SOURCE TEST REPORT
2023 COMPLIANCE EMISSIONS TESTING

SEMCO ENERGY GAS COMPANY-
MORTON FACILITY
MARYSVILLE, MICHIGAN

SPARK IGNITION INTERNAL COMBUSTION ENGINE (EUENGINE4)

Prepared For:

SEMCO Energy Gas Company
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For Submittal To:

Michigan Department of Environment, Great Lakes, and Energy, Division of Air Quality (EGLE)
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REVIEW AND CERTIFICATION

All work, calculations, and other activities and tasks performed and presented in this document were carried out by me or under my direction and supervision. I hereby certify that, to the best of my knowledge, Montrose operated in conformance with the requirements of the Montrose Quality Management System and ASTM D7036-04 during this test project. I have reviewed, technically and editorially, details, calculations, results, conclusions, and other appropriate written materials contained herein. I hereby certify that, to the best of my knowledge, the presented material is authentic, accurate, and conforms to the requirements of the Montrose Quality Management System and ASTM D7036-04.

Signature: _____ Date: June 13th, 2023

Name: John Nestor Title: District Manager

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1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

SEMCO Energy Gas Company - Morton Facility contracted Montrose Air Quality Services, LLC (Montrose) to perform a compliance emissions test program on the Spark Ignition Internal Combustion Engine (EUENGINE4) at the SEMCO Energy Gas Company - Morton facility located in Marysville, Michigan. The tests were conducted to satisfy the emissions testing requirements pursuant to Michigan Department of Environment, Great Lakes, and Energy, Division of Air Quality (EGLE) Permit No. 126-07B and 40 CFR Part 60, Subpart JJJJ.

The specific objectives were to:

- Verify the nitrogen oxides (NO_x) as NO_2, carbon monoxide (CO), and non-methane volatile organic compounds (NMVOC) emissions from EUENGINE4
- Conduct the test program with a focus on safety

Montrose performed the tests to measure the emission parameters listed in Table 1-1.

TABLE 1-1
SUMMARY OF TEST PROGRAM

Test Date(s)	Unit ID/ Source Name	Activity/ Parameters	Test Methods	No. of Runs	Duration (Minutes)
4/14/2023	EUENGINE4	Velocity/Volumetric Flow Rate	EPA 1 & 2	3	7-12
4/14/2023	EUENGINE4	O_2, CO_2	EPA 3A	3	60
4/14/2023	EUENGINE4	NO_x	EPA 7E	3	60
4/14/2023	EUENGINE4	CO	EPA 10	3	60
4/14/2023	EUENGINE4	TGO	EPA 25A	3	60
4/14/2023	EUENGINE4	CH_4, Ethane, H_2O	EPA 320	3	60

To simplify this report, a list of Units and Abbreviations is included in Appendix C.1. Throughout this report, chemical nomenclature, acronyms, and reporting units are not defined. Please refer to the list for specific details.

This report presents the test results and supporting data, descriptions of the testing procedures, descriptions of the facility and sampling locations, and a summary of the quality assurance procedures used by Montrose. The average emission test results are summarized and compared to their respective permit limits in Table 1-2. Detailed results for individual test runs can be found in Section 4.0. All supporting data can be found in the appendices.

The testing was conducted by the Montrose personnel listed in Table 1-3 on April 14, 2023. The tests were conducted according to the test plan (protocol) that was submitted to and approved by EGLE.

TABLE 1-2
SUMMARY OF AVERAGE COMPLIANCE RESULTS -
EUENGINE4
APRIL 14, 2023

Parameter/Units	Average Results	Emission Limits
Nitrogen Oxides (NO_x as NO_2)		
g/BHP-hr	0.5	1.0
Carbon Monoxide (CO)		
g/BHP-hr	0.04	2.0
Non-methane Volatile Organic Compounds, as Propane (NMVOC)		
g/BHP-hr	0.06	0.7

1.2 KEY PERSONNEL

A list of project participants is included below:

Facility Information

Source Location:	SEMCO Energy Gas Company - Morton 1100 Gratiot Avenue Marysville, Michigan
Project Contact:	Elisabeth Barr
Role:	Environmental and Storage Analyst
Company:	SEMCO Energy Gas Company
Telephone:	810-887-3081
Email:	elisabeth.barr@semcoenergy.com

Agency Information

Regulatory Agency:	EGLE	
Agency Contact:	Jeremy Howe	Andrew Riley
Telephone:	231-878-6687	586-565-7379
Email:	howej1@michigan.gov	Rileya8@michigan.gov

Testing Company Information

Testing Firm:	Montrose Air Quality Services, LLC
Contact:	John Nestor
Title:	District Manager
Telephone:	248-765-5032
Email:	jonestor@montrose-env.com

Test personnel and observers are summarized in Table 1-3.

TABLE 1-3
TEST PERSONNEL AND OBSERVERS

Name	Affiliation	Role/Responsibility
John Nestor	Montrose	Field Project Manager, QI
Roy Zimmer	Montrose	Field Technician
Clayton DeRonne	Montrose	Field Technician
Elisabeth Barr	SEMCO Energy Gas Company	Observer/Client Liaison/Test Coordinator

2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 PROCESS DESCRIPTION, OPERATION, AND CONTROL EQUIPMENT

The Spark Ignition Internal Combustion Engine (EUENGINE4) operated by the facility is a natural gas-fired compressor engine (Model 3516B LE) manufactured by Caterpillar. Emissions from EUENGINE4 were uncontrolled. EUENGINE4 was in operation during the test event.

2.2 FLUE GAS SAMPLING LOCATION

Information regarding the sampling location is presented in Table 2-1.

TABLE 2-1
SAMPLING LOCATION

Sampling Location	Stack Inside Diameter (in.)	Distance from Nearest Disturbance		Number of Traverse Points
		Downstream EPA "B" (in./dia.)	Upstream EPA "A" (in./dia.)	
EUENGINE4 Exhaust	13.5	180 / 13.3	240 / 17.8	Flow: 16 (8/port), Gaseous: 3

The sample location was verified in the field to conform to EPA Method 1. Acceptable cyclonic flow conditions were confirmed prior to testing using EPA Method 1, Section 11.4. See Appendix A.1 for more information.

2.3 OPERATING CONDITIONS AND PROCESS DATA

The emissions test was performed while the source was operating at the conditions required by the permit. The unit was tested when operating normally/as found/at greater than 90% of rated.

Plant personnel were responsible for establishing the test conditions and collecting all applicable unit-operating data. The process data that was provided is presented in Appendix B. Data collected includes the following parameters:

- Engine operating load, % of maximum BHP
- Exhaust catalyst pressure drop, in-H_20
- Catalyst inlet temperature, °F
- Natural gas combustion rate, scfm

3.0 SAMPLING AND ANALYTICAL PROCEDURES

3.1 TEST METHODS

The test methods for this test program were presented previously in Table 1-1. Additional information regarding specific applications or modifications to standard procedures is presented below.

3.1.1 EPA Method 1, Sample and Velocity Traverses for Stationary Sources

EPA Method 1 is used to assure that representative measurements of volumetric flow rate are obtained by dividing the cross-section of the stack or duct into equal areas, and then locating a traverse point within each of the equal areas. Acceptable sample locations must be located at least two stack or duct equivalent diameters downstream from a flow disturbance and one-half equivalent diameter upstream from a flow disturbance.

3.1.2 EPA Method 2, Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)

EPA Method 2 is used to measure the gas velocity using an S-type pitot tube connected to a pressure measurement device, and to measure the gas temperature using a calibrated thermocouple connected to a thermocouple indicator. Typically, Type S (Stausscheibe) pitot tubes conforming to the geometric specifications in the test method are used, along with an inclined manometer.

3.1.3 EPA Method 3A, Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)

EPA Method 3A is an instrumental test method used to measure the concentration of O_2 and CO_2 in stack gas. The effluent gas is continuously or intermittently sampled and conveyed to analyzers that measure the concentration of O_2 and CO_2. The performance requirements of the method must be met to validate data.

The sampling system is detailed in Figure 3-2.

3.1.5 EPA Method 7E, Determination of Nitrogen Oxides Emissions from Stationary Source (Instrumental Analyzer Procedure)

EPA Method 7E is an instrumental test method used to continuously measure emissions of NO_x as NO_2. Conditioned gas is sent to an analyzer to measure the concentration of NO_x. The performance requirements of the method must be met to validate the data.

The sampling system is detailed in Figure 3-2.

3.1.6 EPA Method 10, Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)

EPA Method 10 is an instrumental test method used to continuously measure emissions of CO. Conditioned gas is sent to an analyzer to measure the concentration of CO. The performance requirements of the method must be met to validate the data.

The sampling system is detailed in Figure 3-2.

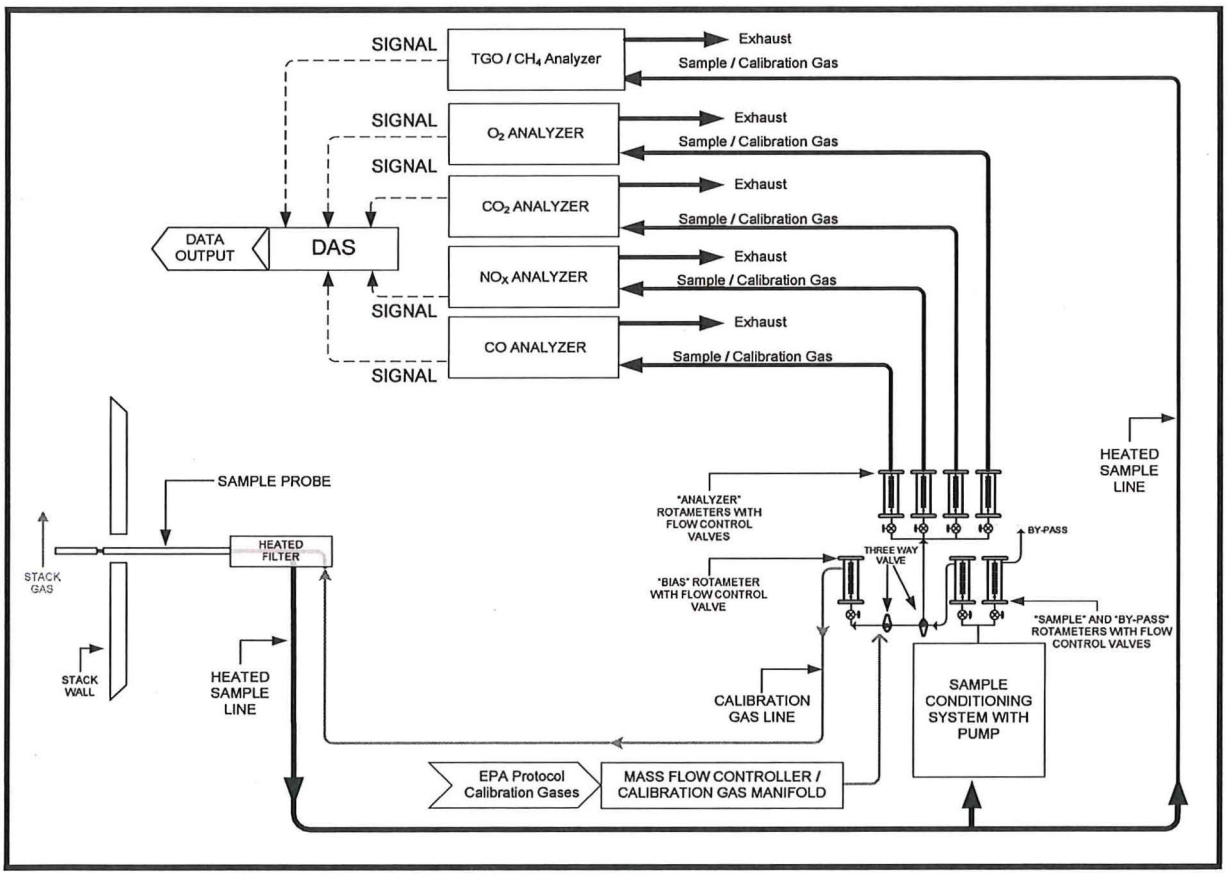
3.1.7 EPA Method 25A, Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer

EPA Method 25A is an instrumental test method used to measure the concentration of TGO in stack gas. A gas sample is extracted from the source through a heated sample line and glass fiber filter to a flame ionization analyzer (FIA). Results are reported as volume concentration equivalents of the calibration gas or as carbon equivalents.

For the purpose of this test, dual FIAs were utilized to measure TGO (as propane) and CH_4 (as methane).

The sampling system is detailed in Figure 3-2.

FIGURE 3-2
EPA METHODS 3A (O_2/CO_2), 7E, 10, 25A SAMPLING TRAIN



The sampling system is detailed in Figure 3-2.

3.1.8 Methane, Ethane, and Moisture Determination using FTIR Spectroscopy (USEPA Method 320)

VOC, HAP, and acetaldehyde sampling was conducted using FTIR instrumentation following the principles of USEPA Method 320 and ASTM Method D6348-03.

An MKS Model MultiGas 2030 FTIR was used to measure the concentrations of the specific compounds. The MultiGas 2030 analyzer is composed of a 2102 process FTIR spectrometer, a high optical throughput sampling cell, analysis software, and a quantitative spectral library. The analyzer collects high resolution spectra in the mid infrared spectral region (400 to 4,000 cm^{-1}), which are analyzed using the quantitative spectral library. This provides an accurate, highly sensitive measurement of gases and vapors.

As shown in Figure 3-3, the sample delivery system consisted of a stainless steel sampling probe, calibration tee assembly, Teflon sampling line, fast loop bypass pump, dilution system, and sample manifold. The gas sample was continuously extracted from each source at approximately 8 liters per minute.

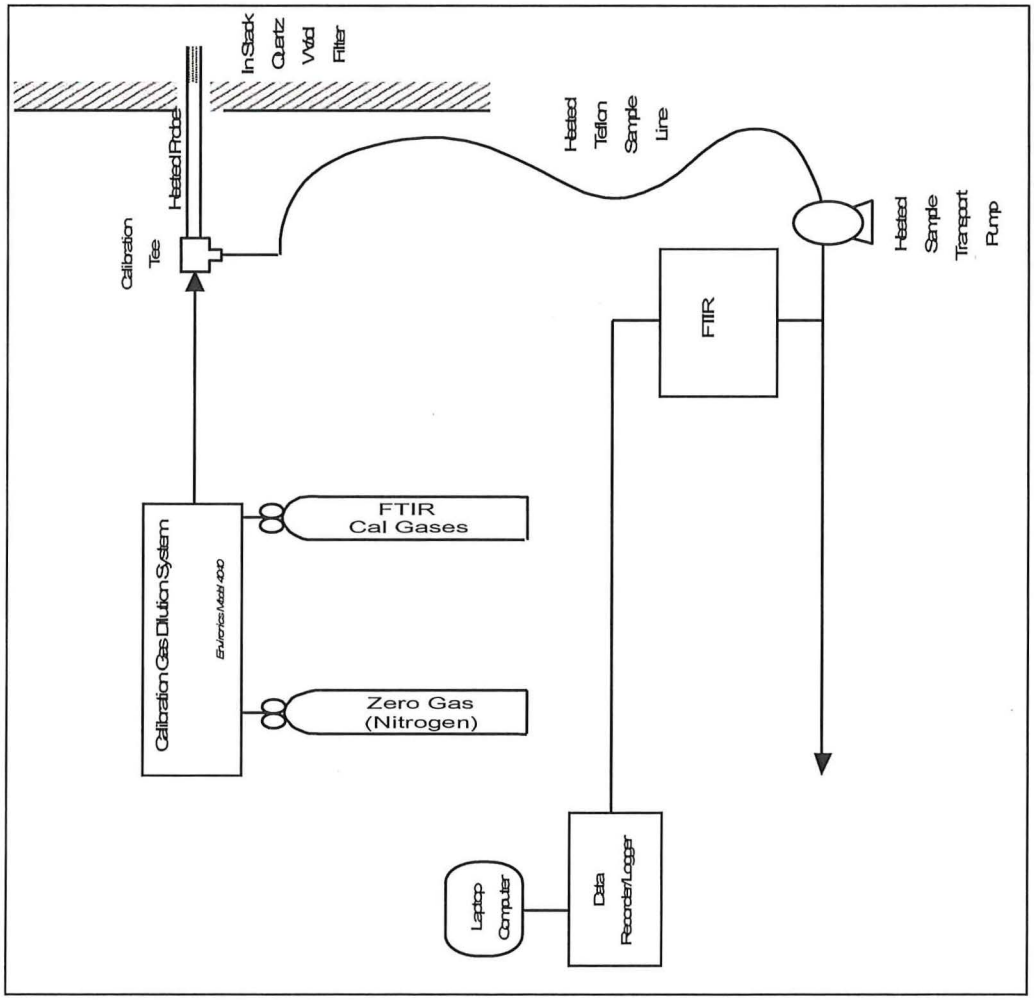


FIGURE 3-3
FTIR SAMPLING SYSTEM

It should be noted that the main principles and calibration procedures of USEPA Method 320 were followed. USEPA Method 320 specifies a number of analytical uncertainty parameters that the analyst calculated to characterize the FTIR system performance. However, this did not provide analytical detection limits. To calculate the method detection limit (MDL) for the target compounds, the guidelines in Appendix B of 40 CFR 136 were followed. With this, the Student t-test is used to calculate the MDL for each analyte at a 99% confidence level. This follows USEPA guidelines for reporting of zeroes or non-detects and also meets the NELAC requirements for determination of MDL values.

The MKS software calculates the analytical error of the FTIR measurement which includes the root mean standard deviation (RMSD). The concentration uncertainty reported by MKS is called the standard error of estimated concentration (SEC) and is also known as the marginal standard deviation. The uncertainties in the concentration are proportional to the square root of the sums of the squares of the residual. After the residual spectrum is obtained, which is called R, the error variance for the case of a single reference spectrum is calculated by the software.

Independent calculations of optical path length were not performed because the instrument has a fixed path of 5.11 meters. A signal to noise ratio test (S/N) was performed using MKS software to verify instrument performance. Performance parameters measured included signal to noise tests, noise equivalent absorbance (NEA), detector linearity, background spectra, potential interferents, and cell and system leakage.

Quality assurance procedures included baseline measurement with ultra high purity nitrogen, measurement of a calibration transfer standard (~100 ppm ethylene), direct analyte calibration measurements, and measurements to determine baseline shift. SF_6 was used as a tracer gas in the calibration gases to evaluate dilution ratios and verify the sample delivery system integrity.

The general FTIR field sampling procedure was as follows:

PRE-TEST

1) Background spectrum
   - Evaluate diagnostics of the instrumentation
2) Baseline (cylinder UHP-N_2 for zero check)
   - Determine the level of background noise
   - Observe spectrum for baseline tilt, i.e., indicates vibrations/perturbations affecting instrument
3) Calibration transfer standard (cylinder 100 ppm ethylene for span check)
   - Determine level of response to evaluate the spectral response and stability of the instrument
   - Create a field reference spectrum
4) Baseline evaluation
   - Note baseline flush/clean out FTIR sample cell
   - Observe spectrum for baseline tilt
5) Collection of spectra stack gas
   - Determine stack gas analyte concentrations
6) Measurement of analyte calibration gas
7) Perform dynamic spiking recovery study (recovery must be $0.7 \leq R \leq 1.3$)

TEST (REPEAT EACH RUN)

1) Baseline Determination
2) Measurement of Calibration Transfer Standard
3) Collect sequential spectra of stack gas
4) Baseline Determination
5) Measurement of Calibration Transfer Standard

POST-TEST

1) Baseline Determination
2) Measurement of Calibration Transfer Standard (i.e. span check)
3) Measurement of analyte calibration gas (optional)

3.2 PROCESS TEST METHODS

The test plan did not require that process samples be collected during this test program; therefore, no process sample data are presented in this test report.

4.0 TEST DISCUSSION AND RESULTS

4.1 FIELD TEST DEVIATIONS AND EXCEPTIONS

No field deviations or exceptions from the test plan or test methods occurred during this test program.

4.2 PRESENTATION OF RESULTS

The average results are compared to the permit limits in Table 1-2. The results of individual compliance test runs performed are presented in Table 4-1. Emissions are reported in units consistent with those in the applicable regulations or requirements. Additional information is included in the appendices as presented in the Table of Contents.

TABLE 4-1
NO_X (AS NO_2) CO, AND VOC EMISSIONS RESULTS - EUENGINE4

Run Number	1	2	3	Average
Date	4/14/2023	4/14/2023	4/14/2023	--
Time	12:20-13:19	14:00-14:59	15:45-16:44	--
Process Data				
Engine Load, BHP	1090.1	1090.8	1090.8	1090.6
Flue Gas Parameters				
O_2, % volume dry	9.00	8.88	8.71	8.86
CO_2, % volume dry	6.98	6.84	6.87	6.89
flue gas temperature, °F	742.4	747.8	748.6	746.2
moisture content, % volume	10.9	10.3	10.5	10.6
volumetric flow rate, dscfm	2,200	2,214	2,152	2,188
volumetric flow rate, scfm	2,468	2,467	2,403	2,446
Nitrogen Oxides (NO_x as NO_2)				
ppmvd	73.9	73.5	74.2	73.9
lb/hr	1.2	1.2	1.1	1.2
g/BHP-hr	0.49	0.49	0.48	0.49
Carbon Monoxide (CO)				
ppmvd	8.98	9.17	9.25	9.13
lb/hr	0.09	0.09	0.09	0.09
g/BHP-hr	0.04	0.04	0.04	0.04
Total Gaseous Organics, as Propane (TGO)				
ppmvw	488.5	497.3	501.3	495.7
Methane (CH_4),				
ppmvw	1087.1	1092.7	1096.0	1091.9
ppmvw as propane	362.4	364.2	365.4	364.0
Ethane (C_2H_6),				
ppmvw	35.7	36.4	36.5	36.2
ppmvw as propane	23.8	24.2	24.3	24.1
Non-methane Volatile Organic Compounds, as Propane (NMVOC)*				
ppmvw	4.5	10.4	13.0	9.3
lb/hr	0.08	0.18	0.21	0.16
g/BHP-hr	0.03	0.07	0.09	0.06

*Methane was subtracted using an FID response factor of 1.27 determined while in the field.

5.0 INTERNAL QA/QC ACTIVITIES

5.1 QA/QC AUDITS

The meter box and sampling train used during sampling performed within the requirements of their respective methods. All post-test leak checks, minimum metered volumes met the applicable QA/QC criteria

EPA Method 3A, 7E, and 10 calibration audits were all within the measurement system performance specifications for the calibration drift checks, system calibration bias checks, and calibration error checks.

EPA Method 25A FIA calibration audits were within the measurement system performance specifications for the calibration drift checks and calibration error checks.

The NO_2 to NO converter efficiency check of the analyzer was conducted per the procedures in EPA Method 7E, Section 8.2.4. The conversion efficiency met the criteria.

5.2 QA/QC DISCUSSION

All QA/QC criteria were met during this test program.

5.3 QUALITY STATEMENT

Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 which are conducted by the American Association for Laboratory Accreditation (A2LA). All testing performed by Montrose is supervised on site by at least one Qualified Individual (QI) as defined in D7036-04 Section 8.3.2. Data quality objectives for estimating measurement uncertainty within the documented limits in the test methods are met by using approved test protocols for each project as defined in D7036-04 Sections 7.2.1 and 12.10. Additional quality assurance information is included in the report appendices. The content of this report is modeled after the EPA Emission Measurement Center Guideline Document (GD-043).

APPENDIX A
FIELD DATA AND CALCULATIONS

Appendix A.1
Sampling Locations

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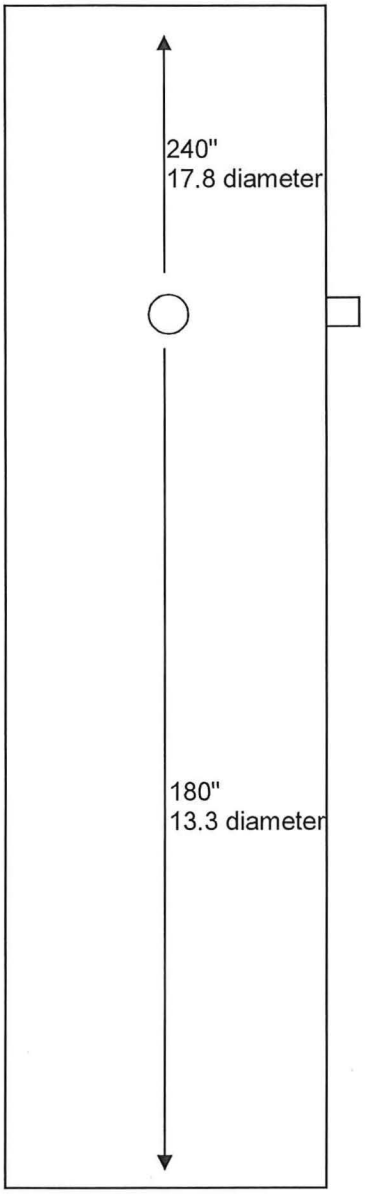
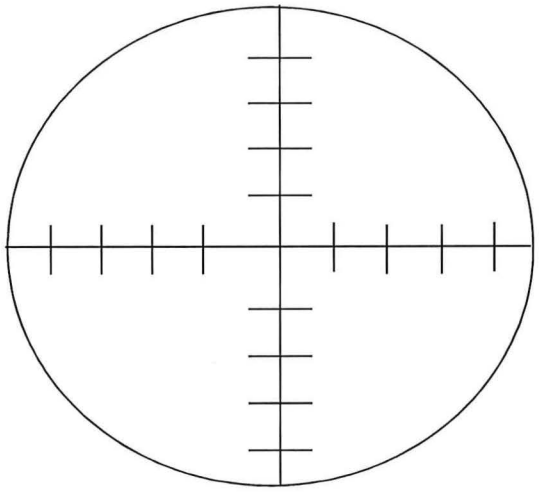
diameter = 13.5





Not to Scale

Points	Distance "
1	1.0
2	1.4
3	2.6
4	4.4
5	9.1
6	10.9
7	12.1
8	13.0

Site: **SEMCO Energy Gas Company** **Morton Facility** **Marysville, MI**	**Sampling Dates:** **4/14/2023**	**Montrose Air Quality Services, LLC** **4949 Fernlee** **Royal Oak, Michigan**