40 CFR Part 63, Subpart ZZZZ
Annual Compliance Demonstration

Consumers Energy Company
Freedom Compressor Station
EUENGINE3-1

Prepared for:
Consumers Energy Company
Jackson, Michigan

Bureau Veritas Project No. 11018-000187.00

January 14, 2019

N3980-TEST_20181214

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Executive Summary

Consumers Energy Company (Consumers) retained Bureau Veritas North America, Inc. to test air emissions from a reciprocating internal combustion engine (RICE) at the Freedom Compressor Station in Manchester, Michigan. The purpose of the testing was to (1) measure gaseous emissions from a reciprocating internal combustion engine as required by Permit to Install (PTI) No. 202-15A, and (2) evaluate compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAP) for RICE, 40 CFR Part 63, Subpart ZZZZ.

The concentrations of the following were measured at two inlet ducts and one exhaust stack:

- Carbon monoxide (CO)
- Oxygen (O_2)

This report summarizes the air emission test program, which was conducted on December 14, 2018. The following source was tested:

- EUENGINE3-1: A 4-stroke lean burn (4SLB), natural gas-fired, reciprocating internal combustion engine.

The sampling was conducted in accordance with United States Environmental Protection Agency (USEPA) Methods 1, 3A, 10, and 205 as described in the Intent-to-Test Plan submitted to MDEQ, by Consumers, on July 9, 2018.

Three 60-minute test runs were performed. Detailed results are presented in Table 1 after the Tables Tab of this report. The results of the testing are summarized in the following table.

EUENGINE3-1 Test Results

Sampling Location	Parameter	Unit	Result			Average	Emission Limit†
			Run 1	Run 2	Run 3		
Inlet	CO	ppmvd @ 15% O_2	178.5	180.6	193.9	184.3	-
Outlet	CO	ppmvd @ 15% O_2	6.2	6.4	6.4	6.3	-
CO Reduction Efficiency		**%**	**96.5**	**96.5**	**96.7**	**96.6**	**≥93**

CO = carbon monoxide

ppmvd @ 15% O_2 = part per million by volume, dry, corrected to 15% oxygen

† 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.

1.0 Introduction

1.1 Summary of Test Program

Consumers Energy Company (Consumers) retained Bureau Veritas North America, Inc. to test air emissions from a reciprocating internal combustion engine (RICE) at the Freedom Compressor Station in Manchester, Michigan. The purpose of the testing was to (1) measure gaseous emissions from a reciprocating internal combustion engine as required by Permit to Install (PTI) No. 202-15A, and (2) evaluate compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAP) for RICE, 40 CFR Part 63, Subpart ZZZZ.

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The sampling was conducted in accordance with United States Environmental Protection Agency (USEPA) Methods 1, 3A, 10, and 205 as described in the Intent-to-Test Plan submitted to MDEQ, by Consumers, on July 9, 2018.

Based on MDEQ ROP, MI-ROP-N3920-2014b, Table 1-1 identifies the emission unit tested.

Table 1-1
Identification of Source

Emission Unit ID	Emission Unit Description	Flexible Group ID
EUENGINE3-1	3,750-horsepower, 4-stroke, lean burn natural-gas fired reciprocating internal combustion engine	FGENGINES-P3

1.2 Key Personnel

Contact information is listed in Table 1-2. Mr. David Kawasaki, with Bureau Veritas, led the emissions testing program. Mr. Vince Hittie, Field Leader with Consumers, provided process coordination and arranged for facility operating parameters to be recorded.

Table 1-2
Key Personnel

Facility Contact	
Vince Hittie Field Leader **Consumers Energy Company** 12201 Pleasant Lake Road Manchester, Michigan 48158 Telephone: 734.428.2051 Vincent.Hittie@cmsenergy.com	Amy Kapuga, P.E. Senior Environmental Engineer **Consumers Energy Company** 1945 West Parnall Road; P22-330 Jackson, Michigan 49201 Telephone: 517.788.2201 Amy.Kapuga@cmsenergy.com
Regulatory Agency	**Emission Testing Project Manager**
Scott Miller District Supervisor **Michigan Department of Environmental Quality** Air Quality Division Jackson District Office, State Office Building, 4th Floor 301 East Louis Glick Highway Jackson, Michigan 48902 Telephone: 517.416.5992 millers@michigan.gov	David Kawasaki, QSTI Staff Consultant **Bureau Veritas North America, Inc.** 22345 Roethel Drive Novi, Michigan 48375 Telephone: 248.344.3081 david.kawasaki@us.bureauveritas.com

2.0 Source and Sampling Locations

2.1 Source Description

Consumers Energy Company operates two reciprocating internal combustion engines at its compressor station in Manchester, Michigan. The engines are Waukesha model 12v275GL, four stroke lean burn (4SLB), spark-ignited engines with rated power of 3,750 brake-horsepower. The engines are used to maintain pressure of natural gas along the pipeline system. Emissions from the RICE are regulated by PTI No. 202-15A. EUENGINE3-1 was tested during this mobilization.

Natural gas is used to fuel the RICE. During testing, the RICE is required to operate within 10% of 100% load. EUENGINE3-1 is equipped with a continuous parameter monitoring system (CPMS), designed to continuously monitor and record the RICE exhaust gas temperature at the catalyst inlet point. The operational load of the engine during testing is summarized in Table 2-1.

Table 2-1
EUENGINE3-1 Operational Load

	Run 1	Run 2	Run 3	Average
Time	12:38 to 13:38	13:54 to 14:54	15:09 to 16:09	-
Load, b-hp	3,290	3,348	3,369	3,336
Percent of engine capacity†	87.7	89.3	89.8	89.0

b-hp: brake horsepower
† Rated engine capacity of Waukesha model 12v275 is 3,750 b-hp.

Due to pipeline pressures and site conditions, the unit could not reach 100±10% load. Because the engine operating load was limited during the test, the facility will restrict the operation of the engine to ±10% of the tested operating load until such time that the engine can be safely operated within ±10% of 100% load and additional testing is conducted to demonstrate compliance with 40 CFR Part 63, Subpart ZZZZ. Additional operating data can be found in Appendix D.

2.2 Control Equipment

EUENGINE3-1 is equipped with an oxidation catalyst system for controlling CO emissions. The catalyst is manufactured by Advanced Catalyst Systems, Inc. Four catalyst modules are installed on the engine. Exhaust gas from the engine enters the outer stack of the catalyst via two horizontal exhaust ducts. Exhaust gas flows downwards through the catalyst, then enters the

inner stack and flows upward to be discharged to ambient air. The catalyst vendor has guaranteed a CO reduction efficiency of 93%.

Pressure differential measurement gauges are also installed to determine the pressure drop across each oxidation catalyst. Unit operational data is included in Appendix D.

2.3 Flue Gas Sampling Locations

EUENGINE3-1 is configured with two identical inlet locations upstream of the oxidation catalyst and a single outlet location downstream. Instead of two separate inlet sample systems, a single system was configured to draw sample gas from each inlet location at the same rate into a single gas conditioner. The gases were combined and delivered to a single analyzer as a representative inlet gas.

The two inlet sampling locations are in 16-inch diameter ducts located:

- 160 inches (10.0 duct diameters) from the nearest upstream disturbance.
- 48 inches (3.0 duct diameters) from the nearest downstream disturbance.

The outlet sampling location is in a 30-inch diameter duct located:

- 240 inches (8.0 duct diameters) from the nearest upstream disturbance.
- 118 inches (3.9 duct diameters) from the nearest downstream disturbance.

All sampling ports were accessible via man lift. Figure 1 in the Appendix depicts the sampling ports of the inlet sampling locations. Figures 2 and 3 in the Appendix depict inlet duct dimensions. Figure 4 in the Appendix depicts the sampling ports of the outlet sampling locations.

2.4 Process Sampling Locations

Process sampling was not required during this test program. A process sample is a sample that is analyzed for operational parameters, such as calorific value of a fuel (e.g., natural gas, coal), organic compound content (e.g., paint coatings), or composition (e.g., polymers).

3.0 Summary and Discussion of Results

3.1 Objectives and Test Matrix

The objective of the testing was to measure CO concentrations and emission rates from the RICE source as required by PTI No. 202-15A, and to evaluate compliance with the NESHAP for RICE, 40 CFR Part 63, Subpart ZZZZ. Table 3-1 summarizes the sampling and analytical test matrix.

Table 3-1
Test Matrix

Emission Unit ID	Sample/Type of Pollutant	USEPA Sampling Method	No. of Test Runs and Duration	Analytical Method	Analytical Laboratory
EUENGINE3-1 Inlet and Outlet	CO and O_2	1, 3A, 10, and 205	Three 60-minute runs	Field measurement, paramagnetic and infrared gas analyzers	N/A

3.2 Field Test Changes and Issues

Field test changes were not required to complete the emissions testing. Communication between Consumers and Bureau Veritas allowed the testing to be performed in accordance with requirements and the test plan.

3.3 Summary of Results

The results are summarized in Table 3-2. Detailed results of the testing are presented in Table 1 in the Tables tab of the Appendix. Graphs of concentrations measured during testing are provided in the Graphs tab of the Appendix. Sample calculations are presented in Appendix B.

Table 3-2
EUENGINE3-1 Test Results

Sampling Location	Parameter	Unit	Result			Average	Emission Limit†
			Run 1	Run 2	Run 3		
Inlet	CO	ppmvd @ 15% O_2	178.5	180.6	193.9	184.3	-
Outlet	CO	ppmvd @ 15% O_2	6.2	6.4	6.4	6.3	-
CO Reduction Efficiency		**%**	**96.5**	**96.5**	**96.7**	**96.6**	**≥93**

CO = carbon monoxide

ppmvd @ 15% O_2 = part per million by volume, dry, corrected to 15% oxygen

† 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.

4.0 Sampling and Analytical Procedures

4.1 Test Methods

Bureau Veritas measured emissions in accordance with the USEPA Methods listed in Table 4-1. Descriptions of the sampling methods and analysis procedures are presented in the following sections.

Table 4-1
Emission Test Parameters and Sampling Method

Parameter	Source		USEPA Reference
	EUENGINE3-1	Method	Title
Sampling ports 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 (Instrumental Analyzer Procedure)
Carbon monoxide	•	10	Determination of Carbon Monoxide Emissions from Stationary Sources
Gas dilution calibration	•	205	Verification of Gas Dilution Systems for Field Instrument Calibrations

4.1.1 Sampling Port Location (USEPA Method 1)

USEPA Method 1, "Sample and Velocity Traverses for Stationary Sources," from the Code of Federal Regulations, Title 40, Part 60 (40 CFR 60), Appendix A, was used to evaluate the sampling locations. Figure 1 (see Figures Tab) depicts the sampling locations.

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

USEPA Method 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrument Analyzer Procedure)," was used to measure the oxygen concentration of the flue gas. Carbon monoxide concentrations were measured using USEPA Method 10, "Determination of Carbon Monoxide Emissions from Stationary Sources." The sampling trains for USEPA Methods 3A and 10 are similar and the flue gas was extracted from the stack through:

- A stainless-steel probe.

- Heated Teflon® sample line to prevent condensation.
- A chilled Teflon condenser with peristaltic pump to remove moisture from the sampled gas stream prior to entering the analyzer.
- Paramagnetic (O_2) and infrared (CO) gas analyzers.

Data were recorded at 1-second intervals on a computer equipped with data acquisition software. Recorded concentrations were reported in 1-minute averages over the duration of each test run.

A three-point stratification test was conducted by measuring the CO gas concentration at a location positioned at 17, 50, and 83% of the stack diameter for at least twice the analyzer response time. Because a single lift was used to access each sampling location, the stratification test was conducted for the outlet and inlet west duct prior to sampling. The stratification test was conducted for the inlet east duct during test run 1. The CO concentrations measured were uniform in the stack cross section and less than ±5% or 0.5 part per million (ppm) of the mean concentration for all traverse points so the gas stream was considered to be unstratified and a single sampling point, located near the centroid of the duct, was used for sampling for subsequent test runs.

A calibration error check was performed by introducing zero-, mid-, and high-level calibration gases directly into the analyzer. The calibration error check was performed to evaluate the analyzer response is within ±2% of the calibration gas span. Prior to each test run, a system-bias test was performed in which known concentrations of calibration gases were introduced at the probe tip to measure if the analyzers response is within ±5% of the calibration span.

At the conclusion of the each test run, an additional system-bias check was performed to evaluate the drift from pre- and post-test system-bias checks. The system-bias checks evaluated if the analyzer drift is within the allowable criterion of ±3% from pre-test to post-test system bias checks. The analyzer drift data was used to correct the measured flue gas concentration.

Figure 4-1 depicts the USEPA Methods 3A and 10 sampling train.

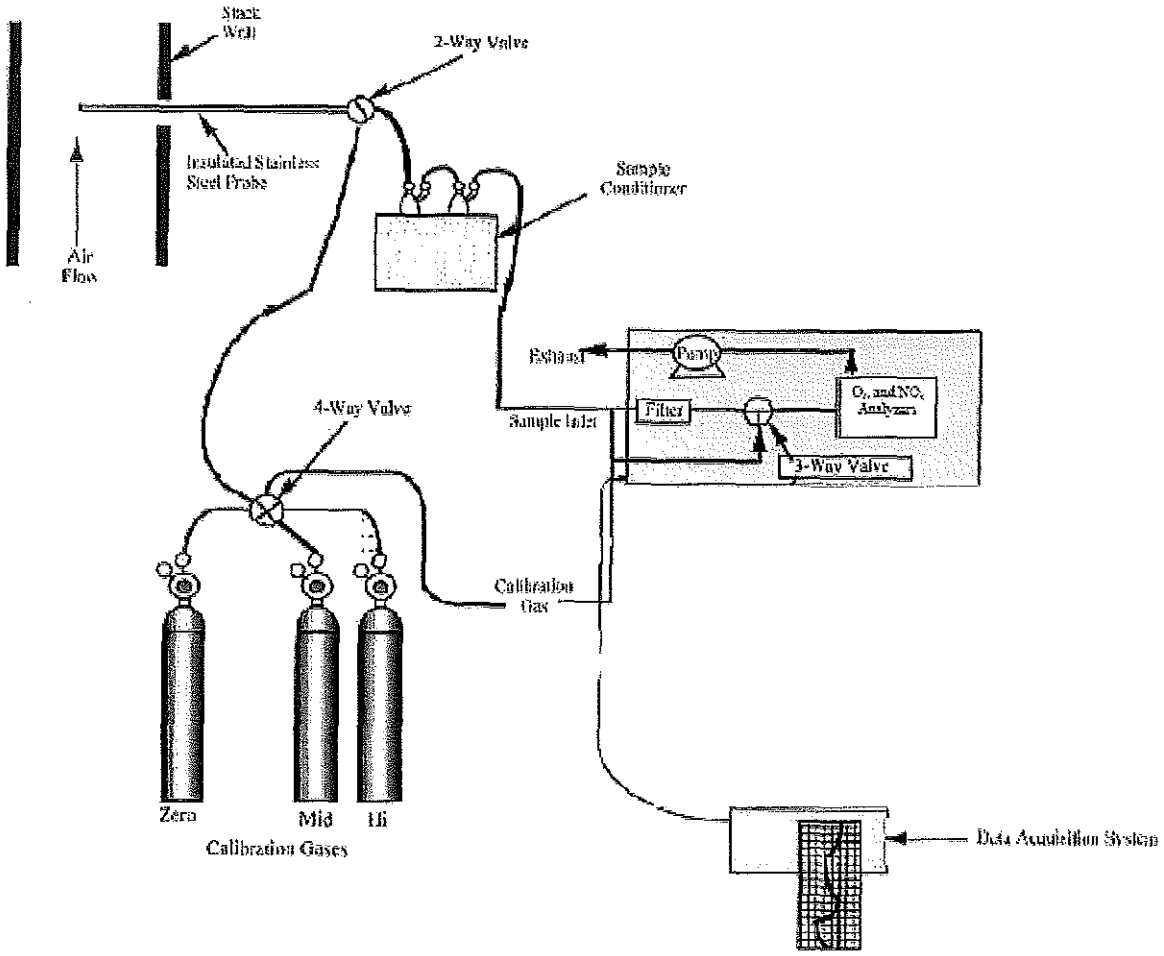

Figure 4-1. USEPA Methods 3A and 10 Sampling Train

4.1.3 Gas Dilution (USEPA Method 205)

A gas dilution system was used to introduce known values of calibration gases into the analyzers. The gas dilution system consists of calibrated orifices or mass flow controls and dilutes a high-level calibration gas to within ±2% of predicted values. The gas divider is capable of diluting gases at set increments and was evaluated for accuracy in the field in accordance with USEPA Method 205, "Verification of Gas Dilution Systems for Field Instrument Calibrations."

Before testing, the gas divider dilutions were measured to evaluate that they were within ±2% of predicted values. Two sets of three dilutions of the high-level calibration gas were performed. In addition, a certified mid-level calibration gas was introduced into an analyzer; this calibration gas concentration was within ± 10% of a gas divider dilution concentration.

4.2 Procedures for Obtaining Process Data

While onsite during testing, the engine CPMS recorded process parameters. The 5-minute averages were provided by Consumers and are included in Appendix D.

4.3 Sampling Identification and Custody

Chain of Custody procedures are not applicable to this test program. The emissions test methods used during this test program provide onsite results and do not require laboratory analysis.

5.0 QA/QC Activities

Equipment used in this emissions test program passed quality assurance/quality control (QA/QC) procedures. Refer to Appendix A for equipment calibration and inspection sheets. Computer-generated Data Sheets are presented in Appendix C.

5.1 Pretest QA/QC Activities

Before testing, the sampling equipment was cleaned, inspected, and calibrated according to procedures outlined in the applicable USEPA sampling methods and USEPA's "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods."

5.2 QA/QC Audits

The results of select sampling and equipment QA/QC audits and the acceptable tolerance are presented in the following sections. Calibration and inspection sheets for analyzers are presented in Appendix A.

5.2.1 Instrument Analyzer QA/QC Audits

The instrument analyzer sampling trains described in Section 4.1 were audited for measurement accuracy and data reliability. The analyzers passed the applicable calibration criteria. Table 5-1 summarizes the gas cylinders used during this test program. Calibration gas selection, bias, and drift checks are included in Appendix A.

Table 5-1
Calibration Gas Cylinder Information

Parameter	Gas Vendor	Cylinder Serial Number	Cylinder Value	Expiration Date
Nitrogen	Airgas	CC173587	-	May 18, 2024
O_2/CO_2	Airgas	ALM-047449	19.99% / 19.89%	May 22, 2026
CO	Airgas	CC148871	45.03 ppm	December 19, 2022
CO	Airgas	XC034476B	126.8 ppm	October 29, 2022
CO	The American Gas Group	EB0022434	945 ppm	October 3, 2019

5.3 QA/QC Checks for Data Reduction and Validation

Mr. Li Wu, Consultant with Bureau Veritas, validated the computer spreadsheets onsite. The computer spreadsheets were used to evaluate the accuracy of field calculations. The computer data sheets were checked for accuracy during review of the draft report. Sample calculations were performed to verify computer spreadsheet computations.

5.4 QA/QC Problems

Equipment audits and QA/QC procedures demonstrate sample collection accuracy for the test runs.

Limitations

The information and opinions rendered in this report are exclusively for use by Consumers Energy Company. Bureau Veritas North America, Inc. will not distribute or publish this report without Consumers Energy Company's consent except as required by law or court order. The information and opinions are given in response to a limited assignment and should be implemented only in light of that assignment. Bureau Veritas North America, Inc. accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

This report prepared by:

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Staff Consultant
Health, Safety, and Environmental Services

This report reviewed by:

Derek R. Wong, Ph.D., P.E.
Director and Vice President
Health, Safety, and Environmental Services

Table

Table 1

EUENGINE3-1 Carbon Monoxide Reduction Efficiency Results
Consumers Energy Freedom Compressor Station

Manchester, Michigan

Bureau Veritas Project No. 11018-0000187.00

Sampling Date: December 14, 2018

Parameter	Units	Run 1	Run 2	Run 3	
Date		**Dec 14, 2018**	**Dec 14, 2018**	**Dec 14, 2018**	**Average**
Start Time	hr:min	12:38	13:54	15:09	
Duration	min	60	60	60	60
Inlet O_2 Concentration (C_{avg})	%, dry	11.6	11.6	11.6	11.6
Inlet Corrected O_2 Concentration (C_{gas})†	**%, dry**	**11.6**	**11.7**	**11.6**	**11.6**
Outlet O_2 Concentration (C_{avg})	%, dry	12.0	12.0	12.0	12.0
Outlet Corrected O_2 Concentration (C_{gas})†	**%, dry**	**11.7**	**11.7**	**11.7**	**11.7**
Inlet CO Concentration (C_{avg})	ppmvd	269.5	279.0	302.8	283.8
Inlet Corrected CO Concentration (C_{gas})†	**ppmvd**	**281.4**	**282.5**	**304.6**	**289.5**
Inlet Corrected CO Concentration (C_{gas})†, @ 15% O2	**ppmvd**	**178.5**	**180.6**	**193.9**	**184.3**
Outlet CO Concentration (C_{avg})	ppmvd	9.0	9.1	9.6	9.2
Outlet Corrected CO Concentration (C_{gas})†	**ppmvd**	**9.6**	**9.9**	**10.0**	**9.8**
Outlet Corrected CO Concentration (C_{gas})†, @ 15% O2	**ppmvd**	**6.2**	**6.4**	**6.4**	**6.3**
Reduction Efficiency (%)		**96.5**	**96.5**	**96.7**	**96.6**

† corrected for analyzer drift

ppmvd: part per million by dry volume

Figures

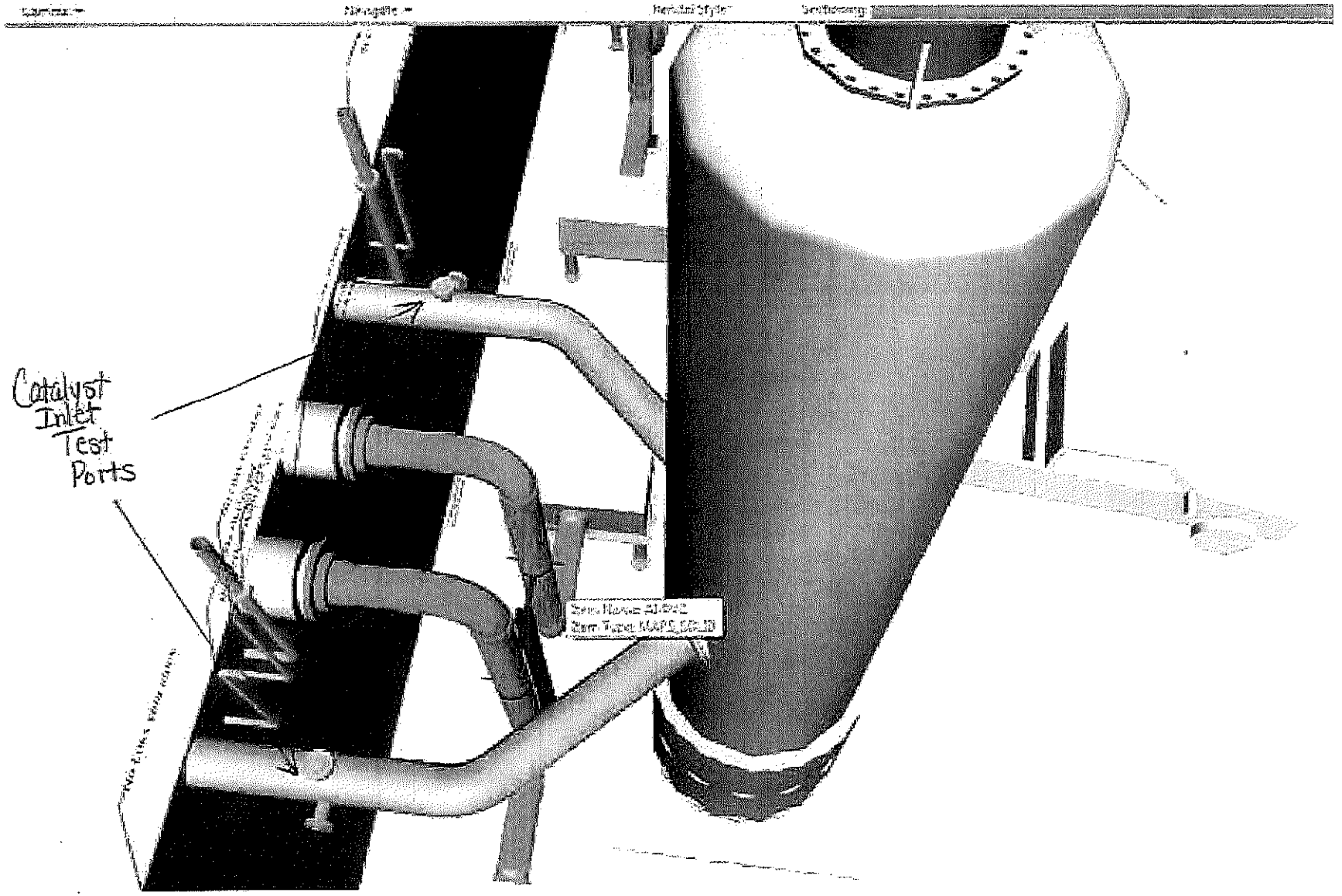


Figure 1
EUENGINE3-1 Inlet Sampling Port Locations

BUREAU VERITAS

Consumers Energy Company Freedom Compressor Station
12201 Pleasant Lake Road
Manchester, Michigan 48158

Project No. 11018-000187.00

Last Revision:
January 4, 2019

DATE: 01/03/2019 07:00 SROORI

FABRICATION MATERIALS

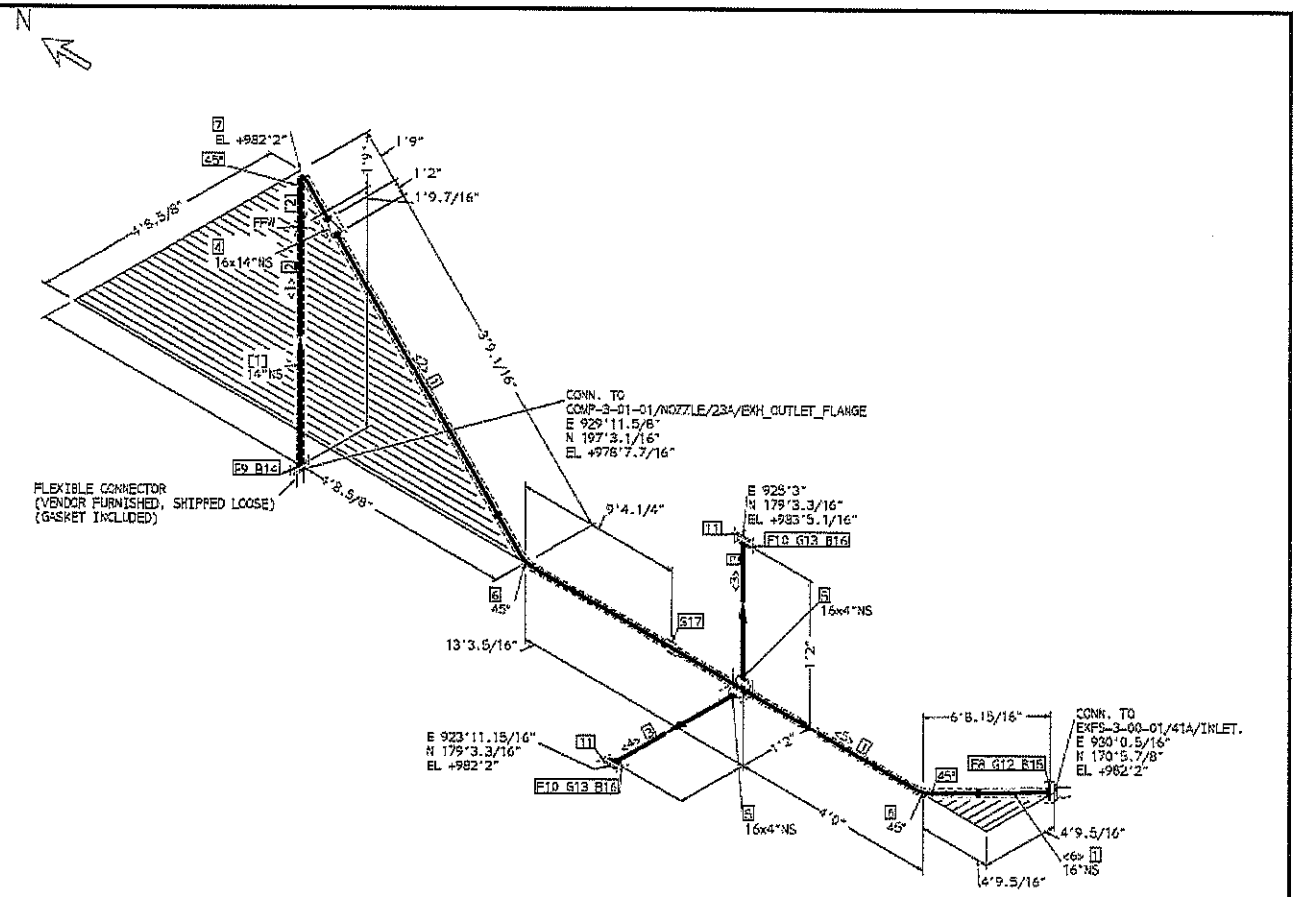
FT ID	COMPONENT DESCRIPTION	N.S. (INS)	ITEM CODE	QTY
	PIPE			
1	PIPE SMLS STD WT A-691 GR CMS75	16	A6/16.0P	24.5'
2	PIPE SMLS STD WT A-691 GR CMS75	14	A6/14.0P	1.0'
3	PIPE SMLS STD WT A-691 GR CMS75	4	A6/4.0P	0.7'
	FITTINGS			
4	REDUCER CONC BW SCH STD A-182 GR F2	16 x 14	A6/16.0CR14.0	1
5	WELDOLET STD WT A-182 GR F11	16 x 4	A6/16.0WOL4.0	2
6	ELBOW 45 DEG LR BW STD WT A-182 GR F2	16	A6/16.0ELL45	2
7	ELBOW 90 DEG LR BW STD WT A-182 GR F2	14	A6/14.0ELL90	1
	FLANGES			
8	FLANGE SO 150# FF A-182 GR F11	16	A6/16.0SOFF	1
9	FLANGE SO 150# FF A-182 GR F11	14	A6/14.0SOFF	1
10	FLANGE SW 150# FF A-182 GR F11	4	A6/4.0WNRF	2

ERECTION MATERIALS

FT NO	COMPONENT DESCRIPTION	N.S. (INS)	ITEM CODE	QTY
	FLANGES			
11	FLANGE BLIND 150# FF A-182 GR F11	4	A6/4.0BFRF	2
	GASKETS			
12	GASKET 150# FF 1/8" THK SPIRAL WOUND 316 SS FLEXIBLE GRAPHITE FILLER, CS INNER AND OUTER RING	16	A6/16.0GRF	1
13	GASKET 150# FF 1/8" THK SPIRAL WOUND 316 SS FLEXIBLE GRAPHITE FILLER, CS INNER AND OUTER RING	4	A6/4.0GRF	2
	BOLTS			
14	5.1/4 STUD BOLTS ASTM A193 GR.B7 XYLAN COATED W/2 HEX NUTS EA. ASTM A194 GR.2H XYLAN COATED	1	A6/14.0SBS.1/4	12
15	5.1/4 STUD BOLTS ASTM A193 GR.B7 XYLAN COATED W/2 HEX NUTS EA. ASTM A194 GR.2H XYLAN COATED	1	A6/16.0SBS.1/4	16
16	3.1/2 STUD BOLTS ASTM A193 GR.B7 XYLAN COATED W/2 HEX NUTS EA. ASTM A194 GR.2H XYLAN COATED	5/8	A6/4.0SBS.1/2	16
	SUPPORTS			
17	PIPE SHOE, CLAMP TYPE, FOR DETAILS SEE DWG. 147A S 2010-004.001 LENGTH = 1'	16	A6/MSH-SHS-16.0	1
	PIPE SPOOLS			
	[1] [2]			

CUT PIPE LENGTH

ITEM CODE	PIECE NO	CUT LENGTH	N.S. (INS)	REMARKS
A6/14.0P	<1>	1'5.1/16	14	FF WELD
A6/16.0P	<2>	2'11.1/16	16	
A6/4.0P	<3>	3.5/8	4	
A6/4.0P	<4>	3.5/8	4	
A6/16.0F	<5>	15'7.5/16	16	
A6/16.0F	<6>	5'10.9/16	16	



NOTES:
1. CONTRACTOR TO VERIFY ALL DIMENSIONS, ELEVATIONS, FIELD FIT-UP AND FIELD WELD LOCATIONS BEFORE FABRICATION
2. FW FIELD WELDS TO BE CUT AND BEVEL. FFW FIELD FIT WELDS TO HAVE 1'-0" OF GREEN ADDED
3. ALL UNDERGROUND PIPING TO BE FBE COATED UP TO 1'-0" MINIMUM ABOVE GRADE
4. SEE PIPING LINE LIST DOC. NO. 147A S 2010-000-001

REFERENCE DRAWINGS

DWG NO.	DESCRIPTION

REV	DATE	BY	DESCRIPTION	CHKD	ENGR	APPR
D	12/29/18	SR	ISSUED FOR CONSTRUCTION	CP	JWR	BJD
A	11/24/15	SR	PRELIMINARY TO STRESS			

WOOD GROUP MUSTANG, INC.
PROJECT NO: 106541

Consumers Energy
GAS T. & S. ENGINEERING
JACKSON, MICHIGAN

P & ID	PIPE PREP.				PIPE STRESS			DESIGN		OPERATING		HYDROTEST	
	X-RAY %	PWHT	PAINT SYS.	INSUL.	REQ'D	ISS DATE	APPR	PSIG	DEG.F	PSIG	DEG.F	PRESS.	DEG.F
114	SEE NOTE 4							SEE NOTE 4					

DWG NO.	PIPE SPEC	DWG
16"-EX-A6-9001	A6	1 OF 1

P:\FCS-NTD\PIPE\A - 16"-EX-A6-9001

Figure 2
EUENGINE3-1 Inlet West Duct Dimensions

BUREAU VERITAS

Consumers Energy Company Freedom Compressor Station
12201 Pleasant Lake Road
Manchester, Michigan 48158

Project No. 11018-000187.00

Last Revision:
January 4, 2019

DATE: 01/03/2016 07:09 SRGORE

FABRICATION MATERIALS

PT NO	COMPONENT DESCRIPTION	N.S. (INS)	ITEM CODE	QTY
	PIPE			
1	PIPE SMLS STD WT A-691 GR CMS75	16	A6/16.0P	24.5'
2	PIPE SMLS STD WT A-691 GR CMS75	14	A6/14.0P	1.8'
3	PIPE SMLS STD WT A-691 GR CMS75	4	A6/4.0P	0.7'
	FITTINGS			
4	REDUCER CONC BW SCH STD A-102 GR F2	16 x 14	A6/16.0CR14.0	1
5	WELDOLET STD WT A-182 GR F11	16 x 4	A6/16.0WOL4.0	2
6	ELBOW 45 DEG LR BW STD WT A-182 GR F2	16	A6/16.0ELL45	2
7	ELBOW 90 DEG LR BW STD WT A-182 GR F2	14	A6/14.0ELL90	1
	FLANGES			
8	FLANGE SO 150# FF A-102 GR F11	16	A6/16.0SOFF	1
9	FLANGE SO 150# FF A-182 GR F11	14	A6/14.0SOFF	1
10	FLANGE SO 150# FF A-182 GR F11	4	A6/4.0WNRF	2

ERECTION MATERIALS

PT NO	COMPONENT DESCRIPTION	N.S. (INS)	ITEM CODE	QTY
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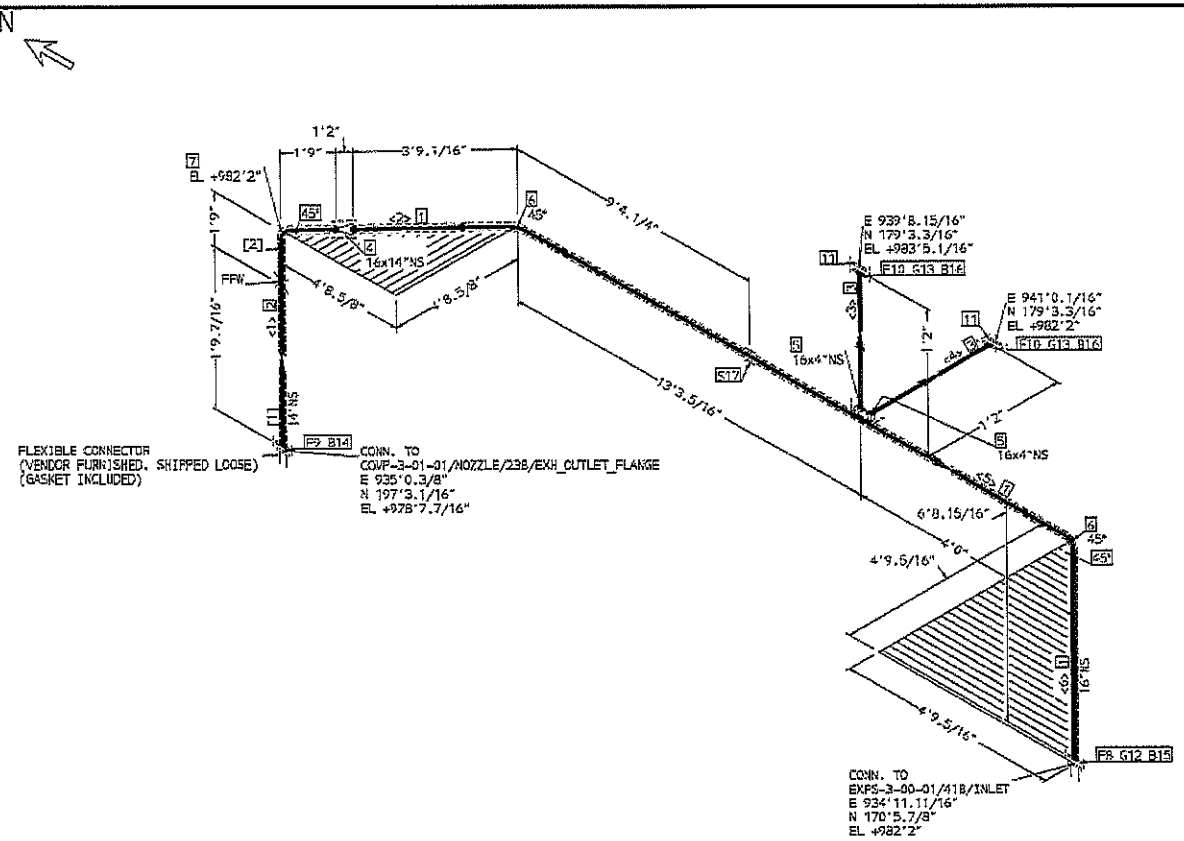
11	FLANGE BLIND 150# FF A-182 GR F11	4	A6/4.0BFRF	2
	GASKETS			
12	GASKET 150# FF 1/8" THK SPIRAL WOUND 316 SS FLEXIBLE GRAPHITE FILLER, CS INNER AND OUTER RING	16	A6/16.0GRF	1
13	GASKET 150# FF 1/8" THK SPIRAL WOUND 316 SS FLEXIBLE GRAPHITE FILLER, CS INNER AND OUTER RING	4	A6/4.0GRF	2
	BOLTS			
14	5.1/4 STUD BOLTS ASTM A193 GR.B7 XYLAN COATED W/2 HEX NUTS EA. ASTM A194 GR.2H XYLAN COATED	1	A6/14.0SBS.1/4	12
15	5.1/4 STUD BOLTS ASTM A193 GR.B7 XYLAN COATED W/2 HEX NUTS EA. ASTM A194 GR.2H XYLAN COATED	1	A6/16.0SBS.1/4	16
16	3.1/2 STUD BOLTS ASTM A193 GR.B7 XYLAN COATED W/2 HEX NUTS EA. ASTM A194 GR.2H XYLAN COATED	5/8	A6/4.0SBS.1/2	16
	SUPPORTS			
17	PIPE SHOE, CLAMP TYPE, FOR DETAILS SEE DWG. 147A S 2010-004.001 LENGTH = 1'	16	A6/MEH-SHS-16.0	1
	PIPE SPOOLS			
	[1] [2]			

CUT PIPE LENGTH

ITEM CODE	PIECE NO	CUT LENGTH	N.S. (INS)	REMARKS
A6/14.0P	<1>	1'9.1/16	14	FF WELD
A6/16.0P	<2>	2'11.1/16	16	
A6/4.0P	<3>	3.5/8	4	
A6/4.0P	<4>	3.5/8	4	
A6/16.0P	<5>	15'7.5/16	16	
A6/16.0P	<6>	5'10.9/16	16	



NOTES:
1. CONTRACTOR TO VERIFY ALL DIMENSIONS, ELEVATIONS, FIELD FIT-UP AND FIELD WELD LOCATIONS BEFORE FABRICATION
2. FW FIELD WELDS TO BE CUT AND BEVEL. FFW FIELD FIT WELDS TO HAVE 1'-0" OF GREEN ADDED
3. ALL UNDERGROUND PIPING TO BE FBE COATED UP TO 1'-0" MINIMUM ABOVE GRADE
4. SEE PIPING LINE LIST DOC. NO. 147A S 2010-005-001

REFERENCE DRAWINGS

DWG NO.	DESCRIPTION

REV	DATE	BY	DESCRIPTION	CHKD	ENGR	APPR
0	12/29/15	SR	ISSUED FOR CONSTRUCTION	CP	JAR	BJD
A	11/24/15	SR	PRELIMINARY TO STRESS			

P & ID	PIPE PREP.				PIPE STRESS			DESIGN		OPERATING		HYDROTEST	
	X-RAY %	PWHT	PAINT SYS.	INSUL.	REQ'D	ISS DATE	APPR	PSIG	DEG.F	PSIG	DEG.F	PRESS.	DEG.F
114	SEE NOTE 4							SEE NOTE 4					

WOOD GROUP MUSTANG, INC.

PROJECT NO: 106541

Consumers Energy

GAS T. & S. ENGINEERING
JACKSON, MICHIGAN

DWG NO.	PIPE SPEC	DWG
16"-EX-A6-9002	A6	1 OF 1

P:\GAS-UTI\PIPE\A - 16"-EX-A6-9002

Figure 3
EUENGINE3-1 Inlet East Duct Dimensions

BUREAU VERITAS

Consumers Energy Company Freedom Compressor Station
12201 Pleasant Lake Road
Manchester, Michigan 48158

Project No. 11018-000187.00

Last Revision:
January 4, 2019

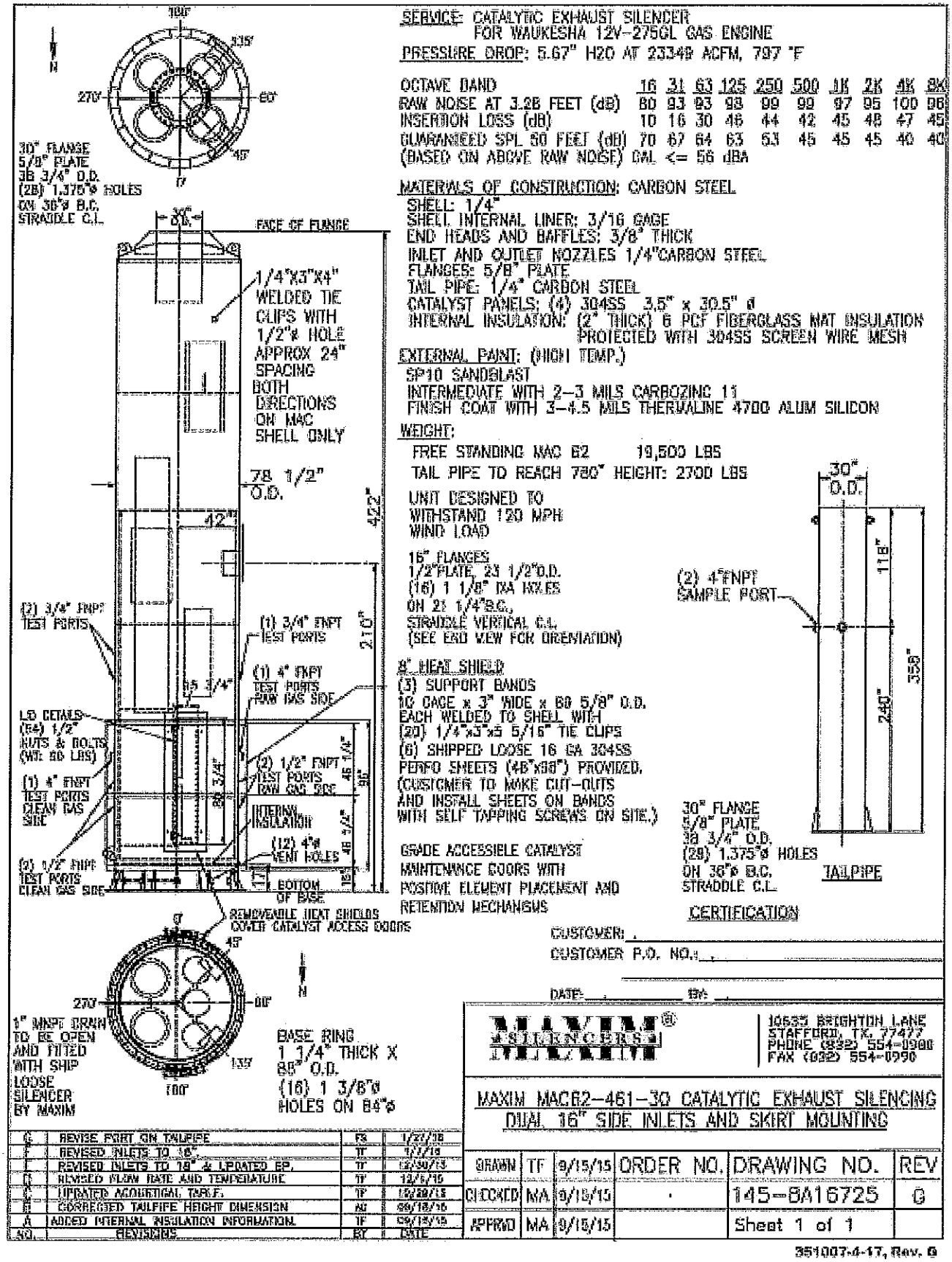


Figure 4
EUENGINE3-1 Outlet Sampling Port Locations

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