TETRA TECH

STATE-ONLY OPERATING PERMIT APPLICATION

FOR

BEC□ERSVILLE STATION

Performed for:

SUNOCO PIPELINE, L.P.

Prepared by:

Tetra Tech, Inc.
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Pittsburgh, Pennsylvania 15220

anuary 9, 2015

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STATE-ONLY OPERATING PERMIT APPLICATION FOR BECKERSVILLE STATION

Submitted to:
Pennsylvania Department of Environmental Protection
Southcentral Regional Office
Harrisburg, Pennsylvania 17110

Submitted by:
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Foster Plaza 7
661 Andersen Drive
Pittsburgh, Pennsylvania 15220

On Behalf of:
Sunoco Pipeline, L.P.

JANUARY 2015

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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: _____

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: Beckersville Station

NAICS Code: 486990 SIC Code: 4619

Description of NAICS Code: All Other Pipeline Transportation

Description of SIC Code: Pipelines, Not Elsewhere Classified

County: Berks Municipality Brecknock Township

Latitude: 40.216963 Longitude: -75.939329

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: _____

Name (Typed): Matt Gordon Title: Project Manager

Please read instructions carefully before completing this application.

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+01
CO2	0.00E+00	6.69E+01
N2O	0.00E+00	6.16E-04
CH4	0.00E+00	3.08E-03
CO	0.00E+00	1.72E-01
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

Please read instructions carefully before completing this application.

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

Please read instructions carefully before completing this application.

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

Please read instructions carefully before completing this application.

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?

Please read instructions carefully before completing this application.

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

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): 297 feet

h. Weather Cap?: ☒ Yes ☐ No

i. Used by Sources:

j. Latitude: 40.216963 Longitude: -75.939329
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:

_____

Please read instructions carefully before completing this application.

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): _____

Please read instructions carefully before completing this application.

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

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: 03/03/14

Type of Submittal

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

SECTION A. GENERAL APPLICATION INFORMATION

Name of Applicant/Permittee/("applicant")
(non-corporations-attach documentation of legal name)
Sunoco Pipeline LP

Address 1818 Market Street, Suite 1500
Philadelphia, PA 19103-3615

Telephone 215-246-8267 **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
☐ Municipality
☐ Proprietorship
☐ Public Corporation
☐ Private Corporation
☐ Syndicate
☐ Municipal Authority
☐ Fictitious Name
☐ Partnership
☒ Limited Partnership
☐ Government Agency
☐ Joint Venture
☐ Association
☐ Other Type of Business, specify below:

Describe below the type(s) of business activities performed.
SIC Code: 4613 - Refined Petroleum Pipeline

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
12/20/12	Icedale	15-00046	Late submittal SMOP Air Permit renewal	NOV	Renewal submitted/Permit renewwed	$5000
						$
						$
						$
						$
						$
						$
						$
						$
						$

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
none				

<u>CONTINUING OBLIGATION</u>. 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.

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	09/02/14 Date
David R. Chalson Name (Print or Type)	
Vice President, Sunoco Logistics Partners Operations GP LLC Title	

Attachment #1: PA Sunoco Pipeline L.P. Related Parties with Air Emission Point Sources

Facility Name	Owner/Operator	Federal Tax ID #	SIC Code	Facility Address	City	Zip Code	State	County	Facility Manager/ Contact	Office Number
Icedale	Sunoco Pipeline L.P.	23-3102656	4613	Route 322; RD#3	Honey Brook	19344-8500	PA	Chester	John Foltz	610-670-3305
Montello Pump Station	Sunoco Pipeline L.P.	23-3102656	4613	501 Fritztown Road	Sinking Spring	19608	PA	Berks	John Foltz	610-670-3305

Attachment #2: Plan Approvals & Operating Permits

Facility	Owner / Operator	State	Permit Type	Permit #	Effective	Expiration
Icedale	Sunoco Pipeline L.P.	PA	Synthetic Minor	15-00046	9/20/2012	9/20/2017
Montello SPL	Sunoco Pipeline L.P.	PA	Title V Permit	06-05050	11/1/2010	10/31/2015

SECTION 4

GENERAL INFORMATION FORM

1300-PM-BIT0001 5/2012
Form

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

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 Sunoco Pipeline L.P.		**Employer ID#** (EIN) 23-3102656	**Dun & Bradstreet ID#**	
Individual Last Name Gordon	**First Name** Matthew	**MI** L	**Suffix**	**SSN**
Additional Individual Last Name	**First Name**	**MI**	**Suffix**	**SSN**
Mailing Address Line 1 525 Fritztown Road		**Mailing Address Line 2**		
Address Last Line – City Sinking Spring	**State** PA	**ZIP+4** 19608	**Country**	
Client Contact Last Name Gordon	**First Name** Matt		**MI** L	**Suffix**
Client Contact Title Project Manager			**Phone** (610) 670-3284	**Ext**
Email Address mlgordon@sunocologistics.com			**FAX**	

SITE INFORMATION

DEP Site ID#	**Site Name** Beckersville 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 Berks	**Municipality** Brecknock	**City** ☐	**Boro** ☐	**Twp** ☒	**State** PA
County Name	**Municipality**	**City** ☐	**Boro** ☐	**Twp** ☐	**State**
Site Location Line 1		**Site Location Line 2**			
Site Location Last Line – City Mohnton		**State** PA	**ZIP+4** 19540		

Detailed Written Directions to Site

909 Elmerton Avenue, Harrisburg, PA to Blainsport station. 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 right to continue on US-322 E, follow signs for I-83 S/Hershey York. Continue onto I-83 S. Keep left to continue on I-283 S, follow signs for Interstate 283 S/Interstate 76/Pennsylvania Turnpike/Airport. Take exit 266-359 on the left to merge onto I-76 E toward Philadelphia. Take exit 266 toward PA-72 N. Turn left onto PA-72 N. Take the Pennsylvania 72 N exit toward Lebanon. Merge onto Quentin Rd. Turn right onto E Main St. Continue onto Freeman Dr. Slight left to stay on Freeman Dr. Turn right onto Cornwall Rd. Turn left onto PA-419 N/Schaeffer Rd, Continue to follow PA-419 N. Continue onto PA-897 S/Heidelberg Ave , Continue to

follow PA-897 S. Sharp left onto State Rte 1057. Arrive at destination on State Rte 1057.

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	13	**1.07**	-75	56	**21.58**

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 733 --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 (Beckersville Station)

Project Description
Natural Gas Liquid Pumping Station

Project Consultant Last Name	**First Name**	**MI**	**Suffix**
Kraus	Matt	D	

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	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)**
Tenative - 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** 3.14	☒	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** PRINCIPAL ENGINEER	**Date** 5/14/14

APPENDI□ A

PADEP DETERMINATION 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:	New Station #10	**RFD Facility ID:**	1876
RFD Application ID:	3689	**Date Received:**	04/03/2014
Reviewed BY:	Thomas J Hanlon	**Approved Date:**	04/03/2014
Approved By:	Thomas J Hanlon		

- [x] **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.**
- [x] **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 Beckersville 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

APPENDI□ B

BEC□ERSVILLE 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 Brecknock Township, Beckersville, Pennsylvania (referred to hereafter as New Station #10) 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 New Station #10 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 flare.

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. All 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

Company/Facility Name: New Station #10 **Plant Name:**

Site Address: 536 Alleghenyville Road Mohton PA 19540

Mailing Address: 535 Fritztown Road Sinking Spring PA 19608

Federal Employer Identification Number (EIN): 23-3096839

Current Operating Permit No: **NAICS Code:** 493190

Name of Person Completing Form: Matthew Kraus **Title:** Tetra Tech

Address	**Telephone:** (412) 921-8729
Foster Plaza 7 661 Andersen Drive	**Fax:**
Pittsburgh PA 15220	**EMail:** matthew.kraus@tetratech.com

Name of Company/Facility Contact Person: Matt Gordon **Title:** Sunoco

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: 40.219101; Longitude: 75.941498

Source Type: ☑ Stationary ☐ Portable

Is equipment existing or proposed? ☐ Existing ☑ Proposed

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

Municipality: Brecknock **County:** Berks

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. 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.

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)

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

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

☐ Yes ☑ No

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

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?
Aggregation Analysis for New Station #10.	N
Project Description for New Station #10.	N
Emission Calculations.	N
Applicability Determination for New Station #10.	N
Flare Design Specifications, Inspection, and Maintenance Forms	Y
Stack Emissions Study - Will be emailed via Tetra Tech file transfer site.	N

G. Signature of Responsible Official or Authorized Representative

I, Matthew Gordon , 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.

Name	Date	Telephone
Matthew Gordon	03/12/2014	610-670-3284

Address	Email Address
535 Fritztown Road Sinking Spring PA 19608	MLGORDON@sunocologistics.com

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: THOMAS HANLON **Date:** 02/12/2014

Subject: The Application is rejected by reviewer.

Message:
Application will be revised as discussed.

From: Matthew Kraus **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.

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.

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	12-26-14
SUBJECT:	Annual Potential Emissions Rate Summary (Producted vented directly to atmosphere) - 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
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
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).

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	12-26-14
SUBJECT:	Annual Potential Emissions Rate Summary (Product vented directly to atmosphere) - 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
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
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).

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	12-26-14
SUBJECT:	Annual Potential Emissions Rate Summary (Product vented directly to atmosphere) - 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
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
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
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.

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	12-26-14
SUBJECT:	Maximum Hourly Potential Emissions Rate Summary (Product vented directly to atmosphere) - 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**
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
Butane	4.77E+02	2.38E-01	4.60E+00	2.30E-03	5.12E-02	2.56E-05	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	0.00E+00	0.00E+00

(1) - The maximum hourly basis calculation assumes that the volume of gas 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).

(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).

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	12-26-15
SUBJECT:	Maximum Hourly Potential Emissions Rate Summary (Producted vented directly to atmosphere) - 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**
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	5.12E-02	2.56E-05	4.05E+02	2.03E-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

(1) - The maximum hourly basis calculation assumes that the volume of gas 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).
(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).

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	12-26-15
SUBJECT:	Maximum Hourly Potential Emissions Rate Summary (Product vented directly to atmosphere) - 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**
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
Ethane	3.27E+02	1.63E-01	2.38E+00	1.19E-03	5.12E-02	2.56E-05	3.29E+02	1.65E-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

(1) - The maximum hourly basis calculation assumes that the volume of gas 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).

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	12/26/14
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**
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)**
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.

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	12/26/14
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

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 are the product. . 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 and assume product is vented directly to the atmosphere.

BTU = British Thermal Units
HAP = hazardous air pollutants
PER = potential emissions rate
scf = standard cubic feet
VOCs = volatile organic compounds

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	12/26/14
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

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	12/26/14
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

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	12/26/14
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).

1-3.2.2 Propane Emissions from Pigging Operations

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	12/26/14
SUBJECT:	Annual Potential Emissions Rate 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**
Total VOCs	3.31E-01	2.90E+03	1.45E+00	6.63E-01	5.80E+03	2.90E+00
Propane	3.31E-01	2.90E+03	1.45E+00	6.63E-01	5.80E+03	2.90E+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)**
Total VOCs	4.02E+02	2.01E-01
Propane	4.02E+02	2.01E-01
Total HAPs	0.00E+00	0.00E+00

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

HAPs = Hazardous Air Pollutants

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	12/26/14
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

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 are the product. . 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 and assume product is vented directly to the atmosphere.

BTU = British Thermal Units
HAP = hazardous air pollutants
PER = potential emissions rate
scf = standard cubic feet
VOCs = volatile organic compounds

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	VOC emissions - Propane - 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 =	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 =	2.90E+03	lb./year
	1.45E+00	ton/year
Propane Emissions =	2.90E+03	lb./year
	1.45E+00	ton/year

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01/27/14
SUBJECT:	VOC emissions - Propane - 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 =	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 =	5.80E+03	lb./year
	2.90E+00	ton/year
Propane Emissions =	5.80E+03	lb./year
	2.90E+00	ton/year

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	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).

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	12-26-14
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**
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)**
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.

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	12-26-14
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

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 are the product. . 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 and assume product is vented directly to the atmosphere.

BTU = British Thermal Units
HAP = hazardous air pollutants
PER = potential emissions rate
scf = standard cubic feet
VOCs = volatile organic compounds

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	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

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	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:	DATE
		100-NRS-T29725	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).

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

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

TETRA TECH			
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

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 - 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.

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 - 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

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	12-26-14
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+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-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
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	12-26-14
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-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-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
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	12-26-14
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-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	2.83E+00	1.42E-03	--	--	--	3.54E-04	3.10E+00	1.55E-03	3.85E-04	3.37E+00	1.69E-03
CO	1.72E-03	1.51E+01	7.54E-03	3.44E-03	3.02E+01	1.51E-02	1.81E-02	1.58E+02	7.92E-02	--	--	--	1.98E-02	1.74E+02	8.68E-02	2.15E-02	1.89E+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
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
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

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-07-15
SUBJECT:	Maximum Hourly Potential to Emit Summary - Delmont Facility - 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	1.81E-02	9.05E-06	--	--	2.50E+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-01	1.63E-04	2.38E-03	1.19E-06	--	--	3.29E-01	1.65E-04
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).
(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 (propane + butane)

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-07-15
SUBJECT:	Maximum Hourly Potential to Emit Summary - Delmont Facility - 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-01	2.01E-04	3.49E-03	1.75E-06	5.12E-02	2.56E-05	4.56E-01	2.28E-04
Propane	4.02E-01	2.01E-04	3.49E-03	1.75E-06	5.12E-02	2.56E-05	4.56E-01	2.28E-04
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).
(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 (propane + butane)

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	01-07-15
SUBJECT:	Maximum Hourly Potential to Emit Summary - Delmont Facility - 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-01	2.38E-04	4.60E-03	2.30E-06	5.12E-02	2.56E-05	5.33E-01	2.66E-04
Propane	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--
Butane	4.77E-01	2.38E-04	4.60E-03	2.30E-06	5.12E-02	2.56E-05	5.33E-01	2.66E-04
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).
(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 (propane + butane)

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	12-22-2014
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+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-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+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-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:	DATE
		100-NRS-T29725	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 (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 (N2O), 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
NOx = nitrogen oxides
PTE = potential to emit

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	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:	DATE
		100-NRS-T29725	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.

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	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	12/26/14
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 =	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.
1 ton = 2000 lbs.

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	12-26-14
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 =	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	12-26-14
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 =	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

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	12-26-14
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:

Gas Volume =	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	12-26-14
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:

Gas Volume =	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	12-26-14
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:

Gas Volume =	3,109.0	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.

1-4.2.2 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-01	8.06E+03	4.03E+00	1.84E+00	1.61E+04	8.06E+00
CO_2	9.16E-01	8.03E+03	4.01E+00	1.83E+00	1.61E+04	8.03E+00
N_2O	8.94E-06	7.84E-02	3.92E-05	1.79E-05	1.57E-01	7.84E-05
CH_4	4.47E-05	3.92E-01	1.96E-04	8.94E-05	7.84E-01	3.92E-04
CO	2.50E-03	2.19E+01	1.10E-02	5.01E-03	4.38E+01	2.19E-02
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+03	5.58E-01
CO_2	1.11E+03	5.56E-01
N_2O	1.08E-02	5.42E-06
CH_4	5.42E-02	2.71E-05
CO	3.03E+00	1.52E-03
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:	DATE
		100-NRS-T29725	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:	DATE
		100-NRS-T29725	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.

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	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.

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	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	12-26-14
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 =	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	12-26-14
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 =	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	12-26-14
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 =	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	12-26-14
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:

Gas Volume =	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	12-26-14
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:

Gas Volume =	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.

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	12-26-14
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:

Gas Volume =	3,461.0	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

1-4.2.3 Ethane Emissions from Pigging Operations

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	12-26-14
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-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-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+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-01	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#resul
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	01-27-14
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:	DATE
		100-NRS-T29725	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.

TETRA TECH			
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
	3.97E+00	lb./year
Ethane Emissions =	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:	DATE
		100-NRS-T29725	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	12-26-14
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 =	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.

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	12-26-14
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 =	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:	DATE
		100-NRS-T29725	12-26-14
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 =	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

TETRA TECH			
CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	DATE
		100-NRS-T29725	12-26-14
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:

Gas Volume =	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	12-26-14
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:

Gas Volume =	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	12-26-14
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:

Gas Volume =	4,118.0	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

1-4.3 Seal Leak Emissions

1-4.3.1 Seal Leak Potential to Emit Summary

1-4.3.2 Seal Leaks Directed to the Flare

TETRA TECH

CLIENT:	Sunoco Partners MKT & TERM, L.P. (EIN 23-3102655)	JOB NUMBER:	100-NRS-T29725
PREPARED BY:	MK	DATE:	12-26-14
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 - Ethane			Scenario 2 - Propane			Scenario 3 - Butane			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	1.81E-02	1.58E+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-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

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% VOC 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

TETRA TECH			
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

TETRA TECH			
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:	12-26-14
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) =	262,800	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+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:	MK	DATE:	12-26-14
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) = 262,800 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+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:	MK	DATE:	12-26-14
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) = 262,800 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+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.

TETRA TECH

CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY:	MK	DATE:	12-26-14
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) =	262,800	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+02	7.92E-02

1 ton = 2000 lbs.

TETRA TECH

CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY: MK		DATE:	12-26-14
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) =	262,800	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+02	1.15E-01

1 ton = 2000 lbs.

TETRA TECH

CLIENT:	Sunoco Pipeline L.P.	JOB NUMBER:	100-NRS-T29725
PREPARED BY:	MK	DATE:	12-26-14
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) =	262,800	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+02	1.45E-01

1 ton = 2000 lbs.

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**

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

TETRA TECH			
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

TETRA TECH			
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.

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

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 New Station #10 Enclosed Flare

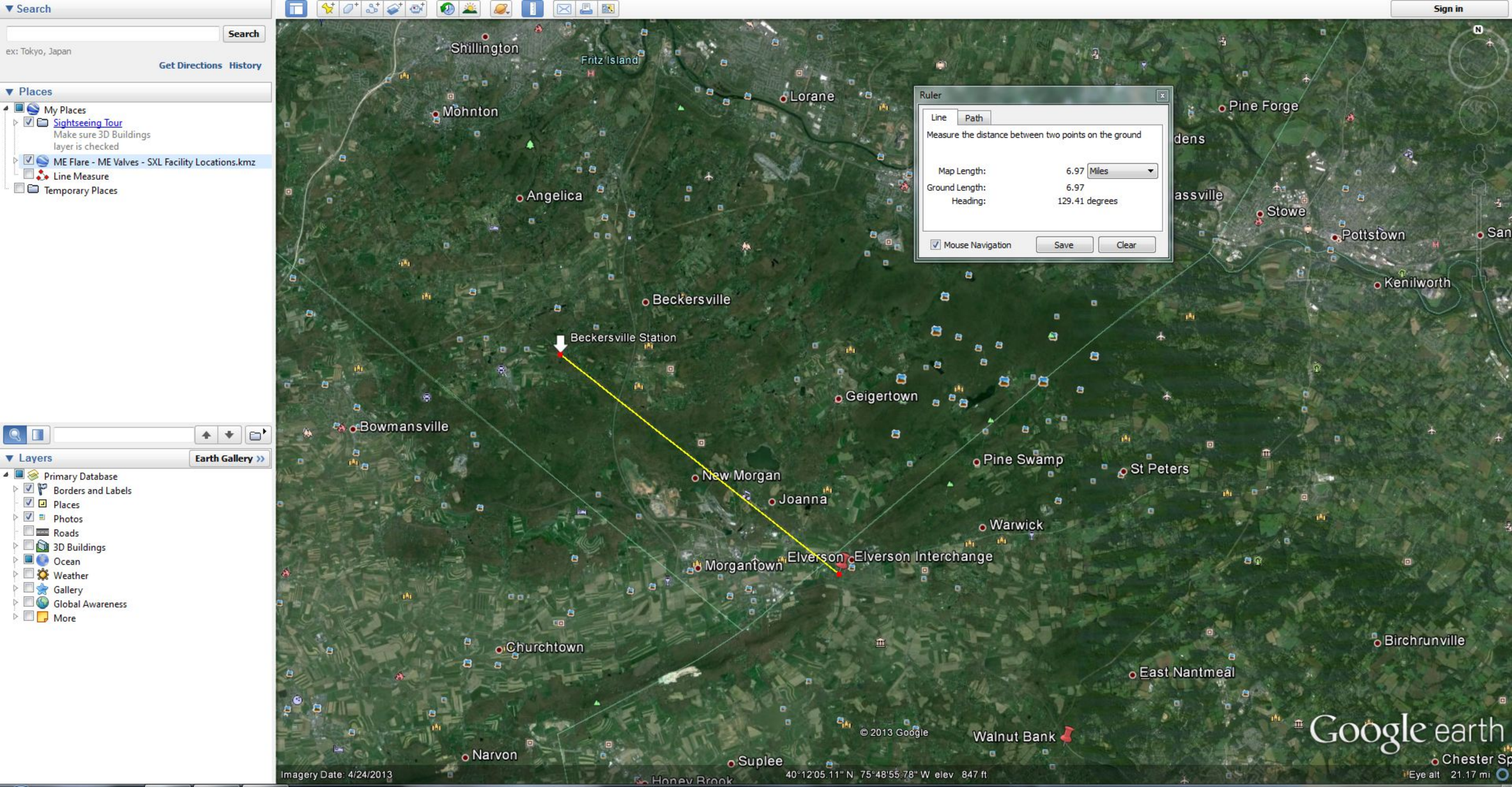
An Aggregation Analysis has been completed on the basis of the facility definition contained in 25 PA Code Section 121.1, Guidance for Performing Single Stationary Source Determinations for Oil and Gas Industries (PADEP 270-0810-006). The entire state of Pennsylvania is considered a “moderate” ozone 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 7.0 miles from the New Station #10 enclosed flare location. Attachment 2-1 illustrates the distance from the New Station #10 flare (identified as Beckersville Station) to the closest common control facility (identified as Elverson Interchange). 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
Search
ex: Tokyo, Japan
Get Directions History
Places
My Places
Sightseeing Tour
Make sure 3D Buildings layer is checked
ME Flare - ME Valves - SXL Facility Locations.kmz
Line Measure
Temporary Places
Layers
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: 6.97 Miles
Ground Length: 6.97
Heading: 129.41 degrees
Mouse Navigation
Save
Clear
Shillington
Fritz Island
Mohnton
Lorane
Pine Forge
Angelica
Stowe
Pottstown
Kenilworth
Beckersville
Beckersville Station
Geigertown
Bowmansville
Pine Swamp
St Peters
New Morgan
Joanna
Warwick
Morgantown
Elverson
Elverson Interchange
Churchtown
Birchrunville
East Nantmeal
Walnut Bank
Narvon
Suplee
Chester Sp
© 2013 Google
Google earth
Imagery Date: 4/24/2013
40°12'05.11" N 75°48'55.78" W elev 847 ft
Eye alt 21.17 mi

ATTACHMENT 3

APPLICABILITY DETERMINATION

Applicability Determination for New Station #10 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 New Station #10 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 New Station #10 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 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 New Station #10 is the PTE from the new emissions unit (enclosed flare) as described in 25 PA Code § 127.203a (4)(ii).

The PTE for carbon monoxide is 1.4×10^{-4} tons per year assuming a liquefied natural gas composition of 100% propane, and 1.7×10^{-4} tons per year assuming a liquefied natural gas composition of 100% butane, and 9.4×10^{-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 New Station #10 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

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			

ATTACHMENT 5

STACK EMISSIONS STUDY

AIR HYGIENE, INC.

Testing Solutions for a Better World

STACK EMISSIONS STUDY
EPA 40 CFR PART 60 SUBPART OOOO
FOR THE
ZTOF040X30PF UNIT
PREPARED FOR
JOHN ZINK, CO LLC
AT THE
TULSA R&D FACILITY
TULSA, OKLAHOMA
MARCH 10-13, 2014

Corporate Headquarters
1600 W Tacoma Street
Broken Arrow, OK 74012

AIR HYGIENE, INC.

(918) 307-8865 or (888) 461-8778
www.airhygiene.com

Remote Testing Offices
Las Vegas, NV 89156
Ft. Worth, TX 76028
Humble, TX 77338
Shreveport, LA 71115
Miami, FL 33101
Philadelphia, PA 19136

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MARCH 10-13, 2014

Prepared and Reviewed by:

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Mars A. Sharief, QSTI,
Regional Manager-Chicago, IL

Min Sum Lee, QSTI,
Test Manager

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APPENDICES

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Stack Emissions Study
ZTOF040X30PF Unit
John Zink, Co LLC
Tulsa R&D Facility
Tulsa, Oklahoma
March 10-13, 2014

1.0 INTRODUCTION

Air Hygiene International, Inc. (Air Hygiene) has completed the emissions testing study for carbon monoxide (CO), total hydrocarbons (THC), flow, visual emission (VE), moisture (H_2O), carbon dioxide (CO_2), and oxygen (O_2) from the exhaust of the ZTOF040X30PF 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 March 10-13, 2014.

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 ramp-up ramp-down test loads (0-30-0%, 30-70-30%, 70-100-70%, and 90-100%). The information will be used to confirm compliance with United States Code of Federal Regulations (CFR), Title 40 (40 CFR), Part 60 (40 CFR 60), Subpart OOOO. The specific objective was to determine the emission concentration of CO, THC, flow, visual emission, H_2O, CO_2, and O_2 from the exhaust of John Zink, Co LLC's ZTOF040X30PF 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
- Oil and Natural Gas Storage 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
- 11920 E Apache St., Tulsa, OK 74116

1.2.5 Equipment Tested
- ZTOF040X30PF Unit

1.2.6 Emission Points
- For all gases, three sample points in the exhaust duct from the ZTOF040X30PF Unit, determined according 40 CFR 60 Subpart OOOO
- For all moisture, flow and fixed gas testing, 20 sampling points in the exhaust duct from the ZTOF040X30PF Unit
- For visual emission, one sample visual observation point from the exit of the exhaust duct to the atmosphere from the ZTOF040X30PF Unit

1.2.7 Pollutants Measured

- CO
- THC
- Flow
- Visual Emission
- H_2O
- CO_2
- O_2

1.2.8 Dates of Emission Test

- March 10-13, 2014

1.3 KEY PERSONNEL

John Zink, Co LLC:	Aron Katz	918-234-2791
Air Hygiene	Min Sum Lee	918-307-8865
Air Hygiene:	Tim Page	918-307-8865
Air Hygiene:	Matt McBride	918-307-8865

2.0 SUMMARY OF TEST RESULTS

Results from the sampling conducted on John Zink, Co LLC's ZTOF040X30PF Unit located at the Tulsa R&D Facility on March 10-13, 2014 are summarized in the following table and relate only to the items tested.

TABLE 2.1
ZTOF040X30PF 0-30-0 LOAD DATA SUMMARY

Parameter	0-30-0 Load, Run - 4.0X30PF R1	0-30-0 Load, Run - 4.0X30PF R2	0-30-0 Load, Run - 4.0X30PF R3	Average
Date (mm/dd/yy)	03/11/14	03/11/14	03/11/14	--
Start Time (hh:mm:ss)	13:16:00	15:27:00	16:48:00	--
End Time (hh:mm:ss)	14:20:00	16:31:00	17:53:00	--
Run Duration (min / run)	61	61	61	61
Bar. Pressure (in. Hg)	29.49	29.41	29.40	29.43
Amb. Temp. (°F)	83	87	84	85
Rel. Humidity (%)	32	26	28	29
Spec. Humidity (lb water / lb air)	0.007782	0.007200	0.007045	0.007342
Wind Speed (mph)	5.0	5.0	5.0	5.0
Wind Direction (--)	SE	S	S	--
Inlet Gas Canister Pressure Start (inHg)	-30.00	-21.20	-10.80	--
Inlet Gas Canister Pressure Stop (inHg)	-21.20	-10.80	-0.05	--
Gross Fuel Heating Value (Btu/ft3)	2,541	2,541	2,541	2,541
Stack Flow (M2) (DSCFH)	96,745	90,702	87,523	91,657
Stack Moisture (Method 4)	7.3	6.4	5.3	6.3
Gross Fuel Heating Value (Btu/ft^3)	2,540.8	2,540.8	2,540.8	2,540.80
Average Inlet Fuel Flowrate (SCFH)	1,123.9	1,097.7	1,091.7	1,104.41
Average Inlet Mass Fuel Flowrate (lb/hr)	130.5	127.5	126.8	128.27
% Excess Air	196.0	196.0	225.1	205.70
CO_2 (%) - Modified method 3C	5.91	5.91	5.53	5.78
O_2 (%) - Modified Method 3C	14.00	14.00	14.60	14.20
N_2 (%) - Modified Method 3C	80.10	80.10	79.90	80.03
Visual Emission (mm:ss)	0:00	0:00	0:00	0.00
CO (ppmvd)	1.06	0.50	0.76	0.77
CO (ppm@3%CO_2)	0.54	0.26	0.41	0.40
THC (ppmvw)	0.11	0.06	0.06	0.07
THC (ppm@3%CO_2)	0.05	0.03	0.03	0.04
THC (lb/hr)	0.00	0.00	0.00	0.00
VOC Destruction Efficiency (%)	99.999	100.000	99.999	99.999

TABLE 2.2
ZTOF040X30PF 30-70-30 LOAD DATA SUMMARY

Parameter	30-70-30 Load, Run - 4.0X30PF R4	30-70-30 Load, Run - 4.0X30PF R5	30-70-30 Load, Run - 4.0X30PF R6	Average
Date (mm/dd/yy)	03/12/14	03/12/14	03/12/14	--
Start Time (hh:mm:ss)	8:34:00	10:00:00	11:23:00	--
End Time (hh:mm:ss)	9:40:00	11:08:00	12:25:00	--
Run Duration (min / run)	61	61	61	61
Bar. Pressure (in. Hg)	30.21	30.26	30.26	30.24
Amb. Temp. (°F)	53	60	66	60
Rel. Humidity (%)	40	33	25	33
Spec. Humidity (lb water / lb air)	0.003355	0.003560	0.003330	0.003415
Wind Speed (mph)	5.0	14.0	12.0	10.3
Wind Direction (--)	N	N	N	--
Inlet Gas Canister Pressure Start (inHg)	-30.00	-19.30	-10.15	-19.82
Inlet Gas Canister Pressure Stop (inHg)	-19.30	-10.15	-0.02	-9.82
Gross Fuel Heating Value (Btu/ft3)	2,556	2,556	2,556	2,556
Stack Flow (M2) (DSCFH)	178,215	192,325	201,263	190,601
Stack Moisture (Method 4)	5.3	5.4	5.4	5.4
Gross Fuel Heating Value (Btu/ft^3)	2,555.5	2,555.5	2,555.5	2,555.50
Average Inlet Fuel Flowrate (SCFH)	2,411.6	2,437.9	2,550.5	2,466.64
Average Inlet Mass Fuel Flowrate (lb/hr)	280.1	283.1	296.2	286.49
% Excess Air	196.0	193.0	225.1	204.70
CO_2 (%) - Modified method 3C	5.90	5.90	5.50	5.77
O_2 (%) - Modified Method 3C	14.00	14.00	14.60	14.20
N_2 (%) - Modified Method 3C	80.10	80.10	79.90	80.03
Visual Emission (mm:ss)	0:00	0:00	0:00	0:00
CO (ppmvd)	1.17	1.01	1.20	1.13
CO (ppm@3%CO_2)	0.60	0.52	0.65	0.59
THC (ppmvw)	0.15	0.07	0.06	0.09
THC (ppm@3%CO_2)	0.08	0.03	0.03	0.05
THC (lb/hr)	0.00	0.00	0.00	0.00
VOC Destruction Efficiency (%)	99.999	99.999	100.000	99.999

TABLE 2.3
ZTOF040X30PF 70-100-70 LOAD DATA SUMMARY

Parameter	70-100-70 Load, Run - 4.0X30PF R7	70-100-70 Load, Run - 4.0X30PF R8	70-100-70 Load, Run - 4.0X30PF R9	Average
Date (mm/dd/yy)	03/12/14	03/12/14	03/13/14	--
Start Time (hh:mm:ss)	13:19:00	16:30:00	8:40:04	--
End Time (hh:mm:ss)	14:22:00	17:33:00	9:43:00	--
Run Duration (min / run)	61	61	61	61
Bar. Pressure (in. Hg)	30.26	30.20	30.19	30.22
Amb. Temp. (°F)	58	72	57	62
Rel. Humidity (%)	28	21	34	28
Spec. Humidity (lb water / lb air)	0.002809	0.003443	0.003300	0.003184
Wind Speed (mph)	6.0	9.0	1.0	10.7
Wind Direction (--)	NW	N	SW	--
Inlet Gas Canister Pressure Start (inHg)	-30.00	-20.31	-10.20	--
Inlet Gas Canister Pressure Stop (inHg)	-20.31	-10.20	-0.02	--
Gross Fuel Heating Value (Btu/ft3)	2,494	2,494	2,494	2,494
Stack Flow (M2) (DSCFH)	307,067	280,468	284,135	290,557
Stack Moisture (Method 4)	6.4	6.0	5.3	5.9
Gross Fuel Heating Value (Btu/ft^3)	2,493.7	2,493.7	2,493.7	2,493.70
Average Inlet Fuel Flowrate (SCFH)	3,851.9	3,769.3	3,719.8	3,780.34
Average Inlet Mass Fuel Flowrate (lb/hr)	445.3	437.8	395.3	426.13
% Excess Air	278.2	230.9	210.5	239.87
CO_2 (%) - Modified method 3C	5.30	5.50	5.70	5.50
O_2 (%) - Modified Method 3C	15.40	14.70	14.30	14.80
N_2 (%) - Modified Method 3C	79.30	79.80	79.90	79.67
Visual Emission (mm:ss)	0:00	0:00	0:00	0:00
CO (ppmvd)	0.03	0.29	0.55	0.29
CO (ppm@3%CO_2)	0.02	0.16	0.29	0.15
THC (ppmvw)	0.06	0.02	0.07	0.05
THC (ppm@3%CO_2)	0.04	0.01	0.03	0.03
THC (lb/hr)	0.00	0.00	0.00	0.00
VOC Destruction Efficiency (%)	99.999	100.000	99.999	100.000

TABLE 2.4
ZTOF040X30PF 90-100 LOAD DATA SUMMARY

Parameter	90-100 Load, Run - 4.0X30PF R10	90-100 Load, Run - 4.0X30PF R11	90-100 Load, Run - 4.0X30PF R12	Average
Date (mm/dd/yy)	03/13/14	03/13/14	03/13/14	--
Start Time (hh:mm:ss)	10:27:04	12:50:04	14:05:04	--
End Time (hh:mm:ss)	11:29:00	13:52:00	15:07:00	--
Run Duration (min / run)	61	61	61	61
Bar. Pressure (in. Hg)	30.20	30.15	30.09	30.15
Amb. Temp. (°F)	63	66	71	67
Rel. Humidity (%)	28	17	14	20
Spec. Humidity (lb water / lb air)	0.003365	0.002269	0.002222	0.002619
Wind Speed (mph)	3.0	8.0	5.0	5.3
Wind Direction (--)	SW	W	W	--
Inlet Gas Canister Pressure Start (inHg)	-30.00	-19.50	-9.70	--
Inlet Gas Canister Pressure Stop (inHg)	-19.50	-9.70	0.05	--
Gross Fuel Heating Value (Btu/ft3)	2,552	2,552	2,552	2,552
Stack Flow (M2) (DSCFH)	291,965	284,219	296,509	290,898
Stack Moisture (Method 4)	5.8	6.4	6.1	6.1
Gross Fuel Heating Value (Btu/ft^3)	2,552.0	2,552.0	2,552.0	2,552.00
Average Inlet Fuel Flowrate (SCFH)	4,024.5	4,013.8	4,057.9	4,032.08
Average Inlet Mass Fuel Flowrate (lb/hr)	467.4	463.5	471.3	467.41
% Excess Air	205.2	192.4	192.6	196.73
CO_2 (%) - Modified method 3C	5.80	6.10	6.10	6.00
O_2 (%) - Modified Method 3C	14.20	13.90	13.90	14.00
N_2 (%) - Modified Method 3C	80.00	80.00	80.10	80.03
Visual Emission (mm:ss)	0:00	0:00	0:00	0:00
CO (ppmvd)	0.26	0.00	0.02	0.10
CO (ppm@3%CO_2)	0.13	0.00	0.01	0.05
THC (ppmvw)	0.06	0.07	0.09	0.07
THC (ppm@3%CO_2)	0.03	0.03	0.05	0.04
THC (lb/hr)	0.00	0.00	0.00	0.00
VOC Destruction Efficiency (%)	100.000	99.999	99.999	99.999

All testing was conducted according to the requirement of 40 CFR 60.5413 and 40 CFR 60.5412.

3.0 SOURCE OPERATION

3.1 PROCESS DESCRIPTION

An Enclosed ZTOF Production Flare is designed to destroy safely various organic compounds generated by production activities. The Flare Control Panel initiates pilot ignition, monitors operating conditions, and discontinues operation if an unacceptable condition occurs. A burner management system, which includes a flame safeguard package, monitors specific parameters and discontinues operation if an unsafe condition occurs. A dedicated thermocouple detects pilot flame. Typical shutdown scenarios include:

Flame Failure:
Flame Failure occurs when the pilot thermocouple is unable to detect the presence of pilot flame. When Flame Failure occurs, system operation discontinues. Upon determining the source of a fault condition and completing the necessary corrective action, a system reset is required to begin operation again.

A typical operating sequence consists of:
Mode Selection
Select either automatic or manual system operation. Automatic mode attempts operation whenever sufficient power is applied. Manual mode requires operator interaction at the panel to initiate operation.

Ignition Sequence
The pilot gas solenoid valve opens automatically, supplying gas to the pilot, and the ignition transformer energizes. The ignition transformer continues as the pilot thermocouple verifies flame is present. The pilot gas solenoid valve remains open.

Gas Supply
Once pilot flame is detected and sufficient inlet pressure exists, the main gas valve opens, supplying gas to the flare. While the pilot thermocouple verifies flame is present, system operation continues.

3.2 SAMPLING LOCATION

The sample ports were located approximately 30 feet above grade level on the exhaust system. The stack had a 4 feet inner diameter and was equipped with two, 4 inch ports oriented at 90 degrees. The ports were 6 duct diameters downstream from the flare tip and 1.25 duct diameters upstream from the stack exit to the atmosphere. THC and CO samples for gaseous emissions were continuously drawn from the exhaust system at one sample port with three sampling points located at 16.7 percent, 50 percent, and 83.3 percent of the stack diameter. All visual emission observation was 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 from a tap located at 8 pipe diameter, 24 inches upstream of the fuel monitoring system. Due to refractor have interfered the flow and temperature reading, the outer traverse points were omitted to collect sample. All flow, fixed gases and moisture sampling was continuously drawn from the exhaust system at two ports with 20 points across the stack according to Method 1.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 TEST METHODS

The emission test on the ZTOF040X30PF 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 March 10-13, 2014.

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
Fuel Flow Rate	EPA Method 2a	Volume Displacement
CO_2, O_2, Methane	EPA Method 3C	Gas Chromatograph-TCD
Stack Moisture Content	EPA Method 4	Gravimetric Analysis
Carbon Monoxide	EPA Method 10	Nondispersive Infrared Analyzer
Visual Emission	EPA Method 22	Visual Observation
Total Hydrocarbons	EPA Method 25a	Flame Ionization Detector
Fuel Content Analysis	ASTM D 1945-03, ASTM D 3588-98	Gas Chromatograph

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, 3c 4, 10, 22, 25a, ASTM D1945-03, and 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 port 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, 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 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. CO 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 moisture and flow testing. An inconel probe with an inconel 3/8 inches tubing, pitots tube and thermocouple were inserted into the sample ports of the stack to extract gas measurements from the emission stream through a glass impinger train. Flow rates were monitored with oil filled manometers and total sample volumes were measured with a dry gas meter. Tedlar bags were collected at the exit of this train.

Three test runs for each of the firing rate at 0-30-0 percent, 30-70-30 percent, 70-100-70 percent, and 90-100 percent (ramp up, ramp down) of approximately 61 minutes each were conducted on the ZTOF040X30PF Unit for CO, THC, CO_2, and O_2.

Figure 4.3 represents the inlet sampling system in accordance with Method 2A, 40 CFR part 60 to measure inlet gas flow rate, pressure and temperature. Fuel sample was collected at 24 inches upstream from gas flow meter.

The stack gas analysis for O_2 and CO_2 concentrations was performed in accordance with procedures set forth in EPA Method 3C. The sample were collected in a tedlar bag and analyzed by GC-TCD at an offsite laboratory.

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	Manufacturer and Model	Range	Sensitivity	Detection Principle
CO	Thermo 48C	User may select up to 10,000 ppm	0.1 ppm	Infrared absorption, gas filter correlation detector, microprocessor based linearization.
THC	Thermo 51C	User may select up to 10,000 ppm	0.1 ppm	Flame Ionization Detector

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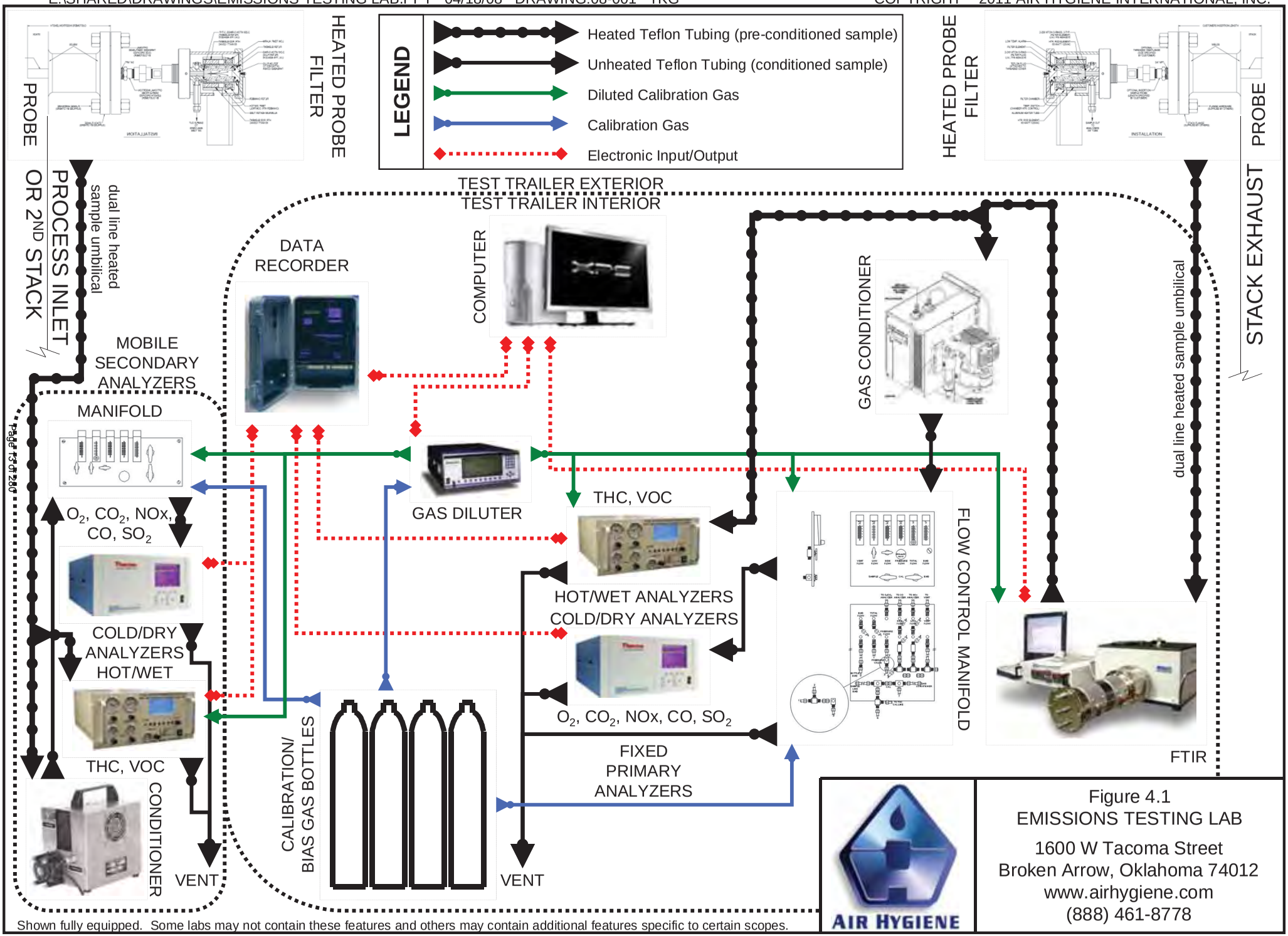

Shown fully equipped. Some labs may not contain these features and others may contain additional features specific to certain scopes.

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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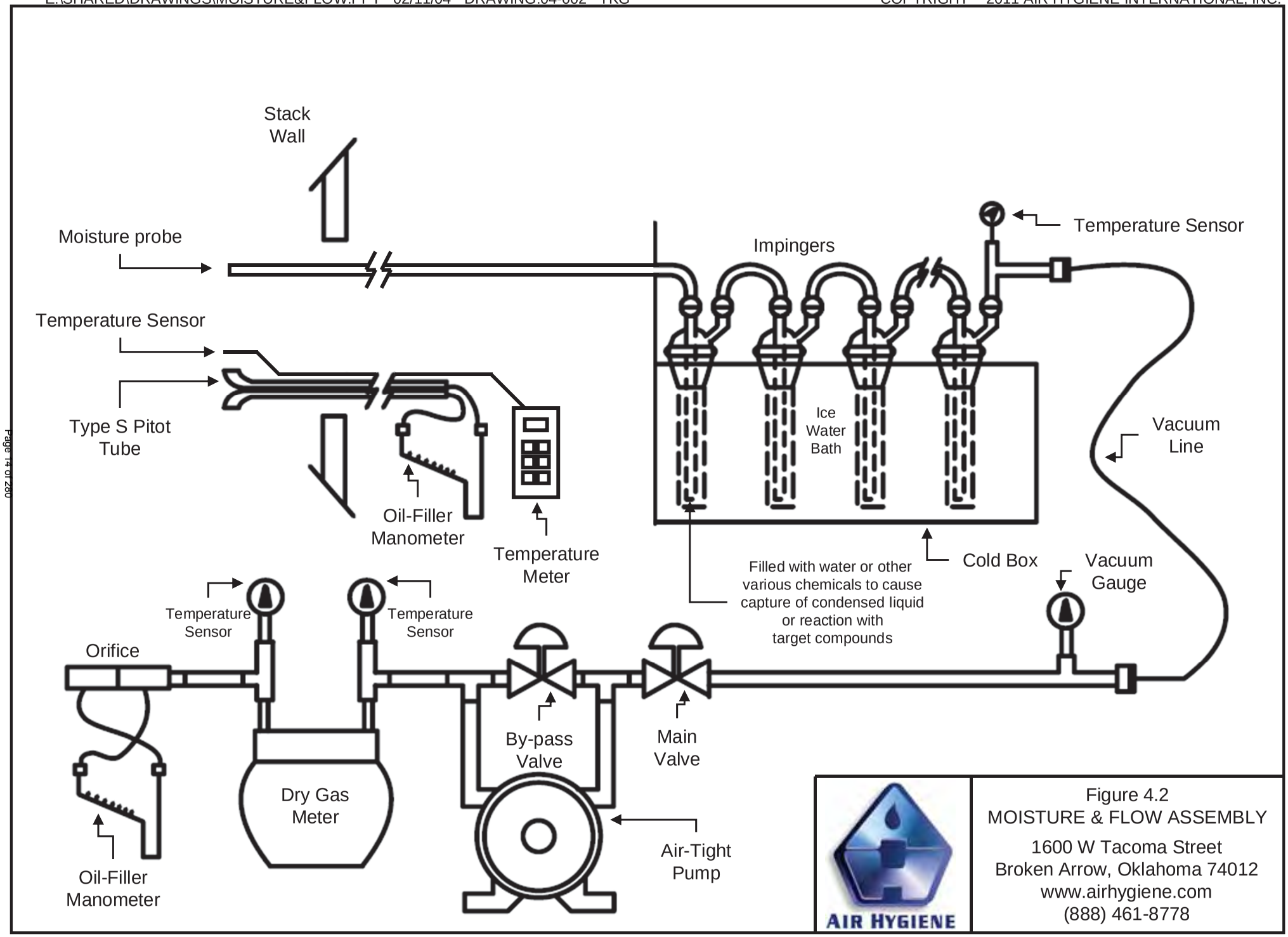
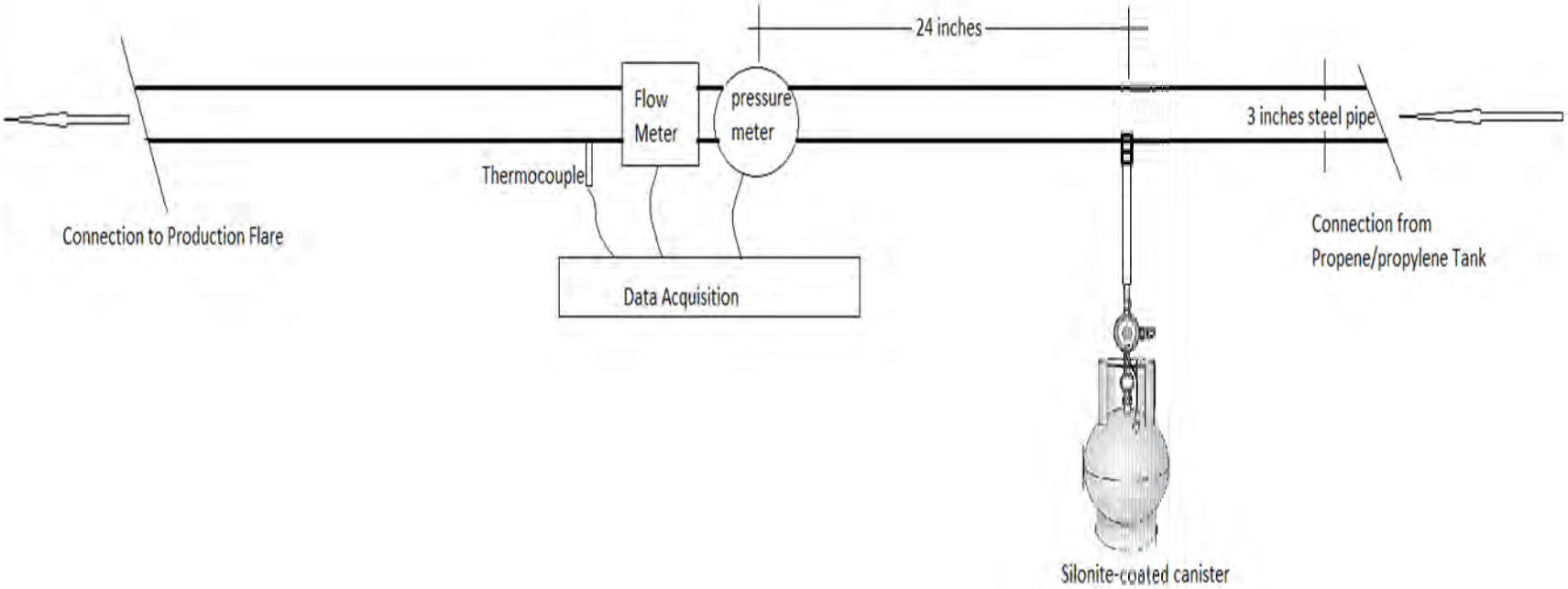


Figure 4.2
MOISTURE & FLOW ASSEMBLY

1600 W Tacoma Street
Broken Arrow, Oklahoma 74012
www.airhygiene.com
(888) 461-8778



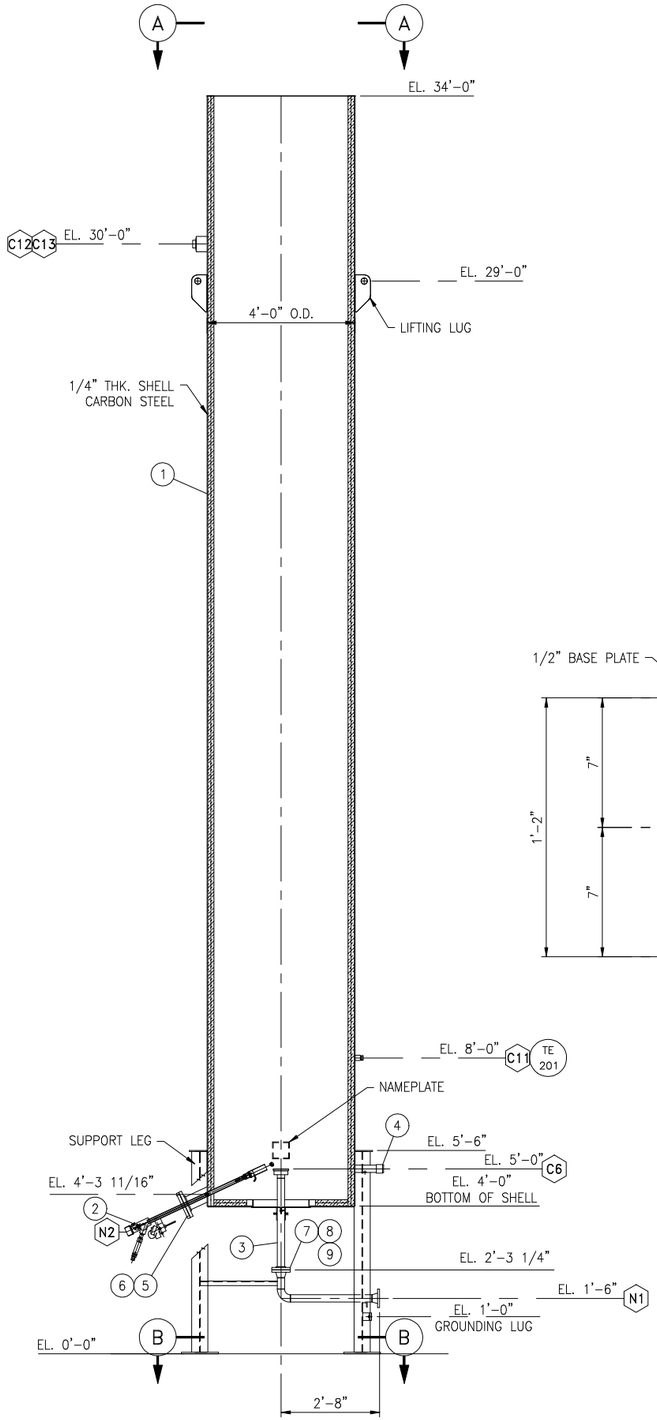
AIR HYGIENE

Figure 4.3

FUEL SAMPLING SETUP

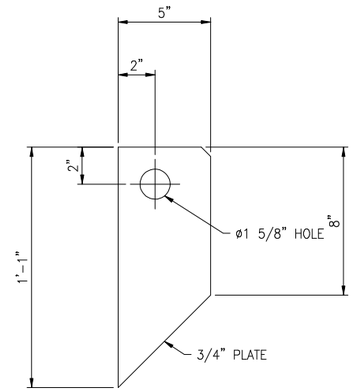
1600 W Tacoma Street
Broken Arrow, Oklahoma 74012

www.airhygiene.com
(888) 461-8778

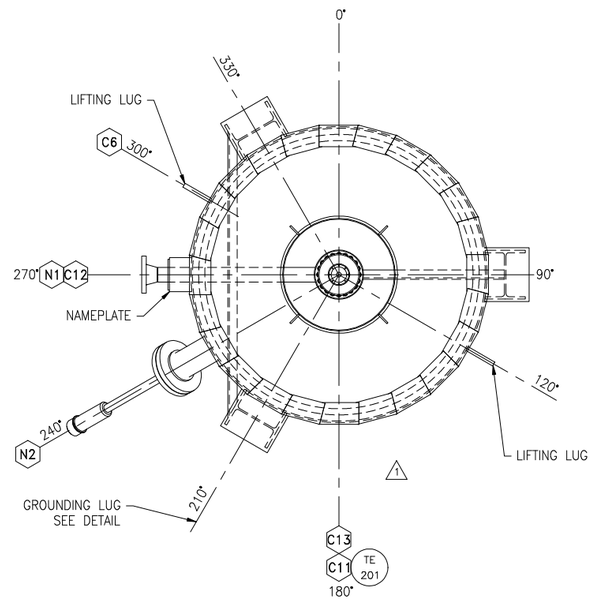


ELEVATION
(NOT TRUE ORIENTATION)

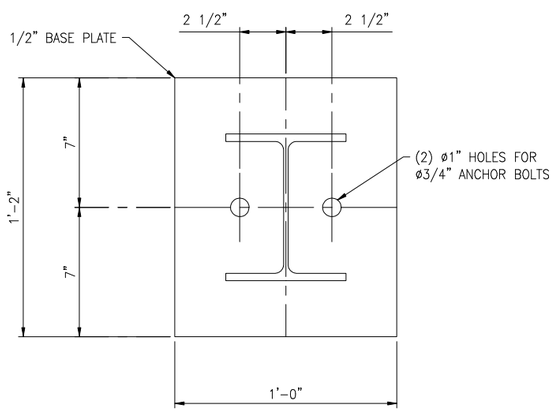
MK: D-701-1



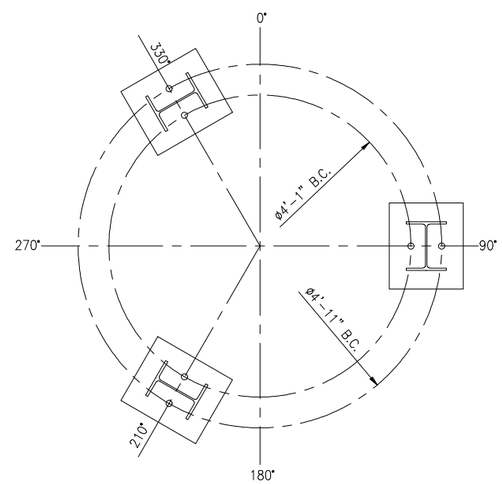
LIFTING LUG DETAIL
TYPICAL TWO PLACES @
120° AND 300°



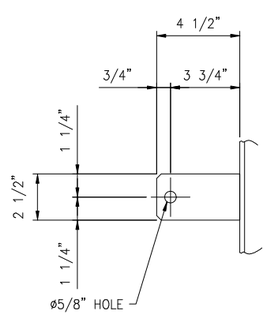
VIEW A-A
(TRUE ORIENTATION)



BASE PLATE DETAIL
(TYP 3 PLACES)



SECTION B-B
(TRUE ORIENTATION)



GROUND LUG DETAIL

PARTS LIST

ITEM	QTY	DESCRIPTION	MK: NO	MATERIAL
1	1	ENCLOSED ZTOF FLARE	D-701-1	
2	1	KE-1D PILOT ASSEMBLY	D-302-1	
3	1	2" FLARE TIP	D-730-1	
4	1	2" SIGHT PORT	CA-ST-0600-1	
5	4	BOLT, HEX HD: 5/8" x 2 1/2" LG (PLATED)	HB-5-2 1/2	A-307
6	4	NUT, REG HEX: 5/8-11NC (PLATED)	HN-5	A-307
7	1	GASKET: 2" 150# RF 1/16"THK DONEX 660	G-2-150R	NON-ASB
8	4	BOLT, STUD: 5/8-NC X 0'-3 1/2" LG (PLATED)	SB-5-3 1/2	A-193-B7
9	8	NUT, HVY HEX: 5/8"-10NC (PLATED)	HHN-5	A-194-2H

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

DESIGN DATA

WINDLOAD (PER ASCE 7-10, EXP. C) 120 M.P.H.
SEISMIC (IBC 2009) SITE CLASS E
SHEAR @ BASE 2,000 LB
MOMENT @ BASE 44,500 LB-FT
DEADLOAD 5,500 LB
SHELL DESIGN TEMPERATURE 500° F
CORROSION ALLOWANCE 0.0

INSULATION LEGEND

A: (1) OVERLAPPING LAYER OF 1" THICK 8 LB DENSITY, 2300° F. BACKED WITH (1) LAYER, 1" THICK 6 LB DENSITY, 2300° F. ON 310 STAINLESS STEEL PINS AND KEEPERS.

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/B69VZ15/B69D11 (3-4 MILS D.F.T.)

FOR PARTS AND SERVICE: • TEL: 1-800-755-4252 • FAX: (918) 234-1968

NO.	REVISION DESCRIPTION	BY	CHK	APP	DATE
	PER ENGINEERING	SAM	SAM	ADG	05-02-14

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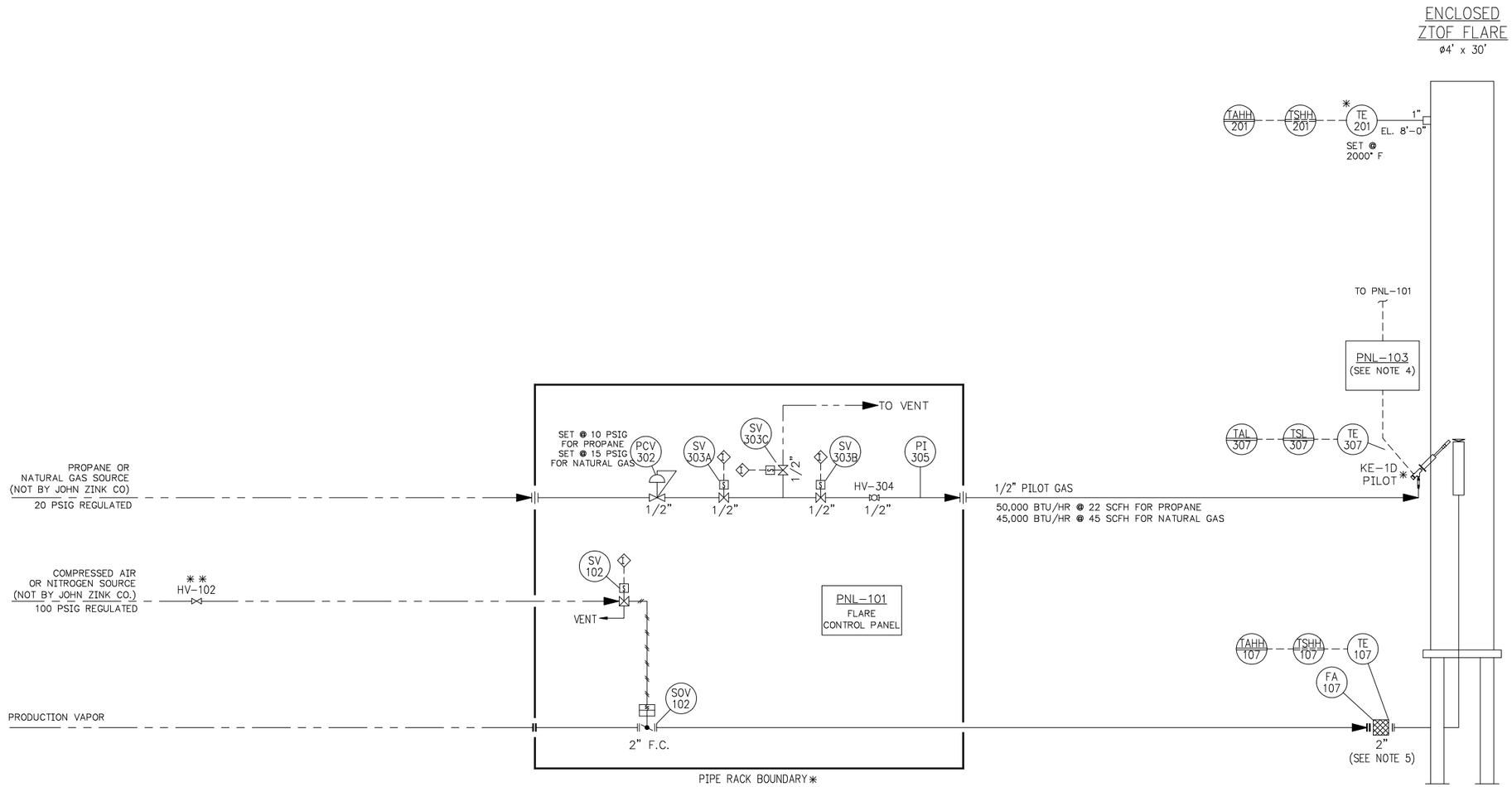
JOHN ZINK HAMWORTHY
COMBUSTION
JOHN ZINK COMPANY, LLC

FOR:
USER:
JOBSITE:
S.O. NO:
P.O. NO:
SCALE:

ENCLOSED ZTOF PRODUCTION FLARE
4'-0" O.D. x 30' H
(QUANTITY ONE)

DRAWN: DATE:
CHK: DATE:
APP: DATE:
SHEET: 1 OF 1
DRAWING NUMBER:
REV. 0

File Name: c:\users\groggg\documents\downloads\301s1r1.dwg Plot Date: 5/2/2014 8:29 AM



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.

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 PIPERACK.
5. LOCATE FLAME ARRESTER WITH 5 DIAMETERS OF STRAIGHT UNDISTURBED FLOW UPSTREAM.

FOR PARTS AND SERVICE: • TEL: 1-800-755-4252 • FAX: (918) 234-1968

NO.	REVISION DESCRIPTION	BY	CHK	APP	DATE

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JOHN ZINK HAMWORTHY COMBUSTION
JOHN ZINK COMPANY, LLC

FOR:
USER:
JOBSITE:
S.O. NO:
P.O. NO:
SCALE:

PROCESS & INSTRUMENT DIAGRAM
FOR AN ENCLOSED ZTOF PRODUCTION FLARE

DRAWN:	CHK:	APP:	SHEET:
DATE:	DATE:	DATE:	1 OF 1

DRAWING NUMBER:
REV. 0

File Name: r:\active\p-vapor\9148215\drafting\drawings\150s1r0.dwg Plot Date: 4/9/2014 1:16 PM

APPENDIX A

TEST RESULTS AND CALCULATIONS

TABLE A.1:
EMISSIONS TESTING SCHEDULE

Unit	Load	Test Type	Run	Date	Start	Stop	Time Sync
ZTOF040X30PF	0-30-0	Performance	4.0X30PF R1	03/11/14	13:16:00	14:20:00	CST
ZTOF040X30PF	0-30-0	Performance	4.0X30PF R2	03/11/14	15:27:00	16:31:00	CST
ZTOF040X30PF	0-30-0	Performance	4.0X30PF R3	03/11/14	16:48:00	17:53:00	CST
ZTOF040X30PF	30-70-30	Performance	4.0X30PF R4	03/12/14	8:34:00	9:40:00	CST
ZTOF040X30PF	30-70-30	Performance	4.0X30PF R5	03/12/14	10:00:00	11:08:00	CST
ZTOF040X30PF	30-70-30	Performance	4.0X30PF R6	03/12/14	11:22:00	12:25:00	CST
ZTOF040X30PF	70-100-70	Performance	4.0X30PF R7	03/12/14	13:19:00	14:22:00	CST
ZTOF040X30PF	70-100-70	Performance	4.0X30PF R8	03/12/14	16:30:00	17:33:00	CST
ZTOF040X30PF	70-100-70	Performance	4.0X30PF R9	03/13/14	8:40:04	9:43:00	CST
ZTOF040X30PF	90-100	Performance	4.0X30PF R10	03/13/14	10:27:04	11:29:00	CST
ZTOF040X30PF	90-100	Performance	4.0X30PF R11	03/13/14	12:50:04	13:52:00	CST
ZTOF040X30PF	90-100	Performance	4.0X30PF R12	03/13/14	14:05:04	15:07:00	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.

$$RH_{sp}(lb/lb) = \left[\left(\frac{gr}{lb}\right) \times \frac{lb}{7000gr}\right]$$

$$RH_{sp} = \frac{54.47\ gr}{lb} \times \frac{1\ lb}{7000\ gr} = 0.007782 \frac{lb\ H_2O}{lb\ Air}$$

EXAMPLE CALCULATIONS (CALIBRATION)

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

$$E_p = \frac{8.49\ ppm - 0.04\ ppm}{8.48\ ppm - 0.00\ ppm} \times 5.04\ ppm + 0.04 = 5.06\ ppm$$

$$ACE = \left(\frac{C_{Dir} - C_V}{CS}\right) \times 100$$

Eq. 7E-1

$$ACE_{THC} = \frac{5.15\ ppm - 5.06\ ppm}{5.04\ ppm} \times 100 = 1.74\ \%$$

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 THC analyzer upscale gas, Run 1 initial bias, if applicable)

$$SB = \left(\frac{C_S - C_{Dir}}{CS}\right) \times 100$$

Eq. 7E-2

$$SB = \frac{3.14\ ppm - 3.03\ ppm}{10.00\ ppm} \times 100 = 1.10\ \%$$

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 THC analyzer upscale drift, Run 1, if applicable)

$$D = \left|SB_{final} - SB_i\right|$$

Eq. 7E-4

$$D = |\ -0.30\ \% - 1.10\ \%\ | = 1.40\ \%$$

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 THC analyzer initial upscale, Run 1, if applicable)

$$SB / D_{Alt} = \left|C_S - C_{Dir}\right|$$

Eq. Section 13.2 and 13.3

$$SB / D_{Alt} = |\ 3.14\ ppm - 3.03\ ppm\ | = 0.11\ ppm$$

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 THC concentration values (e.g., 1-minute averages). Then adjust the value of Cavg for bias, using Equation 7E-5b. (calc for THC analyzer, Run 1, if applicable)

$$C_{Gas} = \left(C_{Avg} - C_O\right) \times \left(\frac{C_{MA}}{C_M - C_O}\right)$$

Eq. 7E-5b

$$C_{Gas} = \left(0.11\ ppm - 0.00\ ppm\right) \times \left(\frac{3.04\ ppm}{3.07\ ppm - 0.00\ ppm}\right) = 0.11\ ppm$$

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

EXAMPLE CALCULATIONS (RUNS)

Diluent-Corrected Pollutant Concentration, CO_2 Based

Calculate the CO_2 corrected pollutant concentration, as follows: (calc for THC gas, Run 1, if applicable)

Uinsg Method 3C fixed gas analysis

$$C_{adj} = 0.12 \text{ ppm} \times \left(\frac{3.00\ \%}{5.90\ \%}\right) = 0.06 \text{ ppm@3\%}CO_2$$

EXAMPLE CALCULATIONS (RUNS)

Emissions Rate (lb/hr)

Calculation for pound per hour emission rate. Calculate, as follows: (calc for THC gas Run 1, if applicable)

$$E_{lb/hr} = \frac{C_{Gas}}{10^6} \times \frac{Q_S \times MW}{G}$$

$$E_{lb/hr} = \frac{0.12 \text{ ppm}}{10^6 \text{ ppm/part}} \times \frac{90{,}702 \text{ SCFH} \times 44.00 \text{ lb/lb-mol}}{385.23 \text{ SCF/lb-mol}} = \frac{0.001 \text{ lb}}{\text{hr}}$$

VOC Destruction Efficiency

Calculation for VOC destructtion Efficiency. Calculate, as follows: (calc for run 1, if applicable)

$$DE\% = \frac{130.533 - 0.001 \text{ lb/hr}}{130.533 \text{ lb/hr}} \times 100 = 99.999\ \%$$

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

EXAMPLE CALCULATIONS (Reference Method 1 - Circular Stack)

Diameter of Stack (in.)

$$D(in.) = L_{fw} - L_{nw}$$

D (in.) = 54.00 in. - 6.00 in. = 48.00 in.

Area of Stack (ft^2)

$$A_s(ft^2) = \pi \times \left(\frac{D}{2 \times 12}\right)^2$$

A_s (ft^2) = 3.14 x ($\frac{48.00 \text{ in.}}{2 \text{ x } 12\text{in./ft}}$)^2 = 12.57 ft^2

Stack Diameters Downstream

$$B_D(dia.) = \frac{B}{D}$$

B_D (dia.) = $\frac{288.00 \text{ in.}}{48.00 \text{ in.}}$ = 6.00 diameters

Stack Diameters Upstream

$$A_D(dia.) = \frac{A}{D}$$

A_D (dia.) = $\frac{60.00 \text{ in.}}{48.00 \text{ in.}}$ = 1.25 diameters

EXAMPLE CALCULATIONS (Reference Method 3C) [Values from Run 1 test]

Carbon Monoxide Concentration (%)

$$\%CO = \frac{ppmCO}{10{,}000}$$

%CO (%) = $\frac{0.00 \text{ ppm}}{10{,}000 \text{ ppm/\%}}$ = 0.0000 %

Nitrogen Concentration (%)

$$\%N_2 = 100 - \%CO_2 - \%O_2 - \%CO$$

$\%N_2$ (%) = 100 - 5.91 % - 14.00 % - 0.00 / 10,000 % = 80.09 %

Stack Dry Molecular Weight (lb/lb-mole)

$$M_d(lb/lb-mol) = \sum\left(\frac{MW_{comp}}{100} \times \%component\right)$$

M_d (lb/lb-mol) = ($\frac{44 \text{ lb/lb-mol}}{100}$ x 5.91 %) +

($\frac{32 \text{ lb/lb-mol}}{100}$ x 14.00 %) + ($\frac{28 \text{ lb/lb-mol}}{100}$ x [$\frac{0.00}{10{,}000}$ + 80.09]) = $\frac{29.51 \text{ lb}}{\text{lb-mol}}$

Stack Wet Molecular Weight (lb/lb-mole)

$$M_S(lb/lb-mol) = \left[M_d \times \left(1 - \frac{B_{WS}}{100}\right)\right] + \left[MW_{H_2O} \times \frac{B_{WS}}{100}\right]$$

M_S (lb/lb-mol) = { $\frac{29.51 \text{ lb}}{\text{lb-mol}}$ x (1 - $\frac{7.28 \%}{100}$) } + { $\frac{18 \text{ lb}}{\text{lb-mol}}$ x $\frac{7.28 \%}{100}$ } = $\frac{28.67 \text{ lb}}{\text{lb-mol}}$

Average Excess Air (%)

$$\%EA_{avg}(\%) = \frac{100 \times \left[(\%O_2)_{avg} - (0.5 \times (\%CO)_{avg})\right]}{(0.264 \times (N_2)_{avg}) - \left[(\%O_2)_{avg} - (0.5 \times (\%CO)_{avg})\right]}$$

$(\%EA)_{AVG}$ = $\frac{100 \text{ x } \{ 14.00 \% - (0.5 \text{ x } 0.000 \%) \}}{(0.264 \text{ x } 80.09 \%) - \{ 14.00 \% - (0.5 \text{ x } 0.000 \%)\}}$ = 195.98 %

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

EXAMPLE CALCULATIONS (Reference Method 2) [Values from Run 1 test]

Absolute Stack Pressure (in. Hg)

$$P_S\,(in.Hg) = P_b + \frac{P_{static}}{13.6}$$

P_s (in. Hg) = 29.49 in. Hg + $\frac{0.00 \text{ in. } H_2O}{13.6 \text{ in. } H_2O/\text{in. Hg}}$ = 29.49 in. Hg

Average Stack Gas Velocity (ft/sec)

$$v_s\,(ft/\sec) = K_p \times C_p \times \left(\sqrt{\Delta p}\right)_{avg} \times \sqrt{\frac{(t_s)_{avg} + T_u}{P_s \times M_s}}$$

v_{sl} (ft/sec) =

$$\left(\frac{85.49 \text{ ft}}{\text{sec}} \frac{(\text{lb/lb-mol})(\text{in. Hg})}{(^oR)(\text{in. } H_2O)}\right)^{1/2} \times 0.82 \times 0.08 \text{ in.}H_2O^{1/2} \times \sqrt{\frac{1285.70 + 460\ ^oR}{29.49 \text{ in. Hg} \times 28.67 \text{ lb/lb-mol}}} = \frac{7.7 \text{ ft}}{\text{sec}}$$

Average Stack Dry Standard Flow Rate (dscfh)

$$Q_{sd}\,(dscfh) = \frac{60 \times 60 \times \left(1 - \frac{B_{ws}}{100}\right) \times v_s \times A_s \times T_{std} \times P_s}{(t_s + T_u) \times P_{std}}$$

$$Q_{sd} \text{ (dscf/hr)} = \frac{3600 \text{ sec}}{\text{hr}} \times \left(1 - \frac{7.28\ \%}{100}\right) \times \frac{7.74 \text{ ft}}{\text{sec}} \times 12.57 \text{ ft}^2 \times \frac{68.00 + 460\ ^oR}{1{,}285.70 + 460\ ^oR} \times \frac{29.49 \text{ in. Hg}}{29.92 \text{ in. Hg}} = \frac{96{,}744.76 \text{ dscf}}{\text{hr}}$$

Average Stack Wet Flow Rate (acfm)

$$Q_{aw}\,(acfm) = 60 \times v_s \times A_s$$

$$Q_{aw} \text{ (acf/min)} = \frac{60 \text{ sec}}{\text{min}} \times \frac{7.74 \text{ ft}}{\text{sec}} \times 12.57 \text{ ft}^2 = \frac{5{,}833.74 \text{ acf}}{\text{min}}$$

Average Stack Wet Standard Flow Rate (ascfh)

$$Q_{sw}\,(ascfh) = \frac{60 \times Q_{aw} \times T_{std} \times P_s}{(t_s + T_u) \times P_{std}}$$

$$Q_{sw} \text{ (ascf/hr)} = \frac{60 \text{ min}}{\text{hr}} \times \frac{5{,}833.74 \text{ acf}}{\text{min}} \times \frac{68.00 + 460\ ^oR}{1{,}285.70 + 460\ ^oR} \times \frac{29.49 \text{ in. Hg}}{29.92 \text{ in. Hg}} = \frac{104{,}346.05 \text{ ascf}}{\text{hr}}$$

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

EXAMPLE CALCULATIONS (Reference Method 4) [Values from Run 1 test]

Water Volume Weighed (scf)

$$V_{wsg\ (std)}(scf) = W_t \times K_5$$

$V_{wsg(std)}$ = 74.00 g x 0.04715 ft^3/g = 3.490 scf

Standard Meter Volume (dscf)

$$V_{m(std)}(dscf) = \frac{K_1 \times Y \times V_m \times \left(P_b + \frac{\Delta H_{avg}}{13.6}\right)}{(t_m)_{avg} + T_u}$$

$$V_{m(std)} = \frac{\frac{17.65\ ^oR}{in.\ Hg} \times 0.92 \times 49.25\ dcf \times \left(29.49\ in.\ Hg + \frac{1.70\ in.\ H_2O}{13.6\ in.\ H_2O / in.\ Hg}\right)}{75.55\ ^oF + 460\ ^oR} = 44.41\ dscf$$

Calculated Moisture Content (%)

$$B_{ws(calc)}(\%) = 100 \times \frac{V_{wsg(std)}}{V_{wsg(std)} + V_{m(std)}}$$

$$B_{ws(calc)} = 100 \times \frac{3.49\ dscf}{3.49\ dscf + 44.41\ dscf} = 7.28\ \%$$

Saturated Moisture Content (%)

$$B_{ws(svp)}(\%) = 100 \times \frac{10^{6.691 - \frac{3144}{t_{s(avg)} + 390.86}}}{P_b + \frac{P_{static}}{13.6}} \leq 100$$

$$B_{ws(svp)} = 100 \times \frac{10^{\left(6.691 - \frac{3144}{1285.70\ ^oF + 390.86}\right)}}{29.49\ in.\ Hg + \frac{0.00\ in.\ H_2O}{13.6\ in.\ H_2O / in.\ Hg}} \leq 100 = 100.00\ \%$$

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_{wa} = 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 B
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_{ga} = 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^{-5} (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_{amb} = ambient temperature, ^oF
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.

Nomenclature

- %CO = carbon monoxide concentration (%)
- $\%CO_2$ = carbon dioxide concentration (%)
- $\%N_2$ = nitrogen concentration (%)
- $\%O_2$ = oxygen concentration (%)
- $\%O_{2,wet}$ = Oxygen content of gas stream, % by volume of wet gas. (Note: The oxygen percentage used in Method 201A, Equation 3 is on a wet gas basis. That means that since oxygen is typically measured on a dry gas basis, the measured percent O2 must be multiplied by the quantity (1 - B_{ws}) to convert to the actual volume fraction. Therefore, $\%O_{2,wet} = (1 - B_{ws}) * \%O_{2,\ dry}$)
- $(\%EA)_{avg}$ = average excess air (%)
- $(F_o)_{avg}$ = average calculated fuel factor
- $[(\Delta p)^{0.5}]_{avg}$ = Average of square roots of the velocity pressures measured during the preliminary traverse, inches W.C.
- μ = Gas viscosity, micropoise
- 12.0 = Constant calculated as 60 percent of 20.5 square inch cross-sectional area of combined cyclone head, square inches
- 17.03 = mg/milliequivalents for ammonium ion
- 22.4 = liters of ideal gas per mol of substance at 0^oC and 1 atm (ref. Civil Engineering Reference Manual, 7th ed. - Michael R. Lindeburg)
- 5.02×10^4 = constant derived from the molecular weight and correcting standard temperature and pressure (ref. Bay Area Air Quality Management District, Source Test Procedure ST-1B, Ammonia Integrated Sampling, Adopted January 20, 1982, Regulation 7-303)
- A = distance upstream (in.)
- A_D = stack diameters upstream (dia.)
- An = Area of nozzle, square feet
- A_s = area of stack (ft^2)
- B = distance downstream (in.)
- B_D = stack diameters downstream (dia.)
- b_f = Average blockage factor calculated in Equation 26, dimensionless
- B_{wm} = meter moisture content (%)
- B_{ws} = stack moisture content (%)
- C = Cunningham correction factor for particle diameter, Dp, and calculated using the actual stack gas temperature, dimensionless
- C_1 = -150.3162 (micropoise)
- C_2 = 18.0614 (micropoise/$K^{0.5}$) = 13.4622 (micropoise/$R^{0.5}$)
- $C_3 = 1.19183 \times 10^6$ (micropoise/K^2) = 3.86153×10^6 (micropoise/R^2)
- C_4 = 0.591123 (micropoise)
- C_5 = 91.9723 (micropoise)
- $C_6 = 4.91705 \times 10^{-5}$ (micropoise/K^2) = 1.51761×10^{-5} (micropoise/R^2)
- C_a = Acetone blank concentration, mg/mg
- C_b = Concentration of NH3 ion in the back half of train (breakthrough)
- C_f = Concentration of NH3 ion in the front half of train (main catch)
- C_{fPM10} = Conc. of filterable PM_{10}, gr/dscf
- $C_{fPM2.5}$ = Conc. of filterable $PM_{2.5}$, gr/dscf
- C_k = K Factor Constant, 849.8
- C_n = nozzle diameter constant, 0.03575
- C_p' = Coefficient for the pitot used in the preliminary traverse, dimensionless

Nomenclature

- C_p = Pitot coefficient for the combined cyclone pitot, dimensionless
- C_{cpm} = Concentration of the condensable PM in the stack gas, dry basis, corrected to standard conditions, milligrams/dry standard cubic foot.
- C_r = Re-estimated Cunningham correction factor for particle diameter equivalent to the actual cut size diameter and calculated using the actual stack gas temperature, dimensionless
- D_{50} = Particle cut diameter, micrometers
- $D_{50(N+1)}$ = D_{50} value for cyclone IV calculated during the N+1 iterative step, micrometers
- $D_{50\text{-}1}$ = Re-calculated particle cut diameters based on re-estimated C_r, micrometers
- D_{50LL} = Cut diameter for cyclone I corresponding to the 2.25 micrometer cut diameter for cyclone IV, micrometer
- D_{50N} = D_{50} value for cyclone IV calculated during the Nth iterative step, micrometers
- D_{50T} = Cyclone I cut diameter corresponding to the middle of the overlap zone shown in Method 201A, Figure 10 of Section 17, micrometers
- D_e = equivalent stack diameter (in.)
- ΔH@ = ΔH @ 0.75 scfm (in. H2O)
- ΔH_{avg} = average orifice pressure (in. H_2O)
- D_n = Inner diameter of sampling nozzle mounted on Cyclone I, inches
- D_{na} = actual nozzle diameter (in.)
- D_p = Physical particle size, micrometers
- Δp = velocity head (in. H_2O)
- Δp_1 = velocity head at first current traverse point (in. H_2O)
- $\Delta p'_1$ = velocity head at first preliminary traverse point (in. H_2O)
- Δp_{avg} = average pitot tube differential pressure (in. H_2O)
- Δp_n = velocity head at subsequent current traverse point (in. H_2O)
- Δp_{RM2} = method 2 velocity head (in. H_2O)
- D_s = diameter of stack (in.)
- F_d = fuel f-factor (dscf/MMBtu)
- f_{O2} = stack gas fraction of O_2, by volume, dry basis
- I = Percent isokinetic sampling, dimensionless
- K_1 = standard volume correction, 17.65^{o}R/in. Hg
- K_4 = isokinetic conversion constant, 0.0945min•in.Hg/sec•^{o}R
- K_5 = water mass to std water vapor, 0.04715 ft^3/g
- K_p = 85.49, ((ft/sec)/(pounds/mole -^{o}R))
- L = length of stack (in.)
- L_{fw} = distance to far wall of stack (in.)
- L_{nw} = distance to near wall of stack (in.) [reference]
- $m_{\#x}$ = weight measurements (g)
- M_1 = Milligrams of PM collected on the filter, less than or equal to 2.5 micrometers
- M_2 = Milligrams of PM recovered from Container #2 (acetone blank corrected), greater than 10 micrometers
- M_3 = Milligrams of PM recovered from Container #3 (acetone blank corrected), less than or equal to 10 and greater than 2.5 micrometers
- M_4 = Milligrams of PM recovered from Container #4 (acetone blank corrected), less than or equal to 2.5 micrometers
- m_a = Mass of residue of acetone after evaporation, mg
- m_c = Mass of the NH4+ added to sample to form ammonium sulfate, mg

Nomenclature

- m_{cpm} = Mass of the total condensable PM, mg
- M_d = Molecular weight of dry gas, pounds/pound mole
- m_{fb} = Mass of total CPM in field train recovery blank, mg
- m_{fx} = final weight, avg of last two measurements (g)
- mg = Milligram
- mg/L = Milligram per liter
- m_i = Mass of inorganic CPM, mg
- m_{ib} = Mass of inorganic CPM in field train recovery blank, mg
- M_n = total particulates (mg)
- m_o = Mass of organic CPM, mg
- m_{ob} = Mass of organic CPM in field train blank, mg
- m_r = Mass of dried sample from inorganic fraction, mg
- m_{tx} = tare weight (g)
- MW = molecular weight (lb/lb-mole)
- M_w = Molecular weight of wet gas, pounds/pound mole
- N = Normality of ammonium hydroxide titrant
- N_a = null angle (deg.)
- N_{re} = Reynolds number, dimensionless
- N_{tp} = Number of iterative steps or total traverse points
- P_b = P_{bar} = barometric pressure (in. Hg)
- P_{bar} = barometric pressure (in. Hg)
- ppmCO = carbon monoxide concentration (ppm)
- ppmv = Parts per million by volume
- ppmw = Parts per million by weight
- P_s = absolute stack pressure (in. Hg)
- P_{static} = static pressure (in. H_2O)
- P_{std} = standard pressure, 29.92 in. Hg
- Θ = total sampling time (min)
- Q_{aw} = average stack wet flow rate (ascf/min)
- Q_I = Sampling rate for cyclone I to achieve specified D_{50}
- Q_m = estimated orifice flow rate, 0.750 acfm, else Vm/Q from previous run
- Q_s = Sampling rate for cyclone I to achieve specified D_{50}
- $Q_{s(std)}$ = total cyclone flow rate at standard conditions (dscf/min)
- Q_{sd} = dry standard stack flow rate (dscfm)
- Q_{sST} = Dry gas sampling rate through the sampling assembly, dscfm
- Q_{sw} = wet standard stack flow rate (ascfm)
- R_{max} = Nozzle/stack velocity ratio parameter, dimensionless
- R_{min} = Nozzle/stack velocity ratio parameter, dimensionless
- t_1 = Sampling time at point 1, min
- t_m = average gas meter temperature (^oF)
- t_m = average meter temperature (^oF)
- T_m = Meter box and orifice gas temperature, ^oR
- t_n = Sampling time at point n, min
- t_r = Total projected run time, min
- T_s = Absolute stack gas temperature, ^oR
- T_{std} = standard temperature, 68^oF, 528^oR

Nomenclature

- T_u = absolute temperature offset, 460°R
- V_a = Volume of acetone blank, ml
- V_{aw} = Volume of acetone used in sample recovery wash, ml
- V_b = Volume of aliquot taken for IC analysis, ml
- V_c = Quantity of water captured in impingers and silica gel, ml
- V_f = final impinger volume (ml)
- V_i = initial impinger volume (ml)
- V_{ic} = Volume of impinger contents sample, ml
- V_m = Dry gas meter volume sampled, acf
- $V_{m(std)}$ = standard meter volume (dscf)
- v_{max} = Maximum gas velocity calculated from Equations 18 or 19, ft/sec
- v_{max} = maximum nozzle velocity (ft/sec)
- V_{mf} = final dry gas meter reading (dcf)
- V_{mi} = initial dry gas meter reading (dcf)
- v_{min} = Minimum gas velocity calculated from Method 201A, Equations 16 or 17, ft/sec
- V_{ms} = Dry gas meter volume sampled, corrected to standard conditions, dscf
- v_n = Sample gas velocity in the nozzle, ft/sec
- v_{org} = organics wash volume (ml)
- V_p = Volume of water added during train purge
- v_s = average stack gas velocity (ft/sec)
- v_{sl} = local velocity (ft/sec)
- V_t = total impinger volume (ml) = ;(V_f-V_i)
- V_t = Volume of NH4OH titrant, ml
- $V_{w(std)}$ = volume of water vapor in gas sample at standard conditions (scf)
- v_x = blank volume (ml)
- W = width of stack (in.)
- $W_{2,3,4}$ = Weight of PM recovered from Containers #2, #3, and #4, mg
- W_a = Weight of blank residue in acetone used to recover samples, mg
- W_f = final impinger weight (g)
- W_i = initial impinger weight (g)
- W_t = total impinger weight (g) = ;(W_f-W_i)
- w_x = blank weight of solids (g)
- Y = meter calibration factor (a.k.a gamma)
- Z = Ratio between estimated cyclone IV D_{50} values, dimensionless
- γ = Dry gas meter gamma value, dimensionless
- ΔH = Meter box orifice pressure drop, inches W.C.
- ΔH@ = Pressure drop across orifice at flow rate of 0.75 scfm at standard conditions, inches W.C. (Note: Specific to each orifice and meter box.)
- Δp_1 = Velocity pressure measured at point 1, inches W.C.
- Δp_{avg} = Average velocity pressure, inches W.C.
- Δp_m = Observed velocity pressure using S-type pitot tube in preliminary traverse, inches W.C.
- Δp_{max} = Maximum velocity pressure, inches W.C.
- Δp_{min} = Minimum velocity pressure, inches W.C.
- Δp_n = Velocity pressure measured at point n during the test run, inches W.C.
- Δp_s = Velocity pressure calculated in Method 201a, Equation 25, inches W.C.
- Δp_{s1} = Velocity pressure adjusted for combined cyclone pitot tube, inches W.C.

Nomenclature

- Δp_{s2} = Velocity pressure corrected for blockage, inches W.C.
- θ = Total run time, min
- ρ_a = Density of acetone, mg/ml (see label on bottle)
- Σ_n = total number of sampling points

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)

$$C_{Gas} = \left(C_{Avg} - C_O\right) \times \left(\frac{C_{MA}}{C_M - C_O}\right)$$

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

$$E_{g/hp \cdot hr} = \frac{E_{lb/hr} \times 453.6}{mw \times 1314.022} \; or \; \frac{E_{lb/hr} \times 453.6}{hp}$$

APPENDIX B

EMISSION DATA RECORDS

John Zink Co, LLC

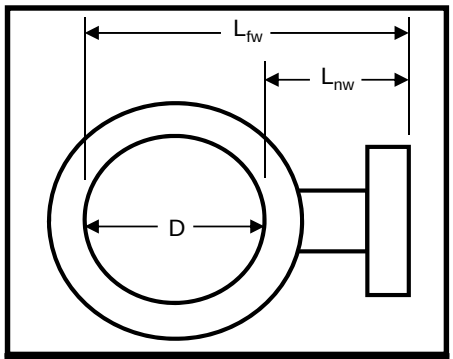
Air Permit # :	40 CFR 60 Sub Part OOOO
Plant Name or Location:	Tulsa R&D Facility
Date:	March 10, 2014
Project Number:	jz-13-tulsa.ok-comp#1
Manufacturer & Equipment:	ZTOF040X30PF
Test Load:	Multiple
Tester(s) / Test Unit(s):	MSL/TP/MM/ML/MW/210

		RUN											
	UNITS	**4.0X30PF R1**	**4.0X30PF R2**	**4.0X30PF R3**	**4.0X30PF R4**	**4.0X30PF R5**	**4.0X30PF R6**	**4.0X30PF R7**	**4.0X30PF R8**	**4.0X30PF R9**	**4.0X30PF R10**	**4.0X30PF R11**	**4.0X30PF R12**
Start Time	hh:mm:ss	13:16:00	15:27:00	16:48:00	08:40:00	10:00:00	11:23:00	13:19:00	16:30:00	08:40:04	10:27:04	12:50:04	14:05:04
End Time	hh:mm:ss	14:16:00	16:27:00	17:48:00	09:40:00	11:00:00	12:23:00	14:19:00	17:30:00	09:40:04	11:27:04	13:50:04	15:05:04
Bar. Pressure	in. Hg	29.49	29.41	29.40	30.21	30.26	30.26	30.26	30.20	30.19	30.20	30.15	30.09
Amb. Temp.	°F	83	87	84	53	60	66	58	72	57	63	66	71
Rel. Humidity	%	32	26	28	40	33	25	28	21	34	28	17	14
Spec. Humidity	lb water / lb air	0.007782	0.007200	0.007045	0.003355	0.003560	0.003330	0.002809	0.003443	0.003300	0.003365	0.002269	0.002222
Date	mm/dd/yy	03/11/14	03/11/14	03/11/14	03/12/14	03/12/14	03/12/14	03/12/14	03/12/14	03/13/14	03/13/14	03/13/14	03/13/14
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
Gross Fuel Heating Value	Btu/ft3	2,541	2,541	2,541	2,556	2,556	2,556	2,494	2,494	2,494	2,552	2,552	2,552
Stack Flow (M2)	dscfh	86,125	85,121	82,138	178,215	192,325	201,263	307,067	280,468	284,135	291,965	284,219	296,509
Stack Moisture	Method 4	7.28	6.40	5.31	5.34	5.43	5.43	6.37	5.99	5.25	5.83	6.36	6.08
Wind Speed	mph	5	5	5	5	14	12	6	9	1	3	8	5
Wind Direction	--	SE	S	S	N	N	N	NW	N	SW	SW	W	W
CO_2 - Method 3C	%	5.9	5.9	5.5	5.9	5.9	5.5	5.3	5.5	5.7	5.8	6.1	6.1
O_2 - Method 3C	%	14.0	14.0	14.6	14.0	14.0	14.6	15.4	14.7	14.3	14.2	13.9	13.9
N_2 -Method 3C	%	80.1	80.1	79.9	80.1	80.1	79.9	79.3	79.8	79.9	80.0	80.0	80.1
Excess Air	%	196.0	196.0	225.1	196.0	193.0	225.1	278.2	230.9	210.5	205.2	192.4	192.6

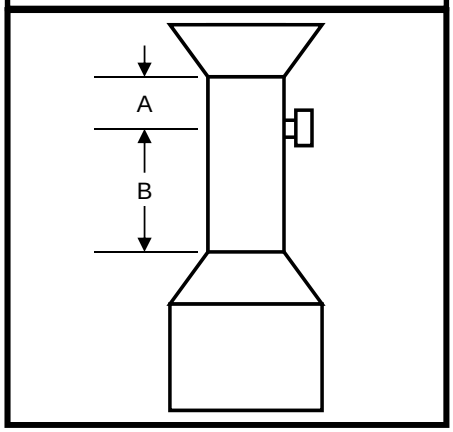
METHOD 1 - SAMPLE AND VELOCITY TRAVERSES FOR CIRCULAR SOURCES

Plant Name	John Zink Tulsa R&D Facility	**Date**	03/11/14
Sampling Location	4.0X30PF	**Stack Type**	Circular
Operator	TP	**Ports Available**	2
Project #	jz-14-tulsa.ok-comp#1	**Ports Used**	2
Stack Size	Large (>24 inch diameter)	**Port ID (inches)**	4.00

Circular Stack or Duct Diameter			
Distance to Far Wall of Stack	(L_{fw})	54.00	in
Distance to Near Wall of Stack	(L_{nw})	6.00	in
Diameter of Stack	(D)	48.00	in
Area of Stack	(A_s)	12.57	ft²



Distance from Port to Disturbances			
Distance Upstream	(A)	60.00	in
Diameters Upstream	(A_D)	1.25	diameters
Distance Downstream	(B)	288.00	in
Diameters Downstream	(B_D)	6.00	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		20	16
Downstream Spec		16	16
Traverse Pts Required		20	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**	10	**Across**
20	**Pts Used**	20	**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

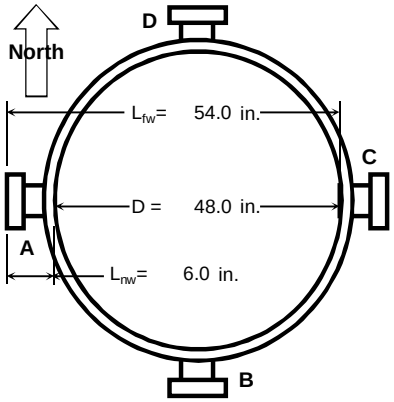
Traverse Point Locations			
Traverse Point Number	**Fraction of Stack Diameter**	**Distance from Inside Wall**	**Distance Including Reference Length**
		in	in
1	0.026	1 2/8	7 2/8
2	0.082	3 7/8	9 7/8
3	0.146	7	13
4	0.226	10 7/8	16 7/8
5	0.342	16 3/8	22 3/8
6	0.658	31 5/8	37 5/8
7	0.774	37 1/8	43 1/8
8	0.854	41	47
9	0.918	44 1/8	50 1/8
10	0.974	46 6/8	52 6/8

METHOD 1 - ISOKINETIC TRAVERSE FOR A CIRCULAR SOURCE

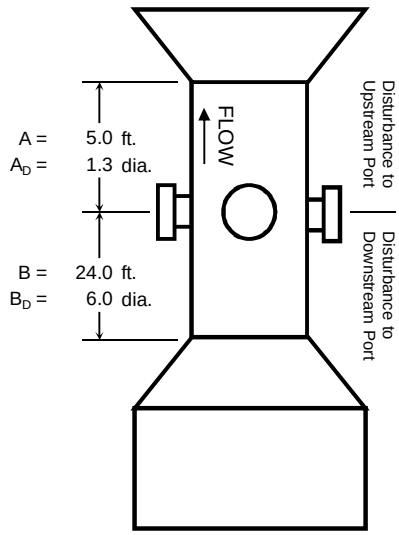
Company	John Zink Co. LLC	**Date**	03/11/14
Plant Name	John Zink Tulsa R&D Facility	**Project #**	jz-14-tulsa.ok-comp#1
Equipment	4.0X30PF	**# of Ports Available**	2
Location	Ports	**# of Ports Used**	2

Circular Stack or Duct Diameter			
Distance to Far Wall of Stack	(L_{fw})	54.00	in.
Distance to Near Wall of Stack	(L_{nw})	6.00	in.
Diameter of Stack	(D)	48.00	in.
Area of Stack	(A_s)	12.57	ft^2

Distance from Disturbances to Port			
Distance Upstream	(A)	60.00	in.
Diameters Upstream	(A_D)	1.25	diameters
Distance Downstream	(B)	288.00	in.
Diameters Downstream	(B_D)	6.00	diameters



Number of Traverse Points Required					
Diameters to Flow Disturbance		**Minimum Number of[1] Traverse Points**		Minimum Number of Traverse Points Comp Stratification	
Down (B_D) Stream	**Up (A_D) Stream**	**Particulate Points**	Velocity Points	Criteria	Points
2.00-4.99	0.50-1.24	24	16	○ RM 7E 8.1.2	12 RM1 pts
5.00-5.99	1.25-1.49	20	16	● OOOO Req.	3 points
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]	Minimum Number of Traverse Points RATA Stratification	
Upstream Spec		20	16		
Downstream Spec		16	12		
Traverse Pts Required		20	16	Criteria	Points
[1] Check Minimum Number of Points for the Upstream and Downstream conditions, then use the largest.				○ Part75/60	12 RM1 pts
				○ 75 abrv (a)	3 points
[2] 8 for Circular Stacks 12 to 24 inches 12 for Circular Stacks over 24 inches				○ 75 abrv (b)	6 points



Number of Traverse Points Used				
2	**Ports by**	3	**Pts / port**	**Gas Sampling**
1	**Pts Used**	3	**Required**	

Traverse Point Locations			
Traverse Point Number	**Percent of Stack Diameter**	**Distance from Inside Wall**	**Distance Including Reference Length**
	%	in.	in.
1	16.7%	8	14
2	50.0%	24	30
3	83.3%	40	46
4			
5			
6			
7			
8			
9			
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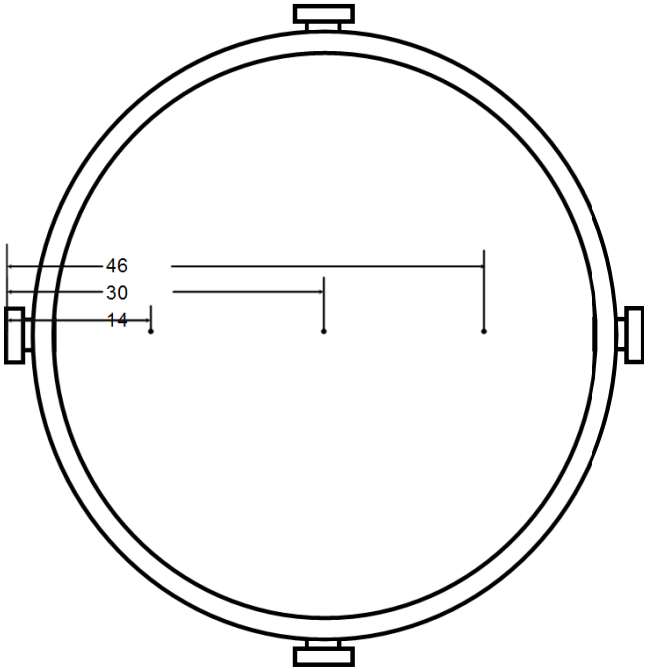


EMISSION DATA RECORDS

0-30-0% Ramp-up, Ramp-down Unit Operations Data

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE

Source Information	
Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Fuel Type	Gas, Propene

Test Information			
Project #		jz-14-tulsa.ok-comp#1	
Operator		TP	
Date for Preliminary Run	(mm/dd/yy)	03/11/14	
Standard Temperature		68	°F
Standard Pressure		29.92	in Hg
Required Sample Vol.	RM4, 8.1.1.2	21	scf
Run Duration	≤0.75 cfm	60	minutes
Unit Number		1	
Base Run Number		0-30-0%	
Number of Ports Available		2	
Number of Ports Used		2	
Port Inside Diameter		4.00	in
Stack Shape		Circular	

Test Equipment Information					
Run		**1**	**2**	**3**	
Test Date	(mm/dd/yy)	03/11/14	03/11/14	03/11/14	
Load	% or w/DB	0-30-0	0-30-0	0-30-0	
Meter Box Number	from ACS	SAMP-CP-0008	SAMP-CP-0008	SAMP-CP-0008	
Meter Calibration Factor	(Y)	0.924	0.924	0.924	
Orifice Meter Coefficient	($\Delta H_@$)	1.700	1.700	1.700	in H_2O
Pitot Identification	from ACS	A4174	A4174	A4174	
Pitot Tube Coefficient	(C_p)	0.819	0.819	0.819	
Probe Number	from ACS	SAMP-HP-0003	SAMP-HP-0003	SAMP-HP-0003	
Probe Length		60.0	60.0	60.0	in
(SS, Glass ….) Liner Material	from list	inconel	inconel	inconel	
Impinger Case Number	from ACS	SAMP-BC-0012	SAMP-BC-0012	SAMP-BC-0012	

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 4 (MOISTURE) [MULTI POINT, NO VARIATION] - RESULTS

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Historical Data	**0-30-0%-1**	**0-30-0%-2**	**0-30-0%-3**	**Average**	**Units**
Run Start Time	13:16	15:27	16:48		hh:mm
Run Stop Time	14:20	16:31	17:53		hh:mm
Test Date	03/11/14	03/11/14	03/11/14		mm/dd/yy
Meter Calibration Factor	0.924	0.924	0.924		
Pitot Tube Coefficient	0.819	0.819	0.819		
Initial Meter Volume	870.231	919.614	968.243		ft^3
Final Meter Volume	919.480	968.007	1017.562		ft^3
Total Meter Volume	49.249	48.393	49.319	48.987	ft^3
Total Sampling Time	60.00	60.00	60.00	60.00	min
Average Meter Temperature	75.55	78.40	79.95	77.97	°F
Average Stack Temperature	1285.70	1387.75	1403.00	1358.82	°F
Barometric Pressure	29.49	29.41	29.40	29.43	in Hg
Stack Static Pressure	0.00	0.00	0.00	0.00	in H_2O
Absolute Stack Pressure	29.49	29.41	29.40	29.43	in Hg
Average Orifice Pressure Drop	1.70	1.70	1.70	1.70	in H_2O
Absolute Meter Pressure	29.62	29.54	29.53	29.56	in Hg
Avg Square Root Pitot Pressure	0.08	0.07	0.07	0.07	√(in H_2O)
Moisture Content Data	**0-30-0%-1**	**0-30-0%-2**	**0-30-0%-3**	**Average**	**Units**
Impinger Water Weight Gain	60.40	54.60	48.80	54.60	g
Silica Gel Weight Gain	13.60	8.20	3.50	8.43	g
Total Water Volume Collected	74.13	62.91	52.39	63.15	ml
Standard Water Vapor Volume	3.49	2.96	2.47	2.97	scf
Standard Meter Volume	44.4	43.3	44.0	43.9	dscf
Calculated Stack Moisture	7.28	6.40	5.31	6.33	%
Saturated Stack Moisture	100.00	100.00	100.00	100.00	%
Reported Stack Moisture Content	7.28	6.40	5.31	6.33	%
Method 3C Gas Analysis Data	**0-30-0%-1**	**0-30-0%-2**	**0-30-0%-3**	**Average**	**Units**
Carbon Dioxide Content	5.9	5.9	5.5	5.8	%
Oxygen Content	14.0	14.0	14.6	14.2	%
Nitrogen Content	80.1	80.1	79.9	80.0	%
Stack Dry Molecular Weight	29.51	29.51	29.47	29.49	lb/lb-mole
Stack Wet Molecular Weight	28.67	28.77	28.86	28.77	lb/lb-mole
Percent Excess Air	196.0	196.0	225.1	205.7	%
Volumetric Flow Rate Data	**0-30-0%-1**	**0-30-0%-2**	**0-30-0%-3**	**Average**	**Units**
Average Stack Gas Velocity	7.74	7.63	7.34	7.57	ft/sec
Stack Cross-Sectional Area	12.57	12.57	12.57	12.57	ft^2
Actual Stack Flow Rate	5,834	5,750	5,532	5,705	acfm
Wet Standard Stack Flow Rate	104	97	92	98	wkscfh
Dry Standard Stack Flow Rate	96,745	90,702	87,523	91,656	dscfh

METHOD 3C - DETERMINATION OF DRY MOLECULAR WEIGHT BY ANALYZER

Plant Name	John Zink Tulsa R&D Facility	**Preliminary Date**	03/11/14		
Sampling Location	4.0X30PF	**Operator**	TP		
Project #	jz-14-tulsa.ok-comp#1	**# of Ports Used**	2		
Fuel Type	Gas, Propene	**Min. Fuel Factor**	N/A	**Max. Fuel Factor**	N/A

Gas Analysis Data									
Run Number	0-30-0%-1		**Date**	03/11/14	**Run Start Time**	13:16		**Run Stop Time**	14:20
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	$(F_o)_{avg}$		$(\%EA)_{avg}$	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:04	5.9	14.0	0.0	80.1	29.51	1.168		196.0	N/A

Gas Analysis Data									
Run Number	0-30-0%-2		**Date**	03/11/14	**Run Start Time**	15:27		**Run Stop Time**	16:31
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	$(F_o)_{avg}$		$(\%EA)_{avg}$	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:04	5.9	14.0	0.0	80.1	29.51	1.168		196.0	N/A

Gas Analysis Data									
Run Number	0-30-0%-3		**Date**	03/11/14	**Run Start Time**	16:48		**Run Stop Time**	17:53
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	$(F_o)_{avg}$		$(\%EA)_{avg}$	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:05	5.5	14.6	0.0	79.9	29.47	1.139		225.1	N/A

METHOD 4 - DETERMINATION OF MOISTURE CONTENT IN STACK GASES

Plant Name	John Zink Tulsa R&D Facility	**Preliminary Date**	03/11/14
Sampling Location	4.0X30PF	**Operator**	TP
Project #	jz-14-tulsa.ok-comp#1	**Ports Used**	2

Moisture Content Data									
Run Number		0-30-0%-1		**Date**	03/11/14	**Start Time**	13:16	**Stop Time**	14:20
Meter Box Number		SAMP-CP-0008				**Meter Cal Factor**	(Y)	0.924	
Total Meter Volume		(V_m)	49.249	dcf		**Barometric Pressure**	(P_b)	29.49	in Hg
Average Stack Temp		(t_s)$_{avg}$	1286	°F		**Stack Static Pressure**	(P_{static})	0.00	in H_2O
Average Meter Temp		(t_m)$_{avg}$	76	°F		**Avg Orifice Pressure**	(ΔH)$_{avg}$	1.70	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		H_2O	H_2O	-	Sil Gel				
Final Value	(V_f),(W_f)	717.30	730.70	577.70	862.40				
Initial Value	(V_i),(W_i)	677.40	716.10	571.80	848.80				
Net Value	(V_n),(W_n)	39.9	14.6	5.9	13.6				
Results									
Total Weight		(W_t)	74.00	g		**Water Vol Weighed**	($V_{wsg(std)}$)	3.489	scf
Std Meter Volume		($V_{m(std)}$)	44.407	dscf		**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content		($B_{ws(calc)}$)	7.28	%		**Final Moisture Content**	(B_{ws})	7.28	%

Moisture Content Data									
Run Number		0-30-0%-2		**Date**	03/11/14	**Start Time**	15:27	**Stop Time**	16:31
Meter Box Number		SAMP-CP-0008				**Meter Cal Factor**	(Y)	0.924	
Total Meter Volume		(V_m)	48.393	dcf		**Barometric Pressure**	(P_b)	29.41	in Hg
Average Stack Temp		(t_s)$_{avg}$	1388	°F		**Stack Static Pressure**	(P_{static})	0.00	in H_2O
Average Meter Temp		(t_m)$_{avg}$	78	°F		**Avg Orifice Pressure**	(ΔH)$_{avg}$	1.70	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		H_2O	H_2O	-	Sil Gel				
Final Value	(V_f),(W_f)	735.10	691.10	591.60	798.90				
Initial Value	(V_i),(W_i)	694.70	679.50	589.00	790.70				
Net Value	(V_n),(W_n)	40.4	11.6	2.6	8.2				
Results									
Total Weight		(W_t)	62.80	g		**Water Vol Weighed**	($V_{wsg(std)}$)	2.961	scf
Std Meter Volume		($V_{m(std)}$)	43.287	dscf		**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content		($B_{ws(calc)}$)	6.40	%		**Final Moisture Content**	(B_{ws})	6.40	%

Moisture Content Data									
Run Number		0-30-0%-3		**Date**	03/11/14	**Start Time**	16:48	**Stop Time**	17:53
Meter Box Number		SAMP-CP-0008				**Meter Cal Factor**	(Y)	0.924	
Total Meter Volume		(V_m)	49.319	dcf		**Barometric Pressure**	(P_b)	29.40	in Hg
Average Stack Temp		(t_s)$_{avg}$	1403	°F		**Stack Static Pressure**	(P_{static})	0.00	in H_2O
Average Meter Temp		(t_m)$_{avg}$	80	°F		**Avg Orifice Pressure**	(ΔH)$_{avg}$	1.70	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		H_2O	H_2O	-	Sil Gel				
Final Value	(V_f),(W_f)	756.10	739.10	579.30	865.90				
Initial Value	(V_i),(W_i)	717.30	730.70	577.70	862.40				
Net Value	(V_n),(W_n)	38.8	8.4	1.6	3.5				
Results									
Total Weight		(W_t)	52.30	g		**Water Vol Weighed**	($V_{wsg(std)}$)	2.466	scf
Std Meter Volume		($V_{m(std)}$)	43.974	dscf		**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content		($B_{ws(calc)}$)	5.31	%		**Final Moisture Content**	(B_{ws})	5.31	%

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Date	03/11/14
Operator	TP
Run Number	0-30-0%-1

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient	(C_p)	0.819	
Average Stack Temp	(t_s)	1285.7	°F
Average Meter Temp	(t_m)	75.6	
Orifice Meter Coefficient	($\Delta H@$)	1.700	in H_2O
Square Root ΔP	($\Delta p^{1/2}_{avg}$)	0.08	in H_2O
Stack Moisture Content	(B_{ws})	7.28	%
Stack Dry Molecular Weight	(M_d)	29.51	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.75	acfm
ΔP to ΔH Isokinetic Factor	(K)		

Leak Checks					
Train	**Pre**	0.000	ft³/min@	15.0	in Hg
PASS	**Post**	0.000	ft³/min@	15.0	in Hg
Pitot	**Pre (+)**	0.2	in H_2O for	15.0	sec
< 3.0	**Pre (-)**	0.1	in H_2O for	15.0	sec
	Post (+)	0.1	in H_2O for	15.0	sec
	Post (-)	0.2	in H_2O for	15.0	sec

Sampling Equipment			
Meter Box Number	SAMP-CP-0008		
Meter Cal Factor	(Y)	0.924	
Nozzle Number			
Average Nozzle Diameter	(D_{na})		in
Suggested Nozzle Diameter	(D_{ni})	0.5182	in
Probe Number	SAMP-HP-0003		in
Probe Length	60		in
Liner Material	inconel		
Sample Case / Oven Number			
Impinger Case Number	SAMP-BC-0012		

Pressures			
Barometric Pressure	(P_b)	29.49	in Hg
Stack Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	29.49	in Hg
Absolute Meter Pressure	(P_m)	29.62	in Hg

Nozzle Measurements				
Pre				**PASS**
Post				**PASS**

Run Time			
Start	13:16	**End**	14:20

Weights	**Imp 1**	**Imp 2**	**Imp 3**	**Imp 4**	**Imp 5**	**Imp 6**	**Imp 7**	**Imp 8**
Pre	677.4	716.1	571.8	848.8				
Post	717.3	730.7	577.7	862.4				

Wash Volumes					ml
					ml

Traverse Point #	**Sampling Time (Θ)**	**Timer Time**	**Dry Gas Meter Reading (V_m)**	**Velocity Head (Δp)**	**Desired Orifice ΔH (ΔH_d)**	**Actual Orifice ΔH (ΔH_a)**	**Stack Temp (t_s)**	**Snorkel Temp (248±25°F)**	**Filter Temp (248±25°F)**	**Impinger Exit Temp (≤68°F)**	**Cond. Temp (≤--°F)**	**CPM Filter Temp (--±--°F)**	**Meter Inlet Temp (t_{mi})**	**Meter Outlet Temp (t_{mo})**	**Pump Vacuum**	**Square Root ΔP ($\Delta p^{1/2}$)**	**Local Stack Velocity (v_s)$_l$**	**Cumul. Meter Volume (V_m)$_{std}$**	**Cumul. Percent IsoKinetic (I)**	**Est-Run Meter Volume (V_m)$_{std}$**
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	870.231	0.005	1.700	1.70	1200	240		68			75	72	3.0	0.07	6.94	2.099		41.981
A-2	3.0	00:03:00	872.550	0.005	1.700	1.70	1420	240		61			75	71	3.0	0.07	7.39	4.500		45.000
A-3	6.0	00:06:00	875.200	0.005	1.700	1.70	1436	240		60			76	71	3.0	0.07	7.42	6.527		43.517
A-4	9.0	00:09:00	877.440	0.008	1.700	1.70	1391	240		61			77	71	3.0	0.09	8.98	8.815		44.077
A-5	12.0	00:12:00	879.970	0.005	1.700	1.70	1349	240		63			78	71	2.5	0.07	7.25	11.056		44.224
A-6	15.0	00:15:00	882.450	0.005	1.700	1.70	1084	240		62			78	71	2.5	0.07	6.69	13.111		43.704
A-7	18.0	00:18:00	884.725	0.005	1.700	1.70	1289	240		61			80	72	2.5	0.07	7.12	15.305		43.729
A-8	21.0	00:21:00	887.160	0.005	1.700	1.70	1256	240		61			80	72	2.5	0.07	7.06	17.490		43.725
A-9	24.0	00:24:00	889.585	0.003	1.700	1.70	1305	240		61			80	72	2.5	0.05	5.54	20.549		45.663
A-10	27.0	00:27:00	892.980	0.001	1.700	1.70	1248	240		63			81	73	2.5	0.03	3.15	21.894		43.788
B-1	30.0	00:30:00	894.476	0.003	1.700	1.70	1350	240		65			78	74	10.0	0.05	5.61	24.123		43.859
B-2	33.0	00:33:00	896.950	0.005	1.700	1.70	1432	240		63			80	74	2.5	0.07	7.41	26.303		43.839
B-3	36.0	00:36:00	899.375	0.005	1.700	1.70	1437	240		64			79	74	2.5	0.07	7.42	28.891		44.448
B-4	39.0	00:39:00	902.250	0.005	1.700	1.70	1331	240		65			80	73	2.5	0.07	7.21	30.736		43.909
B-5	42.0	00:42:00	904.300	0.010	1.700	1.70	1166	240		65			80	73	2.5	0.10	9.71	32.870		43.826
B-6	45.0	00:45:00	906.670	0.005	1.700	1.70	1200	240		65			79	73	2.5	0.07	6.94	35.081		43.852
B-7	48.0	00:48:00	909.125	0.005	1.700	1.70	1198	240		66			79	73	2.5	0.07	6.94	37.356		43.948
B-8	51.0	00:51:00	911.650	0.005	1.700	1.70	1188	240		66			79	73	2.5	0.07	6.92	39.541		43.934
B-9	54.0	00:54:00	914.075	0.005	1.700	1.70	1215	240		66			80	73	2.5	0.07	6.97	41.769		43.967
B-10	57.0	00:57:00	916.550	0.050	1.700	1.70	1219	240		66			80	72	2.5	0.22	22.07	44.408		44.408
Last Pt	60.0	01:00:00	919.480																	
Final Val	60.0	01:00:00	919.480											**Max Vac**	10.0	**Final Values**		44.408		
Average Values				0.01		1.70	1286	240		64			79	72		0.08	7.74			
													76							

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Date	03/11/14
Operator	TP
Run Number	0-30-0%-2

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient	(C_p)	0.819	
Average Stack Temp	(t_s)	1387.8	°F
Average Meter Temp	(t_m)	78.4	
Orifice Meter Coefficient	($\Delta H@$)	1.700	in H_2O
Square Root ΔP	($\Delta p^{1/2}_{avg}$)	0.07	in H_2O
Stack Moisture Content	(B_{ws})	6.40	%
Stack Dry Molecular Weight	(M_d)	29.51	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.74	acfm
ΔP to ΔH Isokinetic Factor	(K)		

Leak Checks					
Train	**Pre**	0.000	ft³/min@	15.0	in Hg
PASS	**Post**	0.000	ft³/min@	15.0	in Hg
Pitot	**Pre (+)**	1.5	in H_2O for	15.0	sec
< 3.0	**Pre (-)**	1.5	in H_2O for	15.0	sec
	Post (+)	1.0	in H_2O for	15.0	sec
	Post (-)	1.0	in H_2O for	15.0	sec

Sampling Equipment			
Meter Box Number	SAMP-CP-0008		
Meter Cal Factor	(Y)	0.924	
Nozzle Number			
Average Nozzle Diameter	(D_{na})		in
Suggested Nozzle Diameter	(D_{ni})	0.5268	in
Probe Number	SAMP-HP-0004		in
Probe Length	60		in
Liner Material	inconel		
Sample Case / Oven Number			
Impinger Case Number	SAMP-BC-0012		

Pressures			
Barometric Pressure	(P_b)	29.41	in Hg
Stack Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	29.41	in Hg
Absolute Meter Pressure	(P_m)	29.54	in Hg

Nozzle Measurements				
Pre				**PASS**
Post				**PASS**

Run Time			
Start	15:27	**End**	16:31

Weights	**Imp 1**	**Imp 2**	**Imp 3**	**Imp 4**	**Imp 5**	**Imp 6**	**Imp 7**	**Imp 8**
Pre	694.7	679.5	589.0	790.7				
Post	735.1	691.1	591.6	798.9				

Wash Volumes					ml
					ml

Traverse Point #	**Sampling Time (Θ)**	**Timer Time**	**Dry Gas Meter Reading (V_m)**	**Velocity Head (Δp)**	**Desired Orifice ΔH (ΔH_d)**	**Actual Orifice ΔH (ΔH_a)**	**Stack Temp (t_s)**	**Snorkel Temp (248±25°F)**	**Filter Temp (248±25°F)**	**Impinger Exit Temp (≤68°F)**	**Cond. Temp (≤--°F)**	**CPM Filter Temp (--±--°F)**	**Meter Inlet Temp (t_{mi})**	**Meter Outlet Temp (t_{mo})**	**Pump Vacuum**	**Square Root ΔP ($\Delta p^{1/2}$)**	**Local Stack Velocity (v_s)$_l$**	**Cumul. Meter Volume (V_m)$_{std}$**	**Cumul. Percent IsoKinetic (I)**	**Est-Run Meter Volume (V_m)$_{std}$**
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	919.614	0.005	1.700	1.70	1130	240		66			79	74	3.5	0.07	6.79	2.223		44.452
A-2	3.0	00:03:00	922.090	0.005	1.700	1.70	1475	240		68			82	74	3.5	0.07	7.49	4.371		43.710
A-3	6.0	00:06:00	924.490	0.010	1.700	1.70	1450	240		68			82	74	3.5	0.10	10.52	6.519		43.462
A-4	9.0	00:09:00	926.890	0.010	1.700	1.70	1489	240		66			83	74	3.5	0.10	10.63	8.751		43.753
A-5	12.0	00:12:00	929.385	0.005	1.700	1.70	1337	240		63			82	74	3.5	0.07	7.22	10.854		43.417
A-6	15.0	00:15:00	931.735	0.005	1.700	1.70	1336	240		62			83	74	3.5	0.07	7.22	12.996		43.321
A-7	18.0	00:18:00	934.130	0.005	1.700	1.70	1505	240		63			80	74	3.5	0.07	7.55	15.199		43.425
A-8	21.0	00:21:00	936.586	0.005	1.700	1.70	1420	240		57			81	74	3.5	0.07	7.38	17.451		43.628
A-9	24.0	00:24:00	939.100	0.005	1.700	1.70	1489	240		60			81	74	3.5	0.07	7.52	19.647		43.659
A-10	27.0	00:27:00	941.550	0.005	1.700	1.70	1435	240		61			83	74	3.5	0.07	7.41	21.797		43.595
B-1	30.0	00:30:00	943.955	0.005	1.700	1.70	1426	240		60			80	74	3.5	0.07	7.40	23.766		43.211
B-2	33.0	00:33:00	946.150	0.005	1.700	1.70	1473	240		61			83	75	3.5	0.07	7.49	25.950		43.251
B-3	36.0	00:36:00	948.595	0.005	1.700	1.70	1430	240		61			83	74	3.5	0.07	7.40	28.048		43.150
B-4	39.0	00:39:00	950.940	0.005	1.700	1.70	1369	240		61			83	75	3.5	0.07	7.28	30.335		43.336
B-5	42.0	00:42:00	953.500	0.005	1.700	1.70	1190	240		62			83	75	3.5	0.07	6.92	32.390		43.187
B-6	45.0	00:45:00	955.800	0.005	1.700	1.70	1174	240		62			84	75	3.5	0.07	6.88	34.640		43.299
B-7	48.0	00:48:00	958.320	0.005	1.700	1.70	1473	240		62			84	75	3.5	0.07	7.49	36.737		43.220
B-8	51.0	00:51:00	960.670	0.005	1.700	1.70	1464	240		62			84	75	3.5	0.07	7.47	39.098		43.443
B-9	54.0	00:54:00	963.315	0.005	1.700	1.70	1440	240		63			84	75	3.5	0.07	7.42	41.094		43.256
B-10	57.0	00:57:00	965.550	0.005	1.700	1.70	1250	240		63			84	75	3.5	0.07	7.04	43.287		43.287
Last Pt	60.0	01:00:00	968.007																	
Final Val	60.0	01:00:00	968.007											**Max Vac**	3.5	**Final Values**		43.287		
Average Values				0.01		1.70	1388	240		63			82	74		0.07	7.63			
													78							

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Date	03/11/14
Operator	TP
Run Number	0-30-0%-3

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient	(C_p)	0.819	
Average Stack Temp	(t_s)	1403.0	°F
Average Meter Temp	(t_m)	80.0	
Orifice Meter Coefficient	($\Delta H@$)	1.700	in H_2O
Square Root ΔP	($\Delta p^{1/2}_{avg}$)	0.07	in H_2O
Stack Moisture Content	(B_{ws})	5.31	%
Stack Dry Molecular Weight	(M_d)	29.47	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.72	acfm
ΔP to ΔH Isokinetic Factor	(K)		

Leak Checks					
Train	**Pre**	0.000	ft³/min@	15.0	in Hg
PASS	**Post**	0.000	ft³/min@	15.0	in Hg
Pitot	**Pre (+)**	0.2	in H_2O for	15.0	sec
< 3.0	**Pre (-)**	0.3	in H_2O for	15.0	sec
	Post (+)	0.1	in H_2O for	15.0	sec
	Post (-)	0.2	in H_2O for	15.0	sec

Sampling Equipment			
Meter Box Number	SAMP-CP-0008		
Meter Cal Factor	(Y)	0.924	
Nozzle Number			
Average Nozzle Diameter	(D_{na})		in
Suggested Nozzle Diameter	(D_{ni})	0.5261	in
Probe Number	SAMP-HP-0005		in
Probe Length	60		in
Liner Material	inconel		
Sample Case / Oven Number			
Impinger Case Number	SAMP-BC-0012		

Pressures			
Barometric Pressure	(P_b)	29.40	in Hg
Stack Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	29.40	in Hg
Absolute Meter Pressure	(P_m)	29.53	in Hg

Nozzle Measurements				
Pre				**PASS**
Post				**PASS**

Run Time			
Start	16:48	**End**	17:53

Weights	Imp 1	Imp 2	Imp 3	Imp 4	Imp 5	Imp 6	Imp 7	Imp 8
Pre	717.3	730.7	577.7	862.4				
Post	756.1	739.1	579.3	865.9				

Wash Volumes					ml
					ml

Traverse Point #	Sampling Time (Θ)	Timer Time	Dry Gas Meter Reading (V_m)	Velocity Head (Δp)	Desired Orifice ΔH (ΔH_d)	Actual Orifice ΔH (ΔH_a)	Stack Temp (t_s)	Snorkel Temp (248±25°F)	Filter Temp (248±25°F)	Impinger Exit Temp (≤68°F)	Cond. Temp (≤--°F)	CPM Filter Temp (--±--°F)	Meter Inlet Temp (t_{mi})	Meter Outlet Temp (t_{mo})	Pump Vacuum	Square Root ΔP ($\Delta p^{1/2}$)	Local Stack Velocity (v_s)$_l$	Cumul. Meter Volume (V_m)$_{std}$	Cumul. Percent IsoKinetic (I)	Est-Run Meter Volume (V_m)$_{std}$
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	968.243	0.005	1.700	1.70	1337	240		58			83	76	2.5	0.07	7.21	2.340		46.796
A-2	3.0	00:03:00	970.865	0.005	1.700	1.70	1430	240		56			86	76	2.5	0.07	7.39	4.640		46.402
A-3	6.0	00:06:00	973.450	0.005	1.700	1.70	1472	240		57			85	76	2.5	0.07	7.47	6.618		44.117
A-4	9.0	00:09:00	975.670	0.005	1.700	1.70	1508	240		58			86	76	2.5	0.07	7.54	8.682		43.410
A-5	12.0	00:12:00	977.990	0.005	1.700	1.70	1514	240		59			84	77	2.5	0.07	7.56	10.847		43.386
A-6	15.0	00:15:00	980.420	0.005	1.700	1.70	1251	240		60			84	77	2.5	0.07	7.03	13.096		43.652
A-7	18.0	00:18:00	982.945	0.005	1.700	1.70	1461	240		60			85	76	2.5	0.07	7.45	15.385		43.956
A-8	21.0	00:21:00	985.515	0.005	1.700	1.70	1459	240		60			86	77	2.5	0.07	7.45	17.812		44.530
A-9	24.0	00:24:00	988.245	0.005	1.700	1.70	1422	240		60			84	77	2.5	0.07	7.38	19.976		44.392
A-10	27.0	00:27:00	990.675	0.005	1.700	1.70	1202	240		61			84	77	2.5	0.07	6.93	21.958		43.916
B-1	30.0	00:30:00	992.900	0.005	1.700	1.70	1452	240		63			80	76	2.5	0.07	7.44	24.253		44.097
B-2	33.0	00:33:00	995.465	0.005	1.700	1.70	1471	240		60			84	76	2.5	0.07	7.47	26.357		43.929
B-3	36.0	00:36:00	997.825	0.005	1.700	1.70	1474	240		61			84	77	2.5	0.07	7.48	28.602		44.003
B-4	39.0	00:39:00	1000.345	0.005	1.700	1.70	1299	240		62			84	76	2.5	0.07	7.13	30.702		43.860
B-5	42.0	00:42:00	1002.700	0.005	1.700	1.70	1312	240		61			84	76	2.5	0.07	7.16	32.975		43.967
B-6	45.0	00:45:00	1005.250	0.005	1.700	1.70	1513	240		61			83	76	2.5	0.07	7.55	35.103		43.879
B-7	48.0	00:48:00	1007.635	0.005	1.700	1.70	1529	240		61			82	75	2.5	0.07	7.58	37.289		43.870
B-8	51.0	00:51:00	1010.080	0.005	1.700	1.70	1484	240		62			82	75	2.5	0.07	7.50	39.529		43.921
B-9	54.0	00:54:00	1012.585	0.005	1.700	1.70	1280	240		61			83	75	2.5	0.07	7.09	41.909		44.115
B-10	57.0	00:57:00	1015.250	0.005	1.700	1.70	1190	240		62			83	75	2.5	0.07	6.91	43.974		43.974
Last Pt	60.0	01:00:00	1017.562																	
Final Val	60.0	01:00:00	1017.562											**Max Vac**	2.5	**Final Values**		43.974		
Average Values				0.01		1.70	1403	240		60			84	76		0.07	7.34			
													80							

John Zink Co, LLC
March 11, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	7.3	%
Stack Exhaust Flow (M2)	86,125	SCFH

Weather Data

Barometric Pressure	29.49	in. Hg
Relative Humidity	32	%
Ambient Temperature	83	^{o}F
Specific Humidity	0.007782	lb H_2O / lb air

0-30-0 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
A1	03/11/14 13:16:00	85770	12.18	8.83	0.24	6.31	4.43	86.82	525.16
	03/11/14 13:16:30	85800	12.83	8.99	0.34	5.95	4.43	86.82	524.76
	03/11/14 13:17:00	85830	11.99	10.07	0.35	6.48	4.43	86.37	525.16
	03/11/14 13:17:30	85860	12.39	9.53	0.26	6.24	4.43	85.92	524.43
	03/11/14 13:18:00	85890	12.80	7.38	0.22	6.03	15.22	85.92	796.30
	03/11/14 13:18:30	85920	13.82	6.53	0.10	5.23	27.13	86.37	1,275.58
	03/11/14 13:19:00	85950	13.31	8.33	0.09	5.42	28.23	87.27	1,298.59
	03/11/14 13:19:30	85980	12.40	4.71	0.08	6.23	27.13	87.72	1,284.40
	03/11/14 13:20:00	86010	12.34	3.02	0.08	6.33	27.13	87.72	1,305.08
	03/11/14 13:20:30	86040	12.64	1.76	0.08	6.08	27.13	88.17	1,299.18
	03/11/14 13:21:00	86070	12.72	0.90	0.09	6.05	27.13	88.17	1,301.85
	03/11/14 13:21:30	86100	12.98	0.44	0.08	5.86	27.13	88.62	1,299.40
	03/11/14 13:22:00	86130	12.82	0.36	0.07	5.92	27.13	88.62	1,298.90
	03/11/14 13:22:30	86160	12.70	0.11	0.08	5.99	27.13	89.07	1,295.79
	03/11/14 13:23:00	86190	12.75	-0.05	0.08	5.99	27.68	89.07	1,298.80
	03/11/14 13:23:30	86220	12.84	-0.14	0.08	5.93	26.57	89.52	1,300.32
	03/11/14 13:24:00	86250	12.80	-0.01	0.09	5.95	26.57	89.52	1,296.46
	03/11/14 13:24:30	86280	12.81	-0.05	0.08	5.95	26.57	89.52	1,297.75
	03/11/14 13:25:00	86310	12.93	-0.13	0.07	5.84	26.57	89.07	1,298.85
	03/11/14 13:25:30	86340	12.83	-0.09	0.07	5.93	26.57	89.07	1,296.92
	03/11/14 13:26:00	86370	12.85	-0.20	0.08	5.88	26.57	89.52	1,295.55
	03/11/14 13:26:30	86400	12.87	-0.15	0.07	5.92	26.57	89.52	1,292.59
	03/11/14 13:27:00	86430	12.95	-0.13	0.08	5.84	26.57	89.52	1,291.58
	03/11/14 13:27:30	86460	12.80	-0.08	0.08	5.92	26.57	89.52	1,293.74
	03/11/14 13:28:00	86490	12.85	-0.02	0.08	5.92	27.13	89.52	1,301.43
	03/11/14 13:28:30	86520	12.68	-0.22	0.07	6.02	26.57	89.07	1,304.56
	03/11/14 13:29:00	86550	12.65	-0.20	0.08	6.07	26.57	89.07	1,298.96
	03/11/14 13:29:30	86580	13.24	0.06	0.09	5.84	2.77	88.62	494.26
	03/11/14 13:30:00	86610	14.95	12.02	0.11	4.28	3.88	88.17	526.73
	03/11/14 13:30:30	86640	13.58	10.80	0.17	5.44	4.43	87.72	523.10
	03/11/14 13:31:00	86670	13.20	0.30	0.27	5.56	4.43	87.72	525.90
	03/11/14 13:31:30	86700	12.13	1.11	0.23	6.35	4.43	87.72	525.22
	03/11/14 13:32:00	86730	11.03	0.28	0.17	7.01	4.43	87.72	523.74
	03/11/14 13:32:30	86760	13.17	-0.30	0.32	5.82	23.25	88.17	898.09
	03/11/14 13:33:00	86790	11.89	-0.30	0.13	6.48	28.79	89.07	1,306.64
	03/11/14 13:33:30	86820	12.01	-0.46	0.07	6.54	27.68	89.52	1,301.51
	03/11/14 13:34:00	86850	12.46	-0.46	0.07	6.25	27.68	89.52	1,301.76
	03/11/14 13:34:30	86880	12.10	-0.45	0.05	6.47	27.68	89.97	1,299.90
	03/11/14 13:35:00	86910	12.20	-0.46	0.08	6.40	27.68	89.97	1,302.02
	03/11/14 13:35:30	86940	12.27	-0.46	0.08	6.34	27.68	90.42	1,298.62
	03/11/14 13:36:00	86970	12.15	-0.42	0.06	6.40	27.13	90.87	1,301.96
A2	03/11/14 13:36:30	87000	12.01	-0.40	0.05	6.47	27.13	90.87	1,299.08
	03/11/14 13:37:00	87030	12.33	-0.40	0.08	6.35	27.13	90.87	1,296.87
	03/11/14 13:37:30	87060	12.46	-0.32	0.07	6.18	27.13	90.87	1,297.97
	03/11/14 13:38:00	87090	12.31	-0.45	0.06	6.33	27.13	91.32	1,299.35
	03/11/14 13:38:30	87120	12.44	-0.42	0.08	6.20	27.13	91.32	1,299.08
	03/11/14 13:39:00	87150	12.84	-0.32	0.08	6.00	27.13	91.77	1,294.74
	03/11/14 13:39:30	87180	13.32	0.33	0.07	5.55	26.57	91.77	1,294.06
	03/11/14 13:40:00	87210	13.11	0.85	0.07	5.70	27.13	91.77	1,297.64
	03/11/14 13:40:30	87240	12.12	0.24	0.07	6.38	27.13	91.77	1,293.47
	03/11/14 13:41:00	87270	12.30	-0.39	0.08	6.37	4.43	91.77	551.54
	03/11/14 13:41:30	87300	14.84	4.56	0.18	4.66	28.79	91.32	1,343.03
	03/11/14 13:42:00	87330	13.18	15.81	0.08	5.63	26.57	91.77	1,299.92
	03/11/14 13:42:30	87360	12.50	1.18	0.08	6.23	26.57	91.77	1,298.65

John Zink Co, LLC
March 11, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	7.3	%
Stack Exhaust Flow (M2)	86,125	SCFH

Weather Data

Barometric Pressure	29.49	in. Hg
Relative Humidity	32	%
Ambient Temperature	83	^{o}F
Specific Humidity	0.007782	lb H_2O / lb air

0-30-0 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
	03/11/14 13:43:00	87390	12.27	-0.19	0.05	6.42	26.57	92.21	1,299.81
	03/11/14 13:43:30	87420	12.95	0.01	0.07	5.98	26.57	92.21	1,296.48
	03/11/14 13:44:00	87450	12.71	0.19	0.08	6.10	26.57	92.21	1,297.75
	03/11/14 13:44:30	87480	12.85	0.20	0.08	5.97	32.39	92.21	1,344.11
	03/11/14 13:45:00	87510	11.80	0.11	0.08	6.52	2.77	92.21	474.37
	03/11/14 13:45:30	87540	11.63	-0.29	0.13	7.06	3.88	91.77	520.49
	03/11/14 13:46:00	87570	13.99	-0.28	0.19	5.13	3.88	91.32	523.68
	03/11/14 13:46:30	87600	13.73	-0.25	0.14	5.31	3.88	90.87	523.01
	03/11/14 13:47:00	87630	13.78	-0.19	0.16	5.26	3.32	90.42	522.42
	03/11/14 13:47:30	87660	13.84	-0.16	0.15	5.12	14.67	89.97	996.29
	03/11/14 13:48:00	87690	12.98	-0.01	0.15	5.77	27.68	90.87	1,309.12
	03/11/14 13:48:30	87720	12.55	-0.09	0.08	6.25	26.57	91.32	1,296.66
	03/11/14 13:49:00	87750	12.66	0.00	0.06	6.09	26.57	91.77	1,296.48
	03/11/14 13:49:30	87780	12.66	0.18	0.07	6.12	26.57	92.21	1,299.48
	03/11/14 13:50:00	87810	12.84	0.14	0.06	5.97	26.57	92.21	1,299.48
	03/11/14 13:50:30	87840	12.83	-0.05	0.06	5.99	26.57	92.66	1,300.21
	03/11/14 13:51:00	87870	12.68	0.23	0.07	6.09	26.02	92.66	1,296.98
	03/11/14 13:51:30	87900	12.68	0.38	0.07	6.05	26.57	92.66	1,298.04
	03/11/14 13:52:00	87930	12.73	0.39	0.07	6.06	26.57	92.21	1,298.47
	03/11/14 13:52:30	87960	12.94	0.38	0.08	5.88	26.57	92.21	1,294.53
	03/11/14 13:53:00	87990	13.14	0.14	0.08	5.76	26.57	92.66	1,298.31
	03/11/14 13:53:30	88020	13.06	0.30	0.08	5.76	26.57	92.66	1,297.25
	03/11/14 13:54:00	88050	12.77	1.90	0.07	5.99	26.57	92.66	1,297.25
	03/11/14 13:54:30	88080	13.08	0.61	0.07	5.78	26.57	92.66	1,298.58
	03/11/14 13:55:00	88110	13.17	0.06	0.08	5.72	26.57	92.66	1,294.76
	03/11/14 13:55:30	88140	13.13	0.40	0.07	5.72	26.57	92.66	1,297.94
	03/11/14 13:56:00	88170	13.20	0.19	0.08	5.67	27.13	92.66	1,297.56
A3	03/11/14 13:56:30	88200	12.83	-0.04	0.08	5.91	26.57	92.66	1,296.54
	03/11/14 13:57:00	88230	12.72	-0.01	0.08	6.01	27.13	92.66	1,294.18
	03/11/14 13:57:30	88260	12.82	-0.07	0.07	5.93	26.57	92.66	1,296.94
	03/11/14 13:58:00	88290	12.70	-0.09	0.07	6.01	26.57	92.66	1,294.40
	03/11/14 13:58:30	88320	12.67	-0.11	0.08	6.01	26.02	92.66	1,296.52
	03/11/14 13:59:00	88350	12.79	-0.14	0.08	5.98	25.47	92.66	1,292.66
	03/11/14 13:59:30	88380	12.76	-0.11	0.07	5.95	1.66	93.11	419.46
	03/11/14 14:00:00	88410	14.47	0.86	0.20	4.97	3.88	92.66	509.60
	03/11/14 14:00:30	88440	12.14	6.33	0.18	6.05	3.88	92.21	511.58
	03/11/14 14:01:00	88470	13.26	0.19	0.29	5.54	3.88	92.21	509.75
	03/11/14 14:01:30	88500	12.54	-0.39	0.26	6.23	3.32	91.77	511.09
	03/11/14 14:02:00	88530	13.56	-0.39	0.32	5.37	3.88	91.77	511.01
	03/11/14 14:02:30	88560	14.07	-0.35	0.34	4.92	14.67	91.77	1,010.75
	03/11/14 14:03:00	88590	12.73	-0.34	0.21	5.95	27.13	92.21	1,299.53
	03/11/14 14:03:30	88620	12.73	-0.17	0.08	6.05	26.57	92.66	1,301.99
	03/11/14 14:04:00	88650	12.78	-0.08	0.08	6.03	26.57	92.66	1,296.83
	03/11/14 14:04:30	88680	12.60	0.02	0.06	6.14	26.02	92.66	1,296.44
	03/11/14 14:05:00	88710	12.56	-0.25	0.06	6.15	26.02	92.66	1,298.35
	03/11/14 14:05:30	88740	12.58	-0.32	0.07	6.18	25.47	92.66	1,296.02
	03/11/14 14:06:00	88770	12.78	-0.13	0.08	5.99	25.47	92.66	1,296.50
	03/11/14 14:06:30	88800	13.28	0.09	0.08	5.68	25.47	93.11	1,299.30
	03/11/14 14:07:00	88830	13.08	0.43	0.07	5.81	26.02	93.11	1,298.41
	03/11/14 14:07:30	88860	13.15	0.51	0.07	5.76	25.47	93.11	1,296.08
	03/11/14 14:08:00	88890	13.12	0.96	0.07	5.76	26.02	93.11	1,296.54
	03/11/14 14:08:30	88920	12.96	0.43	0.08	5.88	25.47	93.11	1,298.24
	03/11/14 14:09:00	88950	12.99	0.17	0.09	5.80	24.91	92.66	1,296.94
	03/11/14 14:09:30	88980	12.89	-0.06	0.06	5.95	25.47	92.66	1,294.18

John Zink Co, LLC
March 11, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	7.3	%
Stack Exhaust Flow (M2)	86,125	SCFH

Weather Data

Barometric Pressure	29.49	in. Hg
Relative Humidity	32	%
Ambient Temperature	83	^{o}F
Specific Humidity	0.007782	lb H_2O / lb air

0-30-0 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
03/11/14 14:10:00	89010	13.06	0.23	0.09	5.77	24.91	93.11	1,298.72
03/11/14 14:10:30	89040	12.92	0.36	0.08	5.89	24.91	93.11	1,298.08
03/11/14 14:11:00	89070	12.89	0.26	0.06	5.91	25.47	93.11	1,293.80
03/11/14 14:11:30	89100	13.09	0.46	0.08	5.79	25.47	93.11	1,298.08
03/11/14 14:12:00	89130	12.95	0.42	0.07	5.83	24.91	93.11	1,294.22
03/11/14 14:12:30	89160	12.92	0.23	0.08	5.87	24.91	93.11	1,299.36
03/11/14 14:13:00	89190	13.02	0.37	0.07	5.83	25.47	93.11	1,294.05
03/11/14 14:13:30	89220	12.89	0.47	0.07	5.91	24.91	93.11	1,296.39
03/11/14 14:14:00	89250	12.91	0.34	0.06	5.90	24.91	93.56	1,295.11
03/11/14 14:14:30	89280	12.95	0.42	0.05	5.84	25.47	93.56	1,296.81
03/11/14 14:15:00	89310	13.11	0.07	0.09	5.86	2.77	93.56	521.69
03/11/14 14:15:30	89340	15.16	0.37	0.28	4.31	2.77	93.11	496.59
03/11/14 14:16:00	89370	14.67	-0.14	0.26	4.54	2.77	92.66	501.33
RAW AVERAGE		**12.87**	**1.04**	**0.11**	**5.91**	**21.57**	**91.04**	**1,123.89**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	INST-22-0004	INST-CO-0022	INST-TH-0009	INST-C2-0016	F-13 LINE 2-3-4 PRESS	F-13 Line 1-3 TE	F-13 Line Orifice
		(%)	(ppmvd)	(ppmvw)	(%)	(in. H_2O)	(^{o}F)	(SCFH)
Bias	**Initial Zero**	0.07	0.01	-0.01	0.04			
	Final Zero	0.01	0.05	0.01	0.01			
	Avg. Zero	0.04	0.03	0.00	0.03			
	Initial UpScale	12.11	8.78	3.14	9.40			
	Final UpScale	12.02	8.46	3.00	9.31			
	Avg. UpScale	12.07	8.62	3.07	9.36			
Upscale Cal Gas		12.00	8.98	3.04	9.42			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.80	1.06	0.12	5.94
Corrected Raw Average (ppm/% wet basis)	11.87	0.98	0.11	5.51
Emission Rate (lb/hr)	N/A	0.01	0.00	N/A

John Zink Co, LLC
March 11, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	6.4	%
Stack Exhaust Flow (M2)	85,121	SCFH

Weather Data

Barometric Pressure	29.41	in. Hg
Relative Humidity	26	%
Ambient Temperature	87	^{o}F
Specific Humidity	0.007200	lb H_2O / lb air

0-30-0 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
A1	03/11/14 15:27:00	93630	13.64	8.21	0.07	5.52	2.21	91.32	526.73
	03/11/14 15:27:30	93660	12.60	5.04	0.09	6.14	2.77	90.87	527.15
	03/11/14 15:28:00	93690	12.12	2.35	0.11	6.69	2.77	90.87	526.89
	03/11/14 15:28:30	93720	12.54	1.27	0.11	6.24	2.77	90.42	526.89
	03/11/14 15:29:00	93750	12.65	0.72	0.13	6.21	5.81	90.42	527.99
	03/11/14 15:29:30	93780	12.32	0.66	0.08	6.48	28.79	90.87	1,346.41
	03/11/14 15:30:00	93810	12.93	1.96	0.07	6.10	27.13	91.77	1,310.37
	03/11/14 15:30:30	93840	12.57	1.83	0.06	6.41	26.02	91.77	1,311.03
	03/11/14 15:31:00	93870	12.40	1.63	0.06	6.59	26.57	91.77	1,308.75
	03/11/14 15:31:30	93900	12.78	1.46	0.06	6.37	26.02	92.21	1,309.61
	03/11/14 15:32:00	93930	12.95	1.34	0.04	6.17	26.57	92.21	1,308.81
	03/11/14 15:32:30	93960	12.95	1.15	0.06	6.17	26.02	92.66	1,311.84
	03/11/14 15:33:00	93990	12.87	0.95	0.07	6.21	26.57	92.66	1,311.68
	03/11/14 15:33:30	94020	12.87	0.81	0.06	6.23	26.02	92.66	1,311.92
	03/11/14 15:34:00	94050	12.80	0.69	0.06	6.27	26.02	93.11	1,307.59
	03/11/14 15:34:30	94080	12.84	0.55	0.06	6.26	26.02	93.11	1,304.22
	03/11/14 15:35:00	94110	12.66	0.61	0.05	6.40	26.02	93.11	1,305.27
	03/11/14 15:35:30	94140	12.66	0.51	0.05	6.42	26.02	93.11	1,305.95
	03/11/14 15:36:00	94170	12.68	0.49	0.06	6.39	26.02	93.11	1,307.02
	03/11/14 15:36:30	94200	12.82	0.35	0.06	6.32	26.02	93.11	1,306.59
	03/11/14 15:37:00	94230	12.84	0.19	0.07	6.26	25.47	93.56	1,307.68
	03/11/14 15:37:30	94260	12.79	0.10	0.07	6.30	26.02	93.56	1,304.13
	03/11/14 15:38:00	94290	12.80	0.07	0.06	6.30	25.47	93.56	1,306.91
	03/11/14 15:38:30	94320	12.78	0.07	0.06	6.31	26.02	94.01	1,306.68
	03/11/14 15:39:00	94350	12.80	0.09	0.06	6.32	26.57	94.46	1,305.05
	03/11/14 15:39:30	94380	12.89	0.03	0.07	6.24	25.47	94.46	1,304.62
	03/11/14 15:40:00	94410	12.77	-0.01	0.06	6.31	25.47	94.46	1,303.55
	03/11/14 15:40:30	94440	12.73	0.00	0.06	6.37	25.47	94.46	1,304.64
	03/11/14 15:41:00	94470	12.85	-0.01	0.05	6.29	25.47	94.46	1,303.77
	03/11/14 15:41:30	94500	12.94	0.10	0.07	6.24	2.21	93.56	518.44
	03/11/14 15:42:00	94530	13.50	0.98	0.07	5.82	2.21	93.11	520.69
	03/11/14 15:42:30	94560	13.40	0.99	0.09	5.68	2.77	92.66	521.34
	03/11/14 15:43:00	94590	13.29	0.22	0.13	5.81	2.21	92.21	522.80
	03/11/14 15:43:30	94620	12.76	0.03	0.13	6.05	2.77	91.77	521.14
	03/11/14 15:44:00	94650	13.18	-0.15	0.17	5.94	2.77	91.32	523.03
	03/11/14 15:44:30	94680	13.94	-0.17	0.24	5.33	2.77	91.32	522.28
	03/11/14 15:45:00	94710	13.92	-0.23	0.23	5.27	20.48	90.87	1,123.79
	03/11/14 15:45:30	94740	13.25	-0.19	0.13	5.78	28.23	91.77	1,315.90
	03/11/14 15:46:00	94770	13.03	0.27	0.07	6.03	27.13	92.21	1,304.95
	03/11/14 15:46:30	94800	12.80	-0.01	0.06	6.30	26.57	92.66	1,304.58
	03/11/14 15:47:00	94830	12.77	-0.04	0.06	6.34	26.02	92.66	1,304.00
A2	03/11/14 15:47:30	94860	12.82	-0.03	0.06	6.34	26.57	92.66	1,301.63
	03/11/14 15:48:00	94890	12.83	-0.03	0.05	6.28	26.57	93.11	1,305.04
	03/11/14 15:48:30	94920	12.68	-0.03	0.05	6.15	26.57	93.11	1,302.97
	03/11/14 15:49:00	94950	12.57	-0.18	0.05	6.13	26.02	93.11	1,303.61
	03/11/14 15:49:30	94980	12.83	-0.28	0.06	5.94	26.57	93.11	1,304.70
	03/11/14 15:50:00	95010	12.83	-0.06	0.06	5.95	26.02	93.11	1,304.30
	03/11/14 15:50:30	95040	12.85	-0.14	0.05	5.96	25.47	93.56	1,304.10
	03/11/14 15:51:00	95070	12.85	-0.11	0.06	5.92	25.47	94.01	1,303.06
	03/11/14 15:51:30	95100	12.85	-0.12	0.06	5.94	25.47	94.01	1,300.50
	03/11/14 15:52:00	95130	12.91	-0.24	0.05	5.91	25.47	94.46	1,300.71

John Zink Co, LLC
March 11, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	6.4	%
Stack Exhaust Flow (M2)	85,121	SCFH

Weather Data

Barometric Pressure	29.41	in. Hg
Relative Humidity	26	%
Ambient Temperature	87	^{o}F
Specific Humidity	0.007200	lb H_2O / lb air

0-30-0 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
	03/11/14 15:52:30	95160	13.01	0.06	0.05	5.84	25.47	94.46	1,301.18
	03/11/14 15:53:00	95190	12.84	0.20	0.05	5.95	26.02	94.46	1,301.82
	03/11/14 15:53:30	95220	12.80	0.00	0.05	5.97	26.02	94.91	1,305.46
	03/11/14 15:54:00	95250	12.68	-0.11	0.04	6.06	26.02	94.91	1,299.92
	03/11/14 15:54:30	95280	12.68	-0.11	0.04	6.04	26.02	94.91	1,305.46
	03/11/14 15:55:00	95310	12.66	-0.06	0.06	6.08	25.47	94.46	1,302.48
	03/11/14 15:55:30	95340	13.06	0.07	0.06	5.93	2.77	94.01	519.82
	03/11/14 15:56:00	95370	13.51	6.34	0.09	5.21	2.77	93.56	520.87
	03/11/14 15:56:30	95400	11.65	1.45	0.10	6.73	2.21	93.11	521.10
	03/11/14 15:57:00	95430	11.54	-0.25	0.12	6.80	2.21	92.66	524.91
	03/11/14 15:57:30	95460	12.16	-0.18	0.11	6.31	2.21	92.66	521.25
	03/11/14 15:58:00	95490	12.00	-0.08	0.07	6.49	2.21	92.21	523.42
	03/11/14 15:58:30	95520	12.74	-0.26	0.08	6.05	2.77	92.21	525.23
	03/11/14 15:59:00	95550	12.78	-0.16	0.09	5.99	2.77	91.77	543.75
	03/11/14 15:59:30	95580	13.67	0.36	0.11	5.34	21.04	92.21	1,189.98
	03/11/14 16:00:00	95610	13.31	4.68	0.06	5.49	24.91	92.66	1,282.55
	03/11/14 16:00:30	95640	12.71	1.97	0.05	6.05	25.47	93.11	1,305.12
	03/11/14 16:01:00	95670	12.61	0.34	0.05	6.08	25.47	93.11	1,306.65
	03/11/14 16:01:30	95700	12.55	0.24	0.05	6.10	25.47	93.56	1,305.80
	03/11/14 16:02:00	95730	12.54	0.04	0.05	6.16	26.02	93.56	1,300.65
	03/11/14 16:02:30	95760	12.69	-0.02	0.05	6.06	24.91	94.01	1,301.61
	03/11/14 16:03:00	95790	12.72	0.16	0.05	5.99	24.91	94.01	1,303.88
	03/11/14 16:03:30	95820	12.93	0.22	0.06	5.83	24.91	94.01	1,305.64
	03/11/14 16:04:00	95850	12.84	0.24	0.06	5.93	24.91	94.01	1,302.21
	03/11/14 16:04:30	95880	12.80	0.12	0.05	5.96	24.91	94.01	1,302.89
	03/11/14 16:05:00	95910	12.83	0.10	0.05	5.91	24.91	94.46	1,303.38
	03/11/14 16:05:30	95940	12.81	-0.01	0.04	5.95	24.91	94.46	1,305.54
	03/11/14 16:06:00	95970	12.90	-0.10	0.05	5.90	24.91	94.91	1,305.30
	03/11/14 16:06:30	96000	12.97	0.00	0.05	5.81	24.91	94.91	1,302.32
	03/11/14 16:07:00	96030	12.79	0.13	0.05	5.96	24.91	94.91	1,306.80
A3	03/11/14 16:07:30	96060	12.84	-0.04	0.05	5.91	24.91	95.47	1,303.81
	03/11/14 16:08:00	96090	12.84	-0.09	0.05	5.96	24.91	94.91	1,300.44
	03/11/14 16:08:30	96120	12.92	0.02	0.05	5.88	24.91	94.91	1,301.29
	03/11/14 16:09:00	96150	12.91	0.26	0.05	5.90	24.36	95.47	1,305.58
	03/11/14 16:09:30	96180	13.05	0.10	0.05	5.78	24.91	95.47	1,303.47
	03/11/14 16:10:00	96210	12.84	0.00	0.04	5.94	24.91	95.47	1,300.86
	03/11/14 16:10:30	96240	12.72	0.20	0.04	6.03	24.91	95.47	1,303.87
	03/11/14 16:11:00	96270	12.90	0.03	0.06	5.92	2.21	95.47	519.86
	03/11/14 16:11:30	96300	14.20	2.99	0.11	4.91	2.21	94.46	523.15
	03/11/14 16:12:00	96330	13.36	2.41	0.20	5.71	2.21	94.01	524.70
	03/11/14 16:12:30	96360	13.78	-0.22	0.26	5.15	2.21	93.11	526.53
	03/11/14 16:13:00	96390	13.20	-0.34	0.22	5.53	2.21	92.66	526.94
	03/11/14 16:13:30	96420	12.73	-0.42	0.20	5.98	2.77	92.66	525.60
	03/11/14 16:14:00	96450	12.26	-0.45	0.19	6.30	2.77	92.21	523.60
	03/11/14 16:14:30	96480	13.01	-0.45	0.24	5.88	9.13	92.21	872.53
	03/11/14 16:15:00	96510	12.70	-0.29	0.10	6.06	25.47	93.11	1,285.07
	03/11/14 16:15:30	96540	12.78	0.32	0.05	6.00	24.91	93.56	1,301.72
	03/11/14 16:16:00	96570	12.60	-0.30	0.06	6.12	24.91	94.01	1,298.49
	03/11/14 16:16:30	96600	12.41	-0.42	0.05	6.25	24.36	94.01	1,294.92
	03/11/14 16:17:00	96630	12.41	-0.30	0.05	6.32	24.91	94.01	1,294.92
	03/11/14 16:17:30	96660	12.76	-0.22	0.04	6.03	24.91	94.01	1,295.13

John Zink Co, LLC
March 11, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	6.4	%
Stack Exhaust Flow (M2)	85,121	SCFH

Weather Data

Barometric Pressure	29.41	in. Hg
Relative Humidity	26	%
Ambient Temperature	87	^{o}F
Specific Humidity	0.007200	lb H_2O / lb air

0-30-0 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
03/11/14 16:18:00	96690	12.83	0.01	0.04	6.00	24.36	94.01	1,294.99
03/11/14 16:18:30	96720	12.87	0.29	0.04	5.97	24.36	94.01	1,301.23
03/11/14 16:19:00	96750	12.95	0.34	0.05	5.88	24.36	94.01	1,294.77
03/11/14 16:19:30	96780	13.06	0.68	0.05	5.84	24.36	94.46	1,300.56
03/11/14 16:20:00	96810	13.11	0.59	0.04	5.78	24.91	94.46	1,300.32
03/11/14 16:20:30	96840	13.04	0.55	0.05	5.85	24.36	94.46	1,295.20
03/11/14 16:21:00	96870	13.13	0.78	0.06	5.77	23.80	94.91	1,300.32
03/11/14 16:21:30	96900	13.17	0.80	0.06	5.72	23.80	94.91	1,299.08
03/11/14 16:22:00	96930	13.25	0.98	0.04	5.70	23.80	95.47	1,300.84
03/11/14 16:22:30	96960	13.19	0.92	0.05	5.70	24.36	95.47	1,298.26
03/11/14 16:23:00	96990	12.97	1.02	0.05	5.85	23.80	95.47	1,294.63
03/11/14 16:23:30	97020	13.25	1.38	0.05	5.69	24.36	95.47	1,295.50
03/11/14 16:24:00	97050	13.30	1.83	0.05	5.62	24.36	95.47	1,299.11
03/11/14 16:24:30	97080	13.34	1.78	0.04	5.61	23.80	95.47	1,294.63
03/11/14 16:25:00	97110	13.44	1.74	0.05	5.53	23.80	95.81	1,297.40
03/11/14 16:25:30	97140	13.49	1.87	0.06	5.51	2.21	95.47	522.10
03/11/14 16:26:00	97170	12.59	2.57	0.14	6.09	2.21	94.46	521.30
03/11/14 16:26:30	97200	12.89	-0.09	0.16	5.89	2.21	93.56	522.35
03/11/14 16:27:00	97230	13.09	-0.36	0.13	5.75	2.21	93.11	524.93
RAW AVERAGE		**12.88**	**0.58**	**0.08**	**6.01**	**19.36**	**93.54**	**1,097.69**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	INST-22-0004	INST-CO-0022	INST-TH-0009	INST-C2-0016	F-13 LINE 2-3-4 PRESS	F-13 Line 1-3 TE	F-13 Line Orifice
						(in. H_2O)	**(^{o}F)**	**(SCFH)**
Bias	**Initial Zero**	0.01	0.05	0.01	0.01			
	Final Zero	0.01	0.14	0.02	0.04			
	Avg. Zero	0.01	0.10	0.02	0.03			
	Initial UpScale	12.02	8.46	3.00	9.31			
	Final UpScale	12.00	8.88	2.94	9.23			
	Avg. UpScale	12.01	8.67	2.97	9.27			
Upscale Cal Gas		12.00	8.98	3.04	9.42			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.87	0.50	0.06	6.09
Corrected Raw Average (ppm/% wet basis)	12.05	0.46	0.06	5.70
Emission Rate (lb/hr)	N/A	0.00	0.00	N/A

John Zink Co, LLC
March 11, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.3	%
Stack Exhaust Flow (M2)	82,138	SCFH

Weather Data

Barometric Pressure	29.40	in. Hg
Relative Humidity	28	%
Ambient Temperature	84	^{o}F
Specific Humidity	0.007045	lb H_2O / lb air

0-30-0 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
A1	03/11/14 16:48:00	98490	13.45	1.01	0.09	5.44	2.21	92.21	534.45
	03/11/14 16:48:30	98520	12.76	1.45	0.09	5.85	2.77	91.77	526.55
	03/11/14 16:49:00	98550	13.14	0.60	0.13	5.70	2.21	91.32	523.12
	03/11/14 16:49:30	98580	13.56	0.49	0.14	5.25	2.77	90.87	523.43
	03/11/14 16:50:00	98610	13.58	0.44	0.15	5.51	2.21	90.42	524.34
	03/11/14 16:50:30	98640	12.92	0.37	0.13	5.83	24.91	90.87	1,266.20
	03/11/14 16:51:00	98670	13.48	2.28	0.06	5.52	26.57	91.32	1,300.21
	03/11/14 16:51:30	98700	13.11	1.82	0.05	5.77	26.02	92.21	1,295.27
	03/11/14 16:52:00	98730	12.88	0.55	0.05	5.95	26.02	92.66	1,304.30
	03/11/14 16:52:30	98760	12.85	0.34	0.06	5.97	26.02	93.11	1,303.07
	03/11/14 16:53:00	98790	12.80	0.32	0.06	6.00	26.57	93.11	1,306.35
	03/11/14 16:53:30	98820	12.74	0.33	0.05	6.07	26.02	93.56	1,300.62
	03/11/14 16:54:00	98850	12.71	0.31	0.05	6.07	26.02	94.01	1,312.15
	03/11/14 16:54:30	98880	12.62	0.26	0.06	6.11	26.57	94.01	1,309.58
	03/11/14 16:55:00	98910	12.41	0.24	0.05	6.27	26.02	94.01	1,310.02
	03/11/14 16:55:30	98940	12.41	0.20	0.05	6.28	26.57	94.46	1,307.70
	03/11/14 16:56:00	98970	12.58	0.16	0.05	6.18	26.02	94.46	1,309.88
	03/11/14 16:56:30	99000	12.81	0.17	0.05	6.00	26.57	94.91	1,309.09
	03/11/14 16:57:00	99030	12.95	0.23	0.04	5.88	26.02	95.47	1,314.27
	03/11/14 16:57:30	99060	12.83	0.27	0.04	5.97	26.02	95.47	1,311.66
	03/11/14 16:58:00	99090	13.11	0.33	0.05	5.82	26.02	95.47	1,313.65
	03/11/14 16:58:30	99120	12.85	0.42	0.05	5.94	26.02	95.47	1,313.22
	03/11/14 16:59:00	99150	12.85	0.22	0.04	5.99	26.02	95.47	1,309.21
	03/11/14 16:59:30	99180	12.76	0.21	0.04	6.06	26.02	95.47	1,311.78
	03/11/14 17:00:00	99210	12.98	0.24	0.05	5.88	26.02	95.81	1,309.00
	03/11/14 17:00:30	99240	12.90	0.34	0.05	5.92	26.02	95.81	1,308.20
	03/11/14 17:01:00	99270	12.81	0.32	0.05	5.99	25.47	95.47	1,310.56
	03/11/14 17:01:30	99300	12.57	0.25	0.05	6.17	26.02	95.47	1,306.69
	03/11/14 17:02:00	99330	12.48	0.18	0.05	6.21	25.47	95.47	1,255.99
	03/11/14 17:02:30	99360	12.13	0.20	0.04	6.33	2.21	94.91	526.72
	03/11/14 17:03:00	99390	12.29	0.29	0.05	6.46	2.77	94.01	528.62
	03/11/14 17:03:30	99420	13.35	0.52	0.08	5.72	2.77	93.56	528.19
	03/11/14 17:04:00	99450	13.12	0.39	0.07	5.69	2.77	93.11	527.76
	03/11/14 17:04:30	99480	13.25	0.26	0.10	5.74	2.21	93.11	529.25
	03/11/14 17:05:00	99510	13.83	0.39	0.10	5.14	2.77	92.66	529.24
	03/11/14 17:05:30	99540	12.38	0.32	0.07	6.22	3.88	92.66	613.21
	03/11/14 17:06:00	99570	13.82	0.32	0.11	5.25	24.91	92.66	1,270.12
	03/11/14 17:06:30	99600	13.37	5.20	0.05	5.31	26.02	93.56	1,302.97
	03/11/14 17:07:00	99630	12.18	1.62	0.03	6.37	25.47	94.01	1,304.43
	03/11/14 17:07:30	99660	12.49	0.16	0.03	6.20	26.02	94.46	1,299.32
	03/11/14 17:08:00	99690	12.60	0.19	0.04	6.08	25.47	94.46	1,305.16
A2	03/11/14 17:08:30	99720	12.80	0.22	0.05	5.95	24.91	94.46	1,304.52
	03/11/14 17:09:00	99750	12.88	0.28	0.06	5.90	26.02	94.91	1,297.86
	03/11/14 17:09:30	99780	13.00	0.24	0.05	5.79	25.47	95.47	1,299.66
	03/11/14 17:10:00	99810	12.96	0.29	0.04	5.78	25.47	95.47	1,303.28
	03/11/14 17:10:30	99840	12.89	0.31	0.04	5.83	26.02	95.47	1,301.57
	03/11/14 17:11:00	99870	12.89	0.28	0.05	5.94	26.02	95.81	1,300.81
	03/11/14 17:11:30	99900	12.99	0.38	0.05	5.88	25.47	95.81	1,298.45
	03/11/14 17:12:00	99930	12.94	0.43	0.05	5.89	26.02	95.81	1,301.00
	03/11/14 17:12:30	99960	12.83	0.31	0.05	5.94	24.91	96.26	1,303.67
	03/11/14 17:13:00	99990	12.86	0.52	0.04	5.94	25.47	95.81	1,300.88

John Zink Co, LLC
March 11, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.3	%
Stack Exhaust Flow (M2)	82,138	SCFH

Weather Data

Barometric Pressure	29.40	in. Hg
Relative Humidity	28	%
Ambient Temperature	84	^{o}F
Specific Humidity	0.007045	lb H_2O / lb air

0-30-0 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
	03/11/14 17:13:30	100020	12.80	0.41	0.04	6.01	25.47	95.81	1,305.16
	03/11/14 17:14:00	100050	12.65	0.38	0.05	6.08	25.47	95.81	1,301.06
	03/11/14 17:14:30	100080	12.72	0.28	0.04	6.05	25.47	95.81	1,303.72
	03/11/14 17:15:00	100110	12.66	0.43	0.05	6.03	26.02	95.47	1,315.56
	03/11/14 17:15:30	100140	12.68	0.32	0.05	6.07	26.02	95.81	1,310.37
	03/11/14 17:16:00	100170	12.76	0.28	0.04	5.94	25.47	95.81	1,308.18
	03/11/14 17:16:30	100200	12.74	0.24	0.03	6.01	2.21	95.47	526.35
	03/11/14 17:17:00	100230	14.40	0.38	0.15	4.83	2.77	94.91	523.66
	03/11/14 17:17:30	100260	12.79	0.52	0.14	5.80	2.77	94.01	524.64
	03/11/14 17:18:00	100290	12.89	0.34	0.18	5.85	2.21	93.56	522.44
	03/11/14 17:18:30	100320	12.43	0.28	0.15	6.17	2.77	93.11	522.28
	03/11/14 17:19:00	100350	12.27	0.25	0.14	6.32	2.77	93.11	521.36
	03/11/14 17:19:30	100380	13.03	0.24	0.17	5.82	2.77	92.66	522.33
	03/11/14 17:20:00	100410	13.28	0.31	0.14	5.59	2.77	92.66	520.45
	03/11/14 17:20:30	100440	13.28	0.31	0.10	5.63	24.91	92.66	1,259.59
	03/11/14 17:21:00	100470	13.84	5.69	0.06	5.10	26.57	93.56	1,311.12
	03/11/14 17:21:30	100500	12.56	2.80	0.05	6.09	27.13	94.01	1,304.05
	03/11/14 17:22:00	100530	12.28	3.22	0.18	6.32	27.13	94.46	1,302.85
	03/11/14 17:22:30	100560	12.73	11.14	0.06	6.04	27.13	94.91	1,313.62
	03/11/14 17:23:00	100590	12.73	1.80	0.06	6.00	26.57	94.91	1,313.35
	03/11/14 17:23:30	100620	12.99	0.64	0.06	5.83	26.02	94.91	1,308.64
	03/11/14 17:24:00	100650	13.02	0.71	0.04	5.75	26.57	94.91	1,303.77
	03/11/14 17:24:30	100680	12.90	0.84	0.04	5.88	26.02	94.91	1,306.97
	03/11/14 17:25:00	100710	12.82	0.50	0.04	5.93	26.02	94.91	1,304.20
	03/11/14 17:25:30	100740	12.97	0.41	0.04	5.84	26.57	95.47	1,302.47
	03/11/14 17:26:00	100770	13.04	0.57	0.04	5.77	26.57	95.47	1,303.98
	03/11/14 17:26:30	100800	12.89	0.46	0.04	5.89	26.02	95.47	1,303.32
	03/11/14 17:27:00	100830	12.86	0.43	0.05	5.89	26.02	95.47	1,304.81
	03/11/14 17:27:30	100860	12.80	0.53	0.06	5.93	26.02	95.47	1,304.38
	03/11/14 17:28:00	100890	12.87	0.46	0.04	5.89	26.57	95.47	1,303.34
A3	03/11/14 17:28:30	100920	12.81	0.44	0.04	5.92	26.02	95.47	1,305.70
	03/11/14 17:29:00	100950	12.86	0.38	0.04	5.91	26.02	95.81	1,307.65
	03/11/14 17:29:30	100980	12.96	0.33	0.04	5.85	26.57	95.81	1,320.04
	03/11/14 17:30:00	101010	12.87	0.39	0.05	5.96	26.02	95.81	1,317.22
	03/11/14 17:30:30	101040	12.86	0.58	0.05	5.96	26.57	95.47	1,325.16
	03/11/14 17:31:00	101070	12.97	0.56	0.05	5.92	19.38	95.47	1,074.54
	03/11/14 17:31:30	101100	12.02	0.59	0.04	6.29	2.21	94.91	518.31
	03/11/14 17:32:00	101130	11.84	0.39	0.10	6.94	2.21	94.46	518.62
	03/11/14 17:32:30	101160	12.27	0.37	0.09	6.24	2.21	93.56	517.02
	03/11/14 17:33:00	101190	12.39	0.23	0.10	6.37	2.21	93.11	514.29
	03/11/14 17:33:30	101220	13.25	0.26	0.11	5.66	2.21	93.11	512.93
	03/11/14 17:34:00	101250	13.51	0.29	0.12	5.37	2.21	92.66	514.67
	03/11/14 17:34:30	101280	15.28	1.36	0.91	4.45	2.21	92.66	512.19
	03/11/14 17:35:00	101310	15.89	9.33	0.89	3.66	13.56	92.66	983.90
	03/11/14 17:35:30	101340	15.26	5.88	0.39	4.12	26.02	92.66	1,299.65
	03/11/14 17:36:00	101370	13.76	6.69	0.18	5.23	26.02	93.11	1,310.91
	03/11/14 17:36:30	101400	12.93	1.46	0.12	5.89	25.47	93.56	1,298.07
	03/11/14 17:37:00	101430	12.92	0.66	0.12	5.99	25.47	93.56	1,292.25
	03/11/14 17:37:30	101460	13.34	0.89	0.13	5.63	25.47	93.56	1,302.55
	03/11/14 17:38:00	101490	12.97	0.88	0.09	5.72	26.02	93.56	1,298.05
	03/11/14 17:38:30	101520	12.35	0.36	0.05	6.18	25.47	93.56	1,305.48

John Zink Co, LLC
March 11, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.3	%
Stack Exhaust Flow (M2)	82,138	SCFH

Weather Data

Barometric Pressure	29.40	in. Hg
Relative Humidity	28	%
Ambient Temperature	84	^{o}F
Specific Humidity	0.007045	lb H_2O / lb air

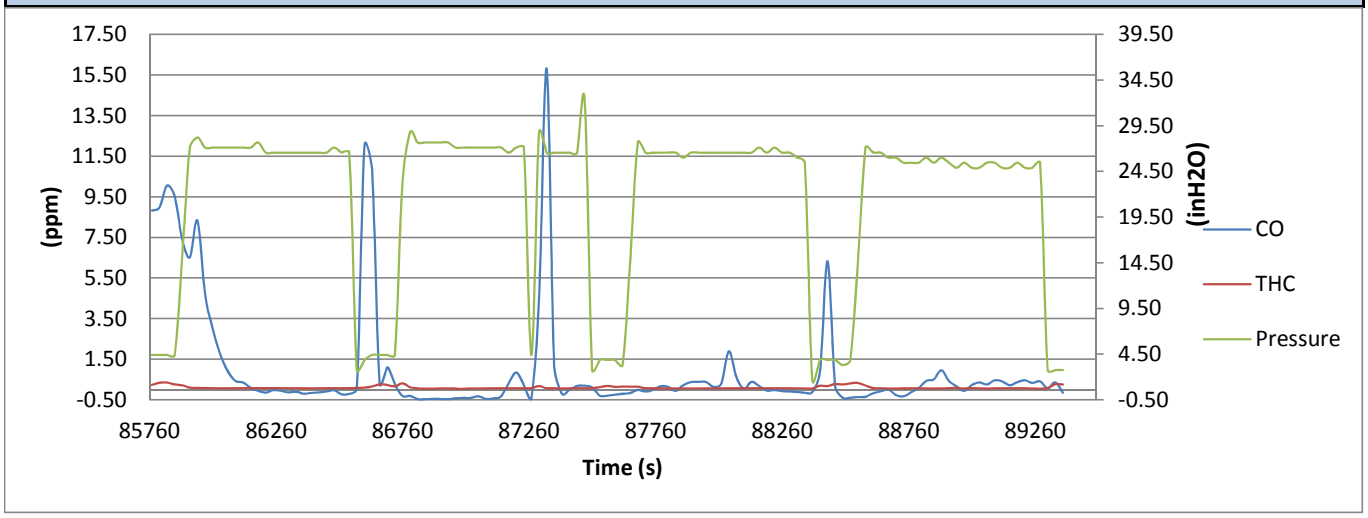
0-30-0 Load, Run - 4.0X30PF R3

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Fuel Temp. ^{o}F	Fuel Flow SCFH
03/11/14 17:39:00	101550	12.29	0.28	0.07	6.38	26.02	93.56	1,306.82
03/11/14 17:39:30	101580	12.30	0.22	0.06	6.40	25.47	93.56	1,297.08
03/11/14 17:40:00	101610	12.11	0.13	0.04	6.52	26.02	93.56	1,299.82
03/11/14 17:40:30	101640	12.57	0.16	0.05	6.25	26.02	93.56	1,298.80
03/11/14 17:41:00	101670	12.86	0.24	0.06	6.02	25.47	93.56	1,297.24
03/11/14 17:41:30	101700	12.97	0.44	0.06	5.93	26.02	93.56	1,296.05
03/11/14 17:42:00	101730	13.05	0.49	0.05	5.86	26.02	94.01	1,306.10
03/11/14 17:42:30	101760	13.04	0.56	0.05	5.86	25.47	94.01	1,295.13
03/11/14 17:43:00	101790	12.93	0.48	0.05	5.97	25.47	94.01	1,309.85
03/11/14 17:43:30	101820	13.00	0.41	0.05	5.94	26.57	94.46	1,318.60
03/11/14 17:44:00	101850	13.12	0.54	0.05	5.83	26.02	94.46	1,311.47
03/11/14 17:44:30	101880	12.93	0.58	0.04	5.93	25.47	94.46	1,300.62
03/11/14 17:45:00	101910	12.95	0.57	0.04	5.85	26.02	94.91	1,306.74
03/11/14 17:45:30	101940	13.01	0.50	0.05	5.84	20.48	94.91	1,115.48
03/11/14 17:46:00	101970	13.99	0.53	0.14	5.31	2.77	94.46	519.05
03/11/14 17:46:30	102000	15.83	1.57	0.31	3.65	2.77	94.01	518.48
03/11/14 17:47:00	102030	14.56	0.71	0.24	4.49	2.77	93.56	520.33
03/11/14 17:47:30	102060	13.10	0.33	0.27	5.81	3.32	93.11	519.00
03/11/14 17:48:00	102090	13.01	0.33	0.23	5.61	2.77	93.11	518.53
RAW AVERAGE		**12.99**	**0.86**	**0.09**	**5.83**	**19.57**	**94.21**	**1,091.65**

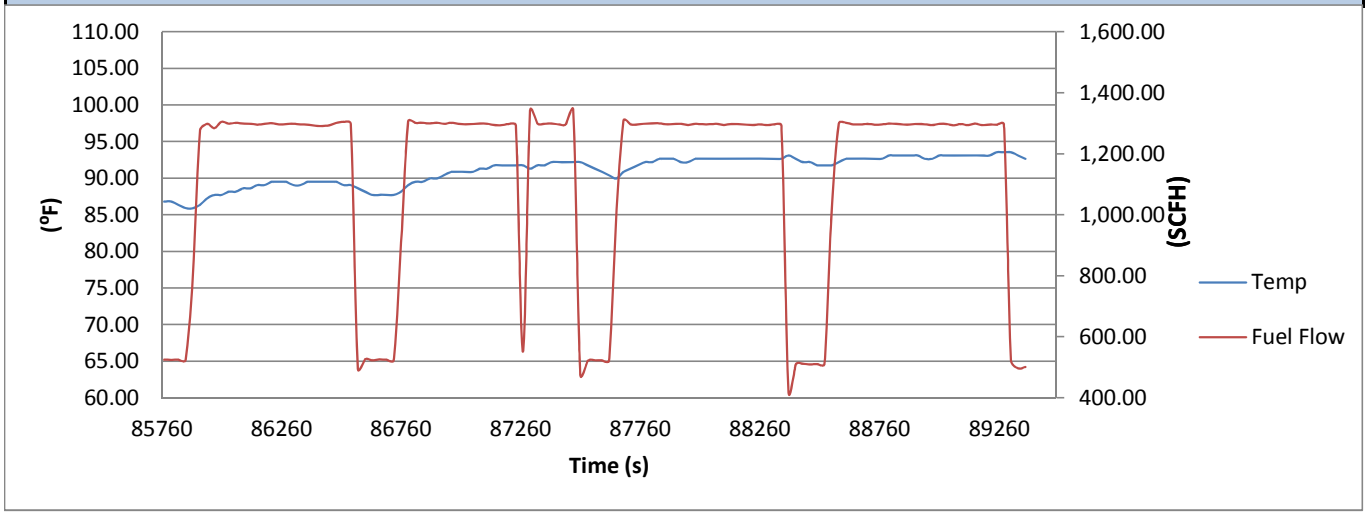
		CO_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	INST-22-0004	INST-CO-0022	INST-TH-0009	INST-C2-0016	F-13 LINE 2-3-4 PRESS	F-13 Line 1-3 TE	F-13 Line Orifice
		(%)	(ppmvd)	(ppmvw)	(%)	(in. H_2O)	(^{o}F)	(SCFH)
Bias	**Initial Zero**	0.01	0.14	0.02	0.04			
	Final Zero	0.01	0.13	0.04	0.03			
	Avg. Zero	0.01	0.14	0.03	0.04			
	Initial UpScale	12.00	8.88	2.94	9.23			
	Final UpScale	12.01	8.49	2.96	9.28			
	Avg. UpScale	12.01	8.69	2.95	9.26			
Upscale Cal Gas		12.00	8.98	3.04	9.42			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.98	0.76	0.06	5.93
Corrected Raw Average (ppm/% wet basis)	12.29	0.71	0.06	5.61
Emission Rate (lb/hr)	N/A	0.00	0.00	N/A

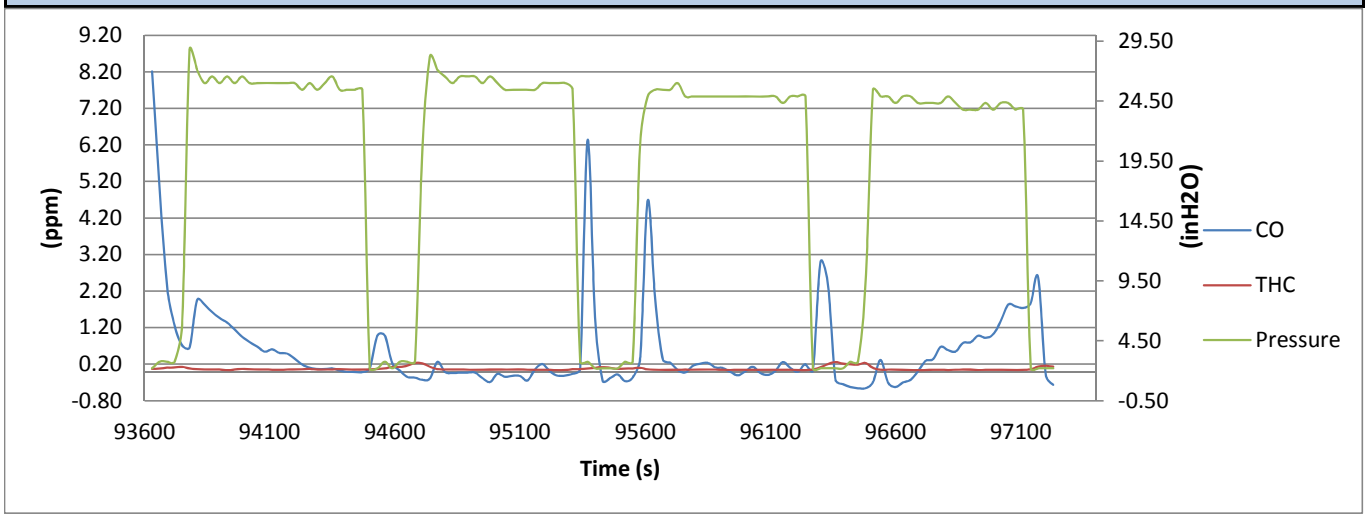
4.0X30PF R1



4.0X30PF R1



4.0X30PF R2



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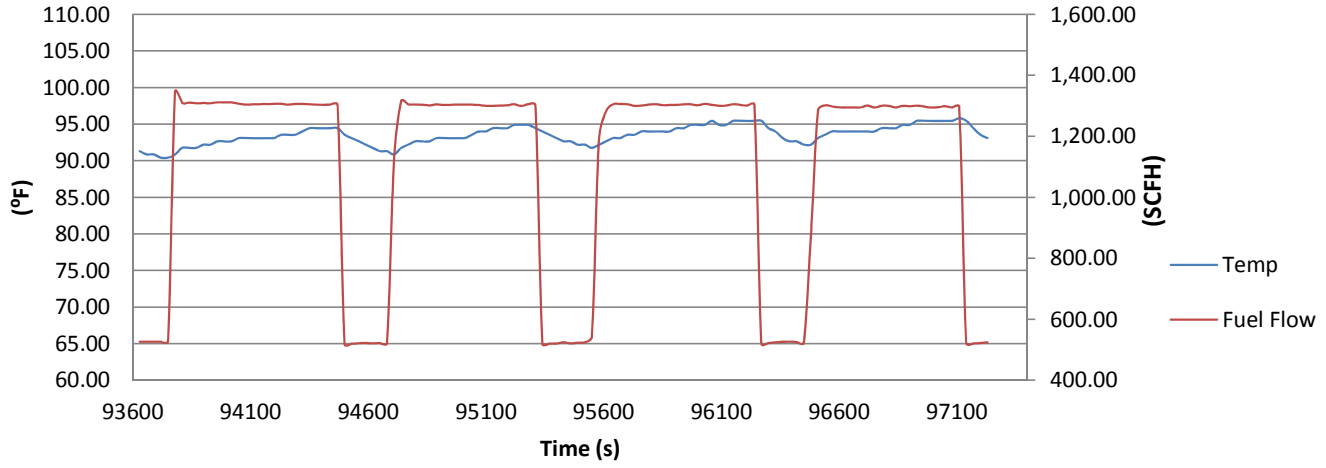
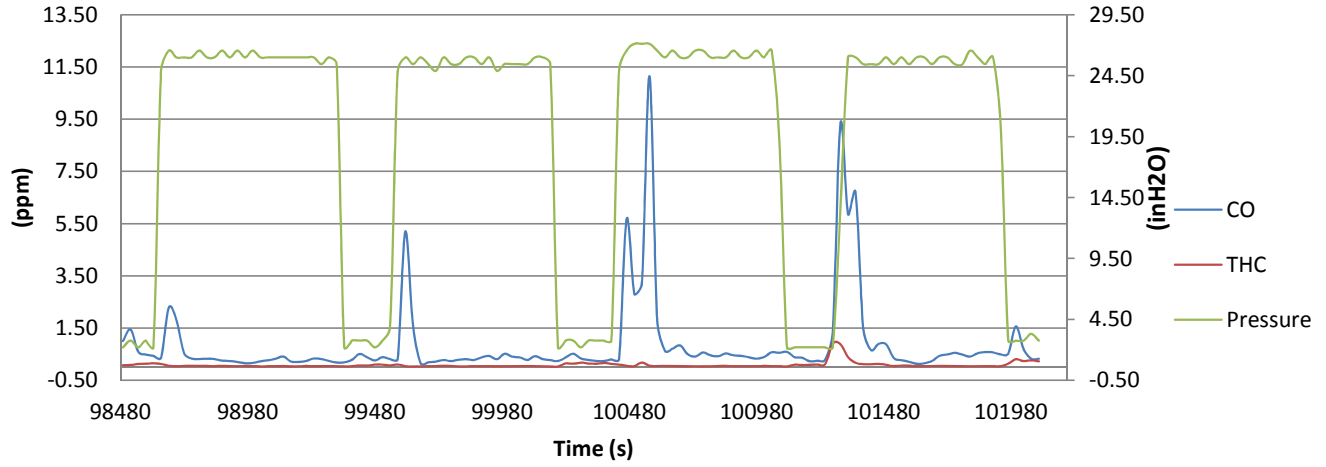


4.0X30PF R3



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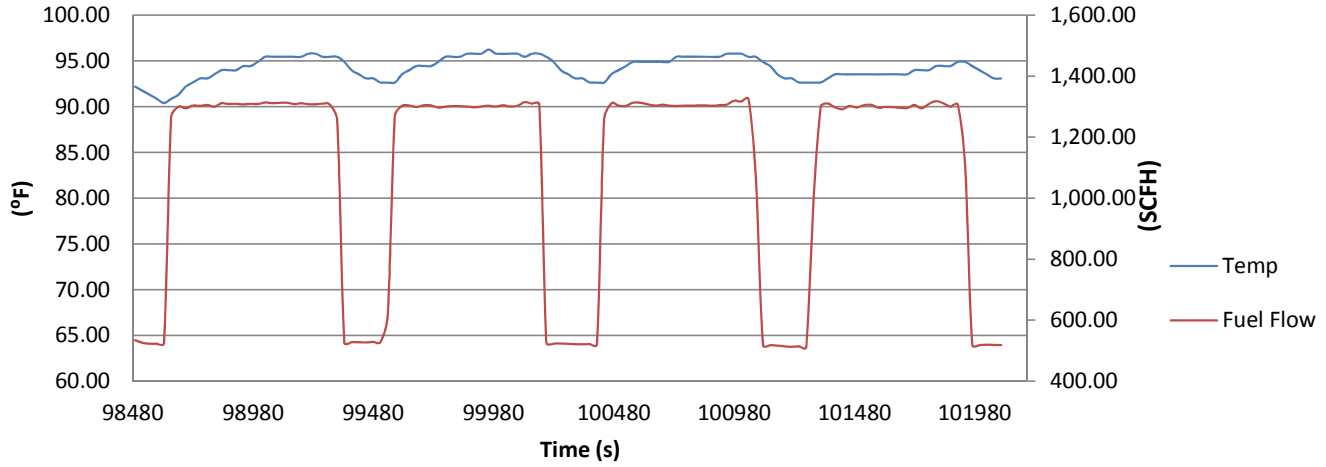
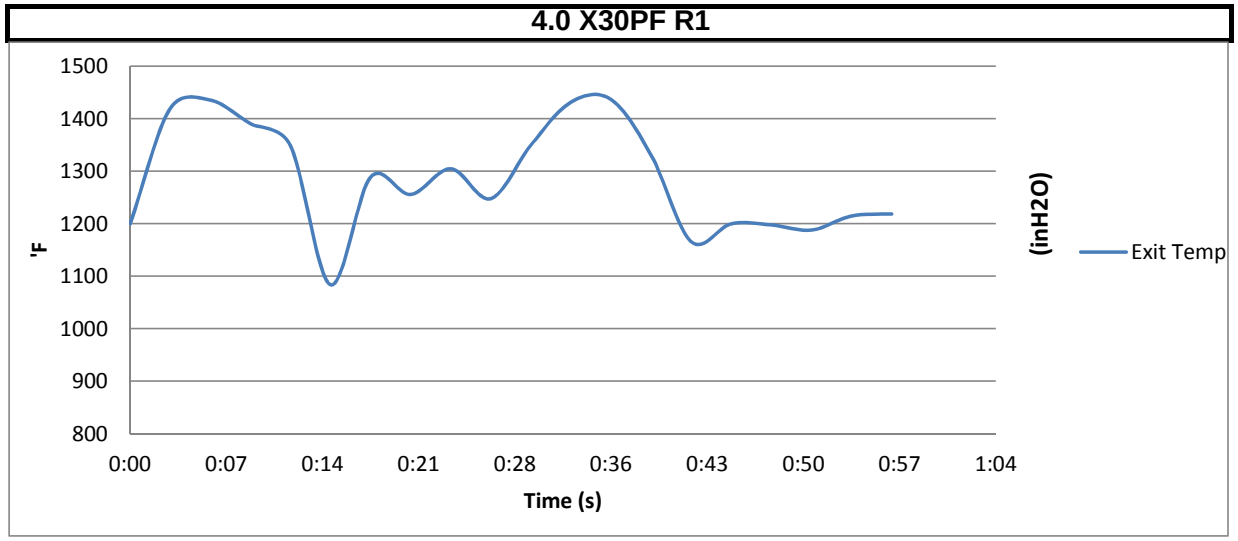
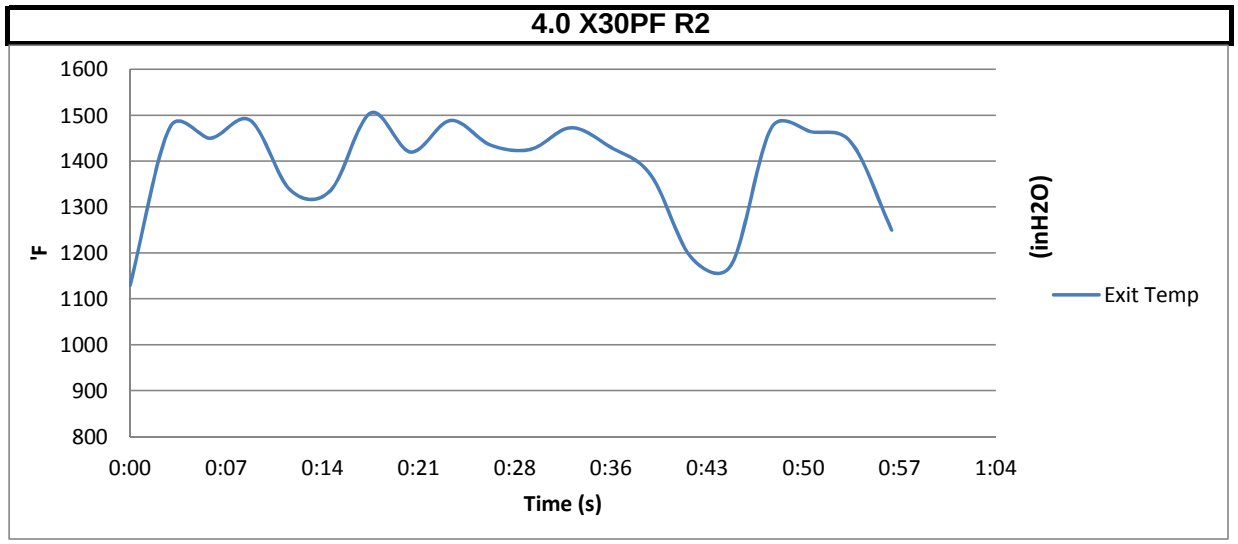
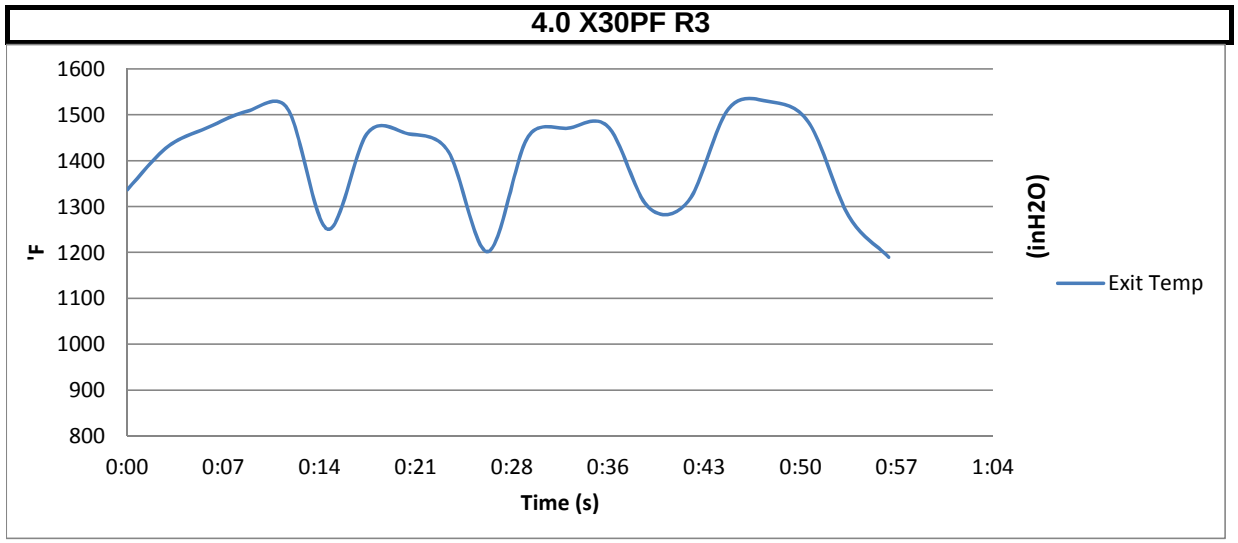



4.0 X30PF R1
1500
1400
1300
1200
1100
1000
900
800
'F
0:00
0:07
0:14
0:21
0:28
0:36
0:43
0:50
0:57
1:04
Time (s)
(inH2O)
Exit Temp


4.0 X30PF R2
1600
1500
1400
1300
1200
1100
1000
900
800
'F
0:00
0:07
0:14
0:21
0:28
0:36
0:43
0:50
0:57
1:04
Time (s)
(inH2O)
Exit Temp


4.0 X30PF R3
1600
1500
1400
1300
1200
1100
1000
900
800
'F
0:00
0:07
0:14
0:21
0:28
0:36
0:43
0:50
0:57
1:04
Time (s)
(inH2O)
Exit Temp

EMISSION DATA RECORDS

30-70-30% Ramp-up, Ramp-down Unit Operations Data

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE

Source Information	
Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Fuel Type	Gas, Propene

Test Information			
Project #		jz-14-tulsa.ok-comp#1	
Operator		TP	
Date for Preliminary Run	(mm/dd/yy)	03/11/14	
Standard Temperature		68	°F
Standard Pressure		29.92	in Hg
Required Sample Vol.	RM4, 8.1.1.2	21	scf
Run Duration	≤0.75 cfm	60	minutes
Unit Number		1	
Base Run Number		30-70-30%	
Number of Ports Available		2	
Number of Ports Used		2	
Port Inside Diameter		4.00	in
Stack Shape		Circular	

Test Equipment Information					
Run		**4**	**5**	**6**	
Test Date	(mm/dd/yy)	03/12/14	03/12/14	03/12/14	
Load	% or w/DB	30-70-30	30-70-30	30-70-30	
Meter Box Number	from ACS	samp-cp-0008	samp-cp-0008	samp-cp-0008	
Meter Calibration Factor	(Y)	0.924	0.924	0.924	
Orifice Meter Coefficient	($\Delta H_@$)	1.700	1.700	1.700	in H_2O
Pitot Identification	from ACS	A4174	A4174	A4174	
Pitot Tube Coefficient	(C_p)	0.819	0.819	0.819	
Probe Number	from ACS	samp-hp-0003	samp-hp-0003	samp-hp-0003	
Probe Length		60.0	60.0	60.0	in
(SS, Glass ….) Liner Material	from list	inconel	inconel	inconel	
Impinger Case Number	from ACS	SAMP-BC-0012	SAMP-BC-0012	SAMP-BC-0012	

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 4 (MOISTURE) [MULTI POINT, NO VARIATION] - RESULTS

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Historical Data	**30-70-30%-4**	**30-70-30%-5**	**30-70-30%-6**	**Average**	**Units**
Run Start Time	08:34	10:00	11:22		hh:mm
Run Stop Time	09:40	11:08	12:25		hh:mm
Test Date	03/12/14	03/12/14	03/12/14		mm/dd/yy
Meter Calibration Factor	0.924	0.924	0.924		
Pitot Tube Coefficient	0.819	0.819	0.819		
Stack Test Data	**30-70-30%-4**	**30-70-30%-5**	**30-70-30%-6**	**Average**	**Units**
Initial Meter Volume	17.782	64.634	114.870		ft^3
Final Meter Volume	64.450	114.633	162.427		ft^3
Total Meter Volume	46.668	49.999	47.557	48.075	ft^3
Total Sampling Time	60.00	60.00	60.00	60.00	min
Average Meter Temperature	51.78	55.73	61.28	56.26	°F
Average Stack Temperature	1552.15	1523.00	1553.05	1542.73	°F
Barometric Pressure	30.21	30.26	30.26	30.24	in Hg
Stack Static Pressure	0.00	0.00	0.00	0.00	in H_2O
Absolute Stack Pressure	30.21	30.26	30.26	30.24	in Hg
Average Orifice Pressure Drop	1.70	1.70	1.70	1.70	in H_2O
Absolute Meter Pressure	30.34	30.39	30.39	30.37	in Hg
Avg Square Root Pitot Pressure	0.15	0.16	0.17	0.16	√(in H_2O)
Moisture Content Data	**30-70-30%-4**	**30-70-30%-5**	**30-70-30%-6**	**Average**	**Units**
Impinger Water Weight Gain	48.50	47.10	47.10	47.57	g
Silica Gel Weight Gain	5.50	11.40	7.90	8.27	g
Total Water Volume Collected	54.10	58.61	55.10	55.93	ml
Standard Water Vapor Volume	2.55	2.76	2.59	2.63	scf
Standard Meter Volume	45.1	48.0	45.2	46.1	dscf
Calculated Stack Moisture	5.34	5.43	5.43	5.40	%
Saturated Stack Moisture	100.00	100.00	100.00	100.00	%
Reported Stack Moisture Content	5.34	5.43	5.43	5.40	%
Gas Analysis Data	**30-70-30%-4**	**30-70-30%-5**	**30-70-30%-6**	**Average**	**Units**
Carbon Dioxide Content	5.9	5.9	5.5	5.8	%
Oxygen Content	14.0	14.0	14.6	14.2	%
Nitrogen Content	80.1	80.1	79.9	80.0	%
Stack Dry Molecular Weight	29.51	29.51	29.47	29.49	lb/lb-mole
Stack Wet Molecular Weight	28.89	28.88	28.85	28.87	lb/lb-mole
Percent Excess Air	196.0	196.0	225.1	205.7	%
Volumetric Flow Rate Data	**30-70-30%-4**	**30-70-30%-5**	**30-70-30%-6**	**Average**	**Units**
Average Stack Gas Velocity	15.71	16.69	17.73	16.71	ft/sec
Stack Cross-Sectional Area	12.57	12.57	12.57	12.57	ft^2
Actual Stack Flow Rate	11,843	12,587	13,371	12,600	acfm
Wet Standard Stack Flow Rate	188	203	213	201	wkscfh
Dry Standard Stack Flow Rate	178,215	192,325	201,263	190,601	dscfh

METHOD 3C - DETERMINATION OF DRY MOLECULAR WEIGHT BY ANALYZER

Plant Name	John Zink Tulsa R&D Facility	**Preliminary Date**	03/11/14		
Sampling Location	4.0X30PF	**Operator**	TP		
Project #	jz-14-tulsa.ok-comp#1	**# of Ports Used**	2		
Fuel Type	Gas, Propene	**Min. Fuel Factor**	N/A	**Max. Fuel Factor**	N/A

Gas Analysis Data									
Run Number	30-70-30%-4		**Date**	03/12/14	**Run Start Time**	08:34		**Run Stop Time**	09:40
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	$(F_o)_{avg}$		$(\%EA)_{avg}$	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:06	5.9	14.0	0.0	80.1	29.51	1.168		196.0	N/A

Gas Analysis Data									
Run Number	30-70-30%-5		**Date**	03/12/14	**Run Start Time**	10:00		**Run Stop Time**	11:08
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	$(F_o)_{avg}$		$(\%EA)_{avg}$	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:08	5.9	14.0	0.0	80.1	29.51	1.168		196.0	N/A

Gas Analysis Data									
Run Number	30-70-30%-6		**Date**	03/12/14	**Run Start Time**	11:22		**Run Stop Time**	12:25
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	$(F_o)_{avg}$		$(\%EA)_{avg}$	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:03	5.5	14.6	0.0	79.9	29.47	1.139		225.1	N/A

METHOD 4 - DETERMINATION OF MOISTURE CONTENT IN STACK GASES

Plant Name	John Zink Tulsa R&D Facility	**Preliminary Date**	03/11/14
Sampling Location	4.0X30PF	**Operator**	TP
Project #	jz-14-tulsa.ok-comp#1	**Ports Used**	2

Moisture Content Data									
Run Number		30-70-30%-4		**Date**	03/12/14	**Start Time**	08:34	**Stop Time**	09:40
Meter Box Number		samp-cp-0008				**Meter Cal Factor**	(Y)	0.924	
Total Meter Volume		(V_m)	46.668	dcf		**Barometric Pressure**	(P_b)	30.21	in Hg
Average Stack Temp		$(t_s)_{avg}$	1552	°F		**Stack Static Pressure**	(P_{static})	0.00	in H_2O
Average Meter Temp		$(t_m)_{avg}$	52	°F		**Avg Orifice Pressure**	$(\Delta H)_{avg}$	1.70	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		H_2O	H_2O	-	Sil Gel				
Final Value	(V_f),(W_f)	773.60	700.10	592.60	804.40				
Initial Value	(V_i),(W_i)	735.10	691.10	591.60	798.90				
Net Value	(V_n),(W_n)	38.5	9.0	1.0	5.5				
Results									
Total Weight		(W_t)	54.00	g		**Water Vol Weighed**	($V_{wsg(std)}$)	2.546	scf
Std Meter Volume		($V_{m(std)}$)	45.105	dscf		**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content		($B_{ws(calc)}$)	5.34	%		**Final Moisture Content**	(B_{ws})	5.34	%

Moisture Content Data									
Run Number		30-70-30%-5		**Date**	03/12/14	**Start Time**	10:00	**Stop Time**	11:08
Meter Box Number		samp-cp-0008				**Meter Cal Factor**	(Y)	0.924	
Total Meter Volume		(V_m)	49.999	dcf		**Barometric Pressure**	(P_b)	30.26	in Hg
Average Stack Temp		$(t_s)_{avg}$	1523	°F		**Stack Static Pressure**	(P_{static})	0.00	in H_2O
Average Meter Temp		$(t_m)_{avg}$	56	°F		**Avg Orifice Pressure**	$(\Delta H)_{avg}$	1.70	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		H_2O	H_2O	-	Sil Gel				
Final Value	(V_f),(W_f)	794.60	748.10	578.90	907.40				
Initial Value	(V_i),(W_i)	739.10	756.10	579.30	896.00				
Net Value	(V_n),(W_n)	55.5	-8.0	-0.4	11.4				
Results									
Total Weight		(W_t)	58.50	g		**Water Vol Weighed**	($V_{wsg(std)}$)	2.758	scf
Std Meter Volume		($V_{m(std)}$)	48.034	dscf		**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content		($B_{ws(calc)}$)	5.43	%		**Final Moisture Content**	(B_{ws})	5.43	%

Moisture Content Data									
Run Number		30-70-30%-6		**Date**	03/12/14	**Start Time**	11:22	**Stop Time**	12:25
Meter Box Number		samp-cp-0008				**Meter Cal Factor**	(Y)	0.924	
Total Meter Volume		(V_m)	47.557	dcf		**Barometric Pressure**	(P_b)	30.26	in Hg
Average Stack Temp		$(t_s)_{avg}$	1553	°F		**Stack Static Pressure**	(P_{static})	0.00	in H_2O
Average Meter Temp		$(t_m)_{avg}$	61	°F		**Avg Orifice Pressure**	$(\Delta H)_{avg}$	1.70	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		H_2O	H_2O	-	Sil Gel				
Final Value	(V_f),(W_f)	809.00	709.40	595.00	812.30				
Initial Value	(V_i),(W_i)	773.60	700.10	592.60	804.40				
Net Value	(V_n),(W_n)	35.4	9.3	2.4	7.9				
Results									
Total Weight		(W_t)	55.00	g		**Water Vol Weighed**	($V_{wsg(std)}$)	2.593	scf
Std Meter Volume		($V_{m(std)}$)	45.201	dscf		**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content		($B_{ws(calc)}$)	5.43	%		**Final Moisture Content**	(B_{ws})	5.43	%

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Date	03/12/14
Operator	TP
Run Number	30-70-30%-4

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient	(C_p)	0.819	
Average Stack Temp	(t_s)	1552.2	°F
Average Meter Temp	(t_m)	51.8	
Orifice Meter Coefficient	($\Delta H@$)	1.700	in H_2O
Square Root ΔP	($\Delta p^{1/2}_{avg}$)	0.15	in H_2O
Stack Moisture Content	(B_{ws})	5.34	%
Stack Dry Molecular Weight	(M_d)	29.51	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.75	acfm
ΔP to ΔH Isokinetic Factor	(K)		

Leak Checks					
Train	**Pre**	0.000	ft³/min@	15.0	in Hg
PASS	**Post**	0.000	ft³/min@	15.0	in Hg
Pitot	**Pre (+)**	0.01	in H_2O for	15.0	sec
< 3.0	**Pre (-)**	0.02	in H_2O for	15.0	sec
	Post (+)	0.02	in H_2O for	15.0	sec
	Post (-)	0.01	in H_2O for	15.0	sec

Sampling Equipment			
Meter Box Number	samp-cp-0008		
Meter Cal Factor	(Y)	0.924	
Nozzle Number			
Average Nozzle Diameter	(D_{na})		in
Suggested Nozzle Diameter	(D_{ni})	0.4710	in
Probe Number	samp-hp-0003		in
Probe Length	60		in
Liner Material	inconel		
Sample Case / Oven Number	SAMP-BC-0012		
Impinger Case Number	SAMP-BC-0012		

Pressures			
Barometric Pressure	(P_b)	30.21	in Hg
Stack Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.21	in Hg
Absolute Meter Pressure	(P_m)	30.34	in Hg

Nozzle Measurements				
Pre				**PASS**
Post				**PASS**

Run Time			
Start	08:34	**End**	09:40

Weights	**Imp 1**	**Imp 2**	**Imp 3**	**Imp 4**	**Imp 5**	**Imp 6**	**Imp 7**	**Imp 8**
Pre	735.1	691.1	591.6	798.9				
Post	773.6	700.1	592.6	804.4				

Wash Volumes					ml
					ml

Traverse Point #	**Sampling Time (Θ)**	**Timer Time**	**Dry Gas Meter Reading (V_m)**	**Velocity Head (Δp)**	**Desired Orifice ΔH (ΔH_d)**	**Actual Orifice ΔH (ΔH_a)**	**Stack Temp (t_s)**	**Snorkel Temp (248±25°F)**	**Filter Temp (248±25°F)**	**Impinger Exit Temp (≤68°F)**	**Cond. Temp (≤--°F)**	**CPM Filter Temp (--±--°F)**	**Meter Inlet Temp (t_{mi})**	**Meter Outlet Temp (t_{mo})**	**Pump Vacuum**	**Square Root ΔP ($\Delta p^{1/2}$)**	**Local Stack Velocity (v_s)$_l$**	**Cumul. Meter Volume (V_m)$_{std}$**	**Cumul. Percent IsoKinetic (I)**	**Est-Run Meter Volume (V_m)$_{std}$**
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	17.782	0.005	1.700	1.70	1460	240		39			47	47	3.5	0.07	7.35	2.325		46.498
A-2	3.0	00:03:00	20.165	0.010	1.700	1.70	1431	240		41			48	47	3.5	0.10	10.31	4.601		46.007
A-3	6.0	00:06:00	22.500	0.015	1.700	1.70	1606	240		43			50	47	3.5	0.12	13.20	6.872		45.814
A-4	9.0	00:09:00	24.835	0.025	1.700	1.70	1602	240		44			51	47	3.5	0.16	17.02	9.141		45.706
A-5	12.0	00:12:00	27.170	0.035	1.700	1.70	1626	240		46			52	47	3.5	0.19	20.26	11.398		45.594
A-6	15.0	00:15:00	29.495	0.010	1.700	1.70	1508	240		46			54	47	3.5	0.10	10.52	13.680		45.601
A-7	18.0	00:18:00	31.850	0.010	1.700	1.70	1436	240		47			55	47	3.5	0.10	10.32	16.129		46.083
A-8	21.0	00:21:00	34.380	0.035	1.700	1.70	1635	240		46			55	48	3.5	0.19	20.30	18.179		45.448
A-9	24.0	00:24:00	36.500	0.035	1.700	1.70	1680	240		47			55	48	3.5	0.19	20.52	20.452		45.449
A-10	27.0	00:27:00	38.850	0.035	1.700	1.70	1664	240		47			56	49	3.5	0.19	20.44	22.701		45.401
B-1	30.0	00:30:00	41.180	0.010	1.700	1.70	1468	240		46			54	48	3.5	0.10	10.41	24.966		45.392
B-2	33.0	00:33:00	43.520	0.025	1.700	1.70	1548	240		46			57	49	3.5	0.16	16.80	27.164		45.274
B-3	36.0	00:36:00	45.800	0.025	1.700	1.70	1556	240		46			57	49	3.5	0.16	16.83	29.353		45.158
B-4	39.0	00:39:00	48.070	0.035	1.700	1.70	1567	240		46			57	50	3.5	0.19	19.97	31.588		45.125
B-5	42.0	00:42:00	50.390	0.010	1.700	1.70	1498	240		47			57	50	3.5	0.10	10.49	33.847		45.129
B-6	45.0	00:45:00	52.735	0.030	1.700	1.70	1578	240		47			57	51	3.5	0.17	18.54	36.122		45.153
B-7	48.0	00:48:00	55.100	0.040	1.700	1.70	1585	240		47			58	51	3.5	0.20	21.45	38.334		45.098
B-8	51.0	00:51:00	57.400	0.050	1.700	1.70	1594	240		48			58	51	3.5	0.22	24.03	40.641		45.157
B-9	54.0	00:54:00	59.800	0.020	1.700	1.70	1531	240		47			58	51	3.5	0.14	14.96	42.852		45.108
B-10	57.0	00:57:00	62.100	0.010	1.700	1.70	1470	240		48			59	52	3.5	0.10	10.42	45.107		45.107
Last Pt	60.0	01:00:00	64.450																	
Final Val	60.0	01:00:00	64.450											**Max Vac**	3.5	**Final Values**		45.107		
Average Values				0.02		1.70	1552	240		46			55	49		0.15	15.71			
													52							

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Date	03/12/14
Operator	TP
Run Number	30-70-30%-5

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient	(C_p)	0.819	
Average Stack Temp	(t_s)	1523.0	°F
Average Meter Temp	(t_m)	55.7	
Orifice Meter Coefficient	($\Delta H@$)	1.700	in H_2O
Square Root ΔP	($\Delta p^{1/2}_{avg}$)	0.16	in H_2O
Stack Moisture Content	(B_{ws})	5.43	%
Stack Dry Molecular Weight	(M_d)	29.51	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.75	acfm
ΔP to ΔH Isokinetic Factor	(K)		

Leak Checks					
Train	**Pre**	0.000	ft³/min@	15.0	in Hg
PASS	**Post**	0.000	ft³/min@	15.0	in Hg
Pitot	**Pre (+)**	0.02	in H_2O for	15.0	sec
< 3.0	**Pre (-)**	0.02	in H_2O for	15.0	sec
	Post (+)	0.03	in H_2O for	15.0	sec
	Post (-)	0.02	in H_2O for	15.0	sec

Sampling Equipment			
Meter Box Number	samp-cp-0008		
Meter Cal Factor	(Y)	0.924	
Nozzle Number			
Average Nozzle Diameter	(D_{na})		in
Suggested Nozzle Diameter	(D_{ni})	0.4602	in
Probe Number	samp-hp-0003		in
Probe Length	60		in
Liner Material	inconel		
Sample Case / Oven Number	SAMP-BC-0012		
Impinger Case Number	SAMP-BC-0012		

Pressures			
Barometric Pressure	(P_b)	30.26	in Hg
Stack Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.26	in Hg
Absolute Meter Pressure	(P_m)	30.39	in Hg

Nozzle Measurements				
Pre				**PASS**
Post				**PASS**

Run Time			
Start	10:00	**End**	11:08

Weights	Imp 1	Imp 2	Imp 3	Imp 4	Imp 5	Imp 6	Imp 7	Imp 8
Pre	739.1	756.1	579.3	896.0				
Post	794.6	748.1	578.9	907.4				

Wash Volumes					ml
					ml

Traverse Point #	Sampling Time (Θ)	Timer Time	Dry Gas Meter Reading (V_m)	Velocity Head (Δp)	Desired Orifice ΔH (ΔH_d)	Actual Orifice ΔH (ΔH_a)	Stack Temp (t_s)	Snorkel Temp (248±25°F)	Filter Temp (248±25°F)	Impinger Exit Temp (≤68°F)	Cond. Temp (≤--°F)	CPM Filter Temp (--±--°F)	Meter Inlet Temp (t_{mi})	Meter Outlet Temp (t_{mo})	Pump Vacuum	Square Root ΔP ($\Delta p^{1/2}$)	Local Stack Velocity (v_s)$_l$	Cumul. Meter Volume (V_m)$_{std}$	Cumul. Percent IsoKinetic (I)	Est-Run Meter Volume (V_m)$_{std}$
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	64.634	0.005	1.700	1.70	1459	240		47			51	51	2.5	0.07	7.34	4.669		93.390
A-2	3.0	00:03:00	69.450	0.025	1.700	1.70	1497	240		44			55	51	2.5	0.16	16.57	6.973		69.729
A-3	6.0	00:06:00	71.835	0.030	1.700	1.70	1517	240		45			56	51	2.5	0.17	18.25	9.231		61.538
A-4	9.0	00:09:00	74.175	0.030	1.700	1.70	1523	240		46			57	51	2.5	0.17	18.28	11.501		57.504
A-5	12.0	00:12:00	76.530	0.010	1.700	1.70	1498	240		48			58	51	2.5	0.10	10.49	13.783		55.132
A-6	15.0	00:15:00	78.900	0.010	1.700	1.70	1464	240		47			58	51	2.5	0.10	10.39	16.094		53.647
A-7	18.0	00:18:00	81.300	0.040	1.700	1.70	1616	240		49			59	52	2.5	0.20	21.59	18.353		52.436
A-8	21.0	00:21:00	83.650	0.040	1.700	1.70	1608	240		49			59	52	2.5	0.20	21.55	20.655		51.637
A-9	24.0	00:24:00	86.045	0.030	1.700	1.70	1565	240		51			59	52	2.5	0.17	18.47	22.956		51.014
A-10	27.0	00:27:00	88.440	0.010	1.700	1.70	1446	240		51			59	53	2.5	0.10	10.35	25.281		50.562
B-1	30.0	00:30:00	90.861	0.030	1.700	1.70	1608	240		51			57	53	2.5	0.17	18.66	27.558		50.106
B-2	33.0	00:33:00	93.228	0.030	1.700	1.70	1601	240		51			59	53	2.5	0.17	18.63	29.821		49.702
B-3	36.0	00:36:00	95.585	0.025	1.700	1.70	1516	240		51			60	53	2.5	0.16	16.65	32.100		49.384
B-4	39.0	00:39:00	97.960	0.010	1.700	1.70	1435	240		51			60	54	2.5	0.10	10.32	34.390		49.129
B-5	42.0	00:42:00	100.350	0.035	1.700	1.70	1560	240		52			61	54	2.5	0.19	19.92	36.645		48.860
B-6	45.0	00:45:00	102.705	0.040	1.700	1.70	1552	240		53			61	54	2.5	0.20	21.26	38.914		48.642
B-7	48.0	00:48:00	105.075	0.045	1.700	1.70	1636	240		55			61	54	2.5	0.21	23.01	41.188		48.456
B-8	51.0	00:51:00	107.450	0.040	1.700	1.70	1639	240		55			61	55	2.5	0.20	21.71	43.531		48.368
B-9	54.0	00:54:00	109.900	0.040	1.700	1.70	1395	240		55			61	55	2.5	0.20	20.41	45.970		48.389
B-10	57.0	00:57:00	112.450	0.010	1.700	1.70	1325	240		57			62	55	2.5	0.10	10.01	48.056		48.056
Last Pt	60.0	01:00:00	114.633																	
Final Val	60.0	01:00:00	114.633											**Max Vac**	2.5	**Final Values**		48.056		
Average Values				0.03		1.70	1523	240		50			59	53		0.16	16.69			
													56							

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Date	03/12/14
Operator	TP
Run Number	30-70-30%-6

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient	(C_p)	0.819	
Average Stack Temp	(t_s)	1553.1	°F
Average Meter Temp	(t_m)	61.3	
Orifice Meter Coefficient	($\Delta H@$)	1.700	in H_2O
Square Root ΔP	($\Delta p^{1/2}_{avg}$)	0.17	in H_2O
Stack Moisture Content	(B_{ws})	5.43	%
Stack Dry Molecular Weight	(M_d)	29.47	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.80	acfm
ΔP to ΔH Isokinetic Factor	(K)		

Leak Checks					
Train	**Pre**	0.000	ft³/min@	15.0	in Hg
PASS	**Post**	0.000	ft³/min@	15.0	in Hg
Pitot	**Pre (+)**	0.03	in H_2O for	15.0	sec
< 3.0	**Pre (-)**	0.04	in H_2O for	15.0	sec
	Post (+)	0.04	in H_2O for	15.0	sec
	Post (-)	0.02	in H_2O for	15.0	sec

Sampling Equipment			
Meter Box Number	samp-cp-0008		
Meter Cal Factor	(Y)	0.924	
Nozzle Number			
Average Nozzle Diameter	(D_{na})		in
Suggested Nozzle Diameter	(D_{ni})	0.4680	in
Probe Number	samp-hp-0003		in
Probe Length	60		in
Liner Material	inconel		
Sample Case / Oven Number	SAMP-BC-0012		
Impinger Case Number	SAMP-BC-0012		

Pressures			
Barometric Pressure	(P_b)	30.26	in Hg
Stack Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.26	in Hg
Absolute Meter Pressure	(P_m)	30.39	in Hg

Nozzle Measurements				
Pre				**PASS**
Post				**PASS**

Run Time			
Start	11:22	**End**	12:25

Weights	**Imp 1**	**Imp 2**	**Imp 3**	**Imp 4**	**Imp 5**	**Imp 6**	**Imp 7**	**Imp 8**
Pre	773.6	700.1	592.6	804.4				
Post	809.0	709.4	595.0	812.3				

Wash Volumes					ml
					ml

Traverse Point #	**Sampling Time (Θ)**	**Timer Time**	**Dry Gas Meter Reading (V_m)**	**Velocity Head (Δp)**	**Desired Orifice ΔH (ΔH_d)**	**Actual Orifice ΔH (ΔH_a)**	**Stack Temp (t_s)**	**Snorkel Temp (248±25°F)**	**Filter Temp (248±25°F)**	**Impinger Exit Temp (≤68°F)**	**Cond. Temp (≤--°F)**	**CPM Filter Temp (--±--°F)**	**Meter Inlet Temp (t_{mi})**	**Meter Outlet Temp (t_{mo})**	**Pump Vacuum**	**Square Root ΔP ($\Delta p^{1/2}$)**	**Local Stack Velocity (v_s)$_l$**	**Cumul. Meter Volume (V_m)$_{std}$**	**Cumul. Percent IsoKinetic (I)**	**Est-Run Meter Volume (V_m)$_{std}$**
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	114.870	0.005	1.700	1.70	1451	240		52			59	55	3.5	0.07	7.33	2.252		45.041
A-2	3.0	00:03:00	117.220	0.025	1.700	1.70	1567	240		51			64	55	3.5	0.16	16.88	4.503		45.028
A-3	6.0	00:06:00	119.580	0.035	1.700	1.70	1591	240		52			64	56	3.5	0.19	20.09	6.732		44.882
A-4	9.0	00:09:00	121.920	0.035	1.700	1.70	1588	240		52			64	56	3.5	0.19	20.07	8.995		44.976
A-5	12.0	00:12:00	124.295	0.040	1.700	1.70	1582	240		53			64	56	3.5	0.20	21.43	11.231		44.926
A-6	15.0	00:15:00	126.642	0.015	1.700	1.70	1464	240		54			65	56	3.5	0.12	12.74	13.495		44.984
A-7	18.0	00:18:00	129.020	0.035	1.700	1.70	1622	240		54			65	57	3.5	0.19	20.24	15.756		45.016
A-8	21.0	00:21:00	131.397	0.040	1.700	1.70	1628	240		55			65	57	3.5	0.20	21.67	18.041		45.102
A-9	24.0	00:24:00	133.800	0.040	1.700	1.70	1618	240		55			65	57	3.5	0.20	21.62	20.271		45.046
A-10	27.0	00:27:00	136.145	0.040	1.700	1.70	1609	240		55			65	58	3.5	0.20	21.57	22.545		45.090
B-1	30.0	00:30:00	138.539	0.005	1.700	1.70	1449	240		55			63	58	3.5	0.07	7.33	24.793		45.077
B-2	33.0	00:33:00	140.900	0.035	1.700	1.70	1610	240		55			65	58	3.5	0.19	20.18	27.030		45.050
B-3	36.0	00:36:00	143.255	0.040	1.700	1.70	1622	240		56			66	58	3.5	0.20	21.64	29.303		45.082
B-4	39.0	00:39:00	145.650	0.040	1.700	1.70	1647	240		56			66	58	3.5	0.20	21.77	31.496		44.994
B-5	42.0	00:42:00	147.960	0.015	1.700	1.70	1487	240		57			66	58	3.5	0.12	12.81	33.764		45.019
B-6	45.0	00:45:00	150.350	0.010	1.700	1.70	1392	240		58			66	59	3.5	0.10	10.20	36.045		45.056
B-7	48.0	00:48:00	152.755	0.045	1.700	1.70	1565	240		58			67	59	3.5	0.21	22.63	38.332		45.097
B-8	51.0	00:51:00	155.170	0.040	1.700	1.70	1605	240		58			67	60	3.5	0.20	21.55	40.613		45.126
B-9	54.0	00:54:00	157.580	0.045	1.700	1.70	1591	240		58			67	60	3.5	0.21	22.78	43.046		45.311
B-10	57.0	00:57:00	160.150	0.010	1.700	1.70	1373	240		60			67	60	3.5	0.10	10.15	45.201		45.201
Last Pt	60.0	01:00:00	162.427																	
Final Val	60.0	01:00:00	162.427											**Max Vac**	3.5	**Final Values**		45.201		
Average Values				0.03		1.70	1553	240		55			65	58		0.17	17.73			
													61							

John Zink Co, LLC
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.3	%
Stack Exhaust Flow (M2)	178,215	SCFH

Weather Data

Barometric Pressure	30.21	in. Hg
Relative Humidity	40	%
Ambient Temperature	53	^{o}F
Specific Humidity	0.003355	lb H_2O / lb air

30-70-30 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
A1	03/12/14 08:40:00	5370	12.83	0.27	0.16	6.00	28.79	62.22	1,292.26
	03/12/14 08:40:30	5400	13.39	0.21	0.14	5.71	28.79	62.22	1,286.42
	03/12/14 08:41:00	5430	12.92	0.37	0.12	5.76	28.23	61.77	1,300.31
	03/12/14 08:41:30	5460	12.43	0.05	0.13	6.38	77.23	61.77	2,301.30
	03/12/14 08:42:00	5490	12.41	0.10	0.13	6.35	146.43	63.57	3,020.25
	03/12/14 08:42:30	5520	12.97	0.01	0.14	6.17	153.07	64.13	3,088.47
	03/12/14 08:43:00	5550	13.40	0.21	0.10	5.74	154.18	65.03	3,096.78
	03/12/14 08:43:30	5580	12.84	0.26	0.10	5.85	151.41	65.48	3,109.53
	03/12/14 08:44:00	5610	13.04	0.10	0.13	5.83	152.52	65.48	3,086.93
	03/12/14 08:44:30	5640	12.64	0.16	0.11	6.15	149.75	66.49	3,100.30
	03/12/14 08:45:00	5670	13.03	0.20	0.11	5.88	150.30	66.49	3,096.84
	03/12/14 08:45:30	5700	13.25	0.28	0.11	5.78	150.86	66.49	3,110.72
	03/12/14 08:46:00	5730	12.81	0.16	0.11	6.00	151.96	66.49	3,102.27
	03/12/14 08:46:30	5760	12.86	0.06	0.10	5.99	150.30	66.94	3,079.31
	03/12/14 08:47:00	5790	13.72	0.12	0.12	5.55	148.64	67.39	3,072.89
	03/12/14 08:47:30	5820	13.69	0.28	0.12	5.37	147.53	67.39	3,059.28
	03/12/14 08:48:00	5850	13.28	0.38	0.12	5.66	149.75	67.39	3,075.95
	03/12/14 08:48:30	5880	7.55	0.02	0.05	10.10	149.75	67.83	3,086.22
	03/12/14 08:49:00	5910	10.15	-0.16	0.06	8.12	151.41	68.28	3,097.41
	03/12/14 08:49:30	5940	10.41	-0.16	0.07	7.83	149.75	67.83	3,089.82
	03/12/14 08:50:00	5970	10.47	-0.14	0.08	7.69	148.64	68.28	3,070.69
	03/12/14 08:50:30	6000	14.53	0.70	0.09	4.84	146.98	68.28	3,055.78
	03/12/14 08:51:00	6030	14.30	3.12	0.10	4.97	150.30	68.73	3,076.26
	03/12/14 08:51:30	6060	13.68	4.65	0.10	5.18	150.30	68.73	3,089.66
	03/12/14 08:52:00	6090	13.34	2.79	0.10	5.68	45.40	68.28	1,672.65
	03/12/14 08:52:30	6120	13.53	2.63	0.09	5.53	28.79	67.39	1,303.30
	03/12/14 08:53:00	6150	13.12	2.97	0.08	5.82	28.79	66.49	1,305.63
	03/12/14 08:53:30	6180	13.33	2.91	0.09	5.60	28.79	65.93	1,310.12
	03/12/14 08:54:00	6210	13.29	2.59	0.10	5.72	28.79	65.48	1,308.11
	03/12/14 08:54:30	6240	13.23	2.95	0.09	5.76	28.79	64.58	1,300.42
	03/12/14 08:55:00	6270	13.28	3.07	0.08	5.74	28.23	64.13	1,294.93
	03/12/14 08:55:30	6300	13.34	3.67	0.11	5.89	27.68	63.57	1,294.68
	03/12/14 08:56:00	6330	12.97	5.69	0.09	5.81	27.68	62.67	1,294.68
	03/12/14 08:56:30	6360	12.68	1.37	0.08	6.09	28.23	62.22	1,294.29
	03/12/14 08:57:00	6390	12.63	1.01	0.08	6.30	27.68	61.77	1,295.25
	03/12/14 08:57:30	6420	12.61	0.68	0.10	6.30	28.23	61.77	1,298.98
	03/12/14 08:58:00	6450	12.29	0.34	0.09	6.59	27.68	61.77	1,296.17
	03/12/14 08:58:30	6480	12.59	0.66	0.09	6.23	28.23	61.32	1,293.83
	03/12/14 08:59:00	6510	12.55	0.38	0.06	6.25	69.75	61.32	2,170.80
	03/12/14 08:59:30	6540	12.34	0.60	0.07	6.38	142.27	62.22	3,028.09
	03/12/14 09:00:00	6570	12.66	0.42	0.08	6.20	148.09	63.57	3,068.44
A2	03/12/14 09:00:30	6600	12.92	0.62	0.09	6.02	148.09	64.58	3,078.10
	03/12/14 09:01:00	6630	12.82	0.84	0.07	6.00	150.30	64.58	3,099.81
	03/12/14 09:01:30	6660	12.79	0.84	0.08	6.11	148.64	65.03	3,118.81
	03/12/14 09:02:00	6690	12.27	0.48	0.05	6.49	149.19	65.48	3,087.98
	03/12/14 09:02:30	6720	12.73	0.27	0.05	6.10	148.64	65.48	3,097.88
	03/12/14 09:03:00	6750	12.81	0.51	0.05	6.08	147.53	65.93	3,090.22
	03/12/14 09:03:30	6780	11.00	0.60	0.03	6.78	146.98	66.49	3,055.78
	03/12/14 09:04:00	6810	11.11	-0.06	0.03	7.38	144.49	66.49	3,040.57
	03/12/14 09:04:30	6840	11.43	-0.12	0.03	7.11	142.83	66.94	3,037.19
	03/12/14 09:05:00	6870	11.53	-0.14	0.03	6.92	146.98	67.39	3,075.60
	03/12/14 09:05:30	6900	11.61	-0.12	0.03	6.93	147.53	67.39	3,092.36

John Zink Co, LLC
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.3	%
Stack Exhaust Flow (M2)	178,215	SCFH

Weather Data

Barometric Pressure	30.21	in. Hg
Relative Humidity	40	%
Ambient Temperature	53	^{o}F
Specific Humidity	0.003355	lb H_2O / lb air

30-70-30 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
	03/12/14 09:06:00	6930	12.60	0.08	0.05	6.26	148.09	67.39	3,097.95
	03/12/14 09:06:30	6960	12.80	0.62	0.05	6.10	148.09	67.83	3,093.28
	03/12/14 09:07:00	6990	12.60	0.79	0.04	6.27	82.21	67.83	2,260.27
	03/12/14 09:07:30	7020	12.65	0.79	0.04	6.23	28.23	66.94	1,322.26
	03/12/14 09:08:00	7050	12.78	0.70	0.05	6.19	27.68	65.93	1,307.10
	03/12/14 09:08:30	7080	13.21	3.02	0.06	5.60	27.68	65.03	1,305.92
	03/12/14 09:09:00	7110	12.40	2.15	0.05	6.37	27.68	64.58	1,297.15
	03/12/14 09:09:30	7140	12.76	0.90	0.05	6.13	27.68	64.58	1,298.20
	03/12/14 09:10:00	7170	12.64	0.71	0.04	6.26	27.68	63.57	1,304.22
	03/12/14 09:10:30	7200	12.81	0.65	0.05	6.11	27.68	63.57	1,307.72
	03/12/14 09:11:00	7230	13.02	0.87	0.05	6.00	28.23	62.67	1,303.59
	03/12/14 09:11:30	7260	12.60	0.76	0.05	6.36	27.68	61.77	1,305.28
	03/12/14 09:12:00	7290	12.52	0.69	0.05	6.32	138.95	62.67	3,017.24
	03/12/14 09:12:30	7320	12.23	0.38	0.05	6.58	149.19	64.58	3,081.77
	03/12/14 09:13:00	7350	12.83	0.48	0.05	6.08	147.53	65.03	3,088.60
	03/12/14 09:13:30	7380	13.06	0.71	0.04	5.92	148.64	65.48	3,102.52
	03/12/14 09:14:00	7410	12.55	0.68	0.03	6.36	147.53	65.48	3,097.28
	03/12/14 09:14:30	7440	13.05	0.78	0.03	5.94	147.53	65.93	3,098.27
	03/12/14 09:15:00	7470	12.65	1.00	0.04	6.18	148.64	66.49	3,103.77
	03/12/14 09:15:30	7500	12.95	0.81	0.04	5.96	149.19	66.49	3,111.26
	03/12/14 09:16:00	7530	13.01	0.93	0.04	5.97	146.98	66.49	3,084.98
	03/12/14 09:16:30	7560	12.68	1.12	0.04	6.08	145.60	65.93	3,081.48
	03/12/14 09:17:00	7590	12.80	1.05	0.04	6.11	145.60	66.49	3,064.39
	03/12/14 09:17:30	7620	12.91	1.13	0.04	5.98	144.49	66.49	3,070.74
	03/12/14 09:18:00	7650	11.12	1.31	0.02	7.63	146.43	66.49	3,088.86
	03/12/14 09:18:30	7680	11.98	0.20	0.02	6.74	147.53	66.94	3,099.43
	03/12/14 09:19:00	7710	12.55	0.21	0.03	6.42	146.98	67.39	3,095.56
	03/12/14 09:19:30	7740	12.77	0.34	0.04	6.18	145.60	67.39	3,077.95
	03/12/14 09:20:00	7770	12.80	0.52	0.04	6.15	145.04	67.83	3,062.45
A3	03/12/14 09:20:30	7800	12.85	0.77	0.02	6.20	145.04	67.83	3,065.36
	03/12/14 09:21:00	7830	13.05	0.85	0.03	5.98	150.30	67.83	3,108.38
	03/12/14 09:21:30	7860	12.89	1.44	0.04	6.04	29.06	67.39	1,374.25
	03/12/14 09:22:00	7890	13.09	1.74	0.01	6.00	27.68	65.93	1,312.72
	03/12/14 09:22:30	7920	13.26	1.74	0.09	5.98	27.68	65.48	1,309.90
	03/12/14 09:23:00	7950	13.11	6.52	0.04	5.79	27.68	64.58	1,311.25
	03/12/14 09:23:30	7980	12.35	1.51	0.03	6.49	27.13	64.13	1,311.13
	03/12/14 09:24:00	8010	12.37	0.99	0.04	6.44	27.13	64.13	1,302.45
	03/12/14 09:24:30	8040	12.07	0.81	0.03	6.81	27.13	63.57	1,293.56
	03/12/14 09:25:00	8070	12.66	1.05	0.02	6.29	26.57	63.12	1,290.37
	03/12/14 09:25:30	8100	12.49	1.12	0.03	6.36	26.57	62.67	1,285.21
	03/12/14 09:26:00	8130	12.62	1.14	0.03	6.21	58.96	62.22	2,125.23
	03/12/14 09:26:30	8160	12.64	1.46	0.03	6.24	142.27	63.57	3,021.88
	03/12/14 09:27:00	8190	12.47	1.01	0.03	6.35	145.87	64.58	3,071.22
	03/12/14 09:27:30	8220	12.61	1.22	0.04	6.18	149.75	65.03	3,089.16
	03/12/14 09:28:00	8250	12.80	1.29	0.03	6.13	145.60	65.03	3,074.47
	03/12/14 09:28:30	8280	12.33	1.39	0.02	6.34	146.98	65.48	3,076.88
	03/12/14 09:29:00	8310	12.65	1.06	0.02	6.19	145.04	65.48	3,069.51
	03/12/14 09:29:30	8340	12.45	1.24	0.01	6.33	145.60	65.93	3,069.89
	03/12/14 09:30:00	8370	12.74	1.23	0.02	6.14	145.87	66.49	3,078.88
	03/12/14 09:30:30	8400	12.38	1.26	0.01	6.38	147.53	66.49	3,085.74
	03/12/14 09:31:00	8430	12.41	0.89	0.02	6.32	148.09	66.94	3,095.76
	03/12/14 09:31:30	8460	12.41	0.93	0.02	6.43	148.09	66.94	3,083.54

John Zink Co, LLC
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.3	%
Stack Exhaust Flow (M2)	178,215	SCFH

Weather Data

Barometric Pressure	30.21	in. Hg
Relative Humidity	40	%
Ambient Temperature	53	^{o}F
Specific Humidity	0.003355	lb H_2O / lb air

30-70-30 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
03/12/14 09:32:00	8490	12.96	1.20	0.03	6.12	145.04	67.39	3,058.15
03/12/14 09:32:30	8520	12.14	2.35	0.00	6.78	144.49	67.39	3,058.11
03/12/14 09:33:00	8550	12.88	0.33	0.00	5.96	146.98	67.39	3,084.19
03/12/14 09:33:30	8580	12.97	0.49	0.00	6.10	149.75	67.39	3,107.47
03/12/14 09:34:00	8610	12.84	0.89	0.02	6.10	150.30	67.39	3,112.70
03/12/14 09:34:30	8640	12.93	0.85	0.01	6.04	151.41	67.39	3,113.28
03/12/14 09:35:00	8670	12.73	1.15	0.01	6.28	148.64	67.39	3,087.70
03/12/14 09:35:30	8700	14.42	1.37	2.03	5.86	146.43	67.83	3,067.40
03/12/14 09:36:00	8730	20.59	0.53	3.07	0.12	28.79	67.39	1,357.44
03/12/14 09:36:30	8760	20.63	0.19	3.10	0.10	26.57	66.49	1,307.75
03/12/14 09:37:00	8790	8.37	0.65	0.13	0.30	27.68	65.48	1,322.69
03/12/14 09:37:30	8820	0.17	8.08	-0.11	0.04	28.79	65.48	1,336.69
03/12/14 09:38:00	8850	0.13	9.04	-0.11	0.02	28.23	65.03	1,344.32
03/12/14 09:38:30	8880	12.29	8.06	0.63	4.15	28.79	64.58	1,346.98
03/12/14 09:39:00	8910	11.62	14.23	-0.03	6.60	28.23	64.13	1,344.11
03/12/14 09:39:30	8940	12.03	0.83	-0.03	9.37	28.23	63.57	1,337.08
RAW AVERAGE		**12.52**	**1.30**	**0.13**	**6.00**	**101.90**	**65.51**	**2,411.60**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	INST-22-0004	INST-CO-0022	INST-TH-0009	INST-C2-0016	F8_PRF1	F8_TE5	
						(in. H_2O)	**(^{o}F)**	**(SCFH)**
	Initial Zero	0.12	0.18	-0.03	0.01	F-13 LINE 2-3-	F-13 Line 1-3	F-13 Line Orifi
	Final Zero	0.12	0.10	-0.03	0.04			
	Avg. Zero	0.12	0.14	-0.03	0.03			
Bias								
	Initial UpScale	12.01	9.00	3.02	9.33			
	Final UpScale	12.02	9.03	3.07	9.38			
	Avg. UpScale	12.02	9.02	3.05	9.36			
Upscale Cal Gas		12.00	8.98	3.04	9.42			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.51	1.17	0.15	6.03
Corrected Raw Average (ppm/% wet basis)	11.84	1.10	0.15	5.71
Emission Rate (lb/hr)	N/A	0.02	0.00	N/A

John Zink Co, LLC
March 12, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.4	%
Stack Exhaust Flow (M2)	192,325	SCFH

Weather Data

Barometric Pressure	30.26	in. Hg
Relative Humidity	33	%
Ambient Temperature	60	^{o}F
Specific Humidity	0.003560	lb H_2O / lb air

30-70-30 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
A1	03/12/14 10:00:00	10170	12.70	7.10	0.04	6.41	27.68	54.47	1,298.51
	03/12/14 10:00:30	10200	12.78	4.66	0.05	6.43	27.68	54.91	1,292.60
	03/12/14 10:01:00	10230	12.79	3.15	0.06	6.39	28.23	54.91	1,295.13
	03/12/14 10:01:30	10260	12.56	2.12	0.04	6.58	28.23	54.91	1,299.05
	03/12/14 10:02:00	10290	12.58	1.42	0.04	6.58	28.23	54.91	1,295.88
	03/12/14 10:02:30	10320	12.67	0.97	0.04	6.46	28.23	54.91	1,295.46
	03/12/14 10:03:00	10350	12.81	0.72	0.07	6.30	28.79	54.91	1,297.88
	03/12/14 10:03:30	10380	12.60	0.69	0.14	6.61	133.14	55.81	2,910.58
	03/12/14 10:04:00	10410	13.94	2.07	0.12	5.69	153.07	57.16	3,080.92
	03/12/14 10:04:30	10440	13.46	1.98	0.12	5.97	151.96	58.17	3,081.72
	03/12/14 10:05:00	10470	13.44	1.21	0.11	6.06	153.07	59.07	3,093.78
	03/12/14 10:05:30	10500	13.70	1.00	0.10	5.83	152.52	59.52	3,085.65
	03/12/14 10:06:00	10530	13.22	0.70	0.11	6.17	149.19	59.97	3,064.90
	03/12/14 10:06:30	10560	13.60	0.52	0.12	5.98	149.75	60.87	3,075.06
	03/12/14 10:07:00	10590	14.18	0.61	0.10	5.38	149.75	61.77	3,070.84
	03/12/14 10:07:30	10620	13.63	0.65	0.09	5.79	154.18	62.22	3,105.58
	03/12/14 10:08:00	10650	13.63	0.49	0.11	5.87	153.07	63.12	3,090.96
	03/12/14 10:08:30	10680	13.66	0.50	0.11	5.86	151.41	63.57	3,086.68
	03/12/14 10:09:00	10710	13.63	0.41	0.10	5.71	147.53	64.13	3,049.33
	03/12/14 10:09:30	10740	13.17	0.34	0.09	6.11	145.87	64.13	3,048.66
	03/12/14 10:10:00	10770	13.48	0.26	0.10	6.01	146.98	65.03	3,042.75
	03/12/14 10:10:30	10800	13.67	0.39	0.11	5.82	147.53	65.03	3,054.23
	03/12/14 10:11:00	10830	13.81	0.41	0.10	5.68	150.30	65.48	3,084.83
	03/12/14 10:11:30	10860	13.41	0.37	0.09	5.95	153.62	65.48	3,097.30
	03/12/14 10:12:00	10890	13.20	0.25	0.09	6.16	151.41	65.93	3,076.39
	03/12/14 10:12:30	10920	13.19	0.19	0.09	6.23	148.64	66.49	3,058.32
	03/12/14 10:13:00	10950	13.59	0.29	0.08	5.88	147.53	66.94	3,049.38
	03/12/14 10:13:30	10980	13.03	0.28	0.06	6.18	148.64	66.94	3,053.30
	03/12/14 10:14:00	11010	13.06	0.27	0.07	6.11	28.79	66.94	1,331.51
	03/12/14 10:14:30	11040	12.61	0.27	0.08	6.38	28.79	65.93	1,313.96
	03/12/14 10:15:00	11070	13.20	0.35	0.06	5.97	28.79	65.48	1,310.87
	03/12/14 10:15:30	11100	13.14	0.37	0.05	5.95	28.79	65.03	1,317.28
	03/12/14 10:16:00	11130	12.94	0.25	0.06	6.12	28.79	64.58	1,311.92
	03/12/14 10:16:30	11160	12.72	0.23	0.06	6.23	28.79	64.58	1,316.23
	03/12/14 10:17:00	11190	12.67	0.37	0.06	6.25	28.79	64.58	1,311.88
	03/12/14 10:17:30	11220	12.84	0.68	0.05	6.13	28.23	64.13	1,301.32
	03/12/14 10:18:00	11250	12.93	0.74	0.06	6.04	28.23	64.13	1,298.43
	03/12/14 10:18:30	11280	12.87	0.41	0.06	6.10	28.23	63.57	1,290.22
	03/12/14 10:19:00	11310	13.06	0.44	0.05	5.93	27.68	63.12	1,294.62
	03/12/14 10:19:30	11340	12.95	0.58	0.04	5.96	96.33	63.12	2,230.99
	03/12/14 10:20:00	11370	13.48	1.50	0.06	5.58	153.62	64.13	3,086.58
A2	03/12/14 10:20:30	11400	12.71	1.85	0.08	6.16	148.64	65.03	3,067.77
	03/12/14 10:21:00	11430	12.61	0.33	0.05	6.21	151.41	65.48	3,078.23
	03/12/14 10:21:30	11460	12.84	0.11	0.05	6.13	151.41	66.49	3,093.06
	03/12/14 10:22:00	11490	13.04	0.13	0.06	5.99	153.07	66.94	3,112.58
	03/12/14 10:22:30	11520	13.11	0.34	0.06	5.88	150.86	66.94	3,084.54
	03/12/14 10:23:00	11550	13.42	0.27	0.06	5.78	146.98	67.39	3,061.17
	03/12/14 10:23:30	11580	12.92	0.44	0.05	5.96	146.98	67.83	3,039.96
	03/12/14 10:24:00	11610	12.80	0.53	0.06	6.07	146.98	67.83	3,038.49
	03/12/14 10:24:30	11640	12.72	0.50	0.05	6.15	146.43	67.83	3,044.69
	03/12/14 10:25:00	11670	12.73	0.59	0.06	6.14	146.98	67.83	3,048.88

John Zink Co, LLC
March 12, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.4	%
Stack Exhaust Flow (M2)	192,325	SCFH

Weather Data

Barometric Pressure	30.26	in. Hg
Relative Humidity	33	%
Ambient Temperature	60	^{o}F
Specific Humidity	0.003560	lb H_2O / lb air

30-70-30 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
	03/12/14 10:25:30	11700	12.82	0.69	0.05	6.11	150.30	68.28	3,078.48
	03/12/14 10:26:00	11730	12.53	0.66	0.05	6.29	153.07	68.28	3,088.57
	03/12/14 10:26:30	11760	12.47	0.35	0.05	6.37	149.75	68.28	3,076.08
	03/12/14 10:27:00	11790	12.51	0.20	0.04	6.39	146.98	68.73	3,037.14
	03/12/14 10:27:30	11820	12.88	0.45	0.04	6.10	149.19	69.18	3,072.19
	03/12/14 10:28:00	11850	12.64	0.67	0.04	6.05	149.75	68.73	3,086.99
	03/12/14 10:28:30	11880	12.80	0.35	0.04	6.03	30.72	68.73	1,472.88
	03/12/14 10:29:00	11910	11.42	0.37	0.03	6.95	28.79	67.83	1,348.30
	03/12/14 10:29:30	11940	12.78	0.28	0.03	6.03	28.79	66.94	1,307.31
	03/12/14 10:30:00	11970	12.88	1.13	0.04	5.94	28.23	65.93	1,309.81
	03/12/14 10:30:30	12000	12.93	1.41	0.05	5.87	27.68	65.48	1,310.02
	03/12/14 10:31:00	12030	13.00	1.63	0.04	5.83	28.23	65.03	1,299.56
	03/12/14 10:31:30	12060	12.88	2.03	0.03	5.93	28.23	65.03	1,296.38
	03/12/14 10:32:00	12090	13.10	1.78	0.02	5.78	27.68	64.58	1,289.22
	03/12/14 10:32:30	12120	12.94	2.14	0.02	5.92	27.68	64.13	1,291.59
	03/12/14 10:33:00	12150	12.96	1.79	0.02	5.95	27.68	64.13	1,289.30
	03/12/14 10:33:30	12180	13.17	1.83	0.02	5.84	28.79	63.57	1,289.63
	03/12/14 10:34:00	12210	13.30	2.74	0.03	5.76	133.69	64.13	2,907.30
	03/12/14 10:34:30	12240	13.14	4.09	0.04	5.70	150.30	65.03	3,072.82
	03/12/14 10:35:00	12270	12.66	1.81	0.04	6.15	153.62	65.48	3,098.13
	03/12/14 10:35:30	12300	12.52	0.89	0.03	6.25	149.75	65.93	3,085.89
	03/12/14 10:36:00	12330	12.29	0.49	0.04	6.45	150.30	66.49	3,094.23
	03/12/14 10:36:30	12360	12.27	0.33	0.04	6.47	153.07	66.49	3,108.66
	03/12/14 10:37:00	12390	12.45	0.26	0.02	6.39	151.41	66.49	3,108.05
	03/12/14 10:37:30	12420	12.66	0.43	0.02	6.23	150.86	66.94	3,092.07
	03/12/14 10:38:00	12450	12.55	0.41	0.02	6.31	149.75	67.39	3,079.72
	03/12/14 10:38:30	12480	12.79	0.51	0.03	6.19	149.75	67.39	3,072.03
	03/12/14 10:39:00	12510	12.82	0.62	0.01	6.11	148.64	67.83	3,084.84
	03/12/14 10:39:30	12540	12.71	0.58	0.01	6.18	149.75	67.83	3,088.29
	03/12/14 10:40:00	12570	12.85	0.65	0.03	6.08	153.62	68.28	3,117.13
A3	03/12/14 10:40:30	12600	12.55	0.64	0.03	6.24	155.28	68.73	3,120.97
	03/12/14 10:41:00	12630	12.18	0.58	0.02	6.51	153.07	68.28	3,102.02
	03/12/14 10:41:30	12660	12.28	0.45	0.02	6.49	148.64	68.73	3,078.46
	03/12/14 10:42:00	12690	12.50	0.59	0.03	6.31	149.75	68.28	3,072.79
	03/12/14 10:42:30	12720	12.65	0.58	0.03	6.21	149.75	68.28	3,072.36
	03/12/14 10:43:00	12750	12.54	0.72	0.02	6.27	149.75	68.28	3,079.77
	03/12/14 10:43:30	12780	11.69	0.82	0.01	6.83	28.23	67.83	1,315.88
	03/12/14 10:44:00	12810	13.00	0.32	0.00	6.04	28.23	66.94	1,317.76
	03/12/14 10:44:30	12840	13.05	0.58	0.01	5.83	28.23	66.49	1,315.12
	03/12/14 10:45:00	12870	13.30	0.93	0.01	5.72	28.23	66.49	1,307.96
	03/12/14 10:45:30	12900	13.26	1.40	0.01	5.67	28.79	65.93	1,307.40
	03/12/14 10:46:00	12930	13.33	1.64	0.02	5.64	28.23	65.93	1,298.34
	03/12/14 10:46:30	12960	13.30	2.96	0.02	5.65	27.68	65.93	1,300.41
	03/12/14 10:47:00	12990	13.43	2.77	0.02	5.57	27.68	65.93	1,299.27
	03/12/14 10:47:30	13020	13.47	2.73	0.01	5.53	27.68	65.93	1,294.42
	03/12/14 10:48:00	13050	13.51	2.98	0.02	5.51	26.57	65.93	1,289.68
	03/12/14 10:48:30	13080	13.58	3.01	0.03	5.48	110.44	65.93	2,740.00
	03/12/14 10:49:00	13110	13.99	6.68	0.11	5.07	148.64	66.94	3,079.14
	03/12/14 10:49:30	13140	12.61	5.59	0.02	6.12	149.75	67.39	3,090.56
	03/12/14 10:50:00	13170	12.42	1.38	0.01	6.31	149.75	67.83	3,088.73
	03/12/14 10:50:30	13200	12.40	0.98	0.01	6.36	150.86	68.28	3,086.69

John Zink Co, LLC
March 12, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.4	%
Stack Exhaust Flow (M2)	192,325	SCFH

Weather Data

Barometric Pressure	30.26	in. Hg
Relative Humidity	33	%
Ambient Temperature	60	^{o}F
Specific Humidity	0.003560	lb H_2O / lb air

30-70-30 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
03/12/14 10:51:00	13230	12.61	1.01	0.01	6.18	154.18	68.73	3,121.09
03/12/14 10:51:30	13260	12.45	1.15	0.01	6.30	149.75	68.73	3,088.55
03/12/14 10:52:00	13290	12.61	0.96	0.01	6.24	147.53	69.18	3,058.14
03/12/14 10:52:30	13320	12.66	1.31	0.01	6.19	148.64	69.63	3,073.83
03/12/14 10:53:00	13350	12.71	1.17	0.01	6.13	150.30	70.08	3,077.73
03/12/14 10:53:30	13380	12.62	1.26	0.01	6.20	149.19	70.08	3,080.58
03/12/14 10:54:00	13410	12.79	1.62	0.01	6.08	149.19	70.53	3,080.44
03/12/14 10:54:30	13440	12.58	1.25	0.00	6.22	151.41	70.08	3,106.57
03/12/14 10:55:00	13470	12.38	0.80	0.00	6.42	153.62	70.08	3,124.78
03/12/14 10:55:30	13500	12.60	0.69	0.01	6.27	154.73	70.53	3,117.94
03/12/14 10:56:00	13530	12.65	0.83	0.01	6.20	151.41	70.53	3,086.09
03/12/14 10:56:30	13560	12.43	0.85	0.00	6.37	150.86	70.53	3,074.48
03/12/14 10:57:00	13590	12.59	0.88	0.01	6.25	149.75	70.53	3,083.78
03/12/14 10:57:30	13620	12.55	0.89	0.01	6.25	150.86	70.53	3,078.17
03/12/14 10:58:00	13650	12.68	1.07	0.00	6.15	152.52	70.53	3,114.43
03/12/14 10:58:30	13680	12.47	0.64	0.01	6.30	25.47	70.08	1,264.54
03/12/14 10:59:30	13740	13.64	2.34	-0.01	5.38	28.23	68.28	1,307.04
03/12/14 11:00:00	13770	13.51	2.47	0.00	5.57	27.68	68.28	1,301.23
RAW AVERAGE		**12.92**	**1.13**	**0.04**	**6.08**	**105.90**	**65.66**	**2,437.87**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	INST-22-0004	INST-CO-0022	INST-TH-0009	INST-C2-0016	F-13 LINE 2-3-4 PRESS	F-13 Line 1-3 TE	F-13 Line Orifice
		(%)	**(ppmvd)**	**(ppmvw)**	**(%)**	**(in. H_2O)**	**(^{o}F)**	**(SCFH)**
Bias	**Initial Zero**	0.12	0.10	-0.03	0.04			
	Final Zero	0.10	0.16	-0.02	0.05			
	Avg. Zero	0.11	0.13	-0.03	0.05			
	Initial UpScale	12.02	9.03	3.07	9.38			
	Final UpScale	12.00	8.98	3.06	9.34			
	Avg. UpScale	12.01	9.01	3.07	9.36			
Upscale Cal Gas		12.00	8.98	3.04	9.42			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.92	1.01	0.07	6.10
Corrected Raw Average (ppm/% wet basis)	12.21	0.95	0.07	5.76
Emission Rate (lb/hr)	N/A	0.01	0.00	N/A

John Zink Co, LLC
March 12, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.4	%
Stack Exhaust Flow (M2)	201,263	SCFH

Weather Data

Barometric Pressure	30.26	in. Hg
Relative Humidity	25	%
Ambient Temperature	66	^{o}F
Specific Humidity	0.003330	lb H_2O / lb air

30-70-30 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
A1	03/12/14 11:23:00	15150	11.23	6.02	0.01	7.19	28.79	61.32	1,306.17
	03/12/14 11:23:30	15180	11.28	1.82	0.01	7.17	28.79	61.32	1,300.24
	03/12/14 11:24:00	15210	12.65	1.22	0.01	6.29	28.23	61.77	1,305.78
	03/12/14 11:24:30	15240	13.02	1.55	0.02	5.89	28.79	61.77	1,305.15
	03/12/14 11:25:00	15270	12.92	1.64	0.03	5.93	28.23	61.77	1,299.84
	03/12/14 11:25:30	15300	12.80	1.17	0.03	6.05	28.23	61.77	1,301.44
	03/12/14 11:26:00	15330	12.99	1.22	0.03	5.99	112.38	62.22	2,749.40
	03/12/14 11:26:30	15360	14.27	3.67	0.04	4.93	154.18	63.57	3,079.82
	03/12/14 11:27:00	15390	13.35	3.07	0.06	5.59	153.07	65.03	3,077.64
	03/12/14 11:27:30	15420	13.40	1.79	0.05	5.68	154.18	65.48	3,091.85
	03/12/14 11:28:00	15450	13.43	1.72	0.04	5.56	154.18	66.49	3,086.38
	03/12/14 11:28:30	15480	12.87	1.22	0.04	6.00	155.28	66.94	3,112.37
	03/12/14 11:29:00	15510	12.83	0.79	0.04	6.05	158.88	67.39	3,144.12
	03/12/14 11:29:30	15540	12.94	0.73	0.05	6.05	154.73	67.83	3,122.11
	03/12/14 11:30:00	15570	13.33	0.61	0.05	5.65	154.18	68.73	3,094.42
	03/12/14 11:30:30	15600	12.79	0.49	0.04	6.10	151.96	68.73	3,083.26
	03/12/14 11:31:00	15630	12.74	0.47	0.04	6.17	151.96	69.63	3,077.58
	03/12/14 11:31:30	15660	13.27	0.52	0.04	5.76	151.96	70.08	3,082.65
	03/12/14 11:32:00	15690	13.09	0.53	0.03	5.89	151.41	70.08	3,074.27
	03/12/14 11:32:30	15720	13.00	0.41	0.03	5.95	153.07	70.53	3,096.96
	03/12/14 11:33:00	15750	13.16	0.35	0.03	5.82	155.28	71.43	3,092.32
	03/12/14 11:33:30	15780	13.15	0.34	0.03	5.85	153.62	72.78	3,096.66
	03/12/14 11:34:00	15810	13.42	0.31	0.03	5.62	151.96	72.78	3,083.70
	03/12/14 11:34:30	15840	13.21	0.36	0.03	5.76	153.07	73.23	3,072.40
	03/12/14 11:35:00	15870	13.25	0.34	0.04	5.82	151.96	73.23	3,077.54
	03/12/14 11:35:30	15900	13.53	0.31	0.04	5.54	151.96	74.13	3,077.53
	03/12/14 11:36:00	15930	13.35	0.34	0.02	5.67	156.39	74.58	3,091.46
	03/12/14 11:36:30	15960	13.08	0.26	0.02	5.82	153.07	74.58	3,072.14
	03/12/14 11:37:00	15990	12.81	0.11	0.02	6.06	70.31	74.58	1,972.28
	03/12/14 11:37:30	16020	11.75	0.08	0.01	6.76	27.68	74.13	1,308.33
	03/12/14 11:38:00	16050	13.24	0.32	0.02	5.76	29.06	74.13	1,313.18
	03/12/14 11:38:30	16080	12.96	1.31	0.02	5.87	28.79	73.23	1,310.40
	03/12/14 11:39:00	16110	13.11	1.41	0.02	5.85	29.06	72.78	1,306.76
	03/12/14 11:39:30	16140	13.13	1.77	0.02	5.81	28.79	72.33	1,307.94
	03/12/14 11:40:00	16170	13.10	1.76	0.02	5.84	28.79	72.78	1,306.45
	03/12/14 11:40:30	16200	13.24	1.86	0.01	5.75	28.79	72.78	1,309.64
	03/12/14 11:41:00	16230	13.48	2.25	0.01	5.69	117.92	72.78	2,806.82
	03/12/14 11:41:30	16260	13.83	3.49	0.01	5.15	156.95	73.68	3,101.64
	03/12/14 11:42:00	16290	13.19	1.61	0.01	5.61	153.62	74.13	3,067.23
	03/12/14 11:42:30	16320	12.86	0.56	0.01	6.05	154.18	74.13	3,080.16
	03/12/14 11:43:00	16350	13.09	0.39	0.02	5.80	154.73	74.58	3,092.79
A2	03/12/14 11:43:30	16380	13.28	0.32	0.02	5.84	155.28	75.03	3,088.49
	03/12/14 11:44:00	16410	13.05	0.53	0.02	5.81	153.07	75.03	3,078.69
	03/12/14 11:44:30	16440	12.85	0.67	0.03	6.06	152.52	75.47	3,073.09
	03/12/14 11:45:00	16470	12.82	0.66	0.04	6.07	152.52	75.47	3,073.78
	03/12/14 11:45:30	16500	12.86	0.66	0.03	6.06	151.96	75.47	3,074.61
	03/12/14 11:46:00	16530	12.97	0.84	0.04	5.94	152.52	75.47	3,077.32
	03/12/14 11:46:30	16560	12.89	0.76	0.04	6.04	154.73	76.04	3,094.61
	03/12/14 11:47:00	16590	12.75	0.71	0.03	6.12	154.18	76.04	3,095.25
	03/12/14 11:47:30	16620	12.83	0.56	0.03	6.09	151.41	76.04	3,088.58
	03/12/14 11:48:00	16650	12.87	0.82	0.03	6.03	151.96	76.49	3,064.59

John Zink Co, LLC
March 12, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.4	%
Stack Exhaust Flow (M2)	201,263	SCFH

Weather Data

Barometric Pressure	30.26	in. Hg
Relative Humidity	25	%
Ambient Temperature	66	^{o}F
Specific Humidity	0.003330	lb H_2O / lb air

30-70-30 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
	03/12/14 11:48:30	16680	12.82	0.84	0.03	6.06	152.52	76.49	3,077.67
	03/12/14 11:49:00	16710	12.57	0.58	0.03	6.27	151.96	76.04	3,070.97
	03/12/14 11:49:30	16740	12.90	0.59	0.02	6.05	154.18	76.49	3,083.18
	03/12/14 11:50:00	16770	12.94	0.75	0.03	6.00	154.18	76.49	3,093.04
	03/12/14 11:50:30	16800	12.68	0.58	0.03	6.20	153.62	76.94	3,076.35
	03/12/14 11:51:00	16830	12.77	0.45	0.01	6.18	152.52	76.94	3,078.03
	03/12/14 11:51:30	16860	13.06	0.68	0.01	5.98	28.23	76.49	1,310.86
	03/12/14 11:52:00	16890	13.42	1.87	0.01	5.66	28.79	76.04	1,314.77
	03/12/14 11:52:30	16920	13.28	2.58	0.02	5.75	28.79	75.03	1,311.50
	03/12/14 11:53:00	16950	13.52	2.89	0.02	5.57	28.79	74.58	1,317.88
	03/12/14 11:53:30	16980	13.36	3.49	0.02	5.69	28.79	73.68	1,317.02
	03/12/14 11:54:00	17010	12.91	2.77	0.01	5.95	27.68	73.23	1,314.88
	03/12/14 11:54:30	17040	12.49	1.58	0.00	6.34	28.23	73.23	1,300.35
	03/12/14 11:55:00	17070	12.73	1.22	0.00	6.18	28.23	72.78	1,296.98
	03/12/14 11:55:30	17100	13.18	1.50	0.00	5.93	27.68	72.33	1,297.32
	03/12/14 11:56:00	17130	13.21	1.44	0.02	6.00	123.18	72.33	2,821.14
	03/12/14 11:56:30	17160	13.41	4.16	0.01	5.61	154.73	73.68	3,098.60
	03/12/14 11:57:00	17190	12.67	1.96	0.00	6.24	153.07	74.13	3,081.00
	03/12/14 11:57:30	17220	12.37	0.65	-0.01	6.46	152.52	74.13	3,096.16
	03/12/14 11:58:00	17250	12.65	0.46	0.01	6.26	154.18	74.58	3,088.41
	03/12/14 11:58:30	17280	12.47	0.49	0.01	6.36	151.96	74.58	3,087.49
	03/12/14 11:59:00	17310	12.72	0.50	-0.01	6.18	150.30	75.03	3,078.64
	03/12/14 11:59:30	17340	12.20	0.43	-0.01	6.51	151.41	74.58	3,078.26
	03/12/14 12:00:00	17370	12.70	0.14	0.01	6.25	153.62	75.03	3,084.27
	03/12/14 12:00:30	17400	12.69	0.48	0.00	6.20	151.41	75.47	3,089.97
	03/12/14 12:01:00	17430	12.89	0.53	0.00	6.09	154.73	76.04	3,103.11
	03/12/14 12:01:30	17460	12.91	0.60	0.00	6.05	152.52	76.49	3,093.01
	03/12/14 12:02:00	17490	12.86	0.59	0.01	6.12	151.41	76.49	3,079.02
	03/12/14 12:02:30	17520	12.72	0.70	0.00	6.17	149.75	76.04	3,074.41
	03/12/14 12:03:00	17550	12.94	0.64	0.00	6.10	150.30	76.49	3,072.29
A3	03/12/14 12:03:30	17580	12.74	0.89	0.00	6.09	151.41	76.49	3,070.18
	03/12/14 12:04:00	17610	12.62	0.40	0.00	6.33	151.96	76.49	3,075.67
	03/12/14 12:04:30	17640	12.68	0.54	0.00	6.18	153.62	76.49	3,087.42
	03/12/14 12:05:00	17670	12.38	0.40	-0.01	6.43	153.62	76.94	3,076.92
	03/12/14 12:05:30	17700	12.44	0.52	-0.01	6.42	151.41	76.94	3,068.13
	03/12/14 12:06:00	17730	12.54	0.44	0.00	6.37	151.41	76.94	3,073.95
	03/12/14 12:06:30	17760	12.67	0.83	0.00	6.23	59.51	77.38	1,711.97
	03/12/14 12:07:00	17790	12.30	0.74	0.01	6.52	27.68	76.49	1,304.41
	03/12/14 12:07:30	17820	13.17	0.43	0.00	5.90	27.68	76.04	1,310.67
	03/12/14 12:08:00	17850	13.31	1.31	0.01	5.72	28.79	75.47	1,316.86
	03/12/14 12:08:30	17880	13.60	1.84	0.02	5.58	28.79	75.03	1,314.81
	03/12/14 12:09:00	17910	13.48	2.47	-0.01	5.60	28.79	74.58	1,313.28
	03/12/14 12:09:30	17940	13.29	2.54	-0.02	5.79	28.79	74.58	1,312.22
	03/12/14 12:10:00	17970	13.62	2.57	0.01	5.54	28.23	74.58	1,311.42
	03/12/14 12:10:30	18000	14.12	2.98	0.03	5.16	66.43	74.13	2,171.20
	03/12/14 12:11:00	18030	14.00	4.75	0.10	5.17	154.18	75.03	3,094.79
	03/12/14 12:11:30	18060	12.87	4.51	0.00	6.03	153.62	76.04	3,086.17
	03/12/14 12:12:00	18090	12.79	1.62	0.00	6.18	151.41	76.04	3,072.57
	03/12/14 12:12:30	18120	13.09	1.79	0.00	5.94	150.86	76.49	3,068.19
	03/12/14 12:13:00	18150	12.72	1.42	-0.01	6.16	151.96	76.49	3,076.77
	03/12/14 12:13:30	18180	12.59	1.33	-0.01	6.28	153.07	77.38	3,095.58

John Zink Co, LLC
March 12, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.4	%
Stack Exhaust Flow (M2)	201,263	SCFH

Weather Data

Barometric Pressure	30.26	in. Hg
Relative Humidity	25	%
Ambient Temperature	66	^{o}F
Specific Humidity	0.003330	lb H_2O / lb air

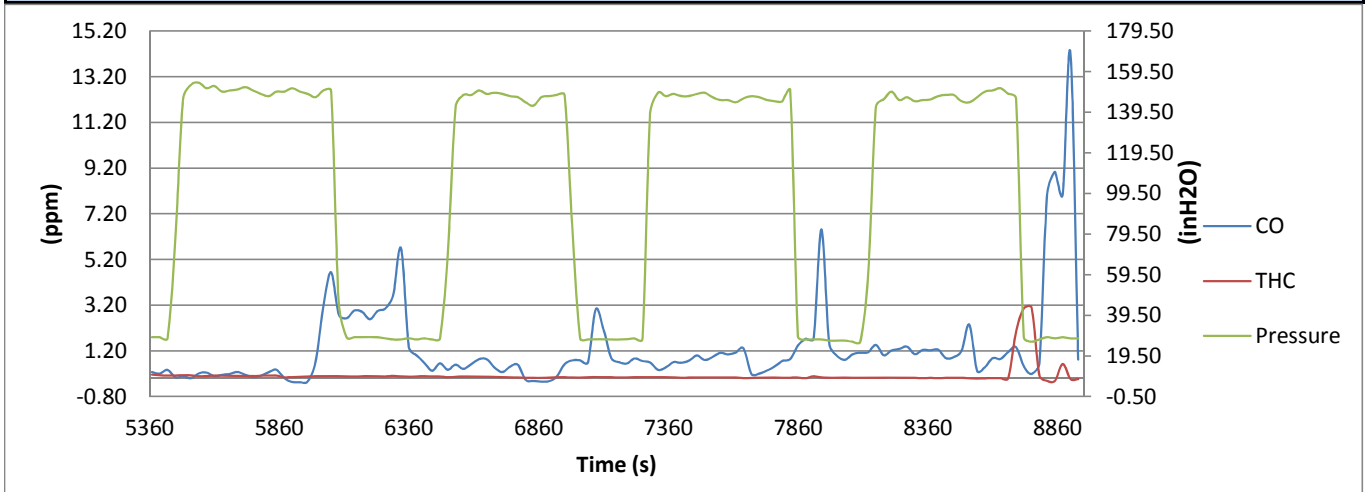
30-70-30 Load, Run - 4.0X30PF R6

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Fuel Temp. ^{o}F	Fuel Flow SCFH
03/12/14 12:14:00	18210	13.03	1.18	0.00	6.00	151.96	78.28	3,089.81
03/12/14 12:14:30	18240	12.82	1.14	0.00	6.11	150.86	78.28	3,082.60
03/12/14 12:15:00	18270	12.68	1.23	0.00	6.22	151.41	78.73	3,071.27
03/12/14 12:15:30	18300	13.00	1.55	0.00	5.95	150.86	78.28	3,085.60
03/12/14 12:16:00	18330	12.69	1.54	-0.02	6.19	151.96	78.28	3,097.04
03/12/14 12:16:30	18360	12.43	0.86	-0.02	6.36	154.18	78.28	3,105.09
03/12/14 12:17:00	18390	12.49	0.63	0.00	6.33	152.52	77.83	3,096.95
03/12/14 12:17:30	18420	12.36	0.75	0.00	6.42	151.96	77.83	3,081.92
03/12/14 12:18:00	18450	12.70	0.75	-0.02	6.19	150.30	77.83	3,083.05
03/12/14 12:18:30	18480	12.57	1.06	-0.02	6.27	150.86	78.28	3,079.57
03/12/14 12:19:00	18510	12.54	0.88	-0.01	6.31	150.30	78.73	3,073.42
03/12/14 12:19:30	18540	12.70	0.95	-0.01	6.15	152.52	78.73	3,092.08
03/12/14 12:20:00	18570	12.65	0.98	-0.02	6.21	151.96	78.73	3,091.89
03/12/14 12:20:30	18600	12.71	1.10	-0.01	6.17	153.07	78.73	3,084.57
03/12/14 12:21:00	18630	12.30	1.10	0.00	6.47	27.68	78.28	1,306.95
03/12/14 12:21:30	18660	13.67	1.90	-0.01	5.58	27.68	76.49	1,311.49
03/12/14 12:22:00	18690	13.72	3.55	-0.01	5.40	28.23	76.49	1,311.99
03/12/14 12:22:30	18720	13.85	4.08	-0.01	5.33	28.23	76.04	1,305.72
03/12/14 12:23:00	18750	13.71	4.64	0.00	5.41	28.23	76.04	1,305.86
RAW AVERAGE		**12.95**	**1.30**	**0.01**	**5.99**	**114.84**	**73.88**	**2,550.45**

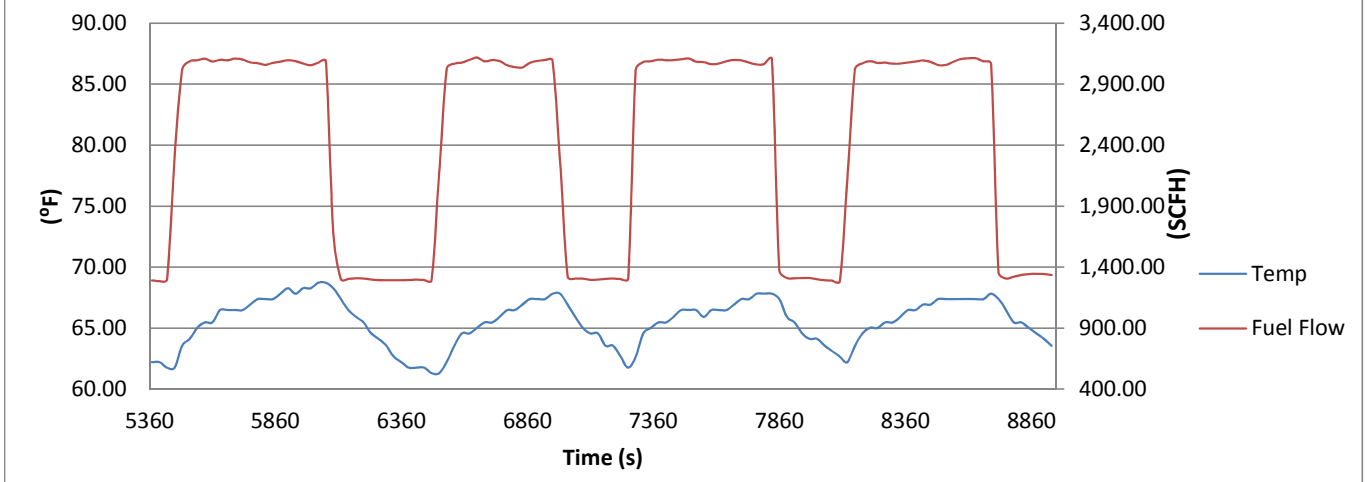
		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	INST-22-0004	INST-CO-0022	INST-TH-0009	INST-C2-0016	F-13 LINE 2-3-4 PRESS	F-13 Line 1-3 TE	F-13 Line Orifice
		(%)	**(ppmvd)**	**(ppmvw)**	**(%)**	**(in. H_2O)**	**(^{o}F)**	**(SCFH)**
Bias	**Initial Zero**	0.10	0.16	-0.02	0.05			
	Final Zero	0.09	0.08	-0.07	0.06			
	Avg. Zero	0.10	0.12	-0.05	0.06			
	Initial UpScale	12.00	8.98	3.06	9.34			
	Final UpScale	11.99	8.94	3.03	9.44			
	Avg. UpScale	12.00	8.96	3.05	9.39			
Upscale Cal Gas		12.00	8.98	3.04	9.42			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.96	1.20	0.06	5.99
Corrected Raw Average (ppm/% wet basis)	12.25	1.12	0.06	5.66
Emission Rate (lb/hr)	N/A	0.02	0.00	N/A

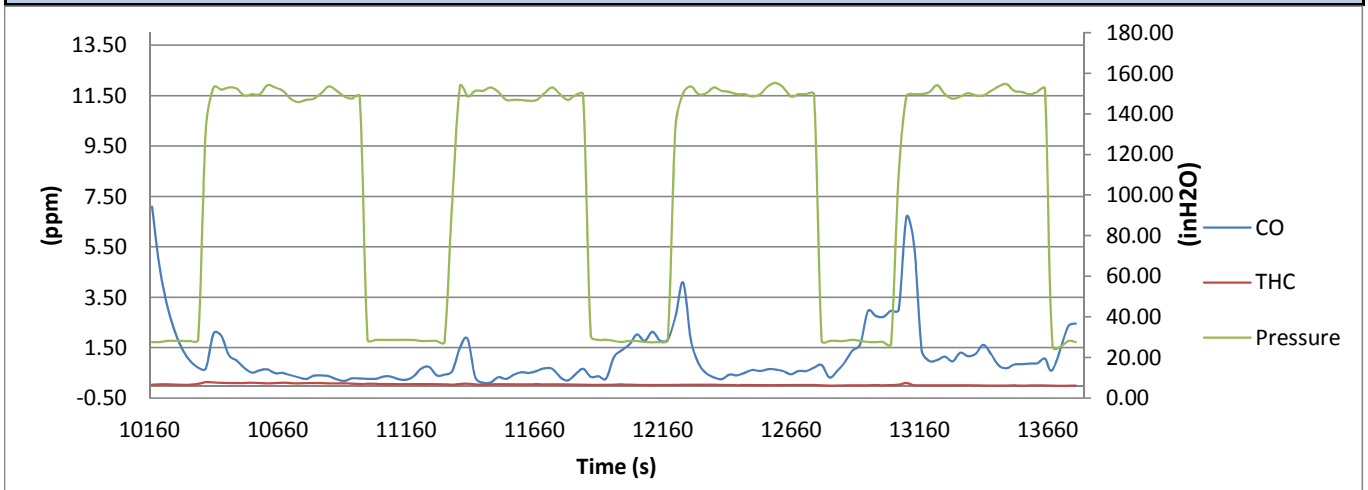
4.0X30PF R4



4.0X30PF R4



4.0X30PF R5



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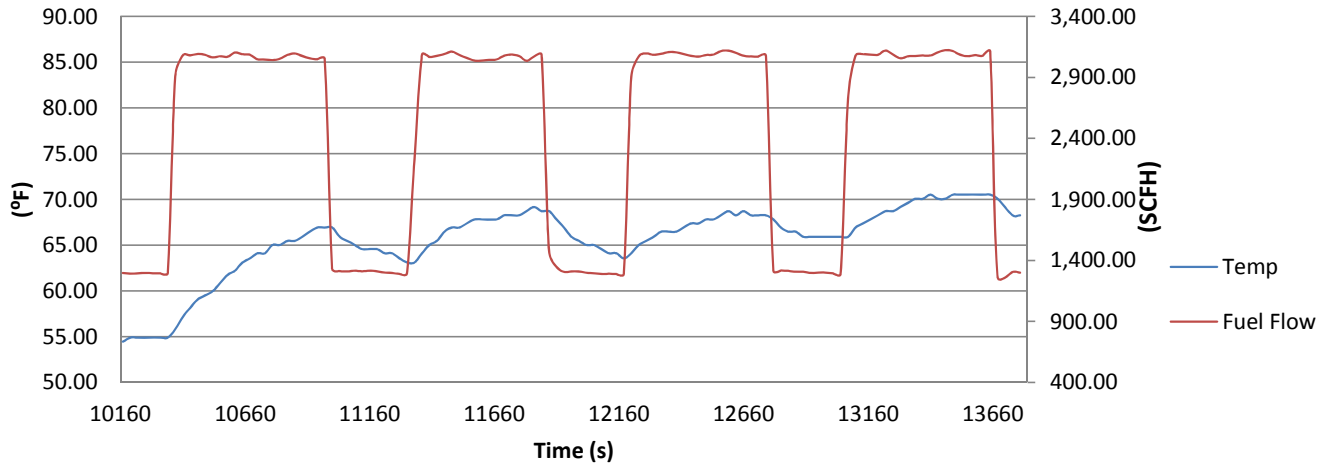
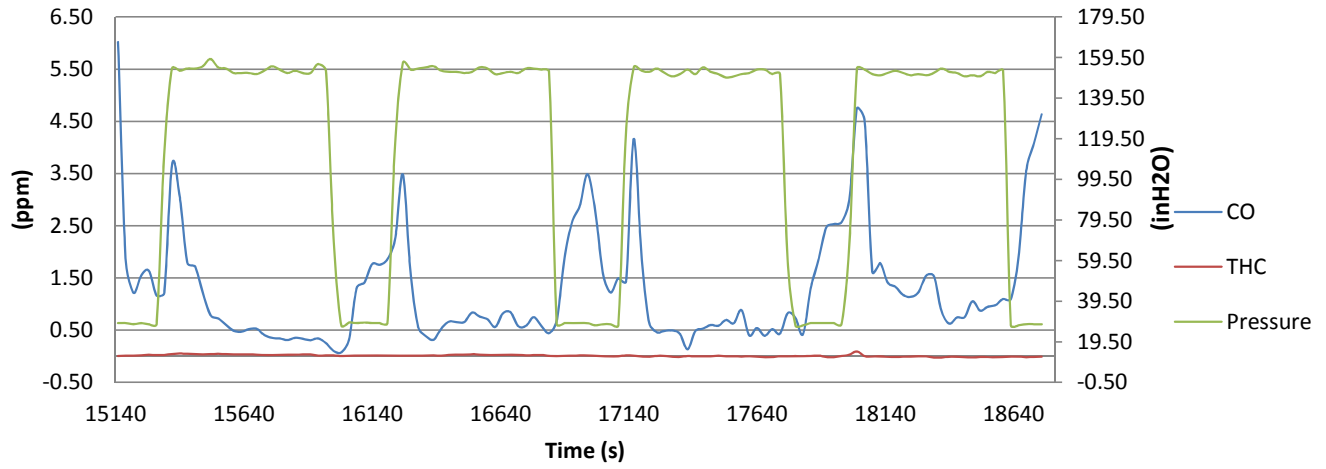


4.0X30PF R6



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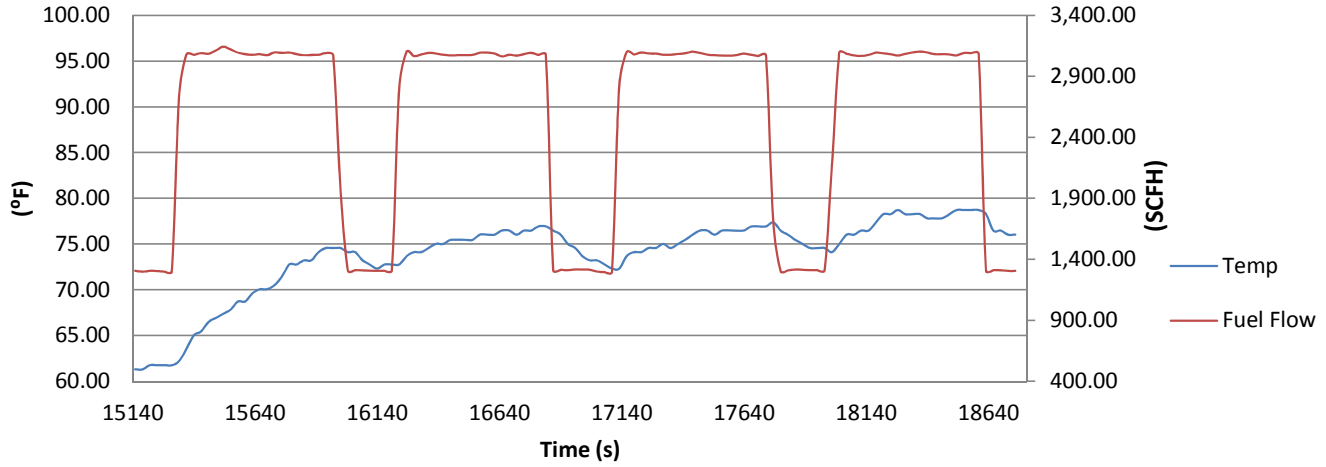
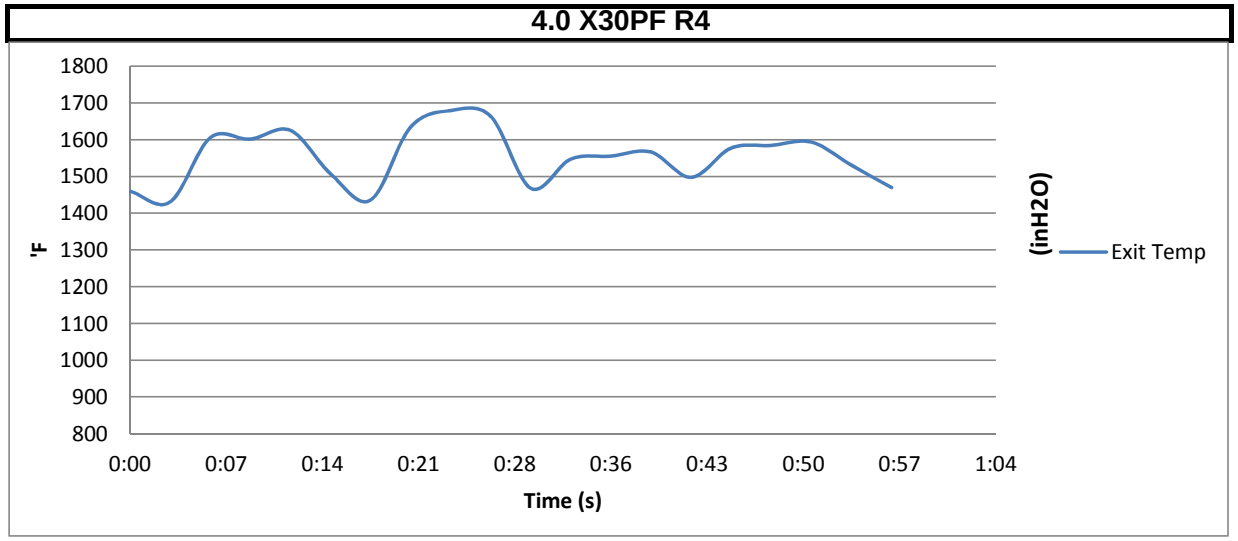
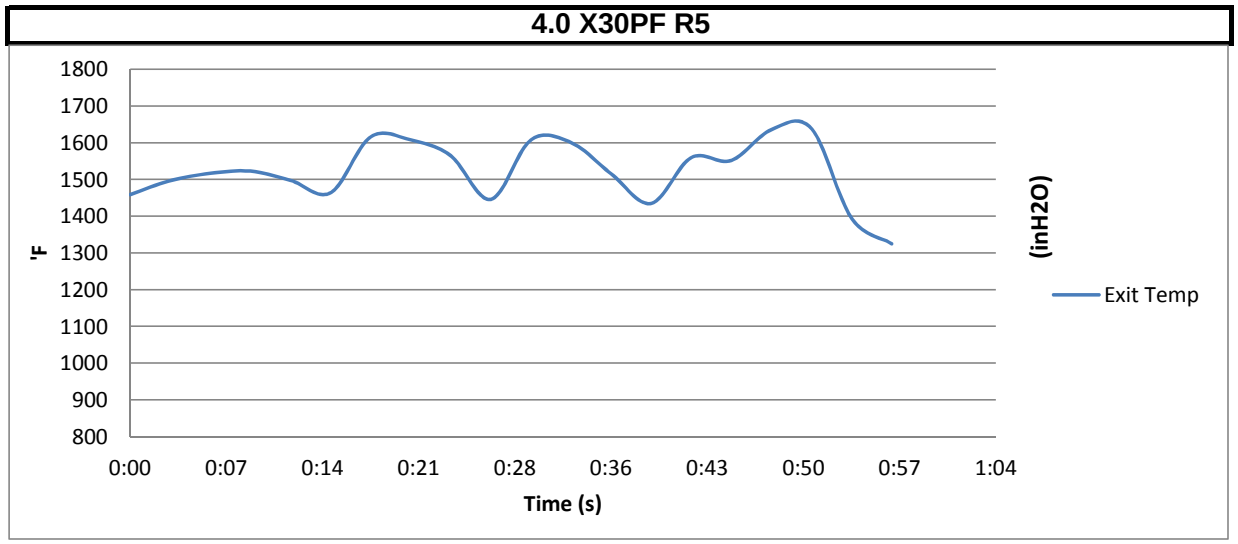
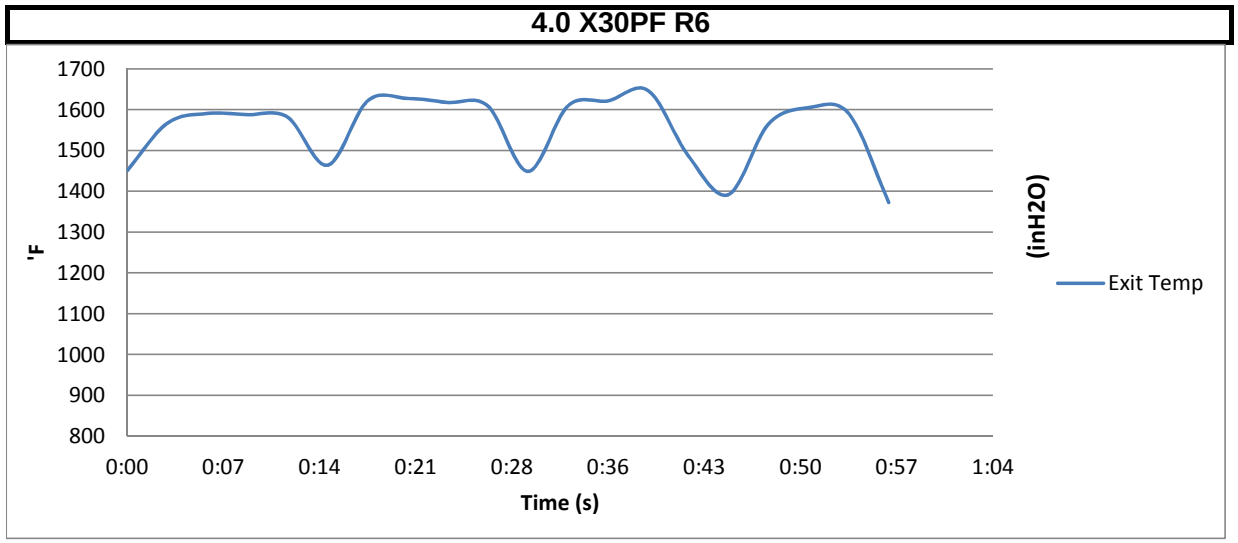



4.0 X30PF R4
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
'F
0:00
0:07
0:14
0:21
0:28
0:36
0:43
0:50
0:57
1:04
Time (s)
(inH2O)
Exit Temp


4.0 X30PF R5
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
'F
0:00
0:07
0:14
0:21
0:28
0:36
0:43
0:50
0:57
1:04
Time (s)
(inH2O)
Exit Temp


4.0 X30PF R6
1700
1600
1500
1400
1300
1200
1100
1000
900
800
'F
0:00
0:07
0:14
0:21
0:28
0:36
0:43
0:50
0:57
1:04
Time (s)
(inH2O)
Exit Temp

EMISSION DATA RECORDS

70-100-70% Ramp-up, Ramp-down Unit Operations Data

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE

Source Information	
Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Fuel Type	Gas, Propene

Test Information			
Project #		jz-14-tulsa.ok-comp#1	
Operator		TP	
Date for Preliminary Run	(mm/dd/yy)	03/11/14	
Standard Temperature		68	°F
Standard Pressure		29.92	in Hg
Required Sample Vol.	RM4, 8.1.1.2	21	scf
Run Duration	≤0.75 cfm	60	minutes
Unit Number		1	
Base Run Number		70-100-70%	
Number of Ports Available		2	
Number of Ports Used		2	
Port Inside Diameter		4.00	in
Stack Shape		Circular	

Test Equipment Information					
Run		**7**	**8**	**9**	
Test Date	(mm/dd/yy)	03/12/14	03/12/14	03/13/14	
Load	% or w/DB	70-100-70	70-100-70	70-100-70	
Meter Box Number	from ACS	samp-cp-0008	samp-cp-0008	samp-cp-0008	
Meter Calibration Factor	(Y)	0.924	0.924	0.924	
Orifice Meter Coefficient	($\Delta H_@$)	1.700	1.700	1.700	in H_2O
Pitot Identification	from ACS	A4174	A4174	A4174	
Pitot Tube Coefficient	(C_p)	0.819	0.819	0.819	
Probe Number	from ACS	samp-hp-0003	samp-hp-0003	samp-hp-0003	
Probe Length		60.0	60.0	60.0	in
(SS, Glass ….) Liner Material	from list	inconel	inconel	inconel	
Impinger Case Number	from ACS	samp-bh-0016	samp-bh-0016	samp-bh-0016	

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 4 (MOISTURE) [MULTI POINT, NO VARIATION] - RESULTS

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Historical Data	70-100-70%-7	70-100-70%-8	70-100-70%-9	**Average**	**Units**
Run Start Time	13:19	16:30	08:40		hh:mm
Run Stop Time	14:22	17:33	09:43		hh:mm
Test Date	03/12/14	03/12/14	03/13/14		mm/dd/yy
Meter Calibration Factor	0.924	0.924	0.924		
Pitot Tube Coefficient	0.819	0.819	0.819		
Stack Test Data	70-100-70%-7	70-100-70%-8	70-100-70%-9	**Average**	**Units**
Initial Meter Volume	162.614	232.300	279.325		ft^3
Final Meter Volume	210.177	279.680	329.761		ft^3
Total Meter Volume	47.563	47.380	50.436	48.460	ft^3
Total Sampling Time	60.00	60.00	60.00	60.00	min
Average Meter Temperature	65.88	71.38	58.10	65.12	°F
Average Stack Temperature	1444.90	1656.35	1594.95	1565.40	°F
Barometric Pressure	30.26	30.19	30.19	30.21	in Hg
Stack Static Pressure	0.00	0.00	0.00	0.00	in H_2O
Absolute Stack Pressure	30.26	30.19	30.19	30.21	in Hg
Average Orifice Pressure Drop	1.70	1.70	1.70	1.70	in H_2O
Absolute Meter Pressure	30.39	30.32	30.32	30.34	in Hg
Avg Square Root Pitot Pressure	0.25	0.24	0.24	0.24	√(in H_2O)
Moisture Content Data	70-100-70%-7	70-100-70%-8	70-100-70%-9	**Average**	**Units**
Impinger Water Weight Gain	53.70	50.20	45.00	49.63	g
Silica Gel Weight Gain	11.00	9.40	11.60	10.67	g
Total Water Volume Collected	64.82	59.71	56.70	60.41	ml
Standard Water Vapor Volume	3.05	2.81	2.67	2.84	scf
Standard Meter Volume	44.8	44.1	48.1	45.7	dscf
Calculated Stack Moisture	6.37	5.99	5.25	5.87	%
Saturated Stack Moisture	100.00	100.00	100.00	100.00	%
Reported Stack Moisture Content	6.37	5.99	5.25	5.87	%
Gas Analysis Data	70-100-70%-7	70-100-70%-8	70-100-70%-9	**Average**	**Units**
Carbon Dioxide Content	5.3	5.5	5.7	5.5	%
Oxygen Content	15.4	14.7	14.3	14.8	%
Nitrogen Content	79.3	79.8	79.9	79.7	%
Stack Dry Molecular Weight	29.44	29.47	29.47	29.46	lb/lb-mole
Stack Wet Molecular Weight	28.71	28.78	28.87	28.79	lb/lb-mole
Percent Excess Air	278.2	230.9	210.5	239.9	%
Volumetric Flow Rate Data	70-100-70%-7	70-100-70%-8	70-100-70%-9	**Average**	**Units**
Average Stack Gas Velocity	25.86	26.20	25.57	25.88	ft/sec
Stack Cross-Sectional Area	12.57	12.57	12.57	12.57	ft^2
Actual Stack Flow Rate	19,499	19,753	19,279	19,510	acfm
Wet Standard Stack Flow Rate	328	298	300	309	wkscfh
Dry Standard Stack Flow Rate	307,067	280,468	284,135	290,557	dscfh

METHOD 3C - DETERMINATION OF DRY MOLECULAR WEIGHT BY ANALYZER

Plant Name	John Zink Tulsa R&D Facility	**Preliminary Date**	03/11/14		
Sampling Location	4.0X30PF	**Operator**	TP		
Project #	jz-14-tulsa.ok-comp#1	**# of Ports Used**	2		
Fuel Type	Gas, Propene	**Min. Fuel Factor**	N/A	**Max. Fuel Factor**	N/A

Gas Analysis Data									
Run Number	70-100-70%-7		**Date**	03/12/14	**Run Start Time**	13:19		**Run Stop Time**	14:22
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	$(F_o)_{avg}$		$(\%EA)_{avg}$	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:03	5.3	15.4	0.0	79.3	29.44	1.048		278.2	N/A

Gas Analysis Data									
Run Number	70-100-70%-8		**Date**	03/12/14	**Run Start Time**	16:30		**Run Stop Time**	17:33
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	$(F_o)_{avg}$		$(\%EA)_{avg}$	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:03	5.5	14.7	0.0	79.8	29.47	1.127		230.9	N/A

Gas Analysis Data									
Run Number	70-100-70%-9		**Date**	03/13/14	**Run Start Time**	08:40		**Run Stop Time**	09:43
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	$(F_o)_{avg}$		$(\%EA)_{avg}$	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:03	5.7	14.3	0.0	79.9	29.47	1.152		210.5	N/A

METHOD 4 - DETERMINATION OF MOISTURE CONTENT IN STACK GASES

Plant Name	John Zink Tulsa R&D Facility	**Preliminary Date**	03/11/14
Sampling Location	4.0X30PF	**Operator**	TP
Project #	jz-14-tulsa.ok-comp#1	**Ports Used**	2

Moisture Content Data									
Run Number		70-100-70%-7		**Date**	03/12/14	**Start Time**	13:19	**Stop Time**	14:22
Meter Box Number		samp-cp-0008				**Meter Cal Factor**	(Y)	0.924	
Total Meter Volume		(V_m)	47.563	dcf		**Barometric Pressure**	(P_b)	30.26	in Hg
Average Stack Temp		$(t_s)_{avg}$	1445	°F		**Stack Static Pressure**	(P_{static})	0.00	in H_2O
Average Meter Temp		$(t_m)_{avg}$	66	°F		**Avg Orifice Pressure**	$(\Delta H)_{avg}$	1.70	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		H_2O	H_2O	-	Sil Gel				
Final Value	(V_f),(W_f)	835.00	758.70	581.60	918.40				
Initial Value	(V_i),(W_i)	794.60	748.10	578.90	907.40				
Net Value	(V_n),(W_n)	40.4	10.6	2.7	11.0				
Results									
Total Weight		(W_t)	64.70	g		**Water Vol Weighed**	($V_{wsg(std)}$)	3.051	scf
Std Meter Volume		($V_{m(std)}$)	44.812	dscf		**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content		($B_{ws(calc)}$)	6.37	%		**Final Moisture Content**	(B_{ws})	6.37	%

Moisture Content Data									
Run Number		70-100-70%-8		**Date**	03/12/14	**Start Time**	16:30	**Stop Time**	17:33
Meter Box Number		samp-cp-0008				**Meter Cal Factor**	(Y)	0.924	
Total Meter Volume		(V_m)	47.380	dcf		**Barometric Pressure**	(P_b)	30.19	in Hg
Average Stack Temp		$(t_s)_{avg}$	1656	°F		**Stack Static Pressure**	(P_{static})	0.00	in H_2O
Average Meter Temp		$(t_m)_{avg}$	71	°F		**Avg Orifice Pressure**	$(\Delta H)_{avg}$	1.70	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		H_2O	H_2O	-	Sil Gel				
Final Value	(V_f),(W_f)	875.30	767.30	582.90	927.80				
Initial Value	(V_i),(W_i)	835.00	758.70	581.60	918.40				
Net Value	(V_n),(W_n)	40.3	8.6	1.3	9.4				
Results									
Total Weight		(W_t)	59.60	g		**Water Vol Weighed**	($V_{wsg(std)}$)	2.810	scf
Std Meter Volume		($V_{m(std)}$)	44.075	dscf		**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content		($B_{ws(calc)}$)	5.99	%		**Final Moisture Content**	(B_{ws})	5.99	%

Moisture Content Data									
Run Number		70-100-70%-9		**Date**	03/13/14	**Start Time**	08:40	**Stop Time**	09:43
Meter Box Number		samp-cp-0008				**Meter Cal Factor**	(Y)	0.924	
Total Meter Volume		(V_m)	50.436	dcf		**Barometric Pressure**	(P_b)	30.19	in Hg
Average Stack Temp		$(t_s)_{avg}$	1595	°F		**Stack Static Pressure**	(P_{static})	0.00	in H_2O
Average Meter Temp		$(t_m)_{avg}$	58	°F		**Avg Orifice Pressure**	$(\Delta H)_{avg}$	1.70	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		H_2O	H_2O	-	Sil Gel				
Final Value	(V_f),(W_f)	732.40	758.30	579.00	886.60				
Initial Value	(V_i),(W_i)	707.30	742.00	575.40	875.00				
Net Value	(V_n),(W_n)	25.1	16.3	3.6	11.6				
Results									
Total Weight		(W_t)	56.60	g		**Water Vol Weighed**	($V_{wsg(std)}$)	2.669	scf
Std Meter Volume		($V_{m(std)}$)	48.120	dscf		**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content		($B_{ws(calc)}$)	5.25	%		**Final Moisture Content**	(B_{ws})	5.25	%

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Date	03/12/14
Operator	TP
Run Number	70-100-70%-7

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient	(C_p)	0.819	
Average Stack Temp	(t_s)	1444.9	°F
Average Meter Temp	(t_m)	65.9	
Orifice Meter Coefficient	($\Delta H@$)	1.700	in H_2O
Square Root ΔP	($\Delta p^{1/2}_{avg}$)	0.25	in H_2O
Stack Moisture Content	(B_{ws})	6.37	%
Stack Dry Molecular Weight	(M_d)	29.44	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.75	acfm
ΔP to ΔH Isokinetic Factor	(K)		

Leak Checks					
Train	**Pre**	0.000	ft³/min@	15.0	in Hg
PASS	**Post**	0.000	ft³/min@	15.0	in Hg
Pitot	**Pre (+)**	0.025	in H_2O for	15.0	sec
< 3.0	**Pre (-)**	0.025	in H_2O for	15.0	sec
	Post (+)	0.035	in H_2O for	15.0	sec
	Post (-)	0.015	in H_2O for	15.0	sec

Sampling Equipment			
Meter Box Number	samp-cp-0008		
Meter Cal Factor	(Y)	0.924	
Nozzle Number			
Average Nozzle Diameter	(D_{na})		in
Suggested Nozzle Diameter	(D_{ni})	0.4013	in
Probe Number	samp-hp-0003		in
Probe Length	60		in
Liner Material	inconel		
Sample Case / Oven Number			
Impinger Case Number	samp-bh-0016		

Pressures			
Barometric Pressure	(P_b)	30.26	in Hg
Stack Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.26	in Hg
Absolute Meter Pressure	(P_m)	30.39	in Hg

Nozzle Measurements				
Pre				**PASS**
Post				**PASS**

Run Time			
Start	13:19	**End**	14:22

Weights	**Imp 1**	**Imp 2**	**Imp 3**	**Imp 4**	**Imp 5**	**Imp 6**	**Imp 7**	**Imp 8**
Pre	794.6	748.1	578.9	907.4				
Post	835.0	758.7	581.6	918.4				

Wash Volumes					ml
					ml

Traverse Point #	**Sampling Time (Θ)**	**Timer Time**	**Dry Gas Meter Reading (V_m)**	**Velocity Head (Δp)**	**Desired Orifice ΔH (ΔH_d)**	**Actual Orifice ΔH (ΔH_a)**	**Stack Temp (t_s)**	**Snorkel Temp (248±25°F)**	**Filter Temp (248±25°F)**	**Impinger Exit Temp (≤68°F)**	**Cond. Temp (≤--°F)**	**CPM Filter Temp (--±--°F)**	**Meter Inlet Temp (t_{mi})**	**Meter Outlet Temp (t_{mo})**	**Pump Vacuum**	**Square Root ΔP ($\Delta p^{1/2}$)**	**Local Stack Velocity (v_s)$_l$**	**Cumul. Meter Volume (V_m)$_{std}$**	**Cumul. Percent IsoKinetic (I)**	**Est-Run Meter Volume (V_m)$_{std}$**
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	162.614	0.030	1.700	1.70	1401	240		67			60	60	2.5	0.17	17.76	1.907		38.131
A-2	3.0	00:03:00	164.615	0.045	1.700	1.70	1426	240		66			62	60	2.5	0.21	21.89	4.236		42.364
A-3	6.0	00:06:00	167.065	0.050	1.700	1.70	1423	240		65			64	60	2.5	0.22	23.06	6.419		42.796
A-4	9.0	00:09:00	169.365	0.075	1.700	1.70	1635	240		65			66	60	2.5	0.27	29.79	8.797		43.986
A-5	12.0	00:12:00	171.875	0.050	1.700	1.70	1580	240		65			67	60	2.5	0.22	24.00	10.974		43.896
A-6	15.0	00:15:00	174.175	0.045	1.700	1.70	1435	240		66			68	61	2.5	0.21	21.95	13.218		44.058
A-7	18.0	00:18:00	176.550	0.070	1.700	1.70	1473	240		67			68	61	2.5	0.26	27.64	15.503		44.296
A-8	21.0	00:21:00	178.970	0.080	1.700	1.70	1463	240		68			69	61	2.5	0.28	29.48	17.797		44.492
A-9	24.0	00:24:00	181.400	0.075	1.700	1.70	1445	240		66			71	62	2.5	0.27	28.41	20.083		44.630
A-10	27.0	00:27:00	183.830	0.060	1.700	1.70	1386	240		64			71	63	2.5	0.24	25.01	22.374		44.747
B-1	30.0	00:30:00	186.266	0.070	1.700	1.70	1424	240		63			68	63	2.5	0.26	27.29	24.631		44.783
B-2	33.0	00:33:00	188.660	0.075	1.700	1.70	1593	240		61			71	63	2.5	0.27	29.49	26.864		44.773
B-3	36.0	00:36:00	191.035	0.080	1.700	1.70	1510	240		58			71	64	2.5	0.28	29.83	29.094		44.760
B-4	39.0	00:39:00	193.410	0.075	1.700	1.70	1492	240		59			72	64	2.5	0.27	28.75	31.337		44.767
B-5	42.0	00:42:00	195.800	0.055	1.700	1.70	1336	240		59			72	65	2.5	0.23	23.62	33.578		44.770
B-6	45.0	00:45:00	198.190	0.050	1.700	1.70	1336	240		59			72	65	2.5	0.22	22.52	35.809		44.761
B-7	48.0	00:48:00	200.570	0.075	1.700	1.70	1411	240		58			72	65	2.5	0.27	28.15	38.040		44.753
B-8	51.0	00:51:00	202.950	0.080	1.700	1.70	1404	240		58			72	65	2.5	0.28	29.02	40.290		44.767
B-9	54.0	00:54:00	205.350	0.070	1.700	1.70	1393	240		59			72	65	2.5	0.26	27.07	42.610		44.853
B-10	57.0	00:57:00	207.825	0.050	1.700	1.70	1332	240		58			74	66	2.5	0.22	22.50	44.809		44.809
Last Pt	60.0	01:00:00	210.177																	
Final Val	60.0	01:00:00	210.177											**Max Vac**	2.5	**Final Values**		44.809		
Average Values				0.06		1.70	1445	240		63			69	63		0.25	25.86			
													66							

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Date	03/12/14
Operator	TP
Run Number	70-100-70%-8

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient	(C_p)	0.819	
Average Stack Temp	(t_s)	1656.4	°F
Average Meter Temp	(t_m)	71.4	
Orifice Meter Coefficient	($\Delta H@$)	1.700	in H_2O
Square Root ΔP	($\Delta p^{1/2}_{avg}$)	0.24	in H_2O
Stack Moisture Content	(B_{ws})	5.99	%
Stack Dry Molecular Weight	(M_d)	29.47	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.75	acfm
ΔP to ΔH Isokinetic Factor	(K)		

Leak Checks					
Train	**Pre**	0.000	ft³/min@	15.0	in Hg
PASS	**Post**	0.000	ft³/min@	15.0	in Hg
Pitot	**Pre (+)**	0.04	in H_2O for	15.0	sec
< 3.0	**Pre (-)**	0.06	in H_2O for	15.0	sec
	Post (+)	0.05	in H_2O for	15.0	sec
	Post (-)	0.04	in H_2O for	15.0	sec

Sampling Equipment			
Meter Box Number	samp-cp-0008		
Meter Cal Factor	(Y)	0.924	
Nozzle Number			
Average Nozzle Diameter	(D_{na})		in
Suggested Nozzle Diameter	(D_{ni})	0.4131	in
Probe Number	samp-hp-0003		in
Probe Length	60		in
Liner Material	inconel		
Sample Case / Oven Number			
Impinger Case Number	samp-bh-0016		

Pressures			
Barometric Pressure	(P_b)	30.19	in Hg
Stack Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.19	in Hg
Absolute Meter Pressure	(P_m)	30.32	in Hg

Nozzle Measurements				
Pre				**PASS**
Post				**PASS**

Run Time			
Start	16:30	**End**	17:33

Weights	Imp 1	Imp 2	Imp 3	Imp 4	Imp 5	Imp 6	Imp 7	Imp 8
Pre	835.0	758.7	581.6	918.4				
Post	875.3	767.3	582.9	927.8				

Wash Volumes					ml
					ml

Traverse Point #	Sampling Time (Θ)	Timer Time	Dry Gas Meter Reading (V_m)	Velocity Head (Δp)	Desired Orifice ΔH (ΔH_d)	Actual Orifice ΔH (ΔH_a)	Stack Temp (t_s)	Snorkel Temp (248±25°F)	Filter Temp (248±25°F)	Impinger Exit Temp (≤68°F)	Cond. Temp (≤--°F)	CPM Filter Temp (--±--°F)	Meter Inlet Temp (t_{mi})	Meter Outlet Temp (t_{mo})	Pump Vacuum	Square Root ΔP ($\Delta p^{1/2}$)	Local Stack Velocity (v_s)$_l$	Cumul. Meter Volume (V_m)$_{std}$	Cumul. Percent IsoKinetic (I)	Est-Run Meter Volume (V_m)$_{std}$
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	232.300	0.035	1.700	1.70	1546	240		45			66	66	2.5	0.19	19.91	2.396		47.928
A-2	3.0	00:03:00	234.850	0.055	1.700	1.70	1707	240		42			68	66	2.5	0.23	25.94	4.582		45.819
A-3	6.0	00:06:00	237.180	0.060	1.700	1.70	1736	240		43			70	66	2.5	0.24	27.28	6.754		45.026
A-4	9.0	00:09:00	239.500	0.060	1.700	1.70	1736	240		44			71	66	2.5	0.24	27.28	8.952		44.759
A-5	12.0	00:12:00	241.850	0.045	1.700	1.70	1658	240		44			72	66	2.5	0.21	23.20	11.208		44.834
A-6	15.0	00:15:00	244.265	0.035	1.700	1.70	1611	240		45			73	66	2.5	0.19	20.23	13.108		43.694
A-7	18.0	00:18:00	246.300	0.080	1.700	1.70	1767	240		46			73	67	2.5	0.28	31.72	15.300		43.714
A-8	21.0	00:21:00	248.650	0.075	1.700	1.70	1800	240		47			74	67	2.5	0.27	30.94	17.485		43.713
A-9	24.0	00:24:00	250.995	0.065	1.700	1.70	1744	240		47			74	67	2.5	0.25	28.44	19.735		43.856
A-10	27.0	00:27:00	253.410	0.040	1.700	1.70	1622	240		49			75	68	2.5	0.20	21.69	21.999		43.998
B-1	30.0	00:30:00	255.844	0.070	1.700	1.70	1598	240		51			75	68	2.5	0.26	28.52	24.190		43.982
B-2	33.0	00:33:00	258.200	0.080	1.700	1.70	1599	240		51			77	68	2.5	0.28	30.50	26.418		44.030
B-3	36.0	00:36:00	260.600	0.080	1.700	1.70	1600	240		51			78	69	2.5	0.28	30.51	28.595		43.993
B-4	39.0	00:39:00	262.950	0.045	1.700	1.70	1490	240		52			79	69	2.5	0.21	22.26	30.803		44.005
B-5	42.0	00:42:00	265.335	0.050	1.700	1.70	1574	240		52			80	69	2.5	0.22	23.97	33.018		44.024
B-6	45.0	00:45:00	267.730	0.050	1.700	1.70	1587	240		52			79	70	2.5	0.22	24.04	35.252		44.064
B-7	48.0	00:48:00	270.145	0.075	1.700	1.70	1781	240		53			77	70	2.5	0.27	30.81	37.480		44.094
B-8	51.0	00:51:00	272.550	0.070	1.700	1.70	1775	240		52			78	70	2.5	0.26	29.72	39.637		44.041
B-9	54.0	00:54:00	274.880	0.050	1.700	1.70	1634	240		53			79	70	2.5	0.22	24.32	41.838		44.040
B-10	57.0	00:57:00	277.260	0.045	1.700	1.70	1562	240		53			79	70	2.5	0.21	22.67	44.076		44.076
Last Pt	60.0	01:00:00	279.680																	
Final Val	60.0	01:00:00	279.680											**Max Vac**	2.5	**Final Values**		44.076		
Average Values				0.06		1.70	1656	240		49			75	68		0.24	26.20			
													71							

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Date	03/13/14
Operator	TP
Run Number	70-100-70%-9

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient	(C_p)	0.819	
Average Stack Temp	(t_s)	1595.0	°F
Average Meter Temp	(t_m)	58.1	
Orifice Meter Coefficient	($\Delta H@$)	1.700	in H_2O
Square Root ΔP	($\Delta p^{1/2}_{avg}$)	0.24	in H_2O
Stack Moisture Content	(B_{ws})	5.25	%
Stack Dry Molecular Weight	(M_d)	29.47	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.73	acfm
ΔP to ΔH Isokinetic Factor	(K)		

Leak Checks					
Train	**Pre**	0.000	ft³/min@	15.0	in Hg
PASS	**Post**	0.000	ft³/min@	15.0	in Hg
Pitot	**Pre (+)**	0.015	in H_2O for	15.0	sec
< 3.0	**Pre (-)**	0.040	in H_2O for	15.0	sec
	Post (+)	0.035	in H_2O for	15.0	sec
	Post (-)	0.015	in H_2O for	15.0	sec

Sampling Equipment			
Meter Box Number	samp-cp-0008		
Meter Cal Factor	(Y)	0.924	
Nozzle Number			
Average Nozzle Diameter	(D_{na})		in
Suggested Nozzle Diameter	(D_{ni})	0.4131	in
Probe Number	samp-hp-0003		in
Probe Length	60		in
Liner Material	inconel		
Sample Case / Oven Number			
Impinger Case Number	samp-bh-0016		

Pressures			
Barometric Pressure	(P_b)	30.19	in Hg
Stack Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.19	in Hg
Absolute Meter Pressure	(P_m)	30.32	in Hg

Nozzle Measurements				
Pre				**PASS**
Post				**PASS**

Run Time			
Start	08:40	**End**	09:43

Weights	Imp 1	Imp 2	Imp 3	Imp 4	Imp 5	Imp 6	Imp 7	Imp 8
Pre	707.3	742.0	575.4	875.0				
Post	732.4	758.3	579.0	886.6				

Wash Volumes					ml
					ml

Traverse Point #	Sampling Time (Θ)	Timer Time	Dry Gas Meter Reading (V_m)	Velocity Head (Δp)	Desired Orifice ΔH (ΔH_d)	Actual Orifice ΔH (ΔH_a)	Stack Temp (t_s)	Snorkel Temp (248±25°F)	Filter Temp (248±25°F)	Impinger Exit Temp (≤68°F)	Cond. Temp (≤--°F)	CPM Filter Temp (--±--°F)	Meter Inlet Temp (t_{mi})	Meter Outlet Temp (t_{mo})	Pump Vacuum	Square Root ΔP ($\Delta p^{1/2}$)	Local Stack Velocity (v_s)$_l$	Cumul. Meter Volume (V_m)$_{std}$	Cumul. Percent IsoKinetic (I)	Est-Run Meter Volume (V_m)$_{std}$
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	279.325	0.040	1.700	1.70	1494	240		41			57	46	2.5	0.20	20.98	2.769		55.375
A-2	3.0	00:03:00	282.190	0.055	1.700	1.70	1552	240		41			62	47	2.5	0.23	24.96	5.214		52.139
A-3	6.0	00:06:00	284.735	0.060	1.700	1.70	1659	240		41			61	47	2.5	0.24	26.76	7.488		49.922
A-4	9.0	00:09:00	287.100	0.060	1.700	1.70	1654	240		43			61	47	2.5	0.24	26.72	9.782		48.910
A-5	12.0	00:12:00	289.485	0.050	1.700	1.70	1515	240		43			61	48	2.5	0.22	23.58	12.198		48.793
A-6	15.0	00:15:00	292.000	0.055	1.700	1.70	1505	240		46			61	49	2.5	0.23	24.67	14.406		48.020
A-7	18.0	00:18:00	294.300	0.055	1.700	1.70	1519	240		47			62	50	2.5	0.23	24.76	16.767		47.906
A-8	21.0	00:21:00	296.765	0.070	1.700	1.70	1693	240		50			63	51	2.5	0.26	29.13	19.048		47.619
A-9	24.0	00:24:00	299.150	0.070	1.700	1.70	1702	240		51			64	51	2.5	0.26	29.19	21.436		47.635
A-10	27.0	00:27:00	301.650	0.035	1.700	1.70	1550	240		52			63	52	2.5	0.19	19.90	23.739		47.477
B-1	30.0	00:30:00	304.061	0.045	1.700	1.70	1440	240		52			60	52	2.5	0.21	21.94	27.392		49.804
B-2	33.0	00:33:00	307.875	0.055	1.700	1.70	1663	240		55			64	54	2.5	0.23	25.64	29.664		49.440
B-3	36.0	00:36:00	310.260	0.070	1.700	1.70	1695	240		56			65	54	2.5	0.26	29.14	31.938		49.135
B-4	39.0	00:39:00	312.650	0.050	1.700	1.70	1570	240		58			66	54	2.5	0.22	23.91	34.267		48.953
B-5	42.0	00:42:00	315.100	0.050	1.700	1.70	1555	240		59			66	55	2.5	0.22	23.82	36.594		48.792
B-6	45.0	00:45:00	317.550	0.075	1.700	1.70	1661	240		60			67	55	2.5	0.27	29.93	38.861		48.577
B-7	48.0	00:48:00	319.940	0.080	1.700	1.70	1717	240		61			68	56	2.5	0.28	31.32	41.233		48.510
B-8	51.0	00:51:00	322.445	0.075	1.700	1.70	1712	240		64			71	57	2.5	0.27	30.29	43.474		48.304
B-9	54.0	00:54:00	324.820	0.050	1.700	1.70	1537	240		65			71	57	2.5	0.22	23.71	45.813		48.225
B-10	57.0	00:57:00	327.300	0.040	1.700	1.70	1506	240		66			71	58	2.5	0.20	21.04	48.133		48.133
Last Pt	60.0	01:00:00	329.761																	
Final Val	60.0	01:00:00	329.761											**Max Vac**	2.5	**Final Values**		48.133		
Average Values				0.06		1.70	1595	240		53			64	52		0.24	25.57			
													58							

John Zink Co, LLC
March 12, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	6.4	%
Stack Exhaust Flow (M2)	307,067	SCFH

Weather Data

Barometric Pressure	30.26	in. Hg
Relative Humidity	28	%
Ambient Temperature	58	^{o}F
Specific Humidity	0.002809	lb H_2O / lb air

70-100-70 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
A1	03/12/14 13:19:00	22110	12.87	0.05	0.03	6.65	152.52	85.47	3,075.24
	03/12/14 13:19:30	22140	13.98	0.13	0.04	5.63	151.41	85.47	3,063.58
	03/12/14 13:20:00	22170	13.50	0.23	0.04	5.93	149.75	85.02	3,054.88
	03/12/14 13:20:30	22200	13.60	0.28	0.03	5.92	150.86	85.47	3,041.11
	03/12/14 13:21:00	22230	14.61	0.36	0.04	5.04	151.41	85.92	3,039.76
	03/12/14 13:21:30	22260	14.81	0.42	0.04	4.78	155.28	85.92	3,081.55
	03/12/14 13:22:00	22290	14.24	0.50	0.04	5.44	156.39	86.37	3,095.40
	03/12/14 13:22:30	22320	15.14	0.59	0.04	4.54	159.44	86.82	3,293.21
	03/12/14 13:23:00	22350	14.97	0.34	0.04	4.57	268.22	86.82	4,104.93
	03/12/14 13:23:30	22380	13.74	0.34	0.03	5.85	306.14	87.72	4,374.63
	03/12/14 13:24:00	22410	14.26	0.11	0.03	5.42	305.59	88.17	4,352.06
	03/12/14 13:24:30	22440	14.26	0.00	0.03	5.27	314.72	88.17	4,435.68
	03/12/14 13:25:00	22470	13.26	0.04	0.04	6.09	314.17	88.17	4,416.83
	03/12/14 13:25:30	22500	13.79	0.44	0.04	5.74	311.95	88.62	4,399.03
	03/12/14 13:26:00	22530	13.68	0.85	0.04	5.92	306.14	89.07	4,375.50
	03/12/14 13:26:30	22560	14.26	0.78	0.04	5.20	305.59	89.07	4,359.29
	03/12/14 13:27:00	22590	14.50	0.55	0.03	5.24	309.74	89.07	4,410.47
	03/12/14 13:27:30	22620	13.83	0.20	0.02	5.82	313.06	89.52	4,429.15
	03/12/14 13:28:00	22650	14.81	-0.06	0.05	4.71	319.15	89.97	4,449.14
	03/12/14 13:28:30	22680	15.05	-0.15	0.04	4.53	317.49	89.97	4,428.63
	03/12/14 13:29:00	22710	13.31	-0.18	0.03	6.04	309.18	89.97	4,416.69
	03/12/14 13:29:30	22740	13.22	-0.24	0.04	6.17	309.74	89.97	4,401.16
	03/12/14 13:30:00	22770	14.35	-0.22	0.05	5.33	313.06	90.42	4,416.40
	03/12/14 13:30:30	22800	13.44	-0.21	0.04	6.02	317.49	90.87	4,433.92
	03/12/14 13:31:00	22830	14.92	-0.23	0.04	4.90	311.40	91.32	4,392.08
	03/12/14 13:31:30	22860	14.58	-0.20	0.04	4.90	309.74	90.87	4,398.48
	03/12/14 13:32:00	22890	13.23	-0.22	0.03	6.03	307.25	90.42	4,373.22
	03/12/14 13:32:30	22920	12.59	-0.26	0.02	6.81	182.69	89.97	3,356.97
	03/12/14 13:33:00	22950	13.72	-0.23	0.05	5.77	146.98	89.52	3,037.46
	03/12/14 13:33:30	22980	13.41	-0.20	0.03	6.00	157.78	89.07	3,101.39
	03/12/14 13:34:00	23010	13.11	-0.20	0.03	6.24	157.78	89.07	3,086.61
	03/12/14 13:34:30	23040	12.82	-0.17	0.02	6.49	154.18	89.07	3,073.21
	03/12/14 13:35:00	23070	13.19	-0.14	0.02	6.27	154.73	89.07	3,066.08
	03/12/14 13:35:30	23100	13.67	-0.05	0.03	5.91	154.18	89.07	3,066.81
	03/12/14 13:36:00	23130	13.23	-0.02	0.02	6.12	152.52	88.62	3,064.71
	03/12/14 13:36:30	23160	13.00	-0.13	0.02	6.41	156.95	88.62	3,092.56
	03/12/14 13:37:00	23190	13.28	-0.12	0.02	6.24	157.78	88.17	3,105.08
	03/12/14 13:37:30	23220	13.56	-0.06	0.02	5.94	217.29	87.72	3,707.73
	03/12/14 13:38:00	23250	13.06	-0.12	0.03	6.38	281.78	88.62	4,256.34
	03/12/14 13:38:30	23280	13.52	-0.14	0.03	6.12	318.60	89.07	4,429.86
	03/12/14 13:39:00	23310	13.50	-0.15	0.02	6.01	311.40	89.07	4,401.63
A2	03/12/14 13:39:30	23340	12.82	-0.20	0.02	6.43	314.17	89.52	4,446.70
	03/12/14 13:40:00	23370	12.73	-0.25	0.02	6.58	319.70	89.52	4,456.40
	03/12/14 13:40:30	23400	12.79	-0.27	0.02	6.61	320.53	89.52	4,440.90
	03/12/14 13:41:00	23430	12.62	-0.26	0.01	6.64	314.72	90.42	4,409.38
	03/12/14 13:41:30	23460	13.52	-0.25	0.02	5.89	311.40	90.87	4,410.59
	03/12/14 13:42:00	23490	13.19	-0.25	0.03	6.19	309.74	91.32	4,410.06
	03/12/14 13:42:30	23520	13.95	-0.25	0.03	5.64	315.83	91.77	4,429.14
	03/12/14 13:43:00	23550	13.73	-0.22	0.03	5.59	309.74	91.77	4,411.94
	03/12/14 13:43:30	23580	13.81	-0.21	0.03	5.78	306.69	92.21	4,383.04
	03/12/14 13:44:00	23610	13.86	-0.04	0.03	5.44	307.80	92.21	4,382.48

John Zink Co, LLC
March 12, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	6.4	%
Stack Exhaust Flow (M2)	307,067	SCFH

Weather Data

Barometric Pressure	30.26	in. Hg
Relative Humidity	28	%
Ambient Temperature	58	^{o}F
Specific Humidity	0.002809	lb H_2O / lb air

70-100-70 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
	03/12/14 13:44:30	23640	12.30	-0.05	0.03	6.39	309.74	92.66	4,388.41
	03/12/14 13:45:00	23670	12.12	-0.24	0.03	6.56	316.38	93.11	4,409.76
	03/12/14 13:45:30	23700	12.12	-0.24	0.03	6.58	317.49	93.56	4,426.40
	03/12/14 13:46:00	23730	12.24	-0.26	0.02	6.53	310.29	93.11	4,415.08
	03/12/14 13:46:30	23760	11.86	-0.22	0.02	6.74	309.18	93.11	4,388.39
	03/12/14 13:47:00	23790	12.30	-0.26	0.01	6.51	306.69	93.56	4,373.54
	03/12/14 13:47:30	23820	12.11	-0.23	0.00	6.57	156.39	93.11	3,107.83
	03/12/14 13:48:00	23850	12.77	-0.17	0.01	6.13	156.39	93.11	3,073.68
	03/12/14 13:48:30	23880	12.20	-0.14	0.00	6.53	157.78	91.77	3,083.36
	03/12/14 13:49:00	23910	12.25	-0.15	0.01	6.45	155.84	90.87	3,079.60
	03/12/14 13:49:30	23940	12.40	-0.16	0.01	6.43	154.73	90.87	3,064.41
	03/12/14 13:50:00	23970	12.64	-0.05	0.00	6.19	156.95	90.42	3,069.25
	03/12/14 13:50:30	24000	12.49	-0.06	0.00	6.37	158.33	89.97	3,083.95
	03/12/14 13:51:00	24030	12.48	0.02	0.01	6.38	155.84	89.97	3,070.80
	03/12/14 13:51:30	24060	13.00	0.13	0.01	5.94	157.22	89.97	3,077.94
	03/12/14 13:52:00	24090	12.72	0.14	0.01	6.21	263.24	90.42	4,114.88
	03/12/14 13:52:30	24120	13.17	0.33	0.00	5.83	316.93	91.77	4,421.29
	03/12/14 13:53:00	24150	12.19	0.21	0.00	6.52	313.61	92.21	4,399.97
	03/12/14 13:53:30	24180	12.11	-0.15	0.00	6.61	308.91	92.66	4,388.83
	03/12/14 13:54:00	24210	12.07	-0.21	0.00	6.61	318.04	92.21	4,422.03
	03/12/14 13:54:30	24240	11.79	-0.21	0.00	6.81	310.29	92.21	4,397.52
	03/12/14 13:55:00	24270	11.67	-0.26	0.00	6.93	310.29	92.21	4,399.15
	03/12/14 13:55:30	24300	12.08	-0.26	0.01	6.65	306.69	92.21	4,367.23
	03/12/14 13:56:00	24330	11.93	-0.26	0.01	6.72	307.80	92.21	4,366.04
	03/12/14 13:56:30	24360	11.88	-0.26	0.00	6.74	305.03	92.66	4,350.21
	03/12/14 13:57:00	24390	12.31	-0.25	0.01	6.47	306.14	93.11	4,371.99
	03/12/14 13:57:30	24420	12.17	-0.23	0.00	6.51	312.51	93.56	4,392.89
	03/12/14 13:58:00	24450	12.01	-0.26	0.01	6.63	300.60	94.01	4,273.33
	03/12/14 13:58:30	24480	12.16	-0.25	0.01	6.56	291.47	94.46	4,260.98
	03/12/14 13:59:00	24510	12.32	-0.24	0.00	6.42	301.16	94.46	4,318.68
A3	03/12/14 13:59:30	24540	12.14	-0.23	-0.01	6.56	297.28	94.46	4,292.64
	03/12/14 14:00:00	24570	11.96	-0.22	-0.01	6.67	300.60	94.01	4,336.00
	03/12/14 14:00:30	24600	11.91	-0.24	0.00	6.71	304.48	94.46	4,339.84
	03/12/14 14:01:00	24630	12.00	-0.25	0.01	6.68	284.55	94.46	4,225.65
	03/12/14 14:01:30	24660	11.99	-0.24	0.01	6.69	280.12	94.46	4,193.73
	03/12/14 14:02:00	24690	11.93	-0.21	-0.01	6.74	174.66	94.01	3,350.10
	03/12/14 14:02:30	24720	12.06	-0.15	0.00	6.76	149.75	93.56	3,027.00
	03/12/14 14:03:00	24750	13.13	0.53	0.00	5.87	155.84	93.11	3,092.65
	03/12/14 14:03:30	24780	12.66	0.72	0.00	6.23	155.84	93.11	3,080.97
	03/12/14 14:04:00	24810	12.82	0.74	0.01	6.14	154.73	93.11	3,064.95
	03/12/14 14:04:30	24840	13.05	0.84	0.00	5.99	154.73	93.11	3,052.84
	03/12/14 14:05:00	24870	13.05	1.16	0.01	5.96	152.52	92.21	3,054.64
	03/12/14 14:05:30	24900	13.10	0.88	0.01	5.94	154.18	91.77	3,049.94
	03/12/14 14:06:00	24930	13.22	0.87	0.01	5.87	154.18	91.77	3,057.94
	03/12/14 14:06:30	24960	13.18	1.29	0.01	5.87	156.39	91.77	3,072.34
	03/12/14 14:07:00	24990	12.98	0.97	-0.01	6.01	155.84	91.32	3,087.40
	03/12/14 14:07:30	25020	13.03	0.85	-0.01	5.96	154.73	91.32	3,083.03
	03/12/14 14:08:00	25050	13.05	0.98	-0.01	5.95	249.40	91.77	3,964.20
	03/12/14 14:08:30	25080	12.64	0.70	-0.01	6.20	269.33	91.77	4,104.64
	03/12/14 14:09:00	25110	11.98	0.24	0.00	6.67	270.43	91.32	4,109.96
	03/12/14 14:09:30	25140	11.94	0.11	0.01	6.74	273.20	91.32	4,128.62

John Zink Co, LLC
March 12, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	6.4	%
Stack Exhaust Flow (M2)	307,067	SCFH

Weather Data

Barometric Pressure	30.26	in. Hg
Relative Humidity	28	%
Ambient Temperature	58	^{o}F
Specific Humidity	0.002809	lb H_2O / lb air

70-100-70 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
03/12/14 14:10:00	25170	12.02	0.06	-0.02	6.69	267.66	91.32	4,098.62
03/12/14 14:10:30	25200	12.03	0.06	-0.02	6.66	270.43	91.32	4,087.29
03/12/14 14:11:00	25230	12.64	0.16	0.00	6.33	267.11	91.77	4,077.26
03/12/14 14:11:30	25260	12.93	0.34	0.00	6.03	270.43	92.21	4,097.22
03/12/14 14:12:00	25290	12.88	0.49	0.00	6.05	268.77	92.21	4,108.05
03/12/14 14:12:30	25320	13.18	0.47	0.00	5.83	272.09	92.21	4,134.34
03/12/14 14:13:00	25350	12.78	0.54	0.00	6.08	269.88	92.66	4,087.50
03/12/14 14:13:30	25380	12.74	0.46	0.00	6.16	270.43	92.66	4,099.23
03/12/14 14:14:00	25410	13.21	0.55	0.00	5.86	270.43	92.66	4,098.39
03/12/14 14:14:30	25440	12.34	0.61	-0.01	6.28	270.99	92.66	4,085.69
03/12/14 14:15:00	25470	12.04	0.15	-0.01	6.68	269.33	92.21	4,117.17
03/12/14 14:15:30	25500	12.25	0.11	-0.01	6.51	273.20	92.21	4,102.68
03/12/14 14:16:00	25530	11.98	0.20	-0.01	6.67	268.77	92.21	4,101.73
03/12/14 14:16:30	25560	12.04	0.11	-0.01	6.63	161.65	91.77	3,110.23
03/12/14 14:17:00	25590	12.18	0.08	0.00	6.59	155.84	91.32	3,082.29
03/12/14 14:17:30	25620	12.53	0.31	0.00	6.30	157.22	91.32	3,080.99
03/12/14 14:18:00	25650	12.54	0.37	-0.01	6.32	158.33	91.32	3,110.89
03/12/14 14:18:30	25680	13.10	0.58	-0.01	5.88	154.73	91.77	3,067.13
03/12/14 14:19:00	25710	12.84	0.93	-0.01	6.08	155.28	90.87	3,072.05
RAW AVERAGE		**12.97**	**0.10**	**0.01**	**6.13**	**244.95**	**90.93**	**3,851.94**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	INST-22-0004	INST-CO-0022	INST-TH-0009	INST-C2-0016	F-13 LINE 2-3-4 PRESS	F-13 Line 1-3 TE	F-13 Line Orifice
		(%)	(ppmvd)	(ppmvw)	(%)	(in. H_2O)	(^{o}F)	(SCFH)
Bias	**Initial Zero**	0.09	0.08	-0.07	0.06			
	Final Zero	0.09	0.06	-0.03	0.05			
	Avg. Zero	0.09	0.07	-0.05	0.06			
	Initial UpScale	11.99	8.94	3.03	9.44			
	Final UpScale	11.97	8.94	3.00	9.37			
	Avg. UpScale	11.98	8.94	3.02	9.41			
Upscale Cal Gas		12.00	8.98	3.04	9.42			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.99	0.03	0.06	6.12
Corrected Raw Average (ppm/% wet basis)	12.16	0.02	0.06	5.73
Emission Rate (lb/hr)	N/A	0.00	0.00	N/A

John Zink Co, LLC
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	6.0	%
Stack Exhaust Flow (M2)	280,468	SCFH

Weather Data

Barometric Pressure	30.20	in. Hg
Relative Humidity	21	%
Ambient Temperature	72	^{o}F
Specific Humidity	0.003443	lb H_2O / lb air

70-100-70 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
A1	03/12/14 16:30:00	33570	13.52	0.80	-0.01	5.52	153.62	87.27	3,082.68
	03/12/14 16:30:30	33600	13.39	1.05	0.00	5.62	150.30	87.72	3,071.22
	03/12/14 16:31:00	33630	13.59	0.64	0.00	5.47	150.86	88.17	3,069.17
	03/12/14 16:31:30	33660	13.79	1.16	-0.01	5.29	150.86	88.62	3,068.57
	03/12/14 16:32:00	33690	13.43	1.01	-0.02	5.55	150.86	89.07	3,069.00
	03/12/14 16:32:30	33720	13.16	0.45	-0.01	5.77	154.18	89.52	3,081.36
	03/12/14 16:33:00	33750	13.08	0.48	-0.01	5.87	154.18	89.97	3,087.87
	03/12/14 16:33:30	33780	13.40	0.61	-0.01	5.61	267.66	90.42	4,090.77
	03/12/14 16:34:00	33810	12.56	0.52	-0.01	6.16	309.74	91.77	4,364.97
	03/12/14 16:34:30	33840	12.56	-0.04	-0.01	6.22	311.95	92.66	4,371.67
	03/12/14 16:35:00	33870	11.87	-0.13	0.00	6.71	310.29	92.21	4,401.23
	03/12/14 16:35:30	33900	12.03	-0.21	0.00	6.61	313.06	92.66	4,395.10
	03/12/14 16:36:00	33930	12.41	-0.21	-0.01	6.33	309.74	93.56	4,385.68
	03/12/14 16:36:30	33960	12.28	-0.20	-0.02	6.42	301.71	94.46	4,314.02
	03/12/14 16:37:00	33990	12.82	-0.21	-0.03	6.01	304.48	94.91	4,332.19
	03/12/14 16:37:30	34020	12.70	-0.19	-0.01	6.14	301.16	95.47	4,338.07
	03/12/14 16:38:00	34050	12.91	-0.18	-0.01	5.94	307.25	95.47	4,365.88
	03/12/14 16:38:30	34080	12.10	-0.21	-0.01	6.50	307.25	95.47	4,371.14
	03/12/14 16:39:00	34110	12.65	-0.23	-0.01	6.17	307.80	95.47	4,344.08
	03/12/14 16:39:30	34140	12.87	-0.20	-0.01	5.98	301.71	95.81	4,316.94
	03/12/14 16:40:00	34170	12.46	-0.21	-0.01	6.31	305.03	96.71	4,319.82
	03/12/14 16:40:30	34200	12.60	-0.19	-0.01	6.18	307.25	96.26	4,331.10
	03/12/14 16:41:00	34230	12.62	-0.21	-0.01	6.17	309.18	97.16	4,354.53
	03/12/14 16:41:30	34260	12.97	-0.19	0.00	5.91	309.74	97.16	4,353.42
	03/12/14 16:42:00	34290	13.02	-0.20	0.00	5.86	303.93	96.71	4,343.62
	03/12/14 16:42:30	34320	12.72	-0.20	0.00	6.09	300.60	96.71	4,317.25
	03/12/14 16:43:00	34350	13.12	-0.21	0.00	5.84	228.08	97.16	3,469.09
	03/12/14 16:43:30	34380	13.61	-0.14	0.00	5.42	155.28	96.71	3,093.18
	03/12/14 16:44:00	34410	13.74	0.05	-0.01	5.29	154.73	96.71	3,081.71
	03/12/14 16:44:30	34440	12.94	0.05	0.00	5.93	153.07	96.26	3,067.06
	03/12/14 16:45:00	34470	12.94	-0.01	-0.01	5.92	152.52	95.81	3,063.32
	03/12/14 16:45:30	34500	13.37	0.13	0.00	5.61	151.41	95.81	3,063.43
	03/12/14 16:46:00	34530	13.57	0.36	-0.01	5.47	155.84	95.47	3,086.96
	03/12/14 16:46:30	34560	12.96	0.29	-0.02	5.94	154.73	95.47	3,083.91
	03/12/14 16:47:00	34590	13.21	0.22	0.00	5.71	153.62	95.47	3,079.60
	03/12/14 16:47:30	34620	13.00	0.12	0.00	5.92	156.95	95.47	3,083.18
	03/12/14 16:48:00	34650	13.27	0.18	-0.01	5.70	155.28	95.47	3,094.54
	03/12/14 16:48:30	34680	13.45	0.20	-0.02	5.55	154.73	94.91	3,079.35
	03/12/14 16:49:00	34710	13.44	0.15	-0.01	5.58	284.55	95.47	4,179.05
	03/12/14 16:49:30	34740	13.35	0.19	-0.01	5.65	309.18	96.26	4,342.46
	03/12/14 16:50:00	34770	13.44	0.07	0.00	5.53	315.27	96.71	4,392.31
A2	03/12/14 16:50:30	34800	12.57	-0.11	0.00	6.22	323.85	96.71	4,432.74
	03/12/14 16:51:00	34830	12.90	-0.19	0.00	6.00	302.82	96.71	4,339.17
	03/12/14 16:51:30	34860	13.19	-0.18	-0.01	5.78	305.03	97.16	4,348.83
	03/12/14 16:52:00	34890	13.03	-0.18	-0.01	5.90	308.35	97.16	4,348.15
	03/12/14 16:52:30	34920	13.09	-0.18	-0.01	5.86	313.06	97.61	4,366.48
	03/12/14 16:53:00	34950	12.87	-0.18	-0.02	5.99	314.72	97.61	4,380.10
	03/12/14 16:53:30	34980	12.52	-0.21	-0.02	6.26	315.27	97.61	4,395.84
	03/12/14 16:54:00	35010	12.48	-0.21	-0.01	6.28	308.91	97.16	4,356.97
	03/12/14 16:54:30	35040	12.63	-0.22	0.00	6.20	306.14	97.61	4,341.52
	03/12/14 16:55:00	35070	12.70	-0.20	0.00	6.12	305.59	97.61	4,332.30
	03/12/14 16:55:30	35100	13.07	-0.22	-0.01	5.90	303.93	98.06	4,328.45

John Zink Co, LLC
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	6.0	%
Stack Exhaust Flow (M2)	280,468	SCFH

Weather Data

Barometric Pressure	30.20	in. Hg
Relative Humidity	21	%
Ambient Temperature	72	^{o}F
Specific Humidity	0.003443	lb H_2O / lb air

70-100-70 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
	03/12/14 16:56:00	35130	13.41	-0.16	0.00	5.61	307.25	98.06	4,357.45
	03/12/14 16:56:30	35160	13.12	-0.18	0.00	5.88	309.74	98.51	4,378.03
	03/12/14 16:57:00	35190	13.27	-0.15	-0.01	5.72	308.91	98.96	4,371.69
	03/12/14 16:57:30	35220	13.19	-0.18	-0.01	5.78	156.39	98.96	3,044.53
	03/12/14 16:58:00	35250	13.16	-0.15	-0.01	5.85	151.96	98.06	3,068.18
	03/12/14 16:58:30	35280	13.72	0.08	-0.01	5.31	153.62	98.06	3,068.68
	03/12/14 16:59:00	35310	13.45	0.22	-0.01	5.63	155.28	97.61	3,084.48
	03/12/14 16:59:30	35340	13.65	0.40	-0.01	5.40	154.73	96.71	3,082.30
	03/12/14 17:00:00	35370	12.88	0.21	0.00	6.00	155.28	96.71	3,076.77
	03/12/14 17:00:30	35400	13.00	0.30	-0.01	5.89	153.62	96.26	3,070.57
	03/12/14 17:01:00	35430	12.58	0.18	-0.02	6.22	153.62	96.26	3,073.88
	03/12/14 17:01:30	35460	12.68	0.16	-0.02	6.14	153.07	96.26	3,058.58
	03/12/14 17:02:00	35490	12.74	0.16	0.00	6.11	154.18	96.26	3,092.52
	03/12/14 17:02:30	35520	12.80	0.36	-0.01	6.06	155.28	95.81	3,101.62
	03/12/14 17:03:00	35550	12.80	0.25	-0.01	6.06	153.62	95.81	3,074.06
	03/12/14 17:03:30	35580	12.90	0.29	-0.01	5.98	280.12	96.71	4,083.32
	03/12/14 17:04:00	35610	12.79	0.44	-0.01	6.05	321.64	98.06	4,423.17
	03/12/14 17:04:30	35640	12.13	0.10	-0.01	6.53	315.27	98.06	4,391.94
	03/12/14 17:05:00	35670	12.11	-0.09	-0.01	6.54	316.93	98.51	4,419.03
	03/12/14 17:05:30	35700	12.27	-0.13	0.00	6.42	315.27	98.96	4,368.36
	03/12/14 17:06:00	35730	12.17	-0.15	-0.01	6.50	312.51	98.96	4,357.82
	03/12/14 17:06:30	35760	12.21	-0.18	-0.02	6.47	311.40	99.40	4,370.12
	03/12/14 17:07:00	35790	12.10	-0.20	-0.01	6.54	310.29	99.85	4,363.58
	03/12/14 17:07:30	35820	12.07	-0.20	-0.01	6.57	313.61	99.85	4,380.54
	03/12/14 17:08:00	35850	11.89	-0.20	-0.01	6.68	316.38	99.85	4,410.87
	03/12/14 17:08:30	35880	11.58	-0.22	-0.01	6.90	316.93	99.85	4,395.77
	03/12/14 17:09:00	35910	11.68	-0.23	-0.01	6.80	318.60	100.30	4,384.03
	03/12/14 17:09:30	35940	11.77	-0.23	0.00	6.77	309.74	100.30	4,353.79
	03/12/14 17:10:00	35970	11.87	-0.24	-0.01	6.69	311.40	100.75	4,364.37
A3	03/12/14 17:10:30	36000	11.86	-0.23	0.00	6.69	315.27	101.20	4,361.13
	03/12/14 17:11:00	36030	11.94	-0.24	-0.01	6.65	309.18	101.65	4,344.88
	03/12/14 17:11:30	36060	12.16	-0.21	-0.01	6.51	192.10	101.20	3,309.18
	03/12/14 17:12:00	36090	12.83	-0.11	0.00	6.02	150.86	100.30	3,070.18
	03/12/14 17:12:30	36120	12.93	0.18	-0.01	5.91	149.75	99.40	3,058.82
	03/12/14 17:13:00	36150	12.27	0.07	0.00	6.45	150.30	98.51	3,048.70
	03/12/14 17:13:30	36180	12.03	0.02	-0.01	6.57	153.07	98.06	3,080.16
	03/12/14 17:14:00	36210	12.04	0.20	-0.02	6.51	155.28	98.06	3,093.15
	03/12/14 17:14:30	36240	11.97	0.35	-0.02	6.59	154.73	97.61	3,086.66
	03/12/14 17:15:00	36270	11.99	0.42	-0.01	6.57	153.07	97.61	3,072.22
	03/12/14 17:15:30	36300	12.20	0.64	-0.01	6.43	153.07	98.06	3,063.57
	03/12/14 17:16:00	36330	12.44	0.87	0.00	6.26	153.07	97.61	3,061.81
	03/12/14 17:16:30	36360	12.57	1.17	-0.01	6.18	154.18	97.16	3,077.63
	03/12/14 17:17:00	36390	12.51	1.20	-0.01	6.23	154.18	96.71	3,090.27
	03/12/14 17:17:30	36420	12.93	1.58	0.00	5.92	154.73	96.71	3,090.26
	03/12/14 17:18:00	36450	12.88	1.92	-0.02	5.94	151.96	96.71	3,072.12
	03/12/14 17:18:30	36480	13.06	2.13	-0.02	5.84	150.86	96.26	3,059.42
	03/12/14 17:19:00	36510	13.01	2.23	-0.02	5.89	151.96	95.81	3,065.76
	03/12/14 17:19:30	36540	12.97	1.95	-0.01	5.91	152.52	95.47	3,093.19
	03/12/14 17:20:00	36570	12.75	1.38	-0.01	6.09	180.75	95.47	3,827.92
	03/12/14 17:20:30	36600	12.40	1.57	-0.01	6.27	308.91	95.81	4,254.97
	03/12/14 17:21:00	36630	11.29	0.50	-0.01	7.10	313.06	96.26	4,355.17
	03/12/14 17:21:30	36660	11.64	-0.02	-0.01	6.86	311.95	96.26	4,339.14

John Zink Co, LLC
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	6.0	%
Stack Exhaust Flow (M2)	280,468	SCFH

Weather Data

Barometric Pressure	30.20	in. Hg
Relative Humidity	21	%
Ambient Temperature	72	^{o}F
Specific Humidity	0.003443	lb H_2O / lb air

70-100-70 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
03/12/14 17:22:00	36690	11.87	-0.01	-0.02	6.70	315.83	96.26	4,377.83
03/12/14 17:22:30	36720	11.80	0.02	-0.02	6.73	313.61	96.26	4,363.04
03/12/14 17:23:00	36750	11.59	-0.08	-0.01	6.87	313.06	96.26	4,363.18
03/12/14 17:23:30	36780	11.82	-0.10	-0.02	6.75	306.69	96.26	4,319.37
03/12/14 17:24:00	36810	12.14	0.10	-0.02	6.52	300.05	96.26	4,306.69
03/12/14 17:24:30	36840	12.29	0.11	-0.02	6.41	300.60	96.71	4,294.03
03/12/14 17:25:00	36870	12.56	0.08	-0.01	6.23	306.14	97.16	4,331.49
03/12/14 17:25:30	36900	11.97	0.15	0.00	6.58	301.16	97.16	4,305.53
03/12/14 17:26:00	36930	11.90	0.03	0.00	6.71	298.94	97.16	4,295.11
03/12/14 17:26:30	36960	11.59	-0.02	-0.01	6.86	298.39	97.61	4,276.06
03/12/14 17:27:00	36990	13.27	2.91	0.00	5.71	154.18	97.61	3,123.29
03/12/14 17:27:30	37020	13.45	3.95	-0.01	5.57	150.30	97.61	3,071.25
03/12/14 17:28:00	37050	13.31	3.80	-0.01	5.68	154.18	97.61	3,104.80
03/12/14 17:28:30	37080	13.25	3.39	-0.01	5.75	155.84	97.16	3,111.98
03/12/14 17:29:00	37110	12.99	3.54	-0.02	5.92	152.52	96.71	3,083.74
03/12/14 17:29:30	37140	12.80	2.55	-0.01	6.06	151.96	96.26	3,070.49
RAW AVERAGE		**12.69**	**0.34**	**-0.01**	**6.11**	**237.56**	**96.48**	**3,769.29**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	INST-22-0004	INST-CO-0022	INST-TH-0009	INST-C2-0016	F-13 LINE 2-3-4 PRESS	F-13 Line 1-3 TE	F-13 Line Orifice
		(%)	**(ppmvd)**	**(ppmvw)**	**(%)**	**(in. H_2O)**	**(^{o}F)**	**(SCFH)**
Bias	**Initial Zero**	0.09	0.06	-0.03	0.05			
	Final Zero	0.06	0.06	-0.03	0.05			
	Avg. Zero	0.08	0.06	-0.03	0.05			
	Initial UpScale	11.97	8.94	3.00	9.37			
	Final UpScale	11.98	8.87	2.95	9.45			
	Avg. UpScale	11.98	8.91	2.98	9.41			
Upscale Cal Gas		12.00	8.98	3.04	9.42			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.73	0.29	0.02	6.10
Corrected Raw Average (ppm/% wet basis)	11.96	0.27	0.02	5.73
Emission Rate (lb/hr)	N/A	0.01	0.00	N/A

John Zink Co, LLC
March 13, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.3	%
Stack Exhaust Flow (M2)	284,135	SCFH

Weather Data

Barometric Pressure	30.19	in. Hg
Relative Humidity	34	%
Ambient Temperature	57	^{o}F
Specific Humidity	0.003300	lb H_2O / lb air

70-100-70 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
A1	03/13/14 8:40:04	5550	13.01	-0.08	0.13	5.96	153.62	81.88	3,099.43
	03/13/14 8:40:34	5580	13.18	-0.06	0.13	5.82	149.75	81.88	3,076.37
	03/13/14 8:41:04	5610	13.24	-0.03	0.13	5.75	149.75	81.88	3,054.48
	03/13/14 8:41:34	5640	13.45	0.09	0.13	5.61	149.19	81.88	3,079.69
	03/13/14 8:42:04	5670	13.34	0.08	0.15	5.72	153.62	81.88	3,103.94
	03/13/14 8:42:34	5700	13.18	-0.04	0.14	5.80	152.52	81.88	3,094.63
	03/13/14 8:43:04	5730	13.20	-0.05	0.11	5.82	150.30	81.43	3,090.76
	03/13/14 8:43:34	5760	13.12	-0.01	0.11	5.82	251.89	81.88	4,009.39
	03/13/14 8:44:04	5790	12.40	-0.05	0.13	6.34	273.75	81.88	4,221.70
	03/13/14 8:44:34	5820	12.14	-0.07	0.12	6.51	298.94	82.33	4,383.13
	03/13/14 8:45:04	5850	11.93	-0.10	0.13	6.68	305.03	82.78	4,387.48
	03/13/14 8:45:34	5880	11.94	-0.11	0.12	6.68	306.14	82.78	4,428.58
	03/13/14 8:46:04	5910	11.89	-0.13	0.13	6.75	302.82	82.78	4,396.21
	03/13/14 8:46:34	5940	12.09	-0.12	0.13	6.61	293.68	82.78	4,362.44
	03/13/14 8:47:04	5970	11.93	-0.13	0.12	6.71	293.13	82.78	4,343.64
	03/13/14 8:47:34	6000	12.11	-0.12	0.12	6.62	285.93	82.78	4,280.29
	03/13/14 8:48:04	6030	12.09	-0.13	0.13	6.62	280.12	82.78	4,235.20
	03/13/14 8:48:34	6060	12.22	-0.12	0.13	6.49	279.57	83.23	4,247.61
	03/13/14 8:49:04	6090	12.20	-0.15	0.13	6.50	285.93	82.78	4,294.68
	03/13/14 8:49:34	6120	12.13	-0.12	0.13	6.55	287.59	83.23	4,305.35
	03/13/14 8:50:04	6150	12.09	-0.13	0.12	6.58	280.12	83.23	4,261.33
	03/13/14 8:50:34	6180	11.99	-0.12	0.12	6.69	276.80	83.23	4,216.64
	03/13/14 8:51:04	6210	12.10	-0.14	0.11	6.62	273.20	83.68	4,205.19
	03/13/14 8:51:34	6240	12.13	-0.13	0.11	6.58	269.88	83.23	4,175.06
	03/13/14 8:52:04	6270	12.92	-0.11	0.12	6.15	136.19	83.23	2,959.48
	03/13/14 8:52:34	6300	13.63	0.13	0.12	5.51	143.94	82.78	3,012.80
	03/13/14 8:53:04	6330	13.71	0.39	0.12	5.44	145.60	82.33	3,014.66
	03/13/14 8:53:34	6360	13.55	0.58	0.11	5.56	151.96	81.88	3,163.22
	03/13/14 8:54:04	6390	13.43	0.64	0.11	5.64	151.96	81.43	3,109.82
	03/13/14 8:54:34	6420	13.34	0.51	0.12	5.74	156.39	81.43	3,116.01
	03/13/14 8:55:04	6450	13.46	0.47	0.12	5.67	155.84	81.43	3,107.23
	03/13/14 8:55:34	6480	13.32	0.51	0.12	5.73	151.96	80.98	3,086.78
	03/13/14 8:56:04	6510	13.58	0.56	0.11	5.44	150.86	80.98	3,085.47
	03/13/14 8:56:34	6540	13.56	0.77	0.11	5.41	149.75	80.98	3,076.33
	03/13/14 8:57:04	6570	13.57	0.64	0.11	5.56	153.07	80.98	3,102.95
	03/13/14 8:57:34	6600	13.41	0.51	0.11	5.69	154.73	80.98	3,132.09
	03/13/14 8:58:04	6630	13.42	0.49	0.12	5.67	155.84	80.53	3,130.92
	03/13/14 8:58:34	6660	13.22	0.43	0.12	5.76	154.18	80.53	3,109.80
	03/13/14 8:59:04	6690	13.46	0.49	0.11	5.53	245.52	80.53	4,025.69
	03/13/14 8:59:34	6720	12.62	0.44	0.11	6.09	285.66	80.98	4,274.45
	03/13/14 9:00:04	6750	12.15	-0.02	0.11	6.50	296.45	80.98	4,358.61
A2	03/13/14 9:00:34	6780	12.33	-0.07	0.12	6.43	276.25	81.43	4,222.16
	03/13/14 9:01:04	6810	12.29	-0.04	0.11	6.40	280.12	81.88	4,247.99
	03/13/14 9:01:34	6840	12.34	-0.04	0.11	6.39	272.09	81.43	4,190.42
	03/13/14 9:02:04	6870	12.46	-0.01	0.11	6.33	268.77	81.43	4,143.25
	03/13/14 9:02:34	6900	12.57	0.00	0.12	6.26	264.34	81.43	4,130.18
	03/13/14 9:03:04	6930	12.51	0.03	0.11	6.30	277.35	81.88	4,225.52
	03/13/14 9:03:34	6960	12.41	0.01	0.11	6.36	278.46	81.88	4,215.82
	03/13/14 9:04:04	6990	12.41	0.02	0.10	6.36	274.58	81.88	4,197.90
	03/13/14 9:04:34	7020	12.45	0.00	0.10	6.31	274.58	81.88	4,204.07
	03/13/14 9:05:04	7050	12.43	0.00	0.09	6.33	267.66	81.43	4,147.41

John Zink Co, LLC
March 13, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.3	%
Stack Exhaust Flow (M2)	284,135	SCFH

Weather Data

Barometric Pressure	30.19	in. Hg
Relative Humidity	34	%
Ambient Temperature	57	^{o}F
Specific Humidity	0.003300	lb H_2O / lb air

70-100-70 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
	03/13/14 9:05:34	7080	12.59	0.01	0.09	6.24	264.34	81.88	4,113.35
	03/13/14 9:06:04	7110	12.64	0.03	0.11	6.18	265.45	82.33	4,144.57
	03/13/14 9:06:34	7140	12.51	0.04	0.11	6.27	274.03	82.33	4,192.93
	03/13/14 9:07:04	7170	12.59	0.03	0.10	6.29	158.88	82.33	3,173.94
	03/13/14 9:07:34	7200	13.35	0.22	0.10	5.71	149.75	81.88	3,068.80
	03/13/14 9:08:04	7230	13.50	0.66	0.11	5.59	149.19	81.88	3,042.77
	03/13/14 9:08:34	7260	13.64	1.09	0.11	5.49	144.49	81.43	3,013.63
	03/13/14 9:09:04	7290	13.65	1.60	0.10	5.49	148.64	80.98	3,059.23
	03/13/14 9:09:34	7320	13.62	1.91	0.10	5.51	150.86	80.98	3,079.62
	03/13/14 9:10:04	7350	13.50	1.58	0.10	5.57	150.86	81.43	3,099.12
	03/13/14 9:10:34	7380	13.44	1.45	0.10	5.62	154.18	80.98	3,114.12
	03/13/14 9:11:04	7410	13.39	1.29	0.08	5.68	148.64	80.53	3,079.85
	03/13/14 9:11:34	7440	13.48	1.30	0.08	5.59	147.53	80.53	3,062.67
	03/13/14 9:12:04	7470	13.62	1.62	0.10	5.47	150.30	80.53	3,069.38
	03/13/14 9:12:34	7500	13.49	1.75	0.10	5.65	150.30	80.53	3,066.20
	03/13/14 9:13:04	7530	13.48	1.51	0.10	5.67	150.30	80.53	3,088.69
	03/13/14 9:13:34	7560	13.44	1.49	0.10	5.65	267.66	80.98	4,135.17
	03/13/14 9:14:04	7590	12.51	1.05	0.10	6.23	275.14	80.98	4,200.05
	03/13/14 9:14:34	7620	12.42	0.14	0.10	6.33	270.99	80.98	4,179.91
	03/13/14 9:15:04	7650	12.43	0.07	0.10	6.32	276.80	81.43	4,212.71
	03/13/14 9:15:34	7680	12.37	0.01	0.10	6.36	276.80	81.43	4,210.31
	03/13/14 9:16:04	7710	12.35	-0.01	0.10	6.39	277.91	81.88	4,236.69
	03/13/14 9:16:34	7740	12.34	-0.02	0.10	6.39	276.80	81.43	4,199.92
	03/13/14 9:17:04	7770	12.40	-0.03	0.09	6.38	275.14	81.88	4,188.47
	03/13/14 9:17:34	7800	12.44	-0.05	0.08	6.34	266.00	81.88	4,138.13
	03/13/14 9:18:04	7830	12.49	-0.02	0.10	6.29	265.45	81.88	4,138.72
	03/13/14 9:18:34	7860	12.48	-0.03	0.10	6.27	276.80	81.88	4,220.45
	03/13/14 9:19:04	7890	12.28	-0.05	0.09	6.41	277.35	82.33	4,226.36
	03/13/14 9:19:34	7920	12.27	-0.08	0.09	6.46	277.35	82.33	4,206.96
	03/13/14 9:20:04	7950	12.37	-0.07	0.08	6.38	277.91	82.33	4,196.70
A3	03/13/14 9:20:34	7980	12.40	-0.06	0.09	6.34	271.54	82.33	4,150.55
	03/13/14 9:21:04	8010	12.44	-0.05	0.10	6.35	276.25	82.78	4,213.37
	03/13/14 9:21:34	8040	12.70	0.05	0.10	6.18	278.46	82.33	4,202.32
	03/13/14 9:22:04	8070	12.93	0.24	0.10	5.93	280.67	82.33	4,232.55
	03/13/14 9:22:34	8100	12.85	0.23	0.10	6.07	177.98	82.33	3,303.55
	03/13/14 9:23:04	8130	13.57	0.94	0.09	5.60	156.39	81.88	3,094.90
	03/13/14 9:23:34	8160	13.70	1.48	0.09	5.48	149.75	82.33	3,069.49
	03/13/14 9:24:04	8190	13.79	1.77	0.09	5.39	149.19	82.33	3,089.39
	03/13/14 9:24:34	8220	13.77	2.53	0.10	5.39	149.75	81.88	3,071.39
	03/13/14 9:25:04	8250	13.71	2.72	0.10	5.44	149.75	81.43	3,063.92
	03/13/14 9:25:34	8280	13.62	2.53	0.09	5.49	151.96	81.43	3,088.69
	03/13/14 9:26:04	8310	13.56	2.19	0.10	5.54	154.18	80.98	3,104.28
	03/13/14 9:26:34	8340	13.63	1.73	0.10	5.52	150.86	81.43	3,081.84
	03/13/14 9:27:04	8370	13.65	1.95	0.10	5.44	149.75	81.43	3,059.67
	03/13/14 9:27:34	8400	13.66	2.17	0.10	5.46	145.87	81.43	3,040.79
	03/13/14 9:28:04	8430	13.64	2.37	0.10	5.46	149.19	80.98	3,081.63
	03/13/14 9:28:34	8460	13.58	2.12	0.10	5.51	150.30	80.98	3,088.33
	03/13/14 9:29:04	8490	13.64	2.16	0.09	5.48	153.07	80.98	3,085.07
	03/13/14 9:29:34	8520	13.64	1.99	0.09	5.46	151.96	81.43	3,082.72
	03/13/14 9:30:04	8550	13.31	2.17	0.10	5.63	309.74	81.43	4,426.84
	03/13/14 9:30:34	8580	12.41	0.80	0.10	6.32	289.81	81.88	4,316.53

John Zink Co, LLC
March 13, 2014
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.3	%
Stack Exhaust Flow (M2)	284,135	SCFH

Weather Data

Barometric Pressure	30.19	in. Hg
Relative Humidity	34	%
Ambient Temperature	57	^{o}F
Specific Humidity	0.003300	lb H_2O / lb air

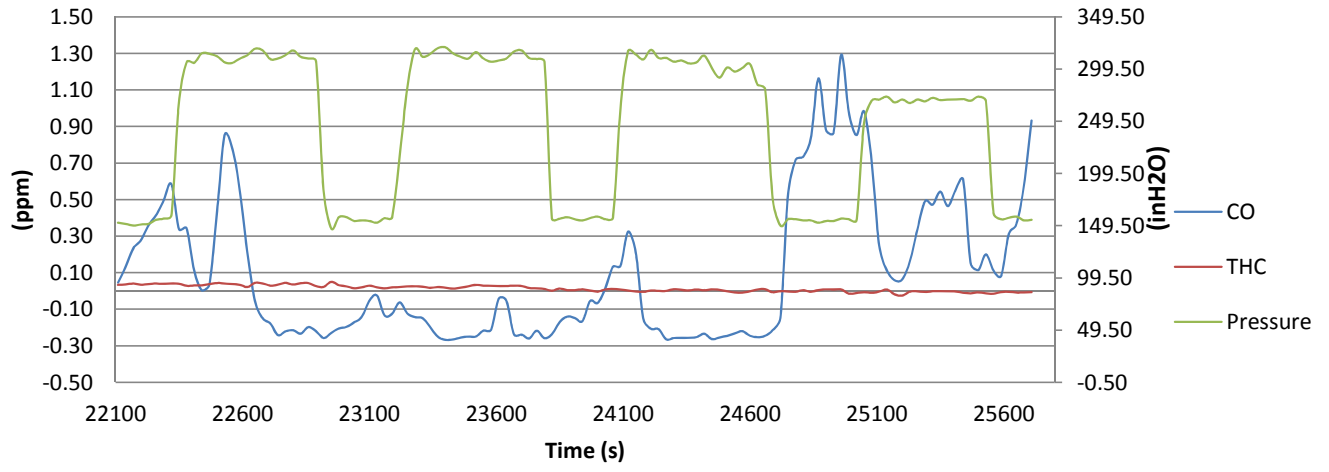
70-100-70 Load, Run - 4.0X30PF R9

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Fuel Temp. ^{o}F	Fuel Flow SCFH
03/13/14 9:31:04	8610	12.48	0.16	0.09	6.29	297.84	82.33	4,369.58
03/13/14 9:31:34	8640	12.35	0.22	0.09	6.39	297.84	82.33	4,364.33
03/13/14 9:32:04	8670	12.23	0.06	0.08	6.46	300.05	82.78	4,362.79
03/13/14 9:32:34	8700	12.32	0.03	0.08	6.45	293.13	83.23	4,350.62
03/13/14 9:33:04	8730	12.50	0.14	0.08	6.28	291.47	83.23	4,338.97
03/13/14 9:33:34	8760	12.45	0.11	0.08	6.30	300.05	83.23	4,376.11
03/13/14 9:34:04	8790	12.40	0.05	0.08	6.38	301.71	83.68	4,379.66
03/13/14 9:34:34	8820	12.27	-0.01	0.09	6.46	304.48	84.13	4,374.93
03/13/14 9:35:04	8850	12.41	-0.04	0.10	6.37	300.05	84.13	4,368.10
03/13/14 9:35:34	8880	12.39	-0.01	0.09	6.37	294.24	84.57	4,342.77
03/13/14 9:36:04	8910	12.34	0.04	0.08	6.41	285.93	84.13	4,285.12
03/13/14 9:36:34	8940	12.53	0.05	0.09	6.28	285.93	84.57	4,294.81
03/13/14 9:37:04	8970	12.57	0.06	0.09	6.21	292.02	84.57	4,311.56
03/13/14 9:37:34	9000	13.00	0.14	0.09	5.97	150.86	84.13	3,067.33
03/13/14 9:38:04	9030	13.54	0.66	0.10	5.53	153.07	84.13	3,078.95
03/13/14 9:38:34	9060	13.59	1.15	0.10	5.50	150.86	84.13	3,075.12
03/13/14 9:39:04	9090	14.25	1.41	0.09	5.38	149.75	83.68	3,048.33
03/13/14 9:39:34	9120	13.95	2.05	0.09	5.33	146.98	83.68	3,033.30
RAW AVERAGE		**12.90**	**0.53**	**0.11**	**6.01**	**222.40**	**82.08**	**3,719.78**

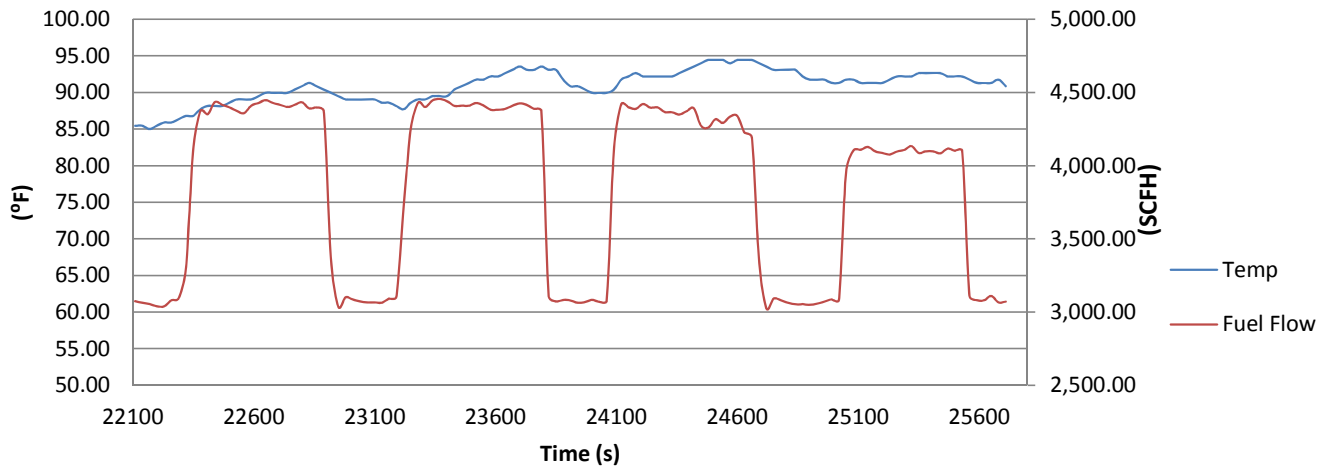
		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	INST-22-0004	INST-CO-0022	INST-TH-0009	INST-C2-0016	F-13 LINE 2-3-4 PRESS	F-13 Line 1-3 TE	F-13 Line Orifice
		(%)	(ppmvd)	(ppmvw)	(%)	(in. H_2O)	(^{o}F)	(SCFH)
Bias	Initial Zero	0.11	-0.07	0.04	0.02			
	Final Zero	0.12	0.04	0.03	0.06			
	Avg. Zero	0.12	-0.02	0.04	0.04			
	Initial UpScale	12.13	8.93	3.12	9.37			
	Final UpScale	12.01	9.00	3.00	9.42			
	Avg. UpScale	12.07	8.97	3.06	9.40			
Upscale Cal Gas		12.00	8.98	3.04	9.42			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.83	0.55	0.07	6.02
Corrected Raw Average (ppm/% wet basis)	12.15	0.52	0.07	5.70
Emission Rate (lb/hr)	N/A	0.01	0.00	N/A

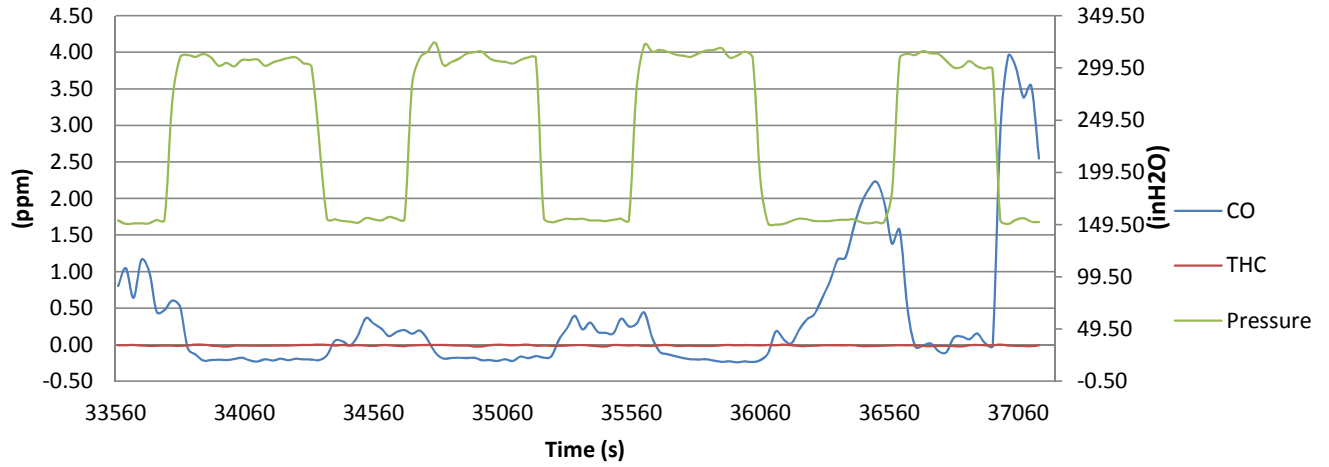
4.0X30PF R7



4.0X30PF R7



4.0X30PF R8



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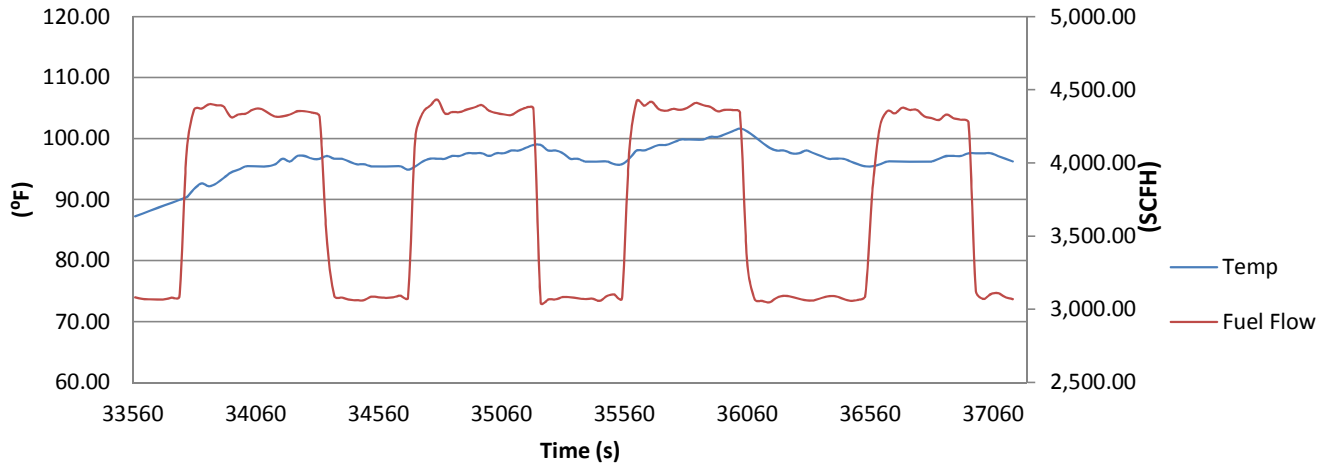

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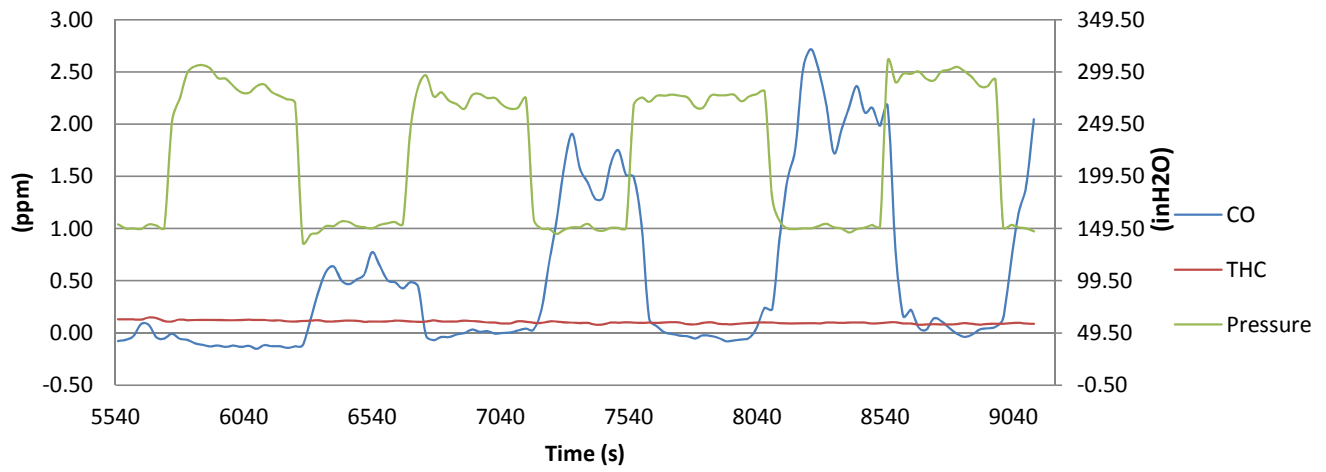

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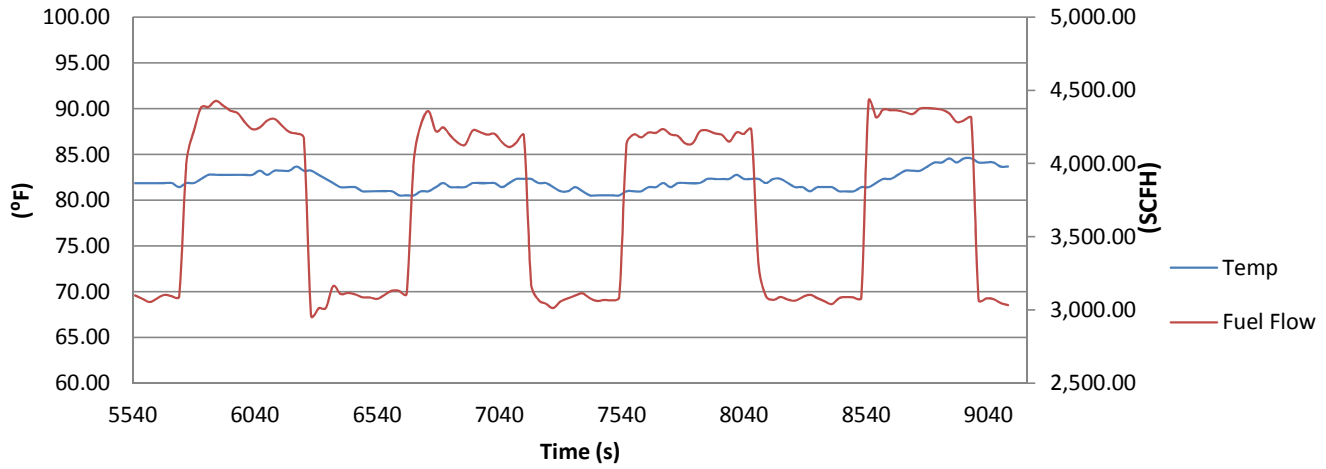
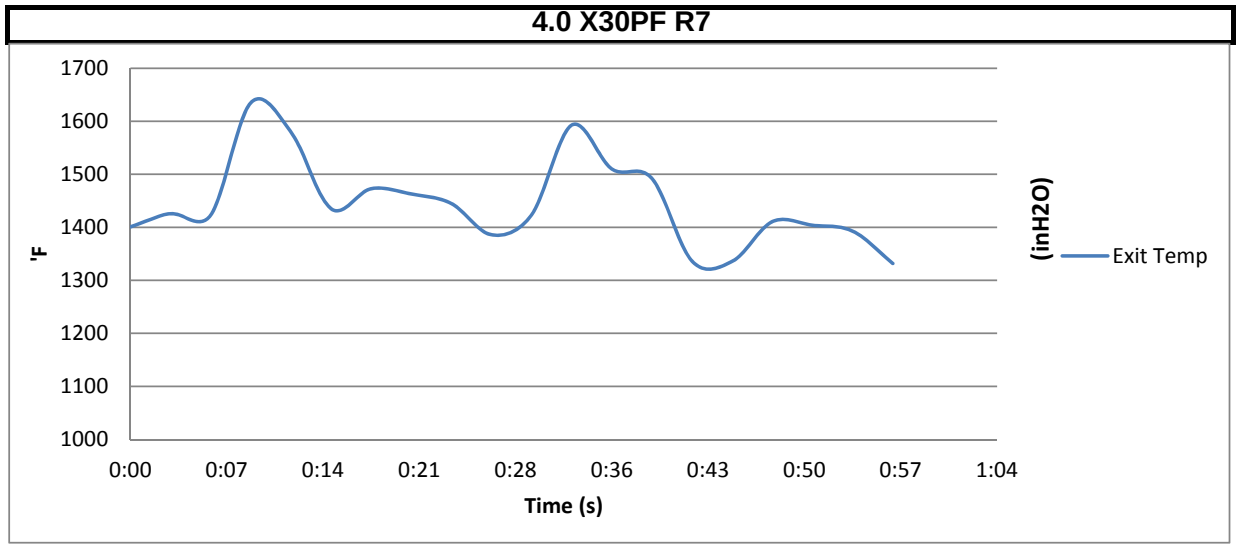
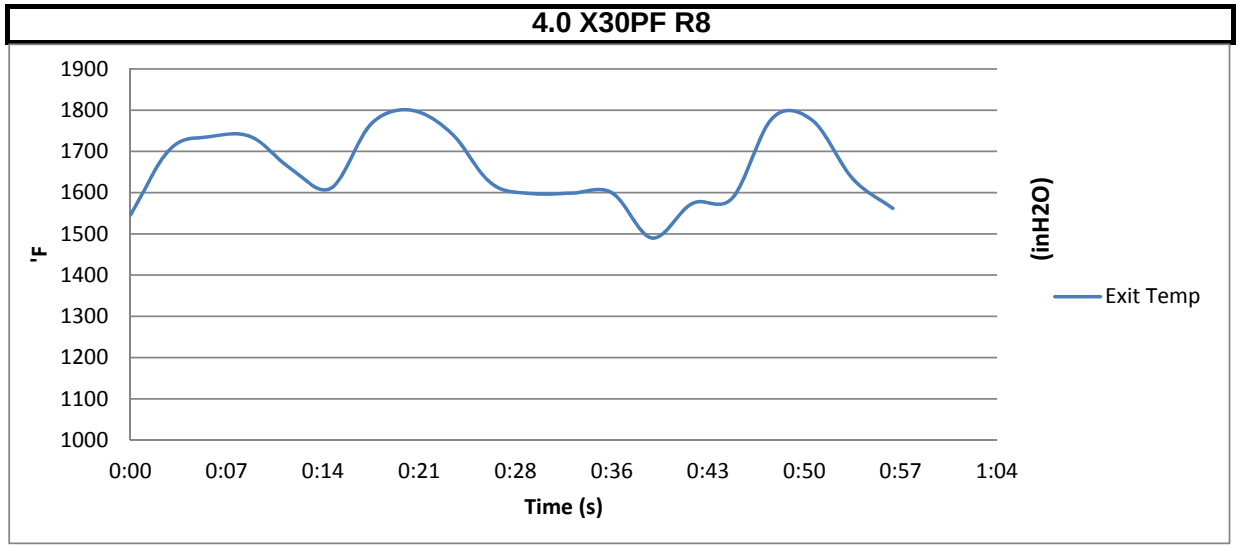
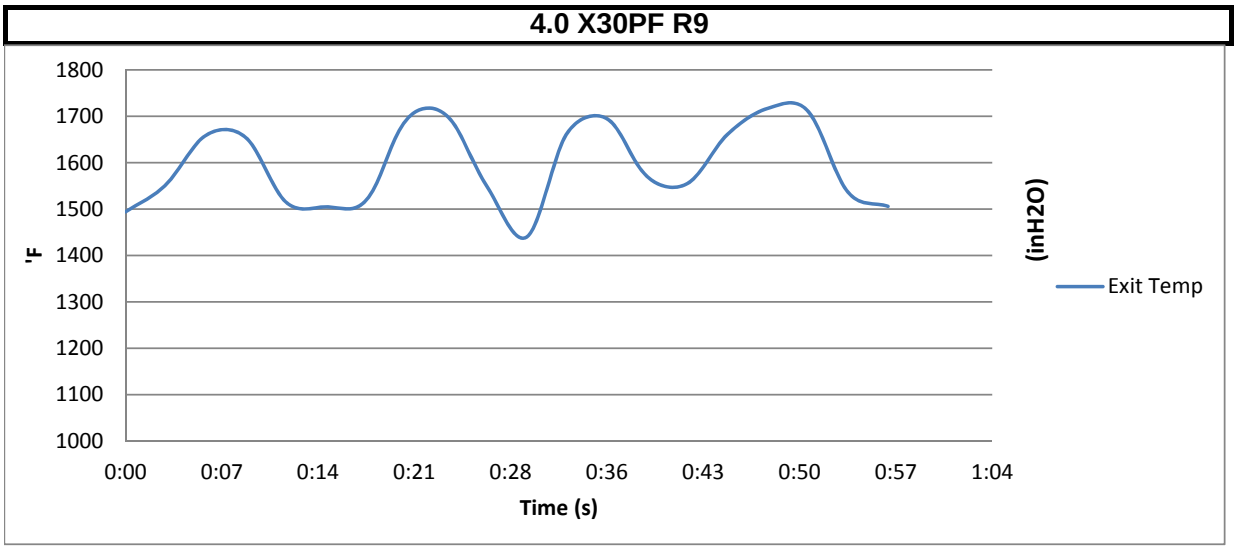



4.0 X30PF R7
1700
1600
1500
1400
1300
1200
1100
1000
'F
0:00
0:07
0:14
0:21
0:28
0:36
0:43
0:50
0:57
1:04
Time (s)
(inH2O)
Exit Temp


4.0 X30PF R8
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
'F
0:00
0:07
0:14
0:21
0:28
0:36
0:43
0:50
0:57
1:04
Time (s)
(inH2O)
Exit Temp


4.0 X30PF R9
1800
1700
1600
1500
1400
1300
1200
1100
1000
'F
0:00
0:07
0:14
0:21
0:28
0:36
0:43
0:50
0:57
1:04
Time (s)
(inH2O)
Exit Temp

EMISSION DATA RECORDS

90-100% Fixed Rate Unit Operations Data

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE

Source Information	
Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Fuel Type	Gas, Propene

Test Information			
Project #		jz-14-tulsa.ok-comp#1	
Operator		TP	
Date for Preliminary Run	(mm/dd/yy)	03/11/14	
Standard Temperature		68	°F
Standard Pressure		29.92	in Hg
Required Sample Vol.	RM4, 8.1.1.2	21	scf
Run Duration	≤0.75 cfm	60	minutes
Unit Number		1	
Base Run Number		90-100%	
Number of Ports Available		2	
Number of Ports Used		2	
Port Inside Diameter		4.00	in
Stack Shape		Circular	

Test Equipment Information					
Run		**10**	**11**	**12**	
Test Date	(mm/dd/yy)	03/13/14	03/13/14	03/13/14	
Load	% or w/DB	90-100	90-100	90-100	
Meter Box Number	from ACS	samp-cp-0008	samp-cp-0008	samp-cp-0008	
Meter Calibration Factor	(Y)	0.924	0.924	0.924	
Orifice Meter Coefficient	($\Delta H_@$)	1.700	1.700	1.700	in H_2O
Pitot Identification	from ACS	A4174	A4174	A4174	
Pitot Tube Coefficient	(C_p)	0.819	0.819	0.819	
Probe Number	from ACS	samp-hp-0003	samp-hp-0003	samp-hp-0003	
Probe Length		60.0	60	60	in
(SS, Glass ….) Liner Material	from list	inconel	inconel	inconel	
Impinger Case Number	from ACS	samp-bh-0016	samp-bh-0016	samp-bh-0016	

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 4 (MOISTURE) [MULTI POINT, NO VARIATION] - RESULTS

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Historical Data	**90-100%-10**	**90-100%-11**	**90-100%-12**	**Average**	**Units**
Run Start Time	10:27	12:50	14:05		hh:mm
Run Stop Time	11:29	13:52	15:07		hh:mm
Test Date	03/13/14	03/13/14	03/13/14		mm/dd/yy
Meter Calibration Factor	0.924	0.924	0.924		
Pitot Tube Coefficient	0.819	0.819	0.819		
Stack Test Data	**90-100%-10**	**90-100%-11**	**90-100%-12**	**Average**	**Units**
Initial Meter Volume	329.925	377.503	426.158		ft^3
Final Meter Volume	377.115	425.893	474.566		ft^3
Total Meter Volume	47.190	48.390	48.408	47.996	ft^3
Total Sampling Time	60.00	60.00	60.00	60.00	min
Average Meter Temperature	69.48	77.00	78.65	75.04	°F
Average Stack Temperature	1631.95	1664.85	1685.80	1660.87	°F
Barometric Pressure	30.20	30.15	30.09	30.15	in Hg
Stack Static Pressure	0.00	0.00	0.00	0.00	in H_2O
Absolute Stack Pressure	30.20	30.15	30.09	30.15	in Hg
Average Orifice Pressure Drop	1.70	1.70	1.70	1.70	in H_2O
Absolute Meter Pressure	30.33	30.28	30.22	30.27	in Hg
Avg Square Root Pitot Pressure	0.25	0.24	0.26	0.25	√(in H_2O)
Moisture Content Data	**90-100%-10**	**90-100%-11**	**90-100%-12**	**Average**	**Units**
Impinger Water Weight Gain	46.80	52.50	52.50	50.60	g
Silica Gel Weight Gain	11.10	11.60	8.30	10.33	g
Total Water Volume Collected	58.00	64.22	60.91	61.04	ml
Standard Water Vapor Volume	2.73	3.02	2.87	2.87	scf
Standard Meter Volume	44.1	44.5	44.3	44.3	dscf
Calculated Stack Moisture	5.83	6.36	6.08	6.09	%
Saturated Stack Moisture	100.00	100.00	100.00	100.00	%
Reported Stack Moisture Content	5.83	6.36	6.08	6.09	%
Gas Analysis Data	**90-100%-10**	**90-100%-11**	**90-100%-12**	**Average**	**Units**
Carbon Dioxide Content	5.8	6.1	6.1	6.0	%
Oxygen Content	14.2	13.9	13.9	14.0	%
Nitrogen Content	80.0	80.0	80.1	80.0	%
Stack Dry Molecular Weight	29.50	29.53	29.52	29.52	lb/lb-mole
Stack Wet Molecular Weight	28.83	28.80	28.82	28.81	lb/lb-mole
Percent Excess Air	205.2	192.4	192.2	196.6	%
Volumetric Flow Rate Data	**90-100%-10**	**90-100%-11**	**90-100%-12**	**Average**	**Units**
Average Stack Gas Velocity	26.90	26.80	28.20	27.30	ft/sec
Stack Cross-Sectional Area	12.57	12.57	12.57	12.57	ft^2
Actual Stack Flow Rate	20,284	20,203	21,263	20,583	acfm
Wet Standard Stack Flow Rate	310	304	316	310	wkscfh
Dry Standard Stack Flow Rate	291,965	284,219	296,509	290,898	dscfh

METHOD 3C - DETERMINATION OF DRY MOLECULAR WEIGHT BY ANALYZER

Plant Name	John Zink Tulsa R&D Facility	**Preliminary Date**	03/11/14		
Sampling Location	4.0X30PF	**Operator**	TP		
Project #	jz-14-tulsa.ok-comp#1	**# of Ports Used**	2		
Fuel Type	Gas, Propene	**Min. Fuel Factor**	N/A	**Max. Fuel Factor**	N/A

Gas Analysis Data								
Run Number	90-100%-10		**Date**	03/13/14	**Run Start Time**	10:27	**Run Stop Time**	11:29
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**	**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	$(F_o)_{avg}$	$(\%EA)_{avg}$	
hh:mm	%	%	ppm	%	lb/lb-mole		%	
01:02	5.8	14.2	0.0	80.0	29.50	1.155	205.2	N/A

Gas Analysis Data								
Run Number	90-100%-11		**Date**	03/13/14	**Run Start Time**	12:50	**Run Stop Time**	13:52
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**	**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	$(F_o)_{avg}$	$(\%EA)_{avg}$	
hh:mm	%	%	ppm	%	lb/lb-mole		%	
01:02	6.1	13.9	0.0	80.0	29.53	1.151	192.4	N/A

Gas Analysis Data								
Run Number	90-100%-12		**Date**	03/13/14	**Run Start Time**	14:05	**Run Stop Time**	15:07
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**	**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	$(F_o)_{avg}$	$(\%EA)_{avg}$	
hh:mm	%	%	ppm	%	lb/lb-mole		%	
01:02	6.1	13.9	0.0	80.1	29.52	1.157	192.2	N/A

METHOD 4 - DETERMINATION OF MOISTURE CONTENT IN STACK GASES

Plant Name	John Zink Tulsa R&D Facility	**Preliminary Date**	03/11/14
Sampling Location	4.0X30PF	**Operator**	TP
Project #	jz-14-tulsa.ok-comp#1	**Ports Used**	2

Moisture Content Data									
Run Number		90-100%-10		**Date**	03/13/14	**Start Time**	10:27	**Stop Time**	11:29
Meter Box Number		samp-cp-0008				**Meter Cal Factor**	(Y)	0.924	
Total Meter Volume		(V_m)	47.190	dcf		**Barometric Pressure**	(P_b)	30.20	in Hg
Average Stack Temp		(t_s)$_{avg}$	1632	°F		**Stack Static Pressure**	(P_{static})	0.00	in H_2O
Average Meter Temp		(t_m)$_{avg}$	69	°F		**Avg Orifice Pressure**	(ΔH)$_{avg}$	1.70	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		H_2O	H_2O	-	Sil Gel				
Final Value	(V_f),(W_f)	739.30	689.90	593.50	886.60				
Initial Value	(V_i),(W_i)	707.30	677.30	591.30	875.50				
Net Value	(V_n),(W_n)	32.0	12.6	2.2	11.1				
Results									
Total Weight		(W_t)	57.90	g		**Water Vol Weighed**	($V_{wsg(std)}$)	2.730	scf
Std Meter Volume		($V_{m(std)}$)	44.071	dscf		**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content		($B_{ws(calc)}$)	5.83	%		**Final Moisture Content**	(B_{ws})	5.83	%

Moisture Content Data									
Run Number		90-100%-11		**Date**	03/13/14	**Start Time**	12:50	**Stop Time**	13:52
Meter Box Number		samp-cp-0008				**Meter Cal Factor**	(Y)	0.924	
Total Meter Volume		(V_m)	48.390	dcf		**Barometric Pressure**	(P_b)	30.15	in Hg
Average Stack Temp		(t_s)$_{avg}$	1665	°F		**Stack Static Pressure**	(P_{static})	0.00	in H_2O
Average Meter Temp		(t_m)$_{avg}$	77	°F		**Avg Orifice Pressure**	(ΔH)$_{avg}$	1.70	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		H_2O	H_2O	-	Sil Gel				
Final Value	(V_f),(W_f)	771.60	768.20	582.40	898.20				
Initial Value	(V_i),(W_i)	732.40	758.30	579.00	886.60				
Net Value	(V_n),(W_n)	39.2	9.9	3.4	11.6				
Results									
Total Weight		(W_t)	64.10	g		**Water Vol Weighed**	($V_{wsg(std)}$)	3.022	scf
Std Meter Volume		($V_{m(std)}$)	44.485	dscf		**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content		($B_{ws(calc)}$)	6.36	%		**Final Moisture Content**	(B_{ws})	6.36	%

Moisture Content Data									
Run Number		90-100%-12		**Date**	03/13/14	**Start Time**	14:05	**Stop Time**	15:07
Meter Box Number		samp-cp-0008				**Meter Cal Factor**	(Y)	0.924	
Total Meter Volume		(V_m)	48.408	dcf		**Barometric Pressure**	(P_b)	30.09	in Hg
Average Stack Temp		(t_s)$_{avg}$	1686	°F		**Stack Static Pressure**	(P_{static})	0.00	in H_2O
Average Meter Temp		(t_m)$_{avg}$	79	°F		**Avg Orifice Pressure**	(ΔH)$_{avg}$	1.70	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		H_2O	H_2O	-	Sil Gel				
Final Value	(V_f),(W_f)	777.80	700.90	596.50	894.90				
Initial Value	(V_i),(W_i)	739.30	689.90	593.50	886.60				
Net Value	(V_n),(W_n)	38.5	11.0	3.0	8.3				
Results									
Total Weight		(W_t)	60.80	g		**Water Vol Weighed**	($V_{wsg(std)}$)	2.867	scf
Std Meter Volume		($V_{m(std)}$)	44.277	dscf		**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content		($B_{ws(calc)}$)	6.08	%		**Final Moisture Content**	(B_{ws})	6.08	%

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Date	03/13/14
Operator	TP
Run Number	90-100%-10

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient	(C_p)	0.819	
Average Stack Temp	(t_s)	1632.0	°F
Average Meter Temp	(t_m)	69.5	
Orifice Meter Coefficient	($\Delta H@$)	1.700	in H_2O
Square Root ΔP	($\Delta p^{1/2}_{avg}$)	0.25	in H_2O
Stack Moisture Content	(B_{ws})	5.83	%
Stack Dry Molecular Weight	(M_d)	29.50	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.75	acfm
ΔP to ΔH Isokinetic Factor	(K)		

Leak Checks					
Train	**Pre**	0.000	ft³/min@	15.0	in Hg
PASS	**Post**	0.000	ft³/min@	15.0	in Hg
Pitot	**Pre (+)**	0.035	in H_2O for	15.0	sec
< 3.0	**Pre (-)**	0.025	in H_2O for	15.0	sec
	Post (+)	0.020	in H_2O for	15.0	sec
	Post (-)	0.035	in H_2O for	15.0	sec

Sampling Equipment			
Meter Box Number	samp-cp-0008		
Meter Cal Factor	(Y)	0.924	
Nozzle Number	samp-hp-0003		
Average Nozzle Diameter	(D_{na})		in
Suggested Nozzle Diameter	(D_{ni})	0.4103	in
Probe Number	samp-hp-0003		in
Probe Length	60		in
Liner Material	inconel		
Sample Case / Oven Number			
Impinger Case Number	samp-bh-0016		

Pressures			
Barometric Pressure	(P_b)	30.20	in Hg
Stack Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.20	in Hg
Absolute Meter Pressure	(P_m)	30.33	in Hg

Nozzle Measurements				
Pre				**PASS**
Post				**PASS**

Run Time			
Start	10:27	**End**	11:29

Weights	Imp 1	Imp 2	Imp 3	Imp 4	Imp 5	Imp 6	Imp 7	Imp 8
Pre	707.3	677.3	591.3	875.5				
Post	739.3	689.9	593.5	886.6				

Wash Volumes					ml
					ml

Traverse Point #	Sampling Time (Θ)	Timer Time	Dry Gas Meter Reading (V_m)	Velocity Head (Δp)	Desired Orifice ΔH (ΔH_d)	Actual Orifice ΔH (ΔH_a)	Stack Temp (t_s)	Snorkel Temp (248±25°F)	Filter Temp (248±25°F)	Impinger Exit Temp (≤68°F)	Cond. Temp (≤--°F)	CPM Filter Temp (--±--°F)	Meter Inlet Temp (t_{mi})	Meter Outlet Temp (t_{mo})	Pump Vacuum	Square Root ΔP ($\Delta p^{1/2}$)	Local Stack Velocity (v_s)$_l$	Cumul. Meter Volume (V_m)$_{std}$	Cumul. Percent IsoKinetic (I)	Est-Run Meter Volume (V_m)$_{std}$
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	329.925	0.035	1.700	1.70	1477	240		58			61	60	3.0	0.19	19.55	2.275		45.505
A-2	3.0	00:03:00	332.320	0.035	1.700	1.70	1547	240		55			64	60	3.0	0.19	19.90	4.620		46.198
A-3	6.0	00:06:00	334.795	0.035	1.700	1.70	1564	240		57			68	61	3.0	0.19	19.98	6.727		44.845
A-4	9.0	00:09:00	337.030	0.045	1.700	1.70	1569	240		59			69	61	3.0	0.21	22.69	8.884		44.418
A-5	12.0	00:12:00	339.320	0.055	1.700	1.70	1618	240		63			71	61	3.0	0.23	25.38	11.041		44.165
A-6	15.0	00:15:00	341.615	0.080	1.700	1.70	1661	240		59			72	62	3.0	0.28	30.93	13.232		44.107
A-7	18.0	00:18:00	343.950	0.090	1.700	1.70	1692	240		57			74	63	3.0	0.30	33.04	15.412		44.034
A-8	21.0	00:21:00	346.280	0.065	1.700	1.70	1667	240		56			74	63	3.0	0.25	27.92	17.597		43.992
A-9	24.0	00:24:00	348.615	0.060	1.700	1.70	1667	240		56			75	64	3.0	0.24	26.82	19.805		44.012
A-10	27.0	00:27:00	350.980	0.060	1.700	1.70	1628	240		57			77	65	3.0	0.24	26.57	22.022		44.043
B-1	30.0	00:30:00	353.360	0.065	1.700	1.70	1597	240		57			75	66	3.0	0.25	27.45	24.203		44.005
B-2	33.0	00:33:00	355.700	0.075	1.700	1.70	1695	240		57			76	66	3.0	0.27	30.18	26.358		43.931
B-3	36.0	00:36:00	358.015	0.060	1.700	1.70	1694	240		58			77	67	3.0	0.24	26.99	28.473		43.805
B-4	39.0	00:39:00	360.290	0.065	1.700	1.70	1685	240		58			78	67	3.0	0.25	28.03	30.613		43.733
B-5	42.0	00:42:00	362.595	0.080	1.700	1.70	1667	240		60			78	68	3.0	0.28	30.97	33.564		44.751
B-6	45.0	00:45:00	365.775	0.080	1.700	1.70	1663	240		60			78	68	3.0	0.28	30.94	35.062		43.827
B-7	48.0	00:48:00	367.390	0.075	1.700	1.70	1660	240		60			78	69	3.0	0.27	29.94	37.296		43.877
B-8	51.0	00:51:00	369.800	0.070	1.700	1.70	1645	240		60			78	69	3.0	0.26	28.82	39.557		43.952
B-9	54.0	00:54:00	372.240	0.060	1.700	1.70	1632	240		60			78	69	3.0	0.24	26.60	41.879		44.083
B-10	57.0	00:57:00	374.745	0.055	1.700	1.70	1611	240		60			79	70	3.0	0.23	25.34	44.071		44.071
Last Pt	60.0	01:00:00	377.115																	
Final Val	60.0	01:00:00	377.115											**Max Vac**	3.0	**Final Values**		44.071		
Average Values				0.06		1.70	1632	240		58			74	65		0.25	26.90			
													69							

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Date	03/13/14
Operator	TP
Run Number	90-100%-11

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient	(C_p)	0.819	
Average Stack Temp	(t_s)	1664.9	°F
Average Meter Temp	(t_m)	77.0	
Orifice Meter Coefficient	($\Delta H@$)	1.700	in H_2O
Square Root ΔP	($\Delta p^{1/2}_{avg}$)	0.24	in H_2O
Stack Moisture Content	(B_{ws})	6.36	%
Stack Dry Molecular Weight	(M_d)	29.53	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.73	acfm
ΔP to ΔH Isokinetic Factor	(K)		

Leak Checks					
Train	**Pre**	0.000	ft³/min@	15.0	in Hg
PASS	**Post**	0.000	ft³/min@	15.0	in Hg
Pitot	**Pre (+)**	0.045	in H_2O for	15.0	sec
< 3.0	**Pre (-)**	0.035	in H_2O for	15.0	sec
	Post (+)	0.020	in H_2O for	15.0	sec
	Post (-)	0.015	in H_2O for	15.0	sec

Sampling Equipment			
Meter Box Number	samp-cp-0008		
Meter Cal Factor	(Y)	0.924	
Nozzle Number	samp-cp-0008		
Average Nozzle Diameter	(D_{na})		in
Suggested Nozzle Diameter	(D_{ni})	0.4058	in
Probe Number	samp-hp-0003		in
Probe Length	60		in
Liner Material	inconel		
Sample Case / Oven Number			
Impinger Case Number	samp-bh-0016		

Pressures			
Barometric Pressure	(P_b)	30.15	in Hg
Stack Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.15	in Hg
Absolute Meter Pressure	(P_m)	30.28	in Hg

Nozzle Measurements				
Pre				**PASS**
Post				**PASS**

Run Time			
Start	12:50	**End**	13:52

Weights	Imp 1	Imp 2	Imp 3	Imp 4	Imp 5	Imp 6	Imp 7	Imp 8
Pre	732.4	758.3	579.0	886.6				
Post	771.6	768.2	582.4	898.2				

Wash Volumes					ml
					ml

Traverse Point #	Sampling Time (Θ)	Timer Time	Dry Gas Meter Reading (V_m)	Velocity Head (Δp)	Desired Orifice ΔH (ΔH_d)	Actual Orifice ΔH (ΔH_a)	Stack Temp (t_s)	Snorkel Temp (248±25°F)	Filter Temp (248±25°F)	Impinger Exit Temp (≤68°F)	Cond. Temp (≤--°F)	CPM Filter Temp (--±--°F)	Meter Inlet Temp (t_{mi})	Meter Outlet Temp (t_{mo})	Pump Vacuum	Square Root ΔP ($\Delta p^{1/2}$)	Local Stack Velocity (v_s)$_l$	Cumul. Meter Volume (V_m)$_{std}$	Cumul. Percent IsoKinetic (I)	Est-Run Meter Volume (V_m)$_{std}$
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	377.503	0.050	1.700	1.70	1550	240		69			72	71	3.0	0.22	23.83	2.282		45.642
A-2	3.0	00:03:00	379.960	0.045	1.700	1.70	1568	240		61			74	71	3.0	0.21	22.71	4.526		45.256
A-3	6.0	00:06:00	382.380	0.050	1.700	1.70	1573	240		58			75	71	3.0	0.22	23.97	6.767		45.113
A-4	9.0	00:09:00	384.800	0.050	1.700	1.70	1581	240		58			77	71	3.0	0.22	24.02	8.986		44.928
A-5	12.0	00:12:00	387.200	0.055	1.700	1.70	1640	240		60			78	72	3.0	0.23	25.55	10.799		43.195
A-6	15.0	00:15:00	389.165	0.065	1.700	1.70	1696	240		62			78	72	3.0	0.25	28.14	13.461		44.870
A-7	18.0	00:18:00	392.050	0.065	1.700	1.70	1751	240		63			79	73	3.0	0.25	28.50	15.681		44.801
A-8	21.0	00:21:00	394.460	0.060	1.700	1.70	1728	240		64			79	73	3.0	0.24	27.24	17.928		44.819
A-9	24.0	00:24:00	396.900	0.050	1.700	1.70	1670	240		63			80	74	3.0	0.22	24.53	20.180		44.845
A-10	27.0	00:27:00	399.350	0.055	1.700	1.70	1663	240		64			81	74	3.0	0.23	25.69	22.430		44.860
B-1	30.0	00:30:00	401.800	0.065	1.700	1.70	1642	240		65			80	74	3.0	0.25	27.79	24.637		44.794
B-2	33.0	00:33:00	404.200	0.060	1.700	1.70	1707	240		65			82	74	3.0	0.24	27.11	26.779		44.632
B-3	36.0	00:36:00	406.535	0.065	1.700	1.70	1703	240		64			83	75	3.0	0.25	28.19	29.037		44.672
B-4	39.0	00:39:00	409.000	0.065	1.700	1.70	1699	240		64			83	75	3.0	0.25	28.16	31.189		44.556
B-5	42.0	00:42:00	411.350	0.075	1.700	1.70	1718	240		65			83	76	3.0	0.27	30.39	33.367		44.489
B-6	45.0	00:45:00	413.730	0.075	1.700	1.70	1724	240		63			83	76	3.0	0.27	30.43	35.577		44.471
B-7	48.0	00:48:00	416.145	0.070	1.700	1.70	1681	240		60			83	76	3.0	0.26	29.10	37.814		44.487
B-8	51.0	00:51:00	418.590	0.065	1.700	1.70	1680	240		59			83	77	3.0	0.25	28.04	40.017		44.463
B-9	54.0	00:54:00	421.000	0.060	1.700	1.70	1663	240		59			84	77	3.0	0.24	26.83	42.223		44.445
B-10	57.0	00:57:00	423.415	0.055	1.700	1.70	1660	240		60			84	77	3.0	0.23	25.67	44.486		44.486
Last Pt	60.0	01:00:00	425.893																	
Final Val	60.0	01:00:00	425.893											**Max Vac**	3.0	**Final Values**		44.486		
Average Values				0.06		1.70	1665	240		62			80	74		0.24	26.80			
													77							

METHOD 4 (MOISTURE) [MULTI POINT, NO VARIATION] SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	John Zink Tulsa R&D Facility
Sampling Location	4.0X30PF
Project #	jz-14-tulsa.ok-comp#1

Date	03/13/14
Operator	TP
Run Number	90-100%-12

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient	(C_p)	0.819	
Average Stack Temp	(t_s)	1685.8	°F
Average Meter Temp	(t_m)	78.7	
Orifice Meter Coefficient	($\Delta H@$)	1.700	in H_2O
Square Root ΔP	($\Delta p^{1/2}_{avg}$)	0.26	in H_2O
Stack Moisture Content	(B_{ws})	6.08	%
Stack Dry Molecular Weight	(M_d)	29.52	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.74	acfm
ΔP to ΔH Isokinetic Factor	(K)		

Leak Checks					
Train	**Pre**	0.000	ft³/min@	15.0	in Hg
PASS	**Post**	0.000	ft³/min@	15.0	in Hg
Pitot	**Pre (+)**	0.025	in H_2O for	15.0	sec
< 3.0	**Pre (-)**	0.015	in H_2O for	15.0	sec
	Post (+)	0.030	in H_2O for	15.0	sec
	Post (-)	0.030	in H_2O for	15.0	sec

Sampling Equipment			
Meter Box Number	samp-cp-0008		
Meter Cal Factor	(Y)	0.924	
Nozzle Number	samp-cp-0008		
Average Nozzle Diameter	(D_{na})		in
Suggested Nozzle Diameter	(D_{ni})	0.4033	in
Probe Number	samp-hp-0003		in
Probe Length	60		in
Liner Material	inconel		
Sample Case / Oven Number			
Impinger Case Number	samp-bh-0016		

Pressures			
Barometric Pressure	(P_b)	30.09	in Hg
Stack Static Pressure	(P_{static})	0.00	in H_2O
Absolute Stack Pressure	(P_s)	30.09	in Hg
Absolute Meter Pressure	(P_m)	30.22	in Hg

Nozzle Measurements				
Pre				**PASS**
Post				**PASS**

Run Time			
Start	14:05	**End**	15:07

Weights	**Imp 1**	**Imp 2**	**Imp 3**	**Imp 4**	**Imp 5**	**Imp 6**	**Imp 7**	**Imp 8**
Pre	739.3	689.9	593.5	886.6				
Post	777.8	700.9	596.5	894.9				

Wash Volumes					
					ml
					ml

Traverse Point #	**Sampling Time (Θ)**	**Timer Time**	**Dry Gas Meter Reading (V_m)**	**Velocity Head (Δp)**	**Desired Orifice ΔH (ΔH_d)**	**Actual Orifice ΔH (ΔH_a)**	**Stack Temp (t_s)**	**Snorkel Temp (248±25°F)**	**Filter Temp (248±25°F)**	**Impinger Exit Temp (≤68°F)**	**Cond. Temp (≤--°F)**	**CPM Filter Temp (--±--°F)**	**Meter Inlet Temp (t_{mi})**	**Meter Outlet Temp (t_{mo})**	**Pump Vacuum**	**Square Root ΔP ($\Delta p^{1/2}$)**	**Local Stack Velocity (v_s)$_l$**	**Cumul. Meter Volume (V_m)$_{std}$**	**Cumul. Percent IsoKinetic (I)**	**Est-Run Meter Volume (V_m)$_{std}$**
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	426.158	0.050	1.700	1.70	1606	240		69			81	75	2.5	0.22	24.18	2.282		45.642
A-2	3.0	00:03:00	428.650	0.055	1.700	1.70	1601	240		65			84	75	2.5	0.23	25.32	4.501		45.012
A-3	6.0	00:06:00	431.080	0.055	1.700	1.70	1637	240		63			84	75	2.5	0.23	25.55	6.757		45.046
A-4	9.0	00:09:00	433.550	0.065	1.700	1.70	1694	240		64			83	75	2.5	0.25	28.15	9.019		45.096
A-5	12.0	00:12:00	436.025	0.070	1.700	1.70	1720	240		60			83	75	2.5	0.26	29.38	11.108		44.431
A-6	15.0	00:15:00	438.310	0.070	1.700	1.70	1677	240		60			83	75	2.5	0.26	29.09	13.334		44.445
A-7	18.0	00:18:00	440.745	0.065	1.700	1.70	1713	240		60			82	75	2.5	0.25	28.27	15.589		44.540
A-8	21.0	00:21:00	443.210	0.060	1.700	1.70	1704	240		60			82	75	2.5	0.24	27.10	17.775		44.439
A-9	24.0	00:24:00	445.600	0.055	1.700	1.70	1696	240		60			83	75	2.5	0.23	25.90	20.024		44.498
A-10	27.0	00:27:00	448.060	0.060	1.700	1.70	1661	240		60			85	75	2.5	0.24	26.83	22.248		44.495
B-1	30.0	00:30:00	450.497	0.065	1.700	1.70	1680	240		61			80	75	2.5	0.25	28.05	24.469		44.488
B-2	33.0	00:33:00	452.920	0.070	1.700	1.70	1745	240		61			81	75	2.5	0.26	29.55	26.689		44.482
B-3	36.0	00:36:00	455.345	0.075	1.700	1.70	1721	240		61			81	75	2.5	0.27	30.42	28.846		44.378
B-4	39.0	00:39:00	457.700	0.080	1.700	1.70	1735	240		61			81	75	2.5	0.28	31.52	31.044		44.348
B-5	42.0	00:42:00	460.100	0.080	1.700	1.70	1731	240		61			82	75	2.5	0.28	31.49	33.194		44.258
B-6	45.0	00:45:00	462.450	0.080	1.700	1.70	1699	240		61			83	75	2.5	0.28	31.26	35.406		44.257
B-7	48.0	00:48:00	464.870	0.075	1.700	1.70	1683	240		62			83	75	2.5	0.27	30.16	37.627		44.267
B-8	51.0	00:51:00	467.300	0.065	1.700	1.70	1683	240		62			82	74	2.5	0.25	28.07	39.825		44.250
B-9	54.0	00:54:00	469.700	0.060	1.700	1.70	1648	240		62			83	74	2.5	0.24	26.75	42.112		44.329
B-10	57.0	00:57:00	472.200	0.060	1.700	1.70	1682	240		63			83	74	2.5	0.24	26.97	44.277		44.277
Last Pt	60.0	01:00:00	474.566																	
Final Val	60.0	01:00:00	474.566											**Max Vac**	2.5	**Final Values**		44.277		
Average Values				0.07		1.70	1686	240		62			82	75		0.26	28.20			
													79							

John Zink Co, LLC
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.8	%
Stack Exhaust Flow (M2)	291,965	SCFH

Weather Data

Barometric Pressure	30.20	in. Hg
Relative Humidity	28	%
Ambient Temperature	63	^{o}F
Specific Humidity	0.003365	lb H_2O / lb air

90-100 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
A1	03/13/14 10:27:04	11970	13.08	0.34	0.10	5.84	227.53	86.82	3,755.09
	03/13/14 10:27:34	12000	13.04	0.40	0.11	5.88	226.14	86.82	3,755.01
	03/13/14 10:28:04	12030	13.12	2.48	0.14	5.81	230.30	87.27	3,768.02
	03/13/14 10:28:34	12060	13.26	11.99	0.13	5.68	232.51	87.72	3,789.19
	03/13/14 10:29:04	12090	13.10	19.85	0.11	5.79	227.53	87.72	3,767.65
	03/13/14 10:29:34	12120	13.11	7.91	0.11	5.82	225.04	87.72	3,734.33
	03/13/14 10:30:04	12150	13.23	1.52	0.11	5.76	224.48	87.72	3,713.44
	03/13/14 10:30:34	12180	13.25	0.90	0.11	5.74	224.48	87.72	3,740.07
	03/13/14 10:31:04	12210	12.95	0.54	0.11	5.92	228.64	88.17	3,765.43
	03/13/14 10:31:34	12240	13.11	0.30	0.11	5.91	227.53	88.17	3,769.28
	03/13/14 10:32:04	12270	13.32	0.09	0.11	5.73	228.08	88.17	3,745.05
	03/13/14 10:32:34	12300	13.40	0.25	0.11	5.62	226.14	88.62	3,712.31
	03/13/14 10:33:04	12330	13.31	0.12	0.11	5.71	229.19	88.62	3,748.16
	03/13/14 10:33:34	12360	13.18	0.03	0.11	5.79	227.53	88.17	3,744.12
	03/13/14 10:34:04	12390	13.15	0.10	0.11	5.86	227.53	88.17	3,756.58
	03/13/14 10:34:34	12420	12.91	0.13	0.11	5.98	230.85	88.17	3,756.62
	03/13/14 10:35:04	12450	13.10	0.03	0.11	5.86	230.30	88.17	3,767.12
	03/13/14 10:35:34	12480	13.25	-0.01	0.10	5.74	230.30	88.62	3,799.89
	03/13/14 10:36:04	12510	13.11	-0.06	0.10	5.84	234.17	88.62	3,801.57
	03/13/14 10:36:34	12540	13.02	-0.05	0.10	5.92	237.49	89.07	3,837.78
	03/13/14 10:37:04	12570	13.00	-0.05	0.11	5.91	246.63	89.07	3,907.95
	03/13/14 10:37:34	12600	12.71	-0.12	0.10	6.11	249.95	89.07	3,922.79
	03/13/14 10:38:04	12630	12.63	-0.23	0.09	6.16	247.18	89.07	3,916.74
	03/13/14 10:38:34	12660	12.75	-0.19	0.09	6.10	247.18	89.07	3,957.04
	03/13/14 10:39:04	12690	12.52	-0.17	0.09	6.26	250.50	89.07	3,945.29
	03/13/14 10:39:34	12720	12.75	-0.16	0.10	6.10	249.95	89.52	3,967.17
	03/13/14 10:40:04	12750	12.73	-0.21	0.10	6.12	250.78	89.52	3,973.99
	03/13/14 10:40:34	12780	12.56	-0.18	0.10	6.19	260.19	89.07	4,023.75
	03/13/14 10:41:04	12810	12.68	-0.20	0.10	6.14	259.64	89.07	4,023.30
	03/13/14 10:41:34	12840	12.71	-0.21	0.10	6.08	256.32	89.52	4,013.80
	03/13/14 10:42:04	12870	12.59	-0.25	0.10	6.14	261.85	89.52	4,068.54
	03/13/14 10:42:34	12900	12.25	-0.24	0.09	6.43	263.79	89.97	4,087.00
	03/13/14 10:43:04	12930	12.55	-0.27	0.10	6.25	270.43	89.52	4,119.73
	03/13/14 10:43:34	12960	12.55	-0.25	0.09	6.24	269.88	89.52	4,139.69
	03/13/14 10:44:04	12990	12.52	-0.28	0.09	6.27	267.11	89.97	4,082.32
	03/13/14 10:44:34	13020	12.60	-0.25	0.09	6.13	263.24	89.97	4,065.42
	03/13/14 10:45:04	13050	12.58	-0.28	0.08	6.13	265.45	89.52	4,068.93
	03/13/14 10:45:34	13080	12.64	-0.27	0.08	6.11	266.56	89.97	4,097.08
	03/13/14 10:46:04	13110	12.28	-0.30	0.08	6.38	269.88	89.97	4,102.96
	03/13/14 10:46:34	13140	12.17	-0.27	0.08	6.54	272.65	89.97	4,142.69
	03/13/14 10:47:04	13170	12.45	-0.23	0.11	6.27	270.99	89.97	4,119.18
	03/13/14 10:47:34	13200	12.66	-0.24	0.10	6.21	266.56	89.97	4,090.16
A2	03/13/14 10:48:04	13230	12.92	-0.25	0.08	6.12	266.00	89.97	4,057.40
	03/13/14 10:48:34	13260	12.70	-0.27	0.09	6.15	264.90	90.42	4,090.18
	03/13/14 10:49:04	13290	12.38	-0.31	0.10	6.36	270.99	90.42	4,120.64
	03/13/14 10:49:34	13320	12.51	-0.27	0.09	6.27	269.88	90.42	4,140.90
	03/13/14 10:50:04	13350	12.60	-0.21	0.10	6.12	266.56	90.87	4,093.34
	03/13/14 10:50:34	13380	12.57	-0.20	0.09	6.16	264.34	91.32	4,073.29
	03/13/14 10:51:04	13410	12.65	-0.17	0.09	6.10	259.64	91.32	4,056.99
	03/13/14 10:51:34	13440	12.58	-0.15	0.09	6.15	264.34	90.87	4,073.88
	03/13/14 10:52:04	13470	12.61	-0.18	0.10	6.13	265.45	90.87	4,086.88
	03/13/14 10:52:34	13500	12.66	-0.19	0.10	6.09	267.66	91.32	4,119.72

John Zink Co, LLC
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.8	%
Stack Exhaust Flow (M2)	291,965	SCFH

Weather Data

Barometric Pressure	30.20	in. Hg
Relative Humidity	28	%
Ambient Temperature	63	^{o}F
Specific Humidity	0.003365	lb H_2O / lb air

90-100 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
	03/13/14 10:53:04	13530	12.54	-0.19	0.10	6.17	268.77	91.77	4,093.31
	03/13/14 10:53:34	13560	12.55	-0.21	0.09	6.22	263.79	91.77	4,081.34
	03/13/14 10:54:04	13590	12.66	-0.21	0.08	6.16	263.79	92.21	4,063.11
	03/13/14 10:54:34	13620	12.56	-0.19	0.09	6.21	267.66	92.21	4,105.21
	03/13/14 10:55:04	13650	12.53	-0.21	0.09	6.23	267.66	92.21	4,092.80
	03/13/14 10:55:34	13680	12.46	-0.21	0.09	6.26	268.77	92.21	4,122.84
	03/13/14 10:56:04	13710	12.52	-0.23	0.09	6.24	268.77	92.21	4,136.02
	03/13/14 10:56:34	13740	12.42	-0.22	0.09	6.29	267.66	92.66	4,089.00
	03/13/14 10:57:04	13770	12.50	-0.23	0.08	6.24	264.90	92.66	4,108.77
	03/13/14 10:57:34	13800	12.54	-0.20	0.08	6.21	267.11	92.66	4,092.94
	03/13/14 10:58:04	13830	12.50	-0.16	0.09	6.29	267.11	92.66	4,119.43
	03/13/14 10:58:34	13860	12.41	-0.18	0.09	6.42	270.43	92.21	4,122.52
	03/13/14 10:59:04	13890	12.63	-0.22	0.09	6.17	267.11	92.66	4,107.49
	03/13/14 10:59:34	13920	12.55	-0.18	0.09	6.20	263.24	92.66	4,085.22
	03/13/14 11:00:04	13950	12.56	-0.16	0.09	6.20	263.24	92.66	4,081.45
	03/13/14 11:00:34	13980	12.55	-0.17	0.09	6.20	266.56	93.11	4,084.73
	03/13/14 11:01:04	14010	12.51	-0.20	0.09	6.21	267.66	93.11	4,099.39
	03/13/14 11:01:34	14040	12.64	-0.23	0.09	6.24	271.54	93.56	4,114.34
	03/13/14 11:02:04	14070	12.92	-0.28	0.08	6.35	267.66	94.01	4,105.35
	03/13/14 11:02:34	14100	12.60	-0.26	0.08	6.25	264.34	94.01	4,079.31
	03/13/14 11:03:04	14130	12.57	-0.25	0.09	6.21	265.45	94.46	4,088.71
	03/13/14 11:03:34	14160	12.52	-0.23	0.08	6.22	265.45	94.91	4,075.05
	03/13/14 11:04:04	14190	12.55	-0.22	0.09	6.20	267.11	94.91	4,118.71
	03/13/14 11:04:34	14220	12.34	-0.27	0.08	6.38	266.00	94.91	4,102.10
	03/13/14 11:05:04	14250	12.47	-0.28	0.08	6.26	263.79	94.91	4,093.44
	03/13/14 11:05:34	14280	12.45	-0.26	0.08	6.27	262.13	94.91	4,060.47
	03/13/14 11:06:04	14310	12.53	-0.25	0.08	6.18	263.79	94.91	4,070.26
	03/13/14 11:06:34	14340	12.51	-0.26	0.08	6.19	263.24	95.47	4,083.07
	03/13/14 11:07:04	14370	12.46	-0.24	0.09	6.25	266.56	95.47	4,119.01
	03/13/14 11:07:34	14400	12.48	-0.27	0.08	6.26	268.22	95.47	4,120.17
A3	03/13/14 11:08:04	14430	12.75	-0.25	0.08	6.10	267.11	95.47	4,094.60
	03/13/14 11:08:34	14460	13.04	-0.04	0.09	5.86	264.90	95.47	4,082.32
	03/13/14 11:09:04	14490	13.10	0.29	0.08	5.80	267.11	95.47	4,084.97
	03/13/14 11:09:34	14520	13.09	0.40	0.09	5.78	264.34	95.47	4,094.93
	03/13/14 11:10:04	14550	12.98	0.22	0.09	5.88	268.22	95.81	4,094.73
	03/13/14 11:10:34	14580	13.06	0.20	0.09	5.83	267.11	95.81	4,099.77
	03/13/14 11:11:04	14610	13.00	0.45	0.08	5.89	264.34	95.47	4,080.27
	03/13/14 11:11:34	14640	13.14	0.30	0.09	5.83	267.11	95.81	4,079.71
	03/13/14 11:12:04	14670	13.30	0.21	0.08	5.74	263.24	96.71	4,075.22
	03/13/14 11:12:34	14700	13.05	-0.02	0.09	5.89	267.66	96.71	4,122.11
	03/13/14 11:13:04	14730	13.23	0.16	0.09	6.07	267.11	97.16	4,108.00
	03/13/14 11:13:34	14760	12.95	-0.04	0.08	6.21	267.66	97.16	4,090.57
	03/13/14 11:14:04	14790	13.28	-0.03	0.09	5.87	263.24	98.06	4,070.15
	03/13/14 11:14:34	14820	12.97	-0.08	0.09	5.98	264.34	98.06	4,063.27
	03/13/14 11:15:04	14850	12.97	-0.16	0.08	6.02	264.34	98.51	4,053.38
	03/13/14 11:15:34	14880	13.05	-0.17	0.08	5.93	267.66	98.51	4,086.70
	03/13/14 11:16:04	14910	12.83	-0.13	0.08	6.01	265.45	98.51	4,086.12
	03/13/14 11:16:34	14940	12.84	-0.18	0.08	6.02	264.34	98.51	4,084.08
	03/13/14 11:17:04	14970	13.13	0.11	0.08	5.79	264.90	98.51	4,074.04
	03/13/14 11:17:34	15000	13.10	-0.02	0.08	5.87	266.00	98.96	4,062.07
	03/13/14 11:18:04	15030	13.06	0.09	0.09	5.87	265.45	99.40	4,056.51
	03/13/14 11:18:34	15060	13.06	0.04	0.09	5.96	269.33	99.40	4,096.05

John Zink Co, LLC
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	5.8	%
Stack Exhaust Flow (M2)	291,965	SCFH

Weather Data

Barometric Pressure	30.20	in. Hg
Relative Humidity	28	%
Ambient Temperature	63	^{o}F
Specific Humidity	0.003365	lb H_2O / lb air

90-100 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
03/13/14 11:19:04	15090	13.06	0.03	0.09	5.89	267.11	99.40	4,091.29
03/13/14 11:19:34	15120	12.82	0.02	0.10	6.05	267.66	99.40	4,088.38
03/13/14 11:20:04	15150	12.99	-0.10	0.08	5.89	262.13	99.85	4,062.27
03/13/14 11:20:34	15180	12.92	-0.14	0.08	5.97	263.24	99.85	4,058.08
03/13/14 11:21:04	15210	13.09	0.05	0.09	5.86	263.24	99.85	4,051.62
03/13/14 11:21:34	15240	12.99	0.14	0.09	5.90	267.66	99.40	4,093.11
03/13/14 11:22:04	15270	13.06	0.24	0.09	5.83	267.11	98.96	4,091.46
03/13/14 11:22:34	15300	12.89	0.28	0.08	5.97	268.22	98.51	4,081.41
03/13/14 11:23:04	15330	12.93	0.39	0.07	5.93	262.68	98.51	4,059.00
03/13/14 11:23:34	15360	13.17	0.31	0.07	5.79	262.68	98.51	4,058.21
03/13/14 11:24:04	15390	13.26	0.46	0.10	5.68	265.45	98.96	4,046.47
03/13/14 11:24:34	15420	13.09	0.27	0.09	5.82	269.33	98.96	4,098.47
03/13/14 11:25:04	15450	13.05	0.21	0.07	5.90	270.99	98.96	4,092.71
03/13/14 11:25:34	15480	13.06	0.18	0.08	5.83	268.22	98.96	4,075.69
03/13/14 11:26:04	15510	13.22	0.29	0.08	5.73	266.56	98.96	4,070.62
03/13/14 11:26:34	15540	13.31	0.68	0.08	5.63	262.68	98.96	4,061.63
03/13/14 11:27:04	15570	13.22	0.47	0.08	5.71	266.00	99.40	4,054.84
RAW AVERAGE		**12.82**	**0.32**	**0.09**	**6.04**	**258.87**	**93.11**	**4,024.51**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	INST-22-0004	INST-CO-0022	INST-TH-0009	INST-C2-0016	F-13 LINE 2-3-4 PRESS	F-13 Line 1-3 TE	F-13 Line Orifice
		(%)	**(ppmvd)**	**(ppmvw)**	**(%)**	**(in. H_2O)**	**(^{o}F)**	**(SCFH)**
Bias	**Initial Zero**	0.12	0.04	0.03	0.06			
	Final Zero	0.09	0.07	0.03	0.08			
	Avg. Zero	0.11	0.06	0.03	0.07			
	Initial UpScale	12.01	9.00	3.00	9.42			
	Final UpScale	11.97	9.11	3.05	9.44			
	Avg. UpScale	11.99	9.06	3.03	9.43			
Upscale Cal Gas		12.00	8.98	3.04	9.42			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.84	0.26	0.06	6.01
Corrected Raw Average (ppm/% wet basis)	12.08	0.24	0.06	5.65
Emission Rate (lb/hr)	N/A	0.01	0.00	N/A

John Zink Co, LLC
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	6.4	%
Stack Exhaust Flow (M2)	284,219	SCFH

Weather Data

Barometric Pressure	30.15	in. Hg
Relative Humidity	17	%
Ambient Temperature	66	^{o}F
Specific Humidity	0.002269	lb H_2O / lb air

90-100 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
A1	03/13/14 12:50:04	20550	12.79	-0.43	0.09	5.98	231.40	101.20	3,735.55
	03/13/14 12:50:34	20580	12.74	-0.42	0.09	6.03	229.74	101.20	3,740.99
	03/13/14 12:51:04	20610	12.89	-0.38	0.07	5.87	229.19	101.20	3,724.68
	03/13/14 12:51:34	20640	12.36	-0.42	0.09	6.34	231.96	100.75	3,755.28
	03/13/14 12:52:04	20670	13.00	-0.43	0.10	5.95	231.40	101.20	3,766.66
	03/13/14 12:52:34	20700	13.03	-0.38	0.08	5.83	230.85	101.65	3,756.30
	03/13/14 12:53:04	20730	12.73	-0.42	0.09	6.06	232.51	102.10	3,745.08
	03/13/14 12:53:34	20760	12.80	-0.43	0.09	6.04	228.08	102.10	3,736.62
	03/13/14 12:54:04	20790	12.58	-0.45	0.08	6.19	229.74	102.10	3,722.31
	03/13/14 12:54:34	20820	12.69	-0.44	0.08	6.12	231.40	102.10	3,759.87
	03/13/14 12:55:04	20850	12.45	-0.45	0.08	6.32	234.17	101.65	3,764.43
	03/13/14 12:55:34	20880	12.83	-0.45	0.09	6.04	233.62	101.65	3,763.33
	03/13/14 12:56:04	20910	12.60	-0.45	0.07	6.13	231.96	101.65	3,750.37
	03/13/14 12:56:34	20940	12.44	-0.46	0.07	6.32	229.19	101.65	3,741.50
	03/13/14 12:57:04	20970	12.71	-0.44	0.08	6.17	229.19	101.65	3,735.84
	03/13/14 12:57:34	21000	12.70	-0.42	0.08	6.15	230.30	102.10	3,738.77
	03/13/14 12:58:04	21030	12.71	-0.44	0.08	6.12	231.96	102.10	3,771.48
	03/13/14 12:58:34	21060	12.91	-0.43	0.09	6.01	231.40	102.55	3,756.84
	03/13/14 12:59:04	21090	13.03	-0.40	0.10	5.88	233.62	102.55	3,774.54
	03/13/14 12:59:34	21120	12.99	-0.41	0.09	5.92	236.39	103.00	3,799.76
	03/13/14 13:00:04	21150	13.01	-0.44	0.09	5.93	236.94	103.45	3,814.30
	03/13/14 13:00:34	21180	12.78	-0.02	0.09	6.02	243.31	103.45	3,836.22
	03/13/14 13:01:04	21210	12.37	-0.03	0.09	6.26	246.63	104.35	3,862.31
	03/13/14 13:01:34	21240	12.43	-0.04	0.08	6.32	245.52	104.80	3,866.59
	03/13/14 13:02:04	21270	12.57	-0.04	0.09	6.21	243.31	104.35	3,853.31
	03/13/14 13:02:34	21300	12.59	-0.01	0.09	6.15	249.95	104.35	3,923.70
	03/13/14 13:03:04	21330	12.62	-0.01	0.09	6.16	254.66	104.35	3,928.19
	03/13/14 13:03:34	21360	12.17	-0.03	0.09	6.43	261.85	103.90	4,003.52
	03/13/14 13:04:04	21390	12.51	-0.04	0.10	6.21	264.90	103.90	4,026.67
	03/13/14 13:04:34	21420	12.57	-0.03	0.09	6.17	259.08	104.35	3,962.05
	03/13/14 13:05:04	21450	12.41	-0.03	0.08	6.28	267.11	104.35	4,060.43
	03/13/14 13:05:34	21480	11.94	-0.07	0.08	6.61	267.11	103.90	4,085.39
	03/13/14 13:06:04	21510	11.87	-0.07	0.09	6.73	273.20	103.90	4,099.28
	03/13/14 13:06:34	21540	12.21	-0.07	0.08	6.50	274.58	104.80	4,121.76
	03/13/14 13:07:04	21570	12.29	-0.04	0.08	6.45	272.09	104.80	4,093.44
	03/13/14 13:07:34	21600	12.29	-0.01	0.08	6.42	269.33	104.80	4,075.55
	03/13/14 13:08:04	21630	12.30	-0.01	0.09	6.41	268.77	105.25	4,068.85
	03/13/14 13:08:34	21660	12.06	-0.01	0.08	6.58	266.56	104.80	4,057.37
	03/13/14 13:09:04	21690	11.86	-0.02	0.08	6.71	263.79	103.90	4,036.75
	03/13/14 13:09:34	21720	11.75	-0.01	0.08	6.82	269.33	103.45	4,068.51
	03/13/14 13:10:04	21750	12.13	-0.05	0.06	6.56	270.99	103.45	4,090.31
	03/13/14 13:10:34	21780	12.28	-0.02	0.07	6.46	271.54	103.90	4,097.52
A2	03/13/14 13:11:04	21810	12.30	0.02	0.07	6.43	270.99	104.35	4,082.16
	03/13/14 13:11:34	21840	12.28	0.03	0.07	6.45	268.77	103.90	4,065.99
	03/13/14 13:12:04	21870	12.15	0.01	0.07	6.39	263.24	103.45	4,060.43
	03/13/14 13:12:34	21900	12.06	-0.01	0.08	6.51	268.77	103.45	4,078.69
	03/13/14 13:13:04	21930	12.13	-0.02	0.08	6.43	268.22	103.45	4,099.39
	03/13/14 13:13:34	21960	12.33	-0.05	0.08	6.34	269.33	103.90	4,088.93
	03/13/14 13:14:04	21990	12.33	0.01	0.09	6.32	267.11	104.35	4,077.20
	03/13/14 13:14:34	22020	12.38	-0.04	0.09	6.28	268.77	104.35	4,062.99
	03/13/14 13:15:04	22050	12.57	0.01	0.09	6.16	265.45	104.80	4,051.77
	03/13/14 13:15:34	22080	12.51	0.04	0.08	6.19	268.22	104.35	4,062.40

John Zink Co, LLC
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	6.4	%
Stack Exhaust Flow (M2)	284,219	SCFH

Weather Data

Barometric Pressure	30.15	in. Hg
Relative Humidity	17	%
Ambient Temperature	66	^{o}F
Specific Humidity	0.002269	lb H_2O / lb air

90-100 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
	03/13/14 13:16:04	22110	12.53	0.06	0.08	6.20	270.43	104.80	4,093.72
	03/13/14 13:16:34	22140	12.42	0.03	0.08	6.25	271.54	105.25	4,082.63
	03/13/14 13:17:04	22170	12.40	0.01	0.09	6.28	270.43	104.80	4,073.41
	03/13/14 13:17:34	22200	12.41	0.02	0.08	6.32	265.45	105.25	4,071.90
	03/13/14 13:18:04	22230	12.49	0.02	0.08	6.29	266.56	105.25	4,058.10
	03/13/14 13:18:34	22260	12.38	0.06	0.08	6.36	266.00	105.25	4,075.31
	03/13/14 13:19:04	22290	12.50	0.05	0.08	6.27	270.99	105.25	4,096.53
	03/13/14 13:19:34	22320	12.35	0.03	0.08	6.38	268.22	104.80	4,086.50
	03/13/14 13:20:04	22350	12.35	0.00	0.07	6.40	267.66	104.35	4,080.66
	03/13/14 13:20:34	22380	12.44	0.02	0.07	6.35	268.77	104.80	4,064.54
	03/13/14 13:21:04	22410	12.52	0.03	0.08	6.25	263.79	104.35	4,053.26
	03/13/14 13:21:34	22440	12.45	0.09	0.08	6.31	267.11	104.35	4,066.20
	03/13/14 13:22:04	22470	12.33	0.03	0.07	6.41	270.43	104.35	4,096.64
	03/13/14 13:22:34	22500	12.35	-0.01	0.07	6.38	268.77	103.90	4,084.68
	03/13/14 13:23:04	22530	12.45	0.02	0.07	6.32	267.66	104.35	4,077.02
	03/13/14 13:23:34	22560	12.52	0.04	0.07	6.27	268.22	104.80	4,065.76
	03/13/14 13:24:04	22590	12.47	0.06	0.07	6.31	264.90	104.80	4,051.67
	03/13/14 13:24:34	22620	12.47	0.03	0.07	6.31	271.54	104.80	4,093.95
	03/13/14 13:25:04	22650	12.23	0.00	0.08	6.48	272.09	104.35	4,113.95
	03/13/14 13:25:34	22680	12.90	0.06	0.08	6.04	272.09	104.80	4,102.71
	03/13/14 13:26:04	22710	12.59	0.27	0.07	6.20	269.33	104.35	4,088.70
	03/13/14 13:26:34	22740	12.73	0.34	0.07	6.17	268.22	104.35	4,085.88
	03/13/14 13:27:04	22770	12.75	0.29	0.08	6.13	266.00	104.35	4,077.64
	03/13/14 13:27:34	22800	12.65	0.24	0.09	6.21	271.54	104.35	4,081.85
	03/13/14 13:28:04	22830	12.77	0.18	0.08	6.14	271.54	104.80	4,107.59
	03/13/14 13:28:34	22860	12.90	0.27	0.07	6.04	272.09	104.80	4,101.95
	03/13/14 13:29:04	22890	12.94	0.32	0.07	6.00	271.54	105.25	4,095.32
	03/13/14 13:29:34	22920	12.83	0.41	0.08	6.07	270.43	104.80	4,081.47
	03/13/14 13:30:04	22950	12.81	0.36	0.08	6.12	267.11	104.80	4,076.85
	03/13/14 13:30:34	22980	12.89	0.34	0.08	6.04	270.99	104.80	4,109.19
A3	03/13/14 13:31:04	23010	12.89	0.31	0.08	6.00	274.58	104.80	4,111.34
	03/13/14 13:31:34	23040	12.79	0.15	0.08	6.13	273.20	105.25	4,109.49
	03/13/14 13:32:04	23070	12.89	0.23	0.08	6.05	267.66	105.25	4,091.63
	03/13/14 13:32:34	23100	12.74	0.41	0.07	6.15	268.22	104.80	4,073.63
	03/13/14 13:33:04	23130	12.76	0.42	0.07	6.07	266.00	104.80	4,082.82
	03/13/14 13:33:34	23160	12.64	0.28	0.07	6.19	273.75	104.35	4,115.90
	03/13/14 13:34:04	23190	12.40	0.30	0.08	6.33	271.54	103.90	4,104.19
	03/13/14 13:34:34	23220	12.52	0.15	0.08	6.30	270.99	103.90	4,082.60
	03/13/14 13:35:04	23250	12.61	0.18	0.07	6.19	269.33	103.90	4,070.21
	03/13/14 13:35:34	23280	12.78	0.22	0.08	6.05	267.66	103.90	4,058.27
	03/13/14 13:36:04	23310	12.80	0.24	0.08	6.00	269.88	103.90	4,094.05
	03/13/14 13:36:34	23340	12.63	0.23	0.08	6.17	271.54	103.90	4,107.28
	03/13/14 13:37:04	23370	12.87	0.26	0.07	5.92	269.33	103.90	4,100.47
	03/13/14 13:37:34	23400	12.69	0.32	0.09	6.15	268.22	103.00	4,081.29
	03/13/14 13:38:04	23430	12.50	0.32	0.07	6.26	266.56	102.55	4,079.72
	03/13/14 13:38:34	23460	12.30	0.23	0.07	6.39	268.22	102.55	4,089.56
	03/13/14 13:39:04	23490	12.39	0.12	0.06	6.34	274.03	102.10	4,126.07
	03/13/14 13:39:34	23520	12.59	0.19	0.08	6.25	275.69	102.55	4,133.75
	03/13/14 13:40:04	23550	12.79	0.22	0.08	6.09	269.33	103.00	4,089.95
	03/13/14 13:40:34	23580	12.95	0.23	0.08	5.98	267.11	103.00	4,077.70
	03/13/14 13:41:04	23610	12.91	0.34	0.07	5.99	266.56	103.00	4,055.34
	03/13/14 13:41:34	23640	13.08	0.43	0.07	5.88	266.56	103.45	4,049.01

John Zink Co, LLC
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	6.4	%
Stack Exhaust Flow (M2)	284,219	SCFH

Weather Data

Barometric Pressure	30.15	in. Hg
Relative Humidity	17	%
Ambient Temperature	66	^{o}F
Specific Humidity	0.002269	lb H_2O / lb air

90-100 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
03/13/14 13:42:04	23670	13.04	0.53	0.07	5.86	268.22	103.45	4,087.45
03/13/14 13:42:34	23700	12.96	0.44	0.08	5.91	268.22	103.00	4,097.17
03/13/14 13:43:04	23730	12.65	0.31	0.07	6.18	268.77	103.00	4,077.63
03/13/14 13:43:34	23760	12.89	0.31	0.08	5.97	264.34	103.00	4,072.89
03/13/14 13:44:04	23790	12.71	0.26	0.07	6.15	264.90	103.00	4,054.79
03/13/14 13:44:34	23820	13.02	0.30	0.07	5.89	263.79	103.00	4,049.76
03/13/14 13:45:04	23850	12.86	0.35	0.07	5.99	269.88	103.45	4,092.71
03/13/14 13:45:34	23880	12.76	0.21	0.07	6.12	268.22	103.45	4,091.79
03/13/14 13:46:04	23910	13.08	0.29	0.07	5.86	268.22	103.90	4,078.48
03/13/14 13:46:34	23940	12.93	0.39	0.07	5.93	266.00	103.90	4,066.59
03/13/14 13:47:04	23970	12.95	0.28	0.07	5.97	266.00	104.35	4,063.98
03/13/14 13:47:34	24000	13.21	0.38	0.07	5.77	264.34	104.35	4,061.34
03/13/14 13:48:04	24030	13.01	0.41	0.07	5.84	274.58	104.35	4,109.16
03/13/14 13:48:34	24060	12.68	0.29	0.07	6.16	275.14	103.90	4,107.51
03/13/14 13:49:04	24090	12.85	0.32	0.08	6.04	272.65	104.35	4,105.40
03/13/14 13:49:34	24120	12.96	0.42	0.08	5.89	269.33	104.35	4,083.90
03/13/14 13:50:04	24150	12.88	0.29	0.07	6.02	270.99	104.35	4,089.20
RAW AVERAGE		**12.60**	**0.05**	**0.08**	**6.19**	**261.31**	**103.76**	**4,013.82**

		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	INST-22-0004	INST-CO-0022	INST-TH-0009	INST-C2-0016	F-13 LINE 2-3-4 PRESS	F-13 Line 1-3 TE	F-13 Line Orifice
		(%)	**(ppmvd)**	**(ppmvw)**	**(%)**	**(in. H_2O)**	**(^{o}F)**	**(SCFH)**
Bias	**Initial Zero**	0.09	0.07	0.03	0.08			
	Final Zero	0.05	0.19	-0.02	0.09			
	Avg. Zero	0.07	0.13	0.01	0.09			
	Initial UpScale	11.97	9.11	3.05	9.44			
	Final UpScale	11.91	9.11	3.05	9.42			
	Avg. UpScale	11.94	9.11	3.05	9.43			
Upscale Cal Gas		12.00	8.98	3.04	9.42			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.67	0.00	0.07	6.15
Corrected Raw Average (ppm/% wet basis)	11.86	0.00	0.07	5.76
Emission Rate (lb/hr)	N/A	0.00	0.00	N/A

John Zink Co, LLC
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	6.1	%
Stack Exhaust Flow (M2)	296,509	SCFH

Weather Data

Barometric Pressure	30.09	in. Hg
Relative Humidity	14	%
Ambient Temperature	71	^{o}F
Specific Humidity	0.002222	lb H_2O / lb air

90-100 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
A1	03/13/14 14:05:04	25050	12.77	0.02	0.08	6.25	231.96	104.80	3,734.01
	03/13/14 14:05:34	25080	12.64	-0.03	0.08	6.29	232.51	105.25	3,746.81
	03/13/14 14:06:04	25110	13.13	0.02	0.08	5.92	235.28	105.25	3,762.81
	03/13/14 14:06:34	25140	12.93	0.05	0.08	6.03	233.06	104.80	3,759.24
	03/13/14 14:07:04	25170	12.72	0.01	0.08	6.19	233.06	104.80	3,750.08
	03/13/14 14:07:34	25200	12.80	0.02	0.08	6.16	232.51	104.80	3,736.40
	03/13/14 14:08:04	25230	13.03	0.02	0.08	5.97	231.40	104.80	3,723.82
	03/13/14 14:08:34	25260	13.15	0.06	0.08	5.85	234.73	104.80	3,753.02
	03/13/14 14:09:04	25290	13.17	0.05	0.08	5.81	235.28	104.80	3,767.95
	03/13/14 14:09:34	25320	12.91	0.02	0.08	5.98	243.31	104.80	3,838.63
	03/13/14 14:10:04	25350	13.09	-0.01	0.09	5.88	242.20	104.80	3,832.18
	03/13/14 14:10:34	25380	12.85	-0.01	0.09	6.04	243.31	105.25	3,845.11
	03/13/14 14:11:04	25410	12.81	-0.04	0.09	6.08	250.50	105.25	3,921.40
	03/13/14 14:11:34	25440	12.75	-0.06	0.09	6.10	257.98	105.25	3,982.42
	03/13/14 14:12:04	25470	12.71	-0.05	0.09	6.08	260.19	105.70	4,005.94
	03/13/14 14:12:34	25500	12.51	-0.09	0.09	6.23	260.74	105.70	4,015.57
	03/13/14 14:13:04	25530	12.58	-0.08	0.07	6.24	269.33	105.70	4,082.41
	03/13/14 14:13:34	25560	12.42	-0.09	0.08	6.34	273.75	106.15	4,111.82
	03/13/14 14:14:04	25590	12.42	-0.10	0.09	6.33	273.20	105.70	4,099.05
	03/13/14 14:14:34	25620	12.22	-0.10	0.08	6.48	275.14	105.70	4,107.55
	03/13/14 14:15:04	25650	12.21	-0.11	0.09	6.46	274.03	105.70	4,105.78
	03/13/14 14:15:34	25680	12.50	-0.10	0.09	6.26	272.09	105.70	4,083.72
	03/13/14 14:16:04	25710	12.53	-0.11	0.08	6.23	267.11	105.70	4,068.92
	03/13/14 14:16:34	25740	12.31	-0.10	0.08	6.38	268.77	106.15	4,065.07
	03/13/14 14:17:04	25770	12.30	-0.11	0.09	6.36	268.22	106.60	4,067.70
	03/13/14 14:17:34	25800	12.28	-0.10	0.09	6.42	270.99	106.60	4,113.61
	03/13/14 14:18:04	25830	12.18	-0.11	0.08	6.43	272.09	106.15	4,108.38
	03/13/14 14:18:34	25860	12.09	-0.09	0.08	6.51	273.20	105.70	4,103.61
	03/13/14 14:19:04	25890	12.33	0.00	0.08	6.40	270.99	105.70	4,085.62
	03/13/14 14:19:34	25920	12.14	0.07	0.08	6.53	266.00	105.25	4,071.87
	03/13/14 14:20:04	25950	12.52	0.01	0.08	6.22	267.66	105.25	4,062.97
	03/13/14 14:20:34	25980	12.45	-0.04	0.07	6.28	268.22	105.25	4,086.68
	03/13/14 14:21:04	26010	12.45	-0.04	0.09	6.26	270.99	105.70	4,102.35
	03/13/14 14:21:34	26040	12.39	-0.06	0.09	6.28	272.65	105.70	4,102.56
	03/13/14 14:22:04	26070	12.24	-0.03	0.08	6.39	267.66	105.25	4,078.09
	03/13/14 14:22:34	26100	12.23	-0.04	0.07	6.44	268.22	105.25	4,080.32
	03/13/14 14:23:04	26130	12.38	-0.04	0.09	6.34	266.00	105.25	4,070.90
	03/13/14 14:23:34	26160	12.42	-0.05	0.08	6.28	271.54	105.25	4,087.22
	03/13/14 14:24:04	26190	12.34	-0.04	0.08	6.35	272.09	105.25	4,100.83
	03/13/14 14:24:34	26220	12.23	-0.05	0.07	6.45	270.43	104.80	4,097.07
	03/13/14 14:25:04	26250	12.19	-0.04	0.08	6.45	268.22	104.35	4,083.18
A2	03/13/14 14:25:34	26280	12.10	-0.08	0.08	6.54	264.90	104.35	4,068.87
	03/13/14 14:26:04	26310	12.23	-0.05	0.08	6.42	267.11	104.35	4,068.53
	03/13/14 14:26:34	26340	12.36	-0.06	0.08	6.32	271.54	104.35	4,092.46
	03/13/14 14:27:04	26370	12.42	-0.05	0.09	6.29	270.99	104.80	4,096.92
	03/13/14 14:27:34	26400	12.40	-0.04	0.08	6.29	268.77	104.80	4,094.83
	03/13/14 14:28:04	26430	12.19	-0.07	0.07	6.41	265.45	104.80	4,068.65
	03/13/14 14:28:34	26460	12.31	-0.05	0.08	6.37	267.66	104.35	4,063.34
	03/13/14 14:29:04	26490	12.36	-0.05	0.08	6.33	263.79	104.35	4,050.13
	03/13/14 14:29:34	26520	12.52	-0.03	0.08	6.20	272.65	104.80	4,105.43
	03/13/14 14:30:04	26550	12.34	-0.05	0.06	6.34	273.75	104.80	4,118.10
	03/13/14 14:30:34	26580	12.33	-0.04	0.06	6.35	272.65	105.25	4,101.54

John Zink Co, LLC
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	6.1	%
Stack Exhaust Flow (M2)	296,509	SCFH

Weather Data

Barometric Pressure	30.09	in. Hg
Relative Humidity	14	%
Ambient Temperature	71	^{o}F
Specific Humidity	0.002222	lb H_2O / lb air

90-100 Load, Run - 4.0X30PF 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	Fuel Temp. ^{o}F	Fuel Flow SCFH
	03/13/14 14:31:04	26610	12.32	-0.04	0.07	6.33	269.33	105.70	4,083.09
	03/13/14 14:31:34	26640	12.39	-0.07	0.07	6.33	269.33	105.70	4,077.59
	03/13/14 14:32:04	26670	12.37	-0.04	0.08	6.30	270.43	105.70	4,073.68
	03/13/14 14:32:34	26700	12.42	-0.06	0.08	6.27	272.09	105.70	4,121.20
	03/13/14 14:33:04	26730	12.35	-0.05	0.09	6.31	271.54	106.15	4,124.41
	03/13/14 14:33:34	26760	12.46	-0.06	0.08	6.28	272.09	105.70	4,098.33
	03/13/14 14:34:04	26790	12.50	-0.02	0.07	6.23	270.99	105.70	4,086.80
	03/13/14 14:34:34	26820	12.27	-0.03	0.07	6.37	269.33	105.70	4,078.68
	03/13/14 14:35:04	26850	12.33	-0.01	0.06	6.31	268.22	105.25	4,084.85
	03/13/14 14:35:34	26880	11.84	-0.05	0.05	6.70	273.20	104.80	4,102.74
	03/13/14 14:36:04	26910	12.03	-0.06	0.06	6.55	272.09	104.35	4,103.50
	03/13/14 14:36:34	26940	12.10	-0.03	0.07	6.58	273.20	104.35	4,097.82
	03/13/14 14:37:04	26970	12.59	0.12	0.06	6.18	270.43	104.35	4,078.01
	03/13/14 14:37:34	27000	12.88	0.20	0.07	5.97	265.45	104.35	4,067.51
	03/13/14 14:38:04	27030	12.80	0.30	0.07	5.96	268.22	104.35	4,079.95
	03/13/14 14:38:34	27060	12.68	0.20	0.06	6.13	272.09	104.35	4,109.71
	03/13/14 14:39:04	27090	12.90	0.29	0.07	5.97	275.14	104.35	4,112.55
	03/13/14 14:39:34	27120	12.76	0.32	0.07	6.02	273.75	104.80	4,097.89
	03/13/14 14:40:04	27150	12.69	0.21	0.07	6.07	266.56	104.35	4,081.35
	03/13/14 14:40:34	27180	12.33	0.18	0.07	6.36	269.88	103.90	4,072.49
	03/13/14 14:41:04	27210	12.85	0.15	0.06	5.99	266.56	103.90	4,067.42
	03/13/14 14:41:34	27240	13.01	0.25	0.07	5.84	273.20	103.90	4,100.11
	03/13/14 14:42:04	27270	13.05	0.30	0.07	5.82	271.54	103.90	4,106.66
	03/13/14 14:42:34	27300	12.77	0.29	0.06	6.06	270.43	103.90	4,093.74
	03/13/14 14:43:04	27330	13.38	0.36	0.08	5.61	266.56	104.35	4,080.09
	03/13/14 14:43:34	27360	12.99	0.46	0.07	5.83	266.00	103.90	4,068.58
	03/13/14 14:44:04	27390	12.94	0.37	0.05	5.93	266.56	103.90	4,075.44
	03/13/14 14:44:34	27420	13.49	0.48	0.07	5.54	273.75	104.35	4,109.27
	03/13/14 14:45:04	27450	13.07	0.53	0.08	5.79	273.20	104.35	4,114.00
A3	03/13/14 14:45:34	27480	12.79	0.34	0.06	6.04	270.99	103.90	4,088.82
	03/13/14 14:46:04	27510	12.95	0.37	0.06	5.90	267.11	103.90	4,071.13
	03/13/14 14:46:34	27540	12.76	0.37	0.06	6.04	267.66	103.45	4,076.76
	03/13/14 14:47:04	27570	13.02	0.34	0.07	5.88	268.77	103.45	4,083.56
	03/13/14 14:47:34	27600	13.06	0.29	0.07	5.82	273.75	104.35	4,109.00
	03/13/14 14:48:04	27630	12.88	0.32	0.06	5.98	271.54	103.90	4,114.92
	03/13/14 14:48:34	27660	12.91	0.34	0.06	5.97	269.33	103.90	4,095.28
	03/13/14 14:49:04	27690	13.29	0.39	0.06	5.67	270.99	103.90	4,085.03
	03/13/14 14:49:34	27720	12.94	0.35	0.07	5.92	267.66	103.90	4,068.59
	03/13/14 14:50:04	27750	12.99	0.29	0.07	5.91	273.75	104.35	4,116.40
	03/13/14 14:50:34	27780	12.95	0.41	0.06	5.88	275.69	104.35	4,135.68
	03/13/14 14:51:04	27810	12.76	0.36	0.07	6.06	277.91	103.90	4,124.49
	03/13/14 14:51:34	27840	12.57	0.24	0.06	6.22	275.14	103.90	4,108.30
	03/13/14 14:52:04	27870	12.71	0.22	0.06	6.11	272.65	103.90	4,103.40
	03/13/14 14:52:34	27900	12.92	0.30	0.06	5.98	268.22	104.35	4,089.80
	03/13/14 14:53:04	27930	12.81	0.36	0.06	5.96	274.58	104.35	4,108.39
	03/13/14 14:53:34	27960	12.75	0.24	0.07	6.09	276.80	104.35	4,120.90
	03/13/14 14:54:04	27990	12.85	0.34	0.07	5.95	275.69	104.35	4,128.57
	03/13/14 14:54:34	28020	12.59	0.31	0.08	6.17	272.09	104.35	4,114.78
	03/13/14 14:55:04	28050	12.80	0.22	0.05	6.07	272.09	104.35	4,086.02
	03/13/14 14:55:34	28080	13.03	0.35	0.06	5.97	266.56	103.90	4,083.06
	03/13/14 14:56:04	28110	12.75	0.34	0.07	6.10	271.54	103.90	4,106.86
	03/13/14 14:56:34	28140	12.46	0.22	0.06	6.33	275.69	103.90	4,113.82

John Zink Co, LLC
ZTOF040X30PF
Tulsa R&D Facility

Unit Data

Meas. Stack Moisture	6.1	%
Stack Exhaust Flow (M2)	296,509	SCFH

Weather Data

Barometric Pressure	30.09	in. Hg
Relative Humidity	14	%
Ambient Temperature	71	^{o}F
Specific Humidity	0.002222	lb H_2O / lb air

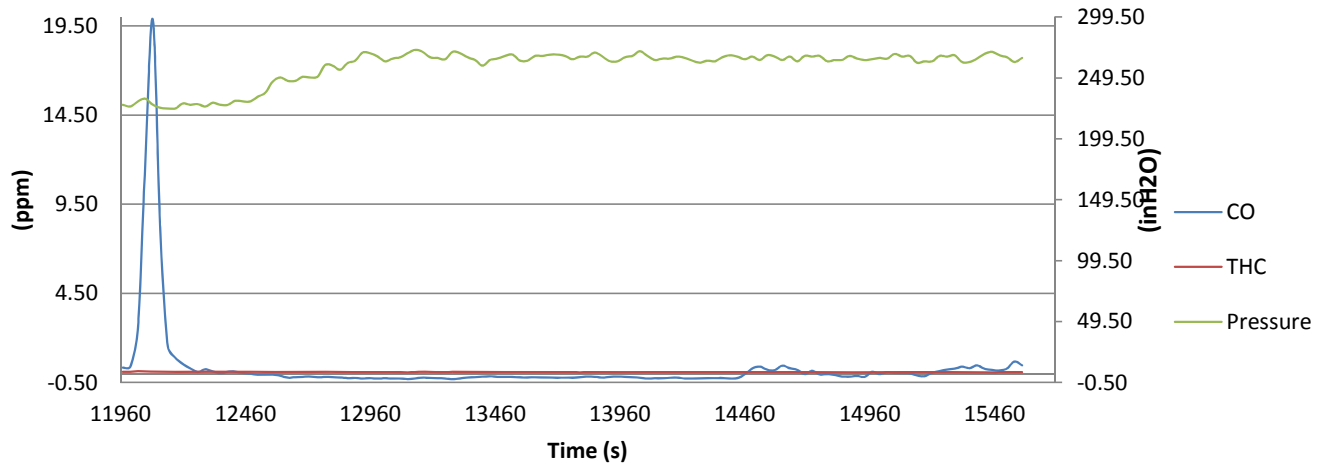
90-100 Load, Run - 4.0X30PF R12

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	CO (ppmvd)	THC (ppmvw)	CO_2 (%)	Fuel Pressure in. H_2O	Fuel Temp. ^{o}F	Fuel Flow SCFH
03/13/14 14:57:04	28170	12.15	0.22	0.06	6.58	270.99	103.45	4,118.04
03/13/14 14:57:34	28200	12.85	0.15	0.06	6.12	273.20	103.90	4,101.14
03/13/14 14:58:04	28230	12.74	0.33	0.05	6.13	269.88	103.45	4,095.46
03/13/14 14:58:34	28260	12.73	0.23	0.06	6.20	266.56	103.45	4,070.17
03/13/14 14:59:04	28290	12.86	0.23	0.08	6.06	270.43	103.45	4,092.68
03/13/14 14:59:34	28320	12.95	0.25	0.10	6.02	275.14	103.90	4,118.37
03/13/14 15:00:04	28350	12.88	0.33	0.09	6.04	272.09	103.90	4,116.48
03/13/14 15:00:34	28380	12.60	0.29	0.08	6.25	269.33	103.45	4,098.00
03/13/14 15:01:04	28410	12.98	0.30	0.07	6.00	269.88	103.90	4,096.19
03/13/14 15:01:34	28440	13.11	0.36	0.07	5.89	268.22	104.35	4,078.16
03/13/14 15:02:04	28470	12.98	0.39	0.06	5.97	269.88	104.35	4,102.90
03/13/14 15:02:34	28500	13.04	0.25	0.07	5.97	272.65	104.80	4,110.98
03/13/14 15:03:04	28530	12.94	0.49	0.07	5.95	272.65	104.35	4,108.17
03/13/14 15:03:34	28560	12.97	0.36	0.06	6.01	270.99	104.35	4,102.95
03/13/14 15:04:04	28590	12.82	0.60	0.06	6.00	267.66	103.90	4,091.81
03/13/14 15:04:34	28620	12.65	0.31	0.06	6.17	267.66	104.35	4,082.37
RAW AVERAGE		**12.64**	**0.12**	**0.07**	**6.16**	**266.72**	**104.69**	**4,057.92**

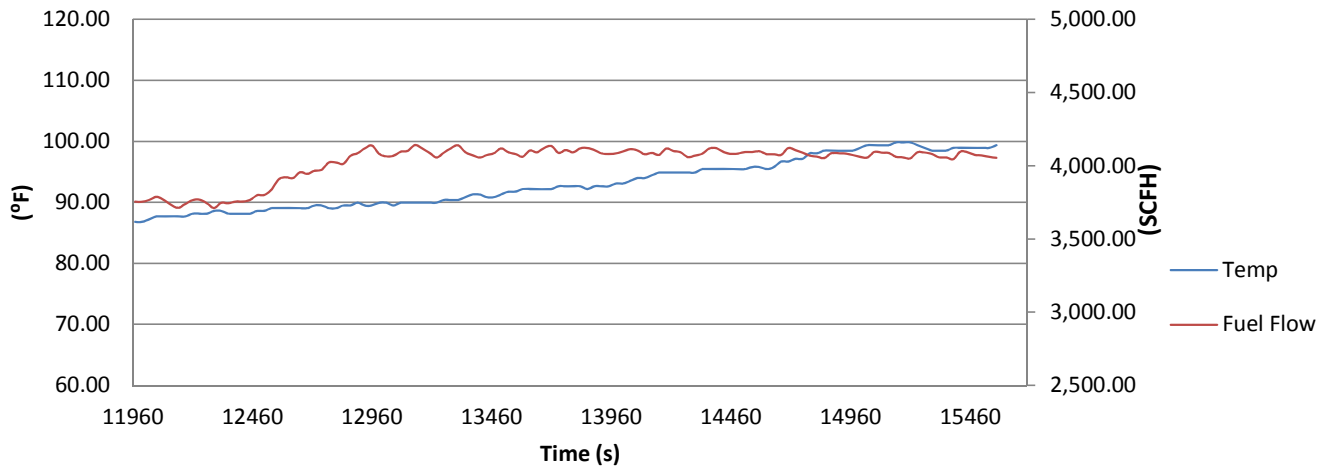
		O_2	CO	THC	CO_2	Press. Trans	Temp. Trans.	F-Flow Trans.
	Serial Number:	INST-22-0004	INST-CO-0022	INST-TH-0009	INST-C2-0016	F-13 LINE 2-3-4 PRESS	F-13 Line 1-3 TE	F-13 Line Orifice
		(%)	(ppmvd)	(ppmvw)	(%)	(in. H_2O)	(^{o}F)	(SCFH)
Bias	**Initial Zero**	0.05	0.19	-0.02	0.09			
	Final Zero	0.07	0.01	-0.03	0.05			
	Avg. Zero	0.06	0.10	-0.03	0.07			
	Initial UpScale	11.91	9.11	3.05	9.42			
	Final UpScale	11.99	9.01	3.04	9.33			
	Avg. UpScale	11.95	9.06	3.05	9.38			
Upscale Cal Gas		12.00	8.98	3.04	9.42			

EMISSIONS DATA	O_2	CO	THC	CO_2
Corrected Raw Average (ppm/% dry basis)	12.70	0.02	0.10	6.16
Corrected Raw Average (ppm/% wet basis)	11.92	0.02	0.09	5.78
Emission Rate (lb/hr)	N/A	0.00	0.00	N/A

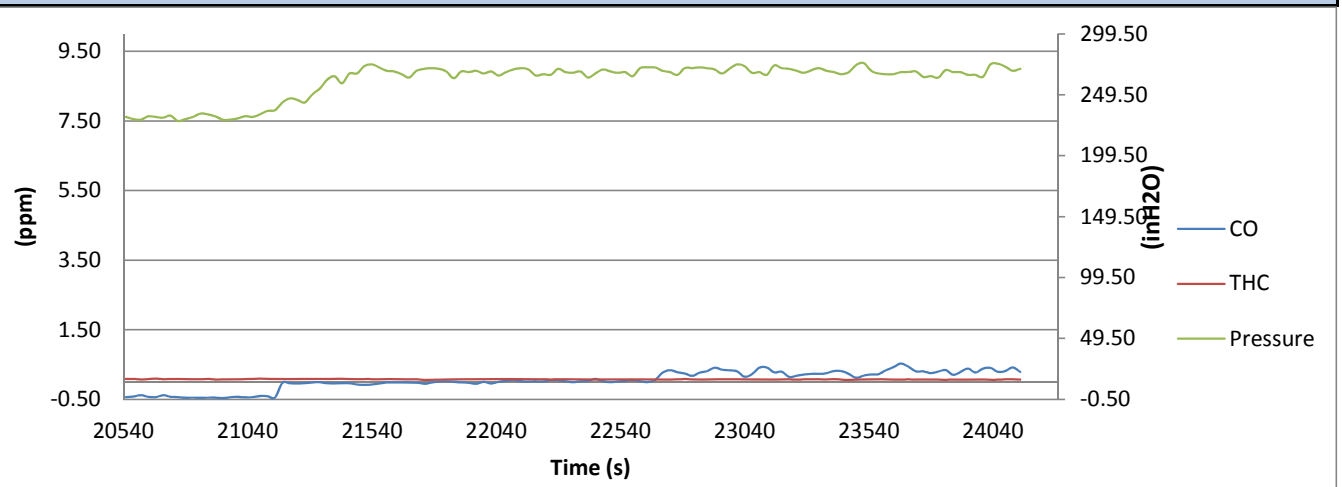
4.0X30PF R10



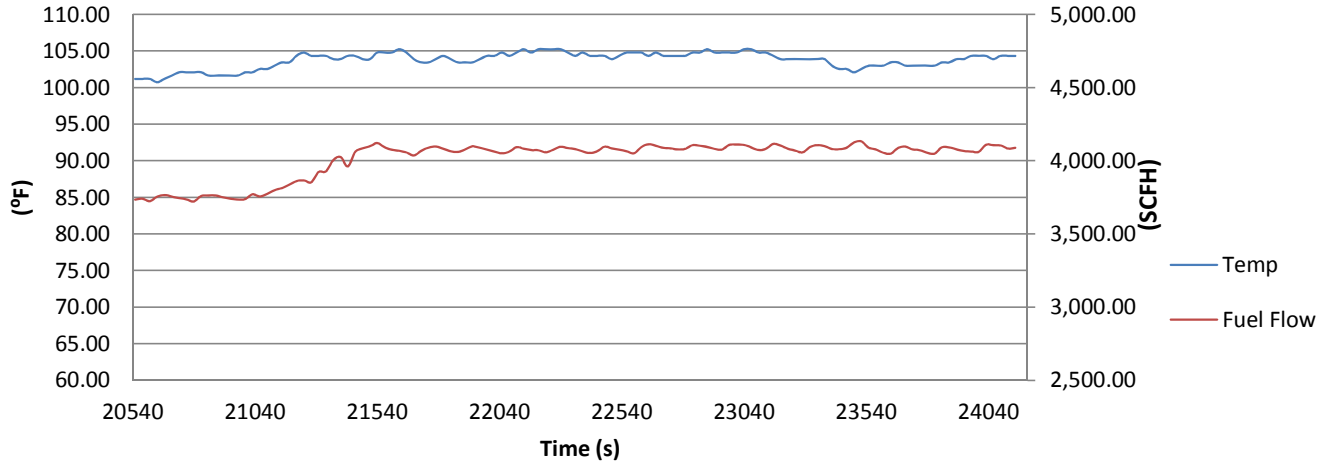
4.0X30PF R10



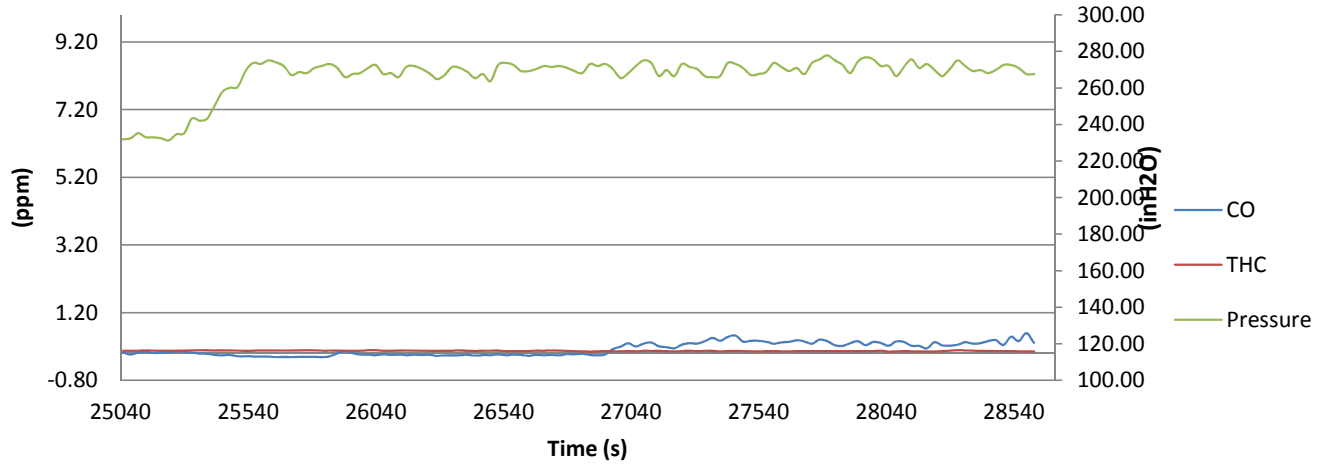
4.0X30PF R11



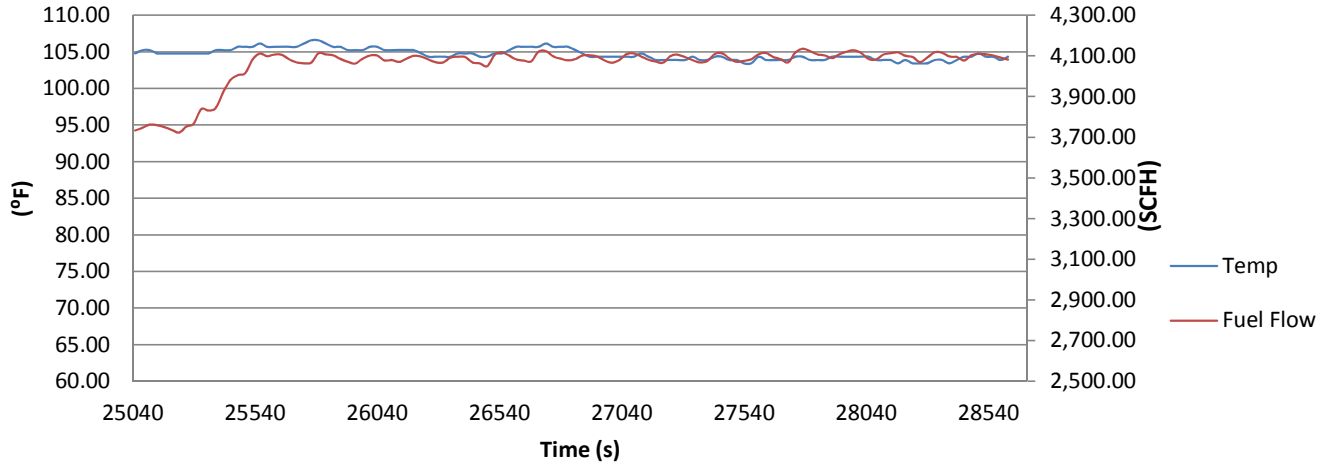
4.0X30PF R11

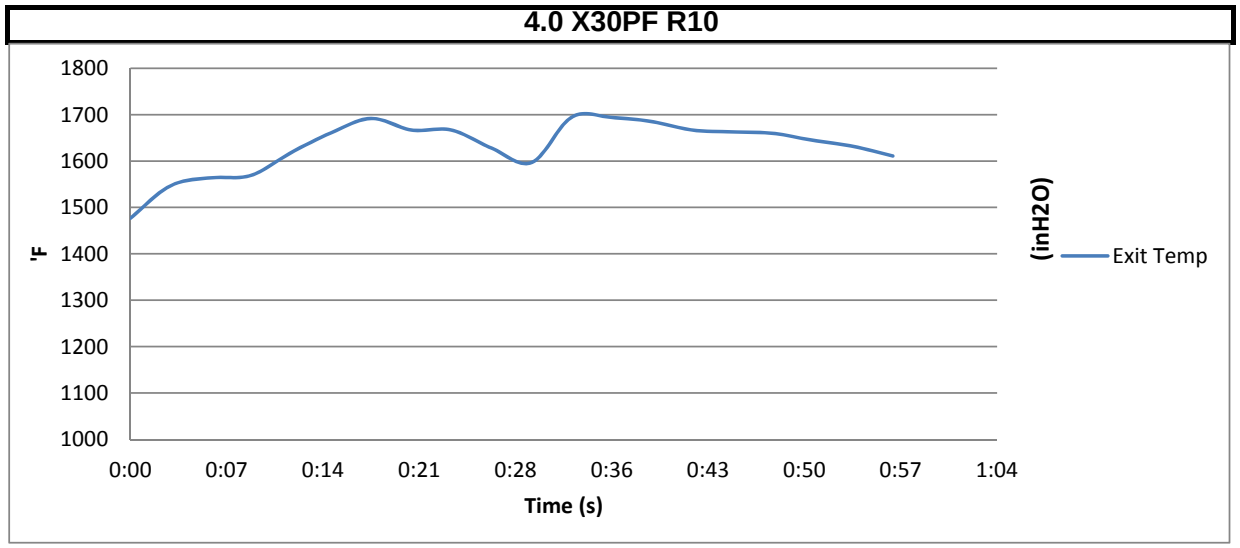


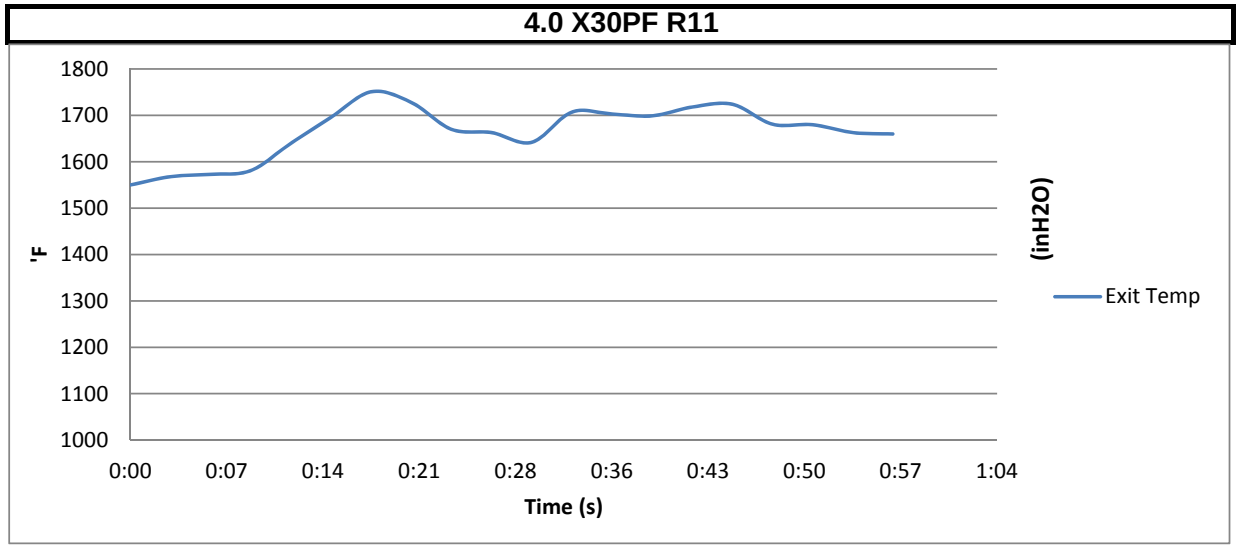
4.0X30PF R12

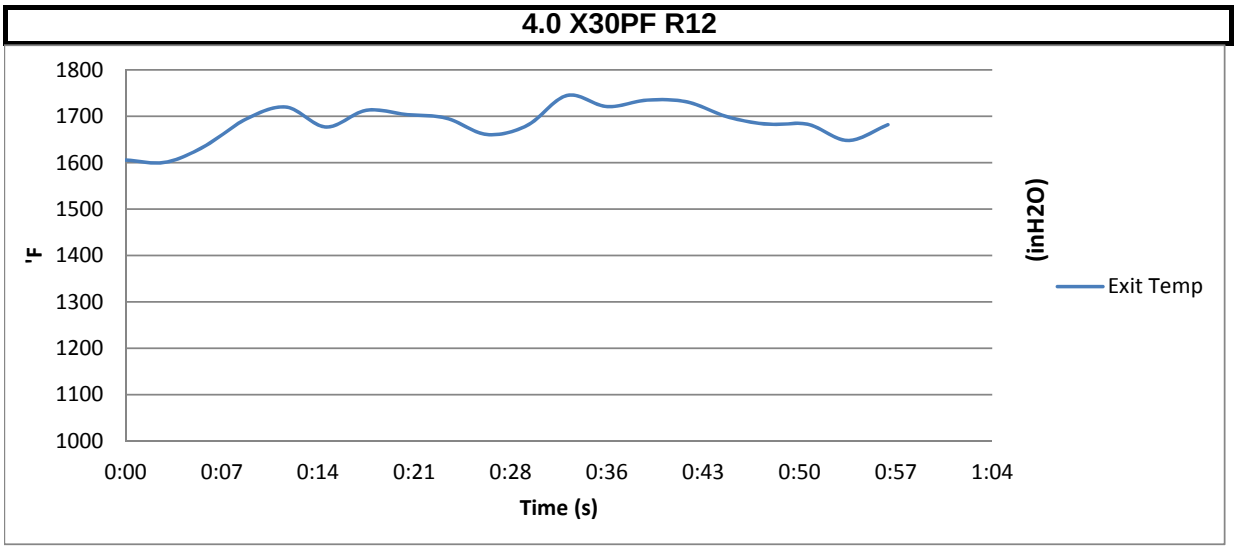


4.0X30PF R12




4.0 X30PF R10
1800
1700
1600
1500
1400
1300
1200
1100
1000
'F
0:00
0:07
0:14
0:21
0:28
0:36
0:43
0:50
0:57
1:04
Time (s)
(inH2O)
Exit Temp


4.0 X30PF R11
1800
1700
1600
1500
1400
1300
1200
1100
1000
'F
0:00
0:07
0:14
0:21
0:28
0:36
0:43
0:50
0:57
1:04
Time (s)
(inH2O)
Exit Temp


4.0 X30PF R12
1800
1700
1600
1500
1400
1300
1200
1100
1000
'F
0:00
0:07
0:14
0:21
0:28
0:36
0:43
0:50
0:57
1:04
Time (s)
(inH2O)
Exit Temp

EMISSION DATA RECORDS

VISUAL EMISSION DATA RECORD

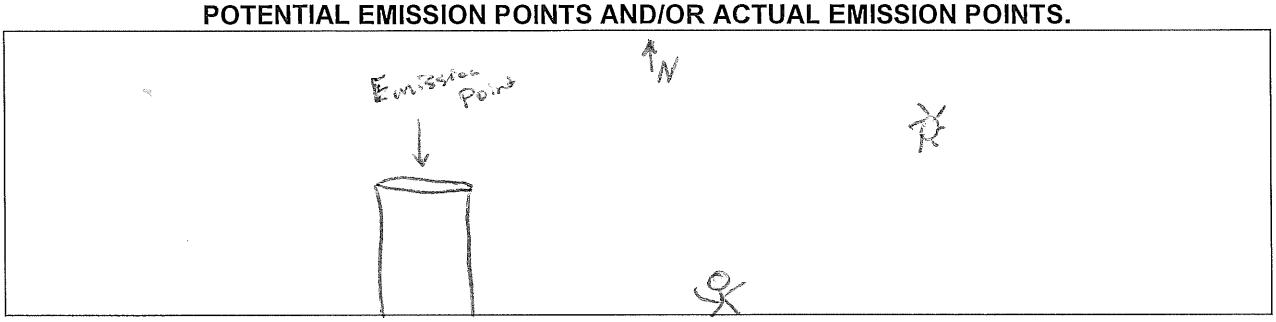
R1

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink Co. LLC. **LOCATION:** John Zink R&D Facility **COMPANY REP:** Aron Katz	**OBSERVER:** Michael Whisenhunt / Zane Tarver **AFFILIATION:** Air Hygiene Inc. **DATE:** 3/11/14
SKY CONDITIONS: CLEAR **PRECIPITATION:** NONE	**WIND DIRECTION:** SE **WIND SPEED:** 5mph B.P. 29.49
INDUSTRY: Manufacturing	**PROCESS UNIT:** 4430 PF

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
13:16	20:00 (2T)	0	
13:36	0	–	
13:36	20:00 (MW)	0	
13:56	0	–	
13:56	20:00 (2T)	0	
14:16	0	–	

Photo @ 14:00

SIGNATURE

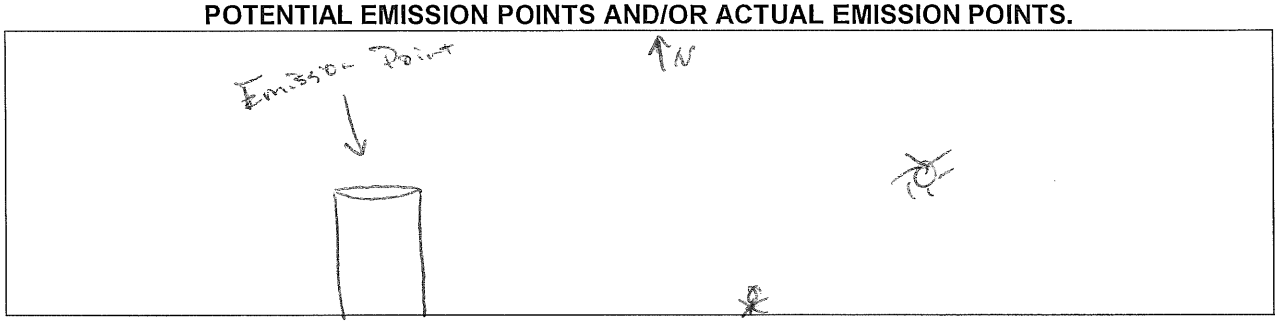
R2

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

AIR HYGIENE

COMPANY: John Zink Co. LLC. **LOCATION:** John Zink R&D Facility **COMPANY REP:** Aron Kate	**OBSERVER:** Michael Whisenhunt Rani Tarver **AFFILIATION:** Air Hygiene Inc. **DATE:** 3-11-14
SKY CONDITIONS: **PRECIPITATION:**	**WIND DIRECTION:** S **WIND SPEED:** 5 mpL BP 29.41
INDUSTRY: Manufacturing	**PROCESS UNIT:** 4X30PF

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
15:27	20 2T	0	
15:47	0	—	
15:47	20 MW	0	
16:07	0	—	
16:07	20 2T	0	
16:27	0	—	

Photo @ 15:54

SIGNATURE

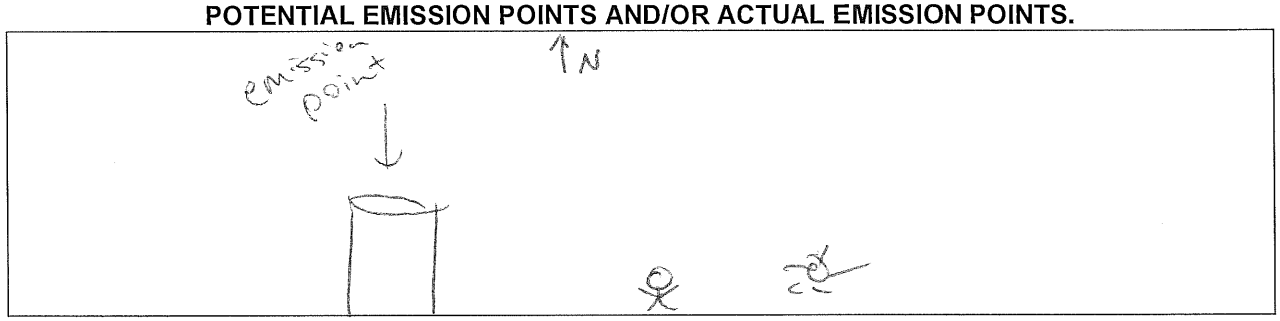
R3

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

AIR HYGIENE

COMPANY: John Zink Co. LLC. **LOCATION:** John Zink R&D Facility **COMPANY REP:**	**OBSERVER:** Michael Whisenhunt / Dave Farrer **AFFILIATION:** Air Hygiene Inc. **DATE:** 3/11/14
SKY CONDITIONS: scattered **PRECIPITATION:** None	**WIND DIRECTION:** S **WIND SPEED:** 5mph 29.40
INDUSTRY: Manufacturing	**PROCESS UNIT:** 4x30PF

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
16:50			
17:10	20 MW	0	
17:10	0	—	
17:30	20 2T	0	
17:30	0	—	
17:50	20	0	
	0 MW	—	

Photo @ : 17:10

SIGNATURE

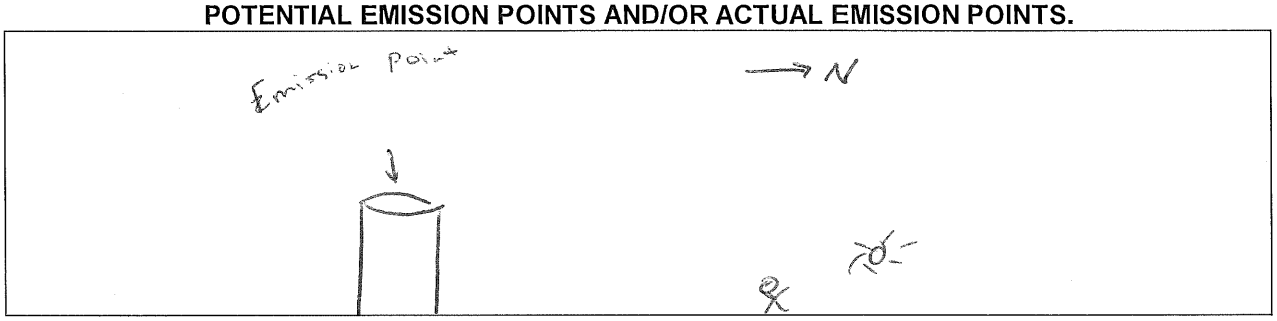
Run 4

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

AIR HYGIENE

COMPANY: John Zink Co. LLC. **LOCATION:** John Zink R&D Facility **COMPANY REP:**	**OBSERVER:** Michael Whisenhunt / Matt Mcbride **AFFILIATION:** Air Hygiene Inc. **DATE:** 3-12-14
SKY CONDITIONS: Clear **PRECIPITATION:** None	**WIND DIRECTION:** N **WIND SPEED:** 4 mpL BP: 30.21
INDUSTRY: Manufacturing	**PROCESS UNIT:** 4x30PF

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
08:34	20 mw	0	
8:54	0	-	
8:54	20 mm	0	
9:14	0	-	
9:14	20 mw	0	
9:34	0	-	

Photo C 9:02

SIGNATURE

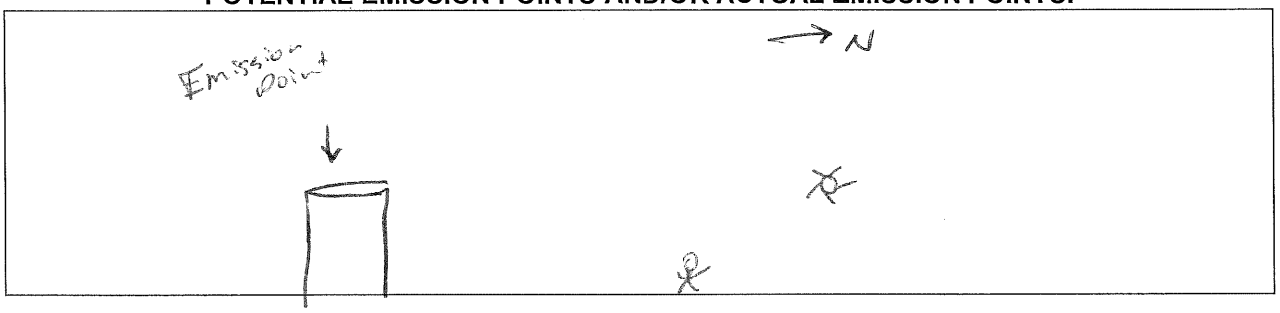
Run 5

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

AIR HYGIENE

COMPANY: John Zink Co. LLC. **LOCATION:** John Zink R&D Facility **COMPANY REP:**	**OBSERVER:** Michael Whisenhunt / Matt McBride **AFFILIATION:** Air Hygiene Inc. **DATE:** 3-12-14
SKY CONDITIONS: Clear **PRECIPITATION:** None	**WIND DIRECTION:** N **WIND SPEED:** 14 mph BP: 30.26
INDUSTRY: Manufacturing	**PROCESS UNIT:** CLX30PF

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
10:00	20 MW	0	
10:20	0	-	
10:20	20 MM	0	
10:40	0	-	
10:40	20 MW	0	
11:00	0	-	

Photo @ 10:45

SIGNATURE

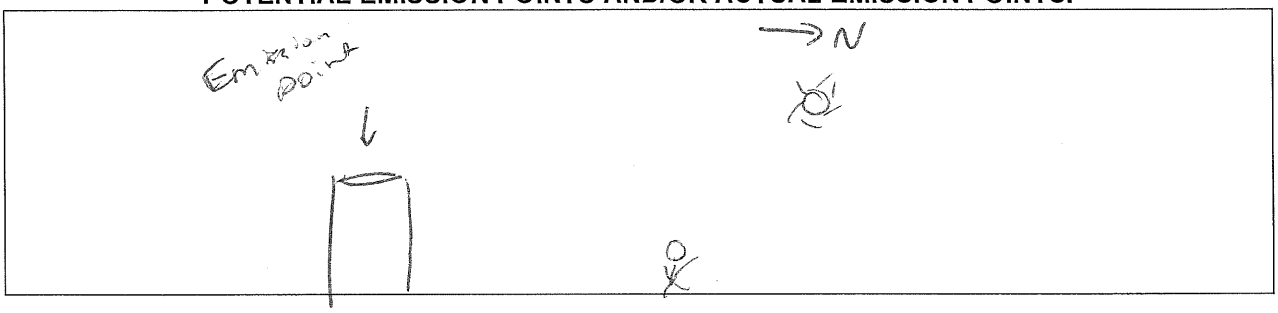
Run 6

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

AIR HYGIENE

COMPANY: John Zink Co. LLC. **LOCATION:** John Zink R&D Facility **COMPANY REP:**	**OBSERVER:** Michael Whisenhunt / Matt Mcbride **AFFILIATION:** Air Hygiene Inc. **DATE:** 3-12-14
SKY CONDITIONS: Clear **PRECIPITATION:** None	**WIND DIRECTION:** N **WIND SPEED:** 12 mph 30.26
INDUSTRY: Manufacturing	**PROCESS UNIT:** 4X30 PF

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
11:22	20 MW	0	
11:42	0	—	
11:42	20 MW	0	
12:02	0	—	
12:02	20 MW	0	
12:22	0	—	

Photo @ 12:02

SIGNATURE

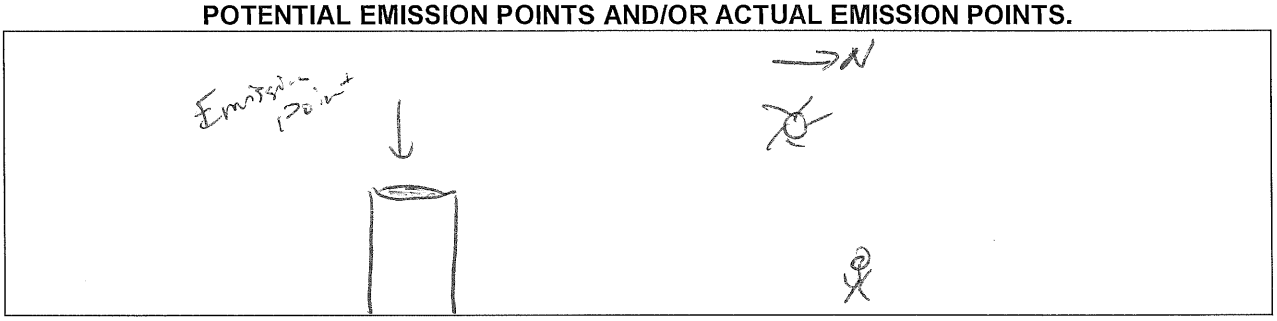
Run 7

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink Co. LLC. **LOCATION:** John Zink R&D Facility **COMPANY REP:**	**OBSERVER:** Michael Whisenhunt / Matt McBride **AFFILIATION:** Air Hygiene Inc. **DATE:** 3-12-14
SKY CONDITIONS: Clear **PRECIPITATION:** None	**WIND DIRECTION:** NW **WIND SPEED:** 6 30.26
INDUSTRY: Manufacturing	**PROCESS UNIT:** 4X30PF

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
13:19	20 MW	0	
13:39	0	–	
13:39	20 MW	0	
13:59	0	–	
13:59	20 MW	0	
14:19	0	–	
14:19			

Photo @ 13:56

SIGNATURE

Matt McBride

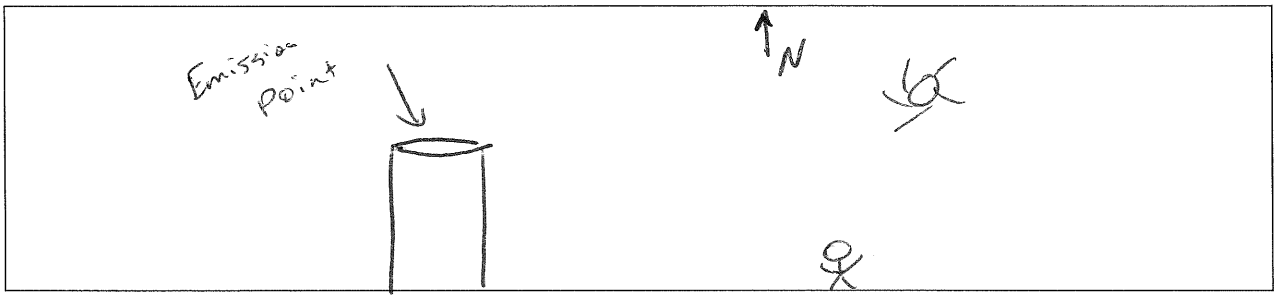
Run 8

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink Co. LLC. **LOCATION:** John Zink R&D Facility **COMPANY REP:**	**OBSERVER:** Michael Whisenhunt/matt mcbride **AFFILIATION:** Air Hygiene Inc. **DATE:** 3-12-14
SKY CONDITIONS: Partly cloudy **PRECIPITATION:** None	**WIND DIRECTION:** N **WIND SPEED:** 9 mph BP: 30.19
INDUSTRY: Manufacturing	**PROCESS UNIT:** 4V30PF

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
16:30	20 MW	0	
16:50	0	-	
16:50	20 MW	0	
17:10	0	-	
17:10	20 MW	0	
17:30	0	-	
17:30			

Photo @ 17:22

SIGNATURE

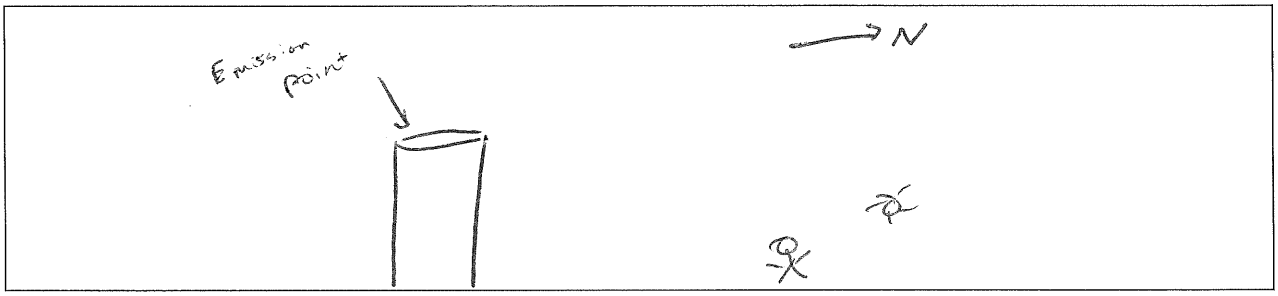
Run 9

METHOD 22
FUGITIVE OR SMOKE EMISSION INSPECTION FORM

AIR HYGIENE

COMPANY: John Zink Co. LLC. **LOCATION:** John Zink R&D Facility **COMPANY REP:**	**OBSERVER:** Michael Whisenhunt / Matt McBride **AFFILIATION:** Air Hygiene Inc. **DATE:** 3-13-14
SKY CONDITIONS: Clear **PRECIPITATION:** None	**WIND DIRECTION:** SW **WIND SPEED:** 1 mph 30.19
INDUSTRY: Manufacturing	**PROCESS UNIT:** 4X30PF

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
8:40	20 mw	0	
900	0	—	
9:00	20 mm	0	
9:20	0	—	
9:20	20 mw	0	
9:40	0	—	

Photo @ 9:05

SIGNATURE

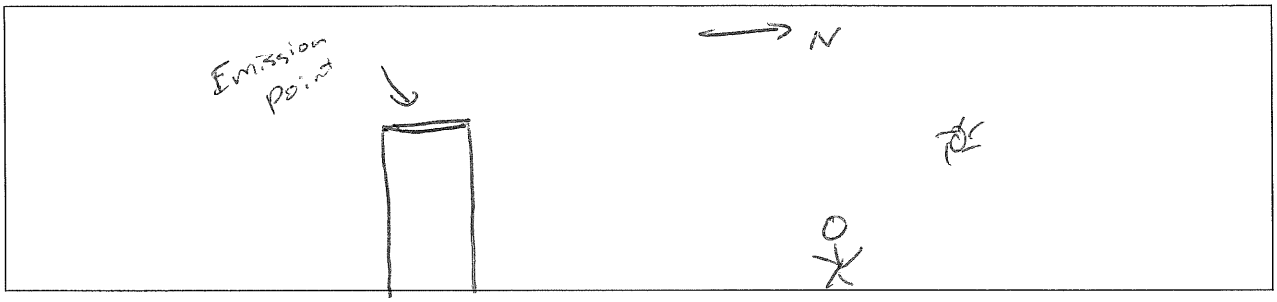
Run 10

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink Co. LLC. **LOCATION:** John Zink R&D Facility **COMPANY REP:**	**OBSERVER:** Michael Whisenhunt / Matt Mcbride **AFFILIATION:** Air Hygiene Inc. **DATE:** 3-13-14
SKY CONDITIONS: Clear **PRECIPITATION:** None	**WIND DIRECTION:** SW **WIND SPEED:** 3 mph BP 30.2
INDUSTRY: Manufacturing	**PROCESS UNIT:** 4470PF

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
10:27	20 MW	0	
10:47	0	–	
10:47	20 MW	0	
11:07	0	–	
11:07	20 MW	0	
11:27	0	–	

Photo @ 11:04

SIGNATURE

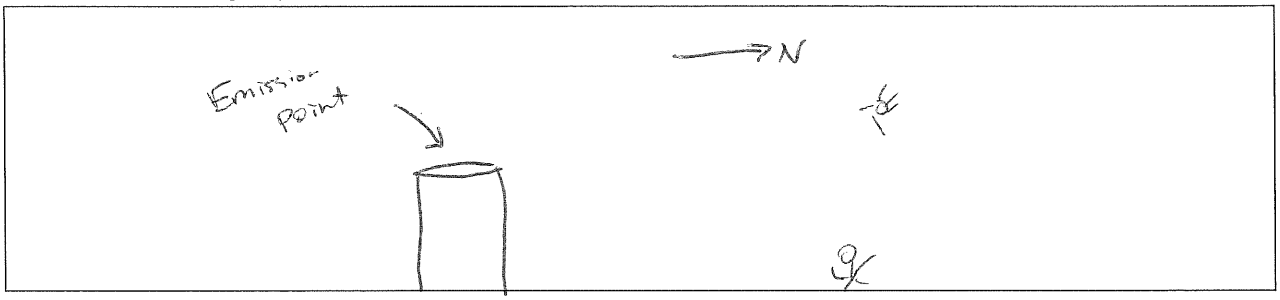
Run 11

AIR HYGIENE

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

COMPANY: John Zink Co. LLC. **LOCATION:** John Zink R&D Facility **COMPANY REP:**	**OBSERVER:** Michael Whisenhunt/Matt Mcbride **AFFILIATION:** Air Hygiene Inc. **DATE:** 3-13-14
SKY CONDITIONS: Clear **PRECIPITATION:** None	**WIND DIRECTION:** W **WIND SPEED:** 8mph BP: 30.15
INDUSTRY: Manufacturing	**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
12:50			
13:10	20 mw	0	
13:10	0	-	
13:30	20 mm	0	
13:30	0	-	
13:50	20 mw	0	
	0	-	

Photo @ 13:12

SIGNATURE

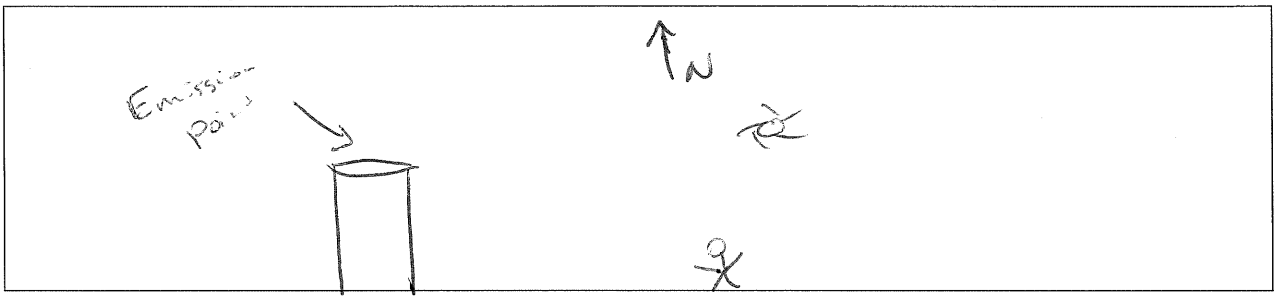
Run 12

METHOD 22
FUGITIVE OR SMOKE EMISSION
INSPECTION FORM

AIR HYGIENE

COMPANY: John Zink Co. LLC. **LOCATION:** John Zink R&D Facility **COMPANY REP:**	**OBSERVER:** Michael Whisenhunt **AFFILIATION:** Air Hygiene Inc. **DATE:** 8-13-14
SKY CONDITIONS: Clear **PRECIPITATION:** None	**WIND DIRECTION:** W **WIND SPEED:** 5 BP: 30.09
INDUSTRY: Manufacturing	**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
14:05	20 MW	0	
14:25	0	—	
14:28	20 MW	0	
14:45	0	—	
14:45	20 MW	0	
15:05	0	—	

Photo @ 14:23

SIGNATURE

APPENDIX C

CALIBRATION GAS CERTIFICATIONS

AIR LIQUIDE

CERTIFICATE OF ANALYSIS

Certification Of Cylinder #: CC113383

Product: Nitrogen **Grade: CEM Zero** **ACID RAIN**

Customer:		**Batch/Lot #:**	170LAP27501C
Date of Certification:	6/19/2012	**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	0.4 PPM
Total Hydrocarbons	<0.1 ppm	<0.1 PPM
Carbon Dioxide	<1 ppm	0.1 PPM
Carbon Monoxide	<0.5 ppm	ND
NOx*	<0.1 ppm	ND
SOx*	<0.1 ppm	ND

**Excludes Argon

*Typical Property

Notes:

EB0008506	ALM006247
CC69343	CC203144
CC92502	BB0000375
CC113383	AAL16580
AAL5944	AAL3879
ALM059777	ALM038890
ALM045085	ALM048480
ALM015296	

Certified By: ERIC DONALDSON

11426 Fairmont Pkwy
281-474-8400
Phone: LaPorte, TX 77571-6000

Air Liquide America, L.P.

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 # : 45457634-001
Folio #:AH073

Customer
AIR HYGIENE

MIKE SCOTT
1800 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: CC75555 **Certification Date:** 27Mar2012 **Exp. Date:** 29Mar2015
Cylinder Pressure*:** 1950 PSIG **Batch No:** LAP0061243

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY**	TRACEABILITY
NITRIC OXIDE	18.4	PPM	+/- 1%	
CARBON MONOXIDE	17.3	PPM	+/- 1%	Direct NIST and VSL
NITROGEN - OXYGEN FREE		BALANCE		
TOTAL OXIDES OF NITROGEN	18.5	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 2629	15Aug2013	KAL003017	19.83	PPM	NITRIC OXIDE
NTRM 2635	01Jun2016	AAL073309	25.54	PPM	CARBON MONOXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
NOX ANALYZER/400-CLD/7M07001	08Mar2012	CHEMI
FTIR//000929060	06Mar2012	FTIR

ANALYZER READINGS

(Z = Zero Gas R = Reference Gas T = Test Gas r = Correlation Coefficient)

First Triad Analysis **Second Triad Analysis** **Calibration Curve**

NITRIC OXIDE

Date: 21Mar2012 Response Unit: PPM
Z1 = 0.00000 R1 = 19.55000 T1 = 18.10000
R2 = 19.55000 Z2 = 0.00000 T2 = 18.10000
Z3 = 0.00000 T3 = 18.15000 R3 = 19.50000
Avg. Concentration: 18.39 PPM

Date: 28Mar2012 Response Unit: PPM
Z1 = 0.00000 R1 = 19.75000 T1 = 18.25000
R2 = 19.60000 Z2 = 0.00000 T2 = 18.12000
Z3 = 0.00000 T3 = 18.12000 R3 = 19.55000
Avg. Concentration: 18.34 PPM

Concentration = A + Bx + Cx2 + Dx3 + Ex4
r = 0.9999927
Constants: A = 0.043392918
B = 1.016595028 C =
D = E =

CARBON MONOXIDE

Date: 20Mar2012 Response Unit: PPM
Z1 = -0.00994 R1 = 25.52915 T1 = 17.22629
R2 = 25.59899 Z2 = -0.00458 T2 = 17.28559
Z3 = -0.00378 T3 = 17.29797 R3 = 25.61528
Avg. Concentration: 17.24 PPM

Date: 27Mar2012 Response Unit: PPM
Z1 = -0.00936 R1 = 25.54199 T1 = 17.30803
R2 = 25.56195 Z2 = 0.00050 T2 = 17.30976
Z3 = 0.01579 T3 = 17.33766 R3 = 25.57913
Avg. Concentration: 17.30 PPM

Concentration = A + Bx + Cx2 + Dx3 + Ex4
r = 9.99995E-1
Constants: A = -9.34270E+2
B = 1.76177E+0 C = 0.00000E+0
D = 0.00000E+0 E = 0.00000E+0

Special Notes: AH073 LIST ITEM AH073 ON CERTS AND TAGS CGA 660; DEW PT. 40 DEG.F.
The expiration date has been extended without re-assay per EPA 600/R23-23/542.

APPROVED BY: RON STITT

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: A32011

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
11426 FAIRMONT PKWY
LA PORTE, TX 77571

P.O. No.:
Document # : 43038000-001
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: CC113655 **Certification Date:** 13Sep2011 **Exp. Date:** 14Sep2014
Cylinder Pressure*:** 2000 PSIG **Batch No:** LAP0048541

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY**	TRACEABILITY
CARBON MONOXIDE	8.98	PPM	+/- 1%	Direct NIST and VSL
NITRIC OXIDE	8.96	PPM	+/- 1%	
NITROGEN - OXYGEN FREE		BALANCE		
TOTAL OXIDES OF NITROGEN	9.08	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 1677	01Jun2012	KAL004005	9.855	PPM	CARBON MONOXIDE
NTRM 2629	15Aug2013	KAL003048	19.83	PPM	NITRIC OXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
FTIR/000929060	01Sep2011	FTIR
NOX ANALYZER/400-CLD/7M07001	29Aug2011	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: 03Sep2011	Response Unit: PPM		Date: 12Sep2011	Response Unit: PPM		Concentration = A + Bx + Cx2 + Dx3 + Ex4	
Z1 = -0.01916	R1 = 9.92474	T1 = 9.06496	Z1 = -0.01019	R1 = 9.90254	T1 = 9.06350	r = 9.99991E-1	
R2 = 9.96444	Z2 = 0.03815	T2 = 9.06560	R2 = 9.95238	Z2 = 0.01288	T2 = 9.08433	Constants:	A = 0.00000E+0
Z3 = 0.05048	T3 = 9.07921	R3 = 10.02259	Z3 = 0.02042	T3 = 9.10360	R3 = 9.97235	B = 9.65718E-1	C = 5.85000E-4
Avg. Concentration:	8.962	PPM	Avg. Concentration:	9.003	PPM	D = 1.00000E-6	E = 0.00000E+0

NITRIC OXIDE

Date: 08Sep2011	Response Unit: PPM		Date: 15Sep2011	Response Unit: PPM		Concentration = A + Bx + Cx2 + Dx3 + Ex4	
Z1 = 0.00000	R1 = 19.60000	T1 = 8.88000	Z1 = 0.00000	R1 = 19.75000	T1 = 8.96000	r = 0.9999932	
R2 = 19.60000	Z2 = 0.00000	T2 = 8.90000	R2 = 19.75000	Z2 = 0.00000	T2 = 8.92000	Constants:	A = -0.04400743
Z3 = 0.00000	T3 = 8.90000	R3 = 19.65000	Z3 = 0.00000	T3 = 8.92000	R3 = 19.65000	B = 1.005705183	C =
Avg. Concentration:	8.966	PPM	Avg. Concentration:	8.960	PPM	D =	E =

Special Notes: WRITTEN CERT AND TAGS TO AIR HYGIENE WITH ITEM NUMBER AH071 CGA 660; DEW PT. 40 DEG.F.
The expiration date has been extended without re-assay per EPA 600/R23-23/542.

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: 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 **Certification Date:** 19Nov2012 **Exp. Date:** 20Nov2020
Cylinder Pressure*:** 1950 PSIG **Batch No:** TRO0069975

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/3400/7506	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 = 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 **Certification Date:** 19Nov2012 **Exp. Date:** 20Nov2020
Cylinder Pressure*:** 2000 PSIG **Batch No:** TR00070121

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

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 # : 48529652-004

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: ALM066309 **Certification Date:** 19Nov2012 **Exp. Date:** 20Nov2020
Cylinder Pressure*:** 2000 PSIG **Batch No:** TR00070134

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ACCURACY**	TRACEABILITY
PROPANE	3.04 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 = 78649.00
R2 = 2563611. Z2 = 0.00000 T2 = 78557.00
Z3 = 0.00000 T3 = 78234.00 R3 = 2564288.
Avg. Concentration: 3.040 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

Guaranteed +/- 1% Accuracy

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 # : 52235725-002
Folio #:AH095

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. EPA/600/R-12/531; May 2012. Do not use this standard if pressure is less than 100 psig.

Cylinder Number: EB0000359 **Certification Date:** 30Sep2013 **Exp. Date:** 01Oct2021
Cylinder Pressure: 2000 PSIG **Batch No:** TRO0093578

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ACCURACY (ABSOLUTE / RELATIVE)
OXYGEN	21.1 %	0.08 % / 0.4 %
CARBON DIOXIDE	18.5 %	0.2 % / 0.8 %
NITROGEN	BALANCE	

TRACEABILITY

REFERENCE STANDARD

COMPONENT	CONCENTRATION	UNCERTAINTY	CYLINDER	TYPE/SRM SAMPLE	EXP. DATE
OXYGEN	23.2000 %	0.0900 %	K024582	NTRM 2350	04Jan2018
CARBON DIOXIDE	23.0400 %	0.1200 %	K026052	NTRM 2300	17Aug2016

ANALYTICAL METHOD

1st Analysis: 30Sep2013

COMPONENT	INSTRUMENT	ANALYTICAL/PRINCIPLE	CALIBRATED	CONCENTRATION
OXYGEN	CAI/110P/V03018	PARAMAGNETIC	30Sep2013	21.10 %
CARBON DIOXIDE	PIR/2000/609015	NDIR	09Sep2013	18.50 %

Special Notes: AH095 LIST ITEM AH095 ON CERTS AND TAGS

APPROVED BY: _____
JEFF CROTEAU

AIR LIQUIDE Air Liquide America Specialty Gases LLC Scott™

RATA CLASS

Guaranteed +/- 1% Accuracy

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 # : 52235725-001
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. EPA/600/R-12/531; May 2012. Do not use this standard if pressure is less than 100 psig.

Cylinder Number: ALM015644
Cylinder Pressure: 2000 PSIG
Certification Date: 30Sep2013
Exp. Date: 01Oct2021
Batch No: TRO0093273

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ACCURACY (ABSOLUTE / RELATIVE)
OXYGEN	12.0 %	0.05 % / 0.4 %
CARBON DIOXIDE	9.42 %	0.1 % / 1.0 %
NITROGEN	BALANCE	

TRACEABILITY

REFERENCE STANDARD

COMPONENT	CONCENTRATION	UNCERTAINTY	CYLINDER	TYPE/SRM SAMPLE	EXP. DATE
OXYGEN	23.2000 %	0.0900 %	K024582	NTRM 2350	04Jan2018
CARBON DIOXIDE	23.0400 %	0.1200 %	K026052	NTRM 2300	17Aug2016

ANALYTICAL METHOD

1st Analysis: 30Sep2013

COMPONENT	INSTRUMENT	ANALYTICAL/PRINCIPLE	CALIBRATED	CONCENTRATION
OXYGEN	CAI/110P/V03018	PARAMAGNETIC	30Sep2013	12.00 %
CARBON DIOXIDE	PIR/2000/609015	NDIR	09Sep2013	9.420 %

Special Notes: AH094 LIST ITEM AH094 ON CERTS AND TAGS

APPROVED BY: _____
JEFF CROTEAU

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 were 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: March 10-13, 2014
Company: John Zink, Co LLC
Location: Tulsa, Oklahoma
Techs: MSL, ML,MM

Sample System Leak Check

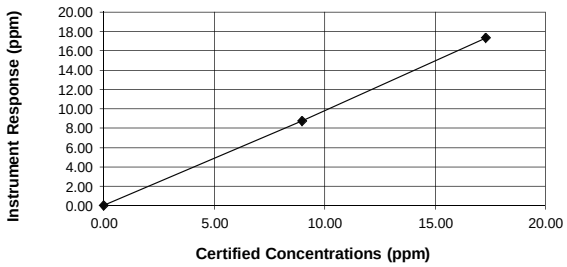
Date	Sample System	Leak Rate (l/min)
March 10-13, 2014	1	0

jz-14-tulsa.ok-comp#1-ZTOF04X30PF-rpt

Calibration Date: March 11, 2014
Client: John Zink Co, LLC

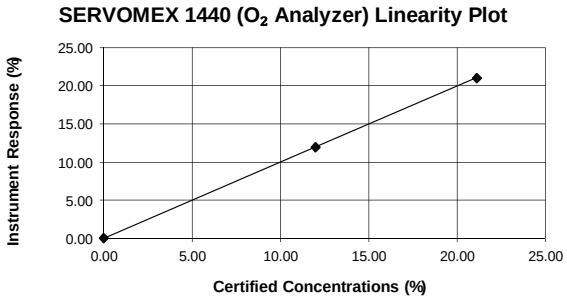
CO Span (ppm) = 17.30

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 (%)
8.98	8.77	-1.21	0.21	YES (%)
17.30	17.32	0.12	0.02	YES (%)
Linearity = 1.001				



O_2 Span (%) = 21.10

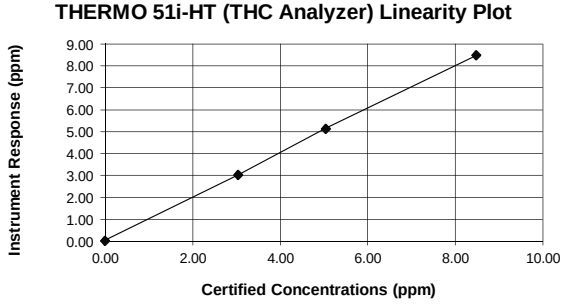
SERVOMEX 1440 (O_2 Analyzer)				
Certified Concentration (%)	Instrument Response (%)	Calibration Error (%)	Absolute Conc. (%)	Pass or Fail (±2%, ≤0.5%)
0.00	0.04	0.19	0.04	YES (%)
12.00	12.01	0.05	0.01	YES (%)
21.10	21.07	-0.14	0.03	YES (%)
Linearity = 1.003				



THC Range (ppm) = 10

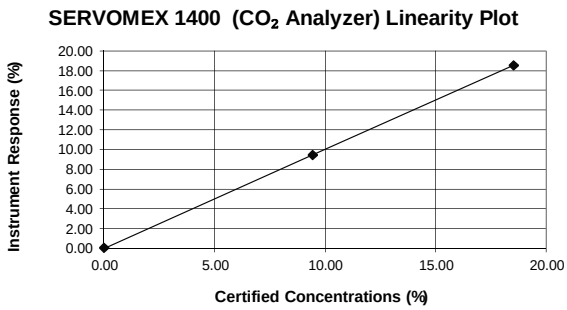
THERMO 51i-HT (THC Analyzer)				
Certified Concentration (ppm)	Instrument Response (ppm)	Calibration Error (%)	Estimated Point (ppm)	Pass or Fail (±2,5%)[1]
0.00	0.04	0.40	N/A	YES
3.04	3.03	-1.29	3.07	YES
5.04	5.15	1.74	5.06	YES
8.48	8.49	0.10	N/A	YES
Linearity = 0.999				

[1]-zero/high based on 2% of span,low/mid based on 5% of concentration



CO_2 Span (%) = 18.50

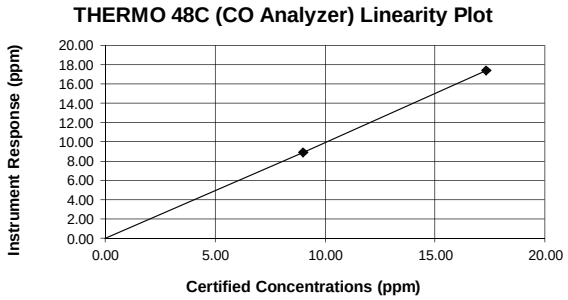
SERVOMEX 1400 (CO_2 Analyzer)				
Certified Concentration (%)	Instrument Response (%)	Calibration Error (%)	Absolute Conc. (%)	Pass or Fail (±2%, ≤0.5%)
0.00	0.01	0.05	0.01	YES (%)
9.42	9.43	0.05	0.01	YES (%)
18.50	18.52	0.11	0.02	YES (%)
Linearity = 0.999				



Calibration Date: March 12, 2014
Client: John Zink Co, LLC

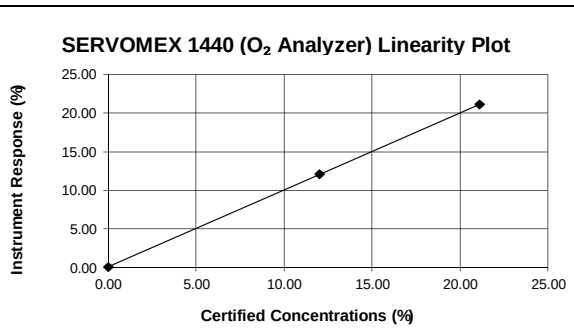
CO Span (ppm) = 17.30

THERMO 48C (CO Analyzer)				
Certified Concentration (ppm)	Instrument Response (ppm)	Calibration Error (%)	Absolute Conc. (ppm)	Pass or Fail (±2%, ≤0.5ppm)
0.00	-0.01	-0.06	0.01	YES (%)
8.98	8.90	-0.46	0.08	YES (%)
17.30	17.37	0.40	0.07	YES (%)
Linearity = 0.996				



O2 Span (%) = 21.10

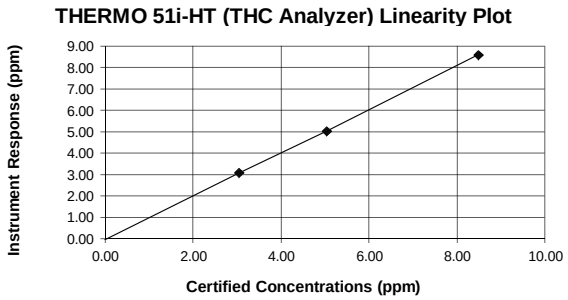
SERVOMEX 1440 (O_2 Analyzer)				
Certified Concentration (%)	Instrument Response (%)	Calibration Error (%)	Absolute Conc. (%)	Pass or Fail (±2%, ≤0.5%)
0.00	0.08	0.38	0.08	YES (%)
12.00	12.06	0.28	0.06	YES (%)
21.10	21.13	0.14	0.03	YES (%)
Linearity = 1.002				



THC Range (ppm) = 10

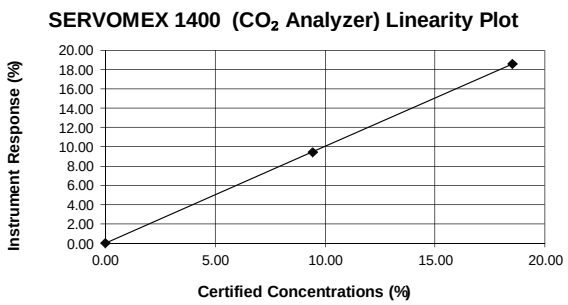
THERMO 51i-HT (THC Analyzer)				
Certified Concentration (ppm)	Instrument Response (ppm)	Calibration Error (%)	Estimated Point (ppm)	Pass or Fail (±2,5%)[1]
0.00	-0.03	-0.30	N/A	YES
3.04	3.07	0.56	3.05	YES
5.04	5.02	-1.22	5.08	YES
8.48	8.57	0.90	N/A	YES
Linearity = 0.987				

[1]-zero/high based on 2% of span,low/mid based on 5% of concentration



CO2 Span (%) = 18.50

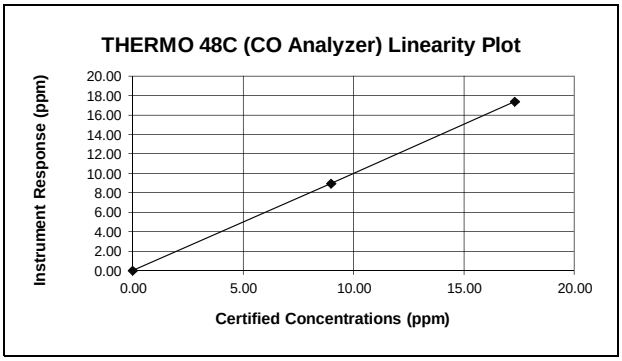
SERVOMEX 1400 (CO_2 Analyzer)				
Certified Concentration (%)	Instrument Response (%)	Calibration Error (%)	Absolute Conc. (%)	Pass or Fail (±2%, ≤0.5%)
0.00	0.00	0.00	0.00	YES (%)
9.42	9.45	0.16	0.03	YES (%)
18.50	18.57	0.38	0.07	YES (%)
Linearity = 0.996				



Calibration Date: March 13, 2014
Client: John Zink Co, LLC

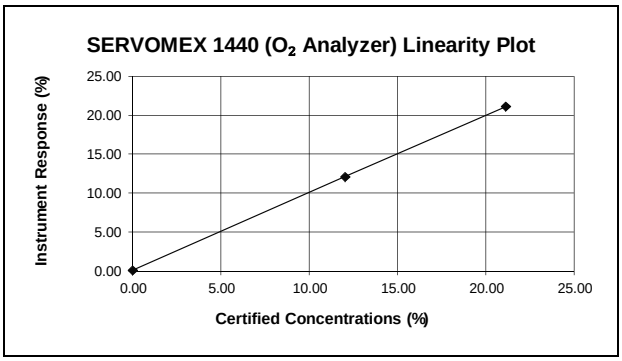
CO Span (ppm) = 17.30

THERMO 48C (CO Analyzer)				
Certified Concentration (ppm)	Instrument Response (ppm)	Calibration Error (%)	Absolute Conc. (ppm)	Pass or Fail (±2%, ≤0.5ppm)
0.00	0.01	0.06	0.01	YES (%)
8.98	8.95	-0.17	0.03	YES (%)
17.30	17.36	0.35	0.06	YES (%)
Linearity = 0.997				



O2 Span (%) = 21.10

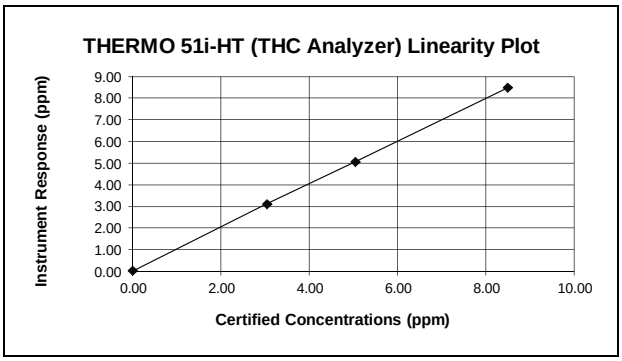
SERVOMEX 1440 (O_2 Analyzer)				
Certified Concentration (%)	Instrument Response (%)	Calibration Error (%)	Absolute Conc. (%)	Pass or Fail (±2%, ≤0.5%)
0.00	0.09	0.43	0.09	YES (%)
12.00	12.09	0.43	0.09	YES (%)
21.10	21.09	-0.05	0.01	YES (%)
Linearity = 1.005				



THC Range (ppm) = 10

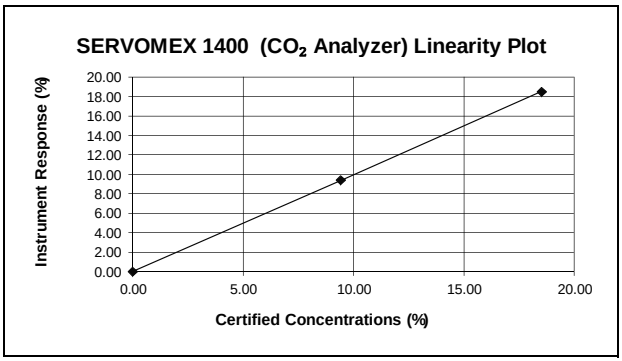
THERMO 51i-HT (THC Analyzer)				
Certified Concentration (ppm)	Instrument Response (ppm)	Calibration Error (%)	Estimated Point (ppm)	Pass or Fail (±2,5%)[1]
0.00	0.03	0.30	N/A	YES
3.04	3.11	1.67	3.06	YES
5.04	5.07	0.35	5.05	YES
8.48	8.48	0.00	N/A	YES
Linearity = 1.013				

[1]-zero/high based on 2% of span,low/mid based on 5% of concentration



CO2 Span (%) = 18.50

SERVOMEX 1400 (CO_2 Analyzer)				
Certified Concentration (%)	Instrument Response (%)	Calibration Error (%)	Absolute Conc. (%)	Pass or Fail (±2%, ≤0.5%)
0.00	0.01	0.05	0.01	YES (%)
9.42	9.39	-0.16	0.03	YES (%)
18.50	18.47	-0.16	0.03	YES (%)
Linearity = 1.002				



DRIFT AND BIAS CHECK				
0-30-0 Load, Run - 4.0X30PF R1	O_2	CO	THC	CO_2
Raw Average	12.87	1.04	0.11	5.91
Corrected Average	12.80	1.06	0.12	5.94
Initial Zero	0.07	0.01	-0.01	0.04
Final Zero	0.01	0.05	0.01	0.01
Avg. Zero	0.04	0.03	0.00	0.03
Initial UpScale	12.11	8.78	3.14	9.40
Final UpScale	12.02	8.46	3.00	9.31
Avg. UpScale	12.07	8.62	3.07	9.36
Sys Resp (Zero)	0.04	0.03	0.04	0.01
Sys Resp (Upscale)	12.01	8.77	3.03	9.43
Upscale Cal Gas	12.00	8.98	3.04	9.42
Initial Zero Bias	0.14%	-0.12%	-0.50%	0.16%
Final Zero Bias	-0.14%	0.12%	-0.30%	0.00%
Zero Drift	0.28%	0.23%	0.20%	0.16%
Initial Upscale Bias	0.47%	0.06%	1.10%	-0.16%
Final Upscale Bias	0.05%	-1.79%	-0.30%	-0.65%
Upscale Drift	0.43%	1.85%	1.40%	0.49%
Alternative Specification Abs Diff: Initial Zero	0.03	0.02	--	0.03
Alternative Specification Abs Diff: Final Zero	0.03	0.02	--	0.00
Alternative Specification Abs Diff: Initial Upscale	0.10	0.01	--	0.03
Alternative Specification Abs Diff: Final Upscale	0.01	0.31	--	0.12
Calibration Span	21.10	17.30	10.00	18.50
3% of Cal. Span (drift)	0.63	0.52	0.30	0.56
5% of Cal. Span (bias)	1.06	0.87	0.50	0.93

DRIFT AND BIAS CHECK				
0-30-0 Load, Run - 4.0X30PF R2	O_2	CO	THC	CO_2
Raw Average	12.88	0.58	0.08	6.01
Corrected Average	12.87	0.50	0.06	6.09
Initial Zero	0.01	0.05	0.01	0.01
Final Zero	0.01	0.14	0.02	0.04
Avg. Zero	0.01	0.10	0.02	0.03
Initial UpScale	12.02	8.46	3.00	9.31
Final UpScale	12.00	8.88	2.94	9.23
Avg. UpScale	12.01	8.67	2.97	9.27
Sys Resp (Zero)	0.04	0.03	0.04	0.01
Sys Resp (Upscale)	12.01	8.77	3.03	9.43
Upscale Cal Gas	12.00	8.98	3.04	9.42
Initial Zero Bias	-0.14%	0.12%	-0.30%	0.00%
Final Zero Bias	-0.14%	0.64%	-0.20%	0.16%
Zero Drift	0.00%	0.52%	0.10%	0.16%
Initial Upscale Bias	0.05%	-1.79%	-0.30%	-0.65%
Final Upscale Bias	-0.05%	0.64%	-0.90%	-1.08%
Upscale Drift	0.09%	2.43%	0.60%	0.43%
Alternative Specification Abs Diff: Initial Zero	0.03	0.02	--	0.00
Alternative Specification Abs Diff: Final Zero	0.03	0.11	--	0.03
Alternative Specification Abs Diff: Initial Upscale	0.01	0.31	--	0.12
Alternative Specification Abs Diff: Final Upscale	0.01	0.11	--	0.20
Calibration Span	21.10	17.30	10.00	18.50
3% of Cal. Span (drift)	0.63	0.52	0.30	0.56
5% of Cal. Span (bias)	1.06	0.87	0.50	0.93

DRIFT AND BIAS CHECK				
0-30-0 Load, Run - 4.0X30PF R3	O_2	CO	THC	CO_2
Raw Average	12.99	0.86	0.09	5.83
Corrected Average	12.98	0.76	0.06	5.93
Initial Zero	0.01	0.14	0.02	0.04
Final Zero	0.01	0.13	0.04	0.03
Avg. Zero	0.01	0.14	0.03	0.04
Initial UpScale	12.00	8.88	2.94	9.23
Final UpScale	12.01	8.49	2.96	9.28
Avg. UpScale	12.01	8.69	2.95	9.26
Sys Resp (Zero)	0.04	0.03	0.04	0.01
Sys Resp (Upscale)	12.01	8.77	3.03	9.43
Upscale Cal Gas	12.00	8.98	3.04	9.42
Initial Zero Bias	-0.14%	0.64%	-0.20%	0.16%
Final Zero Bias	-0.14%	0.58%	0.00%	0.11%
Zero Drift	0.00%	0.06%	0.20%	0.05%
Initial Upscale Bias	-0.05%	0.64%	-0.90%	-1.08%
Final Upscale Bias	0.00%	-1.62%	-0.70%	-0.81%
Upscale Drift	0.05%	2.25%	0.20%	0.27%
Alternative Specification Abs Diff: Initial Zero	0.03	0.11	--	0.03
Alternative Specification Abs Diff: Final Zero	0.03	0.10	--	0.02
Alternative Specification Abs Diff: Initial Upscale	0.01	0.11	--	0.20
Alternative Specification Abs Diff: Final Upscale	0.00	0.28	--	0.15
Calibration Span	21.10	17.30	10.00	18.50
3% of Cal. Span (drift)	0.63	0.52	0.30	0.56
5% of Cal. Span (bias)	1.06	0.87	0.50	0.93

DRIFT AND BIAS CHECK				
30-70-30 Load, Run - 4.0X30PF R4	O_2	CO	THC	CO_2
Raw Average	12.52	1.30	0.13	6.00
Corrected Average	12.51	1.17	0.15	6.03
Initial Zero	0.12	0.18	-0.03	0.01
Final Zero	0.12	0.10	-0.03	0.04
Avg. Zero	0.12	0.14	-0.03	0.03
Initial UpScale	12.01	9.00	3.02	9.33
Final UpScale	12.02	9.03	3.07	9.38
Avg. UpScale	12.02	9.02	3.05	9.36
Sys Resp (Zero)	0.08	-0.01	-0.03	0.00
Sys Resp (Upscale)	12.06	8.90	3.07	9.45
Upscale Cal Gas	12.00	8.98	3.04	9.42
Initial Zero Bias	0.19%	1.10%	0.00%	0.05%
Final Zero Bias	0.19%	0.64%	0.00%	0.22%
Zero Drift	0.00%	0.46%	0.00%	0.16%
Initial Upscale Bias	-0.24%	0.58%	-0.50%	-0.65%
Final Upscale Bias	-0.19%	0.75%	0.00%	-0.38%
Upscale Drift	0.05%	0.17%	0.50%	0.27%
Alternative Specification Abs Diff: Initial Zero	0.04	0.19	--	0.01
Alternative Specification Abs Diff: Final Zero	0.04	0.11	--	0.04
Alternative Specification Abs Diff: Initial Upscale	0.05	0.10	--	0.12
Alternative Specification Abs Diff: Final Upscale	0.04	0.13	--	0.07
Calibration Span	21.10	17.30	10.00	18.50
3% of Cal. Span (drift)	0.63	0.52	0.30	0.56
5% of Cal. Span (bias)	1.06	0.87	0.50	0.93

DRIFT AND BIAS CHECK				
30-70-30 Load, Run - 4.0X30PF R5	O_2	CO	THC	CO_2
Raw Average	12.92	1.13	0.04	6.08
Corrected Average	12.92	1.01	0.07	6.10
Initial Zero	0.12	0.10	-0.03	0.04
Final Zero	0.10	0.16	-0.02	0.05
Avg. Zero	0.11	0.13	-0.03	0.05
Initial UpScale	12.02	9.03	3.07	9.38
Final UpScale	12.00	8.98	3.06	9.34
Avg. UpScale	12.01	9.01	3.07	9.36
Sys Resp (Zero)	0.08	-0.01	-0.03	0.00
Sys Resp (Upscale)	12.06	8.90	3.07	9.45
Upscale Cal Gas	12.00	8.98	3.04	9.42
Initial Zero Bias	0.19%	0.64%	0.00%	0.22%
Final Zero Bias	0.09%	0.98%	0.10%	0.27%
Zero Drift	0.09%	0.35%	0.10%	0.05%
Initial Upscale Bias	-0.19%	0.75%	0.00%	-0.38%
Final Upscale Bias	-0.28%	0.46%	-0.10%	-0.59%
Upscale Drift	0.09%	0.29%	0.10%	0.22%
Alternative Specification Abs Diff: Initial Zero	0.04	0.11	--	0.04
Alternative Specification Abs Diff: Final Zero	0.02	0.17	--	0.05
Alternative Specification Abs Diff: Initial Upscale	0.04	0.13	--	0.07
Alternative Specification Abs Diff: Final Upscale	0.06	0.08	--	0.11
Calibration Span	21.10	17.30	10.00	18.50
3% of Cal. Span (drift)	0.63	0.52	0.30	0.56
5% of Cal. Span (bias)	1.06	0.87	0.50	0.93

DRIFT AND BIAS CHECK				
30-70-30 Load, Run - 4.0X30PF R6	O_2	CO	THC	CO_2
Raw Average	12.95	1.30	0.01	5.99
Corrected Average	12.96	1.20	0.06	5.99
Initial Zero	0.10	0.16	-0.02	0.05
Final Zero	0.09	0.08	-0.07	0.06
Avg. Zero	0.10	0.12	-0.05	0.06
Initial UpScale	12.00	8.98	3.06	9.34
Final UpScale	11.99	8.94	3.03	9.44
Avg. UpScale	12.00	8.96	3.05	9.39
Sys Resp (Zero)	0.08	-0.01	-0.03	0.00
Sys Resp (Upscale)	12.06	8.90	3.07	9.45
Upscale Cal Gas	12.00	8.98	3.04	9.42
Initial Zero Bias	0.09%	0.98%	0.10%	0.27%
Final Zero Bias	0.05%	0.52%	-0.40%	0.32%
Zero Drift	0.05%	0.46%	0.50%	0.05%
Initial Upscale Bias	-0.28%	0.46%	-0.10%	-0.59%
Final Upscale Bias	-0.33%	0.23%	-0.40%	-0.05%
Upscale Drift	0.05%	0.23%	0.30%	0.54%
Alternative Specification Abs Diff: Initial Zero	0.02	0.17	--	0.05
Alternative Specification Abs Diff: Final Zero	0.01	0.09	--	0.06
Alternative Specification Abs Diff: Initial Upscale	0.06	0.08	--	0.11
Alternative Specification Abs Diff: Final Upscale	0.07	0.04	--	0.01
Calibration Span	21.10	17.30	10.00	18.50
3% of Cal. Span (drift)	0.63	0.52	0.30	0.56
5% of Cal. Span (bias)	1.06	0.87	0.50	0.93

DRIFT AND BIAS CHECK				
70-100-70 Load, Run - 4.0X30PF R7	O_2	CO	THC	CO_2
Raw Average	12.97	0.10	0.01	6.13
Corrected Average	12.99	0.03	0.06	6.12
Initial Zero	0.09	0.08	-0.07	0.06
Final Zero	0.09	0.06	-0.03	0.05
Avg. Zero	0.09	0.07	-0.05	0.06
Initial UpScale	11.99	8.94	3.03	9.44
Final UpScale	11.97	8.94	3.00	9.37
Avg. UpScale	11.98	8.94	3.02	9.41
Sys Resp (Zero)	0.08	-0.01	-0.03	0.00
Sys Resp (Upscale)	12.06	8.90	3.07	9.45
Upscale Cal Gas	12.00	8.98	3.04	9.42
Initial Zero Bias	0.05%	0.52%	-0.40%	0.32%
Final Zero Bias	0.05%	0.40%	0.00%	0.27%
Zero Drift	0.00%	0.12%	0.40%	0.05%
Initial Upscale Bias	-0.33%	0.23%	-0.40%	-0.05%
Final Upscale Bias	-0.43%	0.23%	-0.70%	-0.43%
Upscale Drift	0.09%	0.00%	0.30%	0.38%
Alternative Specification Abs Diff: Initial Zero	0.01	0.09	--	0.06
Alternative Specification Abs Diff: Final Zero	0.01	0.07	--	0.05
Alternative Specification Abs Diff: Initial Upscale	0.07	0.04	--	0.01
Alternative Specification Abs Diff: Final Upscale	0.09	0.04	--	0.08
Calibration Span	21.10	17.30	10.00	18.50
3% of Cal. Span (drift)	0.63	0.52	0.30	0.56
5% of Cal. Span (bias)	1.06	0.87	0.50	0.93

DRIFT AND BIAS CHECK				
70-100-70 Load, Run - 4.0X30PF R8	O_2	CO	THC	CO_2
Raw Average	12.69	0.34	-0.01	6.11
Corrected Average	12.73	0.29	0.02	6.10
Initial Zero	0.09	0.06	-0.03	0.05
Final Zero	0.06	0.06	-0.03	0.05
Avg. Zero	0.08	0.06	-0.03	0.05
Initial UpScale	11.97	8.94	3.00	9.37
Final UpScale	11.98	8.87	2.95	9.45
Avg. UpScale	11.98	8.91	2.98	9.41
Sys Resp (Zero)	0.08	-0.01	-0.03	0.00
Sys Resp (Upscale)	12.06	8.90	3.07	9.45
Upscale Cal Gas	12.00	8.98	3.04	9.42
Initial Zero Bias	0.05%	0.40%	0.00%	0.27%
Final Zero Bias	-0.09%	0.40%	0.00%	0.27%
Zero Drift	0.14%	0.00%	0.00%	0.00%
Initial Upscale Bias	-0.43%	0.23%	-0.70%	-0.43%
Final Upscale Bias	-0.38%	-0.17%	-1.20%	0.00%
Upscale Drift	0.05%	0.40%	0.50%	0.43%
Alternative Specification Abs Diff: Initial Zero	0.01	0.07	--	0.05
Alternative Specification Abs Diff: Final Zero	0.02	0.07	--	0.05
Alternative Specification Abs Diff: Initial Upscale	0.09	0.04	--	0.08
Alternative Specification Abs Diff: Final Upscale	0.08	0.03	--	0.00
Calibration Span	21.10	17.30	10.00	18.50
3% of Cal. Span (drift)	0.63	0.52	0.30	0.56
5% of Cal. Span (bias)	1.06	0.87	0.50	0.93

jz-14-tulsa.ok-comp#1-ZTOF04X30PF-GAS R1-12

DRIFT AND BIAS CHECK				
70-100-70 Load, Run - 4.0X30PF R9	O_2	CO	THC	CO_2
Raw Average	12.90	0.53	0.11	6.01
Corrected Average	12.83	0.55	0.07	6.02
Initial Zero	0.11	-0.07	0.04	0.02
Final Zero	0.12	0.04	0.03	0.06
Avg. Zero	0.12	-0.02	0.04	0.04
Initial UpScale	12.13	8.93	3.12	9.37
Final UpScale	12.01	9.00	3.00	9.42
Avg. UpScale	12.07	8.97	3.06	9.40
Sys Resp (Zero)	0.09	0.01	0.03	0.01
Sys Resp (Upscale)	12.09	8.95	3.11	9.39
Upscale Cal Gas	12.00	8.98	3.04	9.42
Initial Zero Bias	0.09%	-0.46%	0.10%	0.05%
Final Zero Bias	0.14%	0.17%	0.00%	0.27%
Zero Drift	0.05%	0.64%	0.10%	0.22%
Initial Upscale Bias	0.19%	-0.12%	0.10%	-0.11%
Final Upscale Bias	-0.38%	0.29%	-1.10%	0.16%
Upscale Drift	0.57%	0.40%	1.20%	0.27%
Alternative Specification Abs Diff: Initial Zero	0.02	0.08	--	0.01
Alternative Specification Abs Diff: Final Zero	0.03	0.03	--	0.05
Alternative Specification Abs Diff: Initial Upscale	0.04	0.02	--	0.02
Alternative Specification Abs Diff: Final Upscale	0.08	0.05	--	0.03
Calibration Span	21.10	17.30	10.00	18.50
3% of Cal. Span (drift)	0.63	0.52	0.30	0.56
5% of Cal. Span (bias)	1.06	0.87	0.50	0.93

DRIFT AND BIAS CHECK				
90-100 Load, Run - 4.0X30PF R10	O_2	CO	THC	CO_2
Raw Average	12.82	0.32	0.09	6.04
Corrected Average	12.84	0.26	0.06	6.01
Initial Zero	0.12	0.04	0.03	0.06
Final Zero	0.09	0.07	0.03	0.08
Avg. Zero	0.11	0.06	0.03	0.07
Initial UpScale	12.01	9.00	3.00	9.42
Final UpScale	11.97	9.11	3.05	9.44
Avg. UpScale	11.99	9.06	3.03	9.43
Sys Resp (Zero)	0.09	0.01	0.03	0.01
Sys Resp (Upscale)	12.09	8.95	3.11	9.39
Upscale Cal Gas	12.00	8.98	3.04	9.42
Initial Zero Bias	0.14%	0.17%	0.00%	0.27%
Final Zero Bias	0.00%	0.35%	0.00%	0.38%
Zero Drift	0.14%	0.17%	0.00%	0.11%
Initial Upscale Bias	-0.38%	0.29%	-1.10%	0.16%
Final Upscale Bias	-0.57%	0.92%	-0.60%	0.27%
Upscale Drift	0.19%	0.64%	0.50%	0.11%
Alternative Specification Abs Diff: Initial Zero	0.03	0.03	--	0.05
Alternative Specification Abs Diff: Final Zero	0.00	0.06	--	0.07
Alternative Specification Abs Diff: Initial Upscale	0.08	0.05	--	0.03
Alternative Specification Abs Diff: Final Upscale	0.12	0.16	--	0.05
Calibration Span	21.10	17.30	10.00	18.50
3% of Cal. Span (drift)	0.63	0.52	0.30	0.56
5% of Cal. Span (bias)	1.06	0.87	0.50	0.93

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DRIFT AND BIAS CHECK				
90-100 Load, Run - 4.0X30PF R11	O_2	CO	THC	CO_2
Raw Average	12.60	0.05	0.08	6.19
Corrected Average	12.67	0.00	0.07	6.15
Initial Zero	0.09	0.07	0.03	0.08
Final Zero	0.05	0.19	-0.02	0.09
Avg. Zero	0.07	0.13	0.01	0.09
Initial UpScale	11.97	9.11	3.05	9.44
Final UpScale	11.91	9.11	3.05	9.42
Avg. UpScale	11.94	9.11	3.05	9.43
Sys Resp (Zero)	0.09	0.01	0.03	0.01
Sys Resp (Upscale)	12.09	8.95	3.11	9.39
Upscale Cal Gas	12.00	8.98	3.04	9.42
Initial Zero Bias	0.00%	0.35%	0.00%	0.38%
Final Zero Bias	-0.19%	1.04%	-0.50%	0.43%
Zero Drift	0.19%	0.69%	0.50%	0.05%
Initial Upscale Bias	-0.57%	0.92%	-0.60%	0.27%
Final Upscale Bias	-0.85%	0.92%	-0.60%	0.16%
Upscale Drift	0.28%	0.00%	0.00%	0.11%
Alternative Specification Abs Diff: Initial Zero	0.00	0.06	--	0.07
Alternative Specification Abs Diff: Final Zero	0.04	0.18	--	0.08
Alternative Specification Abs Diff: Initial Upscale	0.12	0.16	--	0.05
Alternative Specification Abs Diff: Final Upscale	0.18	0.16	--	0.03
Calibration Span	21.10	17.30	10.00	18.50
3% of Cal. Span (drift)	0.63	0.52	0.30	0.56
5% of Cal. Span (bias)	1.06	0.87	0.50	0.93

DRIFT AND BIAS CHECK				
90-100 Load, Run - 4.0X30PF R12	O_2	CO	THC	CO_2
Raw Average	12.64	0.12	0.07	6.16
Corrected Average	12.70	0.02	0.10	6.16
Initial Zero	0.05	0.19	-0.02	0.09
Final Zero	0.07	0.01	-0.03	0.05
Avg. Zero	0.06	0.10	-0.03	0.07
Initial UpScale	11.91	9.11	3.05	9.42
Final UpScale	11.99	9.01	3.04	9.33
Avg. UpScale	11.95	9.06	3.05	9.38
Sys Resp (Zero)	0.09	0.01	0.03	0.01
Sys Resp (Upscale)	12.09	8.95	3.11	9.39
Upscale Cal Gas	12.00	8.98	3.04	9.42
Initial Zero Bias	-0.19%	1.04%	-0.50%	0.43%
Final Zero Bias	-0.09%	0.00%	-0.60%	0.22%
Zero Drift	0.09%	1.04%	0.10%	0.22%
Initial Upscale Bias	-0.85%	0.92%	-0.60%	0.16%
Final Upscale Bias	-0.47%	0.35%	-0.70%	-0.32%
Upscale Drift	0.38%	0.58%	0.10%	0.49%
Alternative Specification Abs Diff: Initial Zero	0.04	0.18	--	0.08
Alternative Specification Abs Diff: Final Zero	0.02	0.00	--	0.04
Alternative Specification Abs Diff: Initial Upscale	0.18	0.16	--	0.03
Alternative Specification Abs Diff: Final Upscale	0.10	0.06	--	0.06
Calibration Span	21.10	17.30	10.00	18.50
3% of Cal. Span (drift)	0.63	0.52	0.30	0.56
5% of Cal. Span (bias)	1.06	0.87	0.50	0.93

jz-14-tulsa.ok-comp#1-ZTOF04X30PF-GAS R1-12

APEX INSTRUMENTS SOURCE TESTING EQUIPMENT

Apex Instruments, Inc.
204 Technology Park Lane
Fuquay-Varina, NC 27526

S-TYPE PITOT TUBE CALIBRATION SHEET

Reference USEPA Reference Method 2 (40CFR60, App. A, Meth. 2)

PITOT SERIAL#	4174	CALIBRATION DATE:	11-Jan-13	
PITOT TYPE:	S-Type	BAROMETRIC PRESSURE:	29.88	in Hg
STD. PITOT TYPE:	Ellipsoidal	STATIC PRESSURE	1.4	in H_20
Cp(std):	0.990	BLOCKAGE %:	N/A	
PROBE SERIAL#	NICK	CORRECTION FACTOR:	1.00	

	SIDE "A" CALIBRATION			
RUN NO.	Δ Pstd in H_2O	Δ Ps in H_2O	Cp(s)	DEVIATION Cp(s) - avg.Cp(s)
1	0.560	0.820	0.818	0.000
2	0.560	0.820	0.818	0.000
3	0.560	0.820	0.818	0.000
		"A" AVERAGE	0.818	0.0000 (must be ≤ 0.01)

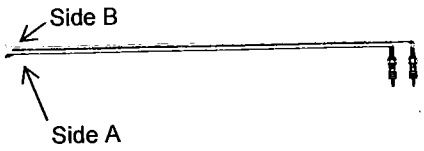
	SIDE "B" CALIBRATION			
RUN NO.	Δ Pstd in H_2O	Δ Ps in H_2O	Cp(s)	DEVIATION Cp(s) - avg.Cp(s)
1	0.560	0.815	0.821	0.000
2	0.560	0.815	0.821	0.000
3	0.560	0.815	0.821	0.000
		"B" AVERAGE	0.821	0.0000 (must be ≤ 0.01)

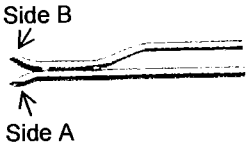
ACCEPTANCE CRITERIA

AVERAGE -0.0025 AVG. Cp (A) - AVG. Cp (B) must be ≤ 0.01

If the Average <u>and</u> both Deviation Averages "A" & "B" are ≤ 0.01, then the OVERALL AVERAGE below may be used.
*** If NOT, use the "A" Average <u>OR</u> "B" Average.**

OVERALL AVERAGE 0.8194





I certify that the above pitot tube was tested in accordance with the US EPA Method 2 standards.
See the Code of Federal Regulations, Title 40, Part 60, Appendix A, Method 2, Item 4.

Print Name: Nick Allen

Signature: Nick Allen

Date 1.11.13

WEATHER STATION CALIBRATION SHEET
Temperature, Barometric Pressure, and Relative Humidity Periodic Calibration
Air Hygiene Asset ID: samp-we-0021

Filename: \\SERVER2\public\Shared\QAQC\Calibrations\Weather Stations\2013\[Weather Station Calibration_samp-we-0021.xlsm]100913
Make: Kestrel
Model #: 4000
Serial #: 686543

NIST ID 21470653
NIST S/N 21470653
Cal Due 10/9/2014

ASTM Temp (deg F)	Thermo. (deg F)	± deg F	ASTM Barometer (in. Hg)	Barometric (in. Hg)	± in. Hg
68.00	68.50	0.50	29.44	29.28	0.16

Sean Barnes — 10/09/13
(signature) (date)

ASTM Temp (deg F)	Thermo. (deg F)	± deg F	ASTM Barometer (in. Hg)	Barometric (in. Hg)	± in. Hg
68.00	68.40	0.40	29.44	29.27	0.17

Sean Barnes — 10/09/13
(signature) (date)

ASTM Temp (deg F)	Thermo. (deg F)	± deg F	ASTM Barometer (in. Hg)	Barometric (in. Hg)	± in. Hg
68.00	68.50	0.50	29.44	29.28	0.16

Sean Barnes — 10/09/13
(signature) (date)

ASTM Temp (deg F)	Thermo. (deg F)	± deg F	ASTM Barometer (in. Hg)	Barometric (in. Hg)	± in. Hg
68.00	68.60	0.60	29.44	29.28	0.16

Sean Barnes — 10/09/13
(signature) (date)

Note: Calibrated against NIST Traceable Barometer and Thermometer (SAMP-WE-0100).

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 ±2F**.

Standard of Calibration for Barometers

40 CFR Part 60, Appendix A, Method 5, Section:
6.0____Equipment and Supplies, 6.1____Sample Collection., 6.1.2____Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in.).
10.0____Calibration and Standardization, 10.6____Barometer. Calibrate against a mercury barometer.

METERING SYSTEM DRY GAS METER CALIBRATION SHEET
EPA Reference Method
Metering System Pre-Test Calibration
Air Hygiene Assett ID: samp-cp-0008

Filename: N:\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0008 Calibration 3-3-14.xls]Original (5 point)

Make: Thermo Environmental
Model #: MST-C1
Serial #: 90706

Date: 03/03/14
Barometric Pressure: 29.92 (in. Hg)
Theoretical Critical Vacuum: 14.11 (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)
0.26	17.00	831.020	836.670	5.650	75.0	69.0
0.55	12.00	836.670	842.380	5.710	75.0	70.0
1.10	10.00	842.380	848.800	6.420	76.0	71.0
2.00	10.00	848.800	857.520	8.720	78.0	71.0
3.50	10.00	857.520	868.930	11.410	79.0	72.0

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)
75.0	70.0	40	0.2346	16.0	66.7	67.1	66.9
77.0	71.0	48	0.3355	16.0	67.1	67.8	67.5
77.0	71.0	55	0.4522	16.0	68.1	68.1	68.1
80.0	72.0	63	0.6118	16.0	68.1	68.7	68.4
80.0	72.0	73	0.8022	15.5	68.7	68.9	68.8

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)
5.606	158.77	5.198	147.2	5.190
5.659	160.27	5.245	148.5	5.242
6.365	180.27	5.888	166.7	5.891
8.641	244.70	7.963	225.5	7.972
11.337	321.07	10.438	295.6	10.458

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)
0.003	0.927	1.560	39.61	-0.141
0.003	0.927	1.612	40.94	-0.089
0.001	0.925	1.775	45.08	0.074
-0.003	0.922	1.762	44.76	0.062
-0.004	0.921	1.794	45.56	0.093
AVERAGE:	**0.924**	**1.700**	43.19	**PASSED**

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: 03/03/14 03/03/14

METERING SYSTEM THERMOCOUPLE CALIBRATION SHEET
EPA Reference Method
Metering System Pre-Test Calibration
Air Hygiene Assett ID: samp-cp-0008

Filename: N:\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0008 Calibration 3-3-14.xls]Original (5 point)

Make: Thermo Environmental
Model #: MST-C1
Serial #: 90706

Date: 03/03/14
Barometric Pressure: 29.92 (in. Hg)
Temperature (ASTM cal): 69.40 (°F)

Thermocouple	100 (°F)		600 (°F)		1200 (°F)	
	Reading	% Error	Reading	% Error	Reading	% Error
Stack	101.00	0.50	601.00	0.17	1202.00	0.17
Probe	101.00	0.50	601.00	0.17	1202.00	0.17
Filter	101.00	0.50	601.00	0.17	1202.00	0.17
Dryer	101.00	0.50	601.00	0.17	1202.00	0.17
Aux.	101.00	0.50	601.00	0.17	1202.00	0.17

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	69.40 (°F)	
	Reading	(±°F)
DGM In	69.0	0.40
DGM Out	69.0	0.40

Note: Calibrated against ASTM Reference Thermometer.

SIGNATURE: Craig McCarty DATE: 03/03/14 03/03/14

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-0076 **Hotbox:** SAMP-BH-0001 **Gooseneck:** SAMP-AD-0039

Filename: N:\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0008 Calibration 3-3-14.xls]Original (5 point)

Barometric Pressure: 29.82

Thermo-couples		Temps (°F)	Signature		Date	
Stack	Ref	69.80	Craig McCarty		03/03/14	03/03/14
	Read	70.00				
	±°F	0.20				
Filter	Ref	69.80	Craig McCarty		03/03/14	03/03/14
	Read	69.00				
	±°F	0.80				
Exit	Ref	69.80	Craig McCarty		03/03/14	03/03/14
	Read	70.00				
	±°F	0.20				

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-0008

Filename: N:\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0008 Calibration 3-3-14.xls]3-19-14 (3 point)

Make: Thermo Environmental
Model #: MST-C1
Serial #: 90706

Date: 03/19/14
Barometric Pressure: 29.63 (in. Hg)
Theoretical Critical Vacuum: 13.98 (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)
1.90	10.00	268.900	277.570	8.670	81.0	74.0
1.90	10.00	277.570	286.250	8.680	81.0	74.0
1.90	10.00	286.250	294.930	8.680	81.0	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)
81.0	74.0	63	0.6100	16.0	71.9	71.9	71.9
81.0	74.0	63	0.6100	16.0	71.9	71.9	71.9
81.0	74.0	63	0.6100	16.0	71.9	71.9	71.9

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)
8.471	239.89	7.837	221.9	7.975
8.480	240.16	7.837	221.9	7.975
8.480	240.16	7.837	221.9	7.975

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	0.925	1.704	43.28	0.000
0.000	0.924	1.704	43.28	0.000
0.000	0.924	1.704	43.28	0.000
AVERAGE:	**0.924**	**1.704**	43.28	**PASSED**
LAST 5-PT:	**0.924**	**1.700**	**PASSED**	5-PT Date:
% DIFF:	**0.0%**	**0.2%**		03/03/14

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: 03/19/14 03/19/14

METERING SYSTEM THERMOCOUPLE CALIBRATION SHEET
EPA Reference Method
Metering System Post-Test Calibration
Air Hygiene Assett ID: samp-cp-0008

Filename: N:\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0008 Calibration 3-3-14.xls]3-19-14 (3 point)

Make: Thermo Environmental
Model #: MST-C1
Serial #: 90706

Date: 03/19/14
Barometric Pressure: 29.63 (in. Hg)
Temperature (ASTM cal): 71.60 (°F)

Thermocouple	100 (°F)		600 (°F)		1200 (°F)	
	Reading	% Error	Reading	% Error	Reading	% Error
Stack	101.00	0.50	601.00	0.17	1202.00	0.17
Probe	101.00	0.50	601.00	0.17	1202.00	0.17
Filter	101.00	0.50	601.00	0.17	1202.00	0.17
Dryer	101.00	0.50	601.00	0.17	1202.00	0.17
Aux.	101.00	0.50	601.00	0.17	1202.00	0.17

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	71.60 (°F)	
	Reading	(±°F)
DGM In	71.0	0.60
DGM Out	71.0	0.60

Note: Calibrated against ASTM Reference Thermometer.

SIGNATURE: Craig McCarty DATE: 03/19/14 03/19/14

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-0033 **Hotbox:** samp-bh-0012 **Gooseneck:** samp-ad-0039

Filename: N:\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0008 Calibration 3-3-14.xls]3-19-14 (3 point)

Barometric Pressure: 29.63

Thermo-couples		Temps (°F)	Signature		Date	
Stack	Ref	71.60	Craig McCarty		03/19/14	03/19/14
	Read	71.00				
	±°F	0.60				
Filter	Ref	71.60	Craig McCarty		03/19/14	03/19/14
	Read	71.00				
	±°F	0.60				
Exit	Ref	71.60	Craig McCarty		03/19/14	03/19/14
	Read	71.00				
	±°F	0.60				

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**.

TEMPERATURE ELEMENT VERIFICATION RECORD

INSTRUMENT TAG: F-13 LINE 2 TE

DATE: 2-26-2014

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	150.1	145.9	+/- 5°F
100	100.1	95.5	+/- 5°F
32	32.0	27.1	+/- 5°F

Element passed: X Element. replaced: _____

Verification Performed by: CHARLES CROWN

Date next verification is to be performed: _____

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F-13 L-2 PRESS

DATE: 3-7-2014

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	25.0			25.1	8 (7.9 to 8.1)			
50	50.0			50.1	12 (11.9 to 12.1)			
75	75.0			75.1	16 (15.9 to 16.1)			
100	98.0			98.2	20 (19.9 to 20.1)			

Trans. passed without cal: X Trans. passed with cal.: _____ Trans. replaced: NEW TRANS

Calibration Performed by: CHARLES CROWN

Date next calibration is to be performed: _____

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F-13 LINE 2 dP

DATE: 2-26-2014

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.

+/- 1.5

% 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	0.05		0.00	4 (3.9 to 4.1)			
25	75.0	74.9		74.87	8 (7.9 to 8.1)			
50	150.0	149.9		150.04	12 (11.9 to 12.1)			
75	225.0	225		225.2	16 (15.9 to 16.1)			
100	298.0	298		297.8	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: _____

TEMPERATURE ELEMENT VERIFICATION RECORD

INSTRUMENT TAG: F-13 LINE 3 TE

DATE: 2-26-2014

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	150.0	149.0	+/- 5°F
100	100.0	98.5	+/- 5°F
32	32.0	29.9	+/- 5°F

Element passed: X Element. replaced: _____

Verification Performed by: CHARLES CROWN

Date next verification is to be performed: _____

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F-13 LINE 3 PRESS

DATE: 2-28-2014

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	25.0			24.9	8 (7.9 to 8.1)			
50	50.0			49.9	12 (11.9 to 12.1)			
75	75.0			75.0	16 (15.9 to 16.1)			
100	98.0			97.8	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: _____

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F-13 LINE 3 dP

DATE: 2-26-2014

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	0.0		0.0	4 (3.9 to 4.1)			
25	75.0	75.0		74.9	8 (7.9 to 8.1)			
50	150.0	150.1		149.8	12 (11.9 to 12.1)			
75	225.0	225		224.9	16 (15.9 to 16.1)			
100	298.0	298		297.8	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: _____

TEMPERATURE ELEMENT VERIFICATION RECORD

INSTRUMENT TAG: F-13 LINE 4 TE

DATE: 2-26-2014

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	150.1	149.4	+/- 5°F
100	100.0	99.0	+/- 5°F
32	31.9	30.9	+/- 5°F

Element passed: X Element replaced: _____

Verification Performed by: CHARLES CROWN

Date next verification is to be performed: _____

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F-13 LINE 4 PRESS.

DATE: 3-7-2014

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	25.0			25.2	8 (7.9 to 8.1)			
50	50.0			50.2	12 (11.9 to 12.1)			
75	75.0			75.2	16 (15.9 to 16.1)			
100	98.0			98.2	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: _____

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F-13 LINE 4 dP

DATE: 2-26-2014

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	-0.1		0.0	4 (3.9 to 4.1)	0.1		0.0
25	75.0	73.1		73.1	8 (7.9 to 8.1)	75.0		75.2
50	150.0	146.3		145.8	12 (11.9 to 12.1)	150.5		150.2
75	225.0	219		218.4	16 (15.9 to 16.1)	225		224.9
100	298.0	290		289.1	20 (19.9 to 20.1)	298		297.6

Trans. passed without cal: _____ Trans. passed with cal.: X Trans. replaced: _____

Calibration Performed by: CHARLES CROWN

Date next calibration is to be performed: _____

TEMPERATURE ELEMENT VERIFICATION RECORD

INSTRUMENT TAG: F-13 Aux. Stack TE (PREHEAT TEMP)

DATE: 3-4-2014

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	150.0	152	+/- 5°F
100	100.0	102	+/- 5°F
32	32.0	35	+/- 5°F

Element passed: X Element. replaced: _____

Verification Performed by: CHARLES CROWN

Date next verification is to be performed: _____

TEMPERATURE ELEMENT VERIFICATION RECORD

INSTRUMENT TAG: F-13 FUEL TEMP TE (Enhanced Gas Temp)

DATE: 3-4-2014

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	150.0	149	+/- 5°F
100	100.0	99	+/- 5°F
32	32.0	30	+/- 5°F

Element passed: X Element. replaced: _____

Verification Performed by: CHARLES CROWN

Date next verification is to be performed: _____

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F-13 FUEL PRESSURE #2

DATE: 3-4-2014

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	NA		0.0	4 (3.9 to 4.1)			
25	20.0			20.0	8 (7.9 to 8.1)			
50	40.0			40.0	12 (11.9 to 12.1)			
75	60.0			60.1	16 (15.9 to 16.1)			
100	78.9			78.9	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: _____

TEMPERATURE ELEMENT VERIFICATION RECORD

INSTRUMENT TAG: F-13 LINE 2 TE

DATE: 3-21-2014

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	150.0	150.3	+/- 5°F
100	100.0	99.4	+/- 5°F
32	32.0	31.3	+/- 5°F

Element passed: X Element. replaced: _____

Verification Performed by: CHARLES CROWN

Date next verification is to be performed: _____

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F-13 LINE 2 dP

DATE: 1-4-2014

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 +/- 1.5	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		0.0	4 (3.9 to 4.1)			
25	75.0	74.8		74.8	8 (7.9 to 8.1)			
50	150.0	149.5		149.6	12 (11.9 to 12.1)			
75	225.0	224		224.9	16 (15.9 to 16.1)			
100	298.0	297		297.5	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: _____

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F-13 LINE 2 PRESS.

DATE: 4-4-2014

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 +/- .5	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	25.0			25.1	8 (7.9 to 8.1)			
50	50.0			50.1	12 (11.9 to 12.1)			
75	75.0			75.2	16 (15.9 to 16.1)			
100	98.0			98.2	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: _____

TEMPERATURE ELEMENT VERIFICATION RECORD

INSTRUMENT TAG: F-13 LINE 3 TE

DATE: 3-21-2014

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	150.0	153.3	+/- 5°F
100	100.0	103.0	+/- 5°F
32	32.0	34.6	+/- 5°F

Element passed: X Element. replaced: _____

Verification Performed by: CHARLES CROWN

Date next verification is to be performed: _____

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F-13 LINE 3 dP

DATE: 4-4-2014

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	0.0		0.0	4 (3.9 to 4.1)			
25	75.0	74.9		74.6	8 (7.9 to 8.1)			
50	150.0	149.9		149.6	12 (11.9 to 12.1)			
75	225.0	225		224.4	16 (15.9 to 16.1)			
100	298.0	298		297.4	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: _____

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F-13 LINE 3 PRESS.

DATE: 4-4-2014

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	25.0			25.1	8 (7.9 to 8.1)			
50	50.0			49.6	12 (11.9 to 12.1)			
75	75.0			74.7	16 (15.9 to 16.1)			
100	98.0			97.8	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: _____

TEMPERATURE ELEMENT VERIFICATION RECORD

INSTRUMENT TAG: F-13 LINE 4 TE

DATE: 3-21-2014

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	150.0	153.3	+/- 5°F
100	100.0	103.0	+/- 5°F
32	32.0	35.0	+/- 5°F

Element passed: X Element replaced: _____

Verification Performed by: CHARLES CROWN

Date next verification is to be performed: _____

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F-13 LINE 4 dP

DATE: 4-4-2014

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	0.0		0.3	4 (3.9 to 4.1)			
25	75.0	75.0		74.9	8 (7.9 to 8.1)			
50	150.0	150.4		15.3	12 (11.9 to 12.1)			
75	225.0	225		225.2	16 (15.9 to 16.1)			
100	298.0	298		297.2	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: _____

TRANSMITTER CALIBRATION RECORD

INSTRUMENT TAG: F-13 LINE 4 PRESS.

DATE: 4-4-2014

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	25.0			25.1	8 (7.9 to 8.1)			
50	50.0			50.0	12 (11.9 to 12.1)			
75	75.0			74.9	16 (15.9 to 16.1)			
100	98.0			98.2	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: _____

TEMPERATURE ELEMENT VERIFICATION RECORD

INSTRUMENT TAG: F-13 FUEL TEMP TE

DATE: 4-4-2014

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	150.0	149	+/- 5°F
100	100.0	98	+/- 5°F
32	32.0	29	+/- 5°F

Element passed: X Element. replaced: _____

Verification Performed by: CHARLES CROWN

Date next verification is to be performed: _____

SERIAL NUMBER 2014135 **04-22-2014**

COMPONENT VALUES DETERMINED AT CALIBRATION

Integral Transducer

PCB 100385	**PCB 100389**
R5 825	R10 2150
R7 825	
R8 88	
R9 700	
R15 5490	

FLOW SENSOR - 50 OHMS NI @ 75 deg F
TEMP SENSOR - 100 OHMS NI @ 75 deg F

CALIBRATION POTENTIOMETERS

TA 788 TC 646

OPERATING RANGE

	minimum	**maximum**
FLOW	0	4500 SCFH N2
TEMPERATURE	40	150 F
PRESSURE	0	25 PSIG

COMMENTS --

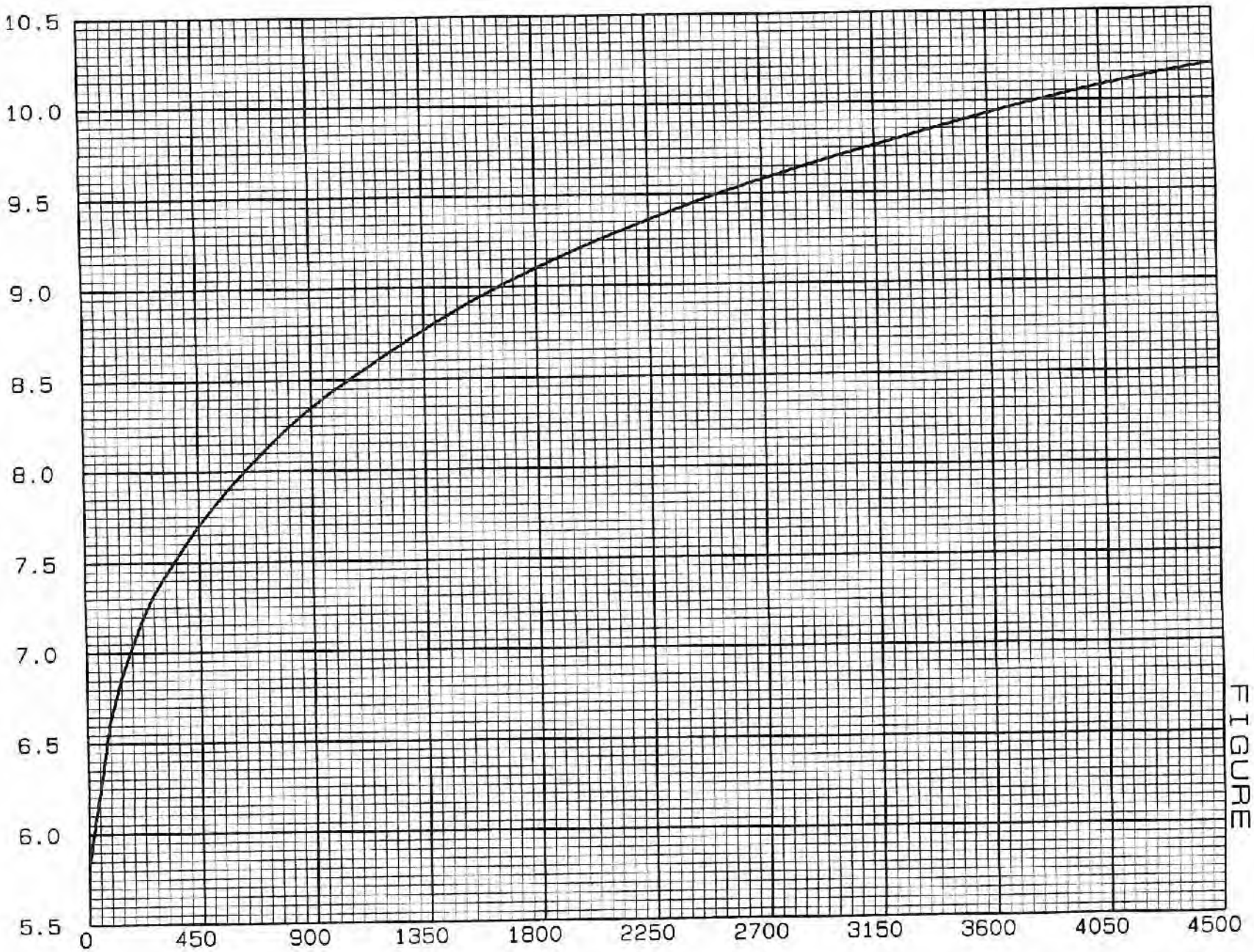
9500P
METER CALIBRATED FOR A 2" SCH 40 LINE

METER OUTPUT SIGNAL CALIBRATION

mA	**SCFH N2**	**EXC Volts**
4	0	5.830
4.32	90	6.630
4.64	180	7.035
4.96	270	7.318
5.28	360	7.520
5.6	450	7.700
7.2	900	8.350
8.8	1350	8.770
10.4	1800	9.100
12	2250	9.360
13.6	2700	9.580
15.2	3150	9.760
16.8	3600	9.930
18.4	4050	10.080
20	4500	10.200

9500 EEPROM Setup Data

Maximum Calibrated Flow	4500
Flow FS at 20ma	4500.0
Flow Full Scale Displayed	4500.0
Totalizer Counts per/hour	4500
Totalizer Decimal Point	0
Zero Offset	0
Display Cutoff	10% FS
Filter Time Constant	1 Sec



FIGURE

PAGE

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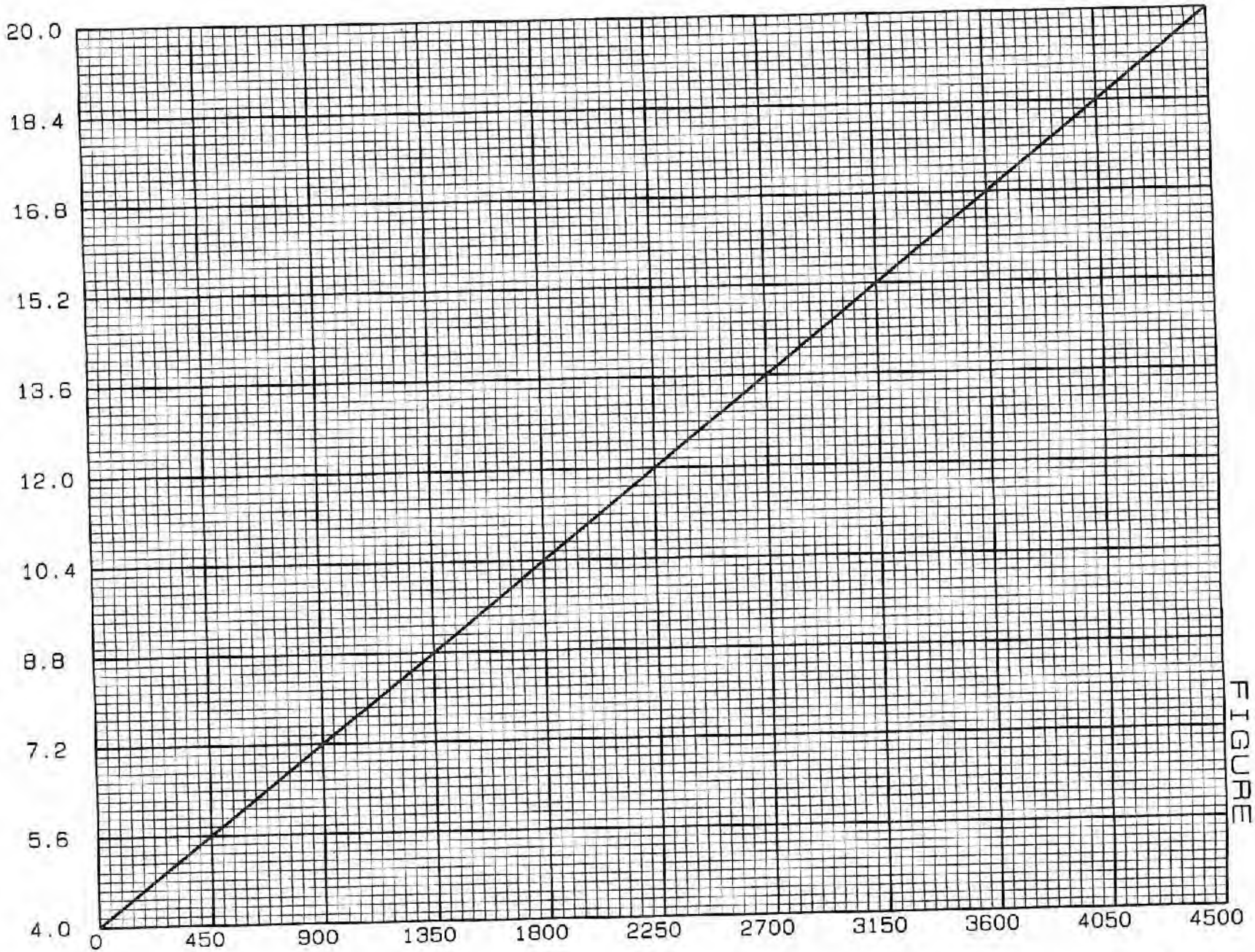
SCFH N2 2" SCH 40 LINE

S/N 2014135.0
04-22-2014



SCFH N2 2" SCH 40 LINE

S/N 2014135.C
04-22-2014

FIGURE

PAGE

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Furnace #13 Data

Date 5/15/2014
Time 2:58:37 PM

FUELS

Nitrogen	Line #1	0.00	% Flow	0	scfh
Nitrogen	Line #2	0.00	% Flow	0	scfh
Nitrogen	Line #3	0.00	% Flow	0	scfh
Nitrogen	Line #4	100.00	% Flow	531	scfh

TIC Meter	524	scfh
Total Flow	531	scfh
Total LHV	0.00	Btu/scf
Total Heat Release	0.000	MMBtu/hr

O2 (DRY)	0.00	%vd
O2 (WET)	20.95	
CO	0.00	ppmvd
NOx	0.00	ppmvd

CO Range	NOx Range	Point	Fuel
5000	100	0.0	?

Job: 0

Work Order: 8356920

Furnace Information

Stack Temp:	69	°F
Furnace Temp:	67	°F
Radiant Furnace Temp:	64	°F
Pre-heated Air:	-240	°F
Entrained Gas Temp:	104	°F
Orifice Gas Temp:	-240	°F
Furnace Draft:	-0.02	in.H2O
Burner dP:	0.01	in.H2O
Fuel Pressure 1:	0.0	psig
Fuel Pressure 2:	0.0	psig
H20 Flow:	18.5	gpm
Flame Length:	0.0	ft
Flame Width:	0.0	ft
Primary Air:	0.0	

Weather Conditions

Ambient Air Temp:	56	°F
Relative Humidity:	50	%
Wind Speed:	5	mph
Atmospheric Pressure:	14.42	psia

Furnace 13 Comments

1.
2.
3.
4.
5.
6.
7.
8.
9.

	Dp	Press	Temp.	LHV	Orifice Bore
Line 1	0.00	0.0	71.9	0.0	0.3450
Line 2	0.00	67.4	92.7	0.0	0.1710
Line 3	0.00	93.6	85.5	0.0	0.3400
Line 4	29.96	80.0	141.4	0.0	0.2250

Furnace #13 Data

Date 5/15/2014
Time 3:04:45 PM

FUELS

Nitrogen	Line #1	0.00	% Flow	0	scfh
Nitrogen	Line #2	0.00	% Flow	0	scfh
Nitrogen	Line #3	100.00	% Flow	1299	scfh
Nitrogen	Line #4	0.00	% Flow	0	scfh

TIC Meter	1303	scfh
Total Flow	1299	scfh
Total LHV	0.00	Btu/scf
Total Heat Release	0.000	MMBtu/hr

O2 (DRY)	0.00	%vd
O2 (WET)	20.92	
CO	0.00	ppmvd
NOx	0.00	ppmvd

Job: 0

Work Order: 8356920

CO Range	NOx Range	Point	Fuel
5000	100	0.0	?

Furnace Information

Stack Temp:	69	°F
Furnace Temp:	67	°F
Radiant Furnace Temp:	64	°F
Pre-heated Air:	-240	°F
Entrained Gas Temp:	109	°F
Orifice Gas Temp:	-240	°F
Furnace Draft:	-0.02	in.H2O
Burner dP:	0.02	in.H2O
Fuel Pressure 1:	0.0	psig
Fuel Pressure 2:	0.0	psig
H20 Flow:	18.4	gpm
Flame Length:	0.0	ft
Flame Width:	0.0	ft
Primary Air:	0.0	

Weather Conditions

Ambient Air Temp:	56	°F
Relative Humidity:	50	%
Wind Speed:	5	mph
Atmospheric Pressure:	14.42	psia

Furnace 13 Comments

1.
2.
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7.
8.
9.

	Dp	Press	Temp.	LHV	Orifice Bore
Line 1	0.00	0.0	71.4	0.0	0.3450
Line 2	0.00	67.7	91.3	0.0	0.1710
Line 3	36.26	60.2	86.8	0.0	0.3400
Line 4	0.00	91.8	139.2	0.0	0.2250

Furnace #13 Data

Date 5/15/2014
Time 3:50:46 PM

FUELS

Nitrogen	Line #1	0.00	% Flow	0	scfh
Nitrogen	Line #2	0.00	% Flow	0	scfh
Nitrogen	Line #3	57.18	% Flow	1774	scfh
Nitrogen	Line #4	42.82	% Flow	1328	scfh

TIC Meter	3096	scfh
Total Flow	3102	scfh
Total LHV	0.00	Btu/scf
Total Heat Release	0.000	MMBtu/hr

O2 (DRY)	0.00	%vd
O2 (WET)	20.96	
CO	0.00	ppmvd
NOx	0.00	ppmvd

CO Range	NOx Range	Point	Fuel
5000	100	0.0	?

Job: 0

Work Order: 8356920

Furnace Information

Stack Temp:	67	°F
Furnace Temp:	64	°F
Radiant Furnace Temp:	63	°F
Pre-heated Air:	-240	°F
Entrained Gas Temp:	99	°F
Orifice Gas Temp:	-240	°F
Furnace Draft:	-0.03	in.H2O
Burner dP:	0.03	in.H2O
Fuel Pressure 1:	0.1	psig
Fuel Pressure 2:	0.0	psig
H20 Flow:	19.7	gpm
Flame Length:	0.0	ft
Flame Width:	0.0	ft
Primary Air:	0.0	

Weather Conditions

Ambient Air Temp:	56	°F
Relative Humidity:	50	%
Wind Speed:	5	mph
Atmospheric Pressure:	14.42	psia

Furnace 13 Comments

1.
2.
3.
4.
5.
6.
7.
8.
9.

	Dp	Press	Temp.	LHV	Orifice Bore
Line 1	0.00	0.0	64.6	0.0	0.3450
Line 2	0.00	66.8	92.7	0.0	0.1710
Line 3	67.77	59.7	77.4	0.0	0.3400
Line 4	186.96	77.5	99.4	0.0	0.2250

Furnace #13 Data

Date 5/15/2014
Time 3:26:53 PM

FUELS

Nitrogen	Line #1	0.00	% Flow	0	scfh
Nitrogen	Line #2	11.25	% Flow	463	scfh
Nitrogen	Line #3	58.86	% Flow	2419	scfh
Nitrogen	Line #4	29.89	% Flow	1228	scfh

TIC Meter	4100	scfh
Total Flow	4110	scfh
Total LHV	0.00	Btu/scf
Total Heat Release	0.000	MMBtu/hr

O2 (DRY)	0.00	%vd
O2 (WET)	20.96	
CO	0.00	ppmvd
NOx	0.00	ppmvd

Job: 0

Work Order: 8356920

CO Range	NOx Range	Point	Fuel
5000	100	0.0	?

Furnace Information

Stack Temp:	69	°F
Furnace Temp:	67	°F
Radiant Furnace Temp:	65	°F
Pre-heated Air:	-240	°F
Entrained Gas Temp:	121	°F
Orifice Gas Temp:	-240	°F
Furnace Draft:	-0.02	in.H2O
Burner dP:	0.01	in.H2O
Fuel Pressure 1:	0.1	psig
Fuel Pressure 2:	0.0	psig
H20 Flow:	19.6	gpm
Flame Length:	0.0	ft
Flame Width:	0.0	ft
Primary Air:	0.0	

Weather Conditions

Ambient Air Temp:	56	°F
Relative Humidity:	50	%
Wind Speed:	5	mph
Atmospheric Pressure:	14.42	psia

Furnace 13 Comments

1.
2.
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7.
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9.

	Dp	Press	Temp.	LHV	Orifice Bore
Line 1	0.00	0.0	70.1	0.0	0.3450
Line 2	78.46	63.7	100.8	0.0	0.1710
Line 3	133.11	57.9	79.6	0.0	0.3400
Line 4	162.49	77.0	108.4	0.0	0.2250

Furnace #13 Data

Date 5/15/2014
Time 3:29:35 PM

FUELS

Nitrogen	Line #1	0.00	% Flow	0	scfh
Nitrogen	Line #2	17.47	% Flow	769	scfh
Nitrogen	Line #3	54.58	% Flow	2402	scfh
Nitrogen	Line #4	27.96	% Flow	1230	scfh

TIC Meter	4437	scfh
Total Flow	4400	scfh
Total LHV	0.00	Btu/scf
Total Heat Release	0.000	MMBtu/hr

O2 (DRY)	0.00	%vd
O2 (WET)	20.96	
CO	0.00	ppmvd
NOx	0.00	ppmvd

Job: 0

Work Order: 8356920

CO Range	NOx Range	Point	Fuel
5000	100	0.0	?

Furnace Information

Stack Temp:	68	°F
Furnace Temp:	67	°F
Radiant Furnace Temp:	65	°F
Pre-heated Air:	-240	°F
Entrained Gas Temp:	117	°F
Orifice Gas Temp:	-240	°F
Furnace Draft:	-0.02	in.H2O
Burner dP:	0.02	in.H2O
Fuel Pressure 1:	0.1	psig
Fuel Pressure 2:	0.0	psig
H20 Flow:	19.5	gpm
Flame Length:	0.0	ft
Flame Width:	0.0	ft
Primary Air:	0.0	

Weather Conditions

Ambient Air Temp:	56	°F
Relative Humidity:	50	%
Wind Speed:	5	mph
Atmospheric Pressure:	14.42	psia

Furnace 13 Comments

1.
2.
3.
4.
5.
6.
7.
8.
9.

	Dp	Press	Temp.	LHV	Orifice Bore
Line 1	0.00	0.0	69.6	0.0	0.3450
Line 2	230.77	62.4	99.4	0.0	0.1710
Line 3	132.53	57.6	79.2	0.0	0.3400
Line 4	163.15	77.1	105.2	0.0	0.2250

Sample Date 11/18/2013 Truck/Trailer No.:

Property	Result	Specification
Methane, PPM Wgt.	BDL	Note (1)
Ethane, PPM Wgt.	8	Note (1)
Ethylene, PPM Wgt.	0.5	100 max.
Propane, Wgt. %	0.34	0.5 max.
Propylene, Wgt. %	99.66	99.5 min.
Total Saturated C4's, PPM Mole	BDL	Note (1)
Propadiene, PPM Wgt.	BDL	5 max.
Methyl Acetylene, PPM Wgt.	BDL	7 max.
Acetylene, PPM Wgt.	BDL	3 max.
Total Butadienes, PPM Wgt.	BDL	10 max.
Total Butenes, PPM Wgt.	BDL	100 max.
1-Butyne, PPM Wgt.	BDL	7 max.
2-Butyne, PPM Wgt.	BDL	7 max.
Cyclopropane, PPM Wgt.	BDL	1 max.
3-Methyl 1-Butene, PPM Wgt.	BDL	1 max.
Total > C5, PPM Wgt.	BDL	20 max.
Carbon Monoxide, PPM Wgt.	BDL	0.033 max.
Carbon Dioxide, PPM Wgt.	BDL	2 max.
Carbonyl Sulfide, PPM Wgt.	BDL	0.043 max.
Hydrogen Sulfide, PPM Wgt.	BDL	1 max.
Total Sulfur, PPM Wgt.	BDL	1 max.
Arsine, PPM Wgt.	BDL	0.056 max.
Phosphine, PPM Wgt.	BDL	0.1 max.
Methanol, PPM Wgt.	BDL	4 max.
2-Propanol, PPM Wgt.	BDL	7 max.
Water, PPM Wgt.	0.05	2 max.
Hydrogen, PPM Wgt.	BDL	1 max.
Oxygen, PPM Wgt.*	BDL	2 max.
Nitrogen, PPM Wgt.	BDL	Note (1)
Ammonia, PPM Wgt.	BDL	0.2 max.

Rail Car CS42500
Source Tank 5

by/for JEO
Robert D. Freeman
Laboratory Manager

Note (1) Total Non-Propane Inerts = 1000 Wt. ppm max.

Revised 09/09/13

APPENDIX E

FUEL ANALYSIS RECORDS

LABORATORY REPORT

March 28, 2014

Min Lee
Air Hygiene, Incorporated
1600 West Tacoma Street
Broken Arrow, OK 74012

RE: JZ-14-Tulsa.ok-comp#1 / 1

Dear Min:

Enclosed are the results of the samples submitted to our laboratory on March 15, 2014. For your reference, these analyses have been assigned our service request number P1401040.

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
Laboratory Director

CASE NARRATIVE

The samples were received intact under chain of custody on March 15, 2014 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.

Benzene Analysis

The samples were analyzed per ASTM D1945-03 for benzene using a gas chromatograph equipped with a flame ionization detector (FID). This procedure is described in laboratory SOP VOA-TO3C1C6. This method is not included on the laboratory's NELAP or AIHA-LAP scope of accreditation.

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 ASTM D1945-03 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 ASTM D1945-03 (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.

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.

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	L14-2
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	643428
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

Service Request: P1401040

Project ID: JZ-14-Tulsa.ok-comp#1 / 1

Date Received: 3/15/2014

Time Received: 10:10

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	Container ID	Pi1 (psig)	Pf1 (psig)	TO-3 Modified - C1C6+ Can	3C Modified - Fxd Gases Can	ASTM D5504-01 - H2S Can	ASTM D5504-08 - Sulfur Can
JZ-0-30-0%-Can-4X30PF	P1401040-001	Air	3/11/2014	13:16	SSC00180	-0.54	3.82	X	X	X	X
JZ-30-70-30%-Can-4X30PF	P1401040-002	Air	3/12/2014	12:24	SSC00082	1.27	3.98	X	X	X	X
JZ-70-100-70%-Can-4X30PF	P1401040-003	Air	3/13/2014	09:40	SSC00037	2.72	3.91	X	X	X	X
JZ-90-100%-Can-4X30PF	P1401040-004	Air	3/13/2014	15:15	SSC00188	0.41	3.82	X	X	X	X

Air - Chain of Custody Record & Analytical Service Request

Page _____ of _____

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
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: P1401040

Company Name & Address (Reporting Information): John Zink, Inc

Project Name: JZ-14- Tulsa.ok -comp# 1

Project Number: 1

Project Manager: Min Sum Lee

P.O. # / Billing Information

Phone: 918-565-5379

Fax:

Email Address for Result Reporting: mlee@airhygiene.com A lab@airhygiene.com

Sampler (Print & Sign):

ALS Contact:

Analysis Method: See Quote or call

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	Comments e.g. Actual Preservative or specific instructions
JZ-0-30-0%-can-4x30PF	1-0.75	3/11/14	13:16:00	SSC00180	SOA-00162	-30.00	-0.05		
JZ-30-70-30%-can-4x30PF	2+1.02	3/12/14	12:24:00	SSC00082	SOA-00068	-30.00	-0.02		
JZ-70-100-70%-can-4x30PF	3+2.55	3/13/14	9:40:00	SSC00037	SOA-00121	-30.00	-0.02		
JZ-90-100%-can-4x30PF	4+0.20	3/13/14	15:15:00	SSC00188	SOA00078	-30.00	0.05		

Report Tier Levels - please select
Tier I - Results (Default in not specified) _____
Tier II (Results + QC Summaries _____
Tier III (Results + QC & Calibration Summaries) _____
Tier IV (Date 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)	3/14/14	Time: 1010

Cooler / Blank Temperature _____°C

ALS Environmental
Sample Acceptance Check Form

Client: Air Hygiene, Incorporated Work order: P1401040

Project: JZ-14-Tulsa.ok-comp#1 / 1

Sample(s) received on: 3/15/14 Date opened: 3/15/14 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
P1401040-001.01	6.0 L Silonite Can					
P1401040-002.01	6.0 L Silonite Can					
P1401040-003.01	6.0 L Silonite Can					
P1401040-004.01	6.0 L Silonite Can					

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 Project ID: **JZ-14-Tulsa.ok-comp#1 / 1** ALS Project ID: P1401040

Benzene

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC8/FID Date(s) Collected: 3/11 - 3/13/14
Analyst: Wade Henton Date Received: 3/15/14
Sampling Media: 6.0 L Silonite Canister(s) Date Analyzed: 3/26/14
Test Notes:

Client Sample ID	ALS Sample ID	Canister Dilution Factor	Injection Volume ml(s)	**Result ppmV**	MRL ppmV	Data Qualifier
JZ-0-30-0%-Can-4X30PF	P1401040-001	1.31	0.050	ND	16	
JZ-30-70-30%-Can-4X30PF	P1401040-002	1.17	0.050	ND	14	
JZ-70-100-70%-Can-4X30PF	P1401040-003	1.07	0.050	ND	13	
JZ-90-100%-Can-4X30PF	P1401040-004	1.23	0.050	ND	15	
Method Blank	P140326-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

LABORATORY CONTROL SAMPLE SUMMARY

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Lab Control Sample**
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1**

ALS Project ID: P1401040
ALS Sample ID: P140326-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: 3/26/14
Volume(s) Analyzed: NA ml(s)

Compound	Spike Amount ppmV	**Result ppmV**	**% Recovery**	ALS Acceptance Limits	Data Qualifier
Benzene	1,100	**1,030**	**94**	50-150	

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-0-30-0%-Can-4X30PF** ALS Project ID: P1401040
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1** ALS Sample ID: P1401040-001

Test Code: ASTM D3588-98
Analyst: Mike Conejo/Nalini Lall Date Collected: 3/11/14
Sample Type: 6.0 L Silonite Canister Date Received: 3/15/14
Test Notes:
Container ID: SSC00180

Initial Pressure (psig): -0.54 Final Pressure (psig): 3.82

Canister Dilution Factor: 1.31

Components	Result Volume %	Result Weight %	Data Qualifier
Hydrogen	< 0.01	< 0.01	
Oxygen + Argon	**0.12**	**0.09**	
Nitrogen	**0.67**	**0.43**	
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	**99.15**	**99.38**	
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	**0.03**	**0.08**	
TOTALS	**99.99**	**99.99**	

Components	Mole %	Weight %
Carbon	**27.24**	**81.30**
Hydrogen	**72.62**	**18.19**
Oxygen + Argon	< 0.10	< 0.10
Nitrogen	**0.12**	**0.43**
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	**2,540.8**
Net Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/ft3	**2,337.6**
Gross Heating Value (Water Saturated at 0.25636 psia)	BTU/ft3	**2,453.6**
Net Heating Value (Water Saturated at 0.25636 psia)	BTU/ft3	**2,257.4**
Gross Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/lb	**21,916.1**
Net Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/lb	**20,163.7**
Compressibility Factor "Z" (60 F, 14.696 psia)		**0.9828**

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-30-70-30%-Can-4X30PF** ALS Project ID: P1401040
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1** ALS Sample ID: P1401040-002

Test Code: ASTM D3588-98
Analyst: Mike Conejo/Nalini Lall Date Collected: 3/12/14
Sample Type: 6.0 L Silonite Canister Date Received: 3/15/14
Test Notes:
Container ID: SSC00082

Initial Pressure (psig): 1.27 Final Pressure (psig): 3.98

Canister Dilution Factor: 1.17

Components	Result Volume %	Result Weight %	Data Qualifier
Hydrogen	< 0.01	< 0.01	
Oxygen + Argon	**0.05**	**0.04**	
Nitrogen	**0.17**	**0.11**	
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	**99.73**	**99.77**	
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	**0.02**	**0.06**	
TOTALS	**99.99**	**99.99**	

Components	Mole %	Weight %
Carbon	**27.26**	**81.60**
Hydrogen	**72.70**	**18.26**
Oxygen + Argon	< 0.10	< 0.10
Nitrogen	< 0.10	**0.11**
Sulfur	< 0.10	< 0.10

Specific Gravity (Air = 1)		**1.5219**
Specific Volume	ft3/lb	**8.61**
Gross Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/ft3	**2,555.5**
Net Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/ft3	**2,351.1**
Gross Heating Value (Water Saturated at 0.25636 psia)	BTU/ft3	**2,467.4**
Net Heating Value (Water Saturated at 0.25636 psia)	BTU/ft3	**2,270.1**
Gross Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/lb	**22,001.7**
Net Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/lb	**20,242.4**
Compressibility Factor "Z" (60 F, 14.696 psia)		**0.9827**

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-70-100-70%-Can-4X30PF** ALS Project ID: P1401040
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1** ALS Sample ID: P1401040-003

Test Code: ASTM D3588-98
Analyst: Mike Conejo/Nalini Lall Date Collected: 3/13/14
Sample Type: 6.0 L Silonite Canister Date Received: 3/15/14
Test Notes:
Container ID: SSC00037

Initial Pressure (psig): 2.72 Final Pressure (psig): 3.91

Canister Dilution Factor: 1.07

Components	Result Volume %	Result Weight %	Data Qualifier
Hydrogen	< 0.01	< 0.01	
Oxygen + Argon	**0.56**	**0.41**	
Nitrogen	**2.03**	**1.30**	
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	**97.36**	**98.18**	
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	**0.04**	**0.09**	
TOTALS	**99.99**	**99.99**	

Components	Mole %	Weight %
Carbon	**27.14**	**80.32**
Hydrogen	**72.37**	**17.97**
Oxygen + Argon	**0.10**	**0.41**
Nitrogen	**0.38**	**1.30**
Sulfur	< 0.10	< 0.10

Specific Gravity (Air = 1)		**1.5097**
Specific Volume	ft3/lb	**8.68**
Gross Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/ft3	**2,493.7**
Net Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/ft3	**2,294.3**
Gross Heating Value (Water Saturated at 0.25636 psia)	BTU/ft3	**2,409.5**
Net Heating Value (Water Saturated at 0.25636 psia)	BTU/ft3	**2,216.8**
Gross Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/lb	**21,641.9**
Net Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/lb	**19,911.5**
Compressibility Factor "Z" (60 F, 14.696 psia)		**0.9833**

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-90-100%-Can-4X30PF** ALS Project ID: P1401040
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1** ALS Sample ID: P1401040-004

Test Code: ASTM D3588-98
Analyst: Mike Conejo/Nalini Lall Date Collected: 3/13/14
Sample Type: 6.0 L Silonite Canister Date Received: 3/15/14
Test Notes:
Container ID: SSC00188

Initial Pressure (psig): 0.41 Final Pressure (psig): 3.82

Canister Dilution Factor: 1.23

Components	Result Volume %	Result Weight %	Data Qualifier
Hydrogen	< 0.01	< 0.01	
Oxygen + Argon	**0.05**	**0.04**	
Nitrogen	**0.30**	**0.19**	
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	**99.61**	**99.69**	
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	**0.02**	**0.06**	
TOTALS	**99.99**	**99.99**	

Components	Mole %	Weight %
Carbon	**27.26**	**81.53**
Hydrogen	**72.68**	**18.24**
Oxygen + Argon	< 0.10	< 0.10
Nitrogen	< 0.10	**0.19**
Sulfur	< 0.10	< 0.10

Specific Gravity (Air = 1)		**1.5211**
Specific Volume	ft3/lb	**8.61**
Gross Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/ft3	**2,552.0**
Net Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/ft3	**2,347.9**
Gross Heating Value (Water Saturated at 0.25636 psia)	BTU/ft3	**2,464.2**
Net Heating Value (Water Saturated at 0.25636 psia)	BTU/ft3	**2,267.1**
Gross Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/lb	**21,982.4**
Net Heating Value (Dry Gas @ 60 F, 14.696 psia)	BTU/lb	**20,224.7**
Compressibility Factor "Z" (60 F, 14.696 psia)		**0.9827**

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-0-30-0%-Can-4X30PF**
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1**

ALS Project ID: P1401040
ALS Sample ID: P1401040-001

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC8/FID
Analyst: Nalini Lall
Sampling Media: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00180

Date Collected: 3/11/14
Date Received: 3/15/14
Date Analyzed: 3/20/14
Volume(s) Analyzed: 0.050 ml(s)

Initial Pressure (psig): -0.54 Final Pressure (psig): 3.82

Canister Dilution Factor: 1.31

Compound	**Result ppmV**	MRL ppmV	Data Qualifier
Methane	ND	13	
C_2 as Ethane	**52**	13	
C_3 as Propane	**990,000**	13	
C_4 as n-Butane	**90**	13	
C_5 as n-Pentane	ND	13	
C_6 as n-Hexane	ND	13	
C_6+ as n-Hexane	**320**	26	

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-30-70-30%-Can-4X30PF**
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1**

ALS Project ID: P1401040
ALS Sample ID: P1401040-002

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC8/FID
Analyst: Nalini Lall
Sampling Media: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00082

Date Collected: 3/12/14
Date Received: 3/15/14
Date Analyzed: 3/20/14
Volume(s) Analyzed: 0.050 ml(s)

Initial Pressure (psig): 1.27 Final Pressure (psig): 3.98

Canister Dilution Factor: 1.17

Compound	**Result ppmV**	MRL ppmV	Data Qualifier
Methane	ND	12	
C_2 as Ethane	**62**	12	
C_3 as Propane	**1,000,000**	12	
C_4 as n-Butane	**64**	12	
C_5 as n-Pentane	ND	12	
C_6 as n-Hexane	ND	12	
C_6+ as n-Hexane	**230**	23	

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-70-100-70%-Can-4X30PF** ALS Project ID: P1401040
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1** ALS Sample ID: P1401040-003

Test Code: ASTM D1945-03 Date Collected: 3/13/14
Instrument ID: HP5890 II/GC8/FID Date Received: 3/15/14
Analyst: Nalini Lall Date Analyzed: 3/20/14
Sampling Media: 6.0 L Silonite Canister Volume(s) Analyzed: 0.050 ml(s)
Test Notes:
Container ID: SSC00037

Initial Pressure (psig): 2.72 Final Pressure (psig): 3.91

Canister Dilution Factor: 1.07

Compound	**Result ppmV**	MRL ppmV	Data Qualifier
Methane	ND	11	
C_2 as Ethane	**39**	11	
C_3 as Propane	**970,000**	11	
C_4 as n-Butane	**66**	11	
C_5 as n-Pentane	ND	11	
C_6 as n-Hexane	ND	11	
C_6+ as n-Hexane	**360**	21	

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-90-100%-Can-4X30PF**
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1**

ALS Project ID: P1401040
ALS Sample ID: P1401040-004

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC8/FID
Analyst: Nalini Lall
Sampling Media: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00188

Date Collected: 3/13/14
Date Received: 3/15/14
Date Analyzed: 3/20/14
Volume(s) Analyzed: 0.050 ml(s)

Initial Pressure (psig): 0.41 Final Pressure (psig): 3.82

Canister Dilution Factor: 1.23

Compound	**Result ppmV**	MRL ppmV	Data Qualifier
Methane	ND	12	
C_2 as Ethane	**36**	12	
C_3 as Propane	**1,000,000**	12	
C_4 as n-Butane	**66**	12	
C_5 as n-Pentane	ND	12	
C_6 as n-Hexane	ND	12	
C_6+ as n-Hexane	**220**	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: **Method Blank**
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1**

ALS Project ID: P1401040
ALS Sample ID: P140320-MB

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC8/FID
Analyst: Nalini Lall
Sampling Media: 6.0 L Silonite Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 3/20/14
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-14-Tulsa.ok-comp#1 / 1**

ALS Project ID: P1401040
ALS Sample ID: P140320-LCS

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC8/FID
Analyst: Nalini Lall
Sampling Media: 6.0 L Silonite Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 3/20/14
Volume(s) Analyzed: NA ml(s)

Compound	Spike Amount ppmV	**Result ppmV**	**% Recovery**	ALS Acceptance Limits	Data Qualifier
Methane	1,020	**1,060**	**104**	83-120	
Ethane	1,010	**1,070**	**106**	85-122	
Propane	1,010	**1,050**	**104**	84-121	
n-Butane	1,010	**995**	**99**	79-114	
n-Pentane	1,010	**1,040**	**103**	80-121	
n-Hexane	1,020	**1,010**	**99**	73-121	

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-0-30-0%-Can-4X30PF** ALS Project ID: P1401040
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1** ALS Sample ID: P1401040-001

Test Code: ASTM D1945-03 Date Collected: 3/11/14
Instrument ID: HP5890 II/GC1/TCD Date Received: 3/15/14
Analyst: Nalini Lall Date Analyzed: 3/18/14
Sample Type: 6.0 L Silonite Canister Volume(s) Analyzed: 0.10 ml(s)
Test Notes:
Container ID: SSC00180

Initial Pressure (psig): -0.54 Final Pressure (psig): 3.82

Canister Dilution Factor: 1.31

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**	**0.121**	0.13	**K**
7727-37-9	**Nitrogen**	**0.607**	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.

K = Analyte was detected above the method reporting limit prior to normalization.

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-30-70-30%-Can-4X30PF**
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1**

ALS Project ID: P1401040
ALS Sample ID: P1401040-002

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC1/TCD
Analyst: Nalini Lall
Sample Type: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00082

Date Collected: 3/12/14
Date Received: 3/15/14
Date Analyzed: 3/18/14
Volume(s) Analyzed: 0.10 ml(s)

Initial Pressure (psig): 1.27 Final Pressure (psig): 3.98

Canister Dilution Factor: 1.17

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	ND	0.12	
7727-37-9	**Nitrogen**	**0.166**	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-70-100-70%-Can-4X30PF** ALS Project ID: P1401040
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1** ALS Sample ID: P1401040-003

Test Code: ASTM D1945-03 Date Collected: 3/13/14
Instrument ID: HP5890 II/GC1/TCD Date Received: 3/15/14
Analyst: Nalini Lall Date Analyzed: 3/18/14
Sample Type: 6.0 L Silonite Canister Volume(s) Analyzed: 0.10 ml(s)
Test Notes:
Container ID: SSC00037

Initial Pressure (psig): 2.72 Final Pressure (psig): 3.91

Canister Dilution Factor: 1.07

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
1333-74-0	Hydrogen	ND	0.11	
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**0.557**	0.11	
7727-37-9	**Nitrogen**	**2.03**	0.11	
630-08-0	Carbon Monoxide	ND	0.11	
124-38-9	Carbon Dioxide	ND	0.11	

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-90-100%-Can-4X30PF**
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1**

ALS Project ID: P1401040
ALS Sample ID: P1401040-004

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC1/TCD
Analyst: Nalini Lall
Sample Type: 6.0 L Silonite Canister
Test Notes:
Container ID: SSC00188

Date Collected: 3/13/14
Date Received: 3/15/14
Date Analyzed: 3/18/14
Volume(s) Analyzed: 0.10 ml(s)

Initial Pressure (psig): 0.41 Final Pressure (psig): 3.82

Canister Dilution Factor: 1.23

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	ND	0.12	
7727-37-9	**Nitrogen**	**0.302**	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-14-Tulsa.ok-comp#1 / 1**

ALS Project ID: P1401040
ALS Sample ID: P140318-MB

Test Code: ASTM D1945-03
Instrument ID: HP5890 II/GC1/TCD
Analyst: Nalini Lall
Sample Type: 6.0 L Silonite Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 3/18/14
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** ALS Project ID: P1401040
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1** ALS Sample ID: P140318-LCS

Test Code: ASTM D1945-03 Date Collected: NA
Instrument ID: HP5890 II/GC1/TCD Date Received: NA
Analyst: Nalini Lall Date Analyzed: 3/18/14
Sample Type: 6.0 L Silonite Canister Volume(s) Analyzed: NA ml(s)
Test Notes:

CAS #	**Compound**	Spike Amount ppmV	**Result ppmV**	**% Recovery**	ALS Acceptance Limits	Data Qualifier
1333-74-0	Hydrogen	40,000	**36,700**	**92**	84-110	
7782-44-7	Oxygen +					
7440-37-1	Argon	50,000	**50,600**	**101**	88-114	
7727-37-9	Nitrogen	50,000	**51,500**	**103**	88-114	
630-08-0	Carbon Monoxide	50,000	**49,900**	**100**	88-113	
124-38-9	Carbon Dioxide	50,000	**49,400**	**99**	84-109	

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **JZ-0-30-0%-Can-4X30PF** ALS Project ID: P1401040
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1** ALS Sample ID: P1401040-001

Test Code:	ASTM D 5504-08	Date Collected:	3/11/14
Instrument ID:	Agilent 6890A/GC13/SCD	Time Collected:	13:16
Analyst:	Mike Conejo	Date Received:	3/15/14
Sample Type:	6.0 L Silonite Canister	Date Analyzed:	3/18/14
Test Notes:		Time Analyzed:	16:05
Container ID:	SSC00180	Volume(s) Analyzed:	1.0 ml(s)

Initial Pressure (psig): -0.54 Final Pressure (psig): 3.82

Canister Dilution Factor: 1.31

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
7783-06-4	Hydrogen Sulfide	ND	9.1	ND	6.6	
463-58-1	Carbonyl Sulfide	ND	16	ND	6.6	
74-93-1	Methyl Mercaptan	ND	13	ND	6.6	
75-08-1	Ethyl Mercaptan	ND	17	ND	6.6	
75-18-3	Dimethyl Sulfide	ND	17	ND	6.6	
75-15-0	Carbon Disulfide	ND	10	ND	3.3	
75-33-2	Isopropyl Mercaptan	ND	20	ND	6.6	
75-66-1	tert-Butyl Mercaptan	ND	24	ND	6.6	
107-03-9	n-Propyl Mercaptan	ND	20	ND	6.6	
624-89-5	Ethyl Methyl Sulfide	ND	20	ND	6.6	
110-02-1	Thiophene	ND	23	ND	6.6	
513-44-0	Isobutyl Mercaptan	ND	24	ND	6.6	
352-93-2	Diethyl Sulfide	ND	24	ND	6.6	
109-79-5	n-Butyl Mercaptan	ND	24	ND	6.6	
624-92-0	Dimethyl Disulfide	ND	13	ND	3.3	
616-44-4	3-Methylthiophene	ND	26	ND	6.6	
110-01-0	Tetrahydrothiophene	ND	24	ND	6.6	
638-02-8	2,5-Dimethylthiophene	ND	30	ND	6.6	
872-55-9	2-Ethylthiophene	ND	30	ND	6.6	
110-81-6	Diethyl Disulfide	ND	16	ND	3.3	

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-30-70-30%-Can-4X30PF** ALS Project ID: P1401040
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1** ALS Sample ID: P1401040-002

Test Code:	ASTM D 5504-08	Date Collected:	3/12/14
Instrument ID:	Agilent 6890A/GC13/SCD	Time Collected:	12:24
Analyst:	Mike Conejo	Date Received:	3/15/14
Sample Type:	6.0 L Silonite Canister	Date Analyzed:	3/18/14
Test Notes:		Time Analyzed:	16:21
Container ID:	SSC00082	Volume(s) Analyzed:	1.0 ml(s)

Initial Pressure (psig): 1.27 Final Pressure (psig): 3.98

Canister Dilution Factor: 1.17

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
7783-06-4	Hydrogen Sulfide	ND	8.2	ND	5.9	
463-58-1	Carbonyl Sulfide	ND	14	ND	5.9	
74-93-1	Methyl Mercaptan	ND	12	ND	5.9	
75-08-1	Ethyl Mercaptan	ND	15	ND	5.9	
75-18-3	Dimethyl Sulfide	ND	15	ND	5.9	
75-15-0	Carbon Disulfide	ND	9.1	ND	2.9	
75-33-2	Isopropyl Mercaptan	ND	18	ND	5.9	
75-66-1	tert-Butyl Mercaptan	ND	22	ND	5.9	
107-03-9	n-Propyl Mercaptan	ND	18	ND	5.9	
624-89-5	Ethyl Methyl Sulfide	ND	18	ND	5.9	
110-02-1	Thiophene	ND	20	ND	5.9	
513-44-0	Isobutyl Mercaptan	ND	22	ND	5.9	
352-93-2	Diethyl Sulfide	ND	22	ND	5.9	
109-79-5	n-Butyl Mercaptan	ND	22	ND	5.9	
624-92-0	Dimethyl Disulfide	ND	11	ND	2.9	
616-44-4	3-Methylthiophene	ND	23	ND	5.9	
110-01-0	Tetrahydrothiophene	ND	21	ND	5.9	
638-02-8	2,5-Dimethylthiophene	ND	27	ND	5.9	
872-55-9	2-Ethylthiophene	ND	27	ND	5.9	
110-81-6	Diethyl Disulfide	ND	15	ND	2.9	

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-70-100-70%-Can-4X30PF** ALS Project ID: P1401040
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1** ALS Sample ID: P1401040-003

Test Code:	ASTM D 5504-08	Date Collected:	3/13/14
Instrument ID:	Agilent 6890A/GC13/SCD	Time Collected:	09:40
Analyst:	Mike Conejo	Date Received:	3/15/14
Sample Type:	6.0 L Silonite Canister	Date Analyzed:	3/18/14
Test Notes:		Time Analyzed:	16:42
Container ID:	SSC00037	Volume(s) Analyzed:	1.0 ml(s)

Initial Pressure (psig): 2.72 Final Pressure (psig): 3.91

Canister Dilution Factor: 1.07

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
7783-06-4	Hydrogen Sulfide	ND	7.5	ND	5.4	
463-58-1	Carbonyl Sulfide	ND	13	ND	5.4	
74-93-1	Methyl Mercaptan	ND	11	ND	5.4	
75-08-1	Ethyl Mercaptan	ND	14	ND	5.4	
75-18-3	Dimethyl Sulfide	ND	14	ND	5.4	
75-15-0	Carbon Disulfide	ND	8.3	ND	2.7	
75-33-2	Isopropyl Mercaptan	ND	17	ND	5.4	
75-66-1	tert-Butyl Mercaptan	ND	20	ND	5.4	
107-03-9	n-Propyl Mercaptan	ND	17	ND	5.4	
624-89-5	Ethyl Methyl Sulfide	ND	17	ND	5.4	
110-02-1	Thiophene	ND	18	ND	5.4	
513-44-0	Isobutyl Mercaptan	ND	20	ND	5.4	
352-93-2	Diethyl Sulfide	ND	20	ND	5.4	
109-79-5	n-Butyl Mercaptan	ND	20	ND	5.4	
624-92-0	Dimethyl Disulfide	ND	10	ND	2.7	
616-44-4	3-Methylthiophene	ND	21	ND	5.4	
110-01-0	Tetrahydrothiophene	ND	19	ND	5.4	
638-02-8	2,5-Dimethylthiophene	ND	25	ND	5.4	
872-55-9	2-Ethylthiophene	ND	25	ND	5.4	
110-81-6	Diethyl Disulfide	ND	13	ND	2.7	

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-90-100%-Can-4X30PF**
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1**

ALS Project ID: P1401040
ALS Sample ID: P1401040-004

Test Code:	ASTM D 5504-08	Date Collected:	3/13/14
Instrument ID:	Agilent 7890A/GC22/SCD	Time Collected:	15:15
Analyst:	Mike Conejo	Date Received:	3/15/14
Sample Type:	6.0 L Silonite Canister	Date Analyzed:	3/18/14
Test Notes:		Time Analyzed:	16:53
Container ID:	SSC00188	Volume(s) Analyzed:	1.0 ml(s)

Initial Pressure (psig): 0.41 Final Pressure (psig): 3.82

Canister Dilution Factor: 1.23

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	**39**	15	**7.8**	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: **Method Blank**
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1**

ALS Project ID: P1401040
ALS Sample ID: P140318-MB

Test Code: ASTM D 5504-08
Instrument ID: Agilent 6890A/GC13/SCD
Analyst: Mike Conejo
Sample Type: 6.0 L Silonite Canister
Test Notes:

Date Collected: NA
Time Collected: NA
Date Received: NA
Date Analyzed: 3/18/14
Time Analyzed: 08:32
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

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Method Blank**
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1**

ALS Project ID: P1401040
ALS Sample ID: P140318-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: 3/18/14
Time Analyzed: 08:32
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-14-Tulsa.ok-comp#1 / 1**

ALS Project ID: P1401040
ALS Sample ID: P140318-LCS

Test Code: ASTM D 5504-08
Instrument ID: Agilent 6890A/GC13/SCD
Analyst: Mike Conejo
Sample Type: 6.0 L Silonite Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 3/18/14
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	**1,850**	**90**	66-131	
463-58-1	Carbonyl Sulfide	2,020	**1,780**	**88**	64-131	
74-93-1	Methyl Mercaptan	1,890	**1,990**	**105**	68-160	

ALS ENVIRONMENTAL

LABORATORY CONTROL SAMPLE SUMMARY

Client: **Air Hygiene, Incorporated**
Client Sample ID: **Lab Control Sample**
Client Project ID: **JZ-14-Tulsa.ok-comp#1 / 1**

ALS Project ID: P1401040
ALS Sample ID: P140318-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: 3/18/14
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	**1,790**	**87**	66-131	
463-58-1	Carbonyl Sulfide	2,020	**1,930**	**96**	64-131	
74-93-1	Methyl Mercaptan	1,890	**2,140**	**113**	68-160	

APPENDIX F

METHOD 3C RESULTS

LABORATORY REPORT

March 26, 2014

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 March 12, 2014. For your reference, these analyses have been assigned our service request number P1400954.

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
Laboratory Director

Client: Air Hygiene, Incorporated Service Request No: P1400954
Project: jz-13-tulsa.ok-comp#1

CASE NARRATIVE

The samples were received intact under chain of custody on March 12, 2014 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.

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	494864
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

Service Request: P1400954

Project ID: jz-13-tulsa.ok-comp#1

Date Received: 3/12/2014

Time Received: 09:45

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	3C Modified - Fxd Gases Bag 2X
R1-0-30-0%-4X30PF	P1400954-001	Air	3/11/14	00:00	X
R2-0-30-0%-4X30PF	P1400954-003	Air	3/11/14	00:00	X
R3-0-30-0%-4X30PF	P1400954-005	Air	3/11/14	00:00	X

P1400954

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	Comments: Neglect Backup bag unless main bag is broken	

Sample Number	Location	Date	Volume	Analysis Method			
				O2	CO2	Nitrogen	Methane-Ethane
R1-0-30-0%-4X30PF	John Zink Tulsa R&D Facility	24-Oct	10	x	x	x	x
R1-0-30-0%-4X30PF-BACKUP	John Zink Tulsa R&D Facility	24-Oct	5	x	x	x	x
R2-0-30-0%-4X30PF	John Zink Tulsa R&D Facility	24-Oct	10	x	x	x	x
R2-0-30-0%-4X30PF-BACKUP	John Zink Tulsa R&D Facility	24-Oct	5	x	x	x	x
R3-0-30-0%-4X30PF	John Zink Tulsa R&D Facility	25-Oct	10	x	x	x	x
R3-0-30-0%-4X30PF-BACKUP	John Zink Tulsa R&D Facility	25-Oct	5	x	x	x	x

Relinquished by: (Signature)	Date: 3/11/14	Time:	Received by: (Signature)	Date: 3/12/14	Time: 0945
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

4-tulsa.ok-comp#1-coc

9H02954

SAMPLE DESCRIPTION AND CHAIN OF CUSTODY RECORD

Air Hygiene International, Inc.
1900 W Tacoma Street
Broken Arrow, Oklahoma 74012
(918) 451-5778
www.airhygiene.com

Project Number	R-13-Hancock-compl1	Laboratory Analysis Requested	RM 25
Person Taking Sample	MB	Comments: Number Darkep bag where cable bag is broken	

Sample Number	Location	Date Sampled	Volume	Analysis Method CO	CO2	Nitrogen	Methane + Ethane
R1-0-30-09-4X30PF	John Zink Tulsa R&D Facility	24-Oct	10	x	x	x	x
R1-0-30-09-4X30PF-duplicate	John Zink Tulsa R&D Facility	24-Oct	5	x	x	x	x
R2-0-30-09-4X30PF	John Zink Tulsa R&D Facility	24-Oct	10	x	x	x	x
R2-0-30-09-4X30PF-duplicate	John Zink Tulsa R&D Facility	24-Oct	5	x	x	x	x
R3-0-30-09-4X30PF	John Zink Tulsa R&D Facility	25-Oct	10	x	x	x	x
R3-0-30-09-4X30PF-duplicate	John Zink Tulsa R&D Facility	25-Oct	5	x	x	x	x

Signature of Sampler: 3/11/14 — Signature of Receiver: 3/11/14 — 0935

Signature of Sampler — Date — Time — Signature of Receiver — Date — Time

Hancock-compl1.doc

ALS Environmental
Sample Acceptance Check Form

Client: Air Hygiene, Incorporated Work order: P1400954

Project: jz-13-tulsa.ok-comp#1

Sample(s) received on: 3/12/14 Date opened: 3/12/14 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
P1400954-001.01	10 L Tedlar Bag					
P1400954-002.01	5.0 L Tedlar Bag					
P1400954-003.01	10 L Tedlar Bag					
P1400954-004.01	5.0 L Tedlar Bag					
P1400954-005.01	10 L Tedlar Bag					
P1400954-006.01	5.0 L Tedlar Bag					

Explain any discrepancies: (include lab sample ID numbers):

Chain of Custody is missing time collected

Dates collected are listed incorrectly on the COC.

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: **R1-0-30-0%-4X30PF** ALS Project ID: P1400954
Client Project ID: **jz-13-tulsa.ok-comp#1** ALS Sample ID: P1400954-001

Test Code: EPA Method 3C Modified Date Collected: 3/11/14
Instrument ID: HP5890 II/GC1/TCD Date Received: 3/12/14
Analyst: Nalini Lall Date Analyzed: 3/13/14
Sample Type: 10 L Tedlar Bag Volume(s) Analyzed: 0.10 ml(s)
Test Notes:

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**14.0**	0.10	
7727-37-9	**Nitrogen**	**80.1**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**5.91**	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: **R2-0-30-0%-4X30PF** ALS Project ID: P1400954
Client Project ID: **jz-13-tulsa.ok-comp#1** ALS Sample ID: P1400954-003

Test Code: EPA Method 3C Modified Date Collected: 3/11/14
Instrument ID: HP5890 II/GC1/TCD Date Received: 3/12/14
Analyst: Nalini Lall Date Analyzed: 3/13/14
Sample Type: 10 L Tedlar Bag Volume(s) Analyzed: 0.10 ml(s)
Test Notes:

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**14.0**	0.10	
7727-37-9	**Nitrogen**	**80.1**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**5.91**	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: **R3-0-30-0%-4X30PF** ALS Project ID: P1400954
Client Project ID: **jz-13-tulsa.ok-comp#1** ALS Sample ID: P1400954-005

Test Code: EPA Method 3C Modified Date Collected: 3/11/14
Instrument ID: HP5890 II/GC1/TCD Date Received: 3/12/14
Analyst: Nalini Lall Date Analyzed: 3/13/14
Sample Type: 10 L Tedlar Bag Volume(s) Analyzed: 0.10 ml(s)
Test Notes:

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**14.6**	0.10	
7727-37-9	**Nitrogen**	**79.9**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**5.53**	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** ALS Project ID: P1400954
Client Project ID: **jz-13-tulsa.ok-comp#1** ALS Sample ID: P140313-MB

Test Code: EPA Method 3C Modified Date Collected: NA
Instrument ID: HP5890 II/GC1/TCD Date Received: NA
Analyst: Nalini Lall Date Analyzed: 3/13/14
Sample Type: 10 L Tedlar Bag Volume(s) Analyzed: 0.10 ml(s)
Test Notes:

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.

LABORATORY REPORT

March 26, 2014

Min Lee
Air Hygiene, Incorporated
1600 West Tacoma Street
Broken Arrow, OK 74012

RE: jz-14-tulsa.ok-comp#1

Dear Min:

Enclosed are the results of the samples submitted to our laboratory on March 13, 2014. For your reference, these analyses have been assigned our service request number P1400986.

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
Laboratory Director

Client: Air Hygiene, Incorporated Service Request No: P1400986
Project: jz-14-tulsa.ok-comp#1

CASE NARRATIVE

The samples were received intact under chain of custody on March 13, 2014 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.

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	494864
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-14-tulsa.ok-comp#1

Service Request: P1400986

Date Received: 3/13/2014
Time Received: 10:00

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	3C Modified - Fxd Gases Bag 2X
R4-30-70-30%-4X30PF	P1400986-001	Air	3/12/2014	00:00	X
R5-30-70-30%-4X30PF	P1400986-003	Air	3/12/2014	00:00	X
R6-30-70-30%-4X30PF	P1400986-005	Air	3/12/2014	00:00	X
R7-70-100-70%-4X30PF	P1400986-007	Air	3/12/2014	00:00	X
R8-70-100-70%-4X30PF	P1400986-009	Air	3/12/2014	00:00	X

P1400986

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-14-tulsa.ok-comp#1	Laboratory Analysis Requested:	RM 3C
Person Taking Samples:	MSL	Comments:Do not analyze backup unless breakage	

	Sample Number	Location	Date	Volume	Analysis Method			
					O2	CO2	Nitrogen	Methane-Ethane
1	R4-30-70-30%-4X30PF	John Zink Tulsa R&D Facility	12-Mar	10	x	x	x	x
2	R4-30-70-30%-4X30PF-Backup	John Zink Tulsa R&D Facility	12-Mar	10	x	x	x	x
3	R5-30-70-30%-4X30PF	John Zink Tulsa R&D Facility	12-Mar	10	x	x	x	x
4	R5-30-70-30%-4X30PF-Backup	John Zink Tulsa R&D Facility	12-Mar	10	x	x	x	x
5	R6-30-70-30%-4X30PF	John Zink Tulsa R&D Facility	12-Mar	10	x	x	x	x
6	R6-30-70-30%-4X30PF-Backup	John Zink Tulsa R&D Facility	12-Mar	10	x	x	x	x
7	R7-70-100-70%-4X30PF	John Zink Tulsa R&D Facility	12-Mar	10	x	x	x	x
8	R7-70-100-70%-4X30PF-Backup	John Zink Tulsa R&D Facility	12-Mar	10	x	x	x	x
9	R8-70-100-70%-4X30PF	John Zink Tulsa R&D Facility	12-Mar	10	x	x	x	x
10	R8-70-100-70%-4X30PF-Backup	John Zink Tulsa R&D Facility	12-Mar	10	x	x	x	x

Relinquished by: (Signature)	Date: 3/12/14	Time: 17:40:00	Received by: (Signature)	Date: 3/13/14	Time: 1000
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

4-tulsa.ok-comp#1-coc

ALS Environmental
Sample Acceptance Check Form

Client: Air Hygiene, Incorporated Work order: P1400986

Project: jz-14-tulsa.ok-comp#1

Sample(s) received on: 3/13/14 Date opened: 3/13/14 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
P1400986-001.01	10 L Tedlar Bag					
P1400986-002.01	10 L Tedlar Bag					
P1400986-003.01	10 L Tedlar Bag					
P1400986-004.01	10 L Tedlar Bag					
P1400986-005.01	10 L Tedlar Bag					
P1400986-006.01	10 L Tedlar Bag					
P1400986-007.01	10 L Tedlar Bag					
P1400986-008.01	10 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: P1400986

Project: jz-14-tulsa.ok-comp#1

Sample(s) received on: 3/13/14 Date opened: 3/13/14 by: MZAMORA

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1400986-009.01	10 L Tedlar Bag					
P1400986-010.01	10 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: **R4-30-70-30%-4X30PF** ALS Project ID: P1400986
Client Project ID: **jz-14-tulsa.ok-comp#1** ALS Sample ID: P1400986-001

Test Code: EPA Method 3C Modified Date Collected: 3/12/14
Instrument ID: HP5890 II/GC1/TCD Date Received: 3/13/14
Analyst: Nalini Lall Date Analyzed: 3/13/14
Sample Type: 10 L Tedlar Bag Volume(s) Analyzed: 0.10 ml(s)
Test Notes:

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**14.0**	0.10	
7727-37-9	**Nitrogen**	**80.1**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**5.91**	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: **R5-30-70-30%-4X30PF** ALS Project ID: P1400986
Client Project ID: **jz-14-tulsa.ok-comp#1** ALS Sample ID: P1400986-003

Test Code: EPA Method 3C Modified Date Collected: 3/12/14
Instrument ID: HP5890 II/GC1/TCD Date Received: 3/13/14
Analyst: Nalini Lall Date Analyzed: 3/13/14
Sample Type: 10 L Tedlar Bag Volume(s) Analyzed: 0.10 ml(s)
Test Notes:

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**14.0**	0.10	
7727-37-9	**Nitrogen**	**80.1**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**5.91**	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%-4X30PF** ALS Project ID: P1400986
Client Project ID: **jz-14-tulsa.ok-comp#1** ALS Sample ID: P1400986-005

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Nalini Lall
Sample Type: 10 L Tedlar Bag
Test Notes:

Date Collected: 3/12/14
Date Received: 3/13/14
Date Analyzed: 3/13/14
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**	**14.6**	0.10	
7727-37-9	**Nitrogen**	**79.9**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**5.53**	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: **R7-70-100-70%-4X30PF** ALS Project ID: P1400986
Client Project ID: **jz-14-tulsa.ok-comp#1** ALS Sample ID: P1400986-007

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Nalini Lall
Sample Type: 10 L Tedlar Bag
Test Notes:

Date Collected: 3/12/14
Date Received: 3/13/14
Date Analyzed: 3/14/14
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**	**15.4**	0.10	
7727-37-9	**Nitrogen**	**79.3**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**5.25**	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%-4X30PF** ALS Project ID: P1400986
Client Project ID: **jz-14-tulsa.ok-comp#1** ALS Sample ID: P1400986-009

Test Code: EPA Method 3C Modified Date Collected: 3/12/14
Instrument ID: HP5890 II/GC1/TCD Date Received: 3/13/14
Analyst: Nalini Lall Date Analyzed: 3/14/14
Sample Type: 10 L Tedlar Bag Volume(s) Analyzed: 0.10 ml(s)
Test Notes:

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**14.7**	0.10	
7727-37-9	**Nitrogen**	**79.8**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**5.50**	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** ALS Project ID: P1400986
Client Project ID: **jz-14-tulsa.ok-comp#1** ALS Sample ID: P140313-MB

Test Code: EPA Method 3C Modified Date Collected: NA
Instrument ID: HP5890 II/GC1/TCD Date Received: NA
Analyst: Nalini Lall Date Analyzed: 3/13/14
Sample Type: 10 L Tedlar Bag Volume(s) Analyzed: 0.10 ml(s)
Test Notes:

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** ALS Project ID: P1400986
Client Project ID: **jz-14-tulsa.ok-comp#1** ALS Sample ID: P140314-MB

Test Code: EPA Method 3C Modified Date Collected: NA
Instrument ID: HP5890 II/GC1/TCD Date Received: NA
Analyst: Nalini Lall Date Analyzed: 3/14/14
Sample Type: 10 L Tedlar Bag Volume(s) Analyzed: 0.10 ml(s)
Test Notes:

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.

LABORATORY REPORT

March 28, 2014

Min Lee
Air Hygiene, Incorporated
1600 West Tacoma Street
Broken Arrow, OK 74012

RE: jz-14-tulsa.ok-comp#1

Dear Min:

Enclosed are the results of the samples submitted to our laboratory on March 14, 2014. For your reference, these analyses have been assigned our service request number P1401010.

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
Laboratory Director

Client: Air Hygiene, Incorporated Service Request No: P1401010
Project: jz-14-tulsa.ok-comp#1

CASE NARRATIVE

The sample were received intact under chain of custody on March 14, 2014 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.

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	494864
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

Service Request: P1401010

Project ID: jz-14-tulsa.ok-comp#1

Date Received: 3/14/2014

Time Received: 10:10

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	3C Modified - Fxd Gases Bag 2X
R9-70-100-70%-4X30PF	P1401010-001	Air	3/13/2014	00:00	X
R10-90-100%-4X30PF	P1401010-003	Air	3/13/2014	00:00	X
R11-90-100%-4X30PF	P1401010-005	Air	3/13/2014	00:00	X
R12-90-100%-4X30PF	P1401010-007	Air	3/13/2014	00:00	X

P1401010

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-14-tulsa.ok-comp#1	Laboratory Analysis Requested:	RM 3C
Person Taking Samples:	MSL	Comments:Do not analyze backup unless breakage	

	Sample Number	Location	Date	Volume	Analysis Method			
					O2	CO2	Nitrogen	Methane-Ethane
1	R9-70-100-70%-4X30PF	John Zink Tulsa R&D Facility	13-Mar	10	x	x	x	x
2	R9-70-100-70%-4X30PF-Back Up	John Zink Tulsa R&D Facility	13-Mar	10	x	x	x	x
3	R10-90-100%-4X30PF	John Zink Tulsa R&D Facility	13-Mar	10	x	x	x	x
4	R10-90-100%-4X30PF-Back Up	John Zink Tulsa R&D Facility	13-Mar	10	x	x	x	x
5	R11-90-100%-4X30PF	John Zink Tulsa R&D Facility	13-Mar	10	x	x	x	x
6	R11-90-100%-4X30PF-Back Up	John Zink Tulsa R&D Facility	13-Mar	10	x	x	x	x
7	R12-90-100%-4X30PF	John Zink Tulsa R&D Facility	13-Mar	10	x	x	x	x
8	R12-90-100%-4X30PF-Back Up	John Zink Tulsa R&D Facility	13-Mar	10	x	x	x	x

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
[signature]	3/13/14	16:00	[signature]	3/14/14	1010

4-tulsa.ok-comp#1-coc

ALS Environmental
Sample Acceptance Check Form

Client: Air Hygiene, Incorporated Work order: P1401010

Project: jz-14-tulsa.ok-comp#1

Sample(s) received on: 3/14/14 Date opened: 3/14/14 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
P1401010-001.01	10 L Tedlar Bag					
P1401010-002.01	10 L Tedlar Bag					
P1401010-003.01	10 L Tedlar Bag					
P1401010-004.01	10 L Tedlar Bag					
P1401010-005.01	10 L Tedlar Bag					
P1401010-006.01	10 L Tedlar Bag					
P1401010-007.01	10 L Tedlar Bag					
P1401010-008.01	10 L Tedlar Bag					Received Tedlar bag flat

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

RESULTS OF ANALYSIS

Client: **Air Hygiene, Incorporated**
Client Sample ID: **R9-70-100-70%-4X30PF** ALS Project ID: P1401010
Client Project ID: **jz-14-tulsa.ok-comp#1** ALS Sample ID: P1401010-001

Test Code: EPA Method 3C Modified Date Collected: 3/13/14
Instrument ID: HP5890 II/GC1/TCD Date Received: 3/14/14
Analyst: Nalini Lall Date Analyzed: 3/14/14
Sample Type: 10 L Tedlar Bag Volume(s) Analyzed: 0.10 ml(s)
Test Notes:

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**14.3**	0.10	
7727-37-9	**Nitrogen**	**79.9**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**5.73**	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%-4X30PF** ALS Project ID: P1401010
Client Project ID: **jz-14-tulsa.ok-comp#1** ALS Sample ID: P1401010-003

Test Code: EPA Method 3C Modified Date Collected: 3/13/14
Instrument ID: HP5890 II/GC1/TCD Date Received: 3/14/14
Analyst: Nalini Lall Date Analyzed: 3/14/14
Sample Type: 10 L Tedlar Bag Volume(s) Analyzed: 0.10 ml(s)
Test Notes:

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**14.2**	0.10	
7727-37-9	**Nitrogen**	**80.0**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**5.80**	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%-4X30PF** ALS Project ID: P1401010
Client Project ID: **jz-14-tulsa.ok-comp#1** ALS Sample ID: P1401010-005

Test Code: EPA Method 3C Modified Date Collected: 3/13/14
Instrument ID: HP5890 II/GC1/TCD Date Received: 3/14/14
Analyst: Nalini Lall Date Analyzed: 3/14/14
Sample Type: 10 L Tedlar Bag Volume(s) Analyzed: 0.10 ml(s)
Test Notes:

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**13.9**	0.10	
7727-37-9	**Nitrogen**	**80.0**	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	**Carbon Dioxide**	**6.08**	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%-4X30PF** ALS Project ID: P1401010
Client Project ID: **jz-14-tulsa.ok-comp#1** ALS Sample ID: P1401010-007

Test Code: EPA Method 3C Modified Date Collected: 3/13/14
Instrument ID: HP5890 II/GC1/TCD Date Received: 3/14/14
Analyst: Nalini Lall Date Analyzed: 3/14/14
Sample Type: 10 L Tedlar Bag Volume(s) Analyzed: 0.10 ml(s)
Test Notes:

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**13.9**	0.10	
7727-37-9	**Nitrogen**	**80.1**	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: **Method Blank** ALS Project ID: P1401010
Client Project ID: **jz-14-tulsa.ok-comp#1** ALS Sample ID: P140314-MB

Test Code: EPA Method 3C Modified Date Collected: NA
Instrument ID: HP5890 II/GC1/TCD Date Received: NA
Analyst: Nalini Lall Date Analyzed: 3/14/14
Sample Type: 10 L Tedlar Bag Volume(s) Analyzed: 0.10 ml(s)
Test Notes:

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.

APPENDIX G

Field Data Sheets

MULTI LOAD TEST - FIELD DATA SHEET

AIR HYGIENE

Company:	John Zink Inc
Location:	John Zink Tulsa R&D Facility
Date:	3/13/14
Unit Make and Model:	4X30PF
Unit Number:	
Serial Number:	
Data Recorded By:	
Tested With AHI Unit(s):	Truck(s): 132 Trailer(s): 210
LDEQ Warmup/Cal Req:	On (Day/Time): 24hr 5min Cal (Day/Time):

CYLINDER SERIAL NUMBERS		O_2	NOx	CO	THC	CO_2	SO_2
	Low						
	Mid						
	High						

NO_2 CONVERSION			
NO_2 Gas (ppm)		NOx Reading (ppm)	
NO Reading (ppm)		Cylinder Num	

Stack Dia. = _____
Measured By: _____
Measured With: _____

RUN INFORMATION	Low Load			Mid Load			Mid-High Load			High Load		
	70-100 % #3	70-100 % #1	70-100 % #2	___% #3	___% #2	___% #3	___% #1	___% #2	___% #3	___% #1	___% #2	___% #3
Time Start (hh:mm:ss)	8:40:04	10:27:04	12:50:04	14:05:04	15:45:23							
Time Stop (hh:mm:ss)	9:40:04	11:27:04	13:50:04	15:05:04	16:45:23							
Rated MegaWatts (MW or hp)												
Actual MegaWatts (MW or hp)												
Barometric Pressure (in. Hg)	30.19	30.20	30.15	30.09	29.93							
Ambient Temperature (°F)	57	63	66	71	83							
Relative Humidity (%)	34	28	17	14	19							
Fuel Flow (lb/min)												
Fuel Flow (SCF/hr)=(lb/min)*21.7												
Specific Humidity (gr/lb)												
Specific Humidity (lb H_2O/lb air)=(gr/lb)/7000												
PCD (psi)												
PCD (mm Hg)=(psi+14.24)*51.71493												
NOx Water Injection (gpm)												

CALIBRATION	O_2		NOx		CO		THC		CO_2		SO_2	
	Conc.	Actual	Conc.	Actual	Conc.	Actual	Conc.	Actual	Conc.	Actual	Conc.	Actual
Zero Gas	0	0.09			0	0.01	0	0.03	0	0.01		
Low Gas							3.04	3.11				
Mid Gas	12.00	12.09			8.98	8.95	5.04	5.07	9.42	9.39		
High Gas	21.10	21.09			17.30	17.36	8.48	8.48	18.50	18.47		

BIAS	O_2		NOx		CO		THC		CO_2		SO_2	
	Zero	Mid	Zero	Mid	Zero	Mid	Zero	Mid	Zero	Mid	Zero	Mid
Initial Low Load Run #1	0.11	12.13			-0.07	8.93	0.04	3.12	0.02	9.37		
Load 1 Run #1 / Load 1 Run #2	0.12	12.09			0.04	9.00	0.03	3.00	0.06	9.42		
Load 1 Run #2 / Load 1 Run #3	0.09	11.97			0.07	8.94	0.03	3.04	0.08	9.44		
Load 1 Run #3 / Load 2 Run #1	0.05	11.91			0.19	9.11	-0.02	3.05	0.09	9.42		
Load 2 Run #1 / Load 2 Run #2	0.07	11.99			0.01	9.01	-0.03	3.04	0.05	9.33		
Load 2 Run #2 / Load 2 Run #3												
Load 2 Run #3 / Load 3 Run #1												
Load 3 Run #1 / Load 3 Run #2												
Load 3 Run #2 / Load 3 Run #3												
Load 3 Run #3 / Load 4 Run #1												
Load 4 Run #1 / Load 4 Run #2												
Load 4 Run #2 / Load 4 Run #3												
Load 4 Run #3 Final												
Bias Gas Actual Conc.												

AIR HYGIENE

MULTI LOAD TEST - FIELD DATA SHEET

Company:	John Zink
Location:	J-7 R&D Facility
Date:	3/12/24
Unit Make and Model:	
Unit Number:	4X30 PF
Serial Number:	
Data Recorded By:	
Tested With AHI Unit(s):	Truck(s): 132 Trailer(s): 210
LDEQ Warmup/Cal Req:	On (Day/Time): 24hr Cal (Day/Time):

CYLINDER SERIAL NUMBERS		O_2	NOx	CO	THC	CO_2	SO_2
	Low						
	Mid						
	High						

NO_2 CONVERSION			
NO_2 Gas (ppm)		NOx Reading (ppm)	
NO Reading (ppm)		Cylinder Num	

Stack Dia. = _____
Measured By: _____
Measured With: _____

RUN INFORMATION	Low Load			Mid Load			Mid-High Load			High Load		
	30-70% #1	30-70% #2	30-70% #3	70-100% #1	70-100% #2	% #3	% #1	% #2	% #3	% #1	% #2	% #3
Time Start (hh:mm:ss)	8:40:00	10:00:00	11:23:00	13:19:00	14:29:00	15:48:00	16:30:00					
Time Stop (hh:mm:ss)	9:40:00	11:00:00	12:23:00	14:19:00	15:29:00	16:48:00	17:30:00					
Rated MegaWatts (MW or hp)												
Actual MegaWatts (MW or hp)												
Barometric Pressure (in. Hg)	30.21	30.26	30.26	30.26	30.22	30.20	30.19					
Ambient Temperature (°F)	53	60	66	58	65	72	70					
Relative Humidity (%)	40	33	25	28	28	21	20					
Fuel Flow (lb/min)												
Fuel Flow (SCF/hr)=(lb/min)*21.7												
Specific Humidity (gr/lb)												
Specific Humidity (lb H_2O/lb air)=(gr/lb)/7000												
PCD (psi)												
PCD (mm Hg)=(psi+14.24)*51.71493												
NOx Water Injection (gpm)												

CALIBRATION	O_2		NOx		CO		THC		CO_2		SO_2	
	Conc.	Actual	Conc.	Actual	Conc.	Actual	Conc.	Actual	Conc.	Actual	Conc.	Actual
Zero Gas	0	0.08			0	-0.01	0	-0.03	0	0.50		
Low Gas							3.04	3.07				
Mid Gas	12.00	12.06			8.98	8.90	5.04	5.02	9.42	9.45		
High Gas	21.10	21.13			17.30	17.37	8.48	8.57	18.50	18.57		

BIAS	O_2		NOx		CO		THC		CO_2		SO_2	
	Zero	Mid	Zero	Mid	Zero	Mid	Zero	Mid	Zero	Mid	Zero	Mid
Initial Low Load Run #1	0.12	12.01			0.18	9.00	-0.03	3.02	0.01	9.33		
Load 1 Run #1 / Load 1 Run #2	0.12	12.02			0.10	9.03	-0.04	3.04	0.04	9.38		
Load 1 Run #2 / Load 1 Run #3	0.10	12.00			0.16	8.98	-0.02	3.06	0.05	9.34		
Load 1 Run #3 / Load 2 Run #1	0.09	11.99			0.08	8.94	-0.07	3.03	0.06	9.44		
Load 2 Run #1 / Load 2 Run #2	0.09	11.97			0.13	8.94	-0.08	3.00	0.07	9.37		
Load 2 Run #2 / Load 2 Run #3	0.06	11.98			0.06	8.87	-0.03	2.95	0.05	9.45		
Load 2 Run #3 / Load 3 Run #1												
Load 3 Run #1 / Load 3 Run #2												
Load 3 Run #2 / Load 3 Run #3												
Load 3 Run #3 / Load 4 Run #1												
Load 4 Run #1 / Load 4 Run #2												
Load 4 Run #2 / Load 4 Run #3												
Load 4 Run #3 Final												
Bias Gas Actual Conc.												

AIR HYGIENE

MULTI LOAD TEST - FIELD DATA SHEET

Company:	John Zink
Location:	TZ RR Facility
Date:	3/14/14
Unit Make and Model:	
Unit Number:	4x30PF
Serial Number:	
Data Recorded By:	MSL
Tested With AHI Unit(s):	Truck(s): 132 Trailer(s): 210
LDEQ Warmup/Cal Req:	On (Day/Time): OVR 24hr Cal (Day/Time):

CYLINDER SERIAL NUMBERS		O_2	NOx	CO	THC	CO_2	SO_2
	Low						
	Mid						
	High						

NO_2 CONVERSION			
NO_2 Gas (ppm)		NOx Reading (ppm)	
NO Reading (ppm)		Cylinder Num	

Stack Dia. = _____
Measured By: _____
Measured With: _____

RUN INFORMATION	Low Load			Mid Load			Mid-High Load			High Load		
	____% #1	____% #2	____% #3	____% #1	____% #2	____% #3	____% #1	____% #2	____% #3	____% #1	____% #2	____% #3
Time Start (hh:mm:ss)	13:16:00	15:27:00	16:48:00									
Time Stop (hh:mm:ss)	14:16:00	16:24:00	17:48:00									
Rated MegaWatts (MW or hp)												
Actual MegaWatts (MW or hp)												
Barometric Pressure (in. Hg)	29.49	29.41	29.40									
Ambient Temperature (°F)	83	87	84									
Relative Humidity (%)	32	26	28									
Fuel Flow (lb/min)												
Fuel Flow (SCF/hr)=(lb/min)*21.7												
Specific Humidity (gr/lb)												
Specific Humidity (lb H_2O/lb air)=(gr/lb)/7000												
PCD (psi)												
PCD (mm Hg)=(psi+14.24)*51.71493												
NOx Water Injection (gpm)												

CALIBRATION	O_2		NOx		CO		THC		CO_2		SO_2	
	Conc.	Actual	Conc.	Actual	Conc.	Actual	Conc.	Actual	Conc.	Actual	Conc.	Actual
Zero Gas	0	0.04			0	0.03	0	0.04	0	0.01		
Low Gas							3.04	3.03				
Mid Gas	12.0	12.01			8.98	8.77	5.04	5.14	9.42	9.43		
High Gas	21.1	21.07			17.3	17.32	8.43	8.49	18.5	18.52		

BIAS	O_2		NOx		CO		THC		CO_2		SO_2	
	Zero	Mid	Zero	Mid	Zero	Mid	Zero	Mid	Zero	Mid	Zero	Mid
Initial Low Load Run #1	0.07	12.11			0.01	8.78	-0.01	3.14	0.04	9.40		
Load 1 Run #1 / Load 1 Run #2	0.01	12.02			0.05	8.46	0.01	3.00	0.01	9.31		
Load 1 Run #2 / Load 1 Run #3	0.01	12.00			0.14	8.88	0.02	2.94	0.04	9.23		
Load 1 Run #3 / Load 2 Run #1	0.01	12.01			0.13	8.49	0.04	2.96	0.03	9.28		
Load 2 Run #1 / Load 2 Run #2												
Load 2 Run #2 / Load 2 Run #3												
Load 2 Run #3 / Load 3 Run #1												
Load 3 Run #1 / Load 3 Run #2												
Load 3 Run #2 / Load 3 Run #3												
Load 3 Run #3 / Load 4 Run #1												
Load 4 Run #1 / Load 4 Run #2												
Load 4 Run #2 / Load 4 Run #3												
Load 4 Run #3 Final												
Bias Gas Actual Conc.												

M4		Pre Run 1	Post		Pre Run 6	Post
Run 1 Box Grey	1.	677.4	717.3	1	773.6	809.0
	2.	716.1	730.7	2	700.1	709.4
	3.	571.8	577.7	3	592.6	595.0
	4.	848.8	862.4.	4	804.4	812.3
					Run 7	
Box Run 2 ~~Blue~~ Grey	1	694.7	735.1	1	794.6	835.0
	2	679.5	691.1	2	748.1	758.7
	3	589.0	591.6	3	578.9	581.6
	4	790.7	798.9	4	907.4	918.4
					TP 13/11/12	
Run 3	1	717.3	~~745.6~~		739.1	scales weren't balanced properly
	2	730.7	~~729.4~~		756.1	
	3	577.7	~~567.5~~		579.3	
	4	862.4	~~850.8~~		865.9	
					~~Run 8~~	
Run 4	1	735.1	773.6	1	~~809.0~~	
	2	691.1	700.1	2	~~709.4~~	
	3	591.6	592.6	3	~~595.0~~	
	4	798.9	804.4	4	~~812.3~~	
					Run 8	
Run 5	1	739.1	794.6	1	835.0	875.3
	2	756.1	748.1	2	758.7	767.3
	3	579.3	578.9	3	581.6	582.9
	4	896.0	907.4	4	918.4	927.8

53 40%

	Run 9 Pre	Post
1	707.3	732.4
2	742.0	758.3
3	575.4	579.0
4	875.0	886.6
	Run 10	
1	707.3	739.3
2	677.3	689.9
3	591.3	593.5
4	875.5	886.6
	Run 11	
1	732.4	771.6
2	758.3	768.2
3	579.0	582.4
4	886.6	898.2
	Run 12	
1	739.3	777.8
2	689.9	700.9
3	593.5	596.5
4	886.6	894.9

Canister pressure 3/11 4x30PF

0/30/0 Run 1-3

-30.0

-21.2

-10.8

-0.05

30/70/30 Run 4-6

-30.00

-19.3

-10.15

-0.02

70/100/70 Run 7-9

-30.0

-20.31

-10.2

-0.02

9/100 Run 10-12

-30.0

-19.5

-9.70

0.05

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end of report

APPENDIX C

MUNICIPLE AND COUNTY NOTIFICATION LETTERS

CERTIFIED MAIL # 7014 0150 0002 0658 2863

Commissioners Office
Berks County Services Center
633 Court Street, 13th Floor
Reading, PA 19601

Re: County Notification
State Only Operating Permit
Sunoco Pipeline, L.P. Beckersville Station
Brecknock Township, Berks County

Dear Berks 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 Beckersville Station located in Brecknock Township, Berks 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 as an air pollution control and safety 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, Southcentral Regional Office, Bureau of Air Quality Control at 909 Elmerton Avenue, Harrisburg, PA (717-705-4700).

Sincerely,

Matthew L. L. Gordon
Sunoco Pipeline, L.P.

CERTIFIED MAIL # 7000 1670 0005 1026 4373

Carol Martin / Brecknock Township
889 Alleghenyville Road
Mohnton, PA 19540

Re: Municipal Notification
State Only Operating Permit
Sunoco Pipeline, L.P. Beckersville Station
Brecknock Township, Berks County

Dear Brecknock Township Supervisors/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 Beckersville Station located in Brecknock Township, Berks 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 Beckersville Station as an air pollution control and safety 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, Southcentral Regional Office, Bureau of Air Quality Control at 909 Elmerton Avenue, Harrisburg, PA 17110 (717-705-4702).

Sincerely,

Matthew L. Gordon
Sunoco Pipeline, L.P.