1,612.31	823.69
10/25/13 9:51:37	180420	12.22	1.38	0.02	6.01	462.50	1,613.82	823.73
10/25/13 9:52:07	180450	12.19	1.18	0.02	6.05	468.83	1,615.70	826.31
10/25/13 9:52:37	180480	12.26	1.25	0.03	5.99	462.85	1,611.28	826.43
10/25/13 9:53:07	180510	12.34	1.22	0.02	5.91	462.50	1,612.48	822.81
10/25/13 9:53:37	180540	12.17	1.11	0.02	6.05	463.55	1,601.54	822.91
10/25/13 9:54:07	180570	12.23	1.05	0.02	6.02	468.48	1,599.39	827.07
10/25/13 9:54:37	180600	12.20	0.94	0.02	6.00	462.15	1,595.92	822.73
10/25/13 9:55:07	180630	12.12	0.97	0.02	6.09	469.53	1,601.12	822.92
10/25/13 9:55:37	180660	12.05	1.04	0.02	6.12	463.20	1,592.91	826.74
10/25/13 9:56:07	180690	12.25	1.18	0.02	5.99	465.66	1,589.45	826.87
10/25/13 9:56:37	180720	12.08	1.76	0.01	6.15	480.44	1,578.79	822.78
10/25/13 9:57:07	180750	12.17	2.27	0.03	6.05	515.98	1,577.56	821.75
10/25/13 9:57:37	180780	12.13	2.84	0.03	6.08	521.61	1,598.27	823.20
10/25/13 9:58:07	180810	12.33	4.21	0.03	5.93	512.11	1,618.28	822.95
10/25/13 9:58:37	180840	12.31	3.53	0.02	5.96	520.20	1,631.48	826.84
10/25/13 9:59:07	180870	12.46	3.11	0.03	5.83	513.51	1,634.96	825.75
10/25/13 9:59:37	180900	12.52	3.71	0.02	5.79	522.66	1,634.64	827.23
10/25/13 10:00:07	180930	12.34	3.27	0.03	5.91	523.37	1,628.49	822.82
10/25/13 10:00:37	180960	12.24	2.19	0.03	5.96	519.50	1,623.85	825.01
10/25/13 10:01:07	180990	12.09	1.31	0.04	6.13	517.03	1,630.22	824.45
10/25/13 10:01:37	181020	12.02	1.46	0.03	6.16	520.90	1,627.41	821.81
10/25/13 10:02:07	181050	12.32	1.88	0.00	5.96	519.50	1,626.81	822.63
10/25/13 10:02:37	181080	12.54	2.14	0.00	5.80	516.68	1,632.79	825.39
10/25/13 10:03:07	181110	12.57	2.97	0.04	5.75	515.98	1,636.76	823.48
10/25/13 10:03:37	181140	12.15	3.22	0.03	6.01	519.85	1,632.88	826.43
10/25/13 10:04:07	181170	12.42	6.05	0.03	5.90	520.90	1,629.74	826.20
10/25/13 10:04:37	181200	12.37	6.19	0.03	5.88	520.20	1,633.30	826.69
10/25/13 10:05:07	181230	12.55	3.41	0.03	5.78	525.48	1,635.46	822.39
10/25/13 10:05:37	181260	12.23	2.25	0.02	5.99	517.74	1,637.38	826.69
10/25/13 10:06:07	181290	12.36	2.29	0.05	5.88	518.44	1,639.65	822.47
10/25/13 10:06:37	181320	12.38	2.42	0.05	5.90	524.07	1,641.22	821.84
10/25/13 10:07:07	181350	12.39	1.94	0.03	5.87	516.68	1,643.27	824.72
10/25/13 10:07:37	181380	12.30	2.20	0.01	5.93	516.68	1,639.23	821.97
10/25/13 10:08:07	181410	12.31	2.33	0.03	5.91	524.42	1,641.37	826.27
10/25/13 10:08:37	181440	12.12	2.36	0.04	6.09	521.96	1,644.39	823.71

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	5.2	%
Stack Exhaust Flow (M2)	462,413	SCFH

Weather Data

Barometric Pressure	30.44	in. Hg
Relative Humidity	56	%
Ambient Temperature	48	°F
Specific Humidity	0.003874	lb H_2O / lb air

90-100 Load, Run - 2.5OD15 R10

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/25/13 10:09:07	181470	12.07	1.94	0.04	6.11	520.20	1,637.54	821.07
10/25/13 10:09:37	181500	12.29	1.92	0.02	5.96	521.25	1,631.75	821.32
10/25/13 10:10:07	181530	12.26	1.98	0.02	5.96	524.07	1,631.01	821.14
10/25/13 10:10:37	181560	12.15	1.97	0.02	6.00	517.74	1,634.43	824.93
10/25/13 10:11:07	181590	12.13	1.80	0.00	6.07	517.38	1,639.14	826.25
10/25/13 10:11:37	181620	12.25	1.76	0.00	6.01	518.44	1,640.57	823.47
10/25/13 10:12:07	181650	12.38	1.93	0.02	5.87	525.83	1,643.56	826.09
10/25/13 10:12:37	181680	12.40	1.71	0.02	5.86	527.59	1,651.69	826.06
10/25/13 10:13:07	181710	12.31	1.58	0.02	5.94	524.42	1,651.21	821.04
10/25/13 10:13:37	181740	12.24	1.88	0.04	6.01	528.29	1,650.51	822.96
10/25/13 10:14:07	181770	12.33	1.74	0.03	5.90	526.18	1,647.08	823.67
10/25/13 10:14:37	181800	12.10	1.90	0.02	6.05	526.88	1,645.73	823.13
10/25/13 10:15:07	181830	11.95	2.37	0.02	6.22	526.53	1,642.76	820.99
10/25/13 10:15:37	181860	12.09	2.71	0.01	6.11	523.37	1,643.22	825.45
10/25/13 10:16:07	181890	12.02	3.48	0.03	6.14	524.77	1,641.89	825.32
10/25/13 10:16:37	181920	12.23	3.58	0.02	6.02	520.20	1,644.16	824.87
10/25/13 10:17:07	181950	12.30	3.03	0.03	5.92	520.20	1,644.24	825.10
10/25/13 10:17:37	181980	12.66	2.42	0.02	5.75	520.55	1,649.63	824.61
10/25/13 10:18:07	182010	12.62	1.83	0.02	5.71	525.12	1,653.90	824.97
10/25/13 10:18:37	182040	12.61	1.49	0.02	5.73	523.01	1,648.55	824.02
10/25/13 10:19:07	182070	12.56	1.68	0.02	5.76	526.88	1,652.08	823.76
10/25/13 10:19:37	182100	12.67	1.68	0.02	5.69	524.77	1,653.14	822.93
10/25/13 10:20:07	182130	12.28	2.01	0.06	5.92	529.70	1,654.98	823.93
10/25/13 10:20:37	182160	12.07	2.07	0.05	6.09	528.29	1,657.33	821.26
10/25/13 10:21:07	182190	12.29	2.26	0.03	5.93	528.64	1,657.66	822.75
10/25/13 10:21:37	182220	12.23	2.19	0.02	6.01	525.12	1,657.10	823.26
10/25/13 10:22:07	182250	12.42	2.45	0.03	5.83	533.92	1,660.98	825.54
10/25/13 10:22:37	182280	12.23	2.70	0.03	5.96	534.27	1,661.69	824.81
10/25/13 10:23:07	182310	12.13	3.70	0.03	6.08	527.59	1,658.12	822.06
10/25/13 10:23:37	182340	12.38	5.00	0.03	5.93	528.29	1,658.47	826.37
10/25/13 10:24:07	182370	12.37	5.34	0.03	5.87	534.62	1,661.46	821.26
10/25/13 10:24:37	182400	12.32	6.55	0.03	5.92	526.88	1,662.97	823.28
10/25/13 10:25:07	182430	12.37	9.92	0.02	5.90	536.03	1,658.96	822.46
10/25/13 10:25:37	182460	12.48	9.46	0.02	5.80	530.40	1,657.51	822.67
10/25/13 10:26:07	182490	12.14	4.06	0.02	6.02	526.88	1,656.79	822.68
10/25/13 10:26:37	182520	12.20	2.76	0.02	6.03	528.29	1,670.02	824.03
10/25/13 10:27:07	182550	12.10	3.70	0.03	6.09	538.14	1,665.07	826.40
10/25/13 10:27:37	182580	12.14	5.78	0.03	6.04	531.46	1,666.20	824.65
10/25/13 10:28:07	182610	12.45	5.87	0.01	5.85	530.75	1,665.12	826.60
10/25/13 10:28:37	182640	12.51	5.71	0.01	5.80	529.35	1,660.71	824.55
10/25/13 10:29:07	182670	12.21	5.12	0.02	5.95	538.14	1,666.10	825.04
10/25/13 10:29:37	182700	12.29	5.40	0.02	5.96	537.09	1,669.42	821.30
10/25/13 10:30:07	182730	12.52	7.36	0.02	5.82	527.24	1,661.70	825.66
10/25/13 10:30:37	182760	12.44	5.32	0.03	5.80	535.33	1,658.31	822.73
10/25/13 10:31:07	182790	12.36	3.47	0.02	5.90	533.92	1,656.26	820.98
10/25/13 10:31:37	182820	12.36	2.57	0.03	5.89	527.59	1,654.56	822.55
10/25/13 10:32:07	182850	12.43	2.94	0.02	5.83	536.03	1,658.45	820.44
10/25/13 10:32:37	182880	12.62	3.00	0.02	5.71	532.16	1,661.40	821.13
10/25/13 10:33:07	182910	12.54	2.96	0.03	5.75	533.57	1,666.15	823.50
10/25/13 10:33:37	182940	12.65	2.58	0.02	5.70	529.70	1,668.31	821.08
10/25/13 10:34:07	182970	12.27	2.97	0.04	5.92	536.03	1,668.70	821.84
10/25/13 10:34:37	183000	12.35	2.80	0.03	5.87	529.00	1,671.97	821.40

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	5.2	%
Stack Exhaust Flow (M2)	462,413	SCFH

Weather Data

Barometric Pressure	30.44	in. Hg
Relative Humidity	56	%
Ambient Temperature	48	°F
Specific Humidity	0.003874	lb H_2O / lb air

90-100 Load, Run - 2.5OD15 R10

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/25/13 10:35:07	183030	12.36	2.74	0.03	5.93	529.70	1,674.11	826.19
10/25/13 10:35:37	183060	12.24	3.68	0.02	5.93	537.79	1,672.58	822.48
10/25/13 10:36:07	183090	12.16	2.91	0.03	6.06	532.51	1,670.19	823.15
10/25/13 10:36:37	183120	12.38	1.72	0.02	5.83	532.87	1,667.78	826.29
10/25/13 10:37:07	183150	12.23	1.48	0.03	5.99	532.87	1,662.47	822.36
10/25/13 10:37:37	183180	12.55	1.92	0.02	5.85	527.94	1,665.62	825.24
10/25/13 10:38:07	183210	12.75	3.91	0.03	5.61	533.92	1,675.43	822.15
10/25/13 10:38:37	183240	12.84	4.59	0.02	5.57	537.79	1,687.92	824.88
10/25/13 10:39:07	183270	12.70	4.27	0.02	5.64	537.09	1,681.11	821.56
10/25/13 10:39:37	183300	12.89	2.71	0.02	5.53	530.05	1,674.41	825.74
10/25/13 10:40:07	183330	12.69	2.77	0.04	5.61	534.98	1,674.19	821.47
10/25/13 10:40:37	183360	12.68	3.34	0.02	5.70	539.55	1,673.52	825.41
10/25/13 10:41:07	183390	12.30	2.91	0.02	5.88	537.09	1,675.75	822.26
10/25/13 10:41:37	183420	12.52	1.80	0.03	5.81	532.87	1,672.24	822.25
10/25/13 10:42:07	183450	12.63	2.24	0.05	5.70	532.51	1,667.68	821.95
10/25/13 10:42:37	183480	12.59	2.91	0.05	5.71	537.44	1,670.92	824.62
RAW AVERAGE		**12.34**	**2.65**	**0.03**	**5.92**	**512.81**	**1,639.56**	**824.03**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	inst-22-0005	inst-co-0020	inst-vc-0003	inst-22-0005	F8_PRF1	F8_TE5	
		(%)	(ppmvd)	(ppmvw)	(%)	(in. H_2O)	(°F)	(SCFH)
Bias	Initial Zero	0.09	0.29	0.03	0.04			
	Final Zero	0.08	0.34	0.05	0.02			
	Avg. Zero	0.09	0.32	0.04	0.03			
	Initial UpScale	11.87	8.72	4.88	8.86			
	Final UpScale	11.95	8.71	4.85	8.87			
	Avg. UpScale	11.91	8.72	4.87	8.87			
Upscale Cal Gas		12.10	9.07	5.04	8.95			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.54	2.52	0.00	5.96
Corrected Raw Average (ppm/% wet basis)	11.88	2.37	-0.02	5.65
Concentration (ppm@ 3%CO_2)	N/A	1.27	0.00	N/A
Emission Rate (lb/hr)	N/A	0.08	0.00	N/A

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	5.8	%
Stack Exhaust Flow (M2)	508,750	SCFH

Weather Data

Barometric Pressure	30.43	in. Hg
Relative Humidity	52	%
Ambient Temperature	50	°F
Specific Humidity	0.003878	lb H_2O / lb air

90-100 Load, Run - 2.5OD15 R11

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/25/13 10:54:07	184170	11.99	2.54	0.02	6.22	550.46	1,669.83	819.71
10/25/13 10:54:37	184200	12.17	3.84	0.02	6.11	551.51	1,680.48	821.87
10/25/13 10:55:07	184230	12.27	5.14	0.04	6.07	559.25	1,694.49	820.98
10/25/13 10:55:37	184260	12.26	6.57	0.04	6.03	555.03	1,690.49	824.40
10/25/13 10:56:07	184290	11.98	7.82	0.02	6.22	548.70	1,688.13	822.87
10/25/13 10:56:37	184320	11.79	8.34	0.02	6.32	552.57	1,686.67	823.03
10/25/13 10:57:07	184350	11.66	9.14	0.01	6.47	548.35	1,677.11	823.97
10/25/13 10:57:37	184380	11.82	10.70	0.01	6.45	545.53	1,685.29	824.18
10/25/13 10:58:07	184410	12.43	12.56	0.02	5.96	547.64	1,688.17	824.85
10/25/13 10:58:37	184440	12.28	6.75	0.02	6.05	552.57	1,686.37	824.28
10/25/13 10:59:07	184470	12.71	5.51	0.04	5.73	544.83	1,682.84	821.44
10/25/13 10:59:37	184500	12.16	11.05	0.04	6.04	554.33	1,682.47	820.48
10/25/13 11:00:07	184530	11.81	15.69	0.03	6.30	552.22	1,686.46	823.66
10/25/13 11:00:37	184560	11.84	14.21	0.03	6.46	549.75	1,681.52	825.10
10/25/13 11:01:07	184590	12.24	10.40	0.02	6.08	545.88	1,682.21	823.25
10/25/13 11:01:37	184620	12.32	7.36	0.02	5.96	551.16	1,679.37	824.87
10/25/13 11:02:07	184650	12.43	6.45	0.02	5.99	549.75	1,675.79	823.31
10/25/13 11:02:37	184680	12.43	7.37	0.02	5.86	544.83	1,689.21	824.56
10/25/13 11:03:07	184710	12.26	5.30	0.03	6.06	548.35	1,709.41	820.36
10/25/13 11:03:37	184740	12.13	1.99	0.02	6.09	555.03	1,702.09	825.09
10/25/13 11:04:07	184770	11.89	1.84	0.04	6.31	551.51	1,698.68	823.28
10/25/13 11:04:37	184800	11.57	2.23	0.03	6.48	547.29	1,701.22	825.30
10/25/13 11:05:07	184830	11.42	4.64	0.02	6.74	551.87	1,698.50	821.19
10/25/13 11:05:37	184860	11.31	5.46	0.02	6.65	553.27	1,690.15	823.50
10/25/13 11:06:07	184890	11.70	6.83	0.02	6.52	550.11	1,688.42	825.72
10/25/13 11:06:37	184920	11.42	11.43	0.03	6.70	544.83	1,684.10	823.32
10/25/13 11:07:07	184950	11.87	13.43	0.02	6.34	550.11	1,677.89	824.60
10/25/13 11:07:37	184980	11.62	12.03	0.02	6.53	548.35	1,663.32	824.07
10/25/13 11:08:07	185010	11.72	10.04	0.02	6.50	540.61	1,643.22	822.27
10/25/13 11:08:37	185040	11.43	8.50	0.02	6.58	544.48	1,637.50	823.26
10/25/13 11:09:07	185070	11.89	7.15	0.02	6.42	546.59	1,637.28	827.04
10/25/13 11:09:37	185100	11.90	5.38	0.02	6.32	541.31	1,640.24	823.13
10/25/13 11:10:07	185130	12.38	3.85	0.02	6.03	545.88	1,637.05	825.54
10/25/13 11:10:37	185160	12.76	2.78	0.02	5.70	542.37	1,627.04	826.30
10/25/13 11:11:07	185190	12.53	2.29	-0.01	5.78	544.83	1,617.24	824.11
10/25/13 11:11:37	185220	12.16	2.71	-0.01	6.24	547.29	1,619.38	823.54
10/25/13 11:12:07	185250	12.69	3.09	0.03	5.71	544.83	1,622.19	826.29
10/25/13 11:12:37	185280	12.71	4.19	0.02	5.76	549.75	1,632.40	824.83
10/25/13 11:13:07	185310	12.86	5.97	0.02	5.67	551.51	1,630.15	821.92
10/25/13 11:13:37	185340	13.24	6.32	0.03	5.41	555.38	1,628.89	822.04
10/25/13 11:14:07	185370	12.93	5.27	0.02	5.55	550.46	1,618.61	822.58
10/25/13 11:14:37	185400	13.25	3.93	0.02	5.42	556.09	1,617.36	823.71
10/25/13 11:15:07	185430	12.52	4.46	0.03	5.70	548.70	1,625.09	822.89
10/25/13 11:15:37	185460	12.07	4.11	0.03	6.23	556.44	1,635.57	825.59
10/25/13 11:16:07	185490	12.40	4.69	0.02	6.00	552.57	1,639.93	825.20
10/25/13 11:16:37	185520	13.28	6.20	0.01	5.40	557.14	1,638.70	821.12
10/25/13 11:17:07	185550	12.97	6.79	0.02	5.59	550.11	1,637.20	823.74
10/25/13 11:17:37	185580	12.82	5.66	0.02	5.49	551.51	1,643.22	821.66
10/25/13 11:18:07	185610	12.40	4.25	0.02	6.02	559.96	1,639.06	822.05
10/25/13 11:18:37	185640	12.96	3.04	0.02	5.59	556.09	1,637.87	823.24
10/25/13 11:19:07	185670	13.03	2.86	0.02	5.57	551.87	1,635.05	822.67
10/25/13 11:19:37	185700	12.72	4.05	0.02	5.63	559.61	1,650.32	823.55

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	5.8	%
Stack Exhaust Flow (M2)	508,750	SCFH

Weather Data

Barometric Pressure	30.43	in. Hg
Relative Humidity	52	%
Ambient Temperature	50	°F
Specific Humidity	0.003878	lb H_2O / lb air

90-100 Load, Run - 2.5OD15 R11

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/25/13 11:20:07	185730	12.16	3.33	0.03	6.13	557.85	1,665.53	825.02
10/25/13 11:20:37	185760	12.60	2.30	0.01	5.81	552.92	1,665.39	822.98
10/25/13 11:21:07	185790	12.80	2.62	0.02	5.69	560.66	1,661.41	824.79
10/25/13 11:21:37	185820	12.73	2.54	0.02	5.68	559.96	1,659.38	821.47
10/25/13 11:22:07	185850	12.52	2.22	0.05	5.86	563.83	1,654.94	824.27
10/25/13 11:22:37	185880	12.44	1.82	0.05	5.91	564.88	1,650.12	819.97
10/25/13 11:23:07	185910	12.64	1.71	0.05	5.87	558.55	1,644.91	819.97
10/25/13 11:23:37	185940	12.93	2.13	0.05	5.54	558.55	1,648.50	824.22
10/25/13 11:24:07	185970	12.96	2.46	0.02	5.55	566.64	1,650.53	819.79
10/25/13 11:24:37	186000	12.72	2.74	0.02	5.73	557.49	1,654.17	823.86
10/25/13 11:25:07	186030	12.58	2.68	0.03	5.86	558.20	1,648.57	823.21
10/25/13 11:25:37	186060	12.25	2.71	0.03	5.97	558.55	1,639.12	824.35
10/25/13 11:26:07	186090	11.75	2.95	0.02	6.43	552.57	1,640.98	824.73
10/25/13 11:26:37	186120	12.40	3.33	0.01	6.01	553.98	1,633.98	820.65
10/25/13 11:27:07	186150	12.21	3.76	0.04	6.09	549.40	1,630.54	819.66
10/25/13 11:27:37	186180	12.87	3.70	0.04	5.68	552.57	1,639.88	824.49
10/25/13 11:28:07	186210	12.93	3.57	0.02	5.56	550.11	1,639.46	824.19
10/25/13 11:28:37	186240	13.13	2.67	0.02	5.44	547.64	1,647.30	825.60
10/25/13 11:29:07	186270	13.08	2.31	0.02	5.50	556.09	1,656.39	823.59
10/25/13 11:29:37	186300	12.80	2.43	0.02	5.66	550.81	1,661.17	822.08
10/25/13 11:30:07	186330	12.81	2.64	0.02	5.74	556.44	1,643.94	820.46
10/25/13 11:30:37	186360	12.80	2.79	0.02	5.61	551.87	1,643.68	820.14
10/25/13 11:31:07	186390	12.60	1.95	0.02	5.81	553.27	1,648.02	821.12
10/25/13 11:31:37	186420	12.15	1.99	0.03	6.02	555.74	1,662.32	823.72
10/25/13 11:32:07	186450	11.84	1.77	0.02	6.43	551.87	1,666.62	823.43
10/25/13 11:32:37	186480	12.71	1.87	0.02	5.82	550.11	1,657.32	824.49
10/25/13 11:33:07	186510	12.87	2.77	0.02	5.58	550.46	1,642.02	823.38
10/25/13 11:33:37	186540	12.67	3.21	0.02	5.74	551.87	1,637.53	823.01
10/25/13 11:34:07	186570	12.53	3.18	0.03	5.76	553.27	1,650.43	821.10
10/25/13 11:34:37	186600	12.10	3.07	0.01	6.23	558.55	1,655.56	820.94
10/25/13 11:35:07	186630	12.43	3.00	0.03	5.97	555.38	1,641.70	824.08
10/25/13 11:35:37	186660	12.76	3.36	0.03	5.76	559.61	1,634.08	822.15
10/25/13 11:36:07	186690	13.16	3.86	0.02	5.41	552.22	1,631.02	820.08
10/25/13 11:36:37	186720	12.91	4.90	0.03	5.55	555.03	1,628.23	823.19
10/25/13 11:37:07	186750	12.71	4.31	0.02	5.76	558.55	1,647.11	823.72
10/25/13 11:37:37	186780	13.48	3.56	0.02	5.31	557.49	1,647.91	821.45
10/25/13 11:38:07	186810	14.18	5.86	0.02	4.71	560.31	1,638.93	819.48
10/25/13 11:38:37	186840	13.73	9.30	0.02	4.96	562.77	1,641.05	824.91
10/25/13 11:39:07	186870	14.03	7.99	0.03	4.87	567.70	1,642.89	821.83
10/25/13 11:39:37	186900	13.81	6.99	0.02	4.93	569.81	1,661.04	826.45
10/25/13 11:40:07	186930	12.73	5.93	0.02	5.64	567.70	1,674.20	825.15
10/25/13 11:40:37	186960	12.98	4.44	0.03	5.57	570.86	1,688.78	826.90
10/25/13 11:41:07	186990	13.56	4.43	0.02	5.21	568.05	1,690.76	824.10
10/25/13 11:41:37	187020	13.02	5.88	0.02	5.45	568.40	1,695.78	825.00
10/25/13 11:42:07	187050	12.46	4.76	0.02	5.81	568.75	1,692.24	823.63
10/25/13 11:42:37	187080	12.02	3.35	0.02	6.18	568.05	1,710.15	824.20
10/25/13 11:43:07	187110	11.57	2.82	0.02	6.57	566.64	1,721.45	823.28
10/25/13 11:43:37	187140	12.19	2.70	0.02	6.22	569.81	1,715.09	827.54
10/25/13 11:44:07	187170	12.35	2.01	0.05	5.94	575.09	1,708.48	824.11
10/25/13 11:44:37	187200	12.85	1.58	0.05	5.76	569.46	1,699.44	824.68
10/25/13 11:45:07	187230	12.80	2.84	0.02	5.54	567.70	1,687.48	822.39
10/25/13 11:45:37	187260	12.64	3.62	0.02	5.79	568.40	1,688.34	823.28

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	5.8	%
Stack Exhaust Flow (M2)	508,750	SCFH

Weather Data

Barometric Pressure	30.43	in. Hg
Relative Humidity	52	%
Ambient Temperature	50	°F
Specific Humidity	0.003878	lb H_2O / lb air

90-100 Load, Run - 2.5OD15 R11

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/25/13 11:46:07	187290	12.49	3.14	0.05	5.84	565.59	1,689.17	822.07
10/25/13 11:46:37	187320	12.53	3.04	0.05	5.93	573.68	1,692.78	824.62
10/25/13 11:47:07	187350	12.94	2.34	0.02	5.61	565.94	1,689.97	822.40
10/25/13 11:47:37	187380	12.69	1.94	0.01	5.72	572.27	1,686.76	825.67
10/25/13 11:48:07	187410	12.69	2.45	0.06	5.70	567.70	1,695.55	824.72
10/25/13 11:48:37	187440	12.79	3.26	0.05	5.76	568.75	1,701.57	823.19
10/25/13 11:49:07	187470	13.19	2.23	0.04	5.43	565.59	1,707.63	821.82
10/25/13 11:49:37	187500	13.17	2.64	0.04	5.38	573.33	1,720.10	826.53
10/25/13 11:50:07	187530	13.03	3.15	0.05	5.46	564.88	1,725.56	826.40
10/25/13 11:50:37	187560	12.88	2.82	0.05	5.68	571.57	1,725.03	826.72
10/25/13 11:51:07	187590	13.06	2.68	0.03	5.46	573.33	1,730.04	823.19
10/25/13 11:51:37	187620	13.41	2.69	0.02	5.26	573.33	1,730.04	823.19
10/25/13 11:52:07	187650	13.41	2.53	0.01	5.27	483.26	526.38	827.73
10/25/13 11:52:37	187680	13.30	2.70	0.03	5.30	526.18	950.81	825.28
10/25/13 11:53:07	187710	13.25	2.16	0.02	5.35	539.90	1,228.06	823.52
10/25/13 11:53:37	187740	13.06	2.00	0.02	5.41	539.90	1,386.39	827.08
RAW AVERAGE		**12.56**	**4.61**	**0.02**	**5.84**	**555.23**	**1,644.02**	**823.48**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	inst-22-0005	inst-co-0020	inst-vc-0003	inst-22-0005	F8_PRF1	F8_TE5	
		(%)	(ppmvd)	(ppmvw)	(%)	(in. H_2O)	(°F)	(SCFH)
Bias	Initial Zero	0.08	0.34	0.05	0.02			
	Final Zero	0.07	0.28	0.02	0.04			
	Avg. Zero	0.08	0.31	0.04	0.03			
	Initial UpScale	11.95	8.71	4.85	8.87			
	Final UpScale	11.95	8.73	4.86	8.86			
	Avg. UpScale	11.95	8.72	4.86	8.87			
Upscale Cal Gas		12.10	9.07	5.04	8.95			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.72	4.63	0.00	5.89
Corrected Raw Average (ppm/% wet basis)	11.98	4.34	-0.01	5.55
Concentration (ppm@ 3%CO_2)	N/A	2.36	0.00	N/A
Emission Rate (lb/hr)	N/A	0.17	0.00	N/A

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.8	%
Stack Exhaust Flow (M2)	508,371	SCFH

Weather Data

Barometric Pressure	30.42	in. Hg
Relative Humidity	46	%
Ambient Temperature	54	°F
Specific Humidity	0.003978	lb H_2O / lb air

90-100 Load, Run - 2.5OD15 R12

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/25/13 12:08:07	188610	13.09	2.25	0.01	5.44	558.55	1,576.52	825.30
10/25/13 12:08:37	188640	13.43	1.52	0.02	5.32	560.31	1,579.14	825.71
10/25/13 12:09:07	188670	13.61	1.69	0.02	5.08	561.36	1,585.14	825.45
10/25/13 12:09:37	188700	12.85	1.92	0.02	5.54	561.36	1,597.28	824.25
10/25/13 12:10:07	188730	13.11	1.27	0.07	5.52	562.77	1,605.58	822.18
10/25/13 12:10:37	188760	13.07	1.29	0.05	5.47	558.55	1,627.93	827.05
10/25/13 12:11:07	188790	13.24	1.05	0.03	5.37	561.01	1,645.84	824.92
10/25/13 12:11:37	188820	13.44	1.08	0.03	5.23	567.70	1,657.33	824.98
10/25/13 12:12:07	188850	12.97	1.70	0.05	5.56	564.53	1,646.33	822.95
10/25/13 12:12:37	188880	12.98	1.29	-0.04	5.47	561.72	1,642.66	826.51
10/25/13 12:13:07	188910	12.68	1.67	0.02	5.74	570.51	1,640.75	823.96
10/25/13 12:13:37	188940	12.63	1.20	0.04	5.79	564.88	1,640.50	824.67
10/25/13 12:14:07	188970	12.25	0.93	0.04	5.98	562.77	1,647.94	826.19
10/25/13 12:14:37	189000	12.45	1.25	0.02	5.99	568.05	1,651.16	826.77
10/25/13 12:15:07	189030	12.77	1.69	0.02	5.63	568.40	1,652.99	826.29
10/25/13 12:15:37	189060	12.71	1.72	0.02	5.74	560.31	1,662.07	822.32
10/25/13 12:16:07	189090	13.05	1.77	0.02	5.53	569.46	1,668.01	828.57
10/25/13 12:16:37	189120	13.01	2.33	0.03	5.53	568.40	1,679.89	829.99
10/25/13 12:17:07	189150	13.02	2.15	0.02	5.50	568.40	1,693.17	830.78
10/25/13 12:17:37	189180	13.14	1.33	0.02	5.45	571.57	1,701.74	829.69
10/25/13 12:18:07	189210	13.09	0.66	0.05	5.44	571.57	1,706.58	832.69
10/25/13 12:18:37	189240	12.88	0.50	0.06	5.61	574.38	1,718.19	829.72
10/25/13 12:19:07	189270	12.68	0.47	0.02	5.71	566.99	1,720.99	828.99
10/25/13 12:19:37	189300	12.69	0.40	0.01	5.74	569.46	1,722.87	828.13
10/25/13 12:20:07	189330	12.76	0.35	0.02	5.66	573.33	1,723.31	828.45
10/25/13 12:20:37	189360	12.47	0.35	0.02	5.87	572.62	1,723.66	831.54
10/25/13 12:21:07	189390	12.13	0.35	0.02	6.10	574.03	1,719.46	828.29
10/25/13 12:21:37	189420	12.14	0.53	0.02	6.12	574.03	1,719.44	827.97
10/25/13 12:22:07	189450	12.12	0.70	0.03	6.15	573.33	1,718.37	831.01
10/25/13 12:22:37	189480	12.13	0.78	0.02	6.13	566.64	1,720.55	828.40
10/25/13 12:23:07	189510	12.05	0.75	0.02	6.18	574.73	1,715.12	830.60
10/25/13 12:23:37	189540	12.04	0.73	0.02	6.22	572.98	1,711.38	831.54
10/25/13 12:24:07	189570	12.24	0.87	0.02	6.07	567.35	1,714.17	827.47
10/25/13 12:24:37	189600	12.44	0.77	0.02	5.91	566.64	1,718.24	826.70
10/25/13 12:25:07	189630	12.20	0.72	0.04	6.05	576.49	1,732.94	826.91
10/25/13 12:25:37	189660	12.30	0.66	0.04	5.99	570.16	1,725.91	826.71
10/25/13 12:26:07	189690	12.38	0.76	0.02	5.98	573.33	1,726.83	827.90
10/25/13 12:26:37	189720	12.35	0.63	0.02	5.94	581.07	1,722.63	825.90
10/25/13 12:27:07	189750	12.16	0.72	0.03	6.07	580.36	1,690.35	824.96
10/25/13 12:27:37	189780	11.84	0.74	0.03	6.33	582.48	1,681.53	828.46
10/25/13 12:28:07	189810	12.17	0.92	0.03	6.14	581.07	1,688.48	828.92
10/25/13 12:28:37	189840	12.62	0.94	0.02	5.81	582.83	1,710.31	830.98
10/25/13 12:29:07	189870	12.52	1.11	0.03	5.87	584.23	1,740.66	829.68
10/25/13 12:29:37	189900	12.73	1.21	0.03	5.72	582.12	1,736.08	825.75
10/25/13 12:30:07	189930	12.82	2.47	0.05	5.67	586.70	1,736.17	825.96
10/25/13 12:30:37	189960	12.99	2.71	0.05	5.49	584.59	1,736.11	826.84
10/25/13 12:31:07	189990	12.73	2.52	-0.01	5.67	583.18	1,729.97	825.25
10/25/13 12:31:37	190020	12.40	2.72	-0.01	5.90	587.75	1,720.37	829.51
10/25/13 12:32:07	190050	12.78	1.83	0.02	5.72	588.46	1,736.31	826.39
10/25/13 12:32:37	190080	12.59	1.59	0.02	5.73	588.10	1,734.62	825.06
10/25/13 12:33:07	190110	12.25	1.40	0.02	6.07	581.77	1,745.16	830.32
10/25/13 12:33:37	190140	12.12	1.31	0.03	6.09	581.77	1,745.39	824.99

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.8	%
Stack Exhaust Flow (M2)	508,371	SCFH

Weather Data

Barometric Pressure	30.42	in. Hg
Relative Humidity	46	%
Ambient Temperature	54	°F
Specific Humidity	0.003978	lb H_2O / lb air

90-100 Load, Run - 2.5OD15 R12

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/25/13 12:34:07	190170	12.28	1.30	0.04	6.14	581.77	1,743.01	825.43
10/25/13 12:34:37	190200	12.52	1.57	0.05	5.75	589.86	1,751.39	828.54
10/25/13 12:35:07	190230	12.10	1.58	0.01	6.15	589.86	1,749.47	827.52
10/25/13 12:35:37	190260	11.88	1.48	0.01	6.26	584.59	1,764.16	823.58
10/25/13 12:36:07	190290	11.96	1.52	0.04	6.34	588.10	1,749.88	827.26
10/25/13 12:36:37	190320	12.36	1.62	0.05	5.99	582.48	1,747.16	828.44
10/25/13 12:37:07	190350	12.45	1.67	0.01	5.85	582.12	1,746.08	827.09
10/25/13 12:37:37	190380	12.19	1.58	0.02	6.09	588.81	1,723.30	825.21
10/25/13 12:38:07	190410	11.81	1.52	0.02	6.26	587.75	1,724.13	828.33
10/25/13 12:38:37	190440	12.07	1.72	0.01	6.31	591.62	1,753.45	825.67
10/25/13 12:39:07	190470	12.17	2.43	0.02	6.09	593.03	1,749.16	828.80
10/25/13 12:39:37	190500	11.93	1.99	0.01	6.27	589.16	1,731.88	827.77
10/25/13 12:40:07	190530	12.38	1.73	0.02	5.99	594.79	1,710.87	827.64
10/25/13 12:40:37	190560	13.37	2.49	0.02	5.35	592.33	1,719.81	827.01
10/25/13 12:41:07	190590	12.33	3.64	0.02	5.95	586.35	1,753.94	828.24
10/25/13 12:41:37	190620	12.73	2.31	0.02	5.71	590.57	1,755.38	824.00
10/25/13 12:42:07	190650	12.93	1.87	0.05	5.60	590.57	1,754.48	824.40
10/25/13 12:42:37	190680	12.91	1.76	0.05	5.55	589.51	1,756.07	828.62
10/25/13 12:43:07	190710	13.42	2.79	0.02	5.30	595.49	1,749.74	828.72
10/25/13 12:43:37	190740	12.06	4.43	0.02	6.00	595.85	1,740.73	827.65
10/25/13 12:44:07	190770	12.33	2.26	0.03	6.02	588.46	1,733.82	824.92
10/25/13 12:44:37	190800	12.53	1.32	0.02	5.85	595.49	1,734.48	826.28
10/25/13 12:45:07	190830	12.65	1.14	0.05	5.78	591.62	1,730.13	828.78
10/25/13 12:45:37	190860	12.64	1.17	0.05	5.76	592.68	1,740.40	824.52
10/25/13 12:46:07	190890	12.73	1.29	0.02	5.65	596.20	1,745.06	825.57
10/25/13 12:46:37	190920	12.62	1.34	0.02	5.78	597.25	1,745.88	827.62
10/25/13 12:47:07	190950	12.56	1.43	0.02	5.81	594.44	1,741.32	823.32
10/25/13 12:47:37	190980	12.66	1.52	0.01	5.76	599.72	1,738.43	829.32
10/25/13 12:48:07	191010	12.75	1.69	0.03	5.71	593.03	1,743.73	829.29
10/25/13 12:48:37	191040	12.54	1.39	0.02	5.79	599.01	1,744.04	824.94
10/25/13 12:49:07	191070	12.55	1.24	0.01	5.80	590.92	1,740.78	826.66
10/25/13 12:49:37	191100	12.22	1.42	0.02	6.07	589.51	1,738.07	827.50
10/25/13 12:50:07	191130	12.48	1.61	0.02	5.86	594.44	1,734.72	824.67
10/25/13 12:50:37	191160	12.46	1.52	0.02	5.84	597.25	1,744.92	827.21
10/25/13 12:51:07	191190	12.39	1.50	0.02	6.01	597.60	1,742.28	823.44
10/25/13 12:51:37	191220	12.58	1.36	0.02	5.82	589.16	1,740.09	826.12
10/25/13 12:52:07	191250	12.64	1.36	0.01	5.72	591.62	1,751.99	824.17
10/25/13 12:52:37	191280	12.74	1.77	0.02	5.79	587.05	1,758.25	821.37
10/25/13 12:53:07	191310	12.09	1.93	0.04	5.97	593.03	1,758.61	820.61
10/25/13 12:53:37	191340	12.14	1.58	0.04	6.23	593.03	1,750.78	818.40
10/25/13 12:54:07	191370	12.88	1.50	0.02	5.60	584.23	1,759.55	820.35
10/25/13 12:54:37	191400	12.37	2.27	0.02	5.85	583.88	1,760.45	818.92
10/25/13 12:55:07	191430	11.59	2.03	0.02	6.52	580.72	1,758.96	814.49
10/25/13 12:55:37	191460	11.59	2.02	0.02	6.55	577.90	1,754.73	808.59
10/25/13 12:56:07	191490	11.25	1.47	0.03	6.74	573.33	1,746.94	806.95
10/25/13 12:56:37	191520	11.38	1.79	0.02	6.70	599.01	1,747.54	834.90
10/25/13 12:57:07	191550	11.89	1.65	0.03	6.40	607.46	1,757.77	833.54
10/25/13 12:57:37	191580	12.16	1.61	0.03	6.05	606.75	1,771.24	824.84
10/25/13 12:58:07	191610	11.90	1.63	0.02	6.30	595.14	1,766.47	820.28
10/25/13 12:58:37	191640	11.97	1.54	0.02	6.23	597.60	1,757.45	818.12
10/25/13 12:59:07	191670	11.72	1.83	0.01	6.46	589.86	1,767.63	813.61
10/25/13 12:59:37	191700	12.34	2.16	0.02	6.09	585.99	1,781.93	811.18

John Zink Co, LLC
ZTOF025X15PF
John Zink Testing and Research Facility

Unit Data

Meas. Stack Moisture	6.8	%
Stack Exhaust Flow (M2)	508,371	SCFH

Weather Data

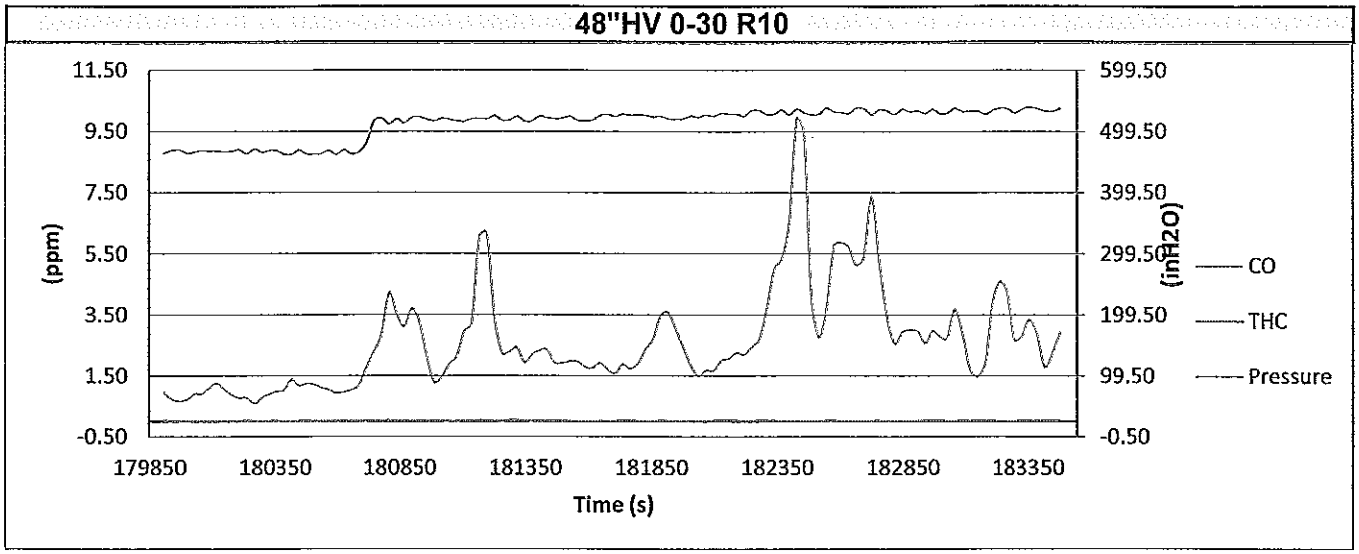
Barometric Pressure	30.42	in. Hg
Relative Humidity	46	%
Ambient Temperature	54	°F
Specific Humidity	0.003978	lb H_2O / lb air

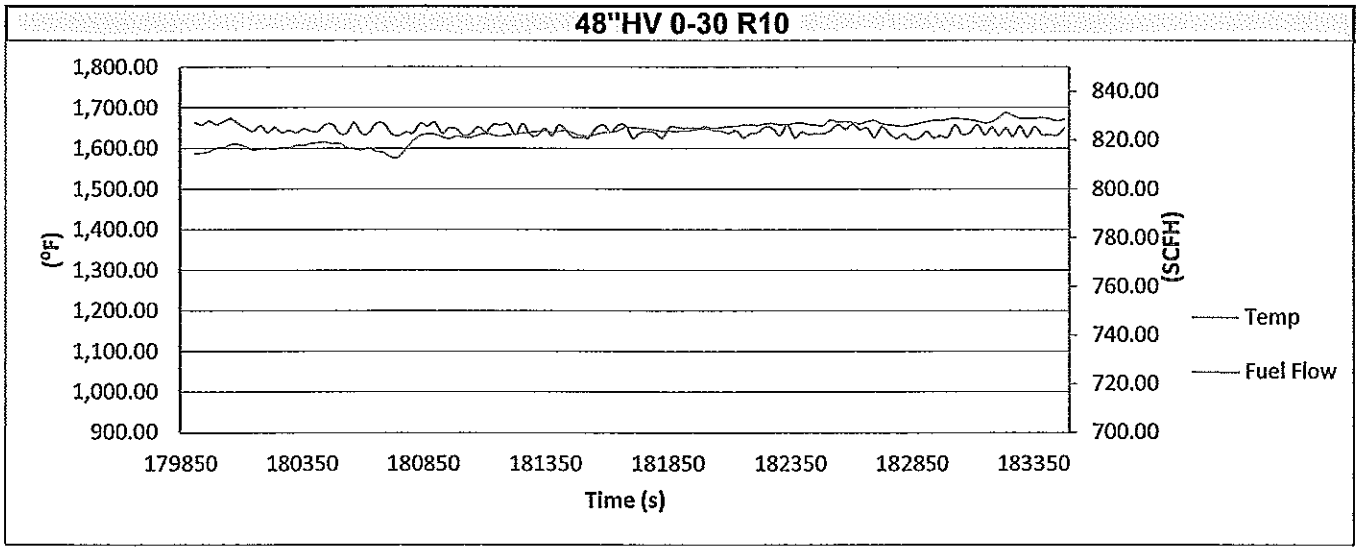
90-100 Load, Run - 2.5OD15 R12

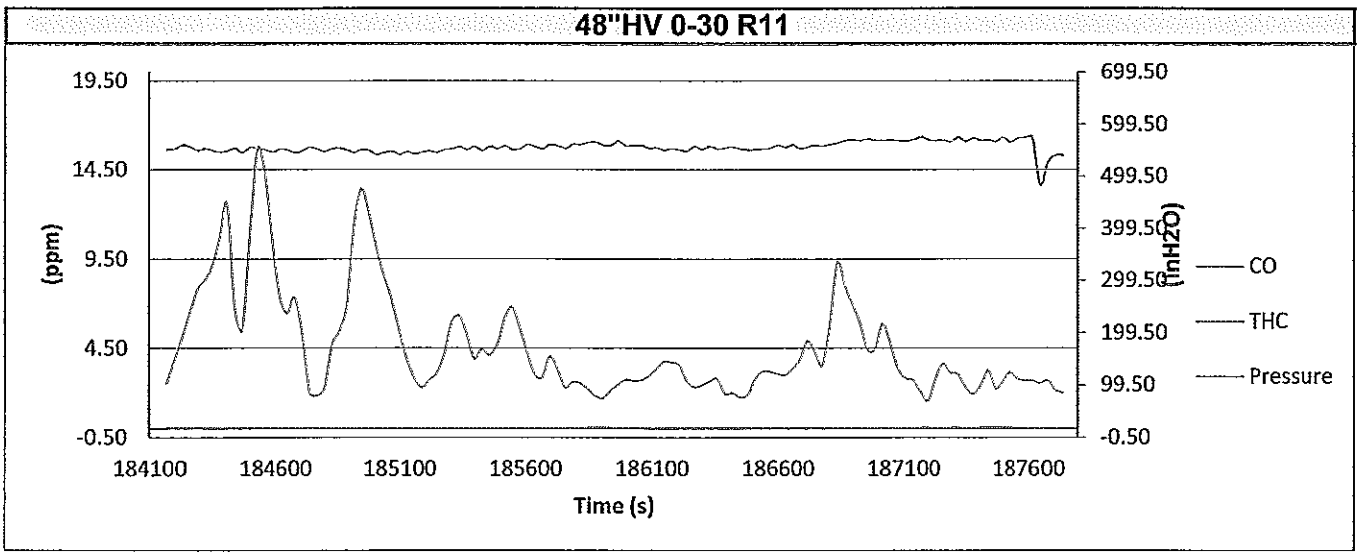
Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Temperature °F	Fuel Flow SCFH
10/25/13 13:00:07	191730	12.91	2.45	0.00	5.57	582.48	1,778.29	800.24
10/25/13 13:00:37	191760	13.16	2.60	0.01	5.45	601.12	1,773.16	830.50
10/25/13 13:01:07	191790	13.62	3.04	-0.01	5.17	602.88	1,781.59	833.91
10/25/13 13:01:37	191820	14.18	5.98	-0.01	4.69	602.88	1,792.17	823.87
10/25/13 13:02:07	191850	13.86	5.16	0.04	4.87	600.42	1,807.97	829.36
10/25/13 13:02:37	191880	13.89	3.47	0.05	4.86	606.75	1,818.81	829.42
10/25/13 13:03:07	191910	13.89	3.31	0.05	4.87	612.38	1,831.86	831.19
10/25/13 13:03:37	191940	13.94	4.00	0.04	4.78	603.94	1,843.26	822.56
10/25/13 13:04:07	191970	13.61	3.51	0.05	5.09	601.83	1,839.74	832.96
10/25/13 13:04:37	192000	13.25	3.03	0.05	5.30	611.33	1,840.11	824.13
10/25/13 13:05:07	192030	12.79	2.01	0.02	5.59	619.77	1,849.35	831.07
10/25/13 13:05:37	192060	12.89	1.68	0.02	5.60	614.14	1,859.50	829.09
10/25/13 13:06:07	192090	13.11	1.91	0.02	5.42	614.49	1,872.42	822.84
10/25/13 13:06:37	192120	12.91	1.53	0.03	5.51	680.64	1,876.01	844.28
10/25/13 13:07:07	192150	12.59	1.76	0.02	5.85	683.45	1,911.94	841.63
10/25/13 13:07:37	192180	13.16	2.20	0.02	5.42	678.18	1,939.68	840.00
RAW AVERAGE		**12.60**	**1.70**	**0.02**	**5.80**	**586.83**	**1,734.77**	**826.32**

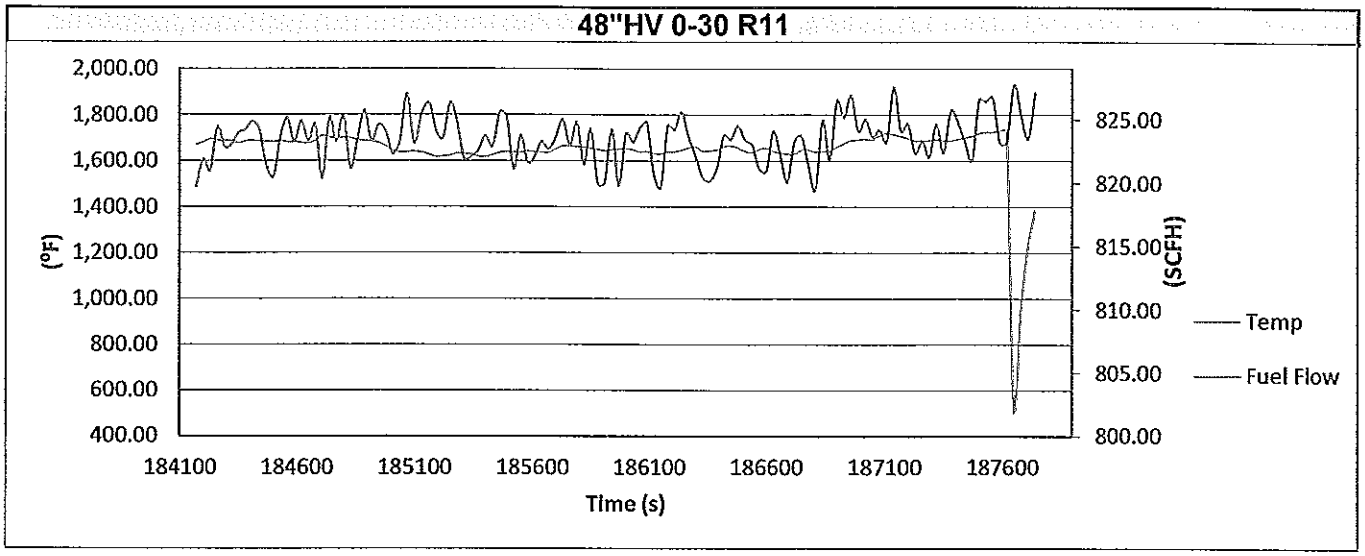
		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	inst-22-0005	inst-co-0020	inst-vc-0003	inst-22-0005	F8_PRF1	F8_TE5	
		(%)	(ppmvd)	(ppmvw)	(%)	(in. H_2O)	(°F)	(SCFH)
Bias	Initial Zero	0.07	0.28	0.02	0.04			
	Final Zero	0.08	0.28	0.02	0.08			
	Avg. Zero	0.08	0.28	0.02	0.06			
	Initial UpScale	11.95	8.73	4.86	8.86			
	Final UpScale	11.94	8.69	4.97	8.83			
	Avg. UpScale	11.95	8.71	4.92	8.85			
Upscale Cal Gas		12.10	9.07	5.04	8.95			

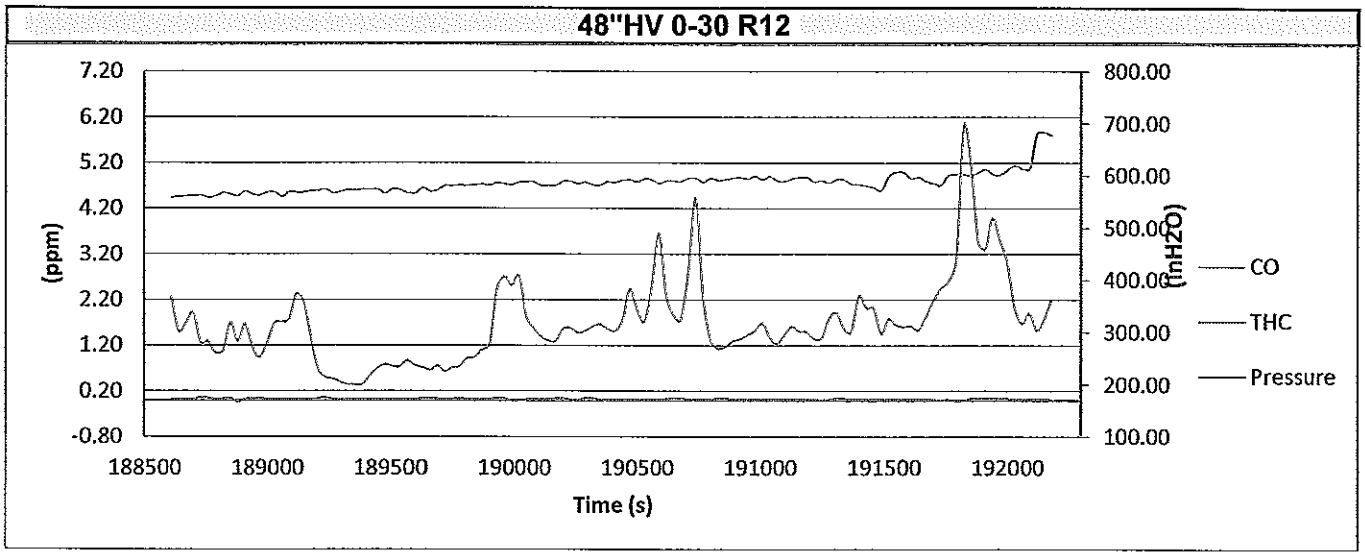
EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.77	1.53	0.00	5.84
Corrected Raw Average (ppm/% wet basis)	11.89	1.41	0.00	5.44
Concentration (ppm@ 3%CO_2)	N/A	0.79	0.00	N/A
Emission Rate (lb/hr)	N/A	0.06	0.00	N/A

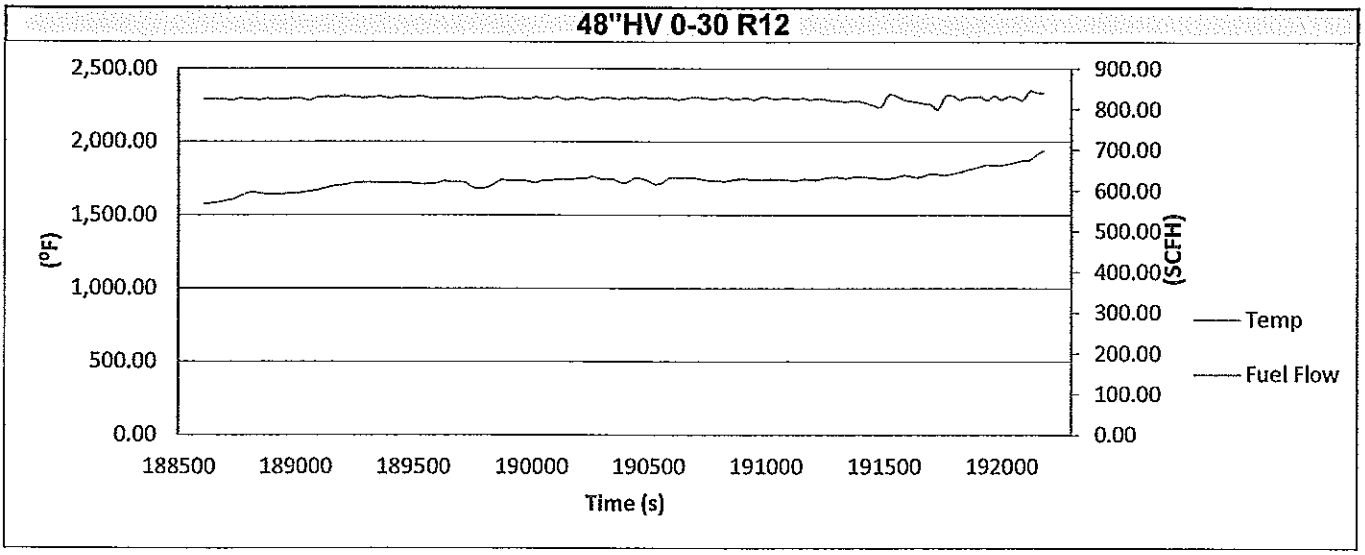

48"HV 0-30 R10
11.50
9.50
7.50
5.50
3.50
1.50
-0.50
(ppm)
599.50
499.50
399.50
299.50
199.50
99.50
-0.50
(inH2O)
CO
THC
Pressure
179850
180350
180850
181350
181850
182350
182850
183350
Time (s)


48"HV 0-30 R10
1,800.00
1,700.00
1,600.00
1,500.00
1,400.00
1,300.00
1,200.00
1,100.00
1,000.00
900.00
(°F)
840.00
820.00
800.00
780.00
760.00
740.00
720.00
700.00
(SCFH)
Temp
Fuel Flow
179850
180350
180850
181350
181850
182350
182850
183350
Time (s)


48"HV 0-30 R11
19.50
14.50
9.50
4.50
-0.50
(ppm)
699.50
599.50
499.50
399.50
299.50
199.50
99.50
-0.50
(inH2O)
CO
THC
Pressure
184100
184600
185100
185600
186100
186600
187100
187600
Time (s)


48"HV 0-30 R11
2,000.00
1,800.00
1,600.00
1,400.00
1,200.00
1,000.00
800.00
600.00
400.00
(°F)
825.00
820.00
815.00
810.00
805.00
800.00
(SCFH)
184100
184600
185100
185600
186100
186600
187100
187600
Time (s)
Temp
Fuel Flow


48"HV 0-30 R12
7.20
6.20
5.20
4.20
3.20
2.20
1.20
0.20
-0.80
(ppm)
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
(inH2O)
188500
189000
189500
190000
190500
191000
191500
192000
Time (s)
CO
THC
Pressure


48"HV 0-30 R12
2,500.00
2,000.00
1,500.00
1,000.00
500.00
0.00
(°F)
900.00
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
(SCFH)
188500
189000
189500
190000
190500
191000
191500
192000
Time (s)
Temp
Fuel Flow

EMISSION DATA RECORDS

Velocity Traverse Data

METHOD 2 (FLOW) SOURCE SAMPLING TITLE PAGE

Source Information	
Plant Name	John Zink Tulsa R&D Facility
Sampling Location	2.5OD X 19 Production Flare
Fuel Type	Gas, Propene

Test Information			
Project #		jz-13-tulsa.ok-comp#1	
Operator		SC/DA	
Date for Preliminary Run	(mm/dd/yy)	10/23/13	
Standard Temperature		68	°F
Standard Pressure		29.92	in Hg
Required Sample Vol.	--	--	scf
Run Duration	--	35	minutes
Unit Number		1	
Base Run Number		1	
Number of Ports Available		2	
Number of Ports Used		2	
Port Inside Diameter		1.00	in
Stack Shape		Circular	

Test Equipment Information			
Test Date	(mm/dd/yy)	10/23/13	
Meter Box Number	from ACS	samp-cp-0019	
Meter Calibration Factor	(Y)	0.976	
Orifice Meter Coefficient	($\Delta H_@$)	1.855	in H_2O
Pitot Identification	from ACS	samp-pi-0018	
Pitot Tube Coefficient	(C_p)	0.840	
Probe Number	from ACS	samp-pt-0005	
Probe Length		72.0	in
(SS, Glass ....) Liner Material	from list	stainless	
Impinger Case Number	from ACS	samp-bc-0018	

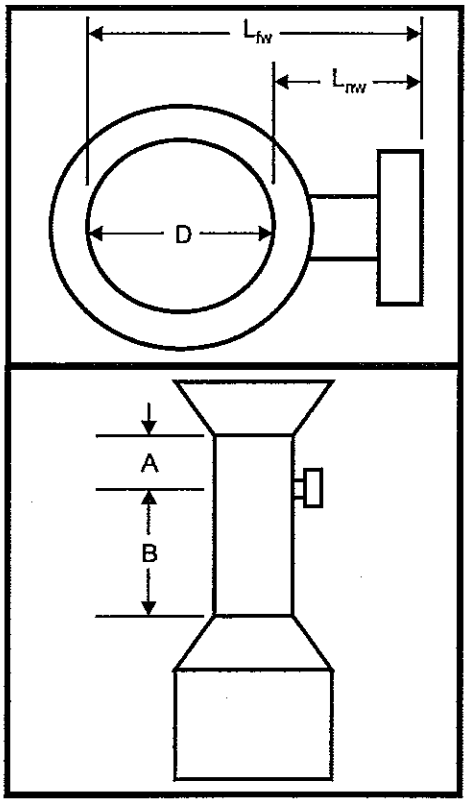
Testing Company Information	
Company Name	Air Hygiene International, Inc. (Tulsa, Oklahoma)
Address	1600 W Tacoma Street
City, State Zip	Broken Arrow, Oklahoma 74012
Project Manager	Min Sum Lee
Phone Number	(918) 307-8865
Fax Number	(918) 307-9131

METHOD 1 - SAMPLE AND VELOCITY TRAVERSES FOR CIRCULAR SOURCES

Plant Name	John Zink Tulsa R&D Facility	Date	10/23/13
Sampling Location	2.5OD X 19 Production Flare	Stack Type	Circular
Operator	SC/DA	Ports Available	2
Project #	jz-13-tulsa.ok-comp#1	Ports Used	2
Stack Size	Large (>24 inch diameter)	Port ID (inches)	1.00

Circular Stack or Duct Diameter			
Distance to Far Wall of Stack	(L_{fw})	98.00	in
Distance to Near Wall of Stack	(L_{nw})	2.00	in
Diameter of Stack	(D)	96.00	in
Area of Stack	(A_s)	50.27	ft²

Distance from Port to Disturbances			
Distance Upstream	(A)	30.00	in
Diameters Upstream	(A_D)	0.31	diameters
Distance Downstream	(B)	150.00	in
Diameters Downstream	(B_D)	1.56	diameters



Number of Traverse Points Required			
Diameters to Flow Disturbance		Minimum Number of[1] Traverse Points	
Down Stream	Up Stream	Particulate Points	Velocity Points
2.00-4.99	0.50-1.24	24	16
5.00-5.99	1.25-1.49	20	16
6.00-6.99	1.50-1.74	16	12
7.00-7.99	1.75-1.99	12	12
>= 8.00	>=2.00	8 or 12[2]	8 or 12[2]
Upstream Spec		Eq Dia<.5	Eq Dia<.5
Downstream Spec		Eq Dia<2	Eq Dia<2
Traverse Pts Required		24	16

[1] Check Minimum Number of Points for the Upstream and Downstream conditions, then use the largest.

[2] 8 for Circular Stacks 12 to 24 inches
12 for Circular Stacks over 24 inches

○ Method 1 Trav

○ 12 Point PM Trav

◉ Velocity

Number of Traverse Points Used			
2	Ports by	8	Across
16	Pts Used	16	Required

Location of Traverse Points in Circular Stacks									
Traverse Point Number	(Fraction of Stack Dimension from Inside Wall to Traverse Point) Number of Traverse Points Across the Stack								
	2	4	6	8	10	12	14	16	18
1	.146	.067	.044	.032	.026	.021	.018	.016	.014
2	.854	.250	.146	.105	.082	.067	.057	.049	.044
3		.750	.296	.194	.146	.118	.099	.085	.075
4		.933	.704	.323	.226	.177	.146	.125	.109
5			.854	.677	.342	.250	.201	.169	.146
6			.956	.806	.658	.356	.269	.220	.188
7				.895	.774	.644	.366	.283	.236
8				.968	.854	.750	.634	.375	.296
9					.918	.823	.731	.625	.382
10					.974	.882	.799	.717	.618
11						.933	.854	.780	.704
12						.979	.901	.831	.764

Traverse Point Locations			
Traverse Point Number	Fraction of Stack Diameter	Distance from Inside Wall	Distance Including Reference Length
		in	in
1	0.032	3 1/8	5 1/8
2	0.105	10 1/8	12 1/8
3	0.194	18 5/8	20 5/8
4	0.323	31	33
5	0.677	65	67
6	0.806	77 3/8	79 3/8
7	0.895	85 7/8	87 7/8
8	0.968	92 7/8	94 7/8
9			

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant Name	John Zink Tulsa R&D Facility			
Sampling Location	2.5OD X 19 Production Flare			
Operator	SC/DA			
Project #	jz-13-tulsa.ok-comp#1			
Pitot Leak Check	x	PreTest	x	PostTest

Date	10/23/13		
Stack Type	Circular		
Ports Available	2		
Pitot Identification	samp-pi-0018		
Pitot Coefficient	0.840		

Stack Dimensions			
Area of Stack	(A_s)	50.27	ft^2
Diameter of Stack	(D)	96.00	in

Pressures			
Barometric Pressure	(P_b)	30.04	in Hg
Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.04	in Hg

Stack Gas Composition			
Composition Data:	Estimated Composition		
Carbon Dioxide Concentration	($\%CO_2$)	6.03	%vd
Oxygen Concentration	($\%O_2$)	13.40	%vd
Carbon Monoxide Concentration	(ppmCO)	0.00	ppmvd
Nitrogen Concentration	($\%N_2$)	80.50	%vd
Stack Moisture Content	(B_{ws})	6.90	%
Stack Dry Molecular Weight	(M_d)	29.48	lb/lb-mole
Stack Wet Molecular Weight	(M_w)	28.69	lb/lb-mole

Results			
Avg Stack Gas Velocity	(v_s)	1.43	ft/sec
Avg Stack Dry Std Flow Rate	(Q_{sd})	68,349	dscf/hr
Avg Stack Dry Std Flow Rate	(Q_{sd})	1,139	dscf/min
Avg Stack Wet Flow Rate	(Q_{aw})	4,307	acf/min
Avg Stack Wet Std Flow Rate	(Q_{sw})	73,415	ascf/hr

40 CFR 60, Method 2G, Section 8.11.1 (but applies to all Method 2 type static pressure measurements):
If a Type S probe is used for this measurement, position the probe at or between any traverse point(s) and rotate the probe until a null differential pressure reading is obtained. Disconnect the tubing from one of the pressure ports; read and record the ΔP. For pressure devices with one-directional scales, if a deflection in the positive direction is noted with the negative side disconnected, then the static pressure is positive. Likewise, if a deflection in the positive direction is noted with the positive side disconnected, then the static pressure is negative.

Stack Cross Section Schematic

Velocity Traverse Data

Run Number		0-30-0% R1		
Run Time	14:32	Start	14:41	End
Traverse Point	Velocity Head (Δp)	Null Angle (N_a)	Stack Temp (t_s)	Local Velocity ($v_{s(l)}$)
	in H_2O	deg	°F	ft/sec
A-1	0.000		1325	0.00
A-2	0.000		1335	0.00
A-3	0.000		1415	0.00
A-4	0.005		1412	7.48
A-5	0.000		1418	0.00
A-6	0.000		1420	0.00
A-7	0.000		1425	0.00
A-8	0.000		1422	0.00
B-1	0.000		1425	0.00
B-2	0.005		1420	7.50
B-3	0.000		1422	0.00
B-4	0.000		1412	0.00
B-5	0.000		1410	0.00
B-6	0.000		1411	0.00
B-7	0.000		1412	0.00
B-8	0.005		1410	7.48
Average	0.001		1406	
	0.014	= Square roots of Δp		

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant Name	John Zink Tulsa R&D Facility			
Sampling Location	2.5OD X 19 Production Flare			
Operator	SC/DA			
Project #	jz-13-tulsa.ok-comp#1			
Pitot Leak Check	x	PreTest	x	PostTest

Date	10/23/13	
Stack Type	Circular	
Ports Available	2	
Pitot Identification	samp-pi-0018	
Pitot Coefficient	0.840	

Stack Dimensions			
Area of Stack	(A_s)	50.27	ft²
Diameter of Stack	(D)	96.00	in

Pressures			
Barometric Pressure	(P_b)	30.02	in Hg
Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.02	in Hg

Stack Gas Composition			
Composition Data:	Estimated Composition		
Carbon Dioxide Concentration	(%CO_2)	5.94	%vd
Oxygen Concentration	(%O_2)	13.60	%vd
Carbon Monoxide Concentration	(ppmCO)	0.00	ppmvd
Nitrogen Concentration	(%N_2)	80.50	%vd
Stack Molsture Content	(B_{ws})	4.70	%
Stack Dry Molecular Weight	(M_d)	29.51	lb/lb-mole
Stack Wet Molecular Weight	(M_w)	28.96	lb/lb-mole

Results			
Avg Stack Gas Velocity	(v_s)	1.41	ft/sec
Avg Stack Dry Std Flow Rate	(Q_{sd})	67,693	dscf/hr
Avg Stack Dry Std Flow Rate	(Q_{sd})	1,128	dscf/min
Avg Stack Wet Flow Rate	(Q_{sw})	4,244	acf/min
Avg Stack Wet Std Flow Rate	(Q_{sw})	71,032	ascf/hr

40 CFR 60, Method 2G, Section 8.11.1 (but applies to all Method 2 type static pressure measurements):
If a Type S probe is used for this measurement, position the probe at or between any traverse point(s) and rotate the probe until a null differential pressure reading is obtained. Disconnect the tubing from one of the pressure ports; read and record the ΔP. For pressure devices with one-directional scales, if a deflection in the positive direction is noted with the negative side disconnected, then the static pressure is positive. Likewise, if a deflection in the positive direction is noted with the positive side disconnected, then the static pressure is negative.

Stack Cross Section Schematic

Velocity Traverse Data				
Run Number		0-30-0% R2		
Run Time	15:42	Start	15:50	End
Traverse Point	Velocity Head (Δp)	Null Angle (N_a)	Stack Temp (t_s)	Local Velocity ($v_{s(l)}$)
	in H_2O	deg	°F	ft/sec
A-1	0.000		1410	0.00
A-2	0.005		1428	7.48
A-3	0.000		1433	0.00
A-4	0.000		1448	0.00
A-5	0.000		1442	0.00
A-6	0.000		1450	0.00
A-7	0.000		1441	0.00
A-8	0.000		1442	0.00
B-1	0.000		1442	0.00
B-2	0.005		1441	7.51
B-3	0.000		1440	0.00
B-4	0.000		1440	0.00
B-5	0.000		1440	0.00
B-6	0.000		1441	0.00
B-7	0.000		1442	0.00
B-8	0.005		1444	7.51
Average	0.001		1439	
	0.013	= Square roots of Δp		

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant Name	John Zink Tulsa R&D Facility			
Sampling Location	2.5OD X 19 Production Flare			
Operator	SC/DA			
Project #	jz-13-tulsa.ok-comp#1			
Pitot Leak Check	x	PreTest	x	PostTest

Date	10/23/13
Stack Type	Circular
Ports Available	2
Pitot Identification	samp-pi-0018
Pitot Coefficient	0.840

Stack Dimensions			
Area of Stack	(A_s)	50.27	ft²
Diameter of Stack	(D)	96.00	in

Pressures			
Barometric Pressure	(P_b)	30.27	in Hg
Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.27	in Hg

Stack Gas Composition			
Composition Data:	Estimated Composition		
Carbon Dioxide Concentration	(%CO_2)	5.08	%vd
Oxygen Concentration	(%O_2)	14.80	%vd
Carbon Monoxide Concentration	(ppmCO)	0.00	ppmvd
Nitrogen Concentration	(%N_2)	80.10	%vd
Stack Moisture Content	(B_{ws})	4.70	%
Stack Dry Molecular Weight	(M_d)	29.40	lb/lb-mole
Stack Wet Molecular Weight	(M_w)	28.86	lb/lb-mole

Results			
Avg Stack Gas Velocity	(v_s)	1.41	ft/sec
Avg Stack Dry Std Flow Rate	(Q_{sd})	67,995	dscf/hr
Avg Stack Dry Std Flow Rate	(Q_{sd})	1,133	dscf/min
Avg Stack Wet Flow Rate	(Q_{aw})	4,239	acf/min
Avg Stack Wet Std Flow Rate	(Q_{sw})	71,348	ascf/hr

40 CFR 60, Method 2G, Section 8.11.1 (but applies to all Method 2 type static pressure measurements):
If a Type S probe is used for this measurement, position the probe at or between any traverse point(s) and rotate the probe until a null differential pressure reading is obtained. Disconnect the tubing from one of the pressure ports; read and record the ΔP. For pressure devices with one-directional scales, if a deflection in the positive direction is noted with the negative side disconnected, then the static pressure is positive. Likewise, if a deflection in the positive direction is noted with the positive side disconnected, then the static pressure is negative.

Stack Cross Section Schematic

Velocity Traverse Data				
Run Number		0-30-0 R3		
Run Time	08:02	Start	08:11	End
Traverse Point	Velocity Head (Δp)	Null Angle (N_a)	Stack Temp (t_s)	Local Velocity ($v_{s(l)}$)
	in H_2O	deg	°F	ft/sec
A-1	0.005		1450	7.51
A-2	0.000		1445	0.00
A-3	0.000		1460	0.00
A-4	0.000		1465	0.00
A-5	0.000		1450	0.00
A-6	0.000		1445	0.00
A-7	0.000		1440	0.00
A-8	0.000		1440	0.00
B-1	0.000		1450	0.00
B-2	0.005		1455	7.52
B-3	0.000		1460	0.00
B-4	0.000		1450	0.00
B-5	0.000		1450	0.00
B-6	0.000		1400	0.00
B-7	0.005		1450	7.51
B-8	0.000		1400	0.00
Average	0.001		1444	
	0.013	= Square roots of Δp		

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant Name	John Zink Tulsa R&D Facility			
Sampling Location	2.5OD X 19 Production Flare			
Operator	SC/DA			
Project #	jz-13-tulsa.ok-comp#1			
Pitot Leak Check	x	PreTest	x	PostTest

Date	10/23/13
Stack Type	Circular
Ports Available	2
Pitot Identification	samp-pi-0018
Pitot Coefficient	0.840

Stack Dimensions			
Area of Stack	(A_s)	50.27	ft²
Diameter of Stack	(D)	96.00	in

Pressures			
Barometric Pressure	(P_b)	30.29	in Hg
Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.29	in Hg

Stack Gas Composition			
Composition Data:	Estimated Composition		
Carbon Dioxide Concentration	($\%CO_2$)	5.55	%vd
Oxygen Concentration	($\%O_2$)	14.20	%vd
Carbon Monoxide Concentration	(ppmCO)	0.00	ppmvd
Nitrogen Concentration	($\%N_2$)	80.30	%vd
Stack Moisture Content	(B_{ws})	6.90	%
Stack Dry Molecular Weight	(M_d)	29.47	lb/lb-mole
Stack Wet Molecular Weight	(M_w)	28.68	lb/lb-mole

Results			
Avg Stack Gas Velocity	(v_s)	3.77	ft/sec
Avg Stack Dry Std Flow Rate	(Q_{sd})	177,398	dscf/hr
Avg Stack Dry Std Flow Rate	(Q_{sd})	2,957	dscf/min
Avg Stack Wet Flow Rate	(Q_{sw})	11,361	acf/min
Avg Stack Wet Std Flow Rate	(Q_{sw})	190,546	ascf/hr

40 CFR 60, Method 2G, Section 8.11.1 (but applies to all Method 2 type static pressure measurements):
If a Type S probe is used for this measurement, position the probe at or between any traverse point(s) and rotate the probe until a null differential pressure reading is obtained. Disconnect the tubing from one of the pressure ports; read and record the ΔP. For pressure devices with one-directional scales, if a deflection in the positive direction is noted with the negative side disconnected, then the static pressure is positive. Likewise, if a deflection in the positive direction is noted with the positive side disconnected, then the static pressure is negative.

Stack Cross Section Schematic

Velocity Traverse Data				
Run Number		30-70-30% R4		
Run Time	09:22	Start	09:35	End
Traverse Point	Velocity Head (Δp)	Null Angle (N_a)	Stack Temp (t_s)	Local Velocity ($v_{s(l)}$)
	in H_2O	deg	°F	ft/sec
A-1	0.000		1446	0.00
A-2	0.005		1450	7.53
A-3	0.005		1455	7.54
A-4	0.005		1455	7.54
A-5	0.000		1466	0.00
A-6	0.000		1465	0.00
A-7	0.000		1460	0.00
A-8	0.005		1430	7.49
B-1	0.000		1440	0.00
B-2	0.000		1455	0.00
B-3	0.005		1455	7.54
B-4	0.005		1451	7.53
B-5	0.005		1453	7.54
B-6	0.005		1450	7.53
B-7	0.000		1460	0.00
B-8	0.000		1444	0.00
Average	0.003		1452	
	0.035	= Square roots of Δp		

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant Name	John Zink Tulsa R&D Facility			
Sampling Location	2.5OD X 19 Production Flare			
Operator	SC/DA			
Project #	jz-13-tulsa.ok-comp#1			
Pitot Leak Check	x	PreTest	x	PostTest

Date	10/23/13
Stack Type	Circular
Ports Available	2
Pitot Identification	samp-pi-0018
Pitot Coefficient	0.840

Stack Dimensions			
Area of Stack	(A_s)	50.27	ft²
Diameter of Stack	(D)	96.00	in

Pressures			
Barometric Pressure	(P_b)	30.32	in Hg
Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.32	in Hg

Stack Gas Composition			
Composition Data:	Estimated Composition		
Carbon Dioxide Concentration	(%CO_2)	5.95	%vd
Oxygen Concentration	(%O_2)	13.60	%vd
Carbon Monoxide Concentration	(ppmCO)	0.00	ppmvd
Nitrogen Concentration	(%N_2)	80.40	%vd
Stack Moisture Content	(B_{ws})	6.10	%
Stack Dry Molecular Weight	(M_d)	29.48	lb/lb-mole
Stack Wet Molecular Weight	(M_w)	28.78	lb/lb-mole

Results			
Avg Stack Gas Velocity	(v_s)	4.65	ft/sec
Avg Stack Dry Std Flow Rate	(Q_{sd})	201,888	dscf/hr
Avg Stack Dry Std Flow Rate	(Q_{sd})	3,365	dscf/min
Avg Stack Wet Flow Rate	(Q_{aw})	14,013	acf/min
Avg Stack Wet Std Flow Rate	(Q_{sw})	215,003	ascf/hr

40 CFR 60, Method 2G, Section 8.11.1 (but applies to all Method 2 type static pressure measurements):
If a Type S probe is used for this measurement, position the probe at or between any traverse point(s) and rotate the probe until a null differential pressure reading is obtained. Disconnect the tubing from one of the pressure ports; read and record the ΔP. For pressure devices with one-directional scales, if a deflection in the positive direction is noted with the negative side disconnected, then the static pressure is positive. Likewise, if a deflection in the positive direction is noted with the positive side disconnected, then the static pressure is negative.

Stack Cross Section Schematic

Velocity Traverse Data

Run Number		30-70-30% R5		
Run Time	13:13	Start	13:21	End
Traverse Point	Velocity Head (Δp)	Null Angle (N_a)	Stack Temp (t_s)	Local Velocity ($v_{s(l)}$)
	in H_2O	deg	°F	ft/sec
A-1	0.000		1630	0.00
A-2	0.000		1645	0.00
A-3	0.000		1633	0.00
A-4	0.005		1631	7.86
A-5	0.005		1634	7.87
A-6	0.005		1630	7.86
A-7	0.001		1632	3.52
A-8	0.000		1635	0.00
B-1	0.000		1629	0.00
B-2	0.000		1628	0.00
B-3	0.005		1629	7.86
B-4	0.010		1635	11.13
B-5	0.015		1637	13.63
B-6	0.001		1631	3.52
B-7	0.010		1632	11.12
B-8	0.000		1628	0.00
Average	0.004		1632	
	0.042	= Square roots of Δp		

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant Name	John Zink Tulsa R&D Facility			
Sampling Location	2.5OD X 19 Production Flare			
Operator	SC/DA			
Project #	jz-13-tulsa.ok-comp#1			
Pitot Leak Check	x	PreTest	x	PostTest

Date	10/23/13
Stack Type	Circular
Ports Available	2
Pitot Identification	samp-pi-0018
Pitot Coefficient	0.840

Stack Dimensions			
Area of Stack	(A_s)	50.27	ft²
Diameter of Stack	(D)	96.00	in

Pressures			
Barometric Pressure	(P_b)	30.36	in Hg
Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.36	in Hg

Stack Gas Composition			
Composition Data:	Estimated Composition		
Carbon Dioxide Concentration	(%CO_2)	6.12	%vd
Oxygen Concentration	(%O_2)	13.40	%vd
Carbon Monoxide Concentration	(ppmCO)	0.00	ppmvd
Nitrogen Concentration	(%N_2)	80.50	%vd
Stack Moisture Content	(B_{ws})	5.60	%
Stack Dry Molecular Weight	(M_d)	29.52	lb/lb-mole
Stack Wet Molecular Weight	(M_w)	28.88	lb/lb-mole

Results			
Avg Stack Gas Velocity	(v_s)	5.02	ft/sec
Avg Stack Dry Std Flow Rate	(Q_{sd})	219,690	dscf/hr
Avg Stack Dry Std Flow Rate	(Q_{sd})	3,661	dscf/min
Avg Stack Wet Flow Rate	(Q_{aw})	15,144	acf/min
Avg Stack Wet Std Flow Rate	(Q_{sw})	232,722	ascf/hr

40 CFR 60, Method 2G, Section 8.11.1 (but applies to all Method 2 type static pressure measurements):
If a Type S probe is used for this measurement, position the probe at or between any traverse point(s) and rotate the probe until a null differential pressure reading is obtained. Disconnect the tubing from one of the pressure ports; read and record the ΔP. For pressure devices with one-directional scales, if a deflection in the positive direction is noted with the negative side disconnected, then the static pressure is positive. Likewise, if a deflection in the positive direction is noted with the positive side disconnected, then the static pressure is negative.

Stack Cross Section Schematic

Velocity Traverse Data				
Run Number		30-70-30% R6		
Run Time	14:26	Start	14:35	End
Traverse Point	Velocity Head (Δp)	Null Angle (N_a)	Stack Temp (t_s)	Local Velocity ($v_{s(l)}$)
	in H_2O	deg	°F	ft/sec
A-1	0.000		1625	0.00
A-2	0.010		1630	11.09
A-3	0.000		1631	0.00
A-4	0.005		1629	7.84
A-5	0.005		1633	7.85
A-6	0.005		1637	7.85
A-7	0.005		1634	7.85
A-8	0.000		1635	0.00
B-1	0.005		1628	7.84
B-2	0.010		1630	11.09
B-3	0.005		1633	7.85
B-4	0.000		1633	0.00
B-5	0.000		1634	0.00
B-6	0.000		1636	0.00
B-7	0.010		1632	11.09
B-8	0.000		1630	0.00
Average	0.004		1632	
	0.05	= Square roots of Δp		

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant Name	John Zink Tulsa R&D Facility			
Sampling Location	2.5OD X 19 Production Flare			
Operator	SC/DA			
Project #	jz-13-tulsa.ok-comp#1			
Pitot Leak Check	x	PreTest	x	PostTest

Date	10/23/13		
Stack Type	Circular		
Ports Available	2		
Pitot Identification	samp-pi-0018		
Pitot Coefficient	0.840		

Stack Dimensions			
Area of Stack	(A_s)	50.27	ft²
Diameter of Stack	(D)	96.00	in

Pressures			
Barometric Pressure	(P_b)	30.30	in Hg
Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.30	in Hg

Stack Gas Composition			
Composition Data:	Estimated Composition		
Carbon Dioxide Concentration	(%CO_2)	5.96	%vd
Oxygen Concentration	(%O_2)	13.60	%vd
Carbon Monoxide Concentration	(ppmCO)	0.00	ppmvd
Nitrogen Concentration	(%N_2)	80.40	%vd
Stack Moisture Content	(B_{ws})	5.60	%
Stack Dry Molecular Weight	(M_d)	29.49	lb/lb-mole
Stack Wet Molecular Weight	(M_w)	28.84	lb/lb-mole

Results			
Avg Stack Gas Velocity	(v_s)	9.49	ft/sec
Avg Stack Dry Std Flow Rate	(Q_{sd})	384,934	dscf/hr
Avg Stack Dry Std Flow Rate	(Q_{sd})	6,416	dscf/min
Avg Stack Wet Flow Rate	(Q_{aw})	28,630	acf/min
Avg Stack Wet Std Flow Rate	(Q_{sw})	407,769	ascf/hr

40 CFR 60, Method 2G, Section 8.11.1 (but applies to all Method 2 type static pressure measurements):
If a Type S probe is used for this measurement, position the probe at or between any traverse point(s) and rotate the probe until a null differential pressure reading is obtained. Disconnect the tubing from one of the pressure ports; read and record the ΔP. For pressure devices with one-directional scales, if a deflection in the positive direction is noted with the negative side disconnected, then the static pressure is positive. Likewise, if a deflection in the positive direction is noted with the positive side disconnected, then the static pressure is negative.

Stack Cross Section Schematic

Velocity Traverse Data				
Run Number		70-100-70% R7		
Run Time	16:00	Start	16:07	End
Traverse Point	Velocity Head (Δp)	Null Angle (N_a)	Stack Temp (t_s)	Local Velocity ($v_{s(l)}$)
	in H_2O	deg	°F	ft/sec
A-1	0.005		1790	8.15
A-2	0.005		1795	8.16
A-3	0.000		1794	0.00
A-4	0.005		1792	8.15
A-5	0.010		1799	11.55
A-6	0.010		1789	11.52
A-7	0.005		1792	8.15
A-8	0.005		1793	8.15
B-1	0.005		1798	8.16
B-2	0.005		1790	8.15
B-3	0.010		1791	11.52
B-4	0.010		1788	11.52
B-5	0.010		1787	11.51
B-6	0.015		1793	14.12
B-7	0.010		1794	11.53
B-8	0.010		1796	11.54
Average	0.008		1793	
	0.082	= Square roots of Δp		

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant Name	John Zink Tulsa R&D Facility			
Sampling Location	2.5OD X 19 Production Flare			
Operator	SC/DA			
Project #	jz-13-tulsa.ok-comp#1			
Pitot Leak Check	x	PreTest	x	PostTest

Date	10/23/13		
Stack Type	Circular		
Ports Available	2		
Pitot Identification	samp-pi-0018		
Pitot Coefficient	0.840		

Stack Dimensions			
Area of Stack	(A_s)	50.27	ft²
Diameter of Stack	(D)	96.00	in

Pressures			
Barometric Pressure	(P_b)	30.30	in Hg
Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.30	in Hg

Stack Gas Composition			
Composition Data:	Estimated Composition		
Carbon Dioxide Concentration	(%CO_2)	6.35	%vd
Oxygen Concentration	(%O_2)	13.10	%vd
Carbon Monoxide Concentration	(ppmCO)	0.00	ppmvd
Nitrogen Concentration	(%N_2)	80.50	%vd
Stack Moisture Content	(B_{ws})	6.00	%
Stack Dry Molecular Weight	(M_d)	29.53	lb/lb-mole
Stack Wet Molecular Weight	(M_w)	28.83	lb/lb-mole

Results			
Avg Stack Gas Velocity	(v_s)	9.59	ft/sec
Avg Stack Dry Std Flow Rate	(Q_{sd})	386,645	dscf/hr
Avg Stack Dry Std Flow Rate	(Q_{sd})	6,444	dscf/min
Avg Stack Wet Flow Rate	(Q_{aw})	28,917	acf/min
Avg Stack Wet Std Flow Rate	(Q_{sw})	411,324	ascf/hr

40 CFR 60, Method 2G, Section 8.11.1 (but applies to all Method 2 type static pressure measurements):
If a Type S probe is used for this measurement, position the probe at or between any traverse point(s) and rotate the probe until a null differential pressure reading is obtained. Disconnect the tubing from one of the pressure ports; read and record the ΔP. For pressure devices with one-directional scales, if a deflection in the positive direction is noted with the negative side disconnected, then the static pressure is positive. Likewise, if a deflection in the positive direction is noted with the positive side disconnected, then the static pressure is negative.

Stack Cross Section Schematic

Velocity Traverse Data				
Run Number		70-100-70% R8		
Run Time	17:11	Start	17:22	End
Traverse Point	Velocity Head (Δp)	Null Angle (N_a)	Stack Temp (t_s)	Local Velocity ($v_{s(l)}$)
	in H_2O	deg	°F	ft/sec
A-1	0.005		1795	8.16
A-2	0.010		1798	11.54
A-3	0.010		1795	11.54
A-4	0.005		1796	8.16
A-5	0.010		1794	11.53
A-6	0.005		1795	8.16
A-7	0.005		1796	8.16
A-8	0.005		1797	8.16
B-1	0.005		1797	8.16
B-2	0.015		1795	14.13
B-3	0.010		1795	11.54
B-4	0.005		1793	8.15
B-5	0.005		1792	8.15
B-6	0.010		1790	11.52
B-7	0.005		1799	8.17
B-8	0.005		1800	8.17
Average	0.007		1795	
	0.083	= Square roots of Δp		

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant Name	John Zink Tulsa R&D Facility			
Sampling Location	2.5OD X 19 Production Flare			
Operator	SC/DA			
Project #	jz-13-tulsa.ok-comp#1			
Pitot Leak Check	x	PreTest	x	PostTest

Date	10/23/13		
Stack Type	Circular		
Ports Available	2		
Pitot Identification	samp-pi-0018		
Pitot Coefficient	0.840		

Stack Dimensions			
Area of Stack	(A_s)	50.27	ft²
Diameter of Stack	(D)	96.00	in

Pressures			
Barometric Pressure	(P_b)	30.44	in Hg
Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.44	in Hg

Stack Gas Composition			
Composition Data:	Estimated Composition		
Carbon Dioxide Concentration	(%CO_2)	5.98	%vd
Oxygen Concentration	(%O_2)	13.60	%vd
Carbon Monoxide Concentration	(ppmCO)	0.00	ppmvd
Nitrogen Concentration	(%N_2)	80.42	%vd
Stack Moisture Content	(B_{ws})	5.90	%
Stack Dry Molecular Weight	(M_d)	29.50	lb/lb-mole
Stack Wet Molecular Weight	(M_w)	28.82	lb/lb-mole

Results			
Avg Stack Gas Velocity	(v_s)	10.66	ft/sec
Avg Stack Dry Std Flow Rate	(Q_{sd})	430,583	dscf/hr
Avg Stack Dry Std Flow Rate	(Q_{sd})	7,176	dscf/min
Avg Stack Wet Flow Rate	(Q_{aw})	32,137	acf/min
Avg Stack Wet Std Flow Rate	(Q_{sw})	457,580	ascf/hr

40 CFR 60, Method 2G, Section 8.11.1 (but applies to all Method 2 type static pressure measurements):
If a Type S probe is used for this measurement, position the probe at or between any traverse point(s) and rotate the probe until a null differential pressure reading is obtained. Disconnect the tubing from one of the pressure ports; read and record the ΔP. For pressure devices with one-directional scales, if a deflection in the positive direction is noted with the negative side disconnected, then the static pressure is positive. Likewise, if a deflection in the positive direction is noted with the positive side disconnected, then the static pressure is negative.

Stack Cross Section Schematic

Velocity Traverse Data				
Run Number		70-100-70% R9		
Run Time	08:35	Start	08:47	End
Traverse Point	Velocity Head (Δp)	Null Angle (N_a)	Stack Temp (t_s)	Local Velocity ($v_{s(l)}$)
	in H_2O	deg	°F	ft/sec
A-1	0.005		1810	8.17
A-2	0.005		1811	8.17
A-3	0.005		1812	8.17
A-4	0.015		1815	14.16
A-5	0.005		1820	8.19
A-6	0.015		1798	14.11
A-7	0.005		1795	8.14
A-8	0.005		1800	8.15
B-1	0.015		1799	14.11
B-2	0.015		1805	14.13
B-3	0.015		1803	14.13
B-4	0.010		1789	11.50
B-5	0.010		1800	11.53
B-6	0.010		1801	11.53
B-7	0.005		1802	8.15
B-8	0.005		1798	8.15
Average	0.009		1804	
	0.092	= Square roots of Δp		

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant Name	John Zink Tulsa R&D Facility			
Sampling Location	2.5OD X 19 Production Flare			
Operator	SC/DA			
Project #	jz-13-tulsa.ok-comp#1			
Pitot Leak Check	x	PreTest	x	PostTest

Date	10/23/13		
Stack Type	Circular		
Ports Available	2		
Pitot Identification	samp-pi-0018		
Pitot Coefficient	0.840		

Stack Dimensions			
Area of Stack	(A_s)	50.27	ft²
Diameter of Stack	(D)	96.00	in

Pressures			
Barometric Pressure	(P_b)	30.43	in Hg
Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.43	in Hg

Stack Gas Composition			
Composition Data:	Estimated Composition		
Carbon Dioxide Concentration	(%CO_2)	6.05	%vd
Oxygen Concentration	(%O_2)	13.50	%vd
Carbon Monoxide Concentration	(ppmCO)	0.00	ppmvd
Nitrogen Concentration	(%N_2)	80.40	%vd
Stack Moisture Content	(B_{ws})	5.20	%
Stack Dry Molecular Weight	(M_d)	29.49	lb/lb-mole
Stack Wet Molecular Weight	(M_w)	28.90	lb/lb-mole

Results			
Avg Stack Gas Velocity	(v_s)	11.31	ft/sec
Avg Stack Dry Std Flow Rate	(Q_{sd})	462,413	dscf/hr
Avg Stack Dry Std Flow Rate	(Q_{sd})	7,707	dscf/min
Avg Stack Wet Flow Rate	(Q_{aw})	34,103	acf/min
Avg Stack Wet Std Flow Rate	(Q_{sw})	487,777	ascf/hr

40 CFR 60, Method 2G, Section 8.11.1 (but applies to all Method 2 type static pressure measurements):
If a Type S probe is used for this measurement, position the probe at or between any traverse point(s) and rotate the probe until a null differential pressure reading is obtained. Disconnect the tubing from one of the pressure ports; read and record the ΔP. For pressure devices with one-directional scales, if a deflection in the positive direction is noted with the negative side disconnected, then the static pressure is positive. Likewise, if a deflection in the positive direction is noted with the positive side disconnected, then the static pressure is negative.

Stack Cross Section Schematic

Velocity Traverse Data				
Run Number		90-100% R10		
Run Time	09:50	Start	09:58	End
Traverse Point	Velocity Head (Δp)	Null Angle (N_a)	Stack Temp (t_s)	Local Velocity ($v_{s(l)}$)
	in H_2O	deg	°F	ft/sec
A-1	0.005		1798	8.14
A-2	0.010		1795	11.50
A-3	0.005		1800	8.14
A-4	0.015		1801	14.10
A-5	0.015		1797	14.09
A-6	0.010		1797	11.51
A-7	0.005		1799	8.14
A-8	0.005		1756	8.06
B-1	0.005		1796	8.13
B-2	0.005		1794	8.13
B-3	0.025		1798	18.20
B-4	0.020		1780	16.21
B-5	0.020		1779	16.21
B-6	0.015		1797	14.09
B-7	0.005		1800	8.14
B-8	0.005		1796	8.13
Average	0.011		1793	
	0.098	= Square roots of Δp		

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant Name	John Zink Tulsa R&D Facility			
Sampling Location	2.5OD X 19 Production Flare			
Operator	SC/DA			
Project #	jz-13-tulsa.ok-comp#1			
Pitot Leak Check	x	PreTest	x	PostTest

Date	10/23/13		
Stack Type	Circular		
Ports Available	2		
Pitot Identification	samp-pi-0018		
Pitot Coefficient	0.840		

Stack Dimensions			
Area of Stack	(A_s)	50.27	ft²
Diameter of Stack	(D)	96.00	in

Pressures			
Barometric Pressure	(P_b)	30.43	in Hg
Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.43	in Hg

Stack Gas Composition			
Composition Data:	Estimated Composition		
Carbon Dioxide Concentration	(%CO_2)	5.98	%vd
Oxygen Concentration	(%O_2)	13.60	%vd
Carbon Monoxide Concentration	(ppmCO)	0.00	ppmvd
Nitrogen Concentration	(%N_2)	80.40	%vd
Stack Moisture Content	(B_{ws})	5.80	%
Stack Dry Molecular Weight	(M_d)	29.50	lb/lb-mole
Stack Wet Molecular Weight	(M_w)	28.83	lb/lb-mole

Results			
Avg Stack Gas Velocity	(v_s)	12.49	ft/sec
Avg Stack Dry Std Flow Rate	(Q_{sd})	508,750	dscf/hr
Avg Stack Dry Std Flow Rate	(Q_{sd})	8,479	dscf/min
Avg Stack Wet Flow Rate	(Q_{aw})	37,682	acf/min
Avg Stack Wet Std Flow Rate	(Q_{sw})	540,074	ascf/hr

40 CFR 60, Method 2G, Section 8.11.1 (but applies to all Method 2 type static pressure measurements):
If a Type S probe is used for this measurement, position the probe at or between any traverse point(s) and rotate the probe until a null differential pressure reading is obtained. Disconnect the tubing from one of the pressure ports; read and record the ΔP. For pressure devices with one-directional scales, if a deflection in the positive direction is noted with the negative side disconnected, then the static pressure is positive. Likewise, if a deflection in the positive direction is noted with the positive side disconnected, then the static pressure is negative.

Stack Cross Section Schematic

Velocity Traverse Data				
Run Number		90-100% R11		
Run Time	11:32	Start	11:41	End
Traverse Point	Velocity Head (Δp)	Null Angle (N_a)	Stack Temp (t_s)	Local Velocity ($v_{s(l)}$)
	in H_2O	deg	°F	ft/sec
A-1	0.005		1759	8.08
A-2	0.005		1736	8.03
A-3	0.020		1789	16.26
A-4	0.025		1769	18.10
A-5	0.020		1795	16.28
A-6	0.020		1801	16.30
A-7	0.010		1763	11.43
A-8	0.005		1793	8.14
B-1	0.010		1796	11.52
B-2	0.010		1799	11.52
B-3	0.025		1798	18.22
B-4	0.015		1800	14.12
B-5	0.015		1801	14.12
B-6	0.005		1804	8.16
B-7	0.010		1807	11.54
B-8	0.005		1799	8.15
Average	0.013		1788	
	0.109	= Square roots of Δp		

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant Name	John Zink Tulsa R&D Facility			
Sampling Location	2.5OD X 19 Production Flare			
Operator	SC/DA			
Project #	jz-13-tulsa.ok-comp#1			
Pitot Leak Check	x	PreTest	x	PostTest

Date	10/23/13
Stack Type	Circular
Ports Available	2
Pitot Identification	samp-pi-0018
Pitot Coefficient	0.840

Stack Dimensions			
Area of Stack	(A_s)	50.27	ft^2
Diameter of Stack	(D)	96.00	in

Pressures			
Barometric Pressure	(P_b)	30.42	in Hg
Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.42	in Hg

Stack Gas Composition			
Composition Data:	Estimated Composition		
Carbon Dioxide Concentration	($\%CO_2$)	6.03	%vd
Oxygen Concentration	($\%O_2$)	13.50	%vd
Carbon Monoxide Concentration	(ppmCO)	0.00	ppmvd
Nitrogen Concentration	($\%N_2$)	80.50	%vd
Stack Moisture Content	(B_{ws})	6.80	%
Stack Dry Molecular Weight	(M_d)	29.51	lb/lb-mole
Stack Wet Molecular Weight	(M_w)	28.73	lb/lb-mole

Results			
Avg Stack Gas Velocity	(v_s)	12.59	ft/sec
Avg Stack Dry Std Flow Rate	(Q_{sd})	508,371	dscf/hr
Avg Stack Dry Std Flow Rate	(Q_{sd})	8,473	dscf/min
Avg Stack Wet Flow Rate	(Q_{aw})	37,962	acf/min
Avg Stack Wet Std Flow Rate	(Q_{sw})	545,462	ascf/hr

40 CFR 60, Method 2G, Section 8.11.1 (but applies to all Method 2 type static pressure measurements):
If a Type S probe is used for this measurement, position the probe at or between any traverse point(s) and rotate the probe until a null differential pressure reading is obtained. Disconnect the tubing from one of the pressure ports; read and record the ΔP. For pressure devices with one-directional scales, if a deflection in the positive direction is noted with the negative side disconnected, then the static pressure is positive. Likewise, if a deflection in the positive direction is noted with the positive side disconnected, then the static pressure is negative.

Stack Cross Section Schematic

Velocity Traverse Data				
Run Number		90-100% R12		
Run Time	12:15	Start	12:23	End
Traverse Point	Velocity Head (Δp)	Null Angle (N_a)	Stack Temp (t_s)	Local Velocity ($v_{s(l)}$)
	in H_2O	deg	°F	ft/sec
A-1	0.005		1782	8.13
A-2	0.015		1785	14.10
A-3	0.020		1789	16.29
A-4	0.020		1798	16.32
A-5	0.020		1785	16.28
A-6	0.015		1782	14.09
A-7	0.005		1776	8.12
A-8	0.005		1762	8.10
B-1	0.005		1759	8.09
B-2	0.025		1768	18.13
B-3	0.010		1789	11.52
B-4	0.025		1782	18.19
B-5	0.020		1785	16.28
B-6	0.010		1793	11.53
B-7	0.005		1791	8.15
B-8	0.005		1780	8.13
Average	0.013		1782	
	0.109	= Square roots of Δp		

EMISSION DATA RECORDS

Moisture Content Data

METHOD 4 - DETERMINATION OF MOISTURE CONTENT IN STACK GASES

Client	John Zink Co, LLC				Date	08/20/13
Sampling Location	John Zink Testing and Research Facility				Project #	jz-13-tulsa.ok-comp#1
Operator	SC/DA				Meter Box Number	samp-cp-0019
Train Leak Check	<0.02@15"	PreTest	<0.02@15"	PostTest	Meter Cal Factor (Y)	0.976

Moisture Content Data							
Run Number	Flare-0-30-0-R1		Run Start Time	14:10	Run Stop Time		14:45
Total Meter Volume	(V_m)	26.470	dcf	Barometric Press.	(P_b)	30.04	in Hg
Avg Meter Temp	$(t_m)_{avg}$	78	°F	Avg Orifice Press.	$(\Delta H)_{avg}$	1.86	in H_2O

		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7	Impinger 8
		g	g	g	g	g	g	g	g
Contents		H_2O	H_2O		Sil Gel				
Final Value	(V_f),(W_f)	736.30	698.10	594.50	875.30				
Initial Value	(V_i),(W_i)	712.50	693.90	590.30	867.20				
Net Value	(V_a),(W_a)	23.8	4.2	4.2	8.1				
Results									
Total Weight	(W_t)	40.30	g	Water Vol Weighed	$(V_{wsg(std)})$	1.900	scf		
Std Meter Volume	$(V_{m(std)})$	25.572	dscf	Sat. Moisture Content	$(B_{ws(sat)})$	100.0	%		
Calc Moisture Content	$(B_{ws(calc)})$	6.9	%	Final Moisture Content	(B_{ws})	6.9	%		

Moisture Content Data							
Run Number	Flare-0-30-0-R2		Run Start Time	15:35	Run Stop Time		16:12
Total Meter Volume	(V_m)	27.740	dcf	Barometric Press.	(P_b)	30.02	in Hg
Avg Meter Temp	$(t_m)_{avg}$	73	°F	Avg Orifice Press.	$(\Delta H)_{avg}$	1.86	in H_2O

		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7	Impinger 8
		g	g	g	g	g	g	g	g
Contents		H_2O	H_2O		Sil Gel				
Final Value	(V_f),(W_f)	759.10	699.20	596.50	877.90				
Initial Value	(V_i),(W_i)	736.30	698.10	594.50	875.30				
Net Value	(V_a),(W_a)	22.8	1.1	2.0	2.6				
Results									
Total Weight	(W_t)	28.50	g	Water Vol Weighed	$(V_{wsg(std)})$	1.344	scf		
Std Meter Volume	$(V_{m(std)})$	27.058	dscf	Sat. Moisture Content	$(B_{ws(sat)})$	100.0	%		
Calc Moisture Content	$(B_{ws(calc)})$	4.7	%	Final Moisture Content	(B_{ws})	4.7	%		

Moisture Content Data							
Run Number	Flare-030-0-R3		Run Start Time	12:59	Run Stop Time		13:34
Total Meter Volume	(V_m)	33.530	dcf	Barometric Press.	(P_b)	30.09	in Hg
Avg Meter Temp	$(t_m)_{avg}$	61	°F	Avg Orifice Press.	$(\Delta H)_{avg}$	1.86	in H_2O

		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7	Impinger 8
		g	g	g	g	g	g	g	g
Contents		H_2O	H_2O		Sil Gel				
Final Value	(V_f),(W_f)	789.70	699.40	596.70	867.40				
Initial Value	(V_i),(W_i)	759.10	699.20	596.20	863.30				
Net Value	(V_a),(W_a)	30.6	0.2	0.5	4.1				
Results									
Total Weight	(W_t)	35.40	g	Water Vol Weighed	$(V_{wsg(std)})$	1.669	scf		
Std Meter Volume	$(V_{m(std)})$	33.505	dscf	Sat. Moisture Content	$(B_{ws(sat)})$	100.0	%		
Calc Moisture Content	$(B_{ws(calc)})$	4.7	%	Final Moisture Content	(B_{ws})	4.7	%		

Moisture Content Data							
Run Number	Flare-30-70-30-R4		Run Start Time	16:11	Run Stop Time		16:46
Total Meter Volume	(V_m)	27.600	dcf	Barometric Press.	(P_b)	30.00	in Hg
Avg Meter Temp	$(t_m)_{avg}$	62	°F	Avg Orifice Press.	$(\Delta H)_{avg}$	1.86	in H_2O

		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7	Impinger 8
		g	g	g	g	g	g	g	g
Contents		H_2O	H_2O		Sil Gel				
Final Value	(V_f),(W_f)	848.20	757.30	593.70	841.80				
Initial Value	(V_i),(W_i)	813.20	756.60	592.20	835.80				
Net Value	(V_a),(W_a)	35.0	0.7	1.5	6.0				
Results									
Total Weight	(W_t)	43.20	g	Water Vol Weighed	$(V_{wsg(std)})$	2.037	scf		
Std Meter Volume	$(V_{m(std)})$	27.471	dscf	Sat. Moisture Content	$(B_{ws(sat)})$	100.0	%		
Calc Moisture Content	$(B_{ws(calc)})$	6.9	%	Final Moisture Content	(B_{ws})	6.9	%		

METHOD 4 - DETERMINATION OF MOISTURE CONTENT IN STACK GASES

Client	John Zink Co, LLC				Date	08/20/13
Sampling Location	John Zink Testing and Research Facility				Project #	jz-13-tulsa.ok-comp#1
Operator					Meter Box Number	samp-cp-0019
Train Leak Check	<0.02@15"	PreTest	<0.02@15"	PostTest	Meter Cal Factor (Y)	0.976

Moisture Content Data							
Run Number	Flare-30-70-30-R5		Run Start Time	13:04	Run Stop Time		13:39
Total Meter Volume	(V_m)	30.730	dcf	Barometric Press.	(P_b)	30.32	in Hg
Avg Meter Temp	$(t_m)_{avg}$	67	°F	Avg Orifice Press.	$(\Delta H)_{avg}$	1.86	in H_2O

		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7	Impinger 8
		g	g	g	g	g	g	g	g
Contents		H_2O	H_2O		Sil Gel				
Final Value	$(V_f),(W_f)$	884.20	758.40	594.00	846.70				
Initial Value	$(V_i),(W_i)$	848.20	757.30	593.70	841.80				
Net Value	$(V_s),(W_s)$	36.0	1.1	0.3	4.9				
Results									
Total Weight	(W_t)	42.30	g	Water Vol Weighed	$(V_{wsg(std)})$	1.994	scf		
Std Meter Volume	$(V_{m(std)})$	30.618	dscf	Sat. Moisture Content	$(B_{ws(sat)})$	100.0	%		
Calc Moisture Content	$(B_{ws(calc)})$	6.1	%	Final Moisture Content	(B_{ws})	6.1	%		

Moisture Content Data							
Run Number	Flare-70-100-R3		Run Start Time	14:18	Run Stop Time		14:53
Total Meter Volume	(V_m)	30.730	dcf	Barometric Press.	(P_b)	30.36	in Hg
Avg Meter Temp	$(t_m)_{avg}$	70	°F	Avg Orifice Press.	$(\Delta H)_{avg}$	1.86	in H_2O

		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7	Impinger 8
		g	g	g	g	g	g	g	g
Contents		H_2O	H_2O		Sil Gel				
Final Value	$(V_f),(W_f)$	847.00	759.10	594.60	839.40				
Initial Value	$(V_i),(W_i)$	813.60	758.40	594.00	835.80				
Net Value	$(V_s),(W_s)$	33.4	0.7	0.6	3.6				
Results									
Total Weight	(W_t)	38.30	g	Water Vol Weighed	$(V_{wsg(std)})$	1.806	scf		
Std Meter Volume	$(V_{m(std)})$	30.455	dscf	Sat. Moisture Content	$(B_{ws(sat)})$	100.0	%		
Calc Moisture Content	$(B_{ws(calc)})$	5.6	%	Final Moisture Content	(B_{ws})	5.6	%		

Moisture Content Data							
Run Number	Flare-30-70-R1		Run Start Time	8:40	Run Stop Time		9:15
Total Meter Volume	(V_m)	27.920	dcf	Barometric Press.	(P_b)	30.10	in Hg
Avg Meter Temp	$(t_m)_{avg}$	71	°F	Avg Orifice Press.	$(\Delta H)_{avg}$	1.86	in H_2O

		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7	Impinger 8
		g	g	g	g	g	g	g	g
Contents		H_2O	H_2O		Sil Gel				
Final Value	$(V_f),(W_f)$	889.10	812.30	593.00	816.50				
Initial Value	$(V_i),(W_i)$	855.10	811.00	592.90	811.10				
Net Value	$(V_s),(W_s)$	34.0	1.3	0.1	5.4				
Results									
Total Weight	(W_t)	40.80	g	Water Vol Weighed	$(V_{wsg(std)})$	1.924	scf		
Std Meter Volume	$(V_{m(std)})$	27.409	dscf	Sat. Moisture Content	$(B_{ws(sat)})$	100.0	%		
Calc Moisture Content	$(B_{ws(calc)})$	6.6	%	Final Moisture Content	(B_{ws})	6.6	%		

Moisture Content Data							
Run Number	Flare-30-70-R2		Run Start Time	8:23	Run Stop Time		8:58
Total Meter Volume	(V_m)	27.860	dcf	Barometric Press.	(P_b)	30.10	in Hg
Avg Meter Temp	$(t_m)_{avg}$	56	°F	Avg Orifice Press.	$(\Delta H)_{avg}$	1.86	in H_2O

		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7	Impinger 8
		g	g	g	g	g	g	g	g
Contents		H_2O	H_2O		Sil Gel				
Final Value	$(V_f),(W_f)$	923.10	812.80	593.20	819.60				
Initial Value	$(V_i),(W_i)$	889.10	812.30	593.00	816.50				
Net Value	$(V_s),(W_s)$	34.0	0.5	0.2	3.1				
Results									
Total Weight	(W_t)	37.80	g	Water Vol Weighed	$(V_{wsg(std)})$	1.782	scf		
Std Meter Volume	$(V_{m(std)})$	28.146	dscf	Sat. Moisture Content	$(B_{ws(sat)})$	100.0	%		
Calc Moisture Content	$(B_{ws(calc)})$	6.0	%	Final Moisture Content	(B_{ws})	6.0	%		

METHOD 4 - DETERMINATION OF MOISTURE CONTENT IN STACK GASES

Client	John Zink Co, LLC				Date	08/21/13
Sampling Location	John Zink Testing and Research Facility				Project #	jz-13-tulsa.ok-comp#1
Operator					Meter Box Number	samp-cp-0019
Train Leak Check	<0.02@15"	PreTest	<0.02@15"	PostTest	Meter Cal Factor (Y)	0.976

Moisture Content Data							
Run Number	Flare-30-70-R3		Run Start Time	8:23	Run Stop Time	8:58	
Total Meter Volume	(V_m)	27.420	dcf	Barometric Press.	(P_b)	30.43	in Hg
Avg Meter Temp	$(t_m)_{avg}$	56	°F	Avg Orifice Press.	$(\Delta H)_{avg}$	1.86	in H_2O

		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7	Impinger 8
		g	g	g	g	g	g	g	g
Contents		H_2O	H_2O		Sil Gel				
Final Value	$(V_f),(W_f)$	828.20	766.50	593.60	849.80				
Initial Value	$(V_i),(W_i)$	797.10	766.00	593.50	844.50				
Net Value	$(V_s),(W_s)$	31.1	0.5	0.1	5.3				
Results									
Total Weight	(W_t)	37.00	g	Water Vol Weighed	$(V_{ws(std)})$	1.745	scf		
Std Meter Volume	$(V_{m(std)})$	28.003	dscf	Sat. Moisture Content	$(B_{ws(sat)})$	100.0	%		
Calc Moisture Content	$(B_{ws(calc)})$	5.9	%	Final Moisture Content	(B_{ws})	5.9	%		

Moisture Content Data							
Run Number	Flare-0-30-0-R1		Run Start Time	9:43	Run Stop Time	10:18	
Total Meter Volume	(V_m)	27.750	dcf	Barometric Press.	(P_b)	30.44	in Hg
Avg Meter Temp	$(t_m)_{avg}$	54	°F	Avg Orifice Press.	$(\Delta H)_{avg}$	1.86	in H_2O

		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7	Impinger 8
		g	g	g	g	g	g	g	g
Contents		H_2O	H_2O		Sil Gel				
Final Value	$(V_f),(W_f)$	855.40	766.90	593.90	854.90				
Initial Value	$(V_i),(W_i)$	828.20	766.50	593.60	849.80				
Net Value	$(V_s),(W_s)$	27.2	0.4	0.3	5.1				
Results									
Total Weight	(W_t)	33.00	g	Water Vol Weighed	$(V_{ws(std)})$	1.556	scf		
Std Meter Volume	$(V_{m(std)})$	28.446	dscf	Sat. Moisture Content	$(B_{ws(sat)})$	100.0	%		
Calc Moisture Content	$(B_{ws(calc)})$	5.2	%	Final Moisture Content	(B_{ws})	5.2	%		

Moisture Content Data							
Run Number	Flare-0-30-0-R2		Run Start Time	10:54	Run Stop Time	11:29	
Total Meter Volume	(V_m)	27.550	dcf	Barometric Press.	(P_b)	30.43	in Hg
Avg Meter Temp	$(t_m)_{avg}$	66	°F	Avg Orifice Press.	$(\Delta H)_{avg}$	1.86	in H_2O

		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7	Impinger 8
		g	g	g	g	g	g	g	g
Contents		H_2O	H_2O		Sil Gel				
Final Value	$(V_f),(W_f)$	784.70	710.60	594.60	854.30				
Initial Value	$(V_i),(W_i)$	755.20	709.10	593.90	849.90				
Net Value	$(V_s),(W_s)$	29.5	1.5	0.7	4.4				
Results									
Total Weight	(W_t)	36.10	g	Water Vol Weighed	$(V_{ws(std)})$	1.702	scf		
Std Meter Volume	$(V_{m(std)})$	27.574	dscf	Sat. Moisture Content	$(B_{ws(sat)})$	100.0	%		
Calc Moisture Content	$(B_{ws(calc)})$	5.8	%	Final Moisture Content	(B_{ws})	5.8	%		

Moisture Content Data							
Run Number	Flare-0-30-0-R3		Run Start Time	12:08	Run Stop Time	12:43	
Total Meter Volume	(V_m)	28.050	dcf	Barometric Press.	(P_b)	30.42	in Hg
Avg Meter Temp	$(t_m)_{avg}$	66	°F	Avg Orifice Press.	$(\Delta H)_{avg}$	1.86	in H_2O

		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7	Impinger 8
		g	g	g	g	g	g	g	g
Contents		H_2O	H_2O		Sil Gel				
Final Value	$(V_f),(W_f)$	819.70	712.00	596.20	823.10				
Initial Value	$(V_i),(W_i)$	784.70	710.60	594.60	817.60				
Net Value	$(V_s),(W_s)$	35.0	1.4	1.6	5.5				
Results									
Total Weight	(W_t)	43.50	g	Water Vol Weighed	$(V_{ws(std)})$	2.051	scf		
Std Meter Volume	$(V_{m(std)})$	28.066	dscf	Sat. Moisture Content	$(B_{ws(sat)})$	100.0	%		
Calc Moisture Content	$(B_{ws(calc)})$	6.8	%	Final Moisture Content	(B_{ws})	6.8	%		

AIR HYGIENE

MOISTURE (EPA METHOD 4) DATA SHEET

Site Info.
Plant Name..... JZ RQD
Sampling Location.....
Unit #..... 2.5 DD
Load.....
Date..... 10/23-24/13

Console Info.
Console.....
Meter Calibratrion Factor
Orifice Meter Coefficient

Stack Dimensions
Dist. to Far Wall of Stack
Dist. to Near Wall of Stack
Dist. Downstream.....
Dist. Upstream.....

Sampling Equipment
Probe Number.....
Probe Length.....
Liner Material.....
Imp. Case Number.....

Run # 1 Start: 14:08 Stop: 14:43
Bar. Press. Stack Static Press. Avg Stack Temp

Sampling Time	Dry Gas Meter Reading	Impinger Exit Temp.	Meter Inlet Temp	Meter Outlet Temp	Pump Vacuum		Initial Imp. Weights	Final Imp. Weights
min	ft3	oF	oF	oF	In Hg		g	g
0.0	454.44	60	67	67	2	1	~~712.5~~	736.3
5.0	458.29	59	67	67	2	2	693.9	698.1
10.0	461.50	60	70	71	2	3	590.3	594.5
15.0	465.18	60	71	71	2	4	867.2	875.3
20.0	469.91	63	72	72	2			
25.0	473.34	63	73	73	2	Pre Leak		0
30.0	477.13	63	74	74	2	Post Leak		0
35.0	480.91							

Run # 2 Start: 15:35 Stop: 16:10
Bar. Press. Stack Static Press. Avg Stack Temp

Sampling Time	Dry Gas Meter Reading	Impinger Exit Temp.	Meter Inlet Temp	Meter Outlet Temp	Pump Vacuum		Initial Imp. Weights	Final Imp. Weights
min	ft3	oF	oF	oF	In Hg		g	g
0.0	481.23	68	71	71	2	1	736.3	759.1
5.0	485.33	66	71	71	2	2	698.1	699.2
10.0	489.26	66	72	72	2	3	594.5	596.2
15.0	493.64	67	72	72	2	4	875.3	877.9
20.0	497.35	67	73	73	2			
25.0	500.99	68	73	73	2	Pre Leak		0
30.0	504.83	67	74	74	2	Post Leak		0
35.0	508.97							

Run # 3 Start: 7:55 Stop: 8:30
Bar. Press. Stack Static Press. Avg Stack Temp

Sampling Time	Dry Gas Meter Reading	Impinger Exit Temp.	Meter Inlet Temp	Meter Outlet Temp	Pump Vacuum		Initial Imp. Weights	Final Imp. Weights
min	ft3	oF	oF	oF	in Hg		g	g
0.0	509.11	43	60	60	2	1	759.1	789.7
5.0	518.57	42	60	60	2	2	699.2	698.4
10.0	522.49	43	60	60	2	3	596.2	592.7
15.0	526.42	46	61	61	2	4	863.3	867.4
20.0	530.49	47	61	61	2			
25.0	534.55	48	62	62	2	Pre Leak		0
30.0	538.64	49	62	62	2	Post Leak		0
35.0	542.64							

AIR HYGIENE

MOISTURE (EPA METHOD 4) DATA SHEET

Site Info.
Plant Name..... JZ R&D
Sampling Location.....
Unit #..... 2.5 DD
Load.....
Date..... 10/24/13

Console Info.
Console.....
Meter Calibration Factor
Orifice Meter Coefficient

Stack Dimensions
Dist. to Far Wall of Stack
Dist. to Near Wall of Stack
Dist. Downstream.....
Dist. Upstream.....

Sampling Equipment
Probe Number.....
Probe Length.....
Liner Material.....
Imp. Case Number.....

Run # 4 Start: 9:16 Stop: 9:51
Bar. Press. Stack Static Press. Avg Stack Temp

Sampling Time	Dry Gas Meter Reading	Impinger Exit Temp.	Meter Inlet Temp	Meter Outlet Temp	Pump Vacuum		Initial Imp. Weights	Final Imp. Weights
min	ft3	oF	oF	oF	in Hg		g	g
0.0	543.21	47	60	60	2	1	813.2	848.2
5.0	546.94	45	60	60	2	2	756.6	757.3
10.0	551.13	45	61	61	2	3	596.2	593.7
15.0	554.93	49	61	61	2	4	835.8	841.8
20.0	558.93	49	62	62	2			
25.0	562.89	53	63	63	2		Pre Leak	0
30.0	566.77	54	63	63	2		Post Leak	0
35.0	570.81							

Run # 5 Start: 13:04 Stop: 13:39
Bar. Press. Stack Static Press. Avg Stack Temp

Sampling Time	Dry Gas Meter Reading	Impinger Exit Temp.	Meter Inlet Temp	Meter Outlet Temp	Pump Vacuum		Initial Imp. Weights	Final Imp. Weights
min	ft3	oF	oF	oF	in Hg		g	g
0.0	571.48	43	63	63	2	1	848.2	884.2
5.0	575.30	41	63	63	2	2	757.3	758.4
10.0	582.18	43	67	67	2	3	593.7	594.0
15.0	588.19	45	67	67	2	4	841.8	846.7
20.0	590.14	47	67	67	2			
25.0	594.18	47	69	69	2		Pre Leak	0
30.0	598.17	49	70	70	2		Post Leak	0
35.0	602.21							

Run # 6 Start: 14:18 Stop: 14:53
Bar. Press. Stack Static Press. Avg Stack Temp

Sampling Time	Dry Gas Meter Reading	Impinger Exit Temp.	Meter Inlet Temp	Meter Outlet Temp	Pump Vacuum		Initial Imp. Weights	Final Imp. Weights
min	ft3	oF	oF	oF	in Hg		g	g
0.0	602.49	54	69	69	2	1	813.6	847.0
5.0	607.40	52	69	69	2	2	758.4	~~758.4~~ 759.1
10.0	610.73	56	69	69	2	3	594.0	594.6
15.0	614.34	53	70	70	2	4	835.8	839.4
20.0	618.29	52	71	71	2			
25.0	622.25	52	71	71	2		Pre Leak	0
30.0	626.31	53	71	71	2		Post Leak	0
35.0	630.20							

AIR HYGIENE

MOISTURE (EPA METHOD 4) DATA SHEET

Site Info.
Plant Name..... JT R&D
Sampling Location.....
Unit #..... 2.500
Load.....
Date..... 12/4-25AB

Console Info.
Console.....
Meter Calibratrion Factor
Orifice Meter Coefficient

Stack Dimensions
Dist. to Far Wall of Stack
Dist. to Near Wall of Stack
Dist. Downstream.....
Dist. Upstream.....

Sampling Equipment
Probe Number.....
Probe Length.....
Liner Material.....
Imp. Case Number.....

Run # 7 Start: 15:52 Stop: 16:27
Bar. Press. Stack Static Press. Avg Stack Temp

Sampling Time	Dry Gas Meter Reading	Impinger Exit Temp.	Meter Inlet Temp	Meter Outlet Temp	Pump Vacuum		Initial Imp. Weights	Final Imp. Weights
min	ft3	oF	oF	oF	in Hg		g	g
0.0	630.81	52	70	70	2	1	855.1	889.1
5.0	634.79	46	69	69	2	2	811.0	812.3
10.0	638.81	52	70	70	2	3	592.9	593.0
15.0	642.79	53	70	70	2	4	811.1	816.5
20.0	646.87	52	71	71	2			
25.0	650.84	51	71	71	2		Pre Leak	0
30.0	654.61	52	71	71	2		Post Leak	0
35.0	658.73							

Run # 8 Start: 17:06 Stop: 17:41
Bar. Press. Stack Static Press. Avg Stack Temp

Sampling Time	Dry Gas Meter Reading	Impinger Exit Temp.	Meter Inlet Temp	Meter Outlet Temp	Pump Vacuum		Initial Imp. Weights	Final Imp. Weights
min	ft3	oF	oF	oF	in Hg		g	g
0.0	660.13	50	70	70	2	1	889.1	923.1
5.0	663.84	45	70	70	2	2	812.3	812.8
10.0	667.97	45	70	70	2	3	593.0	593.2
15.0	671.93	45	70	70	2	4	816.5	819.6
20.0	675.94	45	70	70	2			
25.0	679.97	46	70	70	2		Pre Leak	0
30.0	684.21	46	70	70	2		Post Leak	0
35.0	687.99							

Run # 9 Start: 8:23 Stop: 8:58
Bar. Press. Stack Static Press. Avg Stack Temp

Sampling Time	Dry Gas Meter Reading	Impinger Exit Temp.	Meter Inlet Temp	Meter Outlet Temp	Pump Vacuum		Initial Imp. Weights	Final Imp. Weights
min	ft3	oF	oF	oF	in Hg		g	g
0.0	689.81	35	53	53	2	1	797.1	828.2
5.0	693.67	36	54	54	2	2	766.0	766.5
10.0	697.51	37	54	54	2	3	593.5	593.6
15.0	701.49	39	55	55	2	4	844.5	849.8
20.0	705.40	40	56	56	2			
25.0	709.33	41	57	57	2		Pre Leak	0
30.0	713.30	42	58	58	2		Post Leak	0
35.0	717.23							

AIR HYGIENE

MOISTURE (EPA METHOD 4) DATA SHEET

Site Info.
Plant Name..... JVR&D
Sampling Location.....
Unit #..... 2.500
Load.....
Date..... 10/25/13

Console Info.
Console.....
Meter Calibratrion Factor
Orifice Meter Coefficient

Stack Dimensions
Dist. to Far Wall of Stack
Dist. to Near Wall of Stack
Dist. Downstream.....
Dist. Upstream.....

Sampling Equipment
Probe Number.....
Probe Length.....
Liner Material.....
Imp. Case Number.....

Run # 10 Start: 9:43 Stop: 10:18
Bar. Press. Stack Static Press. Avg Stack Temp

Sampling Time	Dry Gas Meter Reading	Impinger Exit Temp.	Meter Inlet Temp	Meter Outlet Temp	Pump Vacuum		Initial Imp. Weights	Final Imp. Weights
min	ft3	oF	oF	oF	in Hg		g	g
0.0	722.01	43	58	58	2	1	328.2	855.4
5.0	726.10	45	54	54	2	2	766.5	766.9
10.0	730.00	47	60	60	2	3	593.6	593.9
15.0	733.82	47	61	61	2	4	849.8	854.9
20.0	737.81	48	62	62	2			
25.0	741.84	50	64	64	2		Pre Leak	0
30.0	745.80	50	64	64	2		Post Leak	0
35.0	749.76							

Run # 11 Start: 10:54 Stop: 11:29
Bar. Press. Stack Static Press. Avg Stack Temp

Sampling Time	Dry Gas Meter Reading	Impinger Exit Temp.	Meter Inlet Temp	Meter Outlet Temp	Pump Vacuum		Initial Imp. Weights	Final Imp. Weights
min	ft3	oF	oF	oF	in Hg		g	g
0.0	751.03	49	64	64	2	1	755.2	784.7
5.0	754.65	46	64	64	2	2	709.1	710.6
10.0	758.65	48	65	65	2	3	593.9	594.6
15.0	762.68	48	65	65	2	4	849.9	854.3
20.0	766.64	49	67	67	2			
25.0	770.61	50	67	67	2		Pre Leak	0
30.0	774.60	50	68	68	2		Post Leak	0
35.0	778.58							

Run # 12 Start: 12:08 Stop: 12:43
Bar. Press. Stack Static Press. Avg Stack Temp

Sampling Time	Dry Gas Meter Reading	Impinger Exit Temp.	Meter Inlet Temp	Meter Outlet Temp	Pump Vacuum		Initial Imp. Weights	Final Imp. Weights
min	ft3	oF	oF	oF	in Hg		g	g
0.0	779.03	48	64	64	2	1	784.7	819.7
5.0	783.01	44	64	64	2	2	710.6	712.0
10.0	786.81	45	64	64	2	3	594.6	596.2
15.0	790.83	45	64	64	2	4	817.6	823.1
20.0	794.79	46	65	65	2			
25.0	798.81	46	66	66	2		Pre Leak	0
30.0	802.99	46	68	68	2		Post Leak	0
35.0	807.13							

EMISSION DATA RECORDS

Visual Emission Data

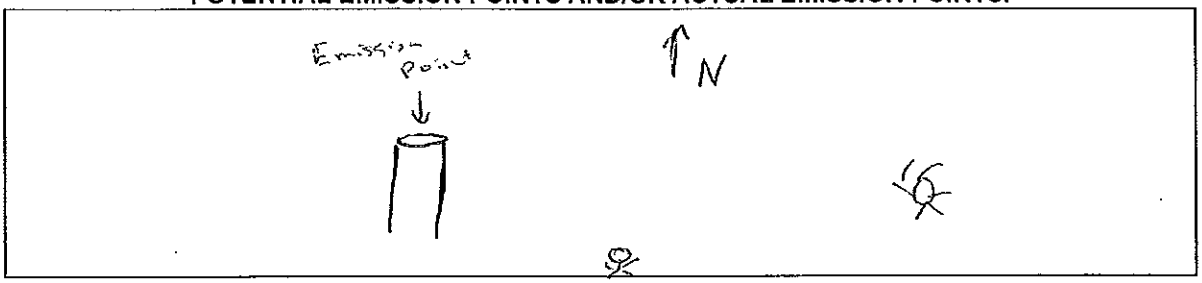
R1

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink LOCATION: COMPANY REP:	OBSERVER: Michael Whisenhunt AFFILIATION: Air Hygiene DATE: 10-23-13
SKY CONDITIONS: Clear PRECIPITATION: None	WIND DIRECTION: S WIND SPEED: 5 mpL
INDUSTRY:	PROCESS UNIT: 2.500

SKETCH PROCESS UNIT: INDICATE OBSERVER POSITION RELATIVE TO SOURCE; INDICATE POTENTIAL EMISSION POINTS AND/OR ACTUAL EMISSION POINTS.

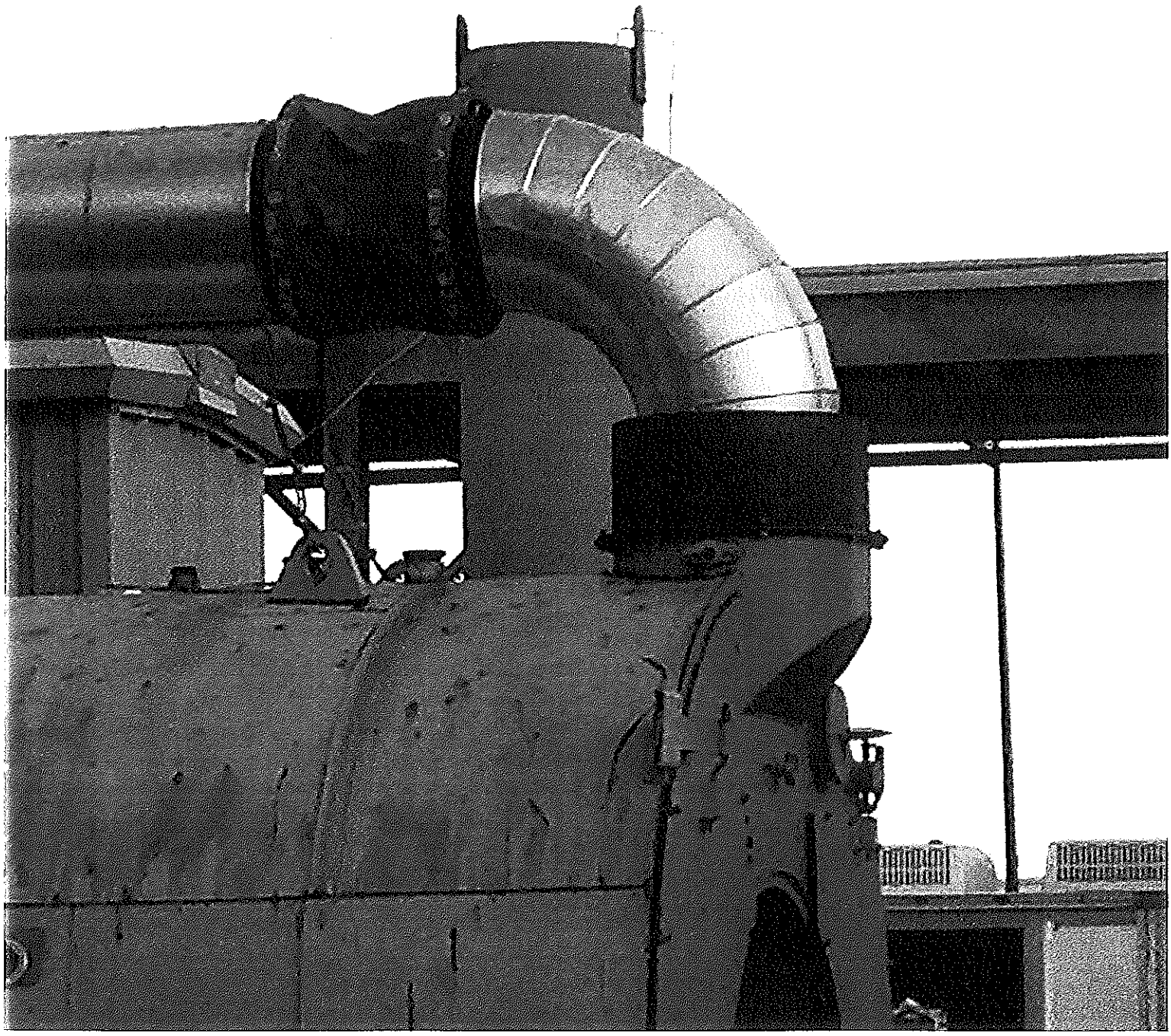


OBSERVATIONS

CLOCK TIME	OBSERVATION PERIOD DURACTION (MIN:SEC)	ACCUMULATION EMISSION TIME (MIN:SEC)	OBSERVATION LOCATION
14:18	10:00	1:13	Black Smoke
14:28	C:00 Break	—	—
14:33	10:00	2:10	Black Smoke
14:43	C:00 Break	—	—
14:48	10:00	1:38	
14:58	5:00 Break	—	—
15:03	10:00	2:11	
15:13			

SIGNATURE

Run 1



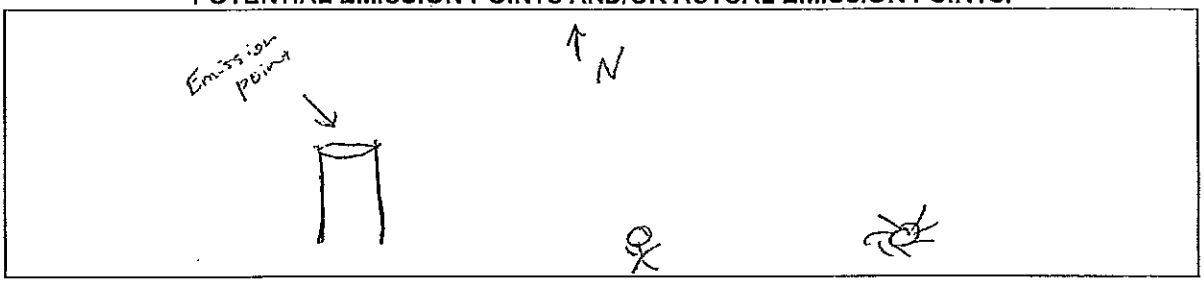
R2

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink LOCATION: COMPANY REP:	OBSERVER: Michael Whisenhunt AFFILIATION: Air Hygiene DATE: 10-23-13
SKY CONDITIONS: Clear PRECIPITATION: None	WIND DIRECTION: S WIND SPEED: <5 mph
INDUSTRY:	PROCESS UNIT: 2.500

SKETCH PROCESS UNIT: INDICATE OBSERVER POSITION RELATIVE TO SOURCE; INDICATE POTENTIAL EMISSION POINTS AND/OR ACTUAL EMISSION POINTS.

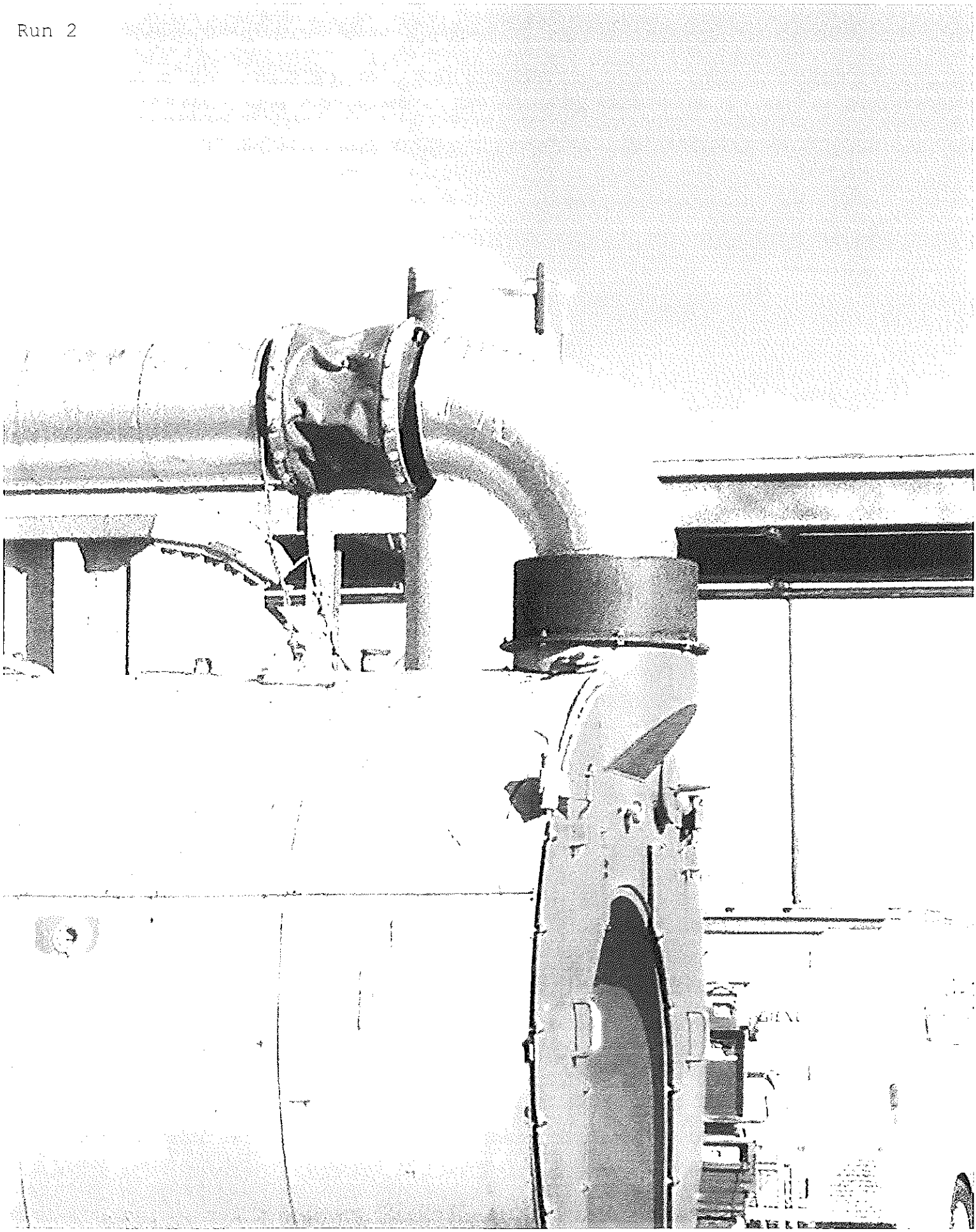


OBSERVATIONS

CLOCK TIME	OBSERVATION PERIOD DURACTION (MIN:SEC)	ACCUMULATION EMISSION TIME (MIN:SEC)	OBSERVATION LOCATION
15:35	10:00	00:43	Black Smoke
15:45	Bk 5:00	—	—
15:50	10:00	00:49	Black Flame
16:00	5:00	—	—
16:05	10:00	3:51	Black smoke
16:15	5:00	—	—
16:20	10:00	1:16	Black Smoke
16:30			

SIGNATURE

Run 2



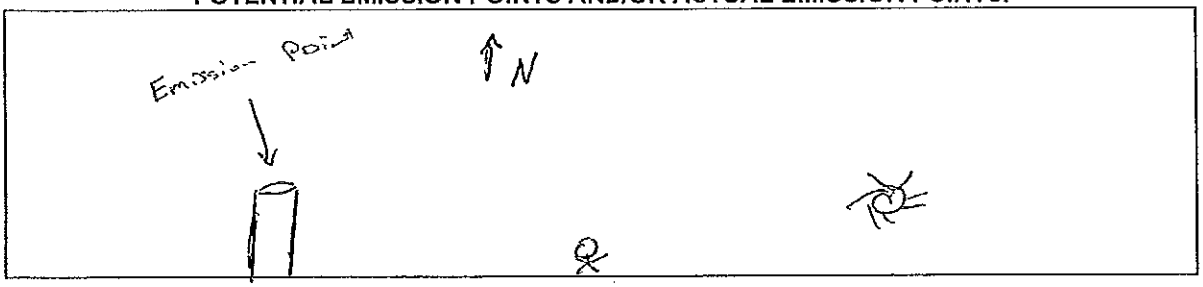
R3

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink LOCATION: COMPANY REP:	OBSERVER: Michael Whisenhunt AFFILIATION: Air Hygiene DATE: 10-24-13
SKY CONDITIONS: Clear PRECIPITATION: None	WIND DIRECTION: NNE WIND SPEED: 5
INDUSTRY:	PROCESS UNIT: 2-500

SKETCH PROCESS UNIT: INDICATE OBSERVER POSITION RELATIVE TO SOURCE; INDICATE POTENTIAL EMISSION POINTS AND/OR ACTUAL EMISSION POINTS.



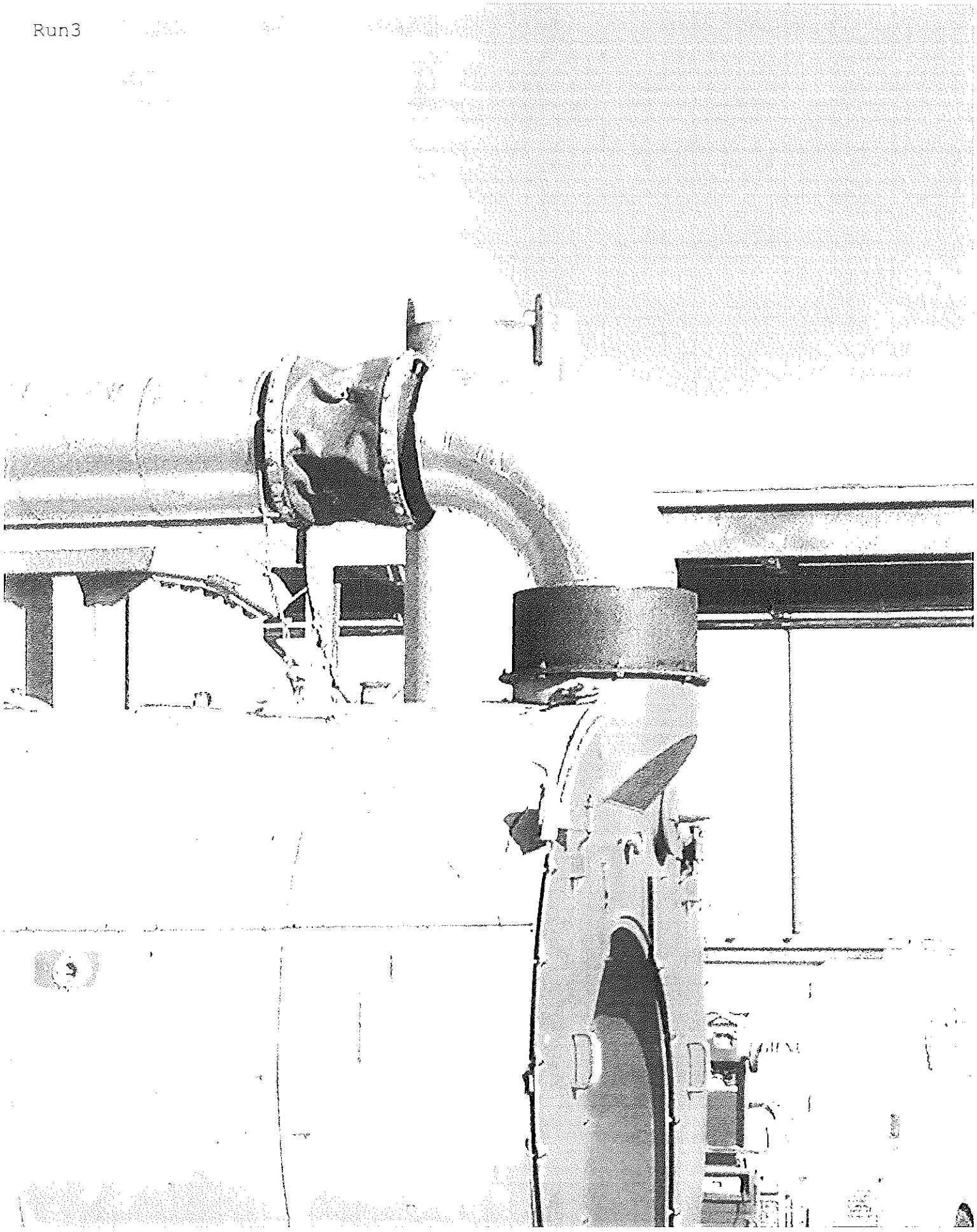
OBSERVATIONS

CLOCK TIME	OBSERVATION PERIOD DURACTION (MIN:SEC)	ACCUMULATION EMISSION TIME (MIN:SEC)	OBSERVATION LOCATION
7:55			
8:05	10:00	00:22	Black Smoke
8:10	5:00 Break	—	—
8:20	10:00	:27	Black Smoke
8:25	5:00 Break	—	—
8:35	10:00	1:23	Black Smoke
8:40	5:00 Break	—	—
8:50	10:00	:57	Black Smoke

* only smoked when changing loads

SIGNATURE

Run3



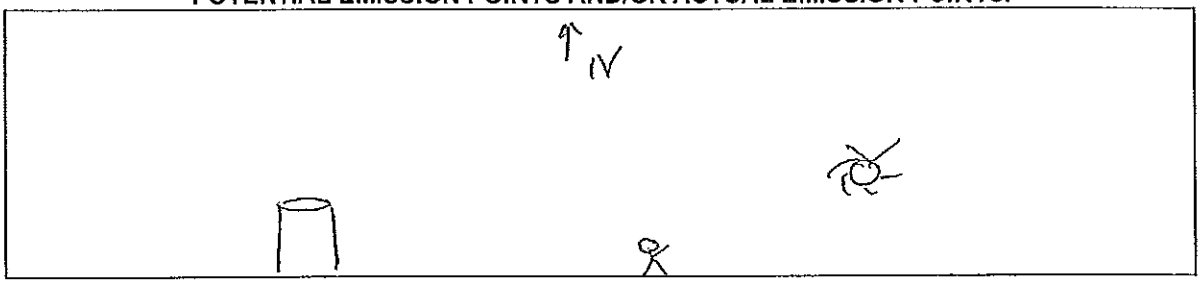
R4

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink LOCATION: COMPANY REP:	OBSERVER: Michael Whisenhunt AFFILIATION: Air Hygiene DATE: 10-24-03
SKY CONDITIONS: Clear PRECIPITATION: None	WIND DIRECTION: N WIND SPEED: 6
INDUSTRY:	PROCESS UNIT: 2-5 00

SKETCH PROCESS UNIT: INDICATE OBSERVER POSITION RELATIVE TO SOURCE; INDICATE POTENTIAL EMISSION POINTS AND/OR ACTUAL EMISSION POINTS.



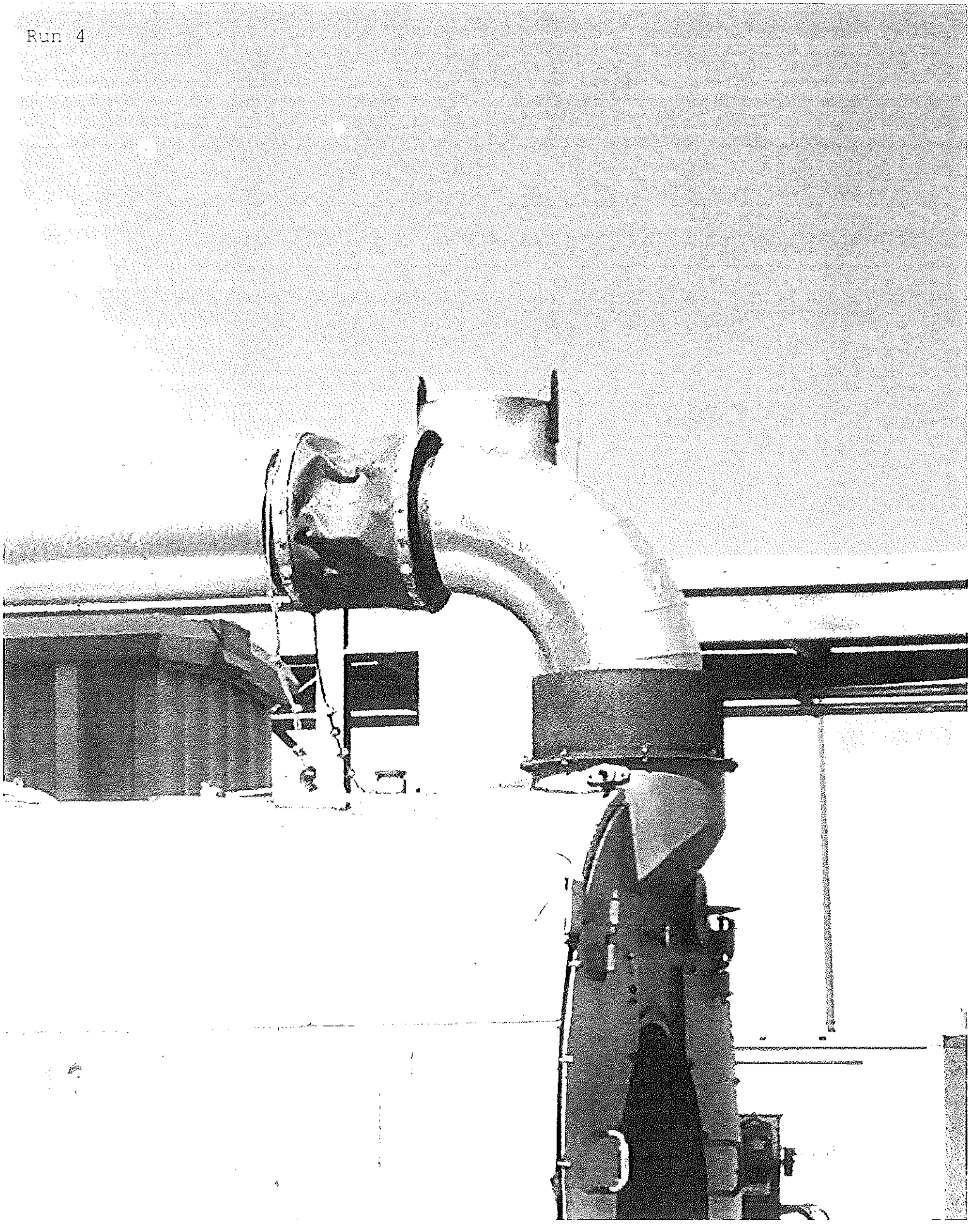
OBSERVATIONS

CLOCK TIME	OBSERVATION PERIOD DURACTION (MIN:SEC)	ACCUMULATION EMISSION TIME (MIN:SEC)	OBSERVATION LOCATION
9:16	10:00	00:00	—
9:26	5:00	—	—
9:31	10:00	00:43	Black Smoke
9:41	5:00	—	—
9:46	10:00	1:13	
9:56	5:00	—	—
10:01	10:00	1:02	
10:11			

SIGNATURE

* only smokes when changing loads

Run 4



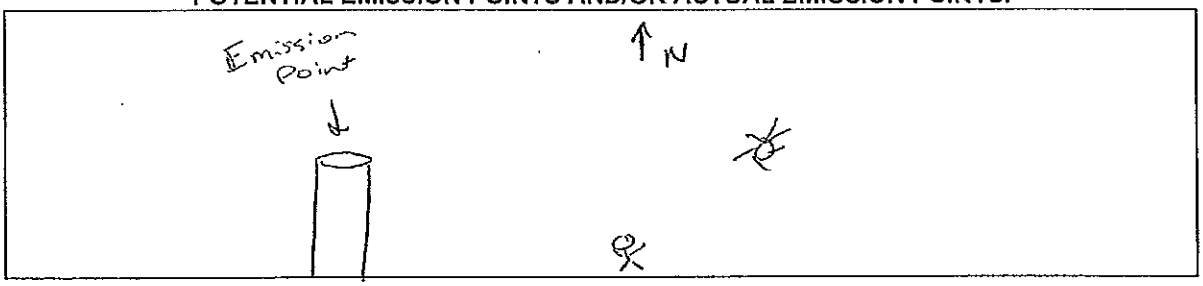
R5

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink LOCATION: COMPANY REP:	OBSERVER: Michael Whisenhunt AFFILIATION: Air Hygiene DATE: 10-24-13
SKY CONDITIONS: Clear PRECIPITATION: None	WIND DIRECTION: NNE WIND SPEED: 9
INDUSTRY:	PROCESS UNIT: 2.500

SKETCH PROCESS UNIT: INDICATE OBSERVER POSITION RELATIVE TO SOURCE; INDICATE POTENTIAL EMISSION POINTS AND/OR ACTUAL EMISSION POINTS.



OBSERVATIONS

CLOCK TIME	OBSERVATION PERIOD DURACTION (MIN:SEC)	ACCUMULATION EMISSION TIME (MIN:SEC)	OBSERVATION LOCATION
13:04			
13:14	10	0	—
13:19	5	—	—
13:29	10	0	—
13:34	5	—	—
13:44	10	0	—
13:49	5	—	—
13:59	10	0	—

SIGNATURE

Run 5

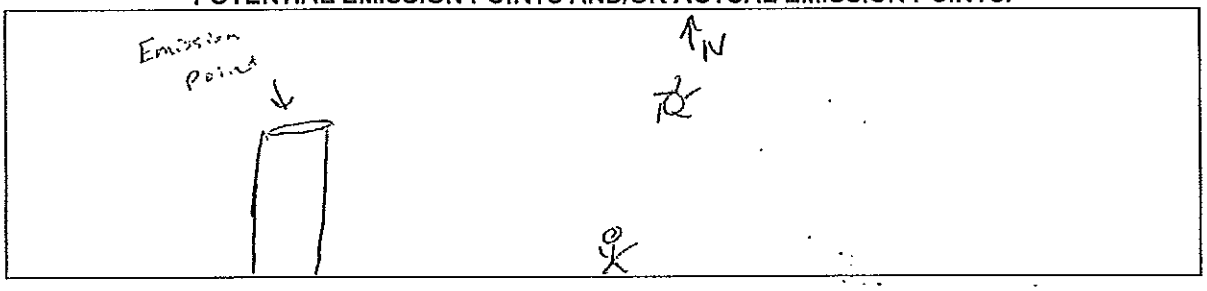
R6

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink LOCATION: COMPANY REP:	OBSERVER: Michael Whisenhunt AFFILIATION: Air Hygiene DATE: 10-24-13
SKY CONDITIONS: Clear PRECIPITATION: None	WIND DIRECTION: N WIND SPEED: 5
INDUSTRY:	PROCESS UNIT: 2.5 OD

SKETCH PROCESS UNIT: INDICATE OBSERVER POSITION RELATIVE TO SOURCE; INDICATE POTENTIAL EMISSION POINTS AND/OR ACTUAL EMISSION POINTS.



OBSERVATIONS

CLOCK TIME	OBSERVATION PERIOD DURACTION (MIN:SEC)	ACCUMULATION EMISSION TIME (MIN:SEC)	OBSERVATION LOCATION
14:18	10	0	—
14:28	5	—	—
14:33	10	0	
14:43	5	—	—
14:48	10	0	
14:58	5	—	—
15:03	10	0	—
15:13			

SIGNATURE

Run 6

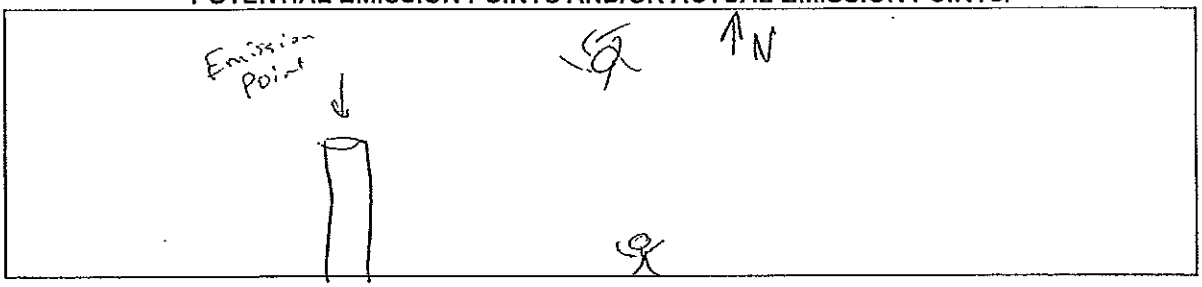
R7

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink LOCATION: COMPANY REP:	OBSERVER: Michael Whisenhunt AFFILIATION: Air Hygiene DATE: 10-24-13
SKY CONDITIONS: Clear PRECIPITATION: None	WIND DIRECTION: NNE WIND SPEED: 4
INDUSTRY:	PROCESS UNIT:

SKETCH PROCESS UNIT: INDICATE OBSERVER POSITION RELATIVE TO SOURCE; INDICATE POTENTIAL EMISSION POINTS AND/OR ACTUAL EMISSION POINTS.

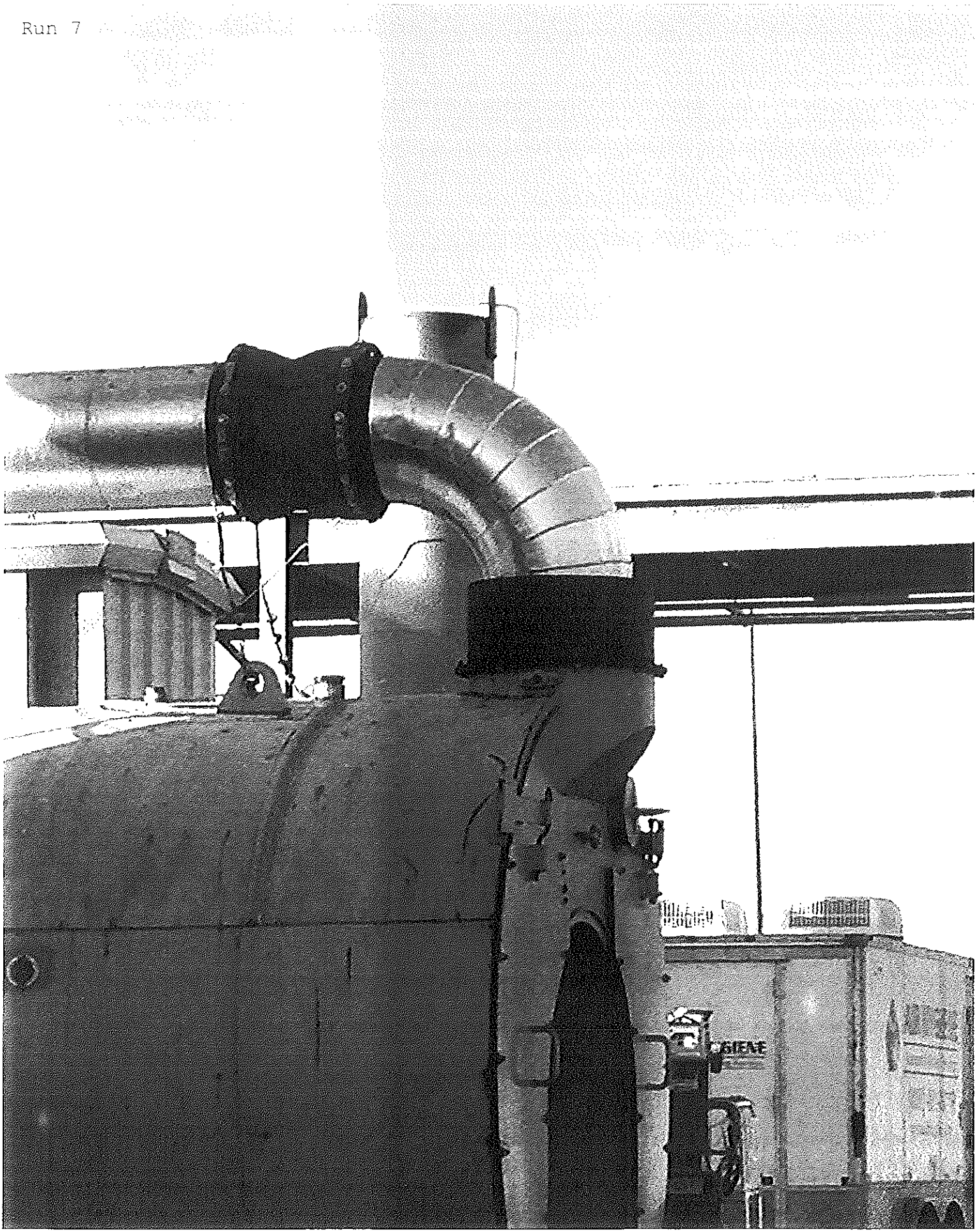


OBSERVATIONS

CLOCK TIME	OBSERVATION PERIOD DURACTION (MIN:SEC)	ACCUMULATION EMISSION TIME (MIN:SEC)	OBSERVATION LOCATION
[redacted] 15:52	10	:08	Black Smoke
[redacted] 16:02	5	—	—
[redacted] 16:07	10	0	—
[redacted] 16:17	5	—	—
[redacted] 17:22	10	0	—
[redacted] 17:32	5	—	—
[redacted] 17:37	10	0	—
[redacted] 17:47			

SIGNATURE

Run 7



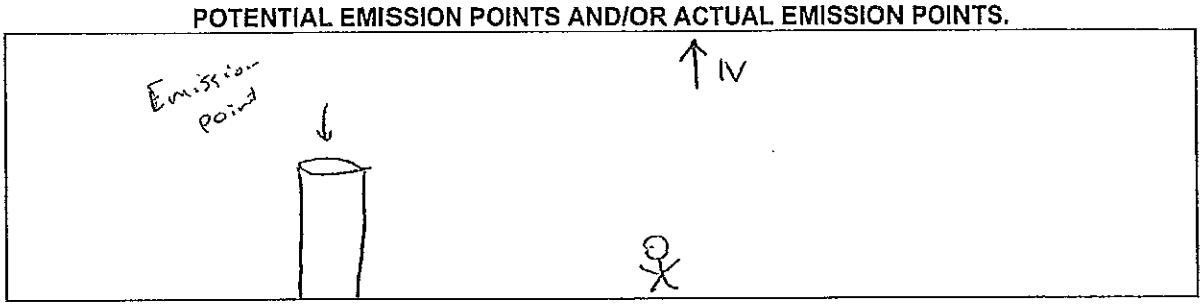
R 8

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink LOCATION: COMPANY REP:	OBSERVER: AFFILIATION: Air Hygiene DATE:
SKY CONDITIONS: Clear PRECIPITATION: None	WIND DIRECTION: NNE WIND SPEED: 7
INDUSTRY:	PROCESS UNIT: 2.500

SKETCH PROCESS UNIT: INDICATE OBSERVER POSITION RELATIVE TO SOURCE; INDICATE POTENTIAL EMISSION POINTS AND/OR ACTUAL EMISSION POINTS.



OBSERVATIONS

CLOCK TIME	OBSERVATION PERIOD DURACTION (MIN:SEC)	ACCUMULATION EMISSION TIME (MIN:SEC)	OBSERVATION LOCATION
17:06	10	0	—
17:16	5	—	—
17:21	10	0	—
17:31	5	—	—
17:36	10	0	—
17:46	5	—	—
17:51	10	0	✓
18:01			

SIGNATURE

Run 8

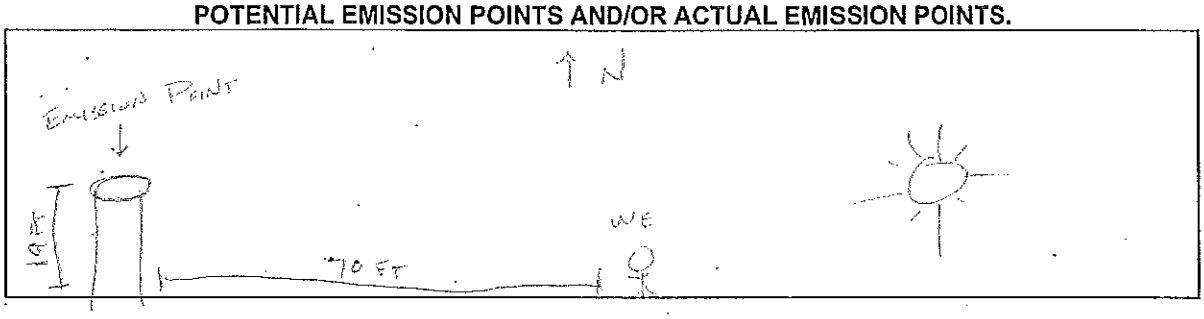
R9

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: Jones Zinc **LOCATION:** Tulsa **COMPANY REP:** Aaron Katz	**OBSERVER:** Zane Tanner **AFFILIATION:** Air Hygiene **DATE:** 10/25/18
SKY CONDITIONS: Clear **PRECIPITATION:** None	**WIND DIRECTION:** NE **WIND SPEED:** 1 mph
INDUSTRY: Combustion	**PROCESS UNIT:** 2500

SKETCH PROCESS UNIT: INDICATE OBSERVER POSITION RELATIVE TO SOURCE; INDICATE POTENTIAL EMISSION POINTS AND/OR ACTUAL EMISSION POINTS.

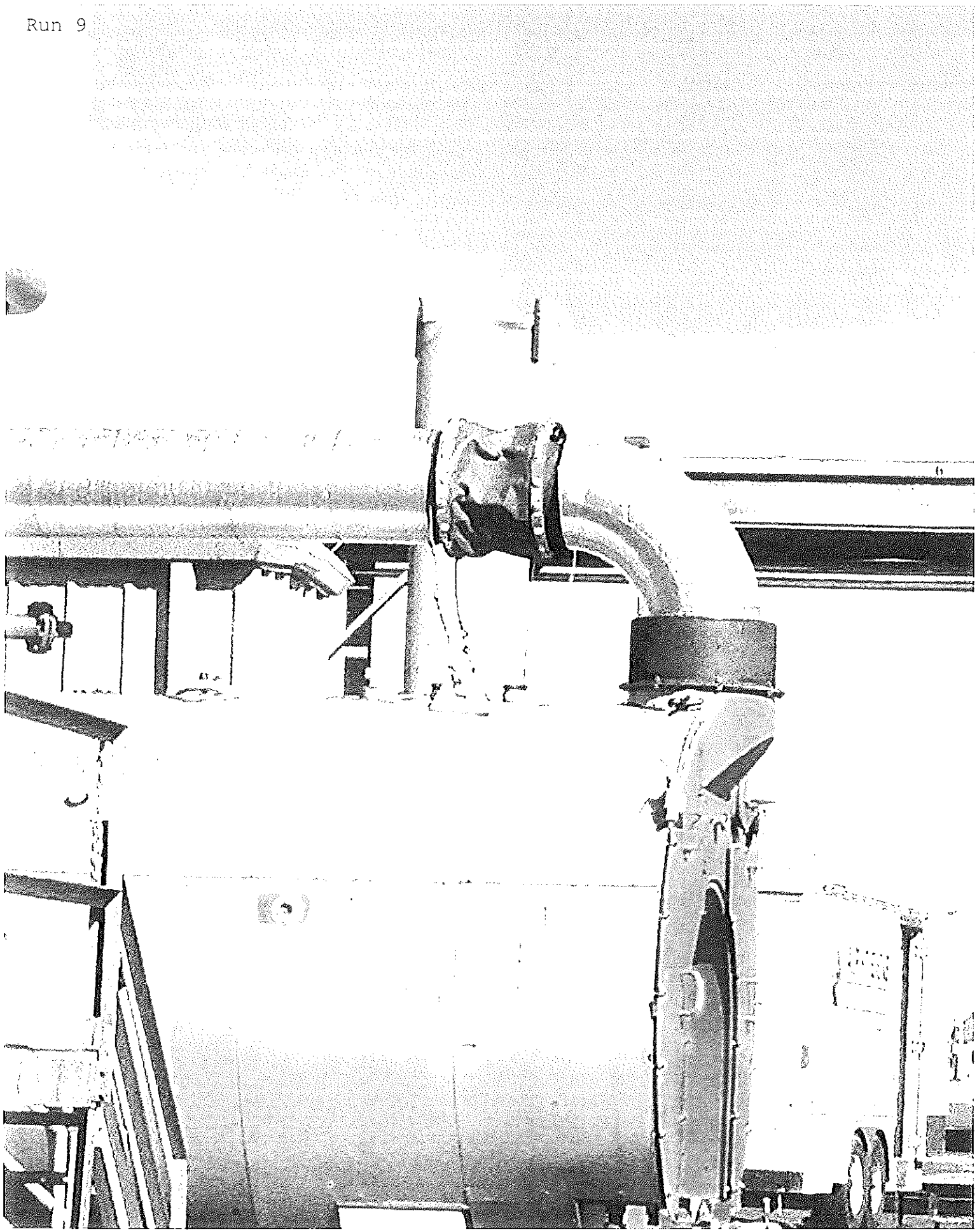


OBSERVATIONS

CLOCK TIME	OBSERVATION PERIOD DURACTION (MIN:SEC)	ACCUMULATION EMISSION TIME (MIN:SEC)	OBSERVATION LOCATION
8:23	10:00	0:00	
8:23	5:00		
8:38	10:00	0.00	
8:48	5:00		
8:53	10:00	0:00	
9:03	5:00		
9:08	10:00	0:00	
9.18			

SIGNATURE

Run 9



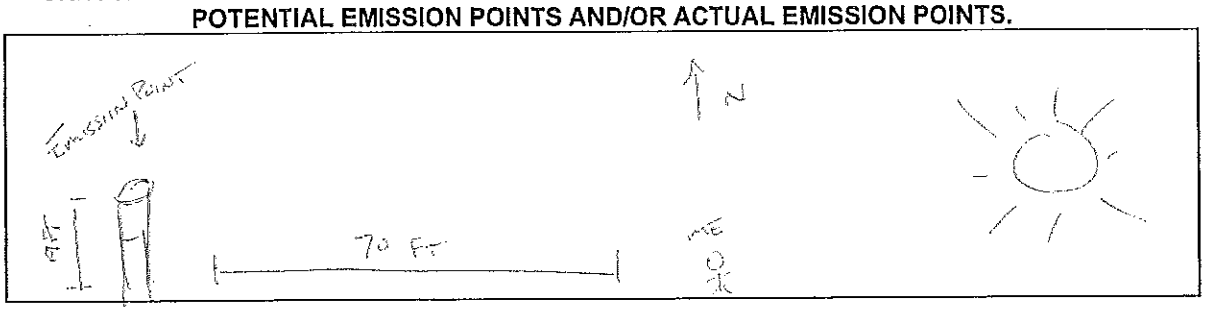
R10

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink LOCATION: Tulsa COMPANY REP: Aaron Katz	OBSERVER: Zane Tarner AFFILIATION: Air Hygiene DATE: 10/25/13
SKY CONDITIONS: Clear PRECIPITATION: None	WIND DIRECTION: ~~SE~~ 2T 10/25/13 SE WIND SPEED: 2.6 MPH
INDUSTRY: Combustion	PROCESS UNIT: 2.5 OD

SKETCH PROCESS UNIT: INDICATE OBSERVER POSITION RELATIVE TO SOURCE; INDICATE POTENTIAL EMISSION POINTS AND/OR ACTUAL EMISSION POINTS.

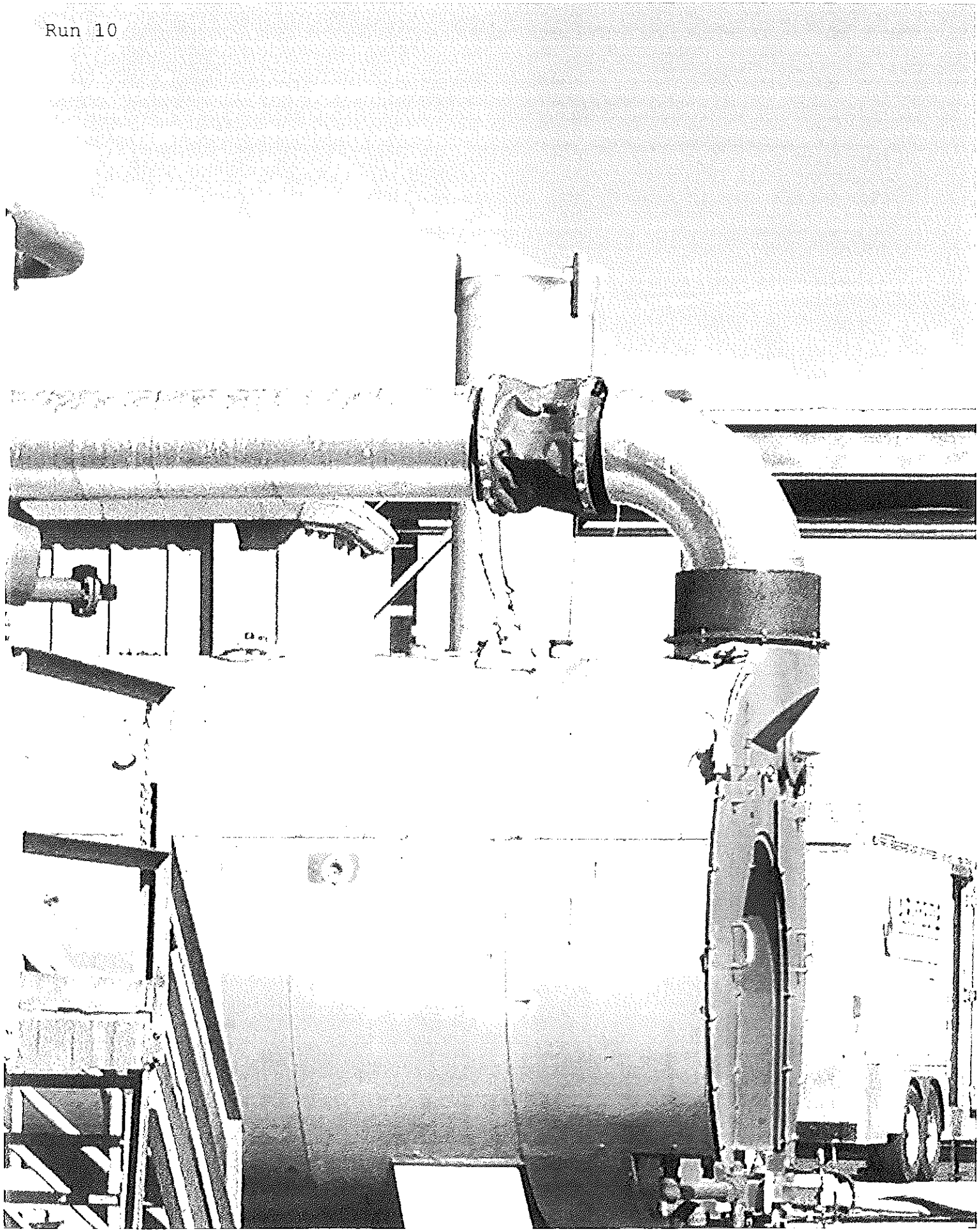


OBSERVATIONS

CLOCK TIME	OBSERVATION PERIOD DURACTION (MIN:SEC)	ACCUMULATION EMISSION TIME (MIN:SEC)	OBSERVATION LOCATION
9:43	10:00	0:00	—
9:53	5:00	—	—
9:58	10:00	0:00	—
10:08	5:00	—	—
10:13	10:00	0:00	—
10:23	5:00	—	—
10:28	10:00	0:00	—
10:38	~~5~~		
~~10:43~~			

SIGNATURE

Run 10



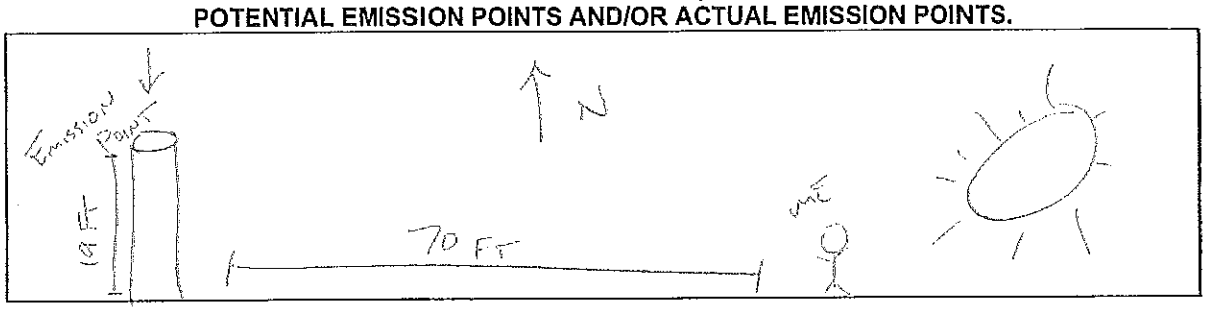
R11

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink LOCATION: Tulsa COMPANY REP: Aaron Kaye	OBSERVER: Zane Tarver AFFILIATION: Air Hygiene DATE: 10/25/13
SKY CONDITIONS: Clear PRECIPITATION: None	WIND DIRECTION: SE WIND SPEED: 6 mph
INDUSTRY: Combustion	PROCESS UNIT: 2.5 oil

SKETCH PROCESS UNIT: INDICATE OBSERVER POSITION RELATIVE TO SOURCE; INDICATE POTENTIAL EMISSION POINTS AND/OR ACTUAL EMISSION POINTS.

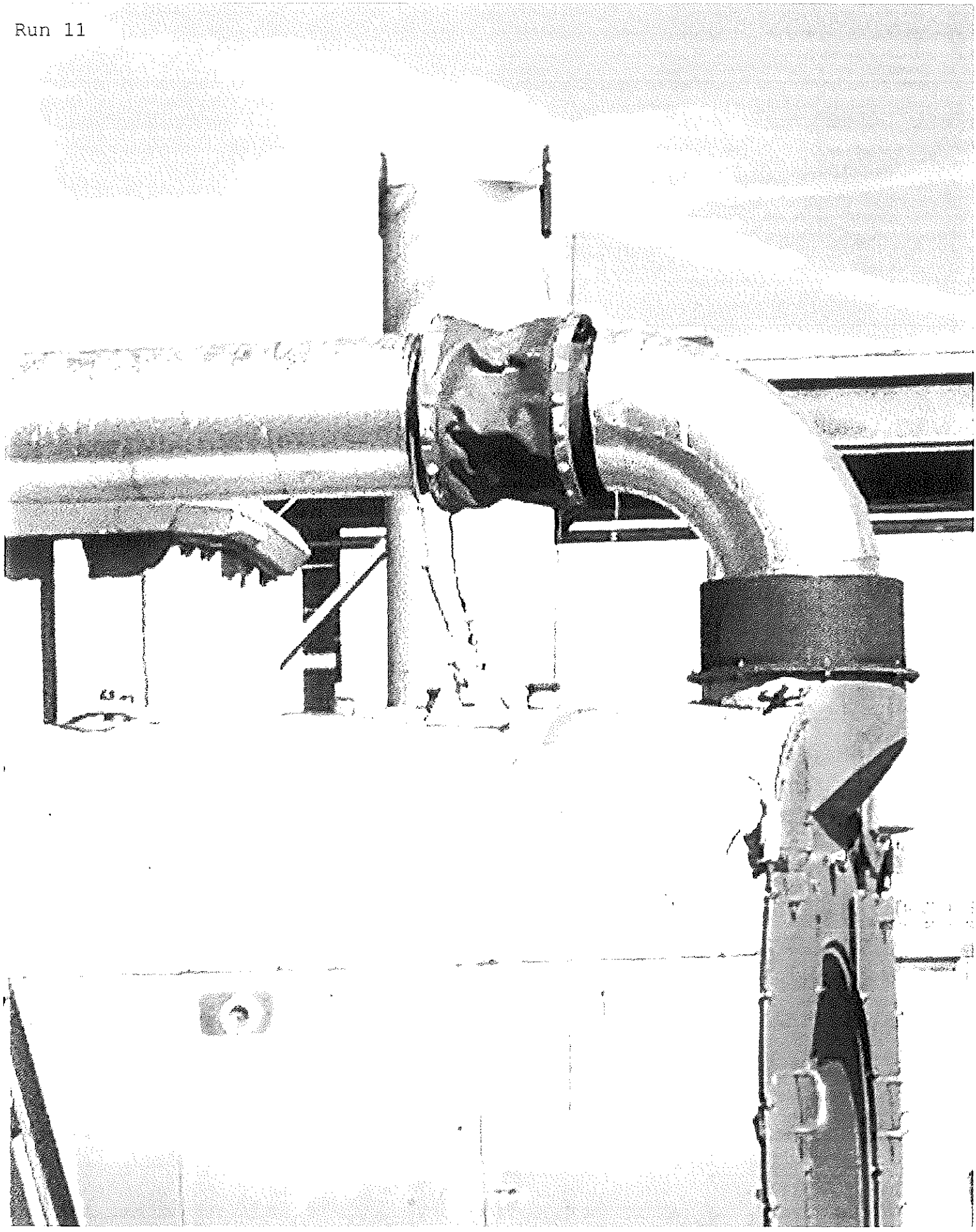


OBSERVATIONS

CLOCK TIME	OBSERVATION PERIOD DURACTION (MIN:SEC)	ACCUMULATION EMISSION TIME (MIN:SEC)	OBSERVATION LOCATION
10:54	10:00	0:00	
11:04	5:00		
11:09	10:00	0:00	
11:19	5:00		
11:24	10:00	0:00	
11:34	5:00		
11:39	10:00	0:00	
11:49			

SIGNATURE

Run 11



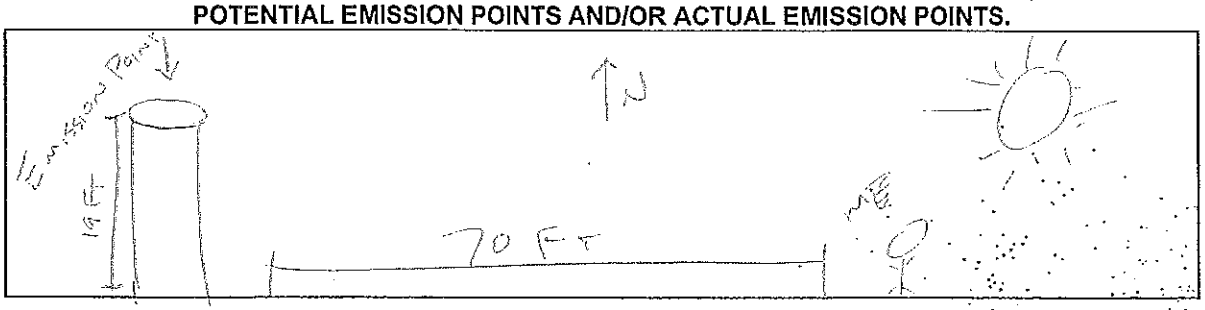
R12

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink LOCATION: Tulsa COMPANY REP: Aaron Kane	OBSERVER: Zane Tarwater AFFILIATION: Air Hygiene DATE: 10/25/13
SKY CONDITIONS: Clear PRECIPITATION: None	WIND DIRECTION: E WIND SPEED: 3 mph
INDUSTRY: Combustion	PROCESS UNIT: 2.5 MM

SKETCH PROCESS UNIT: INDICATE OBSERVER POSITION RELATIVE TO SOURCE; INDICATE POTENTIAL EMISSION POINTS AND/OR ACTUAL EMISSION POINTS.



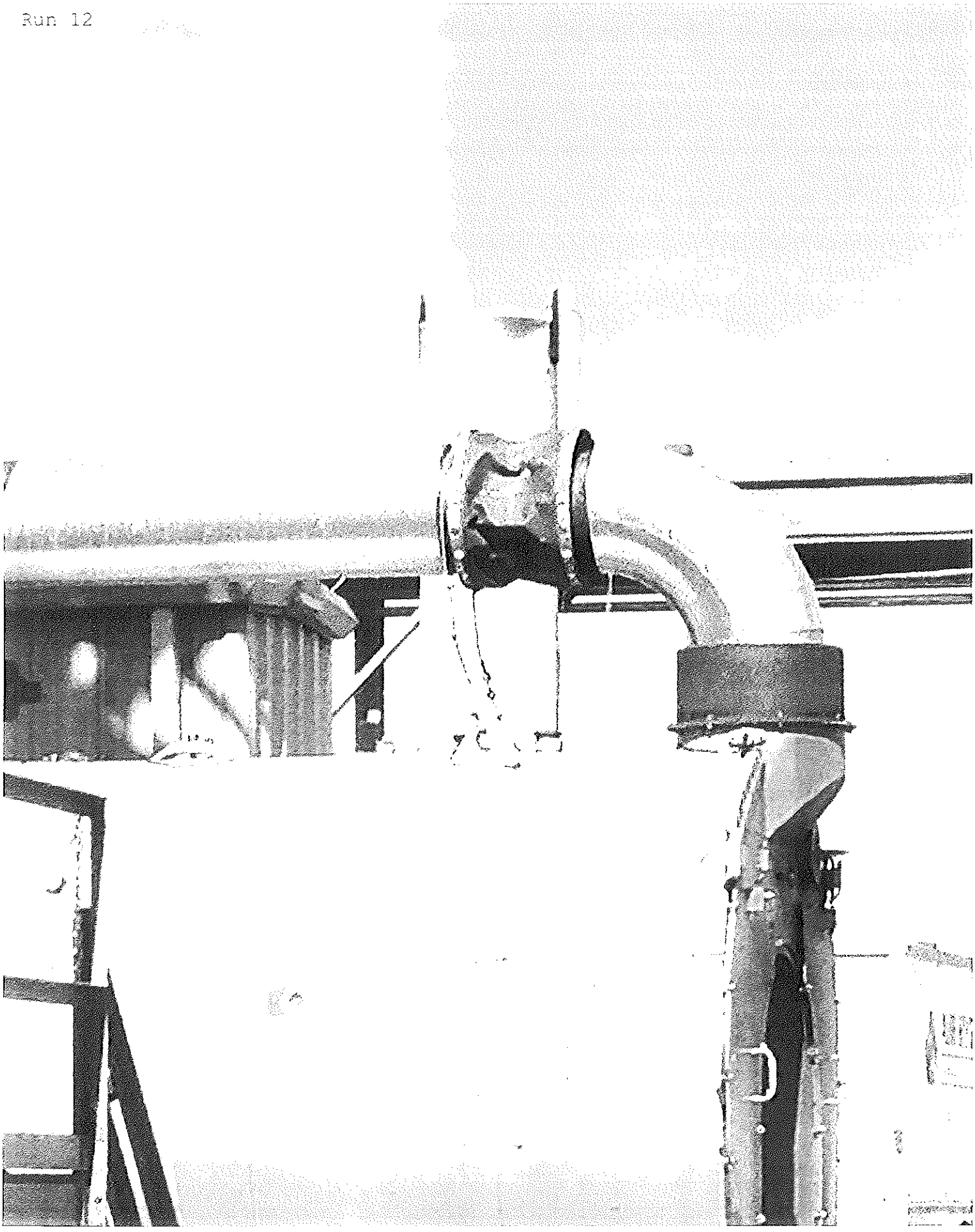
OBSERVATIONS

CLOCK TIME	OBSERVATION PERIOD DURACTION (MIN:SEC)	ACCUMULATION EMISSION TIME (MIN:SEC)	OBSERVATION LOCATION
12:08	10:00	0:00	
12:18	5:00		
12:23	10:00	0:00	
12:33	5:00		
12:38	10:00	0:00	
12:48	5:00		
12:53	10:00	0:00	
1:03			

10/25/13
12:23
12:38

SIGNATURE

Run 12



APPENDIX C

CALIBRATION GAS CERTIFICATIONS

AIR LIQUIDE

CERTIFICATE OF ANALYSIS

Certification Of Cylinder #: ALM053716

Product: Nitrogen **Grade: CEM Zero** **ACID RAIN**

Customer:		**Batch/Lot #:**	010LAP37501E
Date of Certification:	1/10/2013	**Item Number:**	7501-30AL
P.O. Number:		**Valve:**	580
Document Number:		**Cylinder Size:**	30AL

ANALYSIS REPORT

Major Component	Specification	Purity
Nitrogen CEM Zero	99.9995%**	99.9995%

Impurities	Specification	Actual Analysis
Moisture	<2 ppm	1.0 PPM
Oxygen	<0.5 ppm	0.3 PPM
Total Hydrocarbons	<0.1 ppm	<0.1 PPM
Carbon Dioxide	<1 ppm	<1 PPM
Carbon Monoxide	<0.5 ppm	<0.5 PPM
NOx*	<0.1 ppm	<0.1 PPM
SOx*	<0.1 ppm	<0.1 PPM

**Excludes Argon

*Typical Property

Notes:

ALM003295
CC1159
EB0014316
AAL19407
ALM046334
CC189204
CC336991
CC337035

ALM053716
ALM066529
ALM010442
CC336988
CC41569
BAR CODE 040493394

Certified By: ERIC DONALDSON

Air Liquide America, L.P.

11426 Fairmont Pkwy
281-474-8400

Phone: LaPorte, TX 77571-6000

AIR LIQUIDE Air Liquide America Specialty Gases LLC

Scott™

RATA CLASS

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET, TROY, MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A22012

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
1290 COMBERMERE STREET
TROY, MI 48083

P.O. No.: 48529652
Document # : 48529652-001

Customer
AIR HYGIENE

MAX CORBIN
1600 W TACOMA
BROKEN ARROW OK 74012
US

ANALYTICAL INFORMATION Gas Type : NONE

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: ALM003507
Cylinder Pressure*:** 1950 PSIG
Certification Date: 19Nov2012
Exp. Date: 20Nov2020
Batch No: TRO0069974

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ACCURACY**	TRACEABILITY
PROPANE	18.1 PPM	+/- 1%	Direct NIST and VSL
AIR	BALANCE		

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1668	12Jul2018	ALM038653	98.80 PPM	PROPANE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
VARIAN/3400/7506	01Nov2012	TCD/FID

ANALYZER READINGS

(Z = Zero Gas R = Reference Gas T = Test Gas r = Correlation Coefficient)

First Triad Analysis

PROPANE
Date: 19Nov2012 Response Unit: AREA

Z1 = 0.00000	R1 = 2561613.	T1 = 466913.0
R2 = 2563611.	Z2 = 0.00000	T2 = 466431.0
Z3 = 0.00000	T3 = 466278.0	R3 = 2564288.

Avg. Concentration: 18.10 PPM

Second Triad Analysis

Calibration Curve

Concentration = A + Bx + Cx2 + Dx3 + Ex4
r = 0.999998155

Constants:	A = -0.0106566
B = 3.80809E-05	C = 0
D = 0	E = 0

APPROVED BY: ROBERT LESNIAK

AIR LIQUIDE | Air Liquide America Specialty Gases LLC | Scott™

RATA CLASS

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET, TROY, MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A22012

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
1290 COMBERMERE STREET
TROY, MI 48083

P.O. No.: 48529652
Document # : 48529652-002

Customer
AIR HYGIENE

MAX CORBIN
1600 W TACOMA
BROKEN ARROW OK 74012
US

ANALYTICAL INFORMATION Gas Type : NONE

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: ALM035126
Cylinder Pressure***: 1950 PSIG
Certification Date: 19Nov2012
Exp. Date: 20Nov2020
Batch No: TR00069975

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ACCURACY**	TRACEABILITY
PROPANE	8.48 PPM	+/- 1%	Direct NIST and VSL
AIR	BALANCE		

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1668	12Jul2018	ALM038653	98.80 PPM	PROPANE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
VARIAN/3400/7606	01Nov2012	TCD/FID

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

First Triad Analysis

PROPANE
Date: 19Nov2012 Response Unit: AREA
Z1=0.00000 R1=2561613. T1=218575.0
R2=2563611. Z2=0.00000 T2=218288.0
Z3=0.00000 T3=218534.0 R3=2564288.
Avg. Concentration: 8.480 PPM

Second Triad Analysis

Calibration Curve

Concentration=A+Bx+Cx2+Dx3+Ex4
r=0.999998155
Constants: A=-0.0106566
B=3.80809E-05 C=0
D=0 E=0

APPROVED BY: ROBERT LESNIAK

AIR LIQUIDE Air Liquide America Specialty Gases LLC

Scott

RATA CLASS

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET, TROY, MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A22012

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
1290 COMBERMERE STREET
TROY, MI 48083

P.O. No.: 48529652
Document # : 48529652-003

Customer
AIR HYGIENE

MAX CORBIN
1600 W TACOMA
BROKEN ARROW OK 74012
US

ANALYTICAL INFORMATION Gas Type : NONE

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: ALM030515
Cylinder Pressure***: 2000 PSIG
Certification Date: 19Nov2012
Exp. Date: 20Nov2020
Batch No: TRO0070121

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ACCURACY**	TRACEABILITY
PROPANE	5.04 PPM	+/- 1%	Direct NIST and VSL
AIR	BALANCE		

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1668	12Jul2018	ALM038653	98.80 PPM	PROPANE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
VARIAN/3400/7506	01Nov2012	TCD/FID

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

First Triad Analysis

PROPANE
Date: 19Nov2012 Response Unit: AREA
Z1=0.00000 R1=2561613. T1=129917.0
R2=2563611. Z2=0.00000 T2=129951.0
Z3=0.00000 T3=130132.0 R3=2564288.
Avg. Concentration: 5.040 PPM

Second Triad Analysis

Calibration Curve

Concentration=A+Bx+Cx2+Dx3+Ex4
r=0.999998155
Constants: A=-0.0106566
B=3.80809E-05 C=0
D=0 E=0

APPROVED BY: _____
ROBERT LESNIAK

AIR LIQUIDE Air Liquide America Specialty Gases LLC Scott

RATA CLASS

Dual-Analyzed Calibration Standard

11426 FAIRMONT PKWY, LA PORTE, TX 77571 Phone: 800-248-1427 Fax: 281-474-8419

CERTIFICATE™ OF ACCURACY: Interference Free Multi-Component EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A32012

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
11426 FAIRMONT PKWY
LA PORTE, TX 77571

P.O. No.:
Document # : 46623521-002

Customer
AIR HYGIENE

MIKE SCOTT
1600 WEST TACOMA ST
BROKEN ARROW OK 74012
US

ANALYTICAL INFORMATION Gas Type : OC2

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: CC69743 **Certification Date:** 22Jun2012 **Exp. Date:** 22Jun2015
Cylinder Pressure*:** 1950 PSIG **Batch No:** LAP0066342

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY**	TRACEABILITY
OXYGEN	20.9	%	+/- 1%	
CARBON DIOXIDE	19.2	%	+/- 1%	Direct NIST and VSL
NITROGEN		BALANCE		

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION		COMPONENT
NTRM 2658 1	01Feb2016	K025996	10.03	%	OXYGEN
NTRM 1800	01Mar2013	K026135	17.87	%	CARBON DIOXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
SERVOMEX/MODEL 244A/701/716	11Jun2012	PARAMAGNETIC
FTIR//000929060	24May2012	FTIR

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

OXYGEN

First Triad Analysis			Second Triad Analysis	Calibration Curve	
Date: 25Jun2012	Response Unit: VOLTS			Concentration=A+Bx+Cx2+Dx3+Ex4	
Z1=0.00000	R1=0.40700	T1=0.84950		r=0.9999999	
R2=0.40700	Z2=0.00000	T2=0.84950		Constants:	A=0.003114995
Z3=0.00000	T3=0.84950	R3=0.40700		B=24.65203119	C=
Avg. Concentration:	20.93 %			D=	E=

CARBON DIOXIDE

First Triad Analysis			Second Triad Analysis	Calibration Curve	
Date: 22Jun2012	Response Unit: %			Concentration=A+Bx+Cx2+Dx3+Ex4	
Z1=-0.00132	R1=17.77588	T1=19.05334		r=9.99999E-1	
R2=17.78949	Z2=0.00158	T2=19.05767		Constants:	A=0.00000E+0
Z3=0.00419	T3=19.08149	R3=17.80339		B=5.97023E-1	C=4.28800E-3
Avg. Concentration:	19.15 %			D=0.00000E+0	E=0.00000E+0

Special Notes: AH095 LIST ITEM AH095 ON CERTS AND TAGS CGA 590 ; DEW PT. 40 DEG. F.

APPROVED BY: DAVID KELLY

AIR LIQUIDE | Air Liquide America Specialty Gases LLC | Scott™

RATA CLASS

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET, TROY, MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A22013

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
1290 COMBERMERE STREET
TROY, MI 48083

P.O. No.:
Document # : 80758750-002
Folio #:AH094

Customer
AIR HYGIENE

MIKE SCOTT
1600 WEST TACOMA ST
BROKEN ARROW OK 74012
US

ANALYTICAL INFORMATION Gas Type : CO2,O2,BALN

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: CC107297
Cylinder Pressure*:** 2000 PSIG
Certification Date: 30May2013
Exp. Date: 31May2021
Batch No: TRO0083952

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ACCURACY**	TRACEABILITY
OXYGEN	12.1 %	+/- 1%	Direct NIST and VSL
CARBON DIOXIDE	8.95 %	+/- 1%	Direct NIST and VSL
NITROGEN	BALANCE		

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 2350 23	04Jan2018	K024582	23.20 %	OXYGEN
NTRM 2300	17Aug2016	K026052	23.04 %	CARBON DIOXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
CAI/110P/V03018	03May2013	PARAMAGNETIC
PIR/2000/609015	28May2013	NDIR

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

First Triad Analysis

OXYGEN
Date: 29May2013 Response Unit: %
Z1=0.00000 R1=23.20000 T1=12.10000
R2=23.20000 Z2=0.00000 T2=12.10000
Z3=0.00000 T3=12.10000 R3=23.20000
Avg. Concentration: 12.09 %

CARBON DIOXIDE
Date: 30May2013 Response Unit: MV
Z1=0.00000 R1=94.80000 T1=53.50000
R2=94.80000 Z2=0.00000 T2=53.50000
Z3=0.00000 T3=53.50000 R3=94.80000
Avg. Concentration: 8.946 %

Second Triad Analysis

Calibration Curve

Concentration=A+Bx+Cx2+Dx3+Ex4
r=0.999999
Constants: A=-0.01175669
B=1.000226328 C=0
D=0 E=0

Concentration=A+Bx+Cx2+Dx3+Ex4
r=0.999998
Constants: A=-0.00478797
B=0.127855111 C=8.006E-05
D=0.000011465 E=0

Special Notes: AH094 LIST ITEM AH094 ON CERTS AND TAGS

APPROVED BY: JEFF CROTEAU

AIR LIQUIDE Air Liquide America Specialty Gases LLC | Scott

RATA CLASS

Dual-Analyzed Calibration Standard

11426 FAIRMONT PKWY, LA PORTE, TX 77571 Phone: 800-248-1427 Fax: 281-474-8419

CERTIFICATE™ OF ACCURACY: Interference Free Multi-Component EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A32012

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
11426 FAIRMONT PKWY
LA PORTE, TX 77571

P.O. No.:
Document # : 47579022-001

Customer
AIR HYGIENE

MIKE SCOTT
1600 WEST TACOMA ST
BROKEN ARROW OK 74012
US

ANALYTICAL INFORMATION Gas Type : NC

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: CC62432
Cylinder Pressure***: 2000 PSIG
Certification Date: 25Sep2012
Exp. Date: 26Sep2015
Batch No: LAP0071800

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY**	TRACEABILITY
NITRIC OXIDE	18.0	PPM	+/- 1%	
CARBON MONOXIDE	18.0	PPM	+/- 1%	Direct NIST and VSL
NITROGEN - OXYGEN FREE		BALANCE		
TOTAL OXIDES OF NITROGEN	18.2	PPM		Reference Value Only

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 2628	05Jan2016	KAL004076	10.11 PPM	NITRIC OXIDE
NTRM 2635	01Jun2016	AAL073320	25.54 PPM	CARBON MONOXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
NOX ANALYZER/400-CLD/7M07001	27Aug2012	CHEMI
FTIR//000929060	31Aug2012	FTIR

ANALYZER READINGS

(Z = Zero Gas R = Reference Gas T = Test Gas r = Correlation Coefficient)

First Triad Analysis

NITRIC OXIDE
Date: 19Sep2012 Response Unit: VOLTS
Z1 = 0.00000 R1 = 1.00600 T1 = 1.78700
R2 = 1.00600 Z2 = 0.00000 T2 = 1.78800
Z3 = 0.00000 T3 = 1.78850 R3 = 1.00700
Avg. Concentration: 17.98 PPM

CARBON MONOXIDE
Date: 18Sep2012 Response Unit: PPM
Z1 = -0.05045 R1 = 25.51696 T1 = 17.88547
R2 = 25.58403 Z2 = -0.01883 T2 = 17.94540
Z3 = 0.01742 T3 = 17.99860 R3 = 25.62801
Avg. Concentration: 17.92 PPM

Second Triad Analysis

Date: 26Sep2012 Response Unit: VOLTS
Z1 = 0.00000 R1 = 0.99900 T1 = 1.77700
R2 = 1.00010 Z2 = 0.00000 T2 = 1.77400
Z3 = 0.00000 T3 = 1.77100 R3 = 0.99440
Avg. Concentration: 17.99 PPM

Date: 25Sep2012 Response Unit: PPM
Z1 = -0.01312 R1 = 25.59315 T1 = 18.01561
R2 = 25.60461 Z2 = -0.00675 T2 = 18.02020
Z3 = 0.00799 T3 = 18.08122 R3 = 25.62857
Avg. Concentration: 17.99 PPM

Calibration Curve

Concentration = A + Bx + Cx2 + Dx3 + Ex4
r = 0.9999978
Constants: A = -0.03151319
B = 10.0474599 C =
D = E =

Concentration = A + Bx + Cx2 + Dx3 + Ex4
r = 9.99999E-1
Constants: A = 0.00000E+0
B = 9.56905E-1 C = 7.01000E-4
D = 1.00000E-6 E = 0.00000E+0

Special Notes: AH073 LIST ITEM AH073 ON CERTS ANG TAGS CGA 660; DEW PT. 40 DEG.F.

APPROVED BY: DAVID KELLY

AIR LIQUIDE Air Liquide America Specialty Gases LLC | Scott™

RATA CLASS

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET, TROY, MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
1290 COMBERMERE STREET
TROY, MI 48083

P.O. No.: 11082110
Document # : 43301084-001
Folio #:AH071

Customer
AIR HYGIENE

MIKE SCOTT
5634 S. 122ND EAST AVE.
TULSA OK 74146
US

ANALYTICAL INFORMATION Gas Type : CO,NO,BALN

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: AAL070624 **Certification Date:** 30Sep2011 **Exp. Date:** 01Oct2014
Cylinder Pressure*:** 1950 PSIG **Batch No:** TRO0042731

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY**	TRACEABILITY
CARBON MONOXIDE	9.07	PPM	+/- 1%	Direct NIST and VSL
NITRIC OXIDE	9.28	PPM	+/- 1%	Direct NIST and VSL
NITROGEN - OXYGEN FREE		BALANCE		
TOTAL OXIDES OF NITROGEN	9.31	PPM		Reference Value Only

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION		COMPONENT
NTRM 2635	05May2016	KAL003163	25.21	PPM	CARBON MONOXIDE
NTRM 2629	15Jan2013	KAL004325	20.36	PPM	NITRIC OXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
SIEMENS I/ULTRAMAT 6E/N1-VN-0545	06Sep2011	NDIR
ECO PHYSICS/CLD 84M/84M0359	14Sep2011	CHEMI

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

CARBON MONOXIDE

First Triad Analysis			Second Triad Analysis			Calibration Curve	
Date: 22Sep2011	Response Unit: MV		Date: 30Sep2011	Response Unit: MV		Concentration=A+Bx+Cx2+Dx3+Ex4	
Z1=0.00000	R1=25.20000	T1=8.62000	Z1=0.00000	R1=25.21000	T1=8.69000	r=0.9999	
R2=25.20000	Z2=0.00000	T2=8.62000	R2=25.19000	Z2=0.00000	T2=8.67000	Constants:	A=0.00918515
Z3=0.00000	T3=8.62000	R3=25.20000	Z3=0.00000	T3=8.70000	R3=25.17000	B=1.1496757	C=-0.0073488
Avg. Concentration:	9.039	PPM	Avg. Concentration:	9.109	PPM	D=0.000133745	E=0

NITRIC OXIDE

Date: 22Sep2011	Response Unit: MV		Date: 29Sep2011	Response Unit: MV		Concentration=A+Bx+Cx2+Dx3+Ex4	
Z1=0.00000	R1=20.34000	T1=9.24300	Z1=0.00000	R1=20.26000	T1=9.20800	r=0.9999	
R2=20.33000	Z2=0.00000	T2=9.24500	R2=20.27000	Z2=0.00000	T2=9.20700	Constants:	A=0.03172085
Z3=0.00000	T3=9.24900	R3=20.35000	Z3=0.00000	T3=9.20300	R3=20.28000	B=0.998931281	C=0
Avg. Concentration:	9.281	PPM	Avg. Concentration:	9.273	PPM	D=0	E=0

Special Notes: The expiration date has been extended without re-assay per EPA 600/R23-23/542.
Supplemental to test report 05-99426-001 for AAL070624. Amended on 08-07-2013, Thatcher.

APPROVED BY: _____
HILARY THATCHER

AIR LIQUIDE Air Liquide America Specialty Gases LLC

Scott™

RATA CLASS

Dual-Analyzed Calibration Standard

11426 FAIRMONT PKWY, LA PORTE, TX 77571 Phone: 800-248-1427 Fax: 281-474-8419

CERTIFICATE™ OF ACCURACY: Interference Free Multi-Component EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A32012

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
11426 FAIRMONT PKWY
LA PORTE, TX 77571

P.O. No.:
Document # : 47900763-003

Customer
AIR HYGIENE

MIKE SCOTT
1600 WEST TACOMA ST
BROKEN ARROW OK 74012
US

ANALYTICAL INFORMATION Gas Type : NC

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: CC15701
Cylinder Pressure***: 2000 PSIG
Certification Date: 09Oct2012
Exp. Date: 10Oct2020
Batch No: LAP0073104

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY**	TRACEABILITY
CARBON MONOXIDE	95.2	PPM	+/- 1%	Direct NIST and VSL
NITRIC OXIDE	96.2	PPM	+/- 1%	Direct NIST and VSL
NITROGEN - OXYGEN FREE		BALANCE		
TOTAL OXIDES OF NITROGEN	96.3	PPM		Reference Value Only

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1679 1	10Apr2013	KAL004774	98.48 PPM	CARBON MONOXIDE
NTRM 1684	19May2016	KAL004353	96.91 PPM	NITRIC OXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
FTIR//000929060	28Sep2012	FTIR
FTIR//000929060	04Oct2012	FTIR

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

CARBON MONOXIDE

First Triad Analysis			Second Triad Analysis			Calibration Curve	
Date: 02Oct2012	Response Unit: PPM		Date: 09Oct2012	Response Unit: PPM		Concentration=A+Bx+Cx2+Dx3+Ex4	
Z1=-0.01040	R1=98.96009	T1=95.63933	Z1=0.00107	R1=98.88086	T1=95.65459	r=9.99999E-1	
R2=98.96807	Z2=-0.00660	T2=95.73203	R2=98.91457	Z2=0.03060	T2=95.72873	Constants:	A=0.00000E+0
Z3=-0.00091	T3=95.82793	R3=99.00330	Z3=0.04621	T3=95.74888	R3=99.19988	B=9.69506E-1	C=7.44000E-4
Avg. Concentration:	95.25	PPM	Avg. Concentration:	95.21	PPM	D=1.00000E-6	E=0.00000E+0

NITRIC OXIDE

First Triad Analysis			Second Triad Analysis			Calibration Curve	
Date: 02Oct2012	Response Unit: PPM		Date: 09Oct2012	Response Unit: PPM		Concentration=A+Bx+Cx2+Dx3+Ex4	
Z1=-0.07671	R1=97.10940	T1=96.00731	Z1=-0.07467	R1=96.66344	T1=96.22098	r=9.99993E-1	
R2=97.25773	Z2=0.05752	T2=96.13349	R2=96.69491	Z2=-0.00962	T2=96.37452	Constants:	A=0.00000E+0
Z3=0.05926	T3=96.23311	R3=97.31393	Z3=0.01170	T3=96.44186	R3=96.83872	B=9.52009E-1	C=1.72000E-4
Avg. Concentration:	95.81	PPM	Avg. Concentration:	96.52	PPM	D=0.00000E+0	E=0.00000E+0

Special Notes: AH066 LIST ITEM AH066 ON CERTS AND TAGS APPROVED RANGES CARBON MONOXIDE - 94 - 96 PPM NITRIC OXIDE - 94 - 96 PPM DEW POINT 40F CGA 660

APPROVED BY:

Ron Stitt

AIR LIQUIDE Air Liquide America Specialty Gases LLC | Scott™

RATA CLASS

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET, TROY, MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE™ OF ACCURACY: Interference Free Multi-Component EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A22013

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
1290 COMBERMERE STREET
TROY, MI 48083

P.O. No.:
Document # : 50101088-003
Folio #:AH065

Customer
AIR HYGIENE

MIKE SCOTT
1600 WEST TACOMA ST
BROKEN ARROW OK 74012
US

ANALYTICAL INFORMATION Gas Type : CO,NO,BALN

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: CC429440 **Certification Date:** 09Apr2013 **Exp. Date:** 10Apr2021
Cylinder Pressure*:** 1995 PSIG **Batch No:** TRO0078537

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY**	TRACEABILITY
CARBON MONOXIDE	48.3	PPM	+/- 1%	Direct NIST and VSL
NITRIC OXIDE	47.9	PPM	+/- 1%	Direct NIST and VSL
NITROGEN - OXYGEN FREE		BALANCE		
TOTAL OXIDES OF NITROGEN	47.9	PPM		Reference Value Only

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION		COMPONENT
NTRM 1678 50	14Nov2017	KAL003772	48.60	PPM	CARBON MONOXIDE
NTRM 1684 1	19May2016	KAL004045	96.91	PPM	NITRIC OXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
FTIR//0928621	25Mar2013	FTIR
FTIR//0928621	05Apr2013	FTIR

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

First Triad Analysis

CARBON MONOXIDE

Date: 02Apr2013 Response Unit: PPM
Z1=0.01258 R1=240.4199 T1=48.25494
R2=240.6352 Z2=0.08844 T2=48.28050
Z3=0.09056 T3=48.32459 R3=240.9170
Avg. Concentration: 48.26 PPM

NITRIC OXIDE

Date: 02Apr2013 Response Unit: PPM
Z1=-0.14110 R1=96.91880 T1=47.69153
R2=97.00913 Z2=-0.07510 T2=47.80349
Z3=0.23448 T3=47.94430 R3=97.07037
Avg. Concentration: 47.77 PPM

Second Triad Analysis

CARBON MONOXIDE

Date: 09Apr2013 Response Unit: PPM
Z1=-0.01334 R1=48.40355 T1=48.17768
R2=48.44922 Z2=0.01940 T2=48.24433
Z3=0.02659 T3=48.32353 R3=48.45909
Avg. Concentration: 48.41 PPM

NITRIC OXIDE

Date: 09Apr2013 Response Unit: PPM
Z1=-0.01740 R1=96.54342 T1=47.78034
R2=96.58970 Z2=0.10180 T2=48.04054
Z3=0.19334 T3=48.18347 R3=96.87905
Avg. Concentration: 48.07 PPM

Calibration Curve

CARBON MONOXIDE

Concentration=A+Bx+Cx2+Dx3+Ex4
r=9.99994E-1
Constants: A=-9.78638E+2
B=1.77004E+0 C=0.00000E+0
D=0.00000E+0 E=0.00000E+0

NITRIC OXIDE

Concentration=A+Bx+Cx2+Dx3+Ex4
r=9.99970E-1
Constants: A=0.00000E+0
B=1.00399E+0 C=6.60000E-4
D=-1.00000E-6 E=0.00000E+0

Special Notes: AH065 LIST ITEM AH065 ON CERTS AND TAGS APPROVED RANGE CARBON MONOXIDE 47 - 49 PPM NITRIC OXIDE 47 - 49 PPM

APPROVED BY: _____
Rob McCrandall

APPENDIX D

QUALITY ASSURANCE AND QUALITY CONTROL DATA

QA/QC PROGRAM

Air Hygiene ensures the quality and validity of its emission measurement and reporting procedures through a rigorous quality assurance (QA) program. The program is developed and administered by an internal QA team and encompasses five major areas:

1. QA reviews of reports, laboratory work, and field testing
2. Equipment calibration and maintenance
3. Chain-of-custody
4. Training
5. Knowledge of current test methods

Each of these areas is discussed individually below.

QA Reviews

Air Hygiene's review procedure includes review of each source test report, along with laboratory and fieldwork, by the QA Team. The most important review is the one that takes place before a test program begins. The QA Team works closely with technical division personnel to prepare and review test protocols. Test protocol review includes selection of appropriate test procedures, evaluation of interferences or other restrictions that might preclude use of standard test procedures, and evaluation and/or development of alternate procedures.

Equipment Calibration and Maintenance

The equipment used to conduct the emission measurements is maintained according to the manufacturer's instructions to ensure proper operation. In addition to the maintenance program, calibrations are carried out on each measurement device according to the schedule outlined by the Environmental Protection Agency. Quality control checks are also conducted in the field for each test program.

Chain-of-Custody

Air Hygiene maintains full chain-of-custody documentation on all samples and data sheets. In addition to normal documentation of changes between field sample custodians, laboratory personnel, and field test personnel, Air Hygiene documents every individual who handles any test component in the field (e.g., probe wash, impinger loading and recovery, filter loading and recovery, etc.). Samples are stored in a locked area to which only Air Hygiene personnel have access. Field data sheets are secured at Air Hygiene's offices upon return from the field.

Training

Personnel's training is essential to ensure quality testing. Air Hygiene has formal and informal training programs, which include:

1. Attendance at EPA-sponsored training courses
2. Enrollment in EPA correspondence courses
3 A requirement for all technicians to read and understand Air Hygiene's QA manual
4. In-house training and QA meetings on a regular basis
5. Maintenance of training records

Knowledge of Current Test Methods

With the constant updating of standard test methods and the wide variety of emerging test procedures, it is essential that any qualified source tester keep abreast of new developments. Air Hygiene subscribes to services, which provide updates on EPA reference methods, rules, and regulations. Additionally, source test personnel regularly attend and present papers at testing and emission-related seminars and conferences. Air Hygiene personnel maintain membership in the Air and Waste Management Association and the American Industrial Hygiene Association.

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COMBUSTION TESTING QUALITY ASSURANCE ACTIVITIES

A number of quality assurance activities were undertaken before, during, and after this testing project. This section of the report combined with the documentation in Appendix C describes each of those activities.

Each instrument's response was checked and adjusted in the field prior to the collection of data via multi-point calibration. The instrument's linearity was checked by adjusting its zero and span responses to zero nitrogen and an upscale calibration gas in the range of the expected concentrations. The instrument response was then challenged with other calibration gases of known concentration and accepted as being linear if the response of the other calibration gases agreed within plus or minus two percent of the range of predicted values.

After each test run, the analyzers were checked for zero and span drift. This allowed each test run to be bracketed by calibrations and documents the precision of the data just collected. The criterion for acceptable data is that the instrument drift is no more than three percent of the full-scale response. The quality assurance worksheets in the following pages summarize all multipoint calibration checks and zero to span checks performed during the tests. These worksheets (as prepared from the data records of Appendix A) show that no drifts in excess of three percent occurred in the zero to span checks following each test run.

The sampling systems were leak checked by demonstrating that a vacuum greater than 10 in Hg could be held for at least one minute with a decline of less than one inch of Hg. A leak test was conducted after the sample system was set up and before the system was dismantled. This test was conducted to ensure that ambient air had not diluted the sample. Any leakage detected prior to the tests would be repaired and another leak check conducted before testing commenced. No leaks were found during the pre or post-test leak checks.

The absence of leaks in the sampling system was also verified by a sampling system bias check. The sampling system's integrity was tested by comparing the responses of the analyzers to the calibration gases introduced via two paths. The first path was directly into the analyzer and the second path via the sample system at the sample probe. Any difference in the instrument responses by these two methods was attributed to sampling system bias or leakage. The criterion for acceptance is agreement within five percent of the span of the analyzer.

The control gases used to calibrate the instruments were analyzed and certified by the compressed gas vendors to plus or minus one percent accuracy for all gases. EPA Protocol No. 1 was used, where applicable to assign the concentration values traceable to the National Institute of Standards and Technology (NIST), Standard Reference Materials (SRM's). The gas calibration sheets as prepared by the vendor are contained in Appendix C.

Air Hygiene collected and reported the enclosed test data in accordance with the procedures and quality assurance activities described in this test report. Air Hygiene makes no warranty as to the suitability of the test methods. Air Hygiene also assumes no liability relating to the interpretation and use of the test data.

INSTRUMENTAL ANALYSIS
QUALITY ASSURANCE DATA

Date: October 23-25, 2013
Company: John Zink, Co LLC.
Location: Tulsa, Oklahoma
Techs: PS/MSL

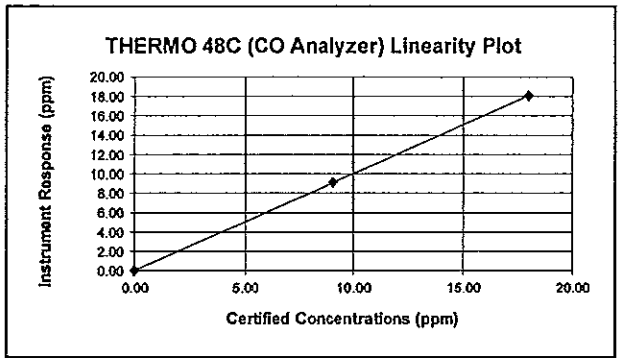
Sample System Leak Check

Date	Sample System	Leak Rate (l/min)
October 23-25, 2013	1	0

Calibration Date: March 11, 2013
Client: John Zink Co, LLC

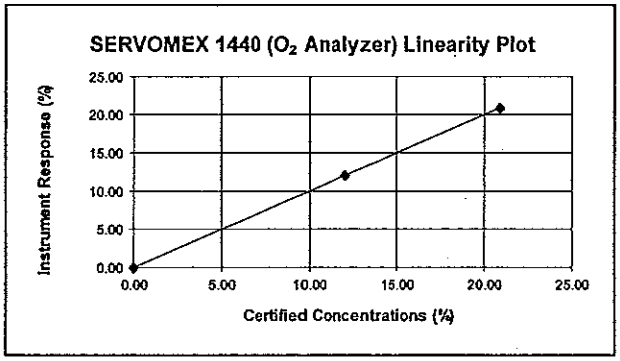
CO Span (ppm) = 18.00

THERMO 48C (CO Analyzer)				
Certified Concentration (ppm)	Instrument Response (ppm)	Calibration Error (%)	Absolute Conc. (ppm)	Pass or Fail (±2%, ≤0.6ppm)
0.00	0.04	0.22	0.04	YES (%)
9.07	9.13	0.33	0.06	YES (%)
18.00	18.07	0.39	0.07	YES (%)
Linearity = 0.998				



O_2 Span (%) = 20.90

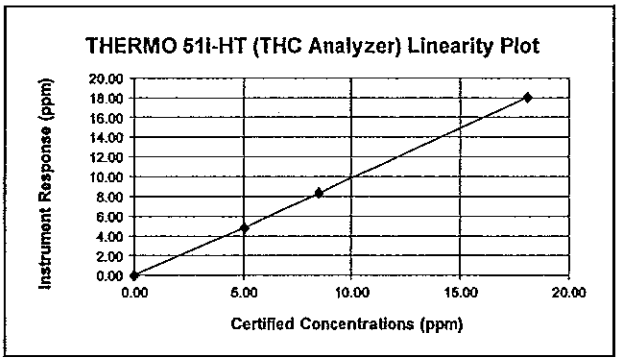
SERVOMEX 1440 (O_2 Analyzer)				
Certified Concentration (%)	Instrument Response (%)	Calibration Error (%)	Absolute Conc. (%)	Pass or Fail (±2%, ≤0.5%)
0.00	0.02	0.10	0.02	YES (%)
12.10	12.06	-0.19	0.04	YES (%)
20.90	20.88	-0.10	0.02	YES (%)
Linearity = 1.002				



THC Range (ppm) = 20

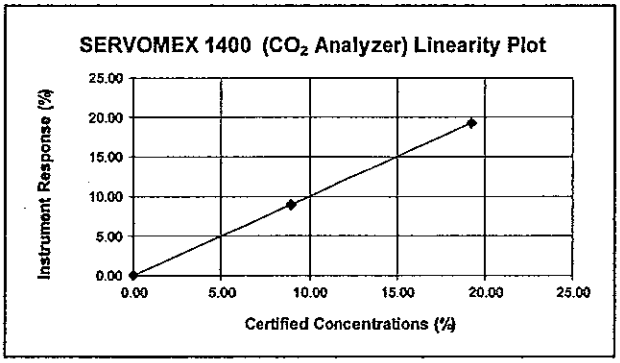
THERMO 51i-HT (THC Analyzer)				
Certified Concentration (ppm)	Instrument Response (ppm)	Calibration Error (%)	Estimated Point (ppm)	Pass or Fail (±2,5%)[1]
0.00	0.05	0.25	N/A	YES
5.04	4.82	-4.92	5.07	YES
8.48	8.35	-1.68	8.49	YES
18.10	18.07	-0.15	N/A	YES
Linearity = 0.987				

[1]-zero/high based on 2% of span,low/mid based on 5% of concentration



CO_2 Span (%) = 19.20

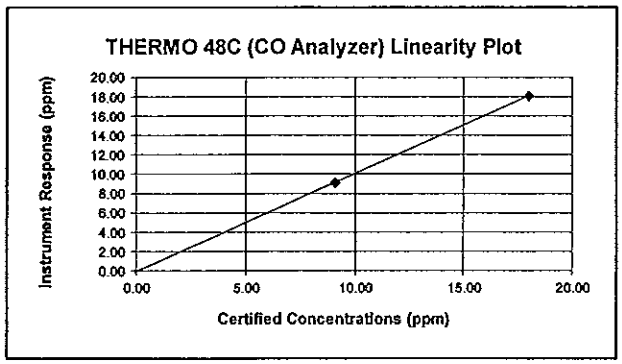
SERVOMEX 1400 (CO_2 Analyzer)				
Certified Concentration (%)	Instrument Response (%)	Calibration Error (%)	Absolute Conc. (%)	Pass or Fail (±2%, ≤0.5%)
0.00	0.03	0.16	0.03	YES (%)
8.95	8.94	-0.05	0.01	YES (%)
19.20	19.22	0.10	0.02	YES (%)
Linearity = 1.000				



Calibration Date: August 21, 2013
Client: John Zink Co, LLC

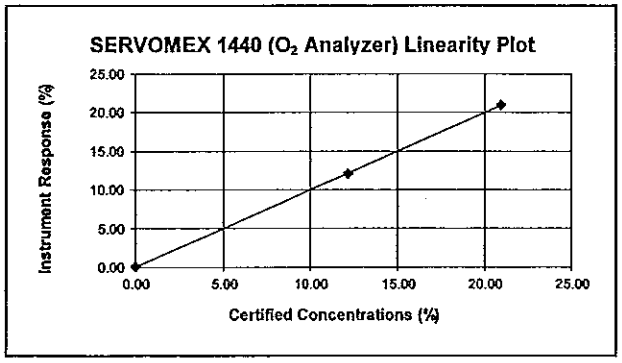
CO Span (ppm) = 18.00

THERMO 48C (CO Analyzer)				
Certified Concentration (ppm)	Instrument Response (ppm)	Calibration Error (%)	Absolute Conc. (ppm)	Pass or Fail (±2%, ≤0.5ppm)
0.00	-0.07	-0.39	0.07	YES (%)
9.07	9.12	0.28	0.05	YES (%)
18.00	18.07	0.39	0.07	YES (%)
Linearity = 0.992				



O2 Span (%) = 20.90

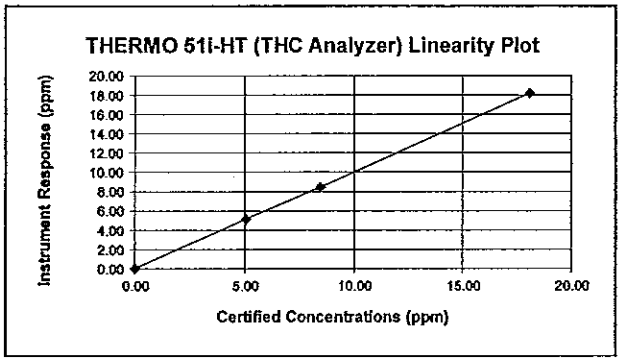
SERVOMEX 1440 (O_2 Analyzer)				
Certified Concentration (%)	Instrument Response (%)	Calibration Error (%)	Absolute Conc. (%)	Pass or Fail (±2%, ≤0.5%)
0.00	0.06	0.29	0.06	YES (%)
12.10	12.08	-0.10	0.02	YES (%)
20.90	20.89	-0.05	0.01	YES (%)
Linearity = 1.004				



THC Range (ppm) = 20

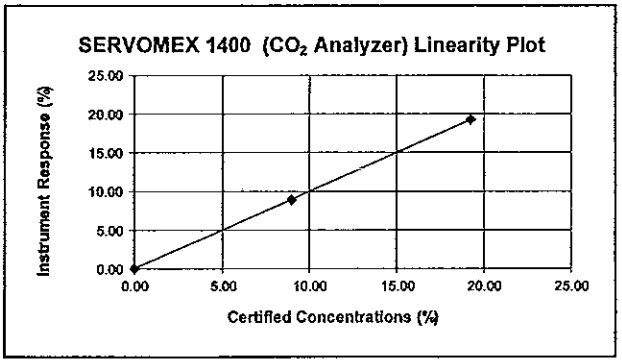
THERMO 51i-HT (THC Analyzer)				
Certified Concentration (ppm)	Instrument Response (ppm)	Calibration Error (%)	Estimated Point (ppm)	Pass or Fail (±2,5%)[1]
0.00	0.04	0.20	N/A	YES
5.04	5.12	0.41	5.10	YES
8.48	8.47	-0.98	8.55	YES
18.10	18.21	0.55	N/A	YES
Linearity = 0.995				

[1]-zero/high based on 2% of span,low/mid based on 5% of concentration



CO2 Span (%) = 19.20

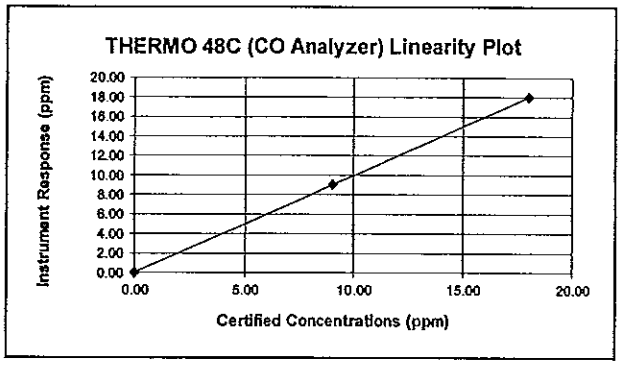
SERVOMEX 1400 (CO_2 Analyzer)				
Certified Concentration (%)	Instrument Response (%)	Calibration Error (%)	Absolute Conc. (%)	Pass or Fail (±2%, ≤0.5%)
0.00	0.03	0.16	0.03	YES (%)
8.95	8.93	-0.10	0.02	YES (%)
19.20	19.24	0.21	0.04	YES (%)
Linearity = 0.999				



Calibration Date: October 25, 2013
Client: John Zink Co, LLC

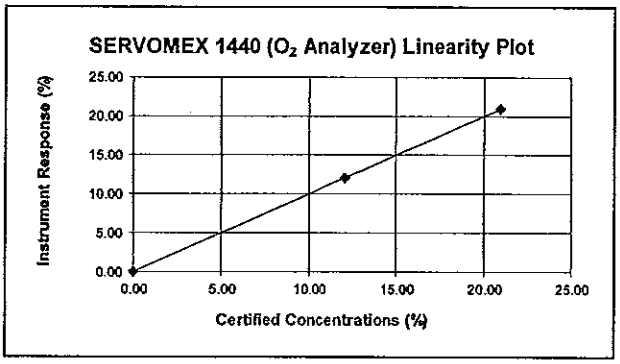
CO Span (ppm) = 18.00

THERMO 48C (CO Analyzer)				
Certified Concentration (ppm)	Instrument Response (ppm)	Calibration Error (%)	Absolute Conc. (ppm)	Pass or Fail (±2%, ≤0.5ppm)
0.00	0.03	0.17	0.03	YES (%)
9.07	9.05	-0.11	0.02	YES (%)
18.00	18.02	0.11	0.02	YES (%)
Linearity = 1.001				



O2 Span (%) = 20.90

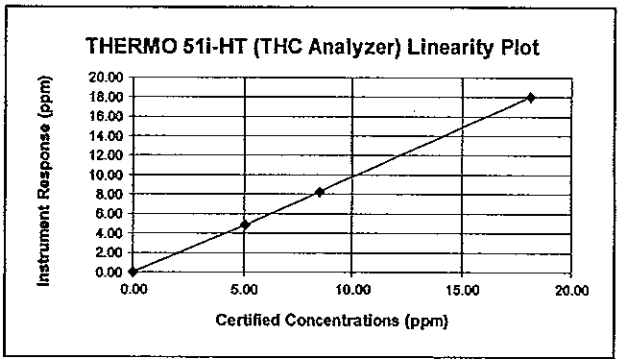
SERVOMEX 1440 (O_2 Analyzer)				
Certified Concentration (%)	Instrument Response (%)	Calibration Error (%)	Absolute Conc. (%)	Pass or Fail (±2%, ≤0.5%)
0.00	0.03	0.14	0.03	YES (%)
12.10	12.08	-0.10	0.02	YES (%)
20.90	20.94	0.19	0.04	YES (%)
Linearity = 1.000				



THC Range (ppm) = 20

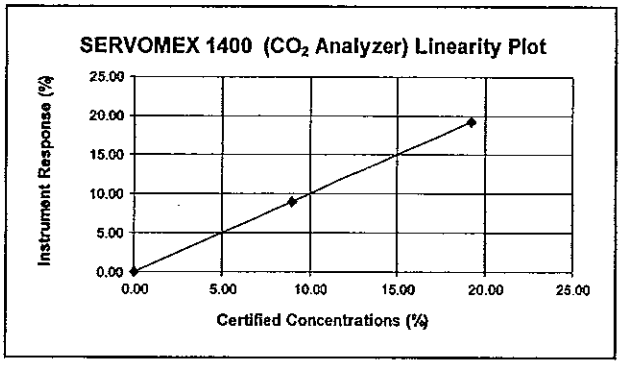
THERMO 51i-HT (THC Analyzer)				
Certified Concentration (ppm)	Instrument Response (ppm)	Calibration Error (%)	Estimated Point (ppm)	Pass or Fail (±2,5%)[1]
0.00	0.02	0.10	N/A	YES
5.04	4.86	-3.42	5.03	YES
8.48	8.24	-2.51	8.45	YES
18.10	18.02	-0.40	N/A	YES
Linearity = 0.990				

[1]-zero/high based on 2% of span,low/mid based on 5% of concentration



CO2 Span (%) = 19.20

SERVOMEX 1400 (CO_2 Analyzer)				
Certified Concentration (%)	Instrument Response (%)	Calibration Error (%)	Absolute Conc. (%)	Pass or Fail (±2%, ≤0.5%)
0.00	0.02	0.10	0.02	YES (%)
8.95	8.96	0.05	0.01	YES (%)
19.20	19.25	0.26	0.05	YES (%)
Linearity = 0.998				



DRIFT AND BIAS CHECK				
0-30-0 Load, Run - 2.5OD15 R1	O_2	CO	THC	CO_2
Raw Average	12.47	18.25	0.19	5.70
Corrected Average	12.68	17.66	0.34	5.74
Initial Zero	0.05	0.16	-0.34	0.04
Final Zero	0.02	0.15	0.05	0.05
Avg. Zero	0.04	0.16	-0.15	0.05
Initial UpScale	12.03	9.37	4.81	8.91
Final UpScale	11.76	9.53	5.07	8.84
Avg. UpScale	11.90	9.45	4.94	8.88
Sys Resp (Zero)	0.02	0.04	0.05	0.03
Sys Resp (Upscale)	12.06	9.13	4.82	8.94
Upscale Cal Gas	12.10	9.07	5.04	8.95
Initial Zero Bias	0.14%	0.67%	-1.95%	0.05%
Final Zero Bias	0.00%	0.61%	0.00%	0.10%
Zero Drift	0.14%	0.06%	1.95%	0.05%
Initial Upscale Bias	-0.14%	1.33%	-0.05%	-0.16%
Final Upscale Bias	-1.44%	2.22%	1.25%	-0.52%
Upscale Drift	1.29%	0.89%	1.30%	0.36%
Alternative Specification Abs Diff Initial Zero	0.03	0.12	--	0.01
Alternative Specification Abs Diff Final Zero	0.00	0.11	--	0.02
Alternative Specification Abs Diff Initial Upscale	0.03	0.24	--	0.03
Alternative Specification Abs Diff Final Upscale	0.30	0.40	--	0.10
Calibration Span	20.90	18.00	20.00	19.20
3% of Cal. Span (drift)	0.63	0.54	0.60	0.58
5% of Cal. Span (bias)	1.05	0.90	1.00	0.96

DRIFT AND BIAS CHECK				
0-30-0 Load, Run - 2.5OD15 R2	O_2	CO	THC	CO_2
Raw Average	12.54	14.80	0.07	5.68
Corrected Average	12.85	14.36	0.03	5.74
Initial Zero	0.02	0.15	0.05	0.05
Final Zero	0.03	0.18	0.03	0.06
Avg. Zero	0.03	0.17	0.04	0.06
Initial UpScale	11.76	9.53	5.07	8.84
Final UpScale	11.85	9.28	5.05	8.82
Avg. UpScale	11.81	9.41	5.06	8.83
Sys Resp (Zero)	0.02	0.04	0.05	0.03
Sys Resp (Upscale)	12.06	9.13	4.82	8.94
Upscale Cal Gas	12.10	9.07	5.04	8.95
Initial Zero Bias	0.00%	0.61%	0.00%	0.10%
Final Zero Bias	0.05%	0.78%	-0.10%	0.16%
Zero Drift	0.05%	0.17%	0.10%	0.05%
Initial Upscale Bias	-1.44%	2.22%	1.25%	-0.52%
Final Upscale Bias	-1.00%	0.83%	1.15%	-0.62%
Upscale Drift	0.43%	1.39%	0.10%	0.10%
Alternative Specification Abs Diff Initial Zero	0.00	0.11	--	0.02
Alternative Specification Abs Diff Final Zero	0.01	0.14	--	0.03
Alternative Specification Abs Diff Initial Upscale	0.30	0.40	--	0.10
Alternative Specification Abs Diff Final Upscale	0.21	0.15	--	0.12
Calibration Span	20.90	18.00	20.00	19.20
3% of Cal. Span (drift)	0.63	0.54	0.60	0.58
5% of Cal. Span (bias)	1.05	0.90	1.00	0.96

DRIFT AND BIAS CHECK				
0-30-0 Load, Run - 2.5OD15 R3	O_2	CO	THC	CO_2
Raw Average	13.08	8.41	0.13	5.39
Corrected Average	13.33	8.58	0.11	5.42
Initial Zero	0.17	0.29	0.03	0.09
Final Zero	0.13	0.30	0.04	0.05
Avg. Zero	0.15	0.30	0.04	0.07
Initial UpScale	11.88	8.78	5.04	8.82
Final UpScale	11.88	8.95	4.96	8.87
Avg. UpScale	11.88	8.87	5.00	8.85
Sys Resp (Zero)	0.06	-0.07	0.04	0.03
Sys Resp (Upscale)	12.08	9.12	5.12	8.93
Upscale Cal Gas	12.10	9.07	5.04	8.95
Initial Zero Bias	0.53%	2.00%	-0.05%	0.31%
Final Zero Bias	0.33%	2.06%	0.00%	0.10%
Zero Drift	0.19%	0.06%	0.05%	0.21%
Initial Upscale Bias	-0.96%	-1.89%	-0.40%	-0.57%
Final Upscale Bias	-0.96%	-0.94%	-0.80%	-0.31%
Upscale Drift	0.00%	0.94%	0.40%	0.26%
Alternative Specification Abs Diff Initial Zero	0.11	0.36	--	0.06
Alternative Specification Abs Diff Final Zero	0.07	0.37	--	0.02
Alternative Specification Abs Diff Initial Upscale	0.20	0.34	--	0.11
Alternative Specification Abs Diff Final Upscale	0.20	0.17	--	0.06
Calibration Span	20.90	18.00	20.00	19.20
3% of Cal. Span (drift)	0.63	0.54	0.60	0.58
5% of Cal. Span (bias)	1.05	0.90	1.00	0.96

DRIFT AND BIAS CHECK				
30-70-30 Load, Run - 2.5OD15 R4	O_2	CO	THC	CO_2
Raw Average	13.07	11.46	0.09	5.44
Corrected Average	13.32	11.84	0.05	5.47
Initial Zero	0.13	0.30	0.04	0.05
Final Zero	0.14	0.29	0.03	0.04
Avg. Zero	0.14	0.30	0.04	0.05
Initial UpScale	11.88	8.95	4.96	8.87
Final UpScale	11.89	8.75	4.95	8.89
Avg. UpScale	11.89	8.85	4.96	8.88
Sys Resp (Zero)	0.06	-0.07	0.04	0.03
Sys Resp (Upscale)	12.08	9.12	5.12	8.93
Upscale Cal Gas	12.10	9.07	5.04	8.95
Initial Zero Bias	0.33%	2.06%	0.00%	0.10%
Final Zero Bias	0.38%	2.00%	-0.05%	0.05%
Zero Drift	0.05%	0.06%	0.05%	0.05%
Initial Upscale Bias	-0.96%	-0.94%	-0.80%	-0.31%
Final Upscale Bias	-0.91%	-2.06%	-0.85%	-0.21%
Upscale Drift	0.05%	1.11%	0.05%	0.10%
Alternative Specification Abs Diff Initial Zero	0.07	0.37	--	0.02
Alternative Specification Abs Diff Final Zero	0.08	0.36	--	0.01
Alternative Specification Abs Diff Initial Upscale	0.20	0.17	--	0.06
Alternative Specification Abs Diff Final Upscale	0.19	0.37	--	0.04
Calibration Span	20.90	18.00	20.00	19.20
3% of Cal. Span (drift)	0.63	0.54	0.60	0.58
5% of Cal. Span (bias)	1.05	0.90	1.00	0.96

DRIFT AND BIAS CHECK				
30-70-30 Load, Run - 2.5OD15 R5	O_2	CO	THC	CO_2
Raw Average	12.27	1.57	0.03	6.00
Corrected Average	12.49	1.38	0.00	6.03
Initial Zero	0.14	0.29	0.03	0.04
Final Zero	0.13	0.26	0.04	0.03
Avg. Zero	0.14	0.28	0.04	0.04
Initial UpScale	11.89	8.75	4.95	8.89
Final UpScale	11.89	8.76	4.94	8.90
Avg. UpScale	11.89	8.76	4.95	8.90
Sys Resp (Zero)	0.06	-0.07	0.04	0.03
Sys Resp (Upscale)	12.08	9.12	5.12	8.93
Upscale Cal Gas	12.10	9.07	5.04	8.95
Initial Zero Bias	0.38%	2.00%	-0.05%	0.05%
Final Zero Bias	0.33%	1.83%	0.00%	0.00%
Zero Drift	0.05%	0.17%	0.05%	0.05%
Initial Upscale Bias	-0.91%	-2.06%	-0.85%	-0.21%
Final Upscale Bias	-0.91%	-2.00%	-0.90%	-0.16%
Upscale Drift	0.00%	0.06%	0.05%	0.05%
Alternative Specification Abs Diff: Initial Zero	0.08	0.36	--	0.01
Alternative Specification Abs Diff: Final Zero	0.07	0.33	--	0.00
Alternative Specification Abs Diff: Initial Upscale	0.19	0.37	--	0.04
Alternative Specification Abs Diff: Final Upscale	0.19	0.36	--	0.03
Calibration Span	20.90	18.00	20.00	19.20
3% of Cal. Span (drift)	0.63	0.54	0.60	0.58
5% of Cal. Span (bias)	1.05	0.90	1.00	0.96

DRIFT AND BIAS CHECK				
30-70-30 Load, Run - 2.5OD15 R6	O_2	CO	THC	CO_2
Raw Average	12.35	3.24	0.03	6.00
Corrected Average	12.51	3.16	0.00	6.02
Initial Zero	0.13	0.26	0.04	0.03
Final Zero	0.14	0.29	0.02	0.07
Avg. Zero	0.14	0.28	0.03	0.05
Initial UpScale	11.89	8.76	4.94	8.90
Final UpScale	12.01	8.82	4.89	8.88
Avg. UpScale	11.95	8.79	4.92	8.89
Sys Resp (Zero)	0.06	-0.07	0.04	0.03
Sys Resp (Upscale)	12.08	9.12	5.12	8.93
Upscale Cal Gas	12.10	9.07	5.04	8.95
Initial Zero Bias	0.33%	1.83%	0.00%	0.00%
Final Zero Bias	0.38%	2.00%	-0.10%	0.21%
Zero Drift	0.05%	0.17%	0.10%	0.21%
Initial Upscale Bias	-0.91%	-2.00%	-0.90%	-0.16%
Final Upscale Bias	-0.33%	-1.67%	-1.15%	-0.26%
Upscale Drift	0.57%	0.33%	0.25%	0.10%
Alternative Specification Abs Diff: Initial Zero	0.07	0.33	--	0.00
Alternative Specification Abs Diff: Final Zero	0.08	0.36	--	0.04
Alternative Specification Abs Diff: Initial Upscale	0.19	0.36	--	0.03
Alternative Specification Abs Diff: Final Upscale	0.07	0.30	--	0.05
Calibration Span	20.90	18.00	20.00	19.20
3% of Cal. Span (drift)	0.63	0.54	0.60	0.58
5% of Cal. Span (bias)	1.05	0.90	1.00	0.96

DRIFT AND BIAS CHECK				
70-100-70 Load, Run - 2.5OD15 R7	O_2	CO	THC	CO_2
Raw Average	12.64	3.29	0.03	5.84
Corrected Average	12.74	3.20	0.01	5.86
Initial Zero	0.14	0.29	0.02	0.07
Final Zero	0.14	0.29	0.03	0.04
Avg. Zero	0.14	0.29	0.03	0.06
Initial UpScale	12.01	8.82	4.89	8.88
Final UpScale	12.00	8.74	4.92	8.89
Avg. UpScale	12.01	8.78	4.91	8.89
Sys Resp (Zero)	0.06	-0.07	0.04	0.03
Sys Resp (Upscale)	12.08	9.12	5.12	8.93
Upscale Cal Gas	12.10	9.07	5.04	8.95
Initial Zero Bias	0.38%	2.00%	-0.10%	0.21%
Final Zero Bias	0.38%	2.00%	-0.05%	0.05%
Zero Drift	0.00%	0.00%	0.05%	0.16%
Initial Upscale Bias	-0.33%	-1.67%	-1.15%	-0.26%
Final Upscale Bias	-0.38%	-2.11%	-1.00%	-0.21%
Upscale Drift	0.05%	0.44%	0.15%	0.05%
Alternative Specification Abs Diff Initial Zero	0.08	0.36	--	0.04
Alternative Specification Abs Diff Final Zero	0.08	0.36	--	0.01
Alternative Specification Abs Diff Initial Upscale	0.07	0.30	--	0.05
Alternative Specification Abs Diff Final Upscale	0.08	0.38	--	0.04
Calibration Span	20.90	18.00	20.00	19.20
3% of Cal. Span (drift)	0.63	0.54	0.60	0.58
5% of Cal. Span (bias)	1.05	0.90	1.00	0.96

DRIFT AND BIAS CHECK				
70-100-70 Load, Run - 2.5OD15 R8	O_2	CO	THC	CO_2
Raw Average	12.21	3.45	0.03	6.14
Corrected Average	12.30	3.38	0.00	6.18
Initial Zero	0.14	0.29	0.03	0.04
Final Zero	0.15	0.30	0.05	0.06
Avg. Zero	0.15	0.30	0.04	0.05
Initial UpScale	12.00	8.74	4.92	8.89
Final UpScale	12.03	8.75	4.90	8.86
Avg. UpScale	12.02	8.75	4.91	8.88
Sys Resp (Zero)	0.06	-0.07	0.04	0.03
Sys Resp (Upscale)	12.08	9.12	5.12	8.93
Upscale Cal Gas	12.10	9.07	5.04	8.95
Initial Zero Bias	0.38%	2.00%	-0.05%	0.05%
Final Zero Bias	0.43%	2.06%	0.05%	0.16%
Zero Drift	0.05%	0.06%	0.10%	0.10%
Initial Upscale Bias	-0.38%	-2.11%	-1.00%	-0.21%
Final Upscale Bias	-0.24%	-2.06%	-1.10%	-0.36%
Upscale Drift	0.14%	0.06%	0.10%	0.16%
Alternative Specification Abs Diff Initial Zero	0.08	0.36	--	0.01
Alternative Specification Abs Diff Final Zero	0.09	0.37	--	0.03
Alternative Specification Abs Diff Initial Upscale	0.08	0.38	--	0.04
Alternative Specification Abs Diff Final Upscale	0.05	0.37	--	0.07
Calibration Span	20.90	18.00	20.00	19.20
3% of Cal. Span (drift)	0.63	0.54	0.60	0.58
5% of Cal. Span (bias)	1.05	0.90	1.00	0.96

DRIFT AND BIAS CHECK				
70-100-70 Load, Run - 2.5OD15 R9	O_2	CO	THC	CO_2
Raw Average	12.59	1.92	0.03	5.75
Corrected Average	12.81	1.72	0.00	5.80
Initial Zero	0.08	0.28	0.06	0.04
Final Zero	0.09	0.29	0.03	0.04
Avg. Zero	0.09	0.29	0.05	0.04
Initial UpScale	11.93	9.10	4.91	8.84
Final UpScale	11.87	8.72	4.88	8.86
Avg. UpScale	11.90	8.91	4.90	8.85
Sys Resp (Zero)	0.03	0.03	0.02	0.02
Sys Resp (Upscale)	12.08	9.05	4.86	8.96
Upscale Cal Gas	12.10	9.07	5.04	8.95
Initial Zero Bias	0.24%	1.39%	0.20%	0.10%
Final Zero Bias	0.29%	1.44%	0.05%	0.10%
Zero Drift	0.05%	0.06%	0.15%	0.00%
Initial Upscale Bias	-0.72%	0.28%	0.25%	-0.63%
Final Upscale Bias	-1.00%	-1.83%	0.10%	-0.52%
Upscale Drift	0.29%	2.11%	0.15%	0.10%
Alternative Specification Abs Diff: Initial Zero	0.05	0.25	--	0.02
Alternative Specification Abs Diff: Final Zero	0.06	0.26	--	0.02
Alternative Specification Abs Diff: Initial Upscale	0.15	0.05	--	0.12
Alternative Specification Abs Diff: Final Upscale	0.21	0.33	--	0.10
Calibration Span	20.90	18.00	20.00	19.20
3% of Cal. Span (drift)	0.63	0.54	0.60	0.58
5% of Cal. Span (bias)	1.05	0.90	1.00	0.96

DRIFT AND BIAS CHECK				
90-100 Load, Run - 2.5OD15 R10	O_2	CO	THC	CO_2
Raw Average	12.34	2.65	0.03	5.92
Corrected Average	12.54	2.52	0.00	5.96
Initial Zero	0.09	0.29	0.03	0.04
Final Zero	0.08	0.34	0.05	0.02
Avg. Zero	0.09	0.32	0.04	0.03
Initial UpScale	11.87	8.72	4.88	8.86
Final UpScale	11.95	8.71	4.85	8.87
Avg. UpScale	11.91	8.72	4.87	8.87
Sys Resp (Zero)	0.03	0.03	0.02	0.02
Sys Resp (Upscale)	12.08	9.05	4.86	8.96
Upscale Cal Gas	12.10	9.07	5.04	8.95
Initial Zero Bias	0.29%	1.44%	0.05%	0.10%
Final Zero Bias	0.24%	1.72%	0.15%	0.00%
Zero Drift	0.05%	0.28%	0.10%	0.10%
Initial Upscale Bias	-1.00%	-1.83%	0.10%	-0.52%
Final Upscale Bias	-0.62%	-1.89%	-0.05%	-0.47%
Upscale Drift	0.38%	0.06%	0.15%	0.05%
Alternative Specification Abs Diff: Initial Zero	0.06	0.26	--	0.02
Alternative Specification Abs Diff: Final Zero	0.05	0.31	--	0.00
Alternative Specification Abs Diff: Initial Upscale	0.21	0.33	--	0.10
Alternative Specification Abs Diff: Final Upscale	0.13	0.34	--	0.09
Calibration Span	20.90	18.00	20.00	19.20
3% of Cal. Span (drift)	0.63	0.54	0.60	0.58
5% of Cal. Span (bias)	1.05	0.90	1.00	0.96

DRIFT AND BIAS CHECK				
90-100 Load, Run - 2.5OD15 R11	O_2	CO	THC	CO_2
Raw Average	12.56	4.61	0.02	5.84
Corrected Average	12.72	4.63	0.00	5.89
Initial Zero	0.08	0.34	0.05	0.02
Final Zero	0.07	0.28	0.02	0.04
Avg. Zero	0.08	0.31	0.04	0.03
Initial UpScale	11.95	8.71	4.85	8.87
Final UpScale	11.95	8.73	4.86	8.86
Avg. UpScale	11.95	8.72	4.86	8.87
Sys Resp (Zero)	0.03	0.03	0.02	0.02
Sys Resp (Upscale)	12.08	9.05	4.86	8.96
Upscale Cal Gas	12.10	9.07	5.04	8.95
Initial Zero Bias	0.24%	1.72%	0.15%	0.00%
Final Zero Bias	0.19%	1.39%	0.00%	0.10%
Zero Drift	0.05%	0.33%	0.15%	0.10%
Initial Upscale Bias	-0.62%	-1.89%	-0.05%	-0.47%
Final Upscale Bias	-0.62%	-1.78%	0.00%	-0.52%
Upscale Drift	0.00%	0.11%	0.05%	0.05%
Alternative Specification Abs Diff: Initial Zero	0.05	0.31	--	0.00
Alternative Specification Abs Diff: Final Zero	0.04	0.25	--	0.02
Alternative Specification Abs Diff: Initial Upscale	0.13	0.34	--	0.09
Alternative Specification Abs Diff: Final Upscale	0.13	0.32	--	0.10
Calibration Span	20.90	18.00	20.00	19.20
3% of Cal. Span (drift)	0.63	0.54	0.60	0.58
5% of Cal. Span (bias)	1.05	0.90	1.00	0.96

DRIFT AND BIAS CHECK				
90-100 Load, Run - 2.5OD15 R12	O_2	CO	THC	CO_2
Raw Average	12.60	1.70	0.02	5.80
Corrected Average	12.77	1.53	0.00	5.84
Initial Zero	0.07	0.28	0.02	0.04
Final Zero	0.08	0.28	0.02	0.08
Avg. Zero	0.08	0.28	0.02	0.06
Initial UpScale	11.95	8.73	4.86	8.86
Final UpScale	11.94	8.69	4.97	8.83
Avg. UpScale	11.95	8.71	4.92	8.85
Sys Resp (Zero)	0.03	0.03	0.02	0.02
Sys Resp (Upscale)	12.08	9.05	4.86	8.96
Upscale Cal Gas	12.10	9.07	5.04	8.95
Initial Zero Bias	0.19%	1.39%	0.00%	0.10%
Final Zero Bias	0.24%	1.39%	0.00%	0.31%
Zero Drift	0.05%	0.00%	0.00%	0.21%
Initial Upscale Bias	-0.62%	-1.78%	0.00%	-0.52%
Final Upscale Bias	-0.67%	-2.00%	0.55%	-0.68%
Upscale Drift	0.05%	0.22%	0.55%	0.16%
Alternative Specification Abs Diff: Initial Zero	0.04	0.25	--	0.02
Alternative Specification Abs Diff: Final Zero	0.05	0.25	--	0.06
Alternative Specification Abs Diff: Initial Upscale	0.13	0.32	--	0.10
Alternative Specification Abs Diff: Final Upscale	0.14	0.36	--	0.13
Calibration Span	20.90	18.00	20.00	19.20
3% of Cal. Span (drift)	0.63	0.54	0.60	0.58
5% of Cal. Span (bias)	1.05	0.90	1.00	0.96

METERING SYSTEM THERMOCOUPLE CALIBRATION SHEET
EPA Reference Method
Metering System Pre-Test Calibration
Air Hygiene Assett ID: samp-cp-0019

Filename: \\SERVER2\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0019 Calibration 4-18-13.xls]Original 4-18-13 (5 point)

Make: Apex
Model #: XC-522
Serial #: 1103025

Date: 04/18/13
Barometric Pressure: 29.30 (in. Hg)
Temperature (ASTM cal): 69.10 (°F)

Thermocouple	100 (°F)		600 (°F)		1200 (°F)	
	Reading	% Error	Reading	% Error	Reading	% Error
Stack	100.00	0.00	600.00	0.00	1200.00	0.00
Probe	100.00	0.00	600.00	0.00	1201.00	0.08
Filter	100.00	0.00	600.00	0.00	1201.00	0.08
Dryer	100.00	0.00	600.00	0.00	1201.00	0.08
Aux.	100.00	0.00	600.00	0.00	1201.00	0.08

Note: Calibrated against an ALTEK Thermocouple Source Series 22, direct temperature output calibrated to ASTM and IPTS standards as outlined in ALTEK Data Sheet 22.

Thermocouple	69.10 (°F)	
	Reading	(±°F)
DGM In	69.0	0.10
DGM Out	69.0	0.10

Note: Calibrated against ASTM Reference Thermometer.

SIGNATURE: Craig McCarty DATE: 04/18/13 04/18/13

Standard for Calibration of Console Thermocouple Systems

40 CFR, Part 60
Appendix A, Method 5
10.3.2 The temperature data recorded in the field shall be considered valid. If, during calibration, the absolute temperature measured with the sensor being calibrated and the reference sensor **agree within 1.5 percent**, the temperature data taken in the field shall be considered valid.

Standard for Calibration of Individual Thermocouples

EMC, ALT-011: After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature, or any other temperature, within the range specified by the manufacturer, using a reference thermometer (either ASTM reference thermometer or a thermometer that has been calibrated against an ASTM reference thermometer). The temperatures of the thermocouple and reference thermometers shall **agree to within ±2°F.**

PROBE (STACK), HOTBOX (FILTER), AND GOOSENECK (EXIT) THERMOCOUPLE CALIBRATION SHEET

EPA Reference Method

Metering System Pre-Test Calibration

Air Hygiene Assett ID(s): **Probe:** samp-hp-0066 **Hotbox:** samp-bh-0012 **Gooseneck:** samp-ad-0002

Filename: \\SERVER2\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0019 Calibration 4-18-13.xls]Original 4-18-13 (5 point)

Barometric Pressure: 29.30

Thermo-couples		Temps (°F)	Signature		Date	
Stack	Ref	69.10	Craig McCarty		04/18/13	04/18/13
	Read	69.00				
	±°F	0.10				
Filter	Ref	69.10	Craig McCarty		04/18/13	04/18/13
	Read	70.00				
	±°F	0.90				
Exit	Ref	69.10	Craig McCarty		04/18/13	04/18/13
	Read	70.00				
	±°F	0.90				

Note: Calibrated against ASTM Reference Thermometer.

Standard for Calibration of Individual Thermocouples

EMC, ALT-011: After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature, or any other temperature, within the range specified by the manufacturer, using a reference thermometer (either ASTM reference thermometer or a thermometer that has been calibrated against an ASTM reference thermometer). The temperatures of the thermocouple and reference thermometers shall agree to within ±2°F.

METERING SYSTEM DRY GAS METER CALIBRATION SHEET

EPA Reference Method
Metering System Post-Test Calibration
Air Hygiene Assett ID: samp-cp-0019

Filename: \\SERVER2\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0019 Calibration 4-18-13.xls]10-28-13 (3 point)

Make: APEX
Model #: 522
Serial #: 1103025

Date: 10/28/13
Barometric Pressure: 29.55 (in. Hg)
Theoretical Critical Vacuum: 13.94 (in. Hg)

DRY GAS METER READINGS

ΔH (in. H2O)	Time (min)	Volume Initial (ft³)	Volume Final (ft³)	Volume Total (ft³)	Initial Temperature Inlet (°F)	Initial Temperature Outlet (°F)
2.00	10.00	873.500	881.770	8.270	72.0	72.0
2.00	10.00	881.770	890.040	8.270	73.0	73.0
2.00	10.00	890.040	898.320	8.280	74.0	74.0

Final Temperature Inlet (°F)	Final Temperature Outlet (°F)	Orifice Serial# (number)	K' Orifice Coefficient (see above)	Actual Vacuum (in. Hg)	Ambient Temperature Initial (°F)	Ambient Temperature Final (°F)	Ambient Temperature Average (°F)
73.0	73.0	63	0.6118	16.0	71.2	71.4	71.3
74.0	74.0	63	0.6118	16.0	71.4	71.4	71.4
74.0	74.0	63	0.6118	16.0	71.2	71.4	71.3

RESULTS

DRY GAS METER VOLUME CORRECTED Vm(std) (ft³)	DRY GAS METER VOLUME CORRECTED Vm(std) (liters)	ORIFICE VOLUME CORRECTED Vcr(std) (ft³)	ORIFICE VOLUME CORRECTED Vcr(std) (liters)	ORIFICE VOLUME NOMINAL Vcr (ft³)
8.136	230.40	7.843	222.1	7.994
8.121	229.97	7.843	222.1	7.995
8.123	230.04	7.843	222.1	7.994

DRY GAS METER CALIBRATION FACTOR Y Variation (number)	DRY GAS METER CALIBRATION FACTOR Y Value (number)	ORIFICE CALIBRATION FACTOR ΔH@ Value (in. H2O)	ORIFICE CALIBRATION FACTOR ΔH@ Value (mm H2O)	ORIFICE CALIBRATION FACTOR ΔH@ Variation (in. H2O)
-0.001	0.964	1.791	45.49	0.003
0.001	0.966	1.788	45.41	0.000
0.000	0.966	1.786	45.36	-0.002
AVERAGE:	**0.965**	**1.788**	45.42	**PASSED**
LAST 5-PT:	**0.976**	**1.855**	**PASSED**	5-PT Date:
% DIFF:	**1.1%**	**3.8%**		04/18/13

40 CFR - CHAPTER I - PART 60
Appendix A, Method 5
10.3.2 Calibration After Use
After each field use, the calibration of the metering system shall be checked by performing three calibration runs at a single, intermediate orifice setting (based on the previous field test)....Calculate the average value of the DGM calibration factor. If the value has changed by more than 5 percent, recalibrate the meter over the full range of orifice settings, as detailed in Section 10.3.1.

10.3.3 Acceptable Variation in Calibration
If the DGM coefficient values obtained before and after a test series differ by more than 5 percent, the test series shall either be voided, or calculations for the test series shall be performed using whichever meter coefficient value (i.e., before or after) gives the lower value of total sample volume.

Notes: 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 H_20 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. For valid test results, the Actual Vacuum should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above. The Critical Orifice Coefficient, K', must be entered in English units, (ft)^3*(deg R)^0.5/((in.Hg)*(min)).

SIGNATURE: Craig McCarty DATE: 10/28/13 10/28/13

METERING SYSTEM THERMOCOUPLE CALIBRATION SHEET
EPA Reference Method
Metering System Post-Test Calibration
Air Hygiene Assett ID: samp-cp-0019

Filename: \\SERVER2\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0019 Calibration 4-18-13.xls]10-28-13 (3 point)

Make: APEX
Model #: 522
Serial #: 1103025

Date: 10/28/13
Barometric Pressure: 29.55 (in. Hg)
Temperature (ASTM cal): 71.20 (°F)

Thermocouple	100 (°F)		600 (°F)		1200 (°F)	
	Reading	% Error	Reading	% Error	Reading	% Error
Stack	99.00	0.50	601.00	0.17	1198.00	0.17
Probe	99.00	0.50	601.00	0.17	1199.00	0.08
Filter	99.00	0.50	601.00	0.17	1198.00	0.17
Dryer	99.00	0.50	601.00	0.17	1199.00	0.08
Aux.	99.00	0.50	601.00	0.17	1199.00	0.08

Note: Calibrated against an ALTEK Thermocouple Source Series 22, direct temperature output calibrated to ASTM and IPTS standards as outlined in ALTEK Data Sheet 22.

Thermocouple	71.20 (°F)	
	Reading	(±°F)
DGM In	72.0	0.80
DGM Out	72.0	0.80

Note: Calibrated against ASTM Reference Thermometer.

SIGNATURE: Craig McCarty DATE: 10/28/13 10/28/13

Standard for Calibration of Console Thermocouple Systems

40 CFR, Part 60
Appendix A, Method 5
10.3.2 The temperature data recorded in the field shall be considered valid. If, during calibration, the absolute temperature measured with the sensor being calibrated and the reference sensor **agree within 1.5 percent**, the temperature data taken in the field shall be considered valid.

Standard for Calibration of Individual Thermocouples

EMC, ALT-011: After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature, or any other temperature, within the range specified by the manufacturer, using a reference thermometer (either ASTM reference thermometer or a thermometer that has been calibrated against an ASTM reference thermometer). The temperatures of the thermocouple and reference thermometers shall **agree to within ±2°F.**

PROBE (STACK), HOTBOX (FILTER), AND GOOSENECK (EXIT) THERMOCOUPLE CALIBRATION SHEET

EPA Reference Method

Metering System Post-Test Calibration

Air Hygiene Assett ID(s): **Probe:** samp-hp-0039 **Hotbox:** samp-bh-0012 **Gooseneck:** samp-ad-0032

Filename: \\SERVER2\pubsc\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0019 Calibration 4-18-13.xls]10-28-13 (3 point)

Barometric Pressure: 29.55

Thermo-couples		Temps (°F)	Signature		Date	
Stack	Ref	71.40	Craig McCarty		10/28/13	10/28/13
	Read	72.00				
	±°F	0.60				
Filter	Ref	71.40	Craig McCarty		10/28/13	10/28/13
	Read	71.00				
	±°F	0.40				
Exit	Ref	71.40	Craig McCarty		10/28/13	10/28/13
	Read	71.00				
	±°F	0.40				

Note: Calibrated against ASTM Reference Thermometer.

Standard for Calibration of Individual Thermocouples

EMC, ALT-011: After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature, or any other temperature, within the range specified by the manufacturer, using a reference thermometer (either ASTM reference thermometer or a thermometer that has been calibrated against an ASTM reference thermometer). The temperatures of the thermocouple and reference thermometers shall agree to within ±2°F.

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F8_PRF1

DATE: 10/23/13

PROCEDURE

1. Before performing any calibration, input all five test points into the transmitter and note down: process value from the transmitter display, milli-amp output values, and the value displayed in the data acquisition system in the appropriate columns.
2. If any value deviates from the expected value by more than 0.5% of span, perform calibration of the transmitter.
3. If calibration is performed, input all five test points into the transmitter and note down: process value from the transmitter display, milli-amp output values, and the value displayed in the data acquisition system in the appropriate columns.

% of Span	Process Value	As Found			Acceptance Criteria (mA)	After Calibration		
	Units: PSIG	Process Value from Transmitter Display	Analog Output (mA)	Data Acquisition Process Value		Process Value from Transmitter Display	Analog Output (mA)	Data Acquisition Process Value
0	0.0	NA	NA	-0.01	4 (3.9 to 4.1)			
25	12.26	NA	NA	12.29	8 (7.9 to 8.1)			
50	23.00	NA	NA	23.04	12 (11.9 to 12.1)			
75	40.15	NA	NA	40.26	16 (15.9 to 16.1)			
100	49.91	NA	NA	49.99	20 (19.9 to 20.1)			

Trans. passed without cal: X Trans. passed with cal.: _____ Trans. replaced: _____

Calibration Performed by: Craig Skaggs

Date next calibration is to be performed: 10/23/14

TEMPERATURE ELEMENT VERIFICATION RECORD

INSTRUMENT TAG: F8-TE5

DATE: 10-23-2013

PROCEDURE

1. If element is connected to a transmitter, calibrate the transmitter first.
2. Insert element into test device, set test device to target temperature, allow temperature of test device to stabilize.
3. Note down the test device temperature in the appropriate column.
4. Note down the data acquisition value in the appropriate column.
5. If data acquisition value is outside the range of the acceptance criteria, replace the element.

Target Temp. °F	Calibration Instrument Reading °F	Data Acquisition Value °F	Acceptance Criteria (mA)
150	150	151	+/- 5°F
100	100	101	+/- 5°F
32	32	35	+/- 5°F

Element passed: X Element. replaced: _____

Verification Performed by: CROWN

Date next verification is to be performed: 10-23-2013

TEMPERATURE ELEMENT VERIFICATION RECORD

INSTRUMENT TAG: F8_TEL3

DATE: 10-28-2013

PROCEDURE

1. If element is connected to a transmitter, calibrate the transmitter first.
2. Insert element into test device, set test device to target temperature, allow temperature of test device to stabilize.
3. Note down the test device temperature in the appropriate column.
4. Note down the data acquisition value in the appropriate column.
5. If data acquisition value is outside the range of the acceptance criteria, replace the element.

Target Temp. °F	Calibration Instrument Reading °F	Data Acquisition Value °F	Acceptance Criteria (mA)
150	150	146.3	+/- 5°F
100	100	95.7	+/- 5°F
32	32	27.5	+/- 5°F

Element passed: X Element. replaced: _____

Verification Performed by: Charles Crain

Date next verification is to be performed: 10-28-2014

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F8_dPL3

DATE: 10-28-2013

PROCEDURE

1. Before performing any calibration, input all five test points into the transmitter and note down: process value from the transmitter display, milli-amp output values, and the value displayed in the data acquisition system in the appropriate columns.
2. If any value deviates from the expected value by more than 0.5% of span, perform calibration of the transmitter.
3. If calibration is performed, input all five test points into the transmitter and note down: process value from the transmitter display, milli-amp output values, and the value displayed in the data acquisition system in the appropriate columns.

% of Span	Process Value	As Found			Acceptance Criteria (mA)	After Calibration		
	Units: IN/H2O	Process Value from Transmitter Display	Analog Output (mA)	Data Acquisition Process Value		Process Value from Transmitter Display	Analog Output (mA)	Data Acquisition Process Value
0	0.0	-.1		0.0	4 (3.9 to 4.1)			
25	75.3	75.1		75.3	8 (7.9 to 8.1)			
50	150.2	150.0	~~150.1~~	150.1	12 (11.9 to 12.1)			
75	225.1	225	~~225.0~~	225.0	16 (15.9 to 16.1)			
100	300.0	300		299.8	20 (19.9 to 20.1)			

Trans. passed without cal: X Trans. passed with cal.: _____ Trans. replaced: _____

Calibration Performed by: Charles Crown

Date next calibration is to be performed: 10-28-2014

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F8_PRL3

DATE: 10-28-2013

PROCEDURE

1. Before performing any calibration, input all five test points into the transmitter and note down: process value from the transmitter display, milli-amp output values, and the value displayed in the data acquisition system in the appropriate columns.
2. If any value deviates from the expected value by more than 0.5% of span, perform calibration of the transmitter.
3. If calibration is performed, input all five test points into the transmitter and note down: process value from the transmitter display, milli-amp output values, and the value displayed in the data acquisition system in the appropriate columns.

% of Span	Process Value	As Found			Acceptance Criteria (mA)	After Calibration		
	Units: PSI	Process Value from Transmitter Display	Analog Output (mA)	Data Acquisition Process Value		Process Value from Transmitter Display	Analog Output (mA)	Data Acquisition Process Value
0	0.0			0.0	4 (3.9 to 4.1)			
25	25.7			25.7	8 (7.9 to 8.1)			
50	50.0			50.0	12 (11.9 to 12.1)			
75	75.8			75.6	16 (15.9 to 16.1)			
100	96.6			96.4	20 (19.9 to 20.1)			

Trans. passed without cal: X Trans. passed with cal.: _____ Trans. replaced: _____

Calibration Performed by: Charles Crown

Date next calibration is to be performed: 10-28-2014

APPENDIX E

FUEL ANALYSIS RECORDS

2655 Park Center Dr., Suite A
Simi Valley, CA 93065
T: +1 805 526 7161
F: +1 805 526 7270
www.alsglobal.com

LABORATORY REPORT

November 15, 2013

Min Lee
Air Hygiene, Incorporated
1600 West Tacoma Street
Broken Arrow, OK 74012

RE: jz.13-Tulsa,ok-comp#1 / 1

Dear Min:

Enclosed are the results of the samples submitted to our laboratory on October 29, 2013. For your reference, these analyses have been assigned our service request number P1304810.

All analyses were performed according to our laboratory's NELAP and DoD-ELAP-approved quality assurance program. The test results meet requirements of the current NELAP and DoD-ELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP and DoD-ELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. Results are intended to be considered in their entirety and apply only to the samples analyzed and reported herein.

If you have any questions, please call me at (805) 526-7161.

Respectfully submitted,

ALS | Environmental

Kelly Horiuchi
By Kelly Horiuchi at 10:25 am, Nov 15, 2013

Kelly Horiuchi
Laboratory Director

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Simi Valley, CA 93065
T: +1 805 526 7161
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www.alsglobal.com

Client: Air Hygiene, Incorporated
Project: jz.13-Tulsa,ok-comp#1 / 1

Service Request No: P1304810

CASE NARRATIVE

The samples were received intact under chain of custody on October 29, 2013 and were stored in accordance with the analytical method requirements. Please refer to the sample acceptance check form for additional information. The results reported herein are applicable only to the condition of the samples at the time of sample receipt.

The canister valve for sample JZ-R3-70-100-70%-Can was received loose. The canister was analyzed and the results did not look comparable to any of the other samples in the set, therefore it was cancelled.

BTU and CHONS Analysis

The results for BTU and CHONS were generated according to ASTM D 3588-98. The following analyses were performed and used to calculate the BTU and CHONS results. This method is not included on the laboratory's NELAP, DoD-ELAP, or AIHA-LAP scope of accreditation.

C2 through C6 Hydrocarbon Analysis

The samples were analyzed according to modified EPA Method TO-3 for C2 through >C6 hydrocarbons using a gas chromatograph equipped with a flame ionization detector (FID). This method is not included on the laboratory's NELAP or AIHA-LAP scope of accreditation.

Fixed Gases Analysis

The samples were also analyzed for fixed gases (hydrogen, oxygen/argon, nitrogen, carbon monoxide, methane and carbon dioxide) according to modified EPA Method 3C (single injection) using a gas chromatograph equipped with a thermal conductivity detector (TCD). This method is not included on the laboratory's NELAP or AIHA-LAP scope of accreditation.

Hydrogen Sulfide Analysis

The samples were also analyzed for hydrogen sulfide per ASTM D 5504-08 using a gas chromatograph equipped with a sulfur chemiluminescence detector (SCD). This method is not included on the laboratory's NELAP, DoD-ELAP, or AIHA-LAP scope of accreditation.

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Client: Air Hygiene, Incorporated
Project: jz.13-Tulsa,ok-comp#1 / 1

Service Request No: P1304810

CASE NARRATIVE

Sulfur Analysis

The samples were also analyzed for twenty sulfur compounds per ASTM D 5504-08 using a gas chromatograph equipped with a sulfur chemiluminescence detector (SCD). All compounds with the exception of hydrogen sulfide and carbonyl sulfide are quantitated against the initial calibration curve for methyl mercaptan. This method is not included on the laboratory's NELAP, DoD-ELAP, or AIHA-LAP scope of accreditation.

The results of analyses are given in the attached laboratory report. All results are intended to be considered in their entirety, and ALS Environmental (ALS) is not responsible for utilization of less than the complete report.

Use of ALS Environmental (ALS)'s Name. Client shall not use ALS's name or trademark in any marketing or reporting materials, press releases or in any other manner ("Materials") whatsoever and shall not attribute to ALS any test result, tolerance or specification derived from ALS's data ("Attribution") without ALS's prior written consent, which may be withheld by ALS for any reason in its sole discretion. To request ALS's consent, Client shall provide copies of the proposed Materials or Attribution and describe in writing Client's proposed use of such Materials or Attribution. If ALS has not provided written approval of the Materials or Attribution within ten (10) days of receipt from Client, Client's request to use ALS's name or trademark in any Materials or Attribution shall be deemed denied. ALS may, in its discretion, reasonably charge Client for its time in reviewing Materials or Attribution requests. Client acknowledges and agrees that the unauthorized use of ALS's name or trademark may cause ALS to incur irreparable harm for which the recovery of money damages will be inadequate. Accordingly, Client acknowledges and agrees that a violation shall justify preliminary injunctive relief. For questions contact the laboratory.

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ALS Environmental - Simi Valley

Certifications, Accreditations, and Registrations

Agency	Web Site	Number
AIHA	http://www.aihaaccreditedlabs.org	101661
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0694
DoD ELAP	http://www.pjlabs.com/search-accredited-labs	L11-203
Florida DOH (NELAP)	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E871020
Maine DHHS	http://www.maine.gov/dhhs/mecdc/environmental-health/water/dwp-services/labcert/labcert.htm	2012039
Minnesota DOH (NELAP)	http://www.health.state.mn.us/accreditation	581572
New Jersey DEP (NELAP)	http://www.nj.gov/dep/oqa/	CA009
New York DOH (NELAP)	http://www.wadsworth.org/labcert/elap/elap.html	11221
Oregon PHD (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	CA200007
Pennsylvania DEP	http://www.depweb.state.pa.us/labs	68-03307 (Registration)
Texas CEQ (NELAP)	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704413-13-4
Utah DOH (NELAP)	http://www.health.utah.gov/lab/labimp/certification/index.html	CA016272013-3
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C946

Analyses were performed according to our laboratory's NELAP and DoD-ELAP approved quality assurance program. A complete listing of specific NELAP and DoD-ELAP certified analytes can be found in the certifications section at www.alsglobal.com, or at the accreditation body's website.

Each of the certifications listed above have an explicit Scope of Accreditation that applies to specific matrices/methods/analytes; therefore, please contact the laboratory for information corresponding to a particular certification.

ALS ENVIRONMENTAL

DETAIL SUMMARY REPORT

Client: Air Hygiene, Incorporated
Project ID: jz.13-Tulsa,ok-comp#1 / 1

Service Request: P1304810

Date Received: 10/29/2013
Time Received: 10:00

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	Container ID	Pil (psig)	Pfl (psig)	TO-3 Modified - C1C6+ Can	3C Modified - Fxd Gases Can	ASTM D5504-01 - H2S Can	ASTM D5504-08 - Sulfur Can
JZ-R1-0-30-0%-Can	P1304810-001	Air	10/23/2013	00:00	SSC00126	0.00	3.88	X	X	X	X
JZ-R2-30-70-30%-Can	P1304810-002	Air	10/24/2013	00:00	SSC00074	0.39	4.05	X	X	X	X
JZ-R4-90-100% Can	P1304810-004	Air	10/25/2013	00:00	SSC00039	0.67	3.97	X	X	X	X

Air - Chain of Custody Record & Analytical Service Request

Page 1 of 1

2655 Park Center Drive, Suite A
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Fax (805) 526-7270

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10-Day-Standard

ALS Project No: PI204810

Company Name & Address (Reporting Information): John Zink, Inc

Project Name: JZ-13-Tulsa, Ok - comp #1

Project Number:

Project Manager: Min Sun Lee

P.O. # / Billing Information

Phone: 918-307-8865

Fax:

Email Address for Result Reporting: mlee@airhygiene.com & lab@airhygiene.com

Sampler (Print & Sign):

ALS Contact:

Analysis Method: See Quote or call

Comments e.g. Actual Preservative or specific Instructions

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume
JZ-R1-0-30.0%-Can	① to.4	10/23/13	3hrs	SSC00126	50A00155	-29.61	0.22	
JZ-R2-30-70-30%-Can	② to.5	10/24/13	3hrs	SSC00074	50A00155	-29.86	0.55	
JZ-R3-70-100-70%Can	③ -0.04	10/24/13	3hrs	SSC00099	50A00156	-29.76	-.10	
JZ-R4-%-100% can	④ 0.73	6/25/13	3hrs	SSC00039	50A00156	-29.97	.17	
	-14 Hg							

Report Tier Levels - please select

Tier I - Results (Default if not specified) _____
Tier II (Results + QC Summaries _____
Tier III (Results + QC & Calibration Summaries) _____
Tier IV (Data Validation Package) 10% Surcharge _____

EDD required YES / No
Type: _____ Units: _____

Chain of Custody Seal: (Circle) INTACT BROKEN ABSENT

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	10/25/13	1000

Cooler / Blank Temperature _____ °C

ALS Environmental
Sample Acceptance Check Form

Client: Air Hygiene, Incorporated Work order: P1304810

Project: jz.13-Tulsa,ok-comp#1 / 1

Sample(s) received on: 10/29/13 Date opened: 10/29/13 by: MZAMORA

Note: This form is used for all samples received by ALS. The use of this form for custody seals is strictly meant to indicate presence/absence and not as an indication of compliance or nonconformity. Thermal preservation and pH will only be evaluated either at the request of the client and/or as required by the method/SOP.

		Yes	No	N/A
1	Were **sample containers** properly marked with client sample ID?	☒	☐	☐
2	Container(s) **supplied by ALS**?	☒	☐	☐
3	Did **sample containers** arrive in good condition?	☒	☐	☐
4	Were **chain-of-custody** papers used and filled out?	☒	☐	☐
5	Did **sample container labels** and/or tags agree with custody papers?	☒	☐	☐
6	Was **sample volume** received adequate for analysis?	☒	☐	☐
7	Are samples within specified holding times?	☒	☐	☐
8	Was proper **temperature** (thermal preservation) of cooler at receipt adhered to?	☐	☐	☒
9	Was a **trip blank** received?	☐	☒	☐
10	Were **custody seals** on outside of cooler/Box?	☐	☒	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
	Were custody seals on outside of sample container?	☐	☒	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
11	Do containers have appropriate **preservation,** according to method/SOP or Client specified information?	☐	☐	☒
	Is there a client indication that the submitted samples are **pH** preserved?	☐	☐	☒
	Were **VOA vials** checked for presence/absence of air bubbles?	☐	☐	☒
	Does the client/method/SOP require that the analyst check the sample pH and if necessary alter it?	☐	☐	☒
12	**Tubes:** Are the tubes capped and intact?	☐	☐	☒
	Do they contain moisture?	☐	☐	☒
13	**Badges:** Are the badges properly capped and intact?	☐	☐	☒
	Are dual bed badges separated and individually capped and intact?	☐	☐	☒

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1304810-001.01	6.0 L Silonite Can					
P1304810-002.01	6.0 L Silonite Can					
P1304810-003.01	6.0 L Silonite Can					
P1304810-004.01	6.0 L Silonite Can					

Explain any discrepancies: (include lab sample ID numbers):

Chain of Custody is missing analysis

No signature relinquishing sample(s) on Chain of Custody (Dates and times also)

VOA for samples -003 & -004 listed on COC, was not received.

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-R1-0-30-0%-Can**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P1304810-001

Test Code: ASTM D3588-98
Analyst: Mike Conejo/Jennifer Young
Sample Type: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00126

Date Collected: 10/23/13
Date Received: 10/29/13

Initial Pressure (psig): Final Pressure (psig): 3.88

Canister Dilution Factor: 1.26

Components	Result Volume %	Result Weight %	Data Qualifier
Hydrogen	< 0.01	< 0.01	
Oxygen + Argon	**0.13**	**0.10**	
Nitrogen	**0.51**	**0.33**	
Carbon Monoxide	< 0.01	< 0.01	
Methane	< 0.01	< 0.01	
Carbon Dioxide	< 0.01	< 0.01	
Hydrogen Sulfide	< 0.01	< 0.01	
C2 as Ethane	< 0.01	< 0.01	
C3 as Propane	**99.35**	**99.57**	
C4 as n-Butane	< 0.01	< 0.01	
C5 as n-Pentane	< 0.01	< 0.01	
C6 as n-Hexane	< 0.01	< 0.01	
> C6 as n-Hexane	< 0.01	< 0.01	
TOTALS	**99.99**	**99.99**	

Components	Mole %	Weight %
Carbon	**27.24**	**81.37**
Hydrogen	**72.64**	**18.21**
Oxygen + Argon	< 0.10	< 0.10
Nitrogen	< 0.10	**0.33**
Sulfur	< 0.10	< 0.10

Specific Gravity (Air = 1)		**1.5190**
Specific Volume	ft3/lb	**8.63**
Gross Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/ft3	**2,543.4**
Net Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/ft3	**2,340.0**
Gross Heating Value (Water Saturated at 0.25636 psia)	BTU/ft3	**2,456.0**
Net Heating Value (Water Saturated at 0.25636 psia)	BTU/ft3	**2,259.6**
Gross Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/lb	**21,937.8**
Net Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/lb	**20,183.6**
Compressibility Factor "Z" (60 F, 14.696 psia)		**0.9828**

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-R2-30-70-30%-Can** ALS Project ID: P1304810
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1** ALS Sample ID: P1304810-002

Test Code: ASTM D3588-98
Analyst: Mike Conejo/Jennifer Young Date Collected: 10/24/13
Sample Type: 6.0 L Silonite Canister Date Received: 10/29/13
Test Notes:
Container ID: SSC00074

Initial Pressure (psig): 0.39 Final Pressure (psig): 4.05

Canister Dilution Factor: 1.24

Components	Result Volume %	Result Weight %	Data Qualifier
Hydrogen	< 0.01	< 0.01	
Oxygen + Argon	**0.12**	**0.09**	
Nitrogen	**0.52**	**0.33**	
Carbon Monoxide	< 0.01	< 0.01	
Methane	< 0.01	< 0.01	
Carbon Dioxide	< 0.01	< 0.01	
Hydrogen Sulfide	< 0.01	< 0.01	
C2 as Ethane	< 0.01	< 0.01	
C3 as Propane	**99.35**	**99.57**	
C4 as n-Butane	< 0.01	< 0.01	
C5 as n-Pentane	< 0.01	< 0.01	
C6 as n-Hexane	< 0.01	< 0.01	
> C6 as n-Hexane	< 0.01	< 0.01	
TOTALS	**99.99**	**99.99**	

Components	Mole %	Weight %
Carbon	**27.24**	**81.37**
Hydrogen	**72.64**	**18.21**
Oxygen + Argon	< 0.10	< 0.10
Nitrogen	< 0.10	**0.33**
Sulfur	< 0.10	< 0.10

Specific Gravity (Air = 1)		**1.5191**
Specific Volume	ft3/lb	**8.63**
Gross Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/ft3	**2,543.5**
Net Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/ft3	**2,340.1**
Gross Heating Value (Water Saturated at 0.25636 psia)	BTU/ft3	**2,456.2**
Net Heating Value (Water Saturated at 0.25636 psia)	BTU/ft3	**2,259.8**
Gross Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/lb	**21,939.0**
Net Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/lb	**20,184.7**
Compressibility Factor "Z" (60 F, 14.696 psia)		**0.9828**

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-R4-90-100% Can**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P1304810-004

Test Code: ASTM D3588-98
Analyst: Mike Conejo/Jennifer Young
Sample Type: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00039

Date Collected: 10/25/13
Date Received: 10/29/13

Initial Pressure (psig): 0.67 Final Pressure (psig): 3.97

Canister Dilution Factor: 1.21

Components	Result Volume %	Result Weight %	Data Qualifier
Hydrogen	< 0.01	< 0.01	
Oxygen + Argon	**0.22**	**0.16**	
Nitrogen	**0.84**	**0.53**	
Carbon Monoxide	< 0.01	< 0.01	
Methane	< 0.01	< 0.01	
Carbon Dioxide	< 0.01	< 0.01	
Hydrogen Sulfide	< 0.01	< 0.01	
C2 as Ethane	< 0.01	< 0.01	
C3 as Propane	**98.93**	**99.29**	
C4 as n-Butane	< 0.01	< 0.01	
C5 as n-Pentane	< 0.01	< 0.01	
C6 as n-Hexane	< 0.01	< 0.01	
> C6 as n-Hexane	< 0.01	< 0.01	
TOTALS	**99.99**	**99.99**	

Components	Mole %	Weight %
Carbon	**27.22**	**81.15**
Hydrogen	**72.59**	**18.16**
Oxygen + Argon	< 0.10	**0.16**
Nitrogen	**0.15**	**0.53**
Sulfur	< 0.10	< 0.10

Specific Gravity (Air = 1)		**1.5169**
Specific Volume	ft3/lb	**8.64**
Gross Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/ft3	**2,532.4**
Net Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/ft3	**2,329.9**
Gross Heating Value (Water Saturated at 0.25636 psia)	BTU/ft3	**2,445.8**
Net Heating Value (Water Saturated at 0.25636 psia)	BTU/ft3	**2,250.3**
Gross Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/lb	**21,874.7**
Net Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/lb	**20,125.5**
Compressibility Factor "Z" (60 F, 14.696 psia)		**0.9829**

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-R1-0-30-0%-Can**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P1304810-001

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC8/FID
Analyst: Wade Henton
Sampling Media: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00126

Date Collected: 10/23/13
Date Received: 10/29/13
Date Analyzed: 11/12/13
Volume(s) Analyzed: 0.050 ml(s)

Initial Pressure (psig): 0.00 Final Pressure (psig): 3.88

Canister Dilution Factor: 1.26

Compound	Result ppmV	MRL ppmV	Data Qualifier
Methane	ND	13	
C_2 as Ethane	ND	13	
C_3 as Propane	**1,100,000**	13	
C_4 as n-Butane	ND	13	
C_5 as n-Pentane	ND	13	
C_6 as n-Hexane	ND	13	
C_6+ as n-Hexane	ND	25	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-R2-30-70-30%-Can**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P1304810-002

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC8/FID
Analyst: Wade Henton
Sampling Media: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00074

Date Collected: 10/24/13
Date Received: 10/29/13
Date Analyzed: 11/12/13
Volume(s) Analyzed: 0.050 ml(s)

Initial Pressure (psig): 0.39 Final Pressure (psig): 4.05

Canister Dilution Factor: 1.24

Compound	Result ppmV	MRL ppmV	Data Qualifier
Methane	ND	12	
C_2 as Ethane	**18**	12	
C_3 as Propane	**1,100,000**	12	
C_4 as n-Butane	ND	12	
C_5 as n-Pentane	ND	12	
C_6 as n-Hexane	ND	12	
C_6+ as n-Hexane	ND	25	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-R4-90-100% Can**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P1304810-004

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC8/FID
Analyst: Wade Henton
Sampling Media: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00039

Date Collected: 10/25/13
Date Received: 10/29/13
Date Analyzed: 11/12/13
Volume(s) Analyzed: 0.050 ml(s)

Initial Pressure (psig): 0.67 Final Pressure (psig): 3.97

Canister Dilution Factor: 1.21

Compound	Result ppmV	MRL ppmV	Data Qualifier
Methane	ND	12	
C_2 as Ethane	**20**	12	
C_3 as Propane	**1,100,000**	12	
C_4 as n-Butane	ND	12	
C_5 as n-Pentane	ND	12	
C_6 as n-Hexane	ND	12	
C_6+ as n-Hexane	ND	24	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**
ALS Project ID: P1304810

Benzene

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC8/FID
Analyst: Wade Henton
Sampling Media: 6.0 L Silonite Canister(s)
Test Notes:

Date(s) Collected: 10/23 - 10/25/13
Date Received: 10/29/13
Date Analyzed: 11/12/13

Client Sample ID	ALS Sample ID	Canister Dilution Factor	Injection Volume ml(s)	Result ppmV	MRL ppmV	Data Qualifier
JZ-R1-0-30-0%-Can	P1304810-001	1.26	1.0	ND	0.76	
JZ-R2-30-70-30%-Can	P1304810-002	1.24	1.0	ND	0.74	
JZ-R4-90-100% Can	P1304810-004	1.21	1.0	ND	0.73	
Method Blank	P131112-MB	1.00	1.0	ND	0.60	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Method Blank**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P131112-MB

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC8/FID
Analyst: Wade Henton
Sampling Media: 6.0 L Silonite Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 11/12/13
Volume(s) Analyzed: 1.0 ml(s)

Compound	Result ppmV	MRL ppmV	Data Qualifier
Methane	ND	0.50	
C_2 as Ethane	ND	0.50	
C_3 as Propane	ND	0.50	
C_4 as n-Butane	ND	0.50	
C_5 as n-Pentane	ND	0.50	
C_6 as n-Hexane	ND	0.50	
C_6+ as n-Hexane	ND	1.0	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

LABORATORY CONTROL SAMPLE SUMMARY

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Lab Control Sample**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P131112-LCS

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC8/FID
Analyst: Wade Henton
Sampling Media: 6.0 L Silonite Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 11/12/13
Volume(s) Analyzed: NA ml(s)

Compound	Spike Amount ppmV	Result ppmV	% Recovery	ALS Acceptance Limits	Data Qualifier
Methane	1,000	**1,060**	**106**	82-108	
Ethane	1,000	**1,070**	**107**	87-113	
Propane	1,000	**1,070**	**107**	85-113	
n-Butane	1,000	**1,020**	**102**	86-113	
n-Pentane	1,020	**1,070**	**105**	80-116	
n-Hexane	1,010	**1,030**	**102**	69-130	

ALS ENVIRONMENTAL

LABORATORY CONTROL SAMPLE SUMMARY

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Lab Control Sample**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P131112-LCS

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC8/FID
Analyst: Wade Henton
Sampling Media: 6.0 L Silonite Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 11/12/13
Volume(s) Analyzed: NA ml(s)

Compound	Spike Amount ppmV	Result ppmV	% Recovery	ALS Acceptance Limits	Data Qualifier
Benzene	549	489	89	50-150	

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-R1-0-30-0%-Can**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P1304810-001

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00126

Date Collected: 10/23/13
Date Received: 10/29/13
Date Analyzed: 11/1/13
Volume(s) Analyzed: 0.10 ml(s)

Initial Pressure (psig): Final Pressure (psig): 3.88

Canister Dilution Factor: 1.26

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
1333-74-0	Hydrogen	ND	0.13	
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**0.140**	0.13	
7727-37-9	**Nitrogen**	**0.547**	0.13	
630-08-0	Carbon Monoxide	ND	0.13	
124-38-9	Carbon Dioxide	ND	0.13	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-R2-30-70-30%-Can**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P1304810-002

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00074

Date Collected: 10/24/13
Date Received: 10/29/13
Date Analyzed: 11/1/13
Volume(s) Analyzed: 0.10 ml(s)

Initial Pressure (psig): 0.39 Final Pressure (psig): 4.05

Canister Dilution Factor: 1.24

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
1333-74-0	Hydrogen	ND	0.12	
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**0.131**	0.12	
7727-37-9	**Nitrogen**	**0.583**	0.12	
630-08-0	Carbon Monoxide	ND	0.12	
124-38-9	Carbon Dioxide	ND	0.12	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-R4-90-100% Can**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P1304810-004

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00039

Date Collected: 10/25/13
Date Received: 10/29/13
Date Analyzed: 11/5/13
Volume(s) Analyzed: 0.10 ml(s)

Initial Pressure (psig): 0.67 Final Pressure (psig): 3.97

Canister Dilution Factor: 1.21

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
1333-74-0	Hydrogen	ND	0.12	
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**0.253**	0.12	
7727-37-9	**Nitrogen**	**0.949**	0.12	
630-08-0	Carbon Monoxide	ND	0.12	
124-38-9	Carbon Dioxide	ND	0.12	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Method Blank**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P131101-MB

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 6.0 L Silonite Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 11/01/13
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
1333-74-0	Hydrogen	ND	0.10	
7782-44-7	Oxygen +			
7440-37-1	Argon	ND	0.10	
7727-37-9	Nitrogen	ND	0.10	
630-08-0	Carbon Monoxide	ND	0.10	
124-38-9	Carbon Dioxide	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Method Blank**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P131105-MB

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 6.0 L Silonite Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 11/05/13
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
1333-74-0	Hydrogen	ND	0.10	
7782-44-7	Oxygen +			
7440-37-1	Argon	ND	0.10	
7727-37-9	Nitrogen	ND	0.10	
630-08-0	Carbon Monoxide	ND	0.10	
124-38-9	Carbon Dioxide	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

LABORATORY CONTROL SAMPLE SUMMARY

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Lab Control Sample**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P131101-LCS

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 6.0 L Silonite Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 11/01/13
Volume(s) Analyzed: NA ml(s)

CAS #	Compound	Spike Amount ppmV	Result ppmV	% Recovery	ALS Acceptance Limits	Data Qualifier
1333-74-0	Hydrogen	40,000	**40,900**	**102**	84-110	
7782-44-7	Oxygen +					
7440-37-1	Argon	50,000	**54,600**	**109**	88-114	
7727-37-9	Nitrogen	50,000	**55,200**	**110**	88-114	
630-08-0	Carbon Monoxide	50,000	**53,700**	**107**	88-113	
124-38-9	Carbon Dioxide	50,000	**51,600**	**103**	84-109	

ALS ENVIRONMENTAL

LABORATORY CONTROL SAMPLE SUMMARY

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Lab Control Sample**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P131105-LCS

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 6.0 L Silonite Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 11/05/13
Volume(s) Analyzed: NA ml(s)

CAS #	Compound	Spike Amount ppmV	Result ppmV	% Recovery	ALS Acceptance Limits	Data Qualifier
1333-74-0	Hydrogen	40,000	**40,200**	**101**	84-110	
7782-44-7	Oxygen +					
7440-37-1	Argon	50,000	**53,000**	**106**	88-114	
7727-37-9	Nitrogen	50,000	**53,100**	**106**	88-114	
630-08-0	Carbon Monoxide	50,000	**52,400**	**105**	88-113	
124-38-9	Carbon Dioxide	50,000	**50,900**	**102**	84-109	

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-R1-0-30-0%-Can**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P1304810-001

Test Code: ASTM D 5504-08
Instrument ID: Agilent 7890A/GC22/SCD
Analyst: Mike Conejo
Sample Type: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00126

Date Collected: 10/23/13
Time Collected: NA
Date Received: 10/29/13
Date Analyzed: 11/1/13
Time Analyzed: 08:48
Volume(s) Analyzed: 1.0 ml(s)

Initial Pressure (psig): 0.00 Final Pressure (psig): 3.88

Canister Dilution Factor: 1.26

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
7783-06-4	Hydrogen Sulfide	ND	8.8	ND	6.3	
463-58-1	Carbonyl Sulfide	ND	15	ND	6.3	
74-93-1	Methyl Mercaptan	ND	12	ND	6.3	
75-08-1	Ethyl Mercaptan	ND	16	ND	6.3	
75-18-3	Dimethyl Sulfide	ND	16	ND	6.3	
75-15-0	Carbon Disulfide	**10**	9.8	**3.2**	3.2	
75-33-2	Isopropyl Mercaptan	ND	20	ND	6.3	
75-66-1	tert-Butyl Mercaptan	ND	23	ND	6.3	
107-03-9	n-Propyl Mercaptan	ND	20	ND	6.3	
624-89-5	Ethyl Methyl Sulfide	ND	20	ND	6.3	
110-02-1	Thiophene	ND	22	ND	6.3	
513-44-0	Isobutyl Mercaptan	ND	23	ND	6.3	
352-93-2	Diethyl Sulfide	ND	23	ND	6.3	
109-79-5	n-Butyl Mercaptan	ND	23	ND	6.3	
624-92-0	Dimethyl Disulfide	ND	12	ND	3.2	
616-44-4	3-Methylthiophene	ND	25	ND	6.3	
110-01-0	Tetrahydrothiophene	ND	23	ND	6.3	
638-02-8	2,5-Dimethylthiophene	ND	29	ND	6.3	
872-55-9	2-Ethylthiophene	ND	29	ND	6.3	
110-81-6	Diethyl Disulfide	**63**	16	**13**	3.2	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-R2-30-70-30%-Can**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P1304810-002

Test Code: ASTM D 5504-08
Instrument ID: Agilent 7890A/GC22/SCD
Analyst: Mike Conejo
Sample Type: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00074

Date Collected: 10/24/13
Time Collected: NA
Date Received: 10/29/13
Date Analyzed: 11/1/13
Time Analyzed: 09:06
Volume(s) Analyzed: 1.0 ml(s)

Initial Pressure (psig): 0.39 Final Pressure (psig): 4.05

Canister Dilution Factor: 1.24

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
7783-06-4	Hydrogen Sulfide	ND	8.6	ND	6.2	
463-58-1	Carbonyl Sulfide	ND	15	ND	6.2	
74-93-1	Methyl Mercaptan	ND	12	ND	6.2	
75-08-1	Ethyl Mercaptan	ND	16	ND	6.2	
75-18-3	Dimethyl Sulfide	ND	16	ND	6.2	
75-15-0	Carbon Disulfide	ND	9.6	ND	3.1	
75-33-2	Isopropyl Mercaptan	ND	19	ND	6.2	
75-66-1	tert-Butyl Mercaptan	ND	23	ND	6.2	
107-03-9	n-Propyl Mercaptan	ND	19	ND	6.2	
624-89-5	Ethyl Methyl Sulfide	ND	19	ND	6.2	
110-02-1	Thiophene	ND	21	ND	6.2	
513-44-0	Isobutyl Mercaptan	ND	23	ND	6.2	
352-93-2	Diethyl Sulfide	ND	23	ND	6.2	
109-79-5	n-Butyl Mercaptan	ND	23	ND	6.2	
624-92-0	Dimethyl Disulfide	ND	12	ND	3.1	
616-44-4	3-Methylthiophene	ND	25	ND	6.2	
110-01-0	Tetrahydrothiophene	ND	22	ND	6.2	
638-02-8	2,5-Dimethylthiophene	ND	28	ND	6.2	
872-55-9	2-Ethylthiophene	ND	28	ND	6.2	
110-81-6	Diethyl Disulfide	**16**	15	**3.3**	3.1	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-R4-90-100% Can**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P1304810-004

Test Code: ASTM D 5504-08
Instrument ID: Agilent 7890A/GC22/SCD
Analyst: Mike Conejo
Sample Type: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00039

Date Collected: 10/25/13
Time Collected: NA
Date Received: 10/29/13
Date Analyzed: 11/1/13
Time Analyzed: 09:46
Volume(s) Analyzed: 1.0 ml(s)

Initial Pressure (psig): 0.67 Final Pressure (psig): 3.97

Canister Dilution Factor: 1.21

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
7783-06-4	Hydrogen Sulfide	ND	8.4	ND	6.1	
463-58-1	Carbonyl Sulfide	ND	15	ND	6.1	
74-93-1	Methyl Mercaptan	ND	12	ND	6.1	
75-08-1	Ethyl Mercaptan	ND	15	ND	6.1	
75-18-3	Dimethyl Sulfide	ND	15	ND	6.1	
75-15-0	Carbon Disulfide	ND	9.4	ND	3.0	
75-33-2	Isopropyl Mercaptan	ND	19	ND	6.1	
75-66-1	tert-Butyl Mercaptan	ND	22	ND	6.1	
107-03-9	n-Propyl Mercaptan	ND	19	ND	6.1	
624-89-5	Ethyl Methyl Sulfide	ND	19	ND	6.1	
110-02-1	Thiophene	ND	21	ND	6.1	
513-44-0	Isobutyl Mercaptan	ND	22	ND	6.1	
352-93-2	Diethyl Sulfide	ND	22	ND	6.1	
109-79-5	n-Butyl Mercaptan	ND	22	ND	6.1	
624-92-0	Dimethyl Disulfide	ND	12	ND	3.0	
616-44-4	3-Methylthiophene	ND	24	ND	6.1	
110-01-0	Tetrahydrothiophene	ND	22	ND	6.1	
638-02-8	2,5-Dimethylthiophene	ND	28	ND	6.1	
872-55-9	2-Ethylthiophene	ND	28	ND	6.1	
110-81-6	Diethyl Disulfide	**22**	15	**4.4**	3.0	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Method Blank**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P131101-MB

Test Code: ASTM D 5504-08
Instrument ID: Agilent 7890A/GC22/SCD
Analyst: Mike Conejo
Sample Type: 6.0 L Silonite Canister
Test Notes:

Date Collected: NA
Time Collected: NA
Date Received: NA
Date Analyzed: 11/01/13
Time Analyzed: 08:33
Volume(s) Analyzed: 1.0 ml(s)

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
7783-06-4	Hydrogen Sulfide	ND	7.0	ND	5.0	
463-58-1	Carbonyl Sulfide	ND	12	ND	5.0	
74-93-1	Methyl Mercaptan	ND	9.8	ND	5.0	
75-08-1	Ethyl Mercaptan	ND	13	ND	5.0	
75-18-3	Dimethyl Sulfide	ND	13	ND	5.0	
75-15-0	Carbon Disulfide	ND	7.8	ND	2.5	
75-33-2	Isopropyl Mercaptan	ND	16	ND	5.0	
75-66-1	tert-Butyl Mercaptan	ND	18	ND	5.0	
107-03-9	n-Propyl Mercaptan	ND	16	ND	5.0	
624-89-5	Ethyl Methyl Sulfide	ND	16	ND	5.0	
110-02-1	Thiophene	ND	17	ND	5.0	
513-44-0	Isobutyl Mercaptan	ND	18	ND	5.0	
352-93-2	Diethyl Sulfide	ND	18	ND	5.0	
109-79-5	n-Butyl Mercaptan	ND	18	ND	5.0	
624-92-0	Dimethyl Disulfide	ND	9.6	ND	2.5	
616-44-4	3-Methylthiophene	ND	20	ND	5.0	
110-01-0	Tetrahydrothiophene	ND	18	ND	5.0	
638-02-8	2,5-Dimethylthiophene	ND	23	ND	5.0	
872-55-9	2-Ethylthiophene	ND	23	ND	5.0	
110-81-6	Diethyl Disulfide	ND	12	ND	2.5	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

LABORATORY CONTROL SAMPLE SUMMARY

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Lab Control Sample**
Client Project ID: **jz.13-Tulsa,ok-comp#1 / 1**

ALS Project ID: P1304810
ALS Sample ID: P131101-LCS

Test Code: ASTM D 5504-08
Instrument ID: Agilent 7890A/GC22/SCD
Analyst: Mike Conejo
Sample Type: 6.0 L Silonite Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 11/01/13
Volume(s) Analyzed: NA ml(s)

CAS #	Compound	Spike Amount ppbV	Result ppbV	% Recovery	ALS Acceptance Limits	Data Qualifier
7783-06-4	Hydrogen Sulfide	2,050	**2,190**	**107**	63-140	
463-58-1	Carbonyl Sulfide	2,020	**2,190**	**108**	63-138	
74-93-1	Methyl Mercaptan	1,890	**2,450**	**130**	63-144	

APPENDIX F

MODIFIED METHOD 3C RESULTS

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LABORATORY REPORT

November 4, 2013

Min Lee
Air Hygiene, Incorporated
1600 West Tacoma Street
Broken Arrow, OK 74012

RE: jz-13-tulsa.ok-comp#1

Dear Min:

Enclosed are the results of the samples submitted to our laboratory on October 25, 2013. For your reference, these analyses have been assigned our service request number P1304759.

All analyses were performed according to our laboratory's NELAP and DoD-ELAP-approved quality assurance program. The test results meet requirements of the current NELAP and DoD-ELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP and DoD-ELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. Results are intended to be considered in their entirety and apply only to the samples analyzed and reported herein.

If you have any questions, please call me at (805) 526-7161.

Respectfully submitted,

ALS | Environmental

Kelly M Horiuchi
By Kelly Horiuchi at 9:18 am, Nov 04, 2013

Kelly Horiuchi
Laboratory Director

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www.alsglobal.com

Client: Air Hygiene, Incorporated
Project: jz-13-tulsa.ok-comp#1

Service Request No: P1304759

CASE NARRATIVE

The samples were received intact under chain of custody on October 25, 2013 and were stored in accordance with the analytical method requirements. Please refer to the sample acceptance check form for additional information. The results reported herein are applicable only to the condition of the samples at the time of sample receipt.

Fixed Gases Analysis

The samples were analyzed for fixed gases (oxygen/argon, nitrogen, methane and carbon dioxide) according to EPA Method 3C (triplicate injection) using a gas chromatograph equipped with a thermal conductivity detector (TCD). This method is not included on the laboratory's NELAP or AIHA-LAP scope of accreditation.

The results of analyses are given in the attached laboratory report. All results are intended to be considered in their entirety, and ALS Environmental (ALS) is not responsible for utilization of less than the complete report.

Use of ALS Environmental (ALS)'s Name. Client shall not use ALS's name or trademark in any marketing or reporting materials, press releases or in any other manner ("Materials") whatsoever and shall not attribute to ALS any test result, tolerance or specification derived from ALS's data ("Attribution") without ALS's prior written consent, which may be withheld by ALS for any reason in its sole discretion. To request ALS's consent, Client shall provide copies of the proposed Materials or Attribution and describe in writing Client's proposed use of such Materials or Attribution. If ALS has not provided written approval of the Materials or Attribution within ten (10) days of receipt from Client, Client's request to use ALS's name or trademark in any Materials or Attribution shall be deemed denied. ALS may, in its discretion, reasonably charge Client for its time in reviewing Materials or Attribution requests. Client acknowledges and agrees that the unauthorized use of ALS's name or trademark may cause ALS to incur irreparable harm for which the recovery of money damages will be inadequate. Accordingly, Client acknowledges and agrees that a violation shall justify preliminary injunctive relief. For questions contact the laboratory.

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www.alsglobal.com

ALS Environmental – Simi Valley

Certifications, Accreditations, and Registrations

Agency	Web Site	Number
AIHA	http://www.aihaaccreditedlabs.org	101661
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0694
DoD ELAP	http://www.pjlabs.com/search-accredited-labs	L11-203
Florida DOH (NELAP)	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E871020
Maine DHHS	http://www.maine.gov/dhhs/mecdc/environmental-health/water/dwp-services/labcert/labcert.htm	2012039
Minnesota DOH (NELAP)	http://www.health.state.mn.us/accreditation	581572
New Jersey DEP (NELAP)	http://www.nj.gov/dep/oqa/	CA009
New York DOH (NELAP)	http://www.wadsworth.org/labcert/elap/elap.html	11221
Oregon PHD (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	CA200007
Pennsylvania DEP	http://www.depweb.state.pa.us/labs	68-03307 (Registration)
Texas CEQ (NELAP)	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704413-13-4
Utah DOH (NELAP)	http://www.health.utah.gov/lab/labimp/certification/index.html	CA016272013-3
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C946

Analyses were performed according to our laboratory's NELAP and DoD-ELAP approved quality assurance program. A complete listing of specific NELAP and DoD-ELAP certified analytes can be found in the certifications section at www.alsglobal.com, or at the accreditation body's website.

Each of the certifications listed above have an explicit Scope of Accreditation that applies to specific matrices/methods/analytes; therefore, please contact the laboratory for information corresponding to a particular certification.

ALS ENVIRONMENTAL

DETAIL SUMMARY REPORT

Client: Air Hygiene, Incorporated
Project ID: jz-13-tulsa.ok-comp#1

Service Request: P1304759

Date Received: 10/25/2013
Time Received: 10:10

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	3C Modified - Fxd Gases Bag 2X
R1-0-30-0%-2.5OD-A	P1304759-001	Air	10/23/2013	00:00	X
R2-0-30-0%-2.5OD-A	P1304759-003	Air	10/23/2013	00:00	X
R3-0-30-0%-2.5OD-A	P1304759-005	Air	10/24/2013	00:00	X
R4-30-70-30%-2.5OD-A	P1304759-007	Air	10/24/2013	00:00	X
R5-30-70-30%-2.5OD-A	P1304759-009	Air	10/24/2013	00:00	X
R6-30-70-30%-2.5OD-A	P1304759-011	Air	10/24/2013	00:00	X

P13D4759

SAMPLE DESCRIPTION AND CHAIN OF CUSTODY RECORD

Air Hygiene International, Inc.
1600 W Tacoma Street
Broken Arrow, Oklahoma 74012
(888) 461-8778
www.airhygiene.com

Project Number:	jz-13-tulsa.ok-comp#1	Laboratory Analysis Requested:	RM 3C
Person Taking Samples:	MSL		

	Sample Number	Location	Date	Volume	Analysis Method			
					O2	CO2	Nitrogen	Methane-Ethane
1	R1-0-30-0%-2.5OD-A	John Zink Tulsa R&D Facility	23-Oct	10	x	x	x	x
2	R1-0-30-0%-2.5OD-B	John Zink Tulsa R&D Facility	23-Oct	1	x	x	x	x
3	R2-0-30-0%-2.5OD-A	John Zink Tulsa R&D Facility	23-Oct	10	x	x	x	x
4	R2-0-30-0%-2.5OD-B	John Zink Tulsa R&D Facility	23-Oct	1	x	x	x	x
5	R3-0-30-0%-2.5OD-A	John Zink Tulsa R&D Facility	24-Oct	10	x	x	x	x
6	R3-0-30-0%-2.5OD-B	John Zink Tulsa R&D Facility	24-Oct	1	x	x	x	x
7	R4-30-70-30%-2.5OD-A	John Zink Tulsa R&D Facility	24-Oct	10	x	x	x	x
8	R4-30-70-30%-2.5OD-B	John Zink Tulsa R&D Facility	24-Oct	1	x	x	x	x
9	R5-30-70-30%-2.5OD-A	John Zink Tulsa R&D Facility	24-Oct	10	x	x	x	x
10	R5-30-70-30%-2.5OD-B	John Zink Tulsa R&D Facility	24-Oct	1	x	x	x	x
11	R6-30-70-30%-2.5OD-A	John Zink Tulsa R&D Facility	24-Oct	10	x	x	x	x
12	R6-30-70-30%-2.5OD-B	John Zink Tulsa R&D Facility	24-Oct	1	x	x	x	x

Relinquished by: (Signature)	10/24/13 Date:	3:00 pm Time:	Received by: (Signature)	10/25/13 Date:	1010 Time:
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

3 ~~tulsa.ok-comp#1-coc~~

ALS Environmental
Sample Acceptance Check Form

Client: Air Hygiene, Incorporated Work order: P1304759

Project: jz-13-tulsa.ok-comp#1

Sample(s) received on: 10/25/13 Date opened: 10/25/13 by: MZAMORA

Note: This form is used for all samples received by ALS. The use of this form for custody seals is strictly meant to indicate presence/absence and not as an indication of compliance or nonconformity. Thermal preservation and pH will only be evaluated either at the request of the client and/or as required by the method/SOP.

		Yes	No	N/A
1	Were **sample containers** properly marked with client sample ID?	☒	☐	☐
2	Container(s) **supplied by ALS**?	☐	☒	☐
3	Did **sample containers** arrive in good condition?	☒	☐	☐
4	Were **chain-of-custody** papers used and filled out?	☒	☐	☐
5	Did **sample container labels** and/or tags agree with custody papers?	☒	☐	☐
6	Was **sample volume** received adequate for analysis?	☒	☐	☐
7	Are samples within specified holding times?	☒	☐	☐
8	Was proper **temperature** (thermal preservation) of cooler at receipt adhered to?	☐	☐	☒
9	Was a **trip blank** received?	☐	☒	☐
10	Were **custody seals** on outside of cooler/Box?	☐	☒	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
	Were custody seals on outside of sample container?	☐	☒	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
11	Do containers have appropriate **preservation**, according to method/SOP or Client specified information?	☐	☐	☒
	Is there a client indication that the submitted samples are **pH** preserved?	☐	☐	☒
	Were **VOA vials** checked for presence/absence of air bubbles?	☐	☐	☒
	Does the client/method/SOP require that the analyst check the sample pH and if necessary alter it?	☐	☐	☒
12	**Tubes:** Are the tubes capped and intact?	☐	☐	☒
	Do they contain moisture?	☐	☐	☒
13	**Badges:** Are the badges properly capped and intact?	☐	☐	☒
	Are dual bed badges separated and individually capped and intact?	☐	☐	☒

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1304759-001.01	10 L Tedlar Bag					
P1304759-002.01	1.0 L Tedlar Bag					
P1304759-003.01	10 L Tedlar Bag					
P1304759-004.01	1.0 L Tedlar Bag					
P1304759-005.01	10 L Tedlar Bag					
P1304759-006.01	1.0 L Tedlar Bag					
P1304759-007.01	10 L Tedlar Bag					
P1304759-008.01	1.0 L Tedlar Bag					

Explain any discrepancies: (include lab sample ID numbers):

Chain of Custody is missing time collected

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

ALS Environmental
Sample Acceptance Check Form

Client: Air Hygiene, Incorporated Work order: P1304759

Project: jz-13-tulsa.ok-comp#1

Sample(s) received on: 10/25/13 Date opened: 10/25/13 by: MZAMORA

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1304759-009.01	10 L Tedlar Bag					
P1304759-010.01	1.0 L Tedlar Bag					
P1304759-011.01	10 L Tedlar Bag					
P1304759-012.01	1.0 L Tedlar Bag					

Explain any discrepancies: (include lab sample ID numbers):

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **R5-30-70-30%-2.5OD-A**
Client Project ID: **jz-13-tulsa.ok-comp#1**

ALS Project ID: P1304759
ALS Sample ID: P1304759-009

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 10 L Tedlar Bag
Test Notes:

Date Collected: 10/24/13
Date Received: 10/25/13
Date Analyzed: 10/26/13
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**13.6**	0.10	
7727-37-9	**Nitrogen**	**80.4**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**5.95**	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **R6-30-70-30%-2.5OD-A**
Client Project ID: **jz-13-tulsa.ok-comp#1**

ALS Project ID: P1304759
ALS Sample ID: P1304759-011

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 10 L Tedlar Bag
Test Notes:

Date Collected: 10/24/13
Date Received: 10/25/13
Date Analyzed: 10/26/13
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**13.4**	0.10	
7727-37-9	**Nitrogen**	**80.5**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**6.12**	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Method Blank**
Client Project ID: **jz-13-tulsa.ok-comp#1**

ALS Project ID: P1304759
ALS Sample ID: P131025-MB

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 10 L Tedlar Bag
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 10/25/13
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	Oxygen +			
7440-37-1	Argon	ND	0.10	
7727-37-9	Nitrogen	ND	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	Carbon Dioxide	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Method Blank**
Client Project ID: **jz-13-tulsa.ok-comp#1**

ALS Project ID: P1304759
ALS Sample ID: P131026-MB

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 10 L Tedlar Bag
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 10/26/13
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	Oxygen +			
7440-37-1	Argon	ND	0.10	
7727-37-9	Nitrogen	ND	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	Carbon Dioxide	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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Simi Valley, CA 93065
T: +1 805 526 7161
F: +1 805 526 7270
www.alsglobal.com

ALS Environmental - Simi Valley

Certifications, Accreditations, and Registrations

Agency	Web Site	Number
AIHA	http://www.aihaaccreditedlabs.org	101661
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0694
DoD ELAP	http://www.pjlabs.com/search-accredited-labs	L11-203
Florida DOH (NELAP)	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E871020
Maine DHHS	http://www.maine.gov/dhhs/mecdc/environmental-health/water/dwp-services/labcert/labcert.htm	2012039
Minnesota DOH (NELAP)	http://www.health.state.mn.us/accreditation	581572
New Jersey DEP (NELAP)	http://www.nj.gov/dep/oqa/	CA009
New York DOH (NELAP)	http://www.wadsworth.org/labcert/elap/elap.html	11221
Oregon PHD (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	CA200007
Pennsylvania DEP	http://www.depweb.state.pa.us/labs	68-03307 (Registration)
Texas CEQ (NELAP)	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704413-13-4
Utah DOH (NELAP)	http://www.health.utah.gov/lab/labimp/certification/index.html	CA016272013-3
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C946

Analyses were performed according to our laboratory's NELAP and DoD-ELAP approved quality assurance program. A complete listing of specific NELAP and DoD-ELAP certified analytes can be found in the certifications section at www.alsglobal.com, or at the accreditation body's website.

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ALS ENVIRONMENTAL

DETAIL SUMMARY REPORT

Client: Air Hygiene, Incorporated
Project ID: jz-13-tulsa.ok-comp#1

Service Request: P1304779

Date Received: 10/26/2013
Time Received: 09:47

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	3C Modified - Fxd Gases Bag 2X
R7-70-100-70%-2.5OD-A	P1304779-001	Air	10/24/2013	00:00	X
R8-70-100-70%-2.5OD-A	P1304779-003	Air	10/24/2013	00:00	X
R9-70-100-70%-2.5OD-A	P1304779-005	Air	10/25/2013	00:00	X
R10-90-100%-2.5OD-A	P1304779-007	Air	10/25/2013	00:00	X
R11-90-100%-2.5OD-A	P1304779-009	Air	10/25/2013	00:00	X
R12-90-100%-2.5OD-A	P1304779-011	Air	10/25/2013	00:00	X

P1304779

SAMPLE DESCRIPTION AND CHAIN OF CUSTODY RECORD

Air Hygiene International, Inc.
1600 W Tacoma Street
Broken Arrow, Oklahoma 74012
(888) 461-8778
www.airhygiene.com

Project Number:	jz-13-tulsa.ok-comp#1	Laboratory Analysis Requested:	RM 3C
Person Taking Samples:	MSL		

Sample Number	Location	Date	Volume	Analysis Method			
				O2	CO2	Nitrogen	Methane-Ethane
R7-70-100-70%-2.5OD-A	John Zink Tulsa R&D Facility	24-Oct	10	x	x	x	x
R7-70-100-70%-2.5OD-B	John Zink Tulsa R&D Facility	24-Oct	1	x	x	x	x
R8-70-100-70%-2.5OD-A	John Zink Tulsa R&D Facility	24-Oct	10	x	x	x	x
R8-70-100-70%-2.5OD-B	John Zink Tulsa R&D Facility	24-Oct	1	x	x	x	x
R9-70-100-70%-2.5OD-A	John Zink Tulsa R&D Facility	25-Oct	10	x	x	x	x
R9-70-100-70%-2.5OD-B	John Zink Tulsa R&D Facility	25-Oct	1	x	x	x	x
R10-90-100%-2.5OD-A	John Zink Tulsa R&D Facility	25-Oct	10	x	x	x	x
R10-90-100%-2.5OD-B	John Zink Tulsa R&D Facility	25-Oct	1	x	x	x	x
R11-90-100%-2.5OD-A	John Zink Tulsa R&D Facility	25-Oct	10	x	x	x	x
R11-90-100%-2.5OD-B	John Zink Tulsa R&D Facility	25-Oct	1	x	x	x	x
R12-90-100%-2.5OD-A	John Zink Tulsa R&D Facility	25-Oct	10	x	x	x	x
R12-90-100%-2.5OD-B	John Zink Tulsa R&D Facility	25-Oct	1	x	x	x	x

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
[signature]	10/25/13	2:00 pm	Kate Aguilera	10/26/13	09:35

ALS Environmental
Sample Acceptance Check Form

Client: Air Hygiene, Incorporated Work order: P1304779

Project: jz-13-tulsa.ok-comp#1

Sample(s) received on: 10/26/13 Date opened: 10/26/13 by: KAGUILERA

Note: This form is used for all samples received by ALS. The use of this form for custody seals is strictly meant to indicate presence/absence and not as an indication of compliance or nonconformity. Thermal preservation and pH will only be evaluated either at the request of the client and/or as required by the method/SOP.

		Yes	No	N/A
1	Were **sample containers** properly marked with client sample ID?	☐	☒	☐
2	Container(s) **supplied by ALS**?	☐	☒	☐
3	Did **sample containers** arrive in good condition?	☒	☐	☐
4	Were **chain-of-custody** papers used and filled out?	☒	☐	☐
5	Did **sample container labels** and/or tags agree with custody papers?	☐	☒	☐
6	Was **sample volume** received adequate for analysis?	☒	☐	☐
7	Are samples within specified holding times?	☒	☐	☐
8	Was proper **temperature** (thermal preservation) of cooler at receipt adhered to?	☐	☐	☒
9	Was a **trip blank** received?	☐	☒	☐
10	Were **custody seals** on outside of cooler/Box?	☐	☒	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
	Were custody seals on outside of sample container?	☐	☒	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
11	Do containers have appropriate **preservation**, according to method/SOP or Client specified information?	☐	☐	☒
	Is there a client indication that the submitted samples are **pH** preserved?	☐	☐	☒
	Were **VOA vials** checked for presence/absence of air bubbles?	☐	☐	☒
	Does the client/method/SOP require that the analyst check the sample pH and if necessary alter it?	☐	☐	☒
12	**Tubes:** Are the tubes capped and intact?	☐	☐	☒
	Do they contain moisture?	☐	☐	☒
13	**Badges:** Are the badges properly capped and intact?	☐	☐	☒
	Are dual bed badges separated and individually capped and intact?	☐	☐	☒

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1304779-001.01	10 L Tedlar Bag					
P1304779-002.01	1.0 L Tedlar Bag					
P1304779-003.01	10 L Tedlar Bag					
P1304779-004.01	1.0 L Tedlar Bag					
P1304779-005.01	10 L Tedlar Bag					
P1304779-006.01	1.0 L Tedlar Bag					
P1304779-007.01	10 L Tedlar Bag					
P1304779-008.01	1.0 L Tedlar Bag					

Explain any discrepancies: (include lab sample ID numbers):

Chain of Custody is missing time collected

he are two samples with ID-008, and no samples with ID-012

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

ALS Environmental
Sample Acceptance Check Form

Client: Air Hygiene, Incorporated Work order: P1304779

Project: jz-13-tulsa.ok-comp#1

Sample(s) received on: 10/26/13 Date opened: 10/26/13 by: KAGUILERA

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1304779-009.01	10 L Tedlar Bag					
P1304779-010.01	1.0 L Tedlar Bag					
P1304779-011.01	10 L Tedlar Bag					
P1304779-012.01	1.0 L Tedlar Bag					

Explain any discrepancies: (include lab sample ID numbers):

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **R7-70-100-70%-2.5OD-A**
Client Project ID: **jz-13-tulsa.ok-comp#1**

ALS Project ID: P1304779
ALS Sample ID: P1304779-001

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 10 L Tedlar Bag
Test Notes:

Date Collected: 10/24/13
Date Received: 10/26/13
Date Analyzed: 10/26/13
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**13.6**	0.10	
7727-37-9	**Nitrogen**	**80.4**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**5.96**	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **R8-70-100-70%-2.5OD-A**
Client Project ID: **jz-13-tulsa.ok-comp#1**

ALS Project ID: P1304779
ALS Sample ID: P1304779-003

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 10 L Tedlar Bag
Test Notes:

Date Collected: 10/24/13
Date Received: 10/26/13
Date Analyzed: 10/26/13
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**13.1**	0.10	
7727-37-9	**Nitrogen**	**80.5**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**6.35**	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **R9-70-100-70%-2.5OD-A**
Client Project ID: **jz-13-tulsa.ok-comp#1**

ALS Project ID: P1304779
ALS Sample ID: P1304779-005

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 10 L Tedlar Bag
Test Notes:

Date Collected: 10/25/13
Date Received: 10/26/13
Date Analyzed: 10/26/13
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**13.6**	0.10	
7727-37-9	**Nitrogen**	**80.4**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**5.98**	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **R10-90-100%-2.5OD-A**
Client Project ID: **jz-13-tulsa.ok-comp#1**

ALS Project ID: P1304779
ALS Sample ID: P1304779-007

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 10 L Tedlar Bag
Test Notes:

Date Collected: 10/25/13
Date Received: 10/26/13
Date Analyzed: 10/26/13
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**13.5**	0.10	
7727-37-9	**Nitrogen**	**80.4**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**6.05**	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **R11-90-100%-2.5OD-A**
Client Project ID: **jz-13-tulsa.ok-comp#1**

ALS Project ID: P1304779
ALS Sample ID: P1304779-009

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 10 L Tedlar Bag
Test Notes:

Date Collected: 10/25/13
Date Received: 10/26/13
Date Analyzed: 10/28/13
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**13.6**	0.10	
7727-37-9	**Nitrogen**	**80.4**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**5.98**	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **R12-90-100%-2.5OD-A**
Client Project ID: **jz-13-tulsa.ok-comp#1**

ALS Project ID: P1304779
ALS Sample ID: P1304779-011

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 10 L Tedlar Bag
Test Notes:

Date Collected: 10/25/13
Date Received: 10/26/13
Date Analyzed: 10/28/13
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**13.5**	0.10	
7727-37-9	**Nitrogen**	**80.5**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**6.03**	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Method Blank**
Client Project ID: **jz-13-tulsa.ok-comp#1**

ALS Project ID: P1304779
ALS Sample ID: P131026-MB

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 10 L Tedlar Bag
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 10/26/13
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	Oxygen +			
7440-37-1	Argon	ND	0.10	
7727-37-9	Nitrogen	ND	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	Carbon Dioxide	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Method Blank**
Client Project ID: **jz-13-tulsa.ok-comp#1**

ALS Project ID: P1304779
ALS Sample ID: P131028-MB

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Jennifer Young
Sample Type: 10 L Tedlar Bag
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 10/28/13
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	Oxygen +			
7440-37-1	Argon	ND	0.10	
7727-37-9	Nitrogen	ND	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	Carbon Dioxide	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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end of report

APPENDIX C

MUNICIPLE AND COUNTY NOTIFICATION LETTERS

CERTIFIED MAIL # 7000 1670 0005 1026 4274

RECEIVED
MAY 22 2014
DEP SOUTHCENTRAL REGION
AIR QUALITY PROGRAM

West Cornwall Township Supervisors
73 South Zinns Mill Rd
Lebanon, PA 17042

Re: Municipal Notification
State Only Operating Permit
Sunoco Pipeline, L.P. Cornwall Station
West Cornwall Township, Lebanon County

Dear West Cornwall Township Supervisors:

Pursuant to 25 Pa Code (for operating permit) (127.413), Sunoco Pipeline L.P. is hereby providing notice that we have submitted an application to the Pennsylvania Department of Environmental Protection (PADEP) for a State Only Operating Permit for a natural gas liquid pumping station known as Cornwall Station located in West Cornwall Township, Lebanon County. The pumping station is part of a natural gas liquid pipeline project known as Mariner East that will deliver butane, propane, and ethane from the liquid-rich Marcellus Shale areas in western Pennsylvania to Marcus Hook, Pennsylvania, where it will be processed, stored, and distributed, to various domestic and waterborne markets. Pumping stations along the pipeline will use electric driven split case multistage centrifugal pumps to transport product through the pipeline. All pumping devices used to transport material will utilize electricity supplied by a public utility. A John Zink Company LLC 4' by 30' ZTOF production flare will be constructed at Cornwall Station as an air pollution control device. The flare is enclosed (i.e., no visible flame) and will be used to control fugitive emissions from potential pump seal leaks as well as emissions that will occur annually and biannually every fifth year associated with pipeline cleaning/maintenance activities known as pigging operations.

A 30-day comment period begins with the receipt of this letter. If you have any questions concerning this notice or the application you can contact me at 610-670-3284 or you can contact the PADEP, South-central Regional Office, Bureau of Air Quality Control at 909 Elmerton Avenue, Harrisburg, PA (717-705-4700).

Sincerely,

Matthew L. Gordon
Sunoco Pipeline, L.P.

RECEIVED
MAY 22 2014
DEP SOUTHCENTRAL REGION
AIR QUALITY PROGRAM

CERTIFIED MAIL # 7012 2920 0002 1351 8807

Lebanon County Commissioners
Room 207, Municipal Building
400 South 8th Street
Lebanon, PA 17042

Re: County Notification
State Only Operating Permit
Sunoco Pipeline, L.P. Cornwall Station
West Cornwall Township, Lebanon County

Dear Lebanon County Commissioners:

Pursuant to 25 Pa Code (for operating permit) (127.413), Sunoco Pipeline L.P. is hereby providing notice that we have submitted an application to the Pennsylvania Department of Environmental Protection (PADEP) for a State Only Operating Permit for a natural gas liquid pumping station known as Cornwall Station located in West Cornwall Township, Lebanon County. The pumping station is part of a natural gas liquid pipeline project known as Mariner East that will deliver butane, propane, and ethane from the liquid-rich Marcellus Shale areas in western Pennsylvania to Marcus Hook, Pennsylvania, where it will be processed, stored, and distributed, to various domestic and waterborne markets. Pumping stations along the pipeline will use electric driven split case multistage centrifugal pumps to transport product through the pipeline. All pumping devices used to transport material will utilize electricity supplied by a public utility. A John Zink Company LLC 4' by 30' ZTOF production flare will be constructed at Cornwall Station as an air pollution control device. The flare is enclosed (i.e., no visible flame) and will be used to control fugitive emissions from potential pump seal leaks as well as emissions that will occur annually and biannually every fifth year associated with pipeline cleaning/maintenance activities known as pigging operations.

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Sincerely,

Matthew L. Gordon
Sunoco Pipeline, L.P.

Cornwall Pump Station

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to: Commissioners
Lebanon County ~~Commissioners~~
Room 207, Municipal Building
400 South 8th Street
Lebanon, PA 17042

COMPLETE THIS SECTION ON DELIVERY

A. Received by (Please Print Clearly) B. Date of Delivery
Diana L. Reinhold 5-27-14

C. Signature
X Diana L Reinhold ☐ Agent ☐ Addressee

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7012 2920 0002 1351 8807

PS Form 3811, March 2001 Domestic Return Receipt 102595-01-M-1424

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:
West Cornwall Township
Supervisors
73 S Zinns Mill Rd
Lebanon, PA 17042

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X ☑ Agent ☐ Addressee

B. Received by (Printed Name) C. Date of Delivery
Debra Doll 5-29-14

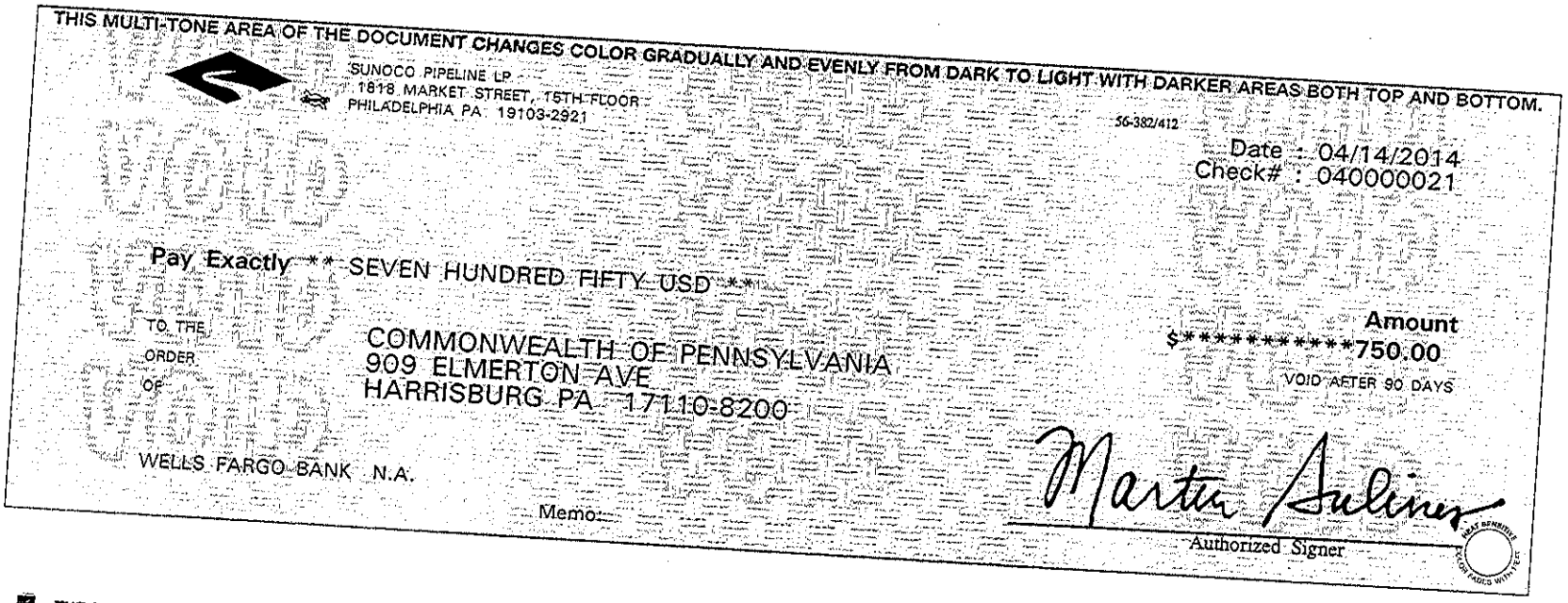
D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7000 1670 0005 1026 4274

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540



THIS MULTI-TONE AREA OF THE DOCUMENT CHANGES COLOR GRADUALLY AND EVENLY FROM DARK TO LIGHT WITH DARKER AREAS BOTH TOP AND BOTTOM.

SUNOCO PIPELINE LP
1818 MARKET STREET, 15TH FLOOR
PHILADELPHIA PA 19103-2921

56-382/412

Date : 04/14/2014
Check# : 040000021

Pay Exactly ** SEVEN HUNDRED FIFTY USD **

TO THE ORDER OF

COMMONWEALTH OF PENNSYLVANIA
909 ELMERTON AVE
HARRISBURG PA 17110-8200

Amount
$**********750.00

VOID AFTER 90 DAYS

WELLS FARGO BANK N.A.

Memo

Authorized Signer

THE ORIGINAL DOCUM

IDORSEMENT.