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40 CFR Part 63, Subpart ZZZZ

Continuous Compliance Demonstration Test Report

EUENGINE31, EUENGINE32, EUENGINE33, EUENGINE34, EUENGINE35

Consumers Energy Company
Ray Compressor Station
69333 Omo Road
Armada, Michigan 48005
SRN: B6636

August 15, 2018

Test Date: July 17 through 19, 2018

Test Performed by the Consumers Energy Company
Regulatory Compliance Testing Section
Air Emissions Testing Body
Laboratory Services Section
Work Order No. 32097156
Version No.: 0

EXECUTIVE SUMMARY

Consumers Energy Regulatory Compliance Testing Section (RCTS) conducted carbon monoxide reduction efficiency testing of oxidation catalysts installed to control exhaust emissions of five natural gas fired, reciprocating internal combustion engines (RICE) identified as EUENGINES31, EUENGINE32, EUENGINE33, EUENGINE34, and EUENGINE35 operating at the Ray Compressor Station in Armada, Michigan. Each engine is classified as a new (installed 2013), four-stroke lean burn (4SLB), spark ignited, 4,735 brake horsepower (BHP) engine, located at a major source of hazardous air pollutant (HAP) emissions. The engines are used to maintain pressure of natural gas in order to move it in and out of storage reservoirs and along the pipeline system. The test program was performed to satisfy the performance testing requirements and evaluate compliance with 40 CFR Part 63, Subpart ZZZZ, "National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines," (aka RICE MACT), as incorporated in Michigan Department of Environmental Quality (MDEQ) Renewable Operating Permit (ROP) MI-ROP-B6636-2015a.

On July 17 through 19, 2018, triplicate 60-minute tests were performed as proposed in the May 1, 2018 Test Protocol submitted to United States Environmental Protection Agency (USEPA) and MDEQ. The testing followed the procedures in USEPA Reference Methods (RM) 1, 3A, and 10 in 40 CFR 60, Appendix A with no deviations from the approved stack test protocol. During testing the engines were operated at load conditions within ±10 percent of 100 percent load, as specified in 40 CFR 63.6620(b). The results of the emissions testing are summarized in the following table:

Table E-1
Summary of Results

Engine	Parameter	Run			Average	Limit[1]
		1	2	3		
EUENGINE31	CO Reduction Efficiency (%)	98.7%	98.7%	98.7%	**98.7%**	**≥93%**
EUENGINE32		99.3%	99.2%	99.2%	**99.2%**	
EUENGINE33		99.2%	99.1%	99.0%	**99.1%**	
EUENGINE34		97.9%	97.7%	97.6%	**97.7%**	
EUENGINE35		99.1%	98.9%	98.9%	**99.0%**	

[1] Table 2a to Subpart ZZZZ of Part 63—Emission Limitations for New and Reconstructed 2SLB and Compression Ignition Stationary RICE >500 HP and New and Reconstructed 4SLB Stationary RICE ≥250 HP Located at a Major Source of HAP Emissions.

The results of the testing indicate each engine is operating in compliance with the applicable limit.

Detailed results are presented in Appendix Tables 1 through 5. Sample calculations and field data sheets are presented in Appendices A and B. Engine operating data and supporting documentation are provided in Appendices C and D.

1.0 INTRODUCTION

This report summarizes the results of July 17 through 19, 2018 continuous compliance air emissions testing of five natural gas fired engines operating at the Ray Compressor Station in Armada, Michigan.

This document was prepared following guidance in Michigan Department of Environmental Quality (MDEQ) *Format for Submittal of Source Emission Test Plans and Reports* published in March of 2018. Please exercise due care if portions of this report are reproduced, as critical substantiating documentation and/or other information may be omitted or taken out of context.

1.1 Identification, Location, and Dates of Tests

Consumers Energy Regulatory Compliance Testing Section (RCTS) conducted compliance carbon monoxide reduction efficiency testing of oxidation catalysts installed to control exhaust emissions of five natural gas fired, reciprocating internal combustion engines (RICE), identified as EUENGINES31, EUENGINE32, EUENGINE33, EUENGINE34, and EUENGINE35 operating at the Ray Compressor Station in Armada, Michigan. A test protocol, describing the proposed testing, methods, and quality assurance procedures was submitted to the Michigan Department of Environmental Quality (MDEQ) and United States Environmental Protection Agency (USEPA) on May 1, 2018. Mr. Mark Dziadosz, Environmental Quality Analyst with the MDEQ, subsequently approved the test protocol in his letter dated June 14, 2018. The testing was performed July 17 through 19, 2018.

1.2 Purpose of Testing

The test program was performed to satisfy the performance testing requirements and evaluate compliance with 40 CFR Part 63, Subpart ZZZZ, "National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines," (aka RICE MACT), as incorporated in MDEQ issued Renewable Operating Permit (ROP) MI-ROP-B6636-2015a. The five engines are grouped within the permit under the FGENGINES3 Flexible Group Conditions. The applicable 40 CFR Part 63, Subpart ZZZZ emission limit compliance options are presented in Table 1-1.

Table 1-1
Applicable 40 CFR 63, Subpart ZZZZ Emission Limit Compliance Options

Parameter	Emission Limit	Applicable Requirement
CO	Reduce CO emissions by 93 percent	40 CFR §63.6600(b) Table 2a to Subpart ZZZZ of Part 63
Or		
Formaldehyde	Limit concentration of formaldehyde in the stationary RICE exhaust to 14 ppmvd or less at 15 percent O_2	

Although compliance with 40 CFR Part 63, Subpart ZZZZ can be achieved by limiting engine exhaust formaldehyde concentrations, Consumers Energy Ray Compressor Station has elected to evaluate compliance with the CO reduction efficiency limit.

1.3 Brief Description of Source

EUENGINE31, EUENGINE32, EUENGINE33, EUENGINE34, and EUENGINE35 are classified as new (installed 2013) four stroke lean burn (4SLB) spark-ignited 4,735 brake horsepower (BHP) engines located at a major source of hazardous air pollutant (HAP) emissions. The engines are used to maintain pressure of natural gas in order to move it in and out of storage reservoirs and along the pipeline system.

1.4 Contact Information

Table 1-2 presents contact information of personnel involved in the test program.

Table 1-2
Contact Information

Program Role	Contact	Address
State Regulatory Administrator	Ms. Karen Kajiya-Mills Technical Programs Unit Manager 517-335-4874 kajiya-millsk@michigan.gov	Michigan Department of Environmental Quality Technical Programs Unit 525 W. Allegan, Constitution Hall, 2nd Floor S Lansing, Michigan 48933
State Technical Programs Field Inspector	Mr. Mark Dziadosz Technical Programs Unit Environmental Quality Analyst 586-753-3745 dziadoszm@michigan.gov	Michigan Department of Environmental Quality Southeast Michigan District 27700 Donald Court Warren, Michigan 48092
State Regulatory Inspector	Mr. Robert Elmouchi Environmental Quality Analyst 586-753-3736 elmouchir@michigan.gov	Michigan Department of Environmental Quality Southeast Michigan District 27700 Donald Court Warren, Michigan 48092
Responsible Official	Mr. Gregory Baustian Executive Director of Gas Compression 616-237-4009 gregory.baustian@cmsenergy.com	Consumers Energy Company Zeeland Generation 425 N. Fairview Road Zeeland, Michigan 49464
Corporate Air Quality Contact	Ms. Amy Kapuga Senior Environmental Engineer 517-788-2201 amy.kapuga@cmsenergy.com	Consumers Energy Company Environmental Services Department 1945 West Parnall Road; P22-330 Jackson, Michigan 49201
Test Facility	Mr. Charles Kelly Gas Field Lead 586-784-2096 Charles.Kelly@cmsenergy.com	Consumers Energy Company Ray Compressor Station 69333 Omo Road Armada, Michigan 48005
Test Facility	Mr. Branden Collins Compressor Station Operator 586-784-2096 brenden.collins@cmsenergy.com	Consumers Energy Company Ray Compressor Station 69333 Omo Road Armada, Michigan 48005
Test Team Representative	Mr. Brian E. Miska, QSTI Engineering Technical Analyst 989-891-3415 brian.miska@cmsenergy.com	Consumers Energy Company D.E. Karn Generating Station 2742 N. Weadock Hwy.; ESD Trailer #4 Essexville, Michigan 48732

2.0 SUMMARY OF RESULTS

2.1 Operating Data

During the performance test, the engines fired natural gas and were operated near maximum operating load conditions. 40 CFR §63.6620(b) states that each performance test must be conducted at any load condition within ±10 percent of 100 percent load. The performance testing was conducted while the engines were operating at 94% of the maximum manufacturer's design capacity for torque at engine site conditions.

The facility data acquisition system was not retrieving the data from the fuel flow monitor for EUENGINE35. This was discovered after Run 1. After discussing with Mark Dziadosz with DEQ, the facility manually recorded the fuel flow rate and consumption (totalizer) at 15 minute intervals for Runs 2 and 3.

Refer to Appendix C for detailed operating data.

2.2 Applicable Permit Information

The Ray Compressor Station has been assigned State of Michigan Registration Number (SRN) B6636 and operates in accordance with air permit MI-ROP-B6636-2015a. EUENGINE31, EUENGINE32, EUENGINE33, EUENGINE34, and EUENGINE35 are the emission unit source identifications in the permit and are included in the FGENGINES3 flexible group. Incorporated within the permit are the applicable requirements of 40 CFR Part 63, Subpart ZZZZ – National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines.

2.3 Results

The results of the testing indicate EUENGINE31, EUENGINE32, EUENGINE33, EUENGINE34, and EUENGINE35 are operating in compliance with the applicable limit. Refer to Table 2-1 for a summary of test results.

Table 2-1
Summary of Results

Engine	Parameter	Run			Average	Limit[1]
		1	2	3		
EUENGINE31	CO Reduction Efficiency (%)	98.7%	98.7%	98.7%	98.7%	≥93%
EUENGINE32		99.3%	99.2%	99.2%	99.2%	
EUENGINE33		99.2%	99.1%	99.0%	99.1%	
EUENGINE34		97.9%	97.7%	97.6%	97.7%	
EUENGINE35		99.1%	98.9%	98.9%	99.0%	

[1] Table 2a to Subpart ZZZZ of Part 63—Emission Limitations for New and Reconstructed 2SLB and Compression Ignition Stationary RICE >500 HP and New and Reconstructed 4SLB Stationary RICE ≥250 HP Located at a Major Source of HAP Emissions.

Detailed results are presented in Appendix Tables 1 through 5. A discussion of the results is presented in Section 5.0. Sample calculations and field data sheets are presented in Appendices A and B. Engine operating data and supporting information are provided in Appendices D and E.

3.0 SOURCE DESCRIPTION

EUENGINE31, EUENGINE32, EUENGINE33, EUENGINE34 and EUENGINE35 are natural gas fired RICE's used to maintain pressure of natural gas in order to move it in and out of storage reservoirs and along the pipeline system. A summary of the engine specifications from vendor data are provided in Table 3-1.

Table 3-1
Summary of Engine Specifications

Parameter[1]	EUENGINE31 through EUENGINE35
Make	Caterpillar
Model	G3616
Output (brake-horsepower)	4,735
Heat Input (mmBtu/hr)	32.0
Exhaust Flow Rate (ACFM, wet)	32,100
Exhaust Gas Temp.	856
Engine Outlet O2 (Vol-%, dry)	12.00
Engine Outlet CO2 (Vol-%, dry)	5.81
CO, Uncontrolled (ppmv, dry)	572.0
CO, Controlled (ppmv, dry)[2]	40.0

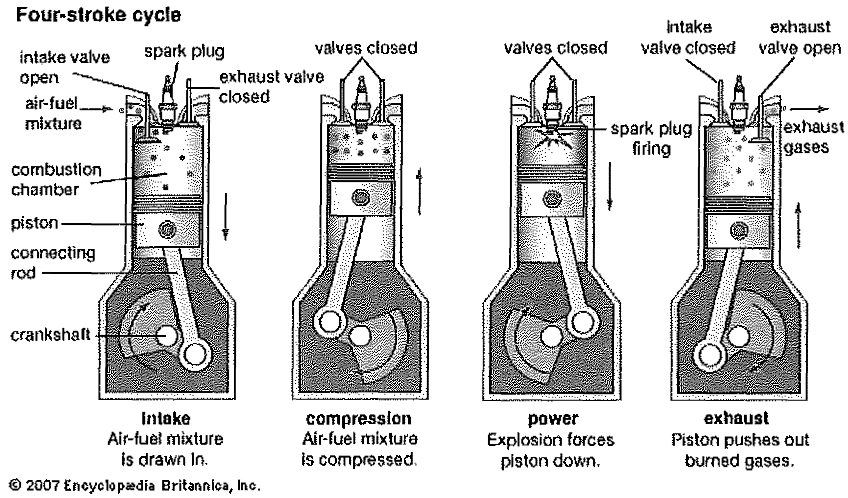
1 Engine specifications are based upon vendor data for operation at 100% of rated engine capacity
2 The controlled CO concentrations are based upon the vendor not to exceed CO concentrations at 100% load, and a reduction 93% by volume for the associated oxidation catalysts.

3.1 Process

EUENGINE31, EUENGINE32, EUENGINE33, EUENGINE34 and EUENGINE35 are natural gas-fired, spark ignited, 4SLB RICE's installed in 2013. In the four-stroke engine, air is aspirated into the cylinder during the downward travel of the piston on the intake stroke. The fuel charge is injected with the piston near the bottom of the intake stroke and the intake ports are then closed as the piston moves to the top of the cylinder, compressing the air/fuel mixture. A spark plug at the top of the cylinder ignites the air/fuel charge causing the charge to expand and initiate the downward movement of the piston, called the power stroke. As the piston reaches the bottom of the power stroke, valves open to exhaust combustion products from the cylinder as the piston travels upward. A new air-to-fuel charge is injected as the piston moves downward in a new intake stroke.

The engine provides mechanical shaft power for compressors and/or pumps. The compressors and/or pumps are used to help inject natural gas into high pressure natural gas storage fields or to help move natural gas and maintain pressure within the natural gas pipeline transmission and distribution system to consumers. Refer to Figure 3-1 for a four-stroke engine process diagram.

Figure 3-1. Four-Stroke Engine Process Diagram



The flue gas generated through natural gas combustion is controlled through parametric controls (i.e., timing and operating at a lean air-to-fuel ratio) and by post-combustion oxidizing catalysts installed on the engine exhaust system. The RICE oxidation catalysts are manufactured by EmeraChem, LLC (Part No. 28283.5-300CO). Four catalyst modules are installed on each engine exhaust stack. The catalysts use proprietary materials to lower the oxidation temperature of CO and other organic compounds, thus maximizing the catalyst efficiency specific to the exhaust gas temperatures of engines. As carbon monoxide passes through the catalytic oxidation system, CO and volatile organic compounds are oxidized to CO_2 and water, while suppressing the conversion of NO to NO_2.

The catalyst vendor has guaranteed a CO destruction efficiency of 93%. Although Consumers Energy has chosen to comply with the CO reduction emission limit requirement, the catalyst also provides control of formaldehyde and non-methane and non-ethane hydrocarbons (NMNEHC). The estimated destruction efficiencies for formaldehyde and NMNEHC are 85% and 75%, respectively. Significant maintenance has not been performed on the engines or oxidation catalysts within the last three months.

Nitrogen oxides (NO_x) emissions from the engines are minimized through the use of lean-burn combustion technology. Lean-burn combustion refers to a high level of excess air (generally 50% to 100% relative to the stoichiometric amount) in the combustion chamber. The excess air absorbs heat during the combustion process, thereby reducing the combustion temperature and pressure resulting in lower NO_x emissions.

A continuous parameter monitoring system (CPMS) is installed to continuously monitor catalyst inlet temperature in accordance with the requirements specified in Table 5 (1) of 40 CFR Part 63, Subpart ZZZZ. This parameter is monitored in accordance with the site-specific preventative maintenance / malfunction and abatement plan as a means to evaluate an efficient catalytic reaction and the performance of the pollution control equipment. Detailed operating data are provided in Appendix D.

3.2 Process Flow

Located in northeastern Macomb County, the Ray Compressor Station helps maintain natural gas pressures in southeast Michigan. The station is used to compress and store natural gas into the Ray gas storage field. This field is approximately 1,600 acres and can store up to 43 billion cubic feet of natural gas which provides enough natural gas to serve up to 40 percent of the supply to Consumers Energy's 1.7 million gas customers in winter. EUENGINE31, EUENGINE32, EUENGINE33, EUENGINE34, and EUENGINE35 are natural gas reciprocating compressor engines used at the facility that drive two-stage compressors to maintain pressure and move natural gas in and out of the storage reservoirs.

The exhaust stacks are of non-typical design. Specifically, the bottom portion of the stack has an outer stack and an inner circular stack (the shape is like a doughnut as viewed looking down from the top of the stack). The exhaust gases from the engine enter the outer stack via two horizontal ducts running from the engine to the free standing stack. Once the gases enter the outer stack, they flow downwards through the oxidation catalysts placed in the bottom of the outer stack. After passing through the catalysts, the exhaust gases enter the inner stack through an opening located near the base of the free standing stack. The exhaust gases then travel upwards, through the free standing stack, (via the inner stack) until they are discharged unobstructed vertically upwards through the approximately 75-feet high stack to atmosphere.

3.3 Materials Processed

The fuel utilized in the engines is exclusively natural gas, as defined in 40 CFR §72.2. The units are classified as new (installed 2013) stationary RICE located at an major source of HAP emissions, non-emergency, non-black start 4SLB stationary RICE >500 HP that is not remote stationary RICE and that operates more than 24 hours per calendar year as described in Table 2d (9) to Subpart ZZZZ.

3.4 Rated Capacity

EUENGINE31, EUENGINE32, EUENGINE33, EUENGINE34, and EUENGINE35 are each limited to a maximum output of approximately 4,735 horsepower. At this achievable output, the heat input rating is approximately 32 mmBtu/hr.

3.5 Process Instrumentation

The process was continuously monitored by operators and data acquisition systems during testing. One-minute data for the following parameters were collected during each test run:

- Date and time
- Discharge pressure (psi)
- Engine torque load (%)
- Engine speed (RPM)
- Engine power (BHP)
- Suction pressure (psi)
- Fuel gas flow (scfh)
- Pressure drop across catalyst (H_2O)
- Engine exhaust/Catalyst inlet temperature (°F)

Refer to Appendix C for operating data.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Consumers Energy RCTS measured oxygen and carbon monoxide concentrations using the United States Environmental Protection Agency (USEPA) test methods presented in Table 4-1. Each RICE is configured with two inlet locations upstream of the oxidation catalyst and a single outlet location downstream. Rather than utilizing two separate inlet CO sample systems, one CO sample system will be configured to draw exhaust gas simultaneously from the paired inlets at the same rate into one gas sample conditioner, where the gases will be blended, conditioned and delivered to a single CO analyzer as a representative inlet CO concentration. Note that this analyzer will be calibrated directly following the ACE guidelines of U.S. EPA Method 7E, *Determination of Nitrogen Oxides from Stationary Sources (Instrumental Analyzer Procedure)*, and sample system bias checks will be individually performed via low and upscale calibration gas injections at each inlet probe outlet to emulate the manner in which a gas sample is collected. Sample system response times will be documented during the system bias to ensure sample rates at each inlet are maintained within 10% of its associated paired inlet. The sampling and analytical procedures associated with each parameter are described in the following sections.

Table 4-1
Test Methods

Parameter	Method	USEPA Title
Sample location and traverse points	1	Sample and Velocity Traverses for Stationary Sources
Oxygen	3A	Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrument Analyzer Procedure)
Carbon monoxide	10	Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)

4.1 Description of Sampling Train and Field Procedures

The test matrix presented in Table 4-2 summarizes the sampling and analytical methods performed for the specified parameters during this test program.

Table 4-2
Test Matrix

Date (2018)	Engine	Run	Start Time (EDT)	Stop Time (EDT)	Test Duration (min)	EPA Test Method	Comment
July 17	31	1	9:43	10:43	60	1, 3A, 10	Test witnessed by MDEQ
		2	11:00	12:00	60		
		3	12:19	13:19	60		
July 17	32	1	14:20	15:20	60	1, 3A, 10	No test or engine issues
		2	15:36	16:36	60		
		3	16:50	17:50	60		
July 18	33	1	8:20	9:20	60	1, 3A, 10	No test or engine issues
		2	9:40	10:40	60		
		3	11:00	12:00	60		
July 18	34	1	13:00	14:00	60	1, 3A, 10	No test or engine issues
		2	14:20	15:20	60		
		3	15:35	16:35	60		
July 19	35	1	8:13	9:12	60	1, 3A, 10	No test or engine issues
		2	10:23	11:22	60		
		3	11:45	12:44	60		

4.1.1 Sample Location and Traverse Points (USEPA Method 1)

The number and location of traverse points were selected according to the requirements in Table 4 of 40 CFR Part 63, Subpart ZZZZ and USEPA Method 1, *Sample and Velocity Traverses for Stationary Sources.*

Pre-catalyst Sampling Ports

Two test ports are located in two 24-inch horizontal exhaust duct exiting the engine and building. The pre-catalyst sampling ports are situated:

- At least 208 inches or 8.7 duct diameters downstream of a duct bend disturbance at the engine exhaust, and

- At least 57 inches or 2.4 duct diameters upstream of flow disturbance caused by a change in duct diameter and flow direction as it enters the oxidation catalyst.

The pre-catalyst sample ports are 4-inch in diameter and extend approximately 1-inch beyond the stack wall.

Post-catalyst Sampling Ports

Two test ports are located in a 36-inch vertical exhaust duct exiting the engine and oxidation catalyst. The post-catalyst sampling ports are situated:

- Approximately 72 inches or 2.0 duct diameters downstream of a duct diameter change flow disturbance, and
- Approximately 43 inches or 1.2 duct diameters upstream of the stack exit.

The post-catalyst sample ports are 4-inch in diameter and extend approximately 4-inches beyond the stack wall.

Because the ducts are >12 inches in diameter and the sampling port location meets the two and half-diameter criterion of Section 11.1.1 of Method 1 of 40 CFR Part 60, Appendix A-1, the duct was sampled at 3 traverse points located at 16.7, 50.0, and 83.3% of the measurement line ('3-point long line'). The flue gas was sampled from the three traverse points at approximately equal intervals during the tests. Pre-catalyst and post-catalyst sampling port location drawings are presented as Figures 4-1 and 4-2.

Figure 4-1. Pre-Catalyst Sampling Port Location

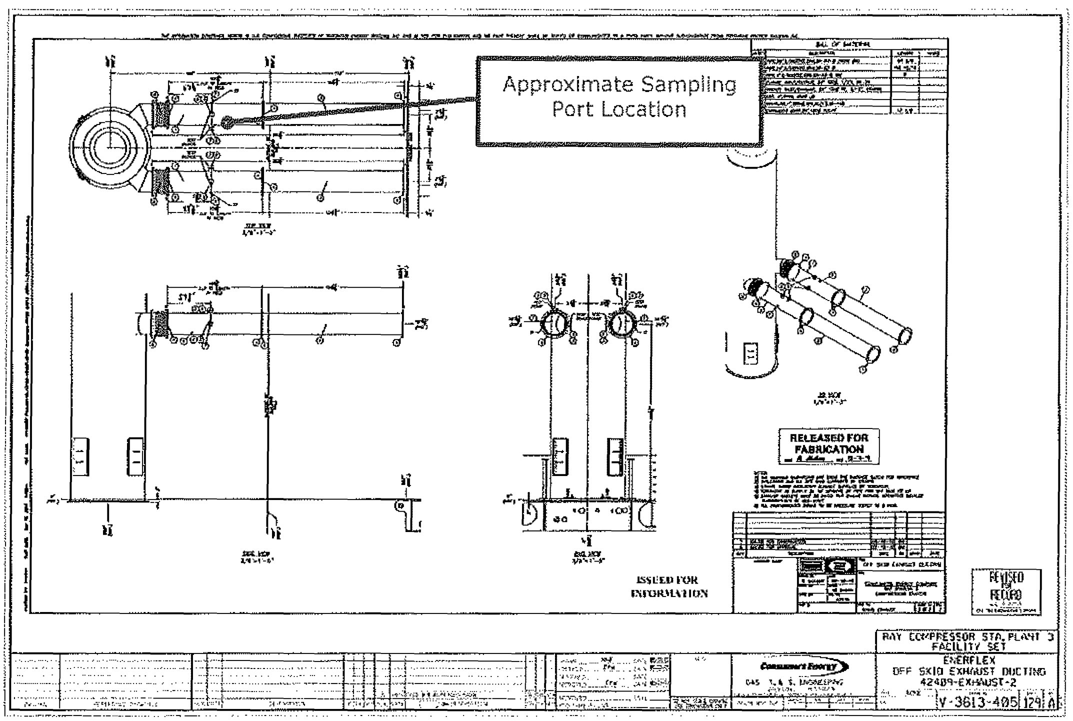
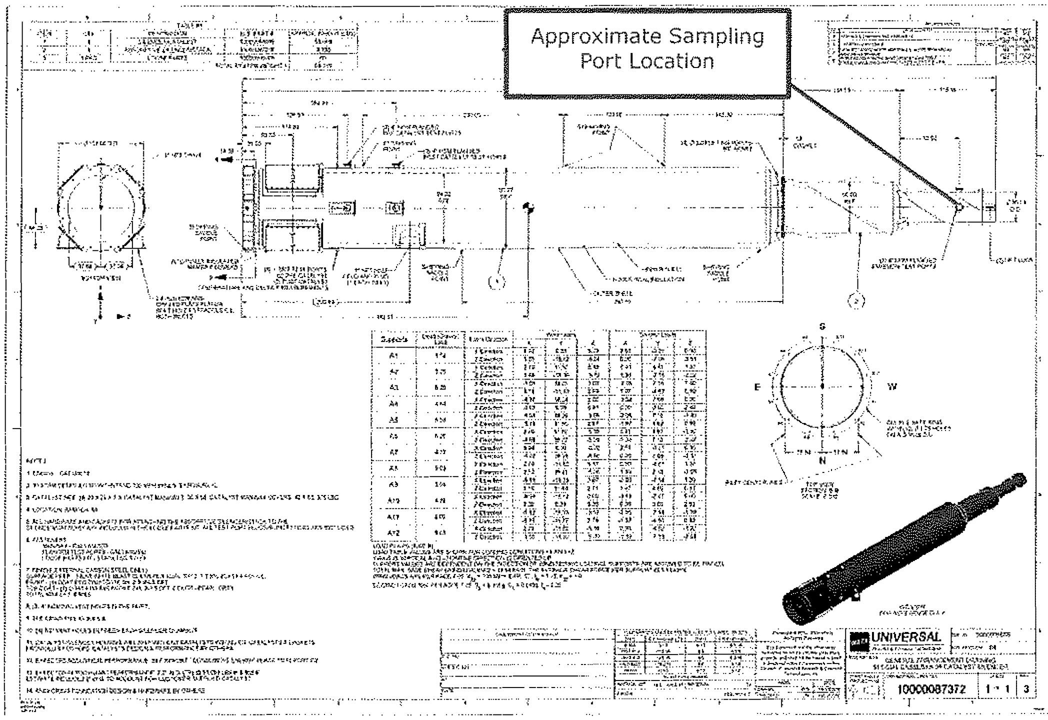


Figure 4-2. Post-Catalyst Sampling Port Location

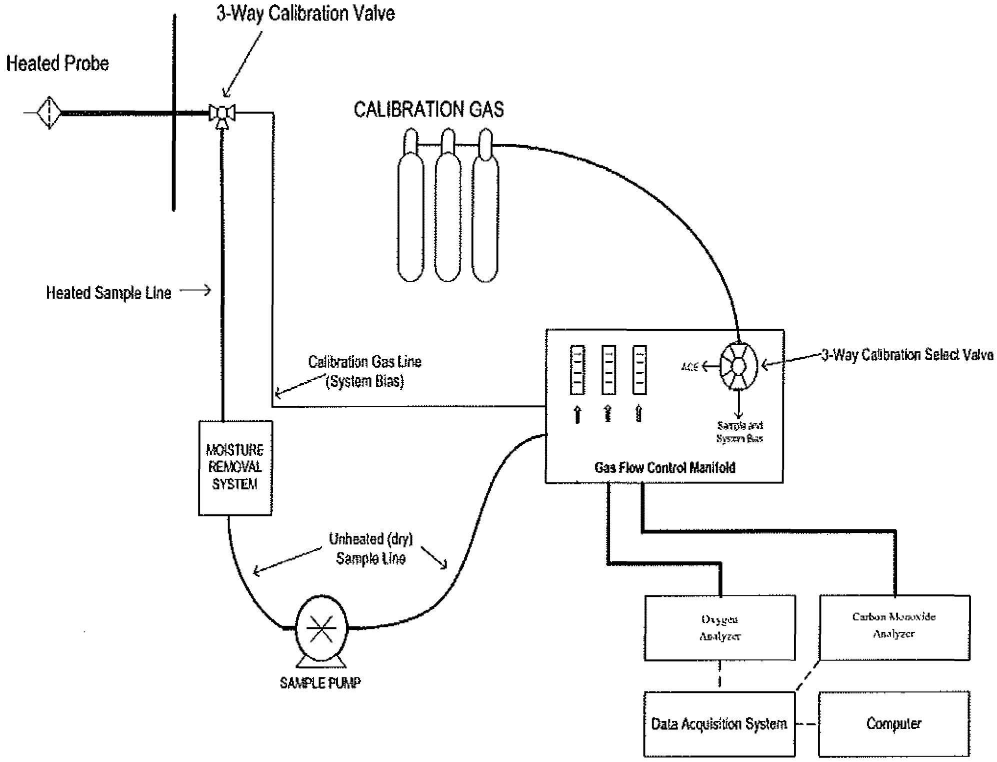


4.1.2 Oxygen and Carbon Monoxide (USEPA Methods 3A and 10)

Oxygen and carbon monoxide concentrations were measured using the sampling and analytical procedures of USEPA Methods 3A, *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)* and 10, *Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure).* The sampling procedures of the methods are similar with the exception of the analyzers and analytical technique used to quantify the parameters of interest. The measured oxygen concentrations were used to adjust the carbon monoxide concentrations to 15% O_2.

Engine exhaust gas was extracted from the stacks through a stainless steel probe, heated Teflon® sample line, and through a gas conditioning system to remove water and dry the sample before entering a sample pump, gas flow control manifold, and paramagnetic, and infrared gas filter correlation gas analyzers. Figure 4-3 depicts the Methods 3A and 10 sampling system.

Figure 4-3. USEPA Method 3A and 10 Sampling System



Prior to sampling engine exhaust gas, the analyzers were calibrated by performing a calibration error test where zero-, mid-, and high-level calibration gases were introduced directly to the back of the analyzers. The calibration error check was performed to evaluate if the analyzers response was within ±2.0% of the calibration gas span or high calibration gas concentration. An initial system-bias test was performed where the zero- and mid- or high- calibration gases are introduced at the sample probe to measure the ability of the system to respond accurately to within ±5.0% of span.

Upon successful completion of the calibration error and initial system bias tests, sample flow rates and component temperatures were verified and the probes were inserted into the ducts at the appropriate traverse point. After confirming the engine was operating at established conditions the test run was initiated. Oxygen and carbon monoxide concentrations were recorded at 1-minute intervals throughout the 60-minute test duration.

At the conclusion of the test run, a post-test system bias check was performed to evaluate analyzer bias and drift from the pre- and post-test system bias checks. The system-bias checks evaluate if the analyzers bias is within ±5.0% of span and drift is within ±3.0%. The analyzers response were used to correct the measured oxygen and carbon monoxide concentrations for analyzer drift. Refer to Appendix D for analyzer calibration supporting documentation.

5.0 TEST RESULTS AND DISCUSSION

The test program was performed to satisfy the continuous performance test requirements and evaluate compliance with the RICE MACT and ROP.

5.1 Tabulation of Results

The results of the testing indicate the CO reduction efficiency for each engine comply with the applicable limit. Table 2-1 summarizes the results and Appendix Tables 1 through 5 presents detailed test data, process operating conditions, and exhaust gas conditions.

5.2 Significance of Results

The results of the testing indicate compliance with the applicable engine operating parameters and emission limit.

5.3 Variations from Sampling or Operating Conditions

No sampling and operating condition variations were encountered during the test program.

5.4 Process or Control Equipment Upset Conditions

The engine and associated control equipment were operating under maximum routine conditions and no upsets were encountered during testing.

5.5 Air Pollution Control Device Maintenance

No significant pollution control device maintenance occurred during the three months prior to the test. Engine optimization and continuous parametric monitoring of the air pollution control device are monitored to ensure compliance with regulatory emission limits.

5.6 Re-Test Discussion

Based on the results of this test program, a re-test is not required. Subsequent air emissions testing will be performed in 2019, following the requirements in 40 CFR §63.6615 and §63.6620 (Table 3 to Subpart ZZZZ of Part 63—Subsequent Performance Tests). Because the facility has demonstrated compliance for two consecutive tests, the frequency of subsequent performance test is annually.

5.7 Results of Audit Samples

Audit samples for the reference methods utilized during this test program are not available from EPA Stationary Source Audit Sample Program providers. The USEPA reference methods performed state reliable results are obtained by persons equipped with a thorough knowledge of the techniques associated with each method. Factors with the potential to cause measurement errors are minimized by implementing quality control (QC) and assurance (QA) programs into the applicable components of field testing. QA/QC components were included in this test program. Table 5-1 summarizes the primary field QA/QC activities required by the reference methods that were performed. Refer to Appendix D for supporting documentation.

Table 5-1
Primary QA/QC Procedures

QA/QC Activity	Purpose	Procedure	Frequency	Acceptance Criteria
M1: Sampling Location	Evaluates if the sampling location is suitable for sampling	Measure distance from ports to downstream and upstream disturbances	Pre-test	≥2 diameters downstream; ≥0.5 diameter upstream.
M1: Duct diameter/ dimensions	Verifies area of stack is accurately measured	Review as-built drawings and field measurement	Pre-test	Field measurement agreement with as-built drawings
M3A and 7E: Calibration gas standards	Ensures accurate calibration standards	Traceability protocol of calibration gases	Pre-test	Calibration gas uncertainty ≤2.0%
M3A and 7E: Calibration Error	Evaluates operation of analyzers	Calibration gases introduced directly into analyzers	Pre-test	±2.0% of the calibration span
M3A and 7E: System Bias and Analyzer Drift	Evaluates analyzer and sample system integrity and accuracy over test duration	Calibration gases introduced at sample probe tip, heated sample line, and into analyzers	Pre-test and Post-test	±5.0% of the analyzer calibration span for bias and ±3.0% of analyzer span for drift
M3A and 7E: Multi-point samples	Ensure representative sample collection	Insert probe into stack and purge sample system	During test	Collect sample from 3 point "long line"

5.8 Calibration Sheets

Calibration sheets, including gas protocol sheets and analyzer quality control and assurance checks are presented in Appendix D.

5.9 Sample Calculations

Sample calculations and formulas used to compute emissions data are presented in Appendix A.

5.10 Field Data Sheets

Field data sheets are presented in Appendix B.

5.11 Laboratory Quality Assurance / Quality Control Procedures

This test program did not require the collection of samples for laboratory analysis.

Table 1

Ray Compressor Station
EUENGINE31 40 CFR 63, Subpart ZZZZ Test Results
July 17, 2018

	Inlet	Outlet
O_2 Concentration, %, dry:	11.7	11.6
Carbon Monoxide (CO) Concentrations and Reduction Efficiency		
CO Concentration, ppmvd:	378.3	4.9
CO Concentration, ppmvd @15% O_2:	241.7	3.1
CO Percent Reduction Efficiency, Percent:	**98.7**	
Engine and Process Data		
Engine Fuel Flow Rate, Ft^3/Min:	537.52	
Engine Speed, RPM:	944.26	
Engine Load, %:	101.14	
Engine Power, HP:	4521.46	
Suction Pressure, PSI:	582.52	
Catalyst Pressure Drop, inches water:	1.94	
Catalyst Inlet Temperature, °F:	845.28	

Table 2

Ray Compressor Station
EUENGINE32 40 CFR 63, Subpart ZZZZ Test Results
July 17, 2018

	Inlet	Outlet
O_2 Concentration, %, dry:	11.6	11.5
Carbon Monoxide (CO) Concentrations and Reduction Efficiency		
CO Concentration, ppmvd:	400.7	3.1
CO Concentration, ppmvd @15% O_2:	254.5	2.0
CO Percent Reduction Efficiency, Percent:	**99.2**	
Engine and Process Data		
Engine Fuel Flow Rate, Ft^3/Min:	538.91	
Engine Speed, RPM:	937.39	
Engine Load, %:	101.85	
Engine Power, HP:	4520.74	
Suction Pressure, PSI:	582.96	
Catalyst Pressure Drop, inches water:	2.21	
Catalyst Inlet Temperature, °F:	849.58	

Table 3

Ray Compressor Station
EUENGINE33 40 CFR 63, Subpart ZZZZ Test Results
July 18, 2018

	Inlet	Outlet
O_2 Concentration, %, dry:	11.8	11.8
Carbon Monoxide (CO) Concentrations and Reduction Efficiency		
CO Concentration, ppmvd:	396.3	3.5
CO Concentration, ppmvd @15% O_2:	257.6	2.3
CO Percent Reduction Efficiency, Percent:	**99.1**	
Engine and Process Data		
Engine Fuel Flow Rate, Ft^3/Min:	502.60	
Engine Speed, RPM:	902.90	
Engine Load, %:	100.75	
Engine Power, HP:	4306.67	
Suction Pressure, PSI:	583.58	
Catalyst Pressure Drop, inches water:	1.71	
Catalyst Inlet Temperature, °F:	822.84	

Table 4
Ray Compressor Station
EUENGINE34 40 CFR 63, Subpart ZZZZ Test Results
July 18, 2018

	Inlet	Outlet
O_2 Concentration, %, dry:	11.6	11.6
Carbon Monoxide (CO) Concentrations and Reduction Efficiency		
CO Concentration, ppmvd:	395.9	8.9
CO Concentration, ppmvd @15% O_2:	252.1	5.7
CO Percent Reduction Efficiency, Percent:	**97.7**	
Engine and Process Data		
Engine Fuel Flow Rate, Ft^3/Min:	526.08	
Engine Speed, RPM:	932.51	
Engine Load, %:	102.44	
Engine Power, HP:	4522.80	
Suction Pressure, PSI:	583.77	
Catalyst Pressure Drop, inches water:	1.97	
Catalyst Inlet Temperature, °F:	838.71	

Table 5

Ray Compressor Station
EUENGINE35 40 CFR 63, Subpart ZZZZ Test Results
July 19, 2018

	Inlet	Outlet
O_2 Concentration, %, dry:	11.8	11.8
Carbon Monoxide (CO) Concentrations and Reduction Efficiency		
CO Concentration, ppmvd:	397.1	4.2
CO Concentration, ppmvd @15% O_2:	256.3	2.7
CO Percent Reduction Efficiency, Percent:	**99.0**	
Engine and Process Data		
Engine Fuel Flow Rate, Ft^3/Min:	528.80	
Engine Speed, RPM:	924.43	
Engine Load, %:	101.65	
Engine Power, HP:	4449.61	
Suction Pressure, PSI:	582.59	
Catalyst Pressure Drop, inches water:	2.06	
Catalyst Inlet Temperature, °F:	829.54	