

Source Test Report

Eastern Research Group
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**U.S. EPA REGION 8
HEARING CLERK**

CAA-08-2024-0003

Uinta Wax
Womack, Gray, Deep Creek, Lamb and ULT

Sources Tested: Nine (9) Pumpjack Engines
Test Dates: September 13 & 16, 2021

AST Project No. 2021-2251-005

Prepared By
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Source Information

<i>Make / Model</i>	<i>Serial #</i>	<i>Facility Name</i>	<i>Target Parameters</i>
Arrow L-975	DDL795005	Womack 13-9-3-1E	NOx, CO, NMHC
Arrow A-90	BDA90S008	Womack 13-9-3-1E-H1	NOx, CO, NMHC
Ajax E-565	86565	Gray 2-17-3-1E	NOx, CO, NMHC
Arrow L-795	L-600842	Deep Creek 14-9-4-2E	NOx, CO, NMHC
Arrow L-95	L-600411	Deep Creek 8-16-4-2E	NOx, CO, NMHC
Arrow L-795	L-600994	Lamb 4-15-4-2E	NOx, CO, NMHC
Ajax E-565	86464	Lamb 6-15-4-2E	NOx, CO, NMHC
Arrow A-90	BEA90S004	ULT 3-35-3-1B	NOx, CO, NMHC
Arrow A-90	BEA90S003	4-35-3-1E	NOx, CO, NMHC

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Unita Wax
Womack, Gray, Deep Creek, Lamb and ULT

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Alliance Source Testing, LLC (AST) has completed the source testing as described in this report. Results apply only to the source(s) tested and operating condition(s) for the specific test date(s) and time(s) identified within this report. All results are intended to be considered in their entirety, and AST is not responsible for use of less than the complete test report without written consent. This report shall not be reproduced in full or in part without written approval from the customer.

To the best of my knowledge and abilities, all information, facts and test data are correct. Data presented in this report has been checked for completeness and is accurate, error-free and legible. Onsite testing was conducted in accordance with approved internal Standard Operating Procedures. Any deviations or problems are detailed in the relevant sections on the test report.

This report is only considered valid once an authorized representative of AST has signed in the space provided below; any other version is considered draft. This document was prepared in portable document format (.pdf) and contains pages as identified in the bottom footer of this document.



Shamit Nakra, QSTI
Alliance Source Testing, LLC

01/10/2022

Date

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Introduction

1.0 Introduction

Alliance Source Testing, LLC (AST) was retained by Eastern Research Group (ERG) to conduct compliance testing at the Unita Wax Womack, Gray, Deep Creek, Lamb, and ULT facilities. Testing was conducted to determine the emission rates of nitrogen oxides (NO_x), carbon monoxide (CO) and non-methane hydrocarbons (NMHC) from the exhaust of four (4) Arrow L-795 engines, two (2) Ajax E-565 engines, and three (3) Arrow A-90 engines. Due to the small diameter of the stacks of these engines, emission rates were calculated using the Wyoming Analyzer Protocol, Page 25, Section 10.1.2. The maximum Engine Brake Work (MAXEBW) horsepower (hp) is the nameplate hp in the field, the Engine Brake Work (EBW) hp is the site-rated hp adjusted to 5,500 elevation.

Where manufacturer-specified Brake Specific Fuel Consumption (BSFC) in BTU/HP-hr and nameplate horsepower in HP were available, those were used in calculations for emission mass rates. Where they were not available, the Wyoming Analyzer Protocol default value of 9,400 BTU/hp-hr was used. Where manufacture year or horsepower were not available on the engine nameplate, or there was no nameplate, the year and horsepower reported were provided by the EPA relying on emission inventory data.

1.1 Project Team

Personnel involved in this project are identified in the following table.

**Table 1-1
Project Team**

EPA Personnel	Cindy Beeler
AST Personnel	Matthew Pellham

Summary of Results

2.0 Summary of Results

AST conducted compliance testing at the Uinta Wax Womack, Gray, Deep Creek, Lamb, and ULT facilities on September 13 and 16, 2021. Testing consisted of determining the emission rates of NO_x, CO and NMHC from the exhaust of nine (9) engines. Due to the small diameter of the stacks of these engines, emission rates were calculated using the Wyoming Analyzer Protocol, Page 25, Section 10.1.2.

Tables 2-1 through 2-3 provide summaries of the emission testing results. Any difference between the summary results listed in the following tables and the detailed results contained in appendices is due to rounding for presentation.

Table 2-1
Summary of Results

Engine ID/Serial #	Womack 13-9-3-1E DDL795005	Womack 13-9-3-1E-H1 BDA90S008	Gray 2-17-3-1E 86565
Date	9/13/21	9/13/21	9/13/21
Carbon Monoxide Data			
Concentration, ppmvd	2,990.6	28,067.5	405.1
Concentration, ppmvd @ 15% O ₂	2,856.6	8,815.8	333.7
Emission Rate, lb/hr	4.2	14.9	0.33
Emission Rate, ton/yr	18.4	65.2	1.5
Emission Factor, g/hp-hr	35.1	73.6	4.5
Nitrogen Oxides Data			
Concentration, ppmvd	123.8	179.9	1.8
Concentration, ppmvd @ 15% O ₂	118.2	56.5	1.5
Emission Rate, lb/hr	0.29	0.16	0.0025
Emission Rate, ton/yr	1.3	0.69	0.011
Emission Factor, g/hp-hr	2.4	0.77	0.034
Methane Data			
Concentration, ppmvd	0.076	0.066	0.046
Concentration, ppmvd @ 15% O ₂	0.072	0.021	0.038
Emission Rate, lb/hr	0.000061	0.000020	0.000022
Emission Rate, ton/yr	0.00027	0.000088	0.000095
Emission Factor, g/hp-hr	0.00051	0.000099	0.00029
Non-Methane Hydrocarbons Data			
Concentration, ppmvd	1,892.0	1,229.2	2,422.7
Concentration, ppmvd @ 15% O ₂	1,807.2	386.1	1,995.4
Emission Rate, lb/hr	4.2	1.0	3.1
Emission Rate, ton/yr	18.3	4.5	13.7
Emission Factor, g/hp-hr	35.0	5.1	42.5

Table 2-2
Summary of Results

Engine ID/Serial #	Deep Creek 14-9-4-2E L-600842	Deep Creek 8-16-4-2E L-600411	Lamb 4-15-4-2E L-600994
Date	9/16/21	9/16/21	9/16/21
Carbon Monoxide Data			
Concentration, ppmvd	18,629.8	448.6	9,423.8
Concentration, ppmvd @ 15% O ₂	8,897.0	371.8	5,893.4
Emission Rate, lb/hr	13.3	0.56	8.8
Emission Rate, ton/yr	58.3	2.4	38.6
Emission Factor, g/hp-hr	109.4	4.6	72.5
Nitrogen Oxides Data			
Concentration, ppmvd	33.5	130.6	89.4
Concentration, ppmvd @ 15% O ₂	16.0	108.3	55.9
Emission Rate, lb/hr	0.039	0.27	0.14
Emission Rate, ton/yr	0.17	1.2	0.60
Emission Factor, g/hp-hr	0.32	2.2	1.1
Methane Data			
Concentration, ppmvd	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>
Concentration, ppmvd @ 15% O ₂	0.00	0.00	0.0
Emission Rate, lb/hr	0.00	0.00	0.00
Emission Rate, ton/yr	0.00	0.00	0.00
Emission Factor, g/hp-hr	0.000	0.000	0.000
Non-Methane Hydrocarbons Data			
Concentration, ppmvd	3,736.3	1,613.6	3,322.1
Concentration, ppmvd @ 15% O ₂	1,784.4	1,337.3	2,077.6
Emission Rate, lb/hr	4.2	3.2	4.9
Emission Rate, ton/yr	18.4	13.8	21.4
Emission Factor, g/hp-hr	34.6	25.9	40.2

Underlined values have been adjusted to zero for calculation purposes.

**Table 2-3
Summary of Results**

Engine ID/Serial #	Lamb 6-15-4-2E 86464	ULT 3-35-3-1E BEA90S004	ULT 4-35-3-1E BEA90S003
Date	9/16/21	9/16/21	9/16/21
Carbon Monoxide Data			
Concentration, ppmvd	350.7	23,147.0	14,768.2
Concentration, ppmvd @ 15% O ₂	320.7	6,663.4	4,619.1
Emission Rate, lb/hr	0.33	9.6	7.8
Emission Rate, ton/yr	1.4	42.0	34.2
Emission Factor, g/hp-hr	4.3	55.6	38.6
Nitrogen Oxides Data			
Concentration, ppmvd	6.5	796.7	2,016.3
Concentration, ppmvd @ 15% O ₂	5.9	229.3	630.7
Emission Rate, lb/hr	0.0099	0.54	1.7
Emission Rate, ton/yr	0.043	2.4	7.7
Emission Factor, g/hp-hr	0.13	3.1	8.6
Methane Data			
Concentration, ppmvd	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>
Concentration, ppmvd @ 15% O ₂	0.0	0.00	0.00
Emission Rate, lb/hr	0.00	0.00	0.00
Emission Rate, ton/yr	0.00	0.00	0.00
Emission Factor, g/hp-hr	0.000	0.000	0.000
Non-Methane Hydrocarbons Data			
Concentration, ppmvd	3,656.2	582.7	600.1
Concentration, ppmvd @ 15% O ₂	3,343.1	167.7	187.7
Emission Rate, lb/hr	5.3	0.38	0.50
Emission Rate, ton/yr	23.4	1.7	2.2
Emission Factor, g/hp-hr	71.3	2.2	2.5

Underlined values have been adjusted to zero for calculation purposes.

Testing Methodology

3.0 Testing Methodology

The emission testing program was conducted in accordance with the test methods listed in Table 3-1. Method descriptions are provided below while quality assurance/quality control data is provided in Appendix C.

Table 3-1
Source Testing Methodology

Parameter	U.S. EPA Reference Test Methods	Notes/Remarks
Oxygen / Carbon Dioxide	3A	Instrumental Analysis
Nitrogen Oxides	7E	Instrumental Analysis
Carbon Monoxide	10	Instrumental Analysis
Volumetric Flow Rate	19	Fuel Factors / Heat Inputs
Non-Methane Hydrocarbons	25A	Instrumental Analysis
Gas Dilution System Certification	205	--

3.1 U.S. EPA Reference Test Method 3A – Oxygen/Carbon Dioxide

The oxygen (O₂) and carbon dioxide (CO₂) testing was conducted in accordance with U.S. EPA Reference Test Method 3A. Data was collected online and reported in one-minute averages. The sampling system consisted of a stainless-steel probe, Teflon sample line(s), gas conditioning system and the identified gas analyzer. The gas conditioning system was a non-contact condenser used to remove moisture from the stack gas. If an unheated Teflon sample line was used, then a portable non-contact condenser was placed in the system directly after the probe. Otherwise, a heated Teflon sample line was used. The quality control measures are described in Section 3.7.

3.2 U.S. EPA Reference Test Method 7E – Nitrogen Oxides

The nitrogen oxides (NO_x) testing was conducted in accordance with U.S. EPA Reference Test Method 7E. Data was collected online and reported in one-minute averages. The sampling system consisted of a stainless-steel probe, Teflon sample line(s), gas conditioning system and the identified gas analyzer. The gas conditioning system was a non-contact condenser used to remove moisture from the stack gas. If an unheated Teflon sample line was used, then a portable non-contact condenser was placed in the system directly after the probe. Otherwise, a heated Teflon sample line was used. The quality control measures are described in Section 3.7.

3.3 U.S. EPA Reference Test Method 10 – Carbon Monoxide

The carbon monoxide (CO) testing was conducted in accordance with U.S. EPA Reference Test Method 10. Data was collected online and reported in one-minute averages. The sampling system consisted of a stainless-steel probe, Teflon sample line(s), gas conditioning system, and the identified gas analyzer. The gas conditioning system was a non-contact condenser used to remove moisture from the gas. If an unheated Teflon sample line was used, then a portable non-contact condenser was placed in the system directly after the probe. Otherwise, a heated Teflon sample line was used. The quality control measures are described in Section 3.7.

3.4 U.S. EPA Reference Test Method 19 – Volumetric Flow Rate

The gas volumetric flow rate was determined in accordance with U.S. EPA Reference Test Method 19 using the measured oxygen concentration, the published fuel factor, the Brake Specific Fuel Consumption (BTU/HP-hr) and the Engine Brake Work (HP).

3.5 U.S. EPA Reference Test Method 25A – Non-Methane Hydrocarbons

The non-methane hydrocarbon (NMHC) testing was conducted in accordance with U.S. EPA Reference Test Method 25A. The Thermo Scientific Model 55i Methane and Non-methane Analyzer is a back-flush gas chromatography (GC) system designed for automated measurement of methane and non-methane hydrocarbons. Data was collected online and reported in one-minute averages. The sampling system consisted of a stainless-steel probe, heated Teflon sample line(s) and the identified gas analyzer. The quality control measures are described in Section 3.8.

3.6 U.S. EPA Reference Test Method 205 – Gas Dilution System Certification

A calibration gas dilution system field check was conducted in accordance with U.S. EPA Reference Method 205. Multiple dilution rates and total gas flow rates were utilized to force the dilution system to perform two dilutions on each mass flow controller. The diluted calibration gases were sent directly to the analyzer, and the analyzer response recorded in an electronic field data sheet. The analyzer response agreed within 2% of the actual diluted gas concentration. A second Protocol 1 calibration gas, with a cylinder concentration within 10% of one of the gas divider settings described above, was introduced directly to the analyzer, and the analyzer response recorded in an electronic field data sheet. The cylinder concentration and the analyzer response agreed within 2%. These steps were repeated three (3) times. Copies of the Method 205 data can be found in the Quality Assurance/Quality Control Appendix.

3.7 Quality Assurance/Quality Control – U.S. EPA Reference Test Methods 3A, 7E and 10

Cylinder calibration gases used met EPA Protocol 1 (+/- 2%) standards. Copies of all calibration gas certificates can be found in the Quality Assurance/Quality Control Appendix.

Low Level gas was introduced directly to the analyzer. After adjusting the analyzer to the Low-Level gas concentration and once the analyzer reading was stable, the analyzer value was recorded. This process was repeated for the High-Level gas. For the Calibration Error Test, Low, Mid, and High Level calibration gases were sequentially introduced directly to the analyzer. All values were within 2.0 percent of the Calibration Span or 0.5 ppmv/% absolute difference.

High or Mid Level gas (whichever was closer to the stack gas concentration) was introduced at the probe and the time required for the analyzer reading to reach 95 percent or 0.5 ppmv/% (whichever was less restrictive) of the gas concentration was recorded. The analyzer reading was observed until it reached a stable value, and this value was recorded. Next, Low Level gas was introduced at the probe and the time required for the analyzer reading to decrease to a value within 5.0 percent or 0.5 ppmv/% (whichever was less restrictive) was recorded. If the Low-Level gas was zero gas, the response was 0.5 ppmv/% or 5.0 percent of the upscale gas concentration (whichever was less restrictive). The analyzer reading was observed until it reached a stable value and this value was recorded. The measurement system response time and initial system bias were determined from these data. The System Bias was within 5.0 percent of the Calibration Span or 0.5 ppmv/% absolute difference.

High or Mid Level gas (whichever was closer to the stack gas concentration) was introduced at the probe. After the analyzer response was stable, the value was recorded. Next, Low Level gas was introduced at the probe, and the

analyzer value recorded once it reached a stable response. The System Bias was within 5.0 percent of the Calibration Span or 0.5 ppmv/% absolute difference or the data was invalidated and the Calibration Error Test and System Bias were repeated.

Drift between pre- and post-run System Bias was within 3 percent of the Calibration Span or 0.5 ppmv/% absolute difference. If the drift exceeded 3 percent or 0.5 ppmv/%, the Calibration Error Test and System Bias were repeated.

An NO₂ – NO converter check was performed on the analyzer at the completion of testing. An approximately 50 ppm nitrogen dioxide cylinder gas was introduced directly to the NOx analyzer and the instrument response was recorded in an electronic data sheet. The instrument response was within +/- 10 percent of the cylinder concentration.

A Data Acquisition System with battery backup was used to record the instrument response in one (1) minute averages. The data was continuously stored as a *.CSV file in Excel format on the hard drive of a computer. At the completion of testing, the data was also saved to the AST server. All data was reviewed by the Field Team Leader before leaving the facility. Once arriving at AST's office, all written and electronic data was relinquished to the report coordinator and then a final review was performed by the Project Manager.

3.8 Quality Assurance/Quality Control – U.S. EPA Reference Test Method 25A

Cylinder calibration gases used met EPA Protocol 1 (+/- 2%) standards. Copies of all calibration gas certificates can be found in the Quality Assurance/Quality Control Appendix.

Within two (2) hours prior to testing, zero gas was introduced through the sampling system to the analyzer. After adjusting the analyzer to the Zero gas concentration and once the analyzer reading was stable, the analyzer value was recorded. This process was repeated for the High-Level gas, and the time required for the analyzer reading to reach 95 percent of the gas concentration was recorded to determine the response time. Next, Low and Mid-Level gases were introduced through the sampling system to the analyzer, and the response was recorded when it was stable. All values were less than +/- 5 percent of the calibration gas concentrations.

Mid Level gas was introduced through the sampling system. After the analyzer response was stable, the value was recorded. Next, Zero gas was introduced through the sampling system, and the analyzer value recorded once it reached a stable response. The Analyzer Drift was less than +/- 3 percent of the span value.

A Data Acquisition System with battery backup was used to record the instrument response in one (1) minute averages. The data was continuously stored as a *.CSV file in Excel format on the hard drive of a computer. At the completion of testing, the data was also saved to the AST server. All data was reviewed by the Field Team Leader before leaving the facility. Once arriving at AST's office, all written and electronic data was relinquished to the report coordinator and then a final review was performed by the Project Manager.

Appendix A

Location: ERG - Uinta Basin, UT

Source: Gray 2-17-3-1E

Project No.: 2021-2251

Run No. /Method Run 1 / Method 10

Stack Gas Volumetric Flow Rate (Qs), dscfm

$$Q_s = \frac{EBW \times BSFC \times F_d \times \left(\frac{20.9}{20.9 - C_{O_2}} \right)}{1.0E+06 \times 60}$$

where,

EBW $\frac{33}{}$ = engine brake work, HP
 BSFC $\frac{13,300}{}$ = brake specific fuel consumption, Btu/HP-hr
 F_{Factor} $\frac{8,710}{}$ = fuel factor, dscf/MMBtu
 C_{O₂} $\frac{13.7}{}$ = oxygen concentration, %
 Q_s $\frac{188}{}$ = dscfm

CO - Outlet Concentration (C_{CO}), ppmvd

$$C_{CO} = (C_{obs} - C_0) \times \left(\frac{C_{MA}}{C_M - C_0} \right)$$

where,

C_{obs} $\frac{419.4}{}$ = average analyzer value during test, ppmvd
 C_o $\frac{2.5}{}$ = average of pretest & posttest zero responses, ppmvd
 C_{MA} $\frac{4500.0}{}$ = actual concentration of calibration gas, ppmvd
 C_M $\frac{4632.5}{}$ = average of pretest & posttest calibration responses, ppmvd
 C_{CO} $\frac{405.1}{}$ = CO Concentration, ppmvd

CO - Outlet Concentration (C_{COc15}), ppmvd @ 15% O₂

$$C_{COc15} = C_{CO} \times \left(\frac{20.9 - 15}{20.9 - O_2} \right)$$

where,

C_{CO} $\frac{405.1}{}$ = CO - Outlet Concentration, ppmvd
 C_{O₂} $\frac{13.7}{}$ = oxygen concentration, %
 C_{COc15} $\frac{333.7}{}$ = ppmvd @15% O₂

CO - Outlet Emission Rate (ER_{CO}), lb/hr

$$ER_{CO} = \frac{C_{CO} \times MW \times Q_s \times 60 \frac{\text{min}}{\text{hr}} \times 28.32 \frac{\text{L}}{\text{ft}^3}}{24.04 \frac{\text{L}}{\text{g-mole}} \times 1.0E06 \times 454 \frac{\text{g}}{\text{lb}}}$$

where,

C_{CO} $\frac{405.1}{}$ = CO - Outlet Concentration, ppmvd
 MW $\frac{28.01}{}$ = CO molecular weight, g/g-mole
 Q_s $\frac{188}{}$ = stack gas volumetric flow rate at standard conditions, dscfm
 ER_{CO} $\frac{0.33}{}$ = lb/hr

CO - Outlet Emission Rate (ER_{CO}TPY), ton/yr

$$ER_{CO}TPY = \frac{ER_{CO} \times 8,760 \frac{hr}{yr}}{2,000 \frac{lb}{ton}}$$

where,

$$ER_{CO} \frac{0.33}{1.5} = \text{CO - Outlet Emission Rate, lb/hr}$$

$$ER_{CO}TPY \frac{1.5}{1.5} = \text{ton/yr}$$

CO - Outlet Emission Factor (EF_{CO}), g/hp-hr

$$EF_{CO} = \frac{ER_{CO} \times 454 \frac{g}{lb}}{EBW}$$

where,

$$ER_{CO} \frac{0.33}{33} = \text{CO - Outlet Emission Rate, lb/hr}$$

$$EBW \frac{33}{33} = \text{engine brake work, HP}$$

$$EF_{CO} \frac{4.5}{4.5} = \text{g/hp-hr}$$

Location: ERG - Uinta Basin, UT

Source: Gray 2-17-3-1E

Project No.: 2021-2251

Run No. /Method Run 1 / Method 7E

NOx - Outlet Concentration (C_{NOx}), ppmvd

$$C_{NOx} = (C_{obs} - C_0) \times \left(\frac{C_{MA}}{(C_M - C_0)} \right)$$

where,

C_{obs}	<u>4.3</u>	= average analyzer value during test, ppmvd
C_0	<u>2.5</u>	= average of pretest & posttest zero responses, ppmvd
C_{MA}	<u>250.0</u>	= actual concentration of calibration gas, ppmvd
C_M	<u>236.9</u>	= average of pretest & posttest calibration responses, ppmvd
C_{NOx}	<u>1.8</u>	= NOx Concentration, ppmvd

NOx - Outlet Concentration (C_{NOxc15}), ppmvd @ 15% O₂

$$C_{NOxc15} = C_{NOx} \times \left(\frac{20.9 - 15}{20.9 - O_2} \right)$$

where,

C_{NOx}	<u>1.8</u>	= NOx - Outlet Concentration, ppmvd
C_{O_2}	<u>13.7</u>	= oxygen concentration, %
C_{NOxc15}	<u>1.5</u>	= ppmvd @15% O ₂

NOx - Outlet Emission Rate (ER_{NOx}), lb/hr

$$ER_{NOx} = \frac{C_{NOx} \times MW \times Qs \times 60 \frac{min}{hr} \times 28.32 \frac{L}{ft^3}}{24.04 \frac{L}{g-mole} \times 1.0E06 \times 454 \frac{g}{lb}}$$

where,

C_{NOx}	<u>1.8</u>	= NOx - Outlet Concentration, ppmvd
MW	<u>46.0055</u>	= NOx molecular weight, g/g-mole
Qs	<u>188</u>	= stack gas volumetric flow rate at standard conditions, dscfm
ER_{NOx}	<u>0.0025</u>	= lb/hr

NOx - Outlet Emission Rate (ER_{NOxTPY}), ton/yr

$$ER_{NOxTPY} = \frac{ER_{NOx} \times 8,760 \frac{hr}{yr}}{2,000 \frac{lb}{ton}}$$

where,

ER_{NOx}	<u>0.0025</u>	= NOx - Outlet Emission Rate, lb/hr
ER_{NOxTPY}	<u>0.011</u>	= ton/yr

NOx - Outlet Emission Factor (EF_{NOx}), g/hp-hr

$$EF_{NOx} = \frac{ER_{NOx} \times 454 \frac{g}{lb}}{EBW}$$

where,

ER_{NOx}	<u>0.0025</u>	= NOx - Outlet Emission Rate, lb/hr
EBW	<u>33</u>	= engine brake work, HP
EF_{NOx}	<u>0.034</u>	= g/hp-hr

Location: ERG - Uinta Basin, UT

Source: Gray 2-17-3-1E

Project No.: 2021-2251

Run No. /Method Run 1 / Method 25A

Methane- Outlet Concentration (as CH₄) (C_{CH₄}), ppmvd

$$C_{\text{Methane}} = \frac{C_{\text{CH}_4\text{w}}}{1 - \text{BWS}}$$

where,

$$\begin{aligned} C_{\text{CH}_4\text{w}} &= \frac{0.0}{0.072} = \text{Methane - Outlet Concentration (as CH}_4\text{), ppmvw} \\ \text{BWS} &= \frac{0.072}{0.072} = \text{moisture fraction, unitless} \\ C_{\text{CH}_4} &= \frac{0.0}{0.0} = \text{ppmvd} \end{aligned}$$

Methane - Outlet Concentration (as CH₄) (C_{MethaneC15}), ppmvd @ 15% O₂

$$C_{\text{MethaneC15}} = C_{\text{CH}_4} \times \left(\frac{20.9 - 15}{20.9 - \text{O}_2} \right)$$

where,

$$\begin{aligned} C_{\text{Methane}} &= \frac{0.0}{13.7} = \text{Methane - Outlet Concentration (as CH}_4\text{), ppmvd} \\ \text{O}_2 &= \frac{13.7}{13.7} = \text{oxygen concentration, \%} \\ C_{\text{MethaneC15}} &= \frac{0.0}{0.0} = \text{ppmvd @15\% O}_2 \end{aligned}$$

Methane- Outlet Emission Rate (as CH₄) (ER_{CH₄}), lb/hr

$$ER_{\text{Methane}} = \frac{C_{\text{CH}_4} \times \text{MW} \times Q_s \times 60 \frac{\text{min}}{\text{hr}} \times 28.32 \frac{\text{L}}{\text{ft}^3}}{24.04 \frac{\text{L}}{\text{g-mole}} \times 1.0\text{E}06 \times 454 \frac{\text{g}}{\text{lb}}}$$

where,

$$\begin{aligned} C_{\text{CH}_4} &= \frac{0.0}{16.04} = \text{Methane - Outlet Concentration (as CH}_4\text{), ppmvd} \\ \text{MW} &= \frac{16.04}{16.04} = \text{Methane molecular weight, g/g-mole} \\ Q_s &= \frac{188}{188} = \text{stack gas volumetric flow rate at standard conditions, dscfm} \\ ER_{\text{CH}_4} &= \frac{0.00}{0.00} = \text{lb/hr} \end{aligned}$$

Methane- Outlet Emission Rate (as CH₄) (ER_{CH₄TPY}), ton/yr

$$ER_{\text{THCTPY}} = \frac{ER_{\text{CH}_4} \times 8,760 \frac{\text{hr}}{\text{yr}}}{2,000 \frac{\text{lb}}{\text{ton}}}$$

where,

$$\begin{aligned} ER_{\text{THC}} &= \frac{0.00}{0.00} = \text{Methane - Outlet Emission Rate (as CH}_4\text{), lb/hr} \\ ER_{\text{THCTPY}} &= \frac{0.00}{0.00} = \text{ton/yr} \end{aligned}$$

Methane- Outlet Emission Factor (as CH₄) (EF_{CH₄}), g/hp-hr

$$EF_{\text{Methane}} = \frac{ER_{\text{CH}_4} \times 454 \frac{\text{g}}{\text{lb}}}{\text{EBW}}$$

where,

$$\begin{aligned} ER_{\text{CH}_4} &= \frac{0.00}{33} = \text{Methane - Outlet Emission Rate (as CH}_4\text{), lb/hr} \\ \text{EBW} &= \frac{33}{33} = \text{engine brake work, HP} \\ EF_{\text{CH}_4} &= \frac{0.000}{0.000} = \text{g/hp-hr} \end{aligned}$$

Location: ERG - Uinta Basin, UT

Source: Gray 2-17-3-1E

Project No.: 2021-2251

Run No. /Method Run 1 / Method Alt-096

NMHC - Outlet Concentration (as C3H8) (C_{NMHC}), ppmvd

$$C_{NMHC} = \frac{C_{NMHCw}}{1 - BWS}$$

where,

$$C_{NMHCw} \frac{2,249.4}{0.072} = \text{NMHC - Outlet Concentration (as C3H8), ppmvw}$$

$$BWS \frac{0.072}{0.072} = \text{moisture fraction, unitless}$$

$$C_{NMHC} \frac{2,422.7}{2,422.7} = \text{ppmvd}$$

NMHC - Outlet Concentration (as C3H8) ($C_{NMHCc15}$), ppmvd @ 15% O₂

$$C_{NMHCc15} = C_{NMHC} \times \left(\frac{20.9 - 15}{20.9 - O_2} \right)$$

where,

$$C_{NMHC} \frac{2,422.7}{13.7} = \text{NMHC - Outlet Concentration (as C3H8), ppmvd}$$

$$C_{O_2} \frac{13.7}{13.7} = \text{oxygen concentration, \%}$$

$$C_{NMHCc15} \frac{1,995.4}{1,995.4} = \text{ppmvd @15\% O}_2$$

NMHC - Outlet Emission Rate (as C3H8) (ER_{NMHC}), lb/hr

$$ER_{NMHC} = \frac{C_{NMHC} \times MW \times Q_s \times 60 \frac{\text{min}}{\text{hr}} \times 28.32 \frac{\text{L}}{\text{ft}^3}}{24.04 \frac{\text{L}}{\text{g-mole}} \times 1.0E06 \times 454 \frac{\text{g}}{\text{lb}}}$$

where,

$$C_{NMHC} \frac{2,422.7}{44.1} = \text{NMHC - Outlet Concentration (as C3H8), ppmvd}$$

$$MW \frac{44.1}{44.1} = \text{NMHC molecular weight, g/g-mole}$$

$$Q_s \frac{188}{188} = \text{stack gas volumetric flow rate at standard conditions, dscfm}$$

$$ER_{NMHC} \frac{3.1}{3.1} = \text{lb/hr}$$

NMHC - Outlet Emission Rate (as C3H8) ($ER_{NMHCPTY}$), ton/yr

$$ER_{NMHCPTY} = \frac{ER_{NMHC} \times 8,760 \frac{\text{hr}}{\text{yr}}}{2,000 \frac{\text{lb}}{\text{ton}}}$$

where,

$$ER_{NMHC} \frac{3.1}{13.7} = \text{NMHC - Outlet Emission Rate (as C3H8), lb/hr}$$

$$ER_{NMHCPTY} \frac{13.7}{13.7} = \text{ton/yr}$$

NMHC - Outlet Emission Factor (as C3H8) (EF_{NMHC}), g/hp-hr

$$EF_{NMHC} = \frac{ER_{NMHC} \times 454 \frac{\text{g}}{\text{lb}}}{EBW}$$

where,

$$ER_{NMHC} \frac{3.1}{33} = \text{NMHC - Outlet Emission Rate (as C3H8), lb/hr}$$

$$EBW \frac{33}{33} = \text{engine brake work, HP}$$

$$EF_{NMHC} \frac{42.5}{42.5} = \text{g/hp-hr}$$

Appendix B

Location ERG - Uinta Basin, UT
Source Womack 13-9-3-1E
Project No. 2021-2251

Run Number	Run 1	
Date	9/13/21	
Start Time	15:20	
Stop Time	15:41	
Engine Data		
Engine Manufacturer	Arrow	
Engine Model	L-795	
Engine Serial Number	DDL795005	
Engine Type	Spark Ignition - 2SLB	
Engine Date of Manufacturer	DOM	4/18/2014
Engine Brake Work, HP	EBW	54
Maximum Engine Brake Work, HP	MaxEBW	65
Fuel Heating Value, Btu/scf	F _{HV}	1,040
Fuel Factor (O2 dry), dscf/MMBtu	Fd	8,710
Ambient Temperature	T _{Amb}	80
Relative Humidity, %	RH	26
Barometric Pressure, in. Hg	Pb	24.76
Brake Specific Fuel Consumption, Btu/HP-hr	BSFC	12,081
Input Data - Outlet		
Volumetric Flow Rate (M19), dscfm	QsI	322
Calculated Data - Outlet		
O ₂ Concentration, % dry	C _{O₂}	14.72
CO ₂ Concentration, % dry	C _{CO₂}	2.94
CO Concentration, ppmvd	C _{CO}	2,990.6
CO Concentration, ppmvd @ 15 % O ₂	C _{COc15}	2,856.6
CO Emission Rate, lb/hr	ER _{CO}	4.2
CO Emission Rate, ton/yr	ER _{COTPY}	18.4
CO Emission Factor, g/HP-hr	EF _{CO}	35.1
NO _x Concentration, ppmvd	C _{NO_x}	123.8
NO _x Concentration, ppmvd @ 15 % O ₂	C _{NOxc15}	118.2
NO _x Emission Rate, lb/hr	ER _{NO_x}	0.29
NO _x Emission Rate, ton/yr	ER _{NOxTPY}	1.3
NO _x Emission Factor, g/HP-hr	EF _{NO_x}	2.4
Methane Concentration, ppmvd	C _{CH₄}	0.076
Methane Concentration, ppmvd @ 15 % O ₂	C _{CH4c15}	0.072
Methane Emission Rate, lb/hr	ER _{CH₄}	0.000061
Methane Emission Rate, ton/yr	ER _{CH4TPY}	0.00027
Methane Emission Factor, g/HP-hr	EF _{CH₄}	0.00051
NMHC (as C3H8) Concentration, ppmvd	C _{NMHC}	1,892.0
NMHC (as C3H8) Concentration, ppmvw	C _{NMHCw}	1,771.3
NMHC (as C3H8) Concentration, ppmvd @ 15 % O ₂	C _{NMHCc15}	1,807.2
NMHC (as C3H8) Emission Rate, lb/hr	ER _{NMHC}	4.2
NMHC (as C3H8) Emission Rate, ton/yr	ER _{NMHCPTY}	18.3
NMHC (as C3H8) Emission Factor, g/HP-hr	EF _{NMHC}	35.0

Location: ERG - Uinta Basin, UT
 Source: Womack 13-9-3-1E
 Project No.: 2021-2251
 Date: 9/13/21

Time Unit Status	O ₂ - Outlet % dry Valid	CO ₂ - Outlet % dry Valid	CO - Outlet ppmvd Valid	NOx - Outlet ppmvd Valid	Methane - Outlet ppmvw Valid	NMHC - Outlet ppmvw Valid
15:20	14.69	3.13	2,973.38	134.35	0.05	1,913.48
15:21	14.85	3.04	3,115.40	125.87	0.07	1,994.50
15:22	14.93	2.99	3,081.39	112.14	0.05	2,225.08
15:23	15.01	2.95	3,094.72	118.15	0.08	1,798.76
15:24	14.96	2.98	3,133.67	112.83	0.09	1,130.20
15:25	15.05	2.96	2,881.41	121.20	0.11	1,740.53
15:26	15.24	2.84	2,750.20	132.68	0.11	1,846.26
15:27	15.19	2.84	3,099.99	107.15	0.10	1,889.75
15:28	15.06	2.93	3,114.65	109.50	0.07	2,035.26
15:29	15.10	2.91	2,981.64	106.42	0.08	1,926.23
15:30	15.14	2.89	2,786.30	130.57	0.12	1,325.38
15:31	15.08	2.93	2,923.53	114.29	0.06	1,469.03
15:32	15.08	2.93	2,843.65	114.92	0.08	1,818.86
15:33	14.75	3.11	2,984.52	120.26	0.08	1,726.45
15:34	14.67	3.17	2,955.67	139.13	0.08	1,651.35
15:35	14.60	3.20	3,084.15	138.24	0.03	1,949.37
15:36	14.74	3.13	2,910.01	125.62	0.06	2,189.22
15:37	14.69	3.15	3,092.02	128.16	0.05	1,804.15
15:38	14.60	3.19	3,092.71	135.30	0.04	1,268.39
15:39	14.50	3.26	3,076.94	137.17	0.06	1,525.14
15:40	14.63	3.19	3,003.14	124.91	0.02	1,970.79

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NOx - Outlet	Methane - Outlet	NMHC - Outlet
Uncorrected Run Average (C _{obs})	14.9	3.0	2,999.0	123.3	0.1	1,771.3
Cal Gas Concentration (C _{MA})	12.0	11.7	4,500.0	250.0	3,000.0	3,000.0
Pretest System Zero Response	0.74	0.18	25.57	8.01	0.12	8.24
Posttest System Zero Response	0.17	0.16	4.43	4.03	0.11	1.42
Average Zero Response (C _o)	0.5	0.2	15.0	6.0	0.1	4.8
Pretest System Cal Response	12.32	11.52	4,373.85	246.89	0.02	2,789.43
Posttest System Cal Response	12.11	11.56	4,636.45	238.92	0.03	2,954.77
Average Cal Response (C _M)	12.2	11.5	4,505.2	242.9	0.0	2,872.1
Corrected Run Average (C _{corr})	14.7	2.9	2,990.6	123.8	NA	NA

Location ERG - Uinta Basin, UT
 Source Womack 13-9-3-1E-H1
 Project No. 2021-2251

Run Number	Run 1	
Date	9/13/21	
Start Time	16:05	
Stop Time	16:26	
Engine Data		
Engine Manufacturer	Arrow	
Engine Model	A-90	
Engine Serial Number	BDA90S008	
Engine Type	Spark Ignition - 4SRB	
Engine Date of Manufacturer	DOM	4/18/2014
Engine Brake Work, HP	EBW	92
Maximum Engine Brake Work, HP	MaxEBW	110
Fuel Heating Value, Btu/scf	F _{HV}	1,040
Fuel Factor (O2 dry), dscf/MMBtu	F _d	8,710
Ambient Temperature	T _{Amb}	81
Relative Humidity, %	RH	22
Barometric Pressure, in. Hg	P _b	24.76
Brake Specific Fuel Consumption, Btu/HP-hr	BSFC	8,200
Input Data - Outlet		
Volumetric Flow Rate (M19), dscfm	QsI	122
Calculated Data - Outlet		
O ₂ Concentration, % dry	C _{O₂}	2.12
CO ₂ Concentration, % dry	C _{CO₂}	8.66
CO Concentration, ppmvd	C _{CO}	28,067.5
CO Concentration, ppmvd @ 15 % O ₂	C _{COe15}	8,815.8
CO Emission Rate, lb/hr	ER _{CO}	14.9
CO Emission Rate, ton/yr	ER _{COTPY}	65.2
CO Emission Factor, g/HP-hr	EF _{CO}	73.6
NO _x Concentration, ppmvd	C _{NO_x}	179.9
NO _x Concentration, ppmvd @ 15 % O ₂	C _{NO_xe15}	56.5
NO _x Emission Rate, lb/hr	ER _{NO_x}	0.16
NO _x Emission Rate, ton/yr	ER _{NO_xTPY}	0.69
NO _x Emission Factor, g/HP-hr	EF _{NO_x}	0.77
Methane Concentration, ppmvd	C _{CH₄}	0.066
Methane Concentration, ppmvd @ 15 % O ₂	C _{CH₄e15}	0.021
Methane Emission Rate, lb/hr	ER _{CH₄}	0.000020
Methane Emission Rate, ton/yr	ER _{CH₄TPY}	0.000088
Methane Emission Factor, g/HP-hr	EF _{CH₄}	0.000099
NMHC (as C3H8) Concentration, ppmvd	C _{NMHC}	1,229.2
NMHC (as C3H8) Concentration, ppmvw	C _{NMHCw}	1,019.7
NMHC (as C3H8) Concentration, ppmvd @ 15 % O ₂	C _{NMHCe15}	386.1
NMHC (as C3H8) Emission Rate, lb/hr	ER _{NMHC}	1.0
NMHC (as C3H8) Emission Rate, ton/yr	ER _{NMHCPTY}	4.5
NMHC (as C3H8) Emission Factor, g/HP-hr	EF _{NMHC}	5.1

Location: ERG - Uinta Basin, UT
 Source: Womack 13-9-3-1E-H1
 Project No.: 2021-2251
 Date: 9/13/21

Time Unit Status	O ₂ - Outlet % dry Valid	CO ₂ - Outlet % dry Valid	CO - Outlet ppmvd Valid	NOx - Outlet ppmvd Valid	Methane - Outlet ppmvw Valid	NMHC - Outlet ppmvw Valid
16:05	2.91	8.47	27,400.00	171.07	0.08	658.87
16:06	2.96	8.47	27,500.00	171.40	0.06	1,011.38
16:07	2.76	8.58	27,000.00	176.24	0.08	1,397.79
16:08	2.84	8.55	27,000.00	174.56	0.07	1,209.88
16:09	2.88	8.52	27,000.00	174.14	0.06	1,114.54
16:10	2.92	8.50	26,900.00	174.22	0.09	729.79
16:11	2.87	8.52	27,000.00	174.74	0.03	650.59
16:12	2.90	8.52	27,000.00	175.94	0.05	892.26
16:13	2.88	8.52	27,100.00	177.94	0.03	1,570.26
16:14	2.88	8.50	26,900.00	182.08	0.06	1,107.90
16:15	2.88	8.51	26,800.00	187.57	0.04	1,125.22
16:16	2.88	8.53	27,000.00	190.06	0.09	679.01
16:17	2.90	8.52	26,700.00	189.68	0.03	658.13
16:18	2.88	8.54	26,500.00	194.40	0.02	896.94
16:19	3.02	8.46	27,100.00	181.82	0.05	1,523.73
16:20	2.92	8.51	26,900.00	185.32	0.08	1,201.38
16:21	2.83	8.55	27,000.00	177.09	0.03	1,052.61
16:22	2.81	8.52	27,100.00	169.10	0.06	697.43
16:23	2.84	8.49	27,300.00	163.19	0.09	645.49
16:24	2.87	8.48	27,400.00	159.84	0.01	1,213.73
16:25	2.80	8.51	27,200.00	159.89	0.04	1,376.58

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NOx - Outlet	Methane - Outlet	NMHC - Outlet
Uncorrected Run Average (C _{obs})	2.9	8.5	27,038.1	176.7	0.1	1,019.7
Cal Gas Concentration (C _{MA})	12.0	11.7	4,500.0	250.0	3,000.0	3,000.0
Pretest System Zero Response	0.93	0.13	0.55	-0.01	0.06	-1.40
Posttest System Zero Response	0.74	0.18	25.57	8.01	0.12	8.24
Average Zero Response (C ₀)	0.8	0.2	13.1	4.0	0.1	3.4
Pretest System Cal Response	12.52	11.32	4,318.00	241.01	0.02	2,890.27
Posttest System Cal Response	12.32	11.52	4,373.85	246.89	0.02	2,789.43
Average Cal Response (C _M)	12.4	11.4	4,345.9	244.0	0.0	2,839.9
Corrected Run Average (C _{corr})	2.1	8.7	28,067.5	179.9	NA	NA

Location ERG - Uinta Basin, UT
 Source Gray 2-17-3-1E
 Project No. 2021-2251

Run Number	Run 1	
Date	9/13/21	
Start Time	17:20	
Stop Time	17:41	
Engine Data		
Engine Manufacturer	AJAX	
Engine Model	E-565	
Engine Serial Number	86565	
Engine Type	Spark Ignition - 2SLB	
Engine Date of Manufacturer	DOM	7/1/2014
Engine Brake Work, HP	EBW	33
Maximum Engine Brake Work, HP	MaxEBW	40
Fuel Heating Value, Btu/scf	F _{HV}	1,040
Fuel Factor (O2 dry), dscf/MMBtu	F _d	8,710
Ambient Temperature	T _{Amb}	79
Relative Humidity, %	RH	25
Barometric Pressure, in. Hg	P _b	24.67
Brake Specific Fuel Consumption, Btu/HP-hr	BSFC	13,300
Input Data - Outlet		
Volumetric Flow Rate (M19), dscfm	Q _{sI}	188
Calculated Data - Outlet		
O ₂ Concentration, % dry	C _{O₂}	13.74
CO ₂ Concentration, % dry	C _{CO₂}	3.89
CO Concentration, ppmvd	C _{CO}	405.1
CO Concentration, ppmvd @ 15 % O ₂	C _{COc15}	333.7
CO Emission Rate, lb/hr	ER _{CO}	0.33
CO Emission Rate, ton/yr	ER _{CO} TPY	1.5
CO Emission Factor, g/HP-hr	EF _{CO}	4.5
NO _x Concentration, ppmvd	C _{NO_x}	1.8
NO _x Concentration, ppmvd @ 15 % O ₂	C _{NO_xc15}	1.5
NO _x Emission Rate, lb/hr	ER _{NO_x}	0.0025
NO _x Emission Rate, ton/yr	ER _{NO_x} TPY	0.011
NO _x Emission Factor, g/HP-hr	EF _{NO_x}	0.034
Methane Concentration, ppmvd	C _{CH₄}	0.046
Methane Concentration, ppmvd @ 15 % O ₂	C _{CH₄c15}	0.038
Methane Emission Rate, lb/hr	ER _{CH₄}	0.000022
Methane Emission Rate, ton/yr	ER _{CH₄} TPY	0.000095
Methane Emission Factor, g/HP-hr	EF _{CH₄}	0.00029
NMHC (as C3H8) Concentration, ppmvd	C _{NMHC}	2,422.7
NMHC (as C3H8) Concentration, ppmvw	C _{NMHCw}	2,249.4
NMHC (as C3H8) Concentration, ppmvd @ 15 % O ₂	C _{NMHCc15}	1,995.4
NMHC (as C3H8) Emission Rate, lb/hr	ER _{NMHC}	3.1
NMHC (as C3H8) Emission Rate, ton/yr	ER _{NMHC} TPY	13.7
NMHC (as C3H8) Emission Factor, g/HP-hr	EF _{NMHC}	42.5

Location ERG - Uinta Basin, UT

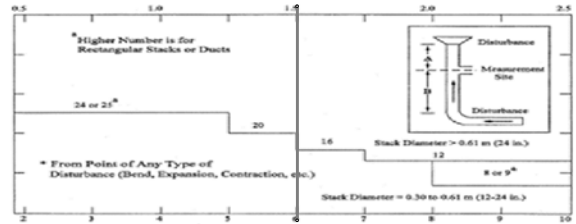
Source Gray 2-17-3-1E

Project No. 2021-2251

Date: 09/13/21

Stack Parameters

Duct Orientation: Horizontal
 Duct Design: Circular
 Distance from Far Wall to Outside of Port: 3.50 in
 Nipple Length: 0.50 in
 Depth of Duct: 3.00 in
 Cross Sectional Area of Duct: 0.05 ft²
 No. of Test Ports: 1
 Distance A: 0.7 ft
 Distance A Duct Diameters: 2.8 (must be > 0.5)
 Distance B: 1.5 ft
 Distance B Duct Diameters: 6.0 (must be > 2)
 Measurer (Initial and Date): MCP 9/13/21
 Reviewer (Initial and Date): MCP 9/13/21



CIRCULAR DUCT

LOCATION OF STRATIFICATION POINTS

Number of traverse points on a diameter

	2	3	4	5	6	7	8	9	10	11	12
1	14.6	--	6.7	--	4.4	--	3.2	--	2.6	--	2.1
2	85.4	--	25.0	--	14.6	--	10.5	--	8.2	--	6.7
3	--	--	75.0	--	29.6	--	19.4	--	14.6	--	11.8
4	--	--	93.3	--	70.4	--	32.3	--	22.6	--	17.7
5	--	--	--	--	85.4	--	67.7	--	34.2	--	25.0
6	--	--	--	--	95.6	--	80.6	--	65.8	--	35.6
7	--	--	--	--	--	--	89.5	--	77.4	--	64.4
8	--	--	--	--	--	--	96.8	--	85.4	--	75.0
9	--	--	--	--	--	--	--	--	91.8	--	82.3
10	--	--	--	--	--	--	--	--	97.4	--	88.2
11	--	--	--	--	--	--	--	--	--	--	93.3
12	--	--	--	--	--	--	--	--	--	--	97.9

**Percent of stack diameter from inside wall to traverse point.*

Traverse Point	% of Diameter	Distance from inside wall	Distance from outside of port
1	16.7	0.50	1.00
2	50.0	1.50	2.00
3	83.3	2.50	3.00
4	--	--	--
5	--	--	--
6	--	--	--
7	--	--	--
8	--	--	--
9	--	--	--
10	--	--	--
11	--	--	--
12	--	--	--

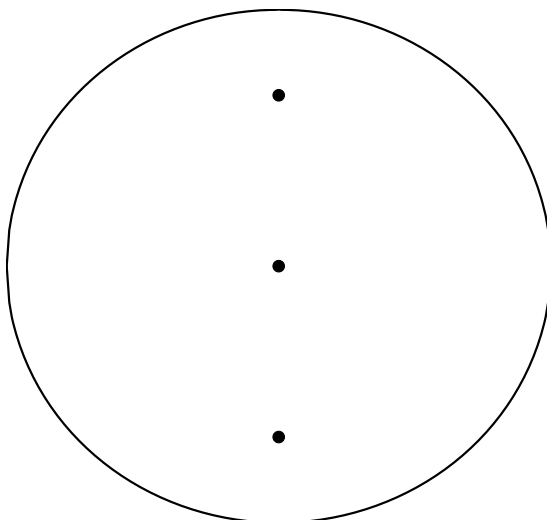
Stack Diagram

A = 0.7 ft.

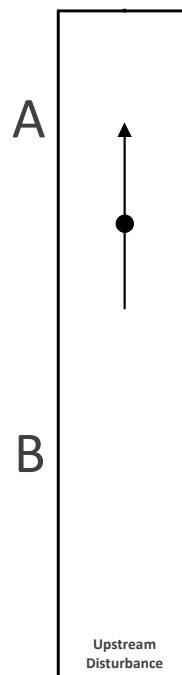
B = 1.5 ft.

Depth of Duct = 3 in.

Cross Sectional Area



Downstream Disturbance



Location: ERG - Uinta Basin, UT
 Source: Gray 2-17-3-1E
 Project No.: 2021-2251
 Date: 9/13/21

Time Unit Status	O ₂ - Outlet % dry Valid	CO ₂ - Outlet % dry Valid	CO - Outlet ppmvd Valid	NOx - Outlet ppmvd Valid	Methane - Outlet ppmvw Valid	NMHC - Outlet ppmvw Valid
17:20	13.51	3.95	409.30	4.85	0.04	2,298.63
17:21	13.52	3.94	417.72	4.69	-0.01	2,285.33
17:22	13.48	3.96	405.99	4.65	0.06	2,391.73
17:23	13.48	3.97	389.22	4.50	-0.01	2,266.44
17:24	13.49	3.96	394.95	4.50	0.03	2,170.97
17:25	13.51	3.95	397.01	4.83	0.08	2,141.64
17:26	13.46	3.98	397.36	5.01	0.06	2,161.35
17:27	13.48	3.97	414.47	4.71	0.03	2,120.14
17:28	13.52	3.95	412.63	3.99	0.08	2,141.11
17:29	13.55	3.93	421.62	4.02	0.06	2,169.62
17:30	13.51	3.95	421.65	3.99	0.04	2,189.50
17:31	13.56	3.92	429.52	4.01	0.02	2,359.04
17:32	13.58	3.91	438.48	4.00	0.03	2,527.35
17:33	13.57	3.91	430.74	4.02	0.04	2,509.94
17:34	13.57	3.92	430.77	4.00	0.05	2,340.71
17:35	13.57	3.92	434.75	4.01	0.07	2,194.98
17:36	13.62	3.89	434.68	3.99	0.06	2,216.27
17:37	13.58	3.91	434.77	4.01	0.08	2,218.34
17:38	13.56	3.93	435.16	4.00	0.04	2,143.37
17:39	13.50	3.96	425.25	4.00	0.02	2,197.26
17:40	13.53	3.94	430.46	4.00	0.03	2,194.24

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NOx - Outlet	Methane - Outlet	NMHC - Outlet
Uncorrected Run Average (C _{obs})	13.5	3.9	419.4	4.3	0.0	2,249.4
Cal Gas Concentration (C _{MA})	12.0	11.7	4,500.0	250.0	3,000.0	3,000.0
Pretest System Zero Response	0.17	0.16	4.43	4.03		1.42
Posttest System Zero Response	0.22	0.16	0.64	1.06		2.46
Average Zero Response (C ₀)	0.2	0.2	2.5	2.5	-	1.9
Pretest System Cal Response	12.11	11.56	4,636.45	238.92		2,954.77
Posttest System Cal Response	11.58	11.45	4,628.64	234.81		2,919.17
Average Cal Response (C _M)	11.8	11.5	4,632.5	236.9	-	2,937.0
Corrected Run Average (C _{corr})	13.7	3.9	405.1	1.8	NA	NA

Location ERG - Uinta Basin, UT
Source Deep Creek 14-9-4-2E
Project No. 2021-2251

Run Number		Run 1
Date		9/16/21
Start Time		10:09
Stop Time		10:30
Engine Data		
Engine Manufacturer		Arrow
Engine Model		L-795
Engine Serial Number		L-600842
Engine Type		Spark Ignition - 2SLB
Engine Brake Work, HP	EBW	55
Maximum Engine Brake Work, HP	MaxEBW	65
Fuel Heating Value, Btu/scf	F _{HV}	1,040
Fuel Factor (O ₂ dry), dscf/MMBtu	F _d	8,710
Ambient Temperature	T _{Amb}	72
Relative Humidity, %	RH	22
Barometric Pressure, in. Hg	P _b	24.65
Brake Specific Fuel Consumption, Btu/HP-hr	BSFC	12,081
Input Data - Outlet		
Volumetric Flow Rate (M19), dscfm	Q _{sI}	164
Calculated Data - Outlet		
O ₂ Concentration, % dry	C _{O₂}	8.55
CO ₂ Concentration, % dry	C _{CO₂}	5.56
CO Concentration, ppmvd	C _{CO}	18,629.8
CO Concentration, ppmvd @ 15 % O ₂	C _{COc15}	8,897.0
CO Emission Rate, lb/hr	ER _{CO}	13.3
CO Emission Rate, ton/yr	ER _{CO} TPY	58.3
CO Emission Factor, g/HP-hr	EF _{CO}	109.4
NO _x Concentration, ppmvd	C _{NO_x}	33.5
NO _x Concentration, ppmvd @ 15 % O ₂	C _{NO_xc15}	16.0
NO _x Emission Rate, lb/hr	ER _{NO_x}	0.039
NO _x Emission Rate, ton/yr	ER _{NO_x} TPY	0.17
NO _x Emission Factor, g/HP-hr	EF _{NO_x}	0.32
Methane Concentration, ppmvd	C _{CH₄}	<u>0.0</u>
Methane Concentration, ppmvd @ 15 % O ₂	C _{CH₄c15}	0.00
Methane Emission Rate, lb/hr	ER _{CH₄}	0.00
Methane Emission Rate, ton/yr	ER _{CH₄} TPY	0.00
Methane Emission Factor, g/HP-hr	EF _{CH₄}	0.000
NMHC (as C ₃ H ₈) Concentration, ppmvd	C _{NMHC}	3,736.3
NMHC (as C ₃ H ₈) Concentration, ppmvw	C _{NMHCw}	3,314.4
NMHC (as C ₃ H ₈) Concentration, ppmvd @ 15 % O ₂	C _{NMHCc15}	1,784.4
NMHC (as C ₃ H ₈) Emission Rate, lb/hr	ER _{NMHC}	4.2
NMHC (as C ₃ H ₈) Emission Rate, ton/yr	ER _{NMHC} TPY	18.4
NMHC (as C ₃ H ₈) Emission Factor, g/HP-hr	EF _{NMHC}	34.6

*Underlined values have been adjusted to zero for calculation purposes

Location: ERG - Uinta Basin, UT

Source: Deep Creek 14-9-4-2E

Project No.: 2021-2251

Date: 9/16/21

Time Unit Status	O ₂ - Outlet % dry Valid	CO ₂ - Outlet % dry Valid	CO - Outlet ppmvd Valid	NOx - Outlet ppmvd Valid	Methane - Outlet ppmvw Valid	NMHC - Outlet ppmvw Valid
10:09	8.72	5.44	18,800.00	38.33	-1.35	3,524.91
10:10	8.80	5.43	18,500.00	32.77	-1.37	3,426.08
10:11	8.63	5.51	19,100.00	33.03	-1.23	2,539.30
10:12	8.52	5.58	19,800.00	32.16	-1.23	3,975.80
10:13	8.61	5.54	20,000.00	30.74	-1.42	4,326.48
10:14	8.54	5.57	19,900.00	31.19	-1.28	3,829.46
10:15	8.52	5.57	19,800.00	31.40	-1.11	3,803.47
10:16	8.68	5.51	19,500.00	31.17	-1.41	3,338.23
10:17	8.64	5.51	18,800.00	30.61	-1.33	2,649.37
10:18	8.46	5.60	20,500.00	30.79	-1.24	3,497.03
10:19	8.43	5.63	19,500.00	31.48	-1.29	3,893.82
10:20	8.59	5.56	18,700.00	32.47	-1.38	3,212.47
10:21	8.59	5.55	19,500.00	32.23	-1.25	3,559.10
10:22	8.64	5.52	19,600.00	34.15	-1.23	2,922.82
10:23	8.50	5.60	18,900.00	31.61	-1.38	2,449.57
10:24	8.50	5.59	19,400.00	32.25	-1.45	2,920.23
10:25	8.55	5.54	19,100.00	33.61	-1.17	3,773.33
10:26	8.54	5.57	19,200.00	34.10	-1.11	3,088.80
10:27	8.50	5.60	18,800.00	32.38	-1.25	3,408.99
10:28	8.56	5.55	19,200.00	33.75	-1.04	3,167.80
10:29	8.63	5.52	19,500.00	32.78	-1.07	2,296.05

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NOx - Outlet	Methane - Outlet	NMHC - Outlet
Uncorrected Run Average (C _{obs})	8.6	5.5	19,338.1	32.5	-1.3	3,314.4
Cal Gas Concentration (C _{MA})	12.0	11.7	4,500.0	250.0	3,000.0	3,000.0
Pretest System Zero Response	0.35	0.10	0.76	-0.20	-1.56	-0.84
Posttest System Zero Response	0.20	0.09	5.95	0.97	-1.24	7.37
Average Zero Response (C _o)	0.3	0.1	3.4	0.4	-1.4	3.3
Pretest System Cal Response	11.99	11.48	4,736.03	235.71	-1.40	2,974.10
Posttest System Cal Response	11.88	11.58	4,611.22	244.79	-1.56	2,848.33
Average Cal Response (C _M)	11.9	11.5	4,673.6	240.3	-1.5	2,911.2
Corrected Run Average (Corr)	8.5	5.6	18,629.8	33.5	NA	NA

Location ERG - Uinta Basin, UT

Source Deep Creek 8-16-4-2E

Project No. 2021-2251

Run Number		Run 1
Date		9/16/21
Start Time		12:58
Stop Time		13:19
Engine Data		
Engine Manufacturer		Arrow
Engine Model		L-795
Engine Serial Number		L-600411
Engine Type		Spark Ignition - 2SLB
Engine Date of Manufacturer	DOM	1/1/2014
Engine Brake Work, HP	EBW	55
Maximum Engine Brake Work, HP	MaxEBW	65
Fuel Heating Value, Btu/scf	F _{HV}	1,040
Fuel Factor (O2 dry), dscf/MMBtu	F _d	8,710
Ambient Temperature	T _{Amb}	80
Relative Humidity, %	RH	17
Barometric Pressure, in. Hg	P _b	24.65
Brake Specific Fuel Consumption, Btu/HP-hr	BSFC	12,081
Input Data - Outlet		
Volumetric Flow Rate (M19), dscfm	Q _{SI}	284
Calculated Data - Outlet		
O ₂ Concentration, % dry	C _{O₂}	13.78
CO ₂ Concentration, % dry	C _{CO₂}	3.97
CO Concentration, ppmvd	C _{CO}	448.6
CO Concentration, ppmvd @ 15 % O ₂	C _{COc15}	371.8
CO Emission Rate, lb/hr	ER _{CO}	0.56
CO Emission Rate, ton/yr	ER _{COTPY}	2.4
CO Emission Factor, g/HP-hr	EF _{CO}	4.6
NO _x Concentration, ppmvd	C _{NO_x}	130.6
NO _x Concentration, ppmvd @ 15 % O ₂	C _{NO_xe15}	108.3
NO _x Emission Rate, lb/hr	ER _{NO_x}	0.27
NO _x Emission Rate, ton/yr	ER _{NO_xTPY}	1.2
NO _x Emission Factor, g/HP-hr	EF _{NO_x}	2.2
Methane Concentration, ppmvd	C _{THC}	<u>0.0</u>
Methane Concentration, ppmvd @ 15 % O ₂ ISO	C _{THC c15ISO}	0.00
Methane Emission Rate, lb/hr	ER _{THC}	0.00
Methane Emission Rate, ton/yr	ER _{THC TPY}	0.00
Methane Emission Factor, g/HP-hr	EF _{THC}	0.000
NMHC (as C3H8) Concentration, ppmvd	C _{NMHC}	1,613.6
NMHC (as C3H8) Concentration, ppmvw	C _{NMHCw}	1,503.7
NMHC (as C3H8) Concentration, ppmvd @ 15 % O ₂	C _{NMHCe15}	1,337.3
NMHC (as C3H8) Emission Rate, lb/hr	ER _{NMHC}	3.2
NMHC (as C3H8) Emission Rate, ton/yr	ER _{NMHC TPY}	13.8
NMHC (as C3H8) Emission Factor, g/HP-hr	EF _{NMHC}	25.9

*Underlined values have been adjusted to zero for calculation purposes

Location: ERG - Uinta Basin, UT
 Source: Deep Creek 8-16-4-2E
 Project No.: 2021-2251
 Date: 9/16/21

Time Unit Status	O ₂ - Outlet % dry Valid	CO ₂ - Outlet % dry Valid	CO - Outlet ppmvd Valid	NOx - Outlet ppmvd Valid	Methane - Outlet ppmvw Valid	NMHC - Outlet ppmvw Valid
12:58	13.18	4.19	577.18	138.83	-0.71	1,196.46
12:59	12.60	4.61	332.55	106.60	-0.81	1,847.10
13:00	13.63	3.95	414.85	154.42	-0.74	2,136.48
13:01	13.32	4.15	869.16	86.28	-0.70	2,013.66
13:02	12.62	4.55	662.24	158.84	-0.77	1,426.80
13:03	13.23	4.23	468.68	74.95	-0.68	1,272.05
13:04	13.34	4.13	472.15	184.69	-0.73	2,041.60
13:05	12.84	4.45	333.60	88.77	-0.74	1,783.95
13:06	13.27	4.18	360.88	170.69	-0.67	1,236.86
13:07	13.29	4.22	595.13	77.48	-0.74	1,776.66
13:08	14.36	3.55	392.64	166.95	-0.75	1,131.41
13:09	14.39	3.62	203.05	81.30	-0.69	1,442.52
13:10	14.70	3.34	485.13	152.58	-0.84	1,705.20
13:11	13.88	3.85	330.81	78.17	-0.73	686.64
13:12	13.04	4.31	321.03	159.91	-0.75	1,948.14
13:13	13.40	4.16	423.03	82.74	-0.86	871.26
13:14	14.66	3.40	490.97	145.41	-0.76	1,210.80
13:15	14.52	3.53	238.63	81.70	-0.87	2,191.23
13:16	14.73	3.36	365.99	138.44	-0.92	335.82
13:17	14.40	3.57	621.27	64.37	-0.80	1,450.73
13:18	13.18	4.24	486.96	168.82	-0.76	1,872.10

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NOx - Outlet	Methane - Outlet	NMHC - Outlet
Uncorrected Run Average (C _{obs})	13.6	4.0	449.8	122.0	-0.8	1,503.7
Cal Gas Concentration (C _{MA})	12.0	11.7	4,500.0	250.0	3,000.0	3,000.0
Pretest System Zero Response	0.27	0.09	0.61	1.96	-0.72	3.75
Posttest System Zero Response	0.38	0.07	3.11	2.04	-0.78	0.75
Average Zero Response (C _o)	0.3	0.1	1.9	2.0	-0.8	2.3
Pretest System Cal Response	11.92	11.59	4,518.84	236.35	-0.81	2,887.46
Posttest System Cal Response	11.93	11.50	4,471.11	226.95	-0.78	2,954.47
Average Cal Response (C _M)	11.9	11.5	4,495.0	231.7	-0.8	2,921.0
Corrected Run Average (C _{corr})	13.8	4.0	448.6	130.6	NA	NA

Location ERG - Uinta Basin, UT
Source Lamb 4-15-4-2E
Project No. 2021-2251

Run Number	Run 1	
Date	9/16/21	
Start Time	11:07	
Stop Time	11:28	
Engine Data		
Engine Manufacturer	Arrow	
Engine Model	L-795	
Engine Serial Number	L-600994	
Engine Type	Spark Ignition - 2SLB	
Engine Brake Work, HP	EBW	55
Maximum Engine Brake Work, HP	MaxEBW	65
Fuel Heating Value, Btu/scf	F _{HV}	1,040
Fuel Factor (O2 dry), dscf/MMBtu	F _d	8,710
Ambient Temperature	T _{Amb}	74
Relative Humidity, %	RH	22
Barometric Pressure, in. Hg	P _b	24.65
Brake Specific Fuel Consumption, Btu/HP-hr	BSFC	12,081
Input Data - Outlet		
Volumetric Flow Rate (M19), dscfm	Q _{sI}	215
Calculated Data - Outlet		
O ₂ Concentration, % dry	C _{O₂}	11.47
CO ₂ Concentration, % dry	C _{CO₂}	4.54
CO Concentration, ppmvd	C _{CO}	9,423.8
CO Concentration, ppmvd @ 15 % O ₂	C _{COc15}	5,893.4
CO Emission Rate, lb/hr	ER _{CO}	8.8
CO Emission Rate, ton/yr	ER _{CO} TPY	38.6
CO Emission Factor, g/HP-hr	EF _{CO}	72.5
NO _x Concentration, ppmvd	C _{NO_x}	89.4
NO _x Concentration, ppmvd @ 15 % O ₂	C _{NO_xc15}	55.9
NO _x Emission Rate, lb/hr	ER _{NO_x}	0.14
NO _x Emission Rate, ton/yr	ER _{NO_x} TPY	0.60
NO _x Emission Factor, g/HP-hr	EF _{NO_x}	1.1
Methane Concentration, ppmvd	C _{CH₄}	<u>0.0</u>
Methane Concentration, ppmvd @ 15 % O ₂	C _{Methane} c15	0.0
Methane Emission Rate, lb/hr	ER _{CH₄}	0.00
Methane Emission Rate, ton/yr	ER _{CH₄} TPY	0.00
Methane Emission Factor, g/HP-hr	EF _{CH₄}	0.000
NMHC (as C3H8) Concentration, ppmvd	C _{NMHC}	3,322.1
NMHC (as C3H8) Concentration, ppmvw	C _{NMHC} w	3,028.4
NMHC (as C3H8) Concentration, ppmvd @ 15 % O ₂	C _{NMHC} c15	2,077.6
NMHC (as C3H8) Emission Rate, lb/hr	ER _{NMHC}	4.9
NMHC (as C3H8) Emission Rate, ton/yr	ER _{NMHC} TPY	21.4
NMHC (as C3H8) Emission Factor, g/HP-hr	EF _{NMHC}	40.2

*Underlined values have been adjusted to zero for calculation purposes

Location: ERG - Uinta Basin, UT
 Source: Lamb 4-15-4-2E
 Project No.: 2021-2251
 Date: 9/16/21

Time Unit Status	O ₂ - Outlet % dry Valid	CO ₂ - Outlet % dry Valid	CO - Outlet ppmvd Valid	NOx - Outlet ppmvd Valid	Methane - Outlet ppmvw Valid	NMHC - Outlet ppmvw Valid
11:07	11.56	4.47	9,544.79	143.96	-1.36	2,999.72
11:08	11.33	4.62	9,507.52	105.00	-1.54	1,829.23
11:09	11.43	4.58	9,730.63	32.40	-1.33	3,787.04
11:10	11.47	4.51	9,737.76	71.83	-1.37	3,383.58
11:11	11.35	4.60	9,625.91	146.92	-1.53	1,995.44
11:12	11.33	4.61	9,620.14	88.12	-1.44	3,382.01
11:13	11.46	4.56	9,720.65	33.25	-1.42	3,622.52
11:14	11.26	4.62	9,717.56	68.32	-1.54	2,957.27
11:15	11.70	4.40	9,411.71	142.27	-1.45	3,243.44
11:16	11.26	4.64	9,700.54	82.28	-1.39	2,842.07
11:17	11.41	4.63	9,481.40	31.41	-1.41	3,403.81
11:18	11.69	4.42	9,559.26	70.37	-1.47	4,097.51
11:19	11.55	4.46	9,651.26	146.91	-1.48	2,333.11
11:20	11.28	4.65	9,836.46	93.24	-1.40	2,595.87
11:21	11.73	4.43	9,701.86	30.37	-1.51	3,966.68
11:22	11.37	4.56	9,658.84	75.32	-1.38	2,251.29
11:23	11.42	4.58	9,595.23	148.16	-1.32	2,057.77
11:24	11.27	4.68	9,648.58	79.56	-1.50	4,103.83
11:25	11.38	4.59	9,726.65	32.62	-1.41	2,693.26
11:26	11.10	4.70	9,884.66	70.61	-1.33	2,399.49
11:27	11.36	4.59	9,808.76	151.71	-1.53	3,651.93

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NOx - Outlet	Methane - Outlet	NMHC - Outlet
Uncorrected Run Average (C _{obs})	11.4	4.6	9,660.5	87.8	-1.4	3,028.4
Cal Gas Concentration (C _{MA})	12.0	11.7	4,500.0	250.0	3,000.0	3,000.0
Pretest System Zero Response	0.20	0.09	5.95	0.97	-1.24	7.37
Posttest System Zero Response	0.30	0.10	2.92	0.94	-1.04	-0.08
Average Zero Response (C _o)	0.3	0.1	4.4	1.0	-1.1	3.6
Pretest System Cal Response	11.88	11.58	4,611.22	244.79	-1.56	2,848.33
Posttest System Cal Response	11.99	11.59	4,619.49	242.87	-1.27	2,914.72
Average Cal Response (C _M)	11.9	11.6	4,615.4	243.8	-1.4	2,881.5
Corrected Run Average (C _{corr})	11.5	4.5	9,423.8	89.4	NA	NA

Location ERG - Uinta Basin, UT
Source Lamb 6-15-4-2E
Project No. 2021-2251

Run Number			Run 1
Date			9/16/21
Start Time			12:02
Stop Time			12:23
Engine Data			
Engine Manufacturer			Ajax
Engine Model			E-565
Engine Serial Number			86464
Engine Type			Spark Ignition - 2SLB
Engine Date of Manufacturer	DOM	4/1/2014	
Engine Brake Work, HP	EBW	34	
Maximum Engine Brake Work, HP	MaxEBW	40	
Fuel Heating Value, Btu/scf	F _{HV}	1,040	
Fuel Factor (O2 dry), dscf/MMBtu	Fd	8,710	
Ambient Temperature	T _{Amb}	82	
Relative Humidity, %	RH	17	
Barometric Pressure, in. Hg	Pb	24.65	
Brake Specific Fuel Consumption, Btu/HP-hr	BSFC	13,300	
Input Data - Outlet			
Volumetric Flow Rate (M19), dscfm	QsI	213	
Calculated Data - Outlet			
O ₂ Concentration, % dry	C _{O₂}	14.45	
CO ₂ Concentration, % dry	C _{CO₂}	3.48	
CO Concentration, ppmvd	C _{CO}	350.7	
CO Concentration, ppmvd @ 15 % O ₂	C _{COc15}	320.7	
CO Emission Rate, lb/hr	ER _{CO}	0.33	
CO Emission Rate, ton/yr	ER _{CO} TPY	1.4	
CO Emission Factor, g/HP-hr	EF _{CO}	4.3	
NO _x Concentration, ppmvd	C _{NO_x}	6.5	
NO _x Concentration, ppmvd @ 15 % O ₂	C _{NO_xe15}	5.9	
NO _x Emission Rate, lb/hr	ER _{NO_x}	0.0099	
NO _x Emission Rate, ton/yr	ER _{NO_x} TPY	0.043	
NO _x Emission Factor, g/HP-hr	EF _{NO_x}	0.13	
Methane Concentration, ppmvd	C _{CH₄}	<u>0.0</u>	
Methane Concentration, ppmvd @ 15 % O ₂	C _{CH₄e15}	0.0	
Methane Emission Rate, lb/hr	ER _{CH₄}	0.00	
Methane Emission Rate, ton/yr	ER _{CH₄} TPY	0.00	
Methane Emission Factor, g/HP-hr	EF _{CH₄}	0.000	
NMHC (as C ₃ H ₈) Concentration, ppmvd	C _{NMHC}	3,656.2	
NMHC (as C ₃ H ₈) Concentration, ppmvw	C _{NMHCw}	3,426.2	
NMHC (as C ₃ H ₈) Concentration, ppmvd @ 15 % O ₂	C _{NMHCe15}	3,343.1	
NMHC (as C ₃ H ₈) Emission Rate, lb/hr	ER _{NMHC}	5.3	
NMHC (as C ₃ H ₈) Emission Rate, ton/yr	ER _{NMHC} TPY	23.4	
NMHC (as C ₃ H ₈) Emission Factor, g/HP-hr	EF _{NMHC}	71.3	

*Underlined values have been adjusted to zero for calculation purposes

Location: ERG - Uinta Basin, UT

Source: Lamb 6-15-4-2E

Project No.: 2021-2251

Date: 9/16/21

Time Unit Status	O ₂ - Outlet % dry Valid	CO ₂ - Outlet % dry Valid	CO - Outlet ppmvd Valid	NOx - Outlet ppmvd Valid	Methane - Outlet ppmvw Valid	NMHC - Outlet ppmvw Valid
12:02	14.51	3.40	335.52	6.63	-0.68	4,183.13
12:03	14.41	3.46	363.99	5.98	-0.61	4,316.37
12:04	14.42	3.47	363.73	5.43	-0.68	4,309.64
12:05	14.44	3.46	354.92	5.72	-0.75	4,051.88
12:06	14.43	3.46	352.07	7.02	-0.70	3,924.04
12:07	14.37	3.49	351.42	10.50	-0.76	3,937.35
12:08	14.25	3.57	365.91	13.93	-0.73	3,962.76
12:09	14.32	3.52	373.33	11.31	-0.68	3,630.20
12:10	14.33	3.54	352.30	9.23	-0.80	3,494.42
12:11	14.36	3.51	343.71	6.98	-0.87	3,489.67
12:12	14.31	3.54	362.13	4.97	-0.76	3,360.80
12:13	14.22	3.60	372.57	4.15	-0.81	3,112.00
12:14	14.34	3.53	357.91	3.98	-0.91	2,906.21
12:15	14.35	3.51	352.31	4.57	-0.81	2,860.01
12:16	14.26	3.58	364.25	4.98	-0.79	2,868.13
12:17	14.27	3.58	366.86	5.97	-0.82	2,855.55
12:18	14.28	3.57	366.41	7.06	-0.73	2,850.86
12:19	14.27	3.57	353.98	9.67	-0.72	2,854.87
12:20	14.25	3.59	361.60	11.48	-0.91	2,908.60
12:21	14.33	3.52	353.53	11.25	-0.83	3,059.35
12:22	14.32	3.54	343.96	9.08	-0.76	3,015.07

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NOx - Outlet	Methane - Outlet	NMHC - Outlet
Uncorrected Run Average (C _{obs})	14.3	3.5	357.7	7.6	-0.8	3,426.2
Cal Gas Concentration (C _{MA})	12.0	11.7	4,500.0	250.0	3,000.0	3,000.0
Pretest System Zero Response	0.30	0.10	2.92	0.94	-1.04	-0.08
Posttest System Zero Response	0.27	0.09	0.61	1.96	-0.72	3.75
Average Zero Response (C _o)	0.3	0.1	1.8	1.5	-0.9	1.8
Pretest System Cal Response	11.99	11.59	4,619.49	242.87	-1.27	2,914.72
Posttest System Cal Response	11.92	11.59	4,518.84	236.35	-0.81	2,887.46
Average Cal Response (C _M)	12.0	11.6	4,569.2	239.6	-1.0	2,901.1
Corrected Run Average (C _{corr})	14.4	3.5	350.7	6.5	NA	NA

Location ERG - Uinta Basin, UT
 Source ULT 3-35-3-1E
 Project No. 2021-2251

Run Number		Run 1
Date		9/16/21
Start Time		14:26
Stop Time		14:47
Engine Data		
Engine Manufacturer		Arrow
Engine Model		A-90
Engine Serial Number		BEA90S004
Engine Type		Spark Ignition - 4SRB
Engine Date of Manufacturer	DOM	5/12/2014
Engine Brake Work, HP	EBW	78
Maximum Engine Brake Work, HP	MaxEBW	92
Fuel Heating Value, Btu/scf	F _{HV}	1,040
Fuel Factor (O2 dry), dscf/MMBtu	F _d	8,710
Ambient Temperature	T _{Amb}	80
Relative Humidity, %	RH	17
Barometric Pressure, in. Hg	Pb	24.65
Brake Specific Fuel Consumption, Btu/HP-hr	BSFC	8,200
Input Data - Outlet		
Volumetric Flow Rate (M19), dscfm	QsI	95
Calculated Data - Outlet		
O ₂ Concentration, % dry	C _{O₂}	0.40
CO ₂ Concentration, % dry	C _{CO₂}	10.55
CO Concentration, ppmvd	C _{CO}	23,147.0
CO Concentration, ppmvd @ 15 % O ₂	C _{COc15}	6,663.4
CO Emission Rate, lb/hr	ER _{CO}	9.6
CO Emission Rate, ton/yr	ER _{CO} TPY	42.0
CO Emission Factor, g/HP-hr	EF _{CO}	55.6
NO _x Concentration, ppmvd	C _{NO_x}	796.7
NO _x Concentration, ppmvd @ 15 % O ₂	C _{NO_xc15}	229.3
NO _x Emission Rate, lb/hr	ER _{NO_x}	0.54
NO _x Emission Rate, ton/yr	ER _{NO_x} TPY	2.4
NO _x Emission Factor, g/HP-hr	EF _{NO_x}	3.1
Methane Concentration, ppmvd	C _{CH₄}	<u>0.0</u>
Methane Concentration, ppmvd @ 15 % O ₂	C _{CH₄c15}	0.00
Methane Emission Rate, lb/hr	ER _{CH₄}	0.00
Methane Emission Rate, ton/yr	ER _{CH₄} TPY	0.00
Methane Emission Factor, g/HP-hr	EF _{CH₄}	0.000
NMHC (as C3H8) Concentration, ppmvd	C _{NMHC}	582.7
NMHC (as C3H8) Concentration, ppmvw	C _{NMHCw}	476.2
NMHC (as C3H8) Concentration, ppmvd @ 15 % O ₂	C _{NMHCc15}	167.7
NMHC (as C3H8) Emission Rate, lb/hr	ER _{NMHC}	0.38
NMHC (as C3H8) Emission Rate, ton/yr	ER _{NMHC} TPY	1.7
NMHC (as C3H8) Emission Factor, g/HP-hr	EF _{NMHC}	2.2

*Underlined values have been adjusted to zero for calculation purposes

Location: ERG - Uinta Basin, UT
 Source: ULT 3-35-3-1E
 Project No.: 2021-2251
 Date: 9/16/21

Time Unit Status	O ₂ - Outlet % dry Valid	CO ₂ - Outlet % dry Valid	CO - Outlet ppmvd Valid	NOx - Outlet ppmvd Valid	Methane - Outlet ppmvw Valid	NMHC - Outlet ppmvw Valid
14:26	0.92	10.27	23,200.00	770.35	-0.08	458.23
14:27	0.91	10.30	24,000.00	625.84	-0.05	609.39
14:28	0.80	10.35	23,700.00	446.16	-0.03	471.95
14:29	0.73	10.37	23,000.00	643.31	-0.07	387.64
14:30	0.70	10.37	24,200.00	897.44	-0.07	407.01
14:31	0.74	10.32	23,000.00	828.79	-0.09	446.88
14:32	0.72	10.32	24,400.00	645.33	-0.05	559.26
14:33	0.75	10.33	22,700.00	784.43	-0.05	598.27
14:34	0.80	10.34	22,000.00	798.89	-0.04	622.02
14:35	0.79	10.38	22,900.00	537.75	-0.03	626.98
14:36	0.72	10.40	23,200.00	515.49	-0.09	590.49
14:37	0.72	10.39	23,100.00	868.15	-0.03	555.75
14:38	0.66	10.40	22,000.00	900.15	-0.05	513.10
14:39	0.65	10.38	22,500.00	707.00	-0.04	473.06
14:40	0.67	10.40	22,200.00	709.97	-0.02	440.23
14:41	0.72	10.41	23,100.00	843.75	-0.01	383.93
14:42	0.78	10.41	22,400.00	666.77	-0.03	374.73
14:43	0.72	10.43	22,900.00	453.52	-0.03	393.23
14:44	0.67	10.44	23,000.00	686.98	0.04	389.79
14:45	0.67	10.43	22,500.00	952.09	-0.07	352.32
14:46	0.69	10.39	23,500.00	833.74	-0.04	346.65

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NOx - Outlet	Methane - Outlet	NMHC - Outlet
Uncorrected Run Average (C _{obs})	0.7	10.4	23,023.8	719.8	0.0	476.2
Cal Gas Concentration (C _{MA})	12.0	11.7	4,500.0	250.0	3,000.0	3,000.0
Pretest System Zero Response	0.38	0.07	3.11	2.04	-0.78	0.75
Posttest System Zero Response	0.32	0.05	3.48	1.00	0.02	3.02
Average Zero Response (C ₀)	0.4	0.1	3.3	1.5	-0.4	1.9
Pretest System Cal Response	11.93	11.50	4,471.11	226.95	-0.78	2,954.47
Posttest System Cal Response	11.86	11.43	4,486.31	226.88	-0.06	2,873.50
Average Cal Response (C _M)	11.9	11.5	4,478.7	226.9	-0.4	2,914.0
Corrected Run Average (C _{corr})	0.4	10.6	23,147.0	796.7	NA	NA

Location ERG - Uinta Basin, UT
 Source ULT 4-35-3-1E
 Project No. 2021-2251

Run Number	Run 1	
Date	9/16/21	
Start Time	15:20	
Stop Time	15:41	
Engine Data		
Engine Manufacturer	Arrow	
Engine Model	A-90	
Engine Serial Number	BEA90S003	
Engine Type	Spark Ignition - 4SRB	
Engine Date of Manufacturer	DOM	1/1/2014
Engine Brake Work, HP	EBW	92
Maximum Engine Brake Work, HP	MaxEBW	110
Fuel Heating Value, Btu/scf	F _{HV}	1,040
Fuel Factor (O2 dry), dscf/MMBtu	F _d	8,710
Ambient Temperature	T _{Amb}	88
Relative Humidity, %	RH	10
Barometric Pressure, in. Hg	P _b	24.65
Brake Specific Fuel Consumption, Btu/HP-hr	BSFC	8,200
Input Data - Outlet		
Volumetric Flow Rate (M19), dscfm	Q _{sI}	121
Calculated Data - Outlet		
O ₂ Concentration, % dry	C _{O₂}	2.04
CO ₂ Concentration, % dry	C _{CO₂}	10.00
CO Concentration, ppmvd	C _{CO}	14,768.2
CO Concentration, ppmvd @ 15 % O ₂	C _{COe15}	4,619.1
CO Emission Rate, lb/hr	ER _{CO}	7.8
CO Emission Rate, ton/yr	ER _{COTPY}	34.2
CO Emission Factor, g/HP-hr	EF _{CO}	38.6
NO _x Concentration, ppmvd	C _{NO_x}	2,016.3
NO _x Concentration, ppmvd @ 15 % O ₂	C _{NO_xe15}	630.7
NO _x Emission Rate, lb/hr	ER _{NO_x}	1.7
NO _x Emission Rate, ton/yr	ER _{NO_xTPY}	7.7
NO _x Emission Factor, g/HP-hr	EF _{NO_x}	8.6
Methane Concentration, ppmvd	C _{CH₄}	<u>0.0</u>
Methane Concentration, ppmvd @ 15 % O ₂	C _{CH₄e15}	0.00
Methane Emission Rate, lb/hr	ER _{CH₄}	0.00
Methane Emission Rate, ton/yr	ER _{CH₄TPY}	0.00
Methane Emission Factor, g/HP-hr	EF _{CH₄}	0.000
NMHC (as C3H8) Concentration, ppmvd	C _{NMHC}	600.1
NMHC (as C3H8) Concentration, ppmvw	C _{NMHCw}	499.9
NMHC (as C3H8) Concentration, ppmvd @ 15 % O ₂	C _{NMHCe15}	187.7
NMHC (as C3H8) Emission Rate, lb/hr	ER _{NMHC}	0.50
NMHC (as C3H8) Emission Rate, ton/yr	ER _{NMHCPTY}	2.2
NMHC (as C3H8) Emission Factor, g/HP-hr	EF _{NMHC}	2.5

* Underlined values have been adjusted to zero for calculations purposes

Location: ERG - Uinta Basin, UT
 Source: ULT 4-35-3-1E
 Project No.: 2021-2251
 Date: 9/16/21

Time Unit Status	O ₂ - Outlet % dry Valid	CO ₂ - Outlet % dry Valid	CO - Outlet ppmvd Valid	NOx - Outlet ppmvd Valid	Methane - Outlet ppmvw Valid	NMHC - Outlet ppmvw Valid
15:20	2.20	9.79	14,500.00	1,850.00	-0.03	1,044.18
15:21	2.28	9.77	15,500.00	1,950.00	-0.08	360.49
15:22	2.26	9.76	15,500.00	1,870.00	-0.01	614.71
15:23	2.32	9.76	14,700.00	1,600.00	-0.05	303.54
15:24	2.31	9.77	13,500.00	1,800.00	-0.06	451.71
15:25	2.37	9.78	15,300.00	1,600.00	0.02	271.76
15:26	2.26	9.74	13,700.00	1,750.00	-0.04	410.31
15:27	2.37	9.74	13,600.00	1,750.00	-0.04	439.00
15:28	2.45	9.72	15,000.00	2,200.00	-0.02	399.39
15:29	2.31	9.77	14,500.00	2,050.00	-0.09	989.91
15:30	2.42	9.76	15,200.00	1,700.00	-0.07	525.50
15:31	2.24	9.79	15,300.00	1,800.00	-0.10	761.47
15:32	2.30	9.76	16,100.00	1,835.00	-0.08	531.99
15:33	2.24	9.76	14,000.00	1,700.00	-0.04	483.80
15:34	2.34	9.77	16,500.00	1,900.00	-0.04	365.27
15:35	2.18	9.81	15,600.00	1,900.00	-0.01	353.02
15:36	2.26	9.79	14,000.00	1,750.00	0.00	296.29
15:37	2.30	9.79	14,000.00	1,900.00	-0.02	295.03
15:38	2.42	9.72	14,500.00	1,800.00	0.00	458.69
15:39	2.36	9.76	13,500.00	1,600.00	-0.04	447.98
15:40	2.39	9.77	15,000.00	1,900.00	-0.01	693.47

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NOx - Outlet	Methane - Outlet	NMHC - Outlet
Uncorrected Run Average (C _{obs})	2.3	9.8	14,738.1	1,819.3	0.0	499.9
Cal Gas Concentration (C _{MA})	12.0	11.7	4,500.0	250.0	3,000.0	3,000.0
Pretest System Zero Response	0.32	0.05	3.48	1.00	0.02	3.02
Posttest System Zero Response	0.40	0.09	5.95	2.03	-0.02	2.43
Average Zero Response (C _o)	0.4	0.1	4.7	1.5	0.0	2.7
Pretest System Cal Response	11.86	11.43	4,486.31	226.88	-0.06	2,873.50
Posttest System Cal Response	11.88	11.35	4,501.90	226.91	0.05	2,723.87
Average Cal Response (C _M)	11.9	11.4	4,494.1	226.9	-0.1	2,798.7
Corrected Run Average (C _{corr})	2.0	10.0	14,768.2	2,016.3	NA	NA

Appendix C

Location ERG - Uinta Basin, UT

Source Womack 13-9-3-1E

Project No. 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Make	Servomex	Servomex	Thermo	Thermo	Thermo
Model	1440	1440	48i	42-C	55i
S/N	1420C-1	1415C-4	1150980011	42CHL70581366	1202108608
Operating Range	0-25	0-25	0-10000	0-1000	5000
Cylinder ID					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	EB0041315
Mid	CC264854	CC264854	ALM014179	EB0087438	EB0041315
High	CC264854	CC264854	ALM014179	EB0087438	EB0041315
Cylinder Certified Values					
Low	NA	NA	NA	NA	4990
Mid	24.80	24.05	17900	514	4990
High	24.80	24.05	17900	514	4990
Cylinder Expiration Date					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	4/19/29
Mid	6/23/28	6/23/28	9/3/22	9/7/28	4/19/29
High	6/23/28	6/23/28	9/3/22	9/7/28	4/19/29

Calibration Data

Location: ERG - Uinta Basin, UT

Source: Womack 13-9-3-1E

Project No.: 2021-2251

Date: 9/13/21

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Expected Average Concentration	12.0	12.0	4,500.0	250.0	2,800.0
Span Between					
Low	12.0	12.0	4,500.0	250.0	4,200.0
High	60.0	60.0	22,500.0	1,250.0	14,000.0
Desired Span	24.8	24.1	9,000.0	514.0	5,700.0
Low Range Gas					
Low	NA	NA	NA	NA	1,425.0
High	NA	NA	NA	NA	1,995.0
Mid Range Gas					
Low	9.9	9.6	3,600.0	205.6	2,565.0
High	14.9	14.4	5,400.0	308.4	3,135.0
High Range Gas					
Low	NA	NA	NA	NA	4,560.0
High	NA	NA	NA	NA	5,130.0
Actual Concentration (% or ppm)					
Zero	0.0	0.0	0.0	0.0	0.0
Low	NA	NA	NA	NA	1,500
Mid	12.00	11.67	4,500	250	3,000
High	24.80	24.05	9,000	514	4,990
Response Time (seconds)	25.0	25.0	25.0	25.0	25.0
Upscale Calibration Gas (C_{MA})	Mid	Mid	Mid	Mid	Mid
Instrument Response (% or ppm)					
Zero	0.1	0.1	0.6	-0.1	-1.4
Low	NA	NA	NA	NA	1,443.6
Mid	11.9	11.9	4,650.3	244.0	2,890.3
High	24.8	24.1	8,964.5	510.1	4,809.4
Performance (% of Span or Cal. Gas Conc.)					
Zero	0.2	0.5	0.0	0.0	0.0
Low	NA	NA	NA	NA	0.1
Mid	0.5	0.8	1.7	1.2	0.0
High	0.2	0.0	0.4	0.8	0.0
Status					
Zero	PASS	PASS	PASS	PASS	PASS
Low	NA	NA	NA	NA	PASS
Mid	PASS	PASS	PASS	PASS	PASS
High	PASS	PASS	PASS	PASS	PASS

Bias/Drift Determinations

Location: ERG - Uinta Basin, UT

Source: Womack 13-9-3-1E

Project No.: 2021-2251

Parameter			O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Run 1	Date	9/13/21					
	Span Value		24.8	24.1	9,000.0	514.0	5,700.0
	Initial Instrument Zero Cal Response		0.1	0.1	0.6	-0.1	-1.4
	Initial Instrument Upscale Cal Response		11.9	11.9	4,650.3	244.0	2,890.3
	Final Instrument Zero Cal Response		0.1	0.1	0.6	-0.1	-1.4
	Final Instrument Upscale Cal Response		11.9	11.9	4,650.3	244.0	2,890.3
	Pretest System Zero Response		0.7	0.2	25.6	8.0	8.2
	Posttest System Zero Response		0.2	0.2	4.4	4.0	1.4
	Pretest System Upscale Response		12.3	11.5	4,373.9	246.9	2,789.4
	Posttest System Upscale Response		12.1	11.6	4,636.5	238.9	2,954.8
Bias (%)							
	Pretest Zero		2.7	0.2	0.3	1.6	NA
	Posttest Zero		0.4	0.2	0.0	0.8	NA
	Pretest Span		1.8	-1.4	-3.1	0.6	NA
	Posttest Span		1.0	-1.2	-0.2	-1.0	NA
Drift (%)							
	Zero		-2.3	-0.1	-0.2	-0.8	-0.1
	Mid		-0.8	0.2	2.9	-1.6	2.9

Location ERG - Uinta Basin, UT
Source Womack 13-9-3-1E-H1
Project No. 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Make	Servomex	Servomex	Thermo	Thermo	Thermo
Model	1440	1440	48i	42-C	55i
S/N	1420C-1	1415C-4	1150980011	42CHL70581366	1202108608
Operating Range	0-25	0-25	0-10000	0-1000	5000
Cylinder ID					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	EB0041315
Mid	CC264854	CC264854	ALM014179	EB0087438	EB0041315
High	CC264854	CC264854	ALM014179	EB0087438	EB0041315
Cylinder Certified Values					
Low	NA	NA	NA	NA	4990
Mid	24.80	24.05	17900	514	4990
High	24.80	24.05	17900	514	4990
Cylinder Expiration Date					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	4/19/29
Mid	5/14/24	6/27/22	3/9/22	9/7/28	4/19/29
High	5/14/24	6/27/22	3/9/22	9/7/28	4/19/29

Calibration Data

Location: ERG - Uinta Basin, UT

Source: Womack 13-9-3-1E-H1

Project No.: 2021-2251

Date: 9/13/21

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Expected Average Concentration	12.0	12.0	4,500.0	250.0	2,800.0
Span Between					
Low	12.0	12.0	4,500.0	250.0	4,200.0
High	60.0	60.0	22,500.0	1,250.0	14,000.0
Desired Span	24.8	24.1	9,000.0	514.0	5,700.0
Low Range Gas					
Low	NA	NA	NA	NA	1,425.0
High	NA	NA	NA	NA	1,995.0
Mid Range Gas					
Low	9.9	9.6	3,600.0	205.6	2,565.0
High	14.9	14.4	5,400.0	308.4	3,135.0
High Range Gas					
Low	NA	NA	NA	NA	4,560.0
High	NA	NA	NA	NA	5,130.0
Actual Concentration (% or ppm)					
Zero	0.0	0.0	0.0	0.0	0.0
Low	NA	NA	NA	NA	1,500
Mid	12.00	11.67	4,500	250	3,000
High	24.80	24.05	9,000	514	4,990
Response Time (seconds)	25.0	25.0	25.0	25.0	25.0
Upscale Calibration Gas (C_{MA})	Mid	Mid	Mid	Mid	Mid
Instrument Response (% or ppm)					
Zero	0.1	0.1	0.6	-0.1	-1.4
Low	NA	NA	NA	NA	1,443.6
Mid	11.9	11.9	4,650.3	244.0	2,890.3
High	24.8	24.1	8,964.5	510.1	4,809.4
Performance (% of Span or Cal. Gas Conc.)					
Zero	0.2	0.5	0.0	0.0	0.0
Low	NA	NA	NA	NA	0.1
Mid	0.5	0.8	1.7	1.2	0.0
High	0.2	0.0	0.4	0.8	0.0
Status					
Zero	PASS	PASS	PASS	PASS	PASS
Low	NA	NA	NA	NA	PASS
Mid	PASS	PASS	PASS	PASS	PASS
High	PASS	PASS	PASS	PASS	PASS

Bias/Drift Determinations

Location: ERG - Uinta Basin, UT

Source: Womack 13-9-3-1E-H1

Project No.: 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Run 1 Date 9/13/21					
Span Value	24.8	24.1	9,000.0	514.0	5,700.0
Initial Instrument Zero Cal Response	0.1	0.1	0.6	-0.1	-1.4
Initial Instrument Upscale Cal Response	11.9	11.9	4,650.3	244.0	2,890.3
Final Instrument Zero Cal Response	0.1	0.1	0.6	-0.1	-1.4
Final Instrument Upscale Cal Response	11.9	11.9	4,650.3	244.0	2,890.3
Pretest System Zero Response	0.9	0.1	0.6	0.0	-1.4
Posttest System Zero Response	0.7	0.2	25.6	8.0	8.2
Pretest System Upscale Response	12.5	11.3	4,318.0	241.0	2,890.3
Posttest System Upscale Response	12.3	11.5	4,373.9	246.9	2,789.4
Bias (%)					
Pretest Zero	3.5	0.0	0.0	0.0	NA
Posttest Zero	2.7	0.2	0.3	1.6	NA
Pretest Span	2.6	-2.2	-3.7	-0.6	NA
Posttest Span	1.8	-1.4	-3.1	0.6	NA
Drift (%)					
Zero	-0.8	0.2	0.3	1.6	0.2
Mid	-0.8	0.8	0.6	1.1	-1.8

Location ERG - Uinta Basin, UT
Source Gray 2-17-3-1E
Project No. 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Make	Servomex	Servomex	Thermo	Thermo	Thermo
Model	1440	1440	48i	42-C	55i
S/N	1420C-1	1415C-4	1150980011	42CHL70581366	1202108608
Operating Range	0-25	0-25	0-10000	0-1000	5000
Cylinder ID					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	EB0041315
Mid	CC264854	CC264854	ALM014179	EB0087438	EB0041315
High	CC264854	CC264854	ALM014179	EB0087438	EB0041315
Cylinder Certified Values					
Low	NA	NA	NA	NA	4990
Mid	24.80	24.05	17900	514	4990
High	24.80	24.05	17900	514	4990
Cylinder Expiration Date					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	4/19/29
Mid	6/23/28	6/23/28	9/3/22	9/7/28	4/19/29
High	6/23/28	6/23/28	9/3/22	9/7/28	4/19/29

Calibration Data

Location: ERG - Uinta Basin, UT

Source: Gray 2-17-3-1E

Project No.: 2021-2251

Date: 9/13/21

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Expected Average Concentration	12.0	12.0	2,500.0	250.0	2,800.0
Span Between					
Low	12.0	12.0	2,500.0	250.0	4,200.0
High	60.0	60.0	12,500.0	1,250.0	14,000.0
Desired Span	24.8	24.1	9,000.0	514.0	5,700.0
Low Range Gas					
Low	NA	NA	NA	NA	1,425.0
High	NA	NA	NA	NA	1,995.0
Mid Range Gas					
Low	9.9	9.6	3,600.0	205.6	2,565.0
High	14.9	14.4	5,400.0	308.4	3,135.0
High Range Gas					
Low	NA	NA	NA	NA	4,560.0
High	NA	NA	NA	NA	5,130.0
Actual Concentration (% or ppm)					
Zero	0.0	0.0	0.0	0.0	0.0
Low	NA	NA	NA	NA	1,500
Mid	12.00	11.67	4,500	250	3,000
High	24.80	24.05	9,000	514	4,990
Response Time (seconds)	25.0	25.0	25.0	25.0	25.0
Upscale Calibration Gas (C_{MA})	Mid	Mid	Mid	Mid	Mid
Instrument Response (% or ppm)					
Zero	0.1	0.1	0.6	-0.1	-1.4
Low	NA	NA	NA	NA	1,443.6
Mid	11.9	11.9	4,650.3	244.0	2,890.3
High	24.8	24.1	8,964.5	510.1	4,809.4
Performance (% of Span or Cal. Gas Conc.)					
Zero	0.2	0.5	0.0	0.0	0.0
Low	NA	NA	NA	NA	0.1
Mid	0.5	0.8	1.7	1.2	0.0
High	0.2	0.1	0.4	0.8	0.0
Status					
Zero	PASS	PASS	PASS	PASS	PASS
Low	NA	NA	NA	NA	PASS
Mid	PASS	PASS	PASS	PASS	PASS
High	PASS	PASS	PASS	PASS	PASS

Bias/Drift Determinations

Location: ERG - Uinta Basin, UT

Source: Gray 2-17-3-1E

Project No.: 2021-2251

Parameter		O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NOx - Outlet	NMHC - Outlet
Run 1	Date					
	9/13/21					
Span Value		24.8	24.1	9,000.0	514.0	5,700.0
Initial Instrument Zero Cal Response		0.1	0.1	0.6	-0.1	-1.4
Initial Instrument Upscale Cal Response		11.9	11.9	4,650.3	244.0	2,890.3
Final Instrument Zero Cal Response		0.1	0.1	0.6	-0.1	-1.4
Final Instrument Upscale Cal Response		11.9	11.9	4,650.3	244.0	2,890.3
Pretest System Zero Response		0.2	0.2	4.4	4.0	1.4
Posttest System Zero Response		0.2	0.2	0.6	1.1	2.5
Pretest System Upscale Response		12.1	11.6	4,636.5	238.9	2,954.8
Posttest System Upscale Response		11.6	11.5	4,628.6	234.8	2,919.2
Bias (%)						
Pretest Zero		0.4	0.2	0.0	0.8	NA
Posttest Zero		0.6	0.2	0.0	0.2	NA
Pretest Span		1.0	-1.2	-0.2	-1.0	NA
Posttest Span		-1.2	-1.7	-0.2	-1.8	NA
Drift (%)						
Zero		0.2	0.0	0.0	-0.6	0.0
Mid		-2.1	-0.5	-0.1	-0.8	-0.6

Location ERG - Uinta Basin, UT
Source Deep Creek 14-9-4-2E
Project No. 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Make	Servomex	Servomex	Thermo	Thermo	Thermo
Model	1440	1440	48i	42-C	55i
S/N	1420C-1	1415C-4	1150980011	42CHL70581366	1202108608
Operating Range	0-25	0-25	0-10000	0-1000	0-5000
Cylinder ID					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	EB0041315
Mid	CC264854	CC264854	ALM014179	EB0087438	EB0041315
High	CC264854	CC264854	ALM014179	EB0087438	EB0041315
Cylinder Certified Values					
Low	NA	NA	NA	NA	4990
Mid	24.8	24.05	17900	514	4990
High	24.8	24.05	17900	514	4990
Cylinder Expiration Date					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	4/19/29
Mid	5/14/24	6/27/22	3/9/22	9/7/28	4/19/29
High	5/14/24	6/27/22	3/9/22	9/7/28	4/19/29

Calibration Data

Location: ERG - Uinta Basin, UT

Source: Deep Creek 14-9-4-2E

Project No.: 2021-2251

Date: 9/16/21

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Expected Average Concentration	12.4	12.0	4,500.0	257.0	2,850.0
Span Between					
Low	12.4	12.0	4,500.0	257.0	4,275.0
High	62.0	60.1	22,500.0	1,285.0	14,250.0
Desired Span	24.8	24.1	9,000.0	514.0	5,700.0
Low Range Gas					
Low	NA	NA	NA	NA	1,425.0
High	NA	NA	NA	NA	1,995.0
Mid Range Gas					
Low	9.9	9.6	3,600.0	205.6	2,565.0
High	14.9	14.4	5,400.0	308.4	3,135.0
High Range Gas					
Low	NA	NA	NA	NA	4,560.0
High	NA	NA	NA	NA	5,130.0
Actual Concentration (% or ppm)					
Zero	0.0	0.0	0.0	0.0	0.0
Low	NA	NA	NA	NA	1,500.0
Mid	12.0	11.7	4,500.0	250.0	3,000.0
High	24.8	24.1	9,000.0	514.0	4,990.0
Response Time (seconds)	25.0	25.0	25.0	25.0	25.0
Upscale Calibration Gas (C_{MA})	Mid	Mid	Mid	Mid	Mid
Instrument Response (% or ppm)					
Zero	0.1	0.1	0.7	-0.2	-0.8
Low	NA	NA	NA	NA	1,479.9
Mid	12.0	11.9	4,600.0	244.0	2,974.1
High	24.8	24.0	8,995.6	512.9	4,988.9
Performance (% of Span or Cal. Gas Conc.)					
Zero	0.4	0.2	0.0	0.0	0.0
Low	NA	NA	NA	NA	1.3
Mid	0.0	1.0	1.1	1.2	0.8
High	0.0	0.1	0.0	0.2	0.0
Status					
Zero	PASS	PASS	PASS	PASS	PASS
Low	NA	NA	NA	NA	PASS
Mid	PASS	PASS	PASS	PASS	PASS
High	PASS	PASS	PASS	PASS	PASS

Bias/Drift Determinations

Location: ERG - Uinta Basin, UT

Source: Deep Creek 14-9-4-2E

Project No.: 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NOx - Outlet	NMHC - Outlet
Run 1 Date 9/16/21					
Span Value	24.8	24.1	9,000.0	514.0	5,700.0
Initial Instrument Zero Cal Response	0.1	0.1	0.7	-0.2	-0.8
Initial Instrument Upscale Cal Response	12.0	11.9	4,600.0	244.0	2,974.1
Final Instrument Zero Cal Response	0.1	0.1	0.7	-0.2	-0.8
Final Instrument Upscale Cal Response	12.0	11.9	4,600.0	244.0	2,974.1
Pretest System Zero Response	0.4	0.1	0.8	-0.2	-0.8
Posttest System Zero Response	0.2	0.1	6.0	1.0	7.4
Pretest System Upscale Response	12.0	11.5	4,736.0	235.7	2,974.1
Posttest System Upscale Response	11.9	11.6	4,611.2	244.8	2,848.3
Bias (%)					
Pretest Zero	1.0	0.2	0.0	0.0	NA
Posttest Zero	0.4	0.1	0.1	0.2	NA
Pretest Span	0.0	-1.8	1.5	-1.6	NA
Posttest Span	-0.5	-1.4	0.1	0.2	NA
Drift (%)					
Zero	-0.6	0.0	0.1	0.2	0.1
Mid	-0.4	0.4	-1.4	1.8	-2.2

Location ERG - Uinta Basin, UT
Source Deep Creek 8-16-4-2E
Project No. 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Make	Servomex	Servomex	Thermo	Thermo	Thermo
Model	1440	1440	48i	42-C	55i
S/N	1420C-1	1415C-4	1150980011	42CHL70581366	1202108608
Operating Range	0-25	0-25	0-10000	0-1000	0-5000
Cylinder ID					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	EB0041315
Mid	CC264854	CC264854	ALM014179	EB0087438	EB0041315
High	CC264854	CC264854	ALM014179	EB0087438	EB0041315
Cylinder Certified Values					
Low	NA	NA	NA	NA	4990
Mid	24.8	24.05	17900	514	4990
High	24.8	24.05	17900	514	4990
Cylinder Expiration Date					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	4/19/29
Mid	5/14/24	6/27/22	3/9/22	9/7/28	4/19/29
High	5/14/24	6/27/22	3/9/22	9/7/28	4/19/29

Calibration Data

Location: ERG - Uinta Basin, UT

Source: Deep Creek 8-16-4-2E

Project No.: 2021-2251

Date: 9/16/21

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Expected Average Concentration	12.4	12.0	4,500.0	257.0	2,850.0
Span Between					
Low	12.4	12.0	4,500.0	257.0	4,275.0
High	62.0	60.1	22,500.0	1,285.0	14,250.0
Desired Span	24.8	24.1	9,000.0	514.0	5,700.0
Low Range Gas					
Low	NA	NA	NA	NA	1,425.0
High	NA	NA	NA	NA	1,995.0
Mid Range Gas					
Low	9.9	9.6	3,600.0	205.6	2,565.0
High	14.9	14.4	5,400.0	308.4	3,135.0
High Range Gas					
Low	NA	NA	NA	NA	4,560.0
High	NA	NA	NA	NA	5,130.0
Actual Concentration (% or ppm)					
Zero	0.0	0.0	0.0	0.0	0.0
Low	NA	NA	NA	NA	1,500.0
Mid	12.0	11.7	4,500.0	250.0	3,000.0
High	24.8	24.1	9,000.0	514.0	4,990.0
Response Time (seconds)	25.0	25.0	25.0	25.0	25.0
Upscale Calibration Gas (C_{MA})	Mid	Mid	Mid	Mid	Mid
Instrument Response (% or ppm)					
Zero	0.1	0.1	0.7	-0.2	-0.8
Low	NA	NA	NA	NA	1,479.9
Mid	12.0	11.9	4,600.0	244.0	2,974.1
High	24.8	24.0	8,995.6	512.9	4,988.9
Performance (% of Span or Cal. Gas Conc.)					
Zero	0.4	0.2	0.0	0.0	0.0
Low	NA	NA	NA	NA	1.3
Mid	0.0	1.0	1.1	1.2	0.8
High	0.0	0.1	0.0	0.2	0.0
Status					
Zero	PASS	PASS	PASS	PASS	PASS
Low	NA	NA	NA	NA	PASS
Mid	PASS	PASS	PASS	PASS	PASS
High	PASS	PASS	PASS	PASS	PASS

Bias/Drift Determinations

Location: ERG - Uinta Basin, UT

Source: Deep Creek 8-16-4-2E

Project No.: 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NOx - Outlet	NMHC - Outlet
Run 1 Date 9/16/21					
Span Value	24.8	24.1	9,000.0	514.0	5,700.0
Initial Instrument Zero Cal Response	0.1	0.1	0.7	-0.2	-0.8
Initial Instrument Upscale Cal Response	12.0	11.9	4,600.0	244.0	2,974.1
Final Instrument Zero Cal Response	0.1	0.1	0.7	-0.2	-0.8
Final Instrument Upscale Cal Response	12.0	11.9	4,600.0	244.0	2,974.1
Pretest System Zero Response	0.3	0.1	0.6	2.0	3.8
Posttest System Zero Response	0.4	0.1	3.1	2.0	0.8
Pretest System Upscale Response	11.9	11.6	4,518.8	236.4	2,887.5
Posttest System Upscale Response	11.9	11.5	4,471.1	227.0	2,954.5
Bias (%)					
Pretest Zero	0.7	0.1	0.0	0.4	NA
Posttest Zero	1.2	0.0	0.0	0.4	NA
Pretest Span	-0.3	-1.3	-0.9	-1.5	NA
Posttest Span	-0.3	-1.7	-1.4	-3.3	NA
Drift (%)					
Zero	0.4	-0.1	0.0	0.0	-0.1
Mid	0.0	-0.4	-0.5	-1.8	1.2

Location ERG - Uinta Basin, UT
Source Lamb 4-15-4-2E
Project No. 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Make	Servomex	Servomex	Thermo	Thermo	Thermo
Model	1440	1440	48i	42-C	55i
S/N	1420C-1	1415C-4	1150980011	42CHL70581366	1202108608
Operating Range	0-25	0-25	0-10000	0-1000	0-5000
Cylinder ID					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	EB0041315
Mid	CC264854	CC264854	ALM014179	EB0087438	EB0041315
High	CC264854	CC264854	ALM014179	EB0087438	EB0041315
Cylinder Certified Values					
Low	NA	NA	NA	NA	4990
Mid	24.8	24.05	17900	514	4990
High	24.8	24.05	17900	514	4990
Cylinder Expiration Date					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	4/19/29
Mid	5/14/24	6/27/22	3/9/22	9/7/28	4/19/29
High	5/14/24	6/27/22	3/9/22	9/7/28	4/19/29

Calibration Data

Location: ERG - Uinta Basin, UT

Source: Lamb 4-15-4-2E

Project No.: 2021-2251

Date: 9/16/21

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Expected Average Concentration	12.4	12.0	4,500.0	257.0	2,850.0
Span Between					
Low	12.4	12.0	4,500.0	257.0	4,275.0
High	62.0	60.1	22,500.0	1,285.0	14,250.0
Desired Span	24.8	24.1	9,000.0	514.0	5,700.0
Low Range Gas					
Low	NA	NA	NA	NA	1,425.0
High	NA	NA	NA	NA	1,995.0
Mid Range Gas					
Low	9.9	9.6	3,600.0	205.6	2,565.0
High	14.9	14.4	5,400.0	308.4	3,135.0
High Range Gas					
Low	NA	NA	NA	NA	4,560.0
High	NA	NA	NA	NA	5,130.0
Actual Concentration (% or ppm)					
Zero	0.0	0.0	0.0	0.0	0.0
Low	NA	NA	NA	NA	1,500.0
Mid	12.0	11.7	4,500.0	250.0	3,000.0
High	24.8	24.1	9,000.0	514.0	4,990.0
Response Time (seconds)	25.0	25.0	25.0	25.0	25.0
Upscale Calibration Gas (C_{MA})	Mid	Mid	Mid	Mid	Mid
Instrument Response (% or ppm)					
Zero	0.1	0.1	0.7	-0.2	-0.8
Low	NA	NA	NA	NA	1,479.9
Mid	12.0	11.9	4,600.0	244.0	2,974.1
High	24.8	24.0	8,995.6	512.9	4,988.9
Performance (% of Span or Cal. Gas Conc.)					
Zero	0.4	0.2	0.0	0.0	0.0
Low	NA	NA	NA	NA	1.3
Mid	0.0	1.0	1.1	1.2	0.8
High	0.0	0.1	0.0	0.2	0.0
Status					
Zero	PASS	PASS	PASS	PASS	PASS
Low	NA	NA	NA	NA	PASS
Mid	PASS	PASS	PASS	PASS	PASS
High	PASS	PASS	PASS	PASS	PASS

Bias/Drift Determinations

Location: ERG - Uinta Basin, UT

Source: Lamb 4-15-4-2E

Project No.: 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Run 1 Date 9/16/21					
Span Value	24.8	24.1	9,000.0	514.0	5,700.0
Initial Instrument Zero Cal Response	0.1	0.1	0.7	-0.2	-0.8
Initial Instrument Upscale Cal Response	12.0	11.9	4,600.0	244.0	2,974.1
Final Instrument Zero Cal Response	0.1	0.1	0.7	-0.2	-0.8
Final Instrument Upscale Cal Response	12.0	11.9	4,600.0	244.0	2,974.1
Pretest System Zero Response	0.2	0.1	6.0	1.0	7.4
Posttest System Zero Response	0.3	0.1	2.9	0.9	-0.1
Pretest System Upscale Response	11.9	11.6	4,611.2	244.8	2,848.3
Posttest System Upscale Response	12.0	11.6	4,619.5	242.9	2,914.7
Bias (%)					
Pretest Zero	0.4	0.1	0.1	0.2	NA
Posttest Zero	0.8	0.2	0.0	0.2	NA
Pretest Span	-0.5	-1.4	0.1	0.2	NA
Posttest Span	0.0	-1.3	0.2	-0.2	NA
Drift (%)					
Zero	0.4	0.0	0.0	0.0	-0.1
Mid	0.4	0.0	0.1	-0.4	1.2

Location ERG - Uinta Basin, UT
Source Lamb 6-15-4-2E
Project No. 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Make	Servomex	Servomex	Thermo	Thermo	Thermo
Model	1440	1440	48i	42-C	55i
S/N	1420C-1	1415C-4	1150980011	42CHL70581366	1202108608
Operating Range	0-25	0-25	0-10000	0-1000	0-5000
Cylinder ID					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	EB0041315
Mid	CC264854	CC264854	ALM014179	EB0087438	EB0041315
High	CC264854	CC264854	ALM014179	EB0087438	EB0041315
Cylinder Certified Values					
Low	NA	NA	NA	NA	4990
Mid	24.8	24.05	17900	514	4990
High	24.8	24.05	17900	514	4990
Cylinder Expiration Date					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	4/19/29
Mid	5/14/24	6/27/22	3/9/22	9/7/28	4/19/29
High	5/14/24	6/27/22	3/9/22	9/7/28	4/19/29

Calibration Data

Location: ERG - Uinta Basin, UT

Source: Lamb 6-15-4-2E

Project No.: 2021-2251

Date: 9/16/21

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Expected Average Concentration	12.0	12.0	4,500.0	257.0	2,800.0
Span Between					
Low	12.0	12.0	4,500.0	257.0	4,200.0
High	60.0	60.0	22,500.0	1,285.0	14,000.0
Desired Span	24.8	24.1	9,000.0	514.0	5,700.0
Low Range Gas					
Low	NA	NA	NA	NA	1,425.0
High	NA	NA	NA	NA	1,995.0
Mid Range Gas					
Low	9.9	9.6	3,600.0	205.6	2,565.0
High	14.9	14.4	5,400.0	308.4	3,135.0
High Range Gas					
Low	NA	NA	NA	NA	4,560.0
High	NA	NA	NA	NA	5,130.0
Actual Concentration (% or ppm)					
Zero	0.0	0.0	0.0	0.0	0.0
Low	NA	NA	NA	NA	1,500.0
Mid	12.0	11.7	4,500.0	250.0	3,000.0
High	24.8	24.1	9,000.0	514.0	4,990.0
Response Time (seconds)	25.0	25.0	25.0	25.0	25.0
Upscale Calibration Gas (C_{MA})	Mid	Mid	Mid	Mid	Mid
Instrument Response (% or ppm)					
Zero	0.1	0.1	0.7	-0.2	-0.8
Low	NA	NA	NA	NA	1,479.9
Mid	12.0	11.9	4,600.0	244.0	2,974.1
High	24.8	24.0	8,995.6	512.9	4,988.9
Performance (% of Span or Cal. Gas Conc.)					
Zero	0.4	0.2	0.0	0.0	0.0
Low	NA	NA	NA	NA	1.3
Mid	0.0	1.0	1.1	1.2	0.8
High	0.0	0.1	0.0	0.2	0.0
Status					
Zero	PASS	PASS	PASS	PASS	PASS
Low	NA	NA	NA	NA	PASS
Mid	PASS	PASS	PASS	PASS	PASS
High	PASS	PASS	PASS	PASS	PASS

Bias/Drift Determinations

Location: ERG - Uinta Basin, UT

Source: Lamb 6-15-4-2E

Project No.: 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NOx - Outlet	NMHC - Outlet
Run 1 Date 9/16/21					
Span Value	24.8	24.1	9,000.0	514.0	5,700.0
Initial Instrument Zero Cal Response	0.1	0.1	0.7	-0.2	-0.8
Initial Instrument Upscale Cal Response	12.0	11.9	4,600.0	244.0	2,974.1
Final Instrument Zero Cal Response	0.1	0.1	0.7	-0.2	-0.8
Final Instrument Upscale Cal Response	12.0	11.9	4,600.0	244.0	2,974.1
Pretest System Zero Response	0.3	0.1	2.9	0.9	-0.1
Posttest System Zero Response	0.3	0.1	0.6	2.0	3.8
Pretest System Upscale Response	12.0	11.6	4,619.5	242.9	2,914.7
Posttest System Upscale Response	11.9	11.6	4,518.8	236.4	2,887.5
Bias (%)					
Pretest Zero	0.8	0.2	0.0	0.2	NA
Posttest Zero	0.7	0.1	0.0	0.4	NA
Pretest Span	0.0	-1.3	0.2	-0.2	NA
Posttest Span	-0.3	-1.3	-0.9	-1.5	NA
Drift (%)					
Zero	-0.1	0.0	0.0	0.2	0.1
Mid	-0.3	0.0	-1.1	-1.3	-0.5

Location ERG - Uinta Basin, UT
Source ULT 3-35-3-1E
Project No. 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Make	Servomex	Servomex	Thermo	Thermo	Thermo
Model	1440	1440	48i	42-C	55i
S/N	1420C-1	1415C-4	1150980011	42CHL70581366	1202108608
Operating Range	0-25	0-25	0-10000	0-1000	0-5000
Cylinder ID					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	EB0041315
Mid	CC264854	CC264854	ALM014179	EB0087438	EB0041315
High	CC264854	CC264854	ALM014179	EB0087438	EB0041315
Cylinder Certified Values					
Low	NA	NA	NA	NA	4990
Mid	24.8	24.05	17900	514	4990
High	24.8	24.05	17900	514	4990
Cylinder Expiration Date					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	--
Mid	5/14/24	6/27/22	3/9/22	9/7/28	4/19/29
High	5/14/24	6/27/22	3/9/22	9/7/28	4/19/29

Location: ERG - Uinta Basin, UT

Source: ULT 3-35-3-1E

Project No.: 2021-2251

Date: 9/16/21

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	Methane - Outlet	NMHC - Outlet
Expected Average Concentration	12.4	12.0	4,500.0	257.0	2,850.0	2,850.0
Span Between						
Low	12.4	12.0	4,500.0	257.0	4,275.0	4,275.0
High	62.0	60.1	22,500.0	1,285.0	14,250.0	14,250.0
Desired Span	24.8	24.1	9,000.0	514.0	5,700.0	5,700.0
Low Range Gas						
Low	NA	NA	NA	NA	1,425.0	1,425.0
High	NA	NA	NA	NA	1,995.0	1,995.0
Mid Range Gas						
Low	9.9	9.6	3,600.0	205.6	2,565.0	2,565.0
High	14.9	14.4	5,400.0	308.4	3,135.0	3,135.0
High Range Gas						
Low	NA	NA	NA	NA	4,560.0	4,560.0
High	NA	NA	NA	NA	5,130.0	5,130.0
Actual Concentration (% or ppm)						
Zero	0.0	0.0	0.0	0.0	0.0	0.0
Low	NA	NA	NA	NA	1,500.0	1,500.0
Mid	12.0	11.7	4,500.0	250.0	3,000.0	3,000.0
High	24.8	24.1	9,000.0	514.0	4,990.0	4,990.0
Response Time (seconds)	25.0	25.0	25.0	25.0	25.0	25.0
Upscale Calibration Gas (C_{MA})	Mid	Mid	Mid	Mid	Mid	Mid
Instrument Response (% or ppm)						
Zero	0.1	0.1	0.7	-0.2	-0.8	-0.8
Low	NA	NA	NA	NA	1,479.9	1,479.9
Mid	12.0	11.9	4,600.0	244.0	2,974.1	2,974.1
High	24.8	24.0	8,995.6	512.9	4,988.9	4,988.9
Performance (% of Span or Cal. Gas Conc.)						
Zero	0.4	0.2	0.0	0.0	0.0	0.0
Low	NA	NA	NA	NA	1.3	1.3
Mid	0.0	1.0	1.1	1.2	0.8	0.8
High	0.0	0.1	0.0	0.2	0.0	0.0
Status						
Zero	PASS	PASS	PASS	PASS	PASS	PASS
Low	NA	NA	NA	NA	PASS	PASS
Mid	PASS	PASS	PASS	PASS	PASS	PASS
High	PASS	PASS	PASS	PASS	PASS	PASS

Bias/Drift Determinations

Location: ERG - Uinta Basin, UT

Source: ULT 3-35-3-1E

Project No.: 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Run 1 Date 9/16/21					
Span Value	24.8	24.1	9,000.0	514.0	5,700.0
Initial Instrument Zero Cal Response	0.1	0.1	0.7	-0.2	-0.8
Initial Instrument Upscale Cal Response	12.0	11.9	4,600.0	244.0	2,974.1
Final Instrument Zero Cal Response	0.1	0.1	0.7	-0.2	-0.8
Final Instrument Upscale Cal Response	12.0	11.9	4,600.0	244.0	2,974.1
Pretest System Zero Response	0.4	0.1	3.1	2.0	0.8
Posttest System Zero Response	0.3	0.1	3.5	1.0	3.0
Pretest System Upscale Response	11.9	11.5	4,471.1	227.0	2,954.5
Posttest System Upscale Response	11.9	11.4	4,486.3	226.9	2,873.5
Bias (%)					
Pretest Zero	1.2	0.0	0.0	0.4	NA
Posttest Zero	0.9	0.0	0.0	0.2	NA
Pretest Span	-0.3	-1.7	-1.4	-3.3	NA
Posttest Span	-0.6	-2.0	-1.3	-3.3	NA
Drift (%)					
Zero	-0.2	-0.1	0.0	-0.2	0.0
Mid	-0.3	-0.3	0.2	0.0	-1.4

Location ERG - Uinta Basin, UT
Source ULT 4-35-3-1E
Project No. 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Make	Servomex	Servomex	Thermo	Thermo	Thermo
Model	1440	1440	48i	42-C	55i
S/N	1420C-1	1415C-4	1150980011	42CHL70581366	1202108608
Operating Range	0-25	0-25	0-10000	0-1000	0-5000
Cylinder ID					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	EB0041315
Mid	CC264854	CC264854	ALM014179	EB0087438	EB0041315
High	CC264854	CC264854	ALM014179	EB0087438	EB0041315
Cylinder Certified Values					
Low	NA	NA	NA	NA	4990
Mid	24.80	24.05	17900	514	4990
High	24.80	24.05	17900	514	4990
Cylinder Expiration Date					
Zero	NA	NA	NA	NA	NA
Low	NA	NA	NA	NA	4/19/29
Mid	6/23/28	6/23/28	9/3/22	9/7/28	4/19/29
High	6/23/28	6/23/28	9/3/22	9/7/28	4/19/29

Calibration Data

Location: ERG - Uinta Basin, UT

Source: ULT 4-35-3-1E

Project No.: 2021-2251

Date: 9/16/21

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Expected Average Concentration	12.0	12.0	4,500.0	250.0	2,800.0
Span Between					
Low	12.0	12.0	4,500.0	250.0	4,200.0
High	60.0	60.0	22,500.0	1,250.0	14,000.0
Desired Span	24.8	24.1	9,000.0	514.0	5,700.0
Low Range Gas					
Low	NA	NA	NA	NA	1,425.0
High	NA	NA	NA	NA	1,995.0
Mid Range Gas					
Low	9.9	9.6	3,600.0	205.6	2,565.0
High	14.9	14.4	5,400.0	308.4	3,135.0
High Range Gas					
Low	NA	NA	NA	NA	4,560.0
High	NA	NA	NA	NA	5,130.0
Actual Concentration (% or ppm)					
Zero	0.0	0.0	0.0	0.0	0.0
Low	NA	NA	NA	NA	1,500
Mid	12.00	11.67	4,500	250	3,000
High	24.80	24.05	9,000	514	4,990
Response Time (seconds)	25.0	25.0	25.0	25.0	25.0
Upscale Calibration Gas (C_{MA})	Mid	Mid	Mid	Mid	Mid
Instrument Response (% or ppm)					
Zero	0.1	0.1	0.7	-0.2	-0.8
Low	NA	NA	NA	NA	1,479.9
Mid	12.1	11.9	4,600.0	244.0	2,974.1
High	24.8	24.0	8,995.6	512.9	4,988.9
Performance (% of Span or Cal. Gas Conc.)					
Zero	0.4	0.2	0.0	0.0	0.0
Low	NA	NA	NA	NA	1.3
Mid	0.4	1.0	1.1	1.2	0.8
High	0.0	0.1	0.0	0.2	0.0
Status					
Zero	PASS	PASS	PASS	PASS	PASS
Low	NA	NA	NA	NA	PASS
Mid	PASS	PASS	PASS	PASS	PASS
High	PASS	PASS	PASS	PASS	PASS

Bias/Drift Determinations

Location: ERG - Uinta Basin, UT

Source: ULT 4-35-3-1E

Project No.: 2021-2251

Parameter	O ₂ - Outlet	CO ₂ - Outlet	CO - Outlet	NO _x - Outlet	NMHC - Outlet
Run 1 Date 9/16/21					
Span Value	24.8	24.1	9,000.0	514.0	5,700.0
Initial Instrument Zero Cal Response	0.1	0.1	0.7	-0.2	-0.8
Initial Instrument Upscale Cal Response	12.1	11.9	4,600.0	244.0	2,974.1
Final Instrument Zero Cal Response	0.1	0.1	0.7	-0.2	-0.8
Final Instrument Upscale Cal Response	12.1	11.9	4,600.0	244.0	2,974.1
Pretest System Zero Response	0.3	0.1	3.5	1.0	3.0
Posttest System Zero Response	0.4	0.1	6.0	2.0	2.4
Pretest System Upscale Response	11.9	11.4	4,486.3	226.9	2,873.5
Posttest System Upscale Response	11.9	11.4	4,501.9	226.9	2,723.9
Bias (%)					
Pretest Zero	0.9	0.0	0.0	0.2	NA
Posttest Zero	1.3	0.1	0.1	0.4	NA
Pretest Span	-1.0	-2.0	-1.3	-3.3	NA
Posttest Span	-0.9	-2.3	-1.1	-3.3	NA
Drift (%)					
Zero	0.3	0.2	0.0	0.2	0.0
Mid	0.1	-0.3	0.2	0.0	-2.6

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E03NI52E15A38Q7	Reference Number: 153-401837544-1
Cylinder Number: CC264854	Cylinder Volume: 163.9 CF
Laboratory: 124 - Tooele (SAP) - UT	Cylinder Pressure: 2015 PSIG
PGVP Number: B72020	Valve Outlet: 296
Gas Code: CO2,O2,BALN	Certification Date: Jun 23, 2020

Expiration Date: Jun 23, 2028

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	24.00 %	24.05 %	G2	+/- 0.5% NIST Traceable	06/23/2020
OXYGEN	24.00 %	24.80 %	G2	+/- 0.3% NIST Traceable	06/23/2020
NITROGEN	Balance			-	

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	06011806	K012669	23.04 % CARBON DIOXIDE/NITROGEN	0.5%	Jun 27, 2022
NTRM	12062008	CC367433	22.883 % OXYGEN/NITROGEN	0.2%	May 14, 2024

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA-510 SV4MEUTJ CO2	CO2 NDIR (Dixon)	Jun 11, 2020
Horiba MPA-510 W603MM58 O2	O2 Paramagnetic (Mason)	Jun 18, 2020

Triad Data Available Upon Request



Signature on file
 Approved for Release



Red Ball Technical Gas Service
 555 Craig Kennedy Way
 Shreveport, LA 71107
 800-551-8150
 PGVP Vendor ID # G12020

EPA PROTOCOL GAS CERTIFICATE OF ANALYSIS

Cylinder Number: EB0087438
 Product ID Number: 124545
 Cylinder Pressure: 1900 PSIG
 COA #: EB0087438.20200812-0
 Customer PO. NO.:
 Customer:

Certification Date: 09/09/2020
 Expiration Date: 09/07/2028
 MFG Facility: - Shreveport - LA
 Lot Number: EB0087438.20200812
 Tracking Number: 095287340
 Previous Certification Dates:

This calibration standard has been certified per the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531, using procedure G1.

Do Not Use This Cylinder Below 100 psig (0.7 Megapascal).

Certified Concentration(s)

Component	Concentration	Uncertainty	Analytical Principle	Assayed On
Carbon Monoxide	518 PPM	±3 PPM	GCF	08/25/2020
Nitric Oxide	514 PPM	±3 PPM	Chemiluminescence	09/02/2020, 09/09/2020
Total Oxides of Nitrogen	514 PPM			
Nitrogen	Balance			

Analytical Measurement Data Available Online.

Reference Standard(s)

Serial Number	Lot	Expiration	Type	Balance	Component	Concentration	Uncertainty(%)	NIST Reference
CC238282	CC238282.20190130	08/28/2027	GMIS	N2	NO	1446 PPM	0.52	2630
EB0026246	EB0026246.20181016	06/02/2028	GMIS	N2	CO	957 PPM	0.308	1681B
EB0078147	EB0078147.20191115	04/21/2028	GMIS	N2	NO	595 PPM	0.503	SRM 2630
EB0083256	EB0083256.20180315	07/08/2028	GMIS	N2	CO	549 PPM	0.456	SRM 1681b
EB0100888	EB0100888.20191115	07/07/2028	GMIS	N2	NO	1431 PPM	0.497	SRM 2630


Analytical Instrumentation

Component	Principle	Make	Model	Serial	MPC Date
CO	GCF	Thermo	T48i	11708001	08/11/2020
NO	Chemiluminescence	Thermo	42i-HL	1162380008	08/20/2020
NO	Chemiluminescence	Thermo	42i-HL	1162380008	09/03/2020

SMART-CERT



This is to certify the gases referenced have been calibrated/tested, and verified to meet the defined specifications. This calibration/test was performed using Gases or Scales that are traceable through National Institute of Standards and Technology (NIST) to the International System of Units (SI). The basis of compliance stated is a comparison of the measurement parameters to the specified or required calibration/testing process. The expanded uncertainties use a coverage factor of k=2 to approximate the 95% confidence level of the measurement, unless otherwise noted. This calibration certificate applies only to the item described and shall not be reproduced other than in full, without written approval from Red Ball Technical Gas Services. If not included, the uncertainty of calibrations are available upon request and were taken into account when determining pass or fail.


Anthony Cyr
 Assistant Operations Manager
 Assay Laboratory: Red Ball TGS
 Version 02-J, Revised on 2018-09-17



Air Liquide America
Specialty Gases LLC



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: A22014

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
1290 COMBERMERE STREET
TROY, MI 48083

P.O. No.: 61517-70-65000
Document # : 56532412-004

Customer

CLEAN AIR ENGINEERING
500 WEST WOOD STREET
PALATINE IL 60067
US

ANALYTICAL INFORMATION Gas Type : CO,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: ALM014179 Certification Date: 02Sep2014 Exp. Date: 03Sep2022
Cylinder Pressure: 2000 PSIG Batch No: TRO0116599

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY (ABSOLUTE / RELATIVE)			
	Value	Unit	Value	Unit	Value	Unit
CARBON MONOXIDE	1.79	%	0.01	%	0.6	%
NITROGEN	BALANCE					

TRACEABILITY

REFERENCE STANDARD

COMPONENT	CONCENTRATION	UNCERTAINTY	CYLINDER	TYPE/SRM SAMPLE	EXP. DATE
CARBON MONOXIDE	1.9700 %	0.0110 %	AAL13283	NTRM 2640	11May2018

ANALYTICAL METHOD

1st Analysis: 02Sep2014

COMPONENT	INSTRUMENT	ANALYTICAL/PRINCIPLE	CALIBRATED	CONCENTRATION
CARBON MONOXIDE	HORIBA/AIA-210/57076204	NDIR	02Sep2014	1.790 %

Special Notes: DELIVERY DOC# IS 56532345

APPROVED BY: 
JEFF CROTEAU



Red Ball Technical Gas Service
 555 Craig Kennedy Way
 Shreveport, LA 71107
 800-551-8150
 PGVP Vendor ID # G12021

EPA PROTOCOL GAS CERTIFICATE OF ANALYSIS

Cylinder Number:	EB0041315	Certification Date:	04/21/2021
Product ID Number:	124111	Expiration Date:	04/19/2029
Cylinder Pressure:	1900 PSIG	MFG Facility:	- Shreveport - LA
COA #	EB0041315.20210406-0	Lot Number:	EB0041315.20210406
Customer PO. NO.:		Tracking Number:	065159642
Customer:		Previous Certification Dates:	

This calibration standard has been certified per the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531, using procedure G2.

Do Not Use This Cylinder Below 100 psig (0.7 Megapascal).

Certified Concentration(s)

Component	Concentration	Uncertainty	Analytical Principle	Assayed On
Propane	4990 PPM	±40 PPM	FTIR	04/21/2021
Nitrogen	Balance			

Analytical Measurement Data Available Online.

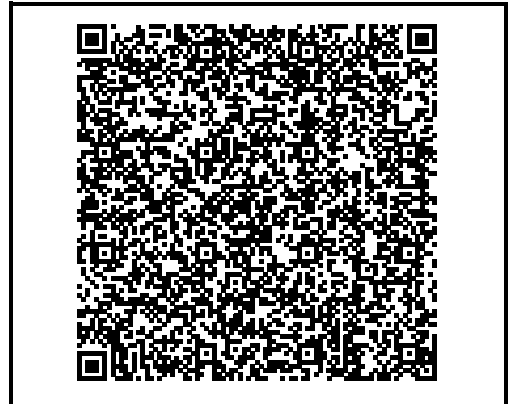
Reference Standard(s)

Serial Number	Lot	Expiration	Type	Balance	Component	Concentration	Uncertainty(%)	NIST Reference
EB0070649	EB0070649.20160114g	05/17/2024	GMS	N2	C3H8	1494 PPM	0.603	2647a

Analytical Instrumentation

Component	Principle	Make	Model	Serial	MPC Date
C3H8	FTIR	MKS	MKS 2031DJG2EKVS13T	017146467	04/20/2021

SMART-CERT



This is to certify the gases referenced have been calibrated/tested, and verified to meet the defined specifications. This calibration/test was performed using Gases or Scales that are traceable through National Institute of Standards and Technology (NIST) to the International System of Units (SI). The basis of compliance stated is a comparison of the measurement parameters to the specified or required calibration/testing process. The expanded uncertainties use a coverage factor of k=2 to approximate the 95% confidence level of the measurement, unless otherwise noted. This calibration certificate applies only to the item described and shall not be reproduced other than in full, without written approval from Red Ball Technical Gas Services. If not included, the uncertainty of calibrations are available upon request and were taken into account when determining pass or fail.

Anthony Cyr
 Assistant Operations Manager
 Assay Laboratory: Red Ball TGS
 Version 02-J, Revised on 2018-09-17

NO_x Converter Efficiency Check

Location: Eastern Research Group
Project No.: 2021-2251

NO ₂ Converter Check - Outlet			
Analyzer Make	Thermo	Pre-Test Date	--
Analyzer Model	42C	Pre-Test Concentration, ppm	--
Serial Number	42CHL70581366	Pre-Test Efficiency, %	-
Cylinder ID Number	CC502915	Post-Test Date	9/30/21
Cylinder Exp. Date	10/2/22	Time	20:15
Cylinder Concentration, ppm	50.1	Post-Test Concentration, ppm	48.7
		Post-Test Efficiency, %	97

**Required Efficiency is ≥ 90 %.*

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E02NI99E15W0030	Reference Number:	153-401603479-1
Cylinder Number:	CC502915	Cylinder Volume:	144.0 CF
Laboratory:	124 - Tooele (SAP) - UT	Cylinder Pressure:	2015 PSIG
PGVP Number:	B72019	Valve Outlet:	660
Gas Code:	NO2,BALN	Certification Date:	Oct 02, 2019

Expiration Date: Oct 02, 2022

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NITROGEN DIOXIDE	50.00 PPM	50.01 PPM	G1	+/- 2.0% NIST Traceable	09/24/2019, 10/02/2019
NITROGEN	Balance			-	

CALIBRATION STANDARDS						
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date	
GMIS	401206801105	CC513733	58.35 PPM NITROGEN DIOXIDE/NITROGEN	1.8%	May 02, 2022	
PRM	12388	D685030	59.5 PPM NITROGEN DIOXIDE/NITROGEN	1.7%	Feb 20, 2020	

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
MKS FTIR NO2 018143349	FTIR	Sep 04, 2019

Triad Data Available Upon Request

PERMANENT NOTES: OXYGEN ADDED TO MAINTAIN STABILITY.



Signature on file
Approved for Release

EPA Method 205 Field Calibration of Dilution System

Location: Eastern Research Group - Uinta Basin, UT
Project No.: 2021-2251

Analyzer Make: Servomex
 Analyzer Model: 1440
 Analyzer SN: 1420C-1
 Envionics ID: 8028
 Component/Balance Gas: O2/N2
 Cylinder Gas ID (Dilution): CC264854
 Cylinder Gas Concentration (Dilution), ppm: 24.80
 Cylinder Gas ID (Mid-Level): CC481021
 Cylinder Gas Concentration (Mid-Level), ppm: 5.002

Target Mass Flow Contollers	Target Dilution (%)	Target Flow Rate lpm	Target Concentration (ppm)	Actual Concentration (ppm)	Injection 1 Analyzer Concentration (ppm)	Injection 2 Analyzer Concentration (ppm)	Injection 3 Analyzer Concentration (ppm)	Average Analyzer Concentration (ppm)	Difference (ppm)	Average Error (± 2 %)
10L/5L	80.0	5.0	19.8	19.6	19.6	19.7	19.8	19.71	0.14	0.7%
10L/5L	50.0	5.0	12.4	12.3	12.2	12.3	12.4	12.29	0.00	0.0%
10L/1L	20.0	4.0	5.0	4.9	4.8	4.9	5.0	4.90	0.00	-0.1%
10L/1L	10.0	4.0	2.5	2.5	2.4	2.5	2.5	2.47	-0.02	-0.7%

*Not all AST Envionics Units have 2-10L Mass Flow Controllers. For these units the 90% @ 7lpm and 80% @ 7lpm injections will not be conducted.

Average Analyzer Concentration (ppm)	Injection 1 Error (± 2 %)	Injection 2 Error (± 2 %)	Injection 3 Error (± 2 %)
19.71	-0.5%	-0.1%	0.6%
12.29	-0.5%	-0.1%	0.6%
4.90	-1.6%	0.1%	1.5%
2.47	-1.8%	1.5%	0.3%

Mid-Level Supply Gas Calibration Direct to Analyzer

Calibration Gas Concentration (ppm)	Injection 1 Analyzer Concentration (ppm)	Injection 2 Analyzer Concentration (ppm)	Injection 3 Analyzer Concentration (ppm)	Average Analyzer Concentration (ppm)	Difference (ppm)	Average Error (± 2 %)
5.00	5.1	5.0	5.1	5.07	0.07	1.4%

Mass Flow Controller Calibration

Dilution System Make:	Environics
Dilution System Model:	4040
Dilution System S/N:	8028
Calibration Equipment Make:	Alicat Scientific
Calibration Equipment Model:	M-10SLPD/5MM-D/5M, M-1SLPM-D/5M
Calibration Equipment S/N:	197206/197208
Flow Cell S/N:	197206
Flow Cell S/N:	197208
Calibration Gas:	Nitrogen
Barometric Pressure, mmHg:	25.61
Ambient Temperature, °F:	63.8

Mass Flow Controller ID	#1			#2			#3		
Size, ccm:	10,000			10,000			1,000		
Make:	Environics			Environics			Environics		
Model:	EFC-202			EFC-202			EFC-202		
S/N:	0455242015			0455242016			0455238008		
	Set Flow	True Flow	Difference	Set Flow	True Flow	Difference	Set Flow	True Flow	Difference
	cc/min	cc/min		cc/min	cc/min		cc/min	cc/min	
5%	500	509	1.8%	500	515	3.0%	50	51	2.0%
10%	1,000	1,014	1.4%	1,000	1,021	2.1%	100	102	2.0%
20%	2,000	2,030	1.5%	2,000	2,038	1.9%	200	205	2.5%
30%	3,000	3,040	1.3%	3,000	3,050	1.7%	300	306	2.0%
40%	4,000	4,052	1.3%	4,000	4,064	1.6%	400	408	2.0%
50%	5,000	5,066	1.3%	5,000	5,075	1.5%	500	508	1.6%
60%	6,000	6,078	1.3%	6,000	6,086	1.4%	600	610	1.7%
70%	7,000	7,104	1.5%	7,000	7,113	1.6%	700	711	1.6%
80%	8,000	8,133	1.7%	8,000	8,141	1.8%	800	810	1.3%
90%	9,000	9,166	1.8%	9,000	9,170	1.9%	900	914	1.6%
100%	10,000	10,202	2.0%	10,000	10,202	2.0%	1,000	1,017	1.7%

Note: The mass flow controller's calibration values are used by the dilution system's operating software to improve accuracy. These calibrations are not necessarily indicative of the systems overall performance. Performance is verified by conducting a Method 205 prior to each field use.

Calibration Performed By Andrew Manos

Date 3/25/21

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E02NI95E15A3186	Reference Number: 153-401255388-1
Cylinder Number: CC481021	Cylinder Volume: 144.8 CF
Laboratory: 124 - Tooele (SAP) - UT	Cylinder Pressure: 2015 PSIG
PGVP Number: B72018	Valve Outlet: 580
Gas Code: O2,BALN	Certification Date: Jul 18, 2018

Expiration Date: Jul 18, 2026

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	5.000 %	5.002 %	G1	+/- 1.0% NIST Traceable	07/18/2018
NITROGEN	Balance			-	

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11060717	CC338451	4.861 % OXYGEN/NITROGEN	0.4%	Dec 13, 2022

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba MPA-510 W603MM58 O2	O2 Paramagnetic (Mason)	Jul 16, 2018

Triad Data Available Upon Request



Signature on file
Approved for Release

Location: ERG - Uinta Basin, UT
Source: Gray 2-17-3-1E
Project No.: 2021-2251
Date: _____

Traverse Point	Time	NOx (ppm)	CO (ppm)	O ₂ (%)	CO ₂ (%)
A-1	17:20	4.85	417.72	13.51	3.95
2	17:21	4.69	405.99	13.52	3.94
3	17:22	4.65	389.22	13.48	3.96
Average		4.7	404.3	13.5	4.0
Criteria Met		Single Point	Single Point	Single Point	Single Point

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