

EXECUTIVE SUMMARY

Montrose Air Quality Services, LLC (Montrose) was retained by Western Michigan University (WMU) to measure carbon monoxide (CO) and oxygen (O₂) concentrations from a single catalytic converter controlling emissions from a peaking engine at the Robert M. Beam Power Plant located at the WMU campus at 1903 Western Michigan Avenue in Kalamazoo, Michigan. The facility operates under Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit No. MI-ROP-K2131-2015a.

The generator set is owned and operated by WMU and is included in Permit No. MI-ROP-K2131-2015a as EU-02-PEAKGEN. The emissions testing is required by the National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines codified at Title 40, Part 63, Subpart ZZZZ of the Code of Federal Regulations (40 CFR 63, Subpart ZZZZ). This standard requires either (1) a CO control efficiency across the catalyst bed of at least 93% or (2) a maximum CO emission rate of less than or equal to 47 ppmvd at 15% O₂.

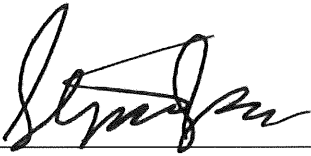
The emission test program was conducted on February 24, 2021. The results of the emission test program are summarized in the following table.

SUMMARY OF AVERAGE COMPLIANCE RESULTS - EU-02 PEAKGEN FEBRUARY 24, 2021

Parameter/Units	Average Results	Emission Limits
EU-02-PEAKGEN INLET		
Carbon Monoxide (CO)		
ppmvd	401.37	--
ppmvd @ 15% O ₂	194.45	--
EU-02-PEAKGEN EXHAUST		
Carbon Monoxide (CO)		
ppmvd	7.01	--
ppmvd @ 15% O ₂	4.00	47
Carbon Monoxide (CO) Reduction Efficiency (RE)		
%	98	93

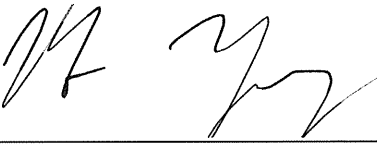
REVIEW AND CERTIFICATION

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.

Signature:  Date: 03 / 12 / 2021

Name: Steve Smith Title: Client Project Manager

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: 03 / 12 / 2021

Name: Matthew Young Title: District Manager

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1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

Montrose Air Quality Services, LLC (Montrose) was retained by Western Michigan University (WMU) to perform an annual compliance test on the Natural Gas-Fired Peaking and Black Start Generator (EU-02-PEAKGEN) at the Robert M. Beam Power Plant facility located at the WMU campus at 1903 Western Michigan Avenue in Kalamazoo, Michigan. The tests were conducted to satisfy the annual testing requirements pursuant to Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit No. MI-ROP-K2131-2015a and 40 CFR §63.6640(c).

The emissions testing is required by the National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines codified at Title 40, Part 63, Subpart ZZZZ of the Code of Federal Regulations (40 CFR 63, Subpart ZZZZ). This standard requires either (1) a CO control efficiency across the catalyst bed of at least 93% or (2) a maximum CO emission rate of less than or equal to 47 ppmvd at 15% O₂.

The specific objectives were to:

- Verify the carbon monoxide (CO) and oxygen (O₂) concentrations from the oxidation catalyst serving EU-02-PEAKGEN
- Verify the CO reduction efficiency (RE) of the oxidation catalyst controlling emissions from EU-02-PEAKGEN
- 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)
2/24/2021	EU-02-PEAKGEN Inlet	O ₂	EPA 3A	1	15
2/24/2021	EU-02-PEAKGEN Inlet	CO	EPA 10	1	15
2/24/2021	EU-02-PEAKGEN Exhaust	O ₂	EPA 3A	1	15
2/24/2021	EU-02-PEAKGEN Exhaust	CO	EPA 10	1	15

WMU-Robert M. Beam Power Plant
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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. The tests were conducted according to the test plan (protocol) dated January 22, 2021 that was submitted to EGLE.

**TABLE 1-2
SUMMARY OF AVERAGE COMPLIANCE RESULTS -
EU-02-PEAKGEN
FEBRUARY 24, 2021**

Parameter/Units	Average Results	Emission Limits
EU-02-PEAKGEN Inlet		
Carbon Monoxide (CO)		
ppmvd	401.37	--
ppmvd @ 15% O ₂	194.45	--
EU-02-PEAKGEN Exhaust		
Carbon Monoxide (CO)		
ppmvd	7.01	--
ppmvd @ 15% O ₂	4.00	47
CO Reduction Efficiency (RE)		
%	98	93

1.2 KEY PERSONNEL

A list of project participants is included below:

Facility Information

Source Location:	WMU Robert M. Beam Power Plant (on Stadium Drive) 1903 West Michigan Avenue Kalamazoo, MI 49008	
Project Contact:	George Jarvis	Mark Weiss
Role:	Power Plant Director	Director of EHS
Company:	WMU	WMU
Telephone:	269-387-8548	269-387-5588
Email:	george.jarvis@wmich.edu	mark.weiss@wmich.edu

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Agency Information

Regulatory Agency: EGLE
Agency Contact: Lindsey Wells
Telephone: 517-282-2345
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Testing Company Information

Testing Firm: Montrose Air Quality Services, LLC
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Steve Smith
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Consultant Information

Company: NTH Consultants, Ltd.
Contact: Rhiana Dombos
Telephone: 517-702-2953
Email: rdornbos@nthconsultants.com

Contact: Abbie Welch
Telephone: 616-451-6243
Email: awelch@nthconsultants.com

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

**TABLE 1-3
TEST PERSONNEL AND OBSERVERS**

Name	Affiliation	Role/Responsibility
Steve Smith	Montrose	Client Project Manager, QI
Ben Durham	Montrose	Field Technician
George Jarvis	WMU	Power Plant Director
Abbie Welch	NTH Consultants	Staff Engineer
Lindsay Wells	EGLE	Staff Engineer

2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 PROCESS DESCRIPTION, OPERATION, AND CONTROL EQUIPMENT

The Robert M. Beam Power Plant operates a natural gas-fired peaking and black start generator (EU-02-PEAKGEN). The emission unit is a Caterpillar Model 3516 four stroke lean-burn generator set rated for a maximum load of 771 kW. An oxidation catalyst was installed to control CO emissions. Generator set specifications are provided in Appendix B.

2.2 FLUE GAS SAMPLING LOCATIONS

O₂ (%) and CO (ppm) concentrations were measured at the inlet duct and exhaust duct of the oxidation catalyst associated with EU-02-PEAKGEN during the test event. See Appendix A for more information.

2.3 OPERATING CONDITIONS AND PROCESS DATA

Emission tests were performed while the generator was operating at the conditions required by the permit. The unit was tested during an average load of 760 kW.

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:

- Generator Load, kW
- Catalyst Inlet Temperature, °F

3.0 SAMPLING AND ANALYTICAL PROCEDURES

3.1 TEST METHODS

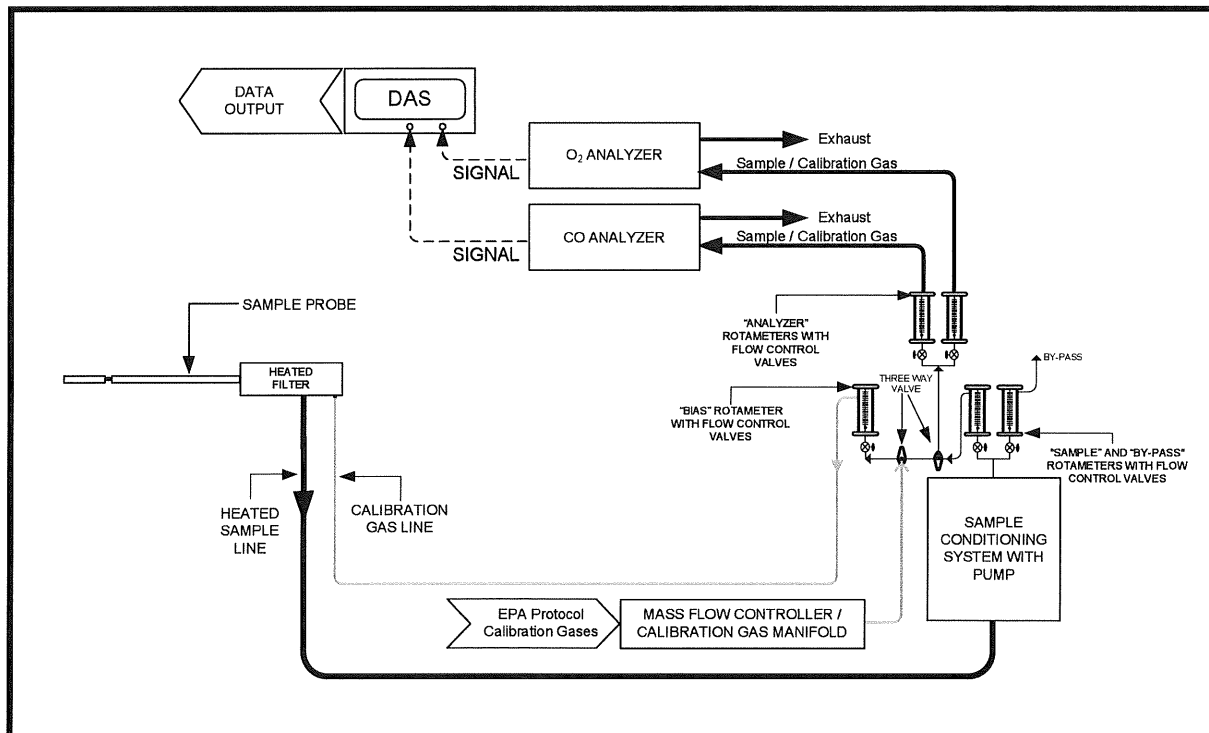
The test methods for this test program were presented previously in Table 1-1. Additional information regarding specific applications or modifications to standard procedures is presented below.

3.1.1 EPA Method 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 O₂ and CO₂ in stack gas. The effluent gas is continuously or intermittently sampled and conveyed to analyzers that measure the concentration of O₂ and CO₂. The performance requirements of the method must be met to validate data. Only O₂ was measured for this test event.

This method was paired with EPA Method 10. The typical sampling system is detailed in Figure 3-1.

**FIGURE 3-1
EPA METHODS 3A (O₂), 10 SAMPLING TRAIN**



3.1.2 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.

This method was paired with EPA Method 3A. The typical sampling system is detailed in Figure 3-1.

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
 CO CONCENTRATION AND RE RESULTS -
 EU-02-PEAKGEN**

	Inlet	Exhaust
Date	02/24/2021	02/24/2021
Time	14:05-14:20	14:05-14:20
Process Data		
Catalyst Inlet Temperature, °F	725	--
Generator Load, kW	--	760
Flue Gas Parameters		
O ₂ , % volume dry	8.72	10.56
Carbon Monoxide (CO)		
ppmvd	401.37	7.01
ppmvd @ 15% O ₂	194.45	4.00
CO Reduction Efficiency (RE)		
%	--	98

5.0 INTERNAL QA/QC ACTIVITIES

5.1 QA/QC AUDITS

EPA Method 3A 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.

5.2 QA/QC DISCUSSION

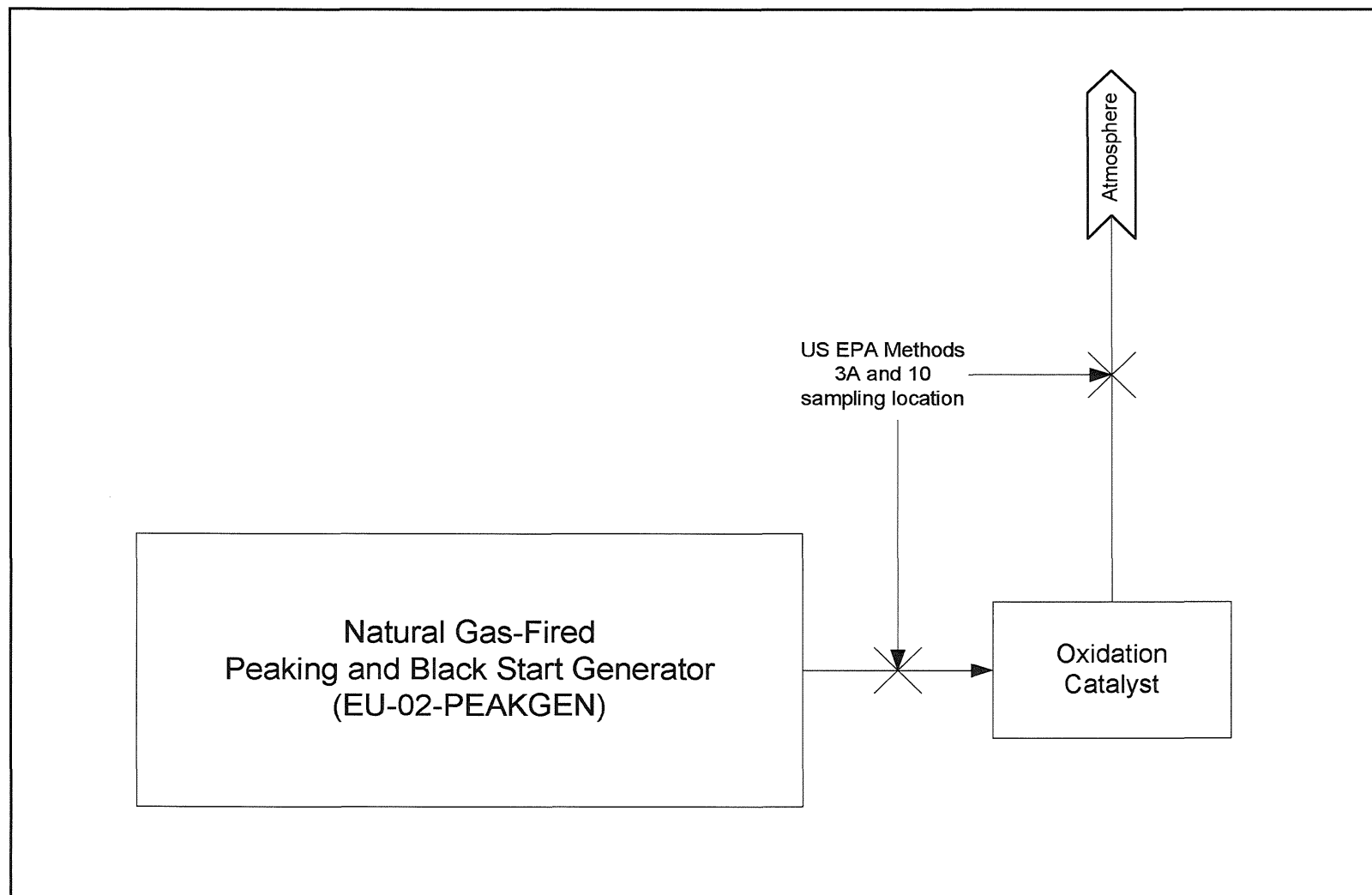
All QA/QC criteria were met during this test program.

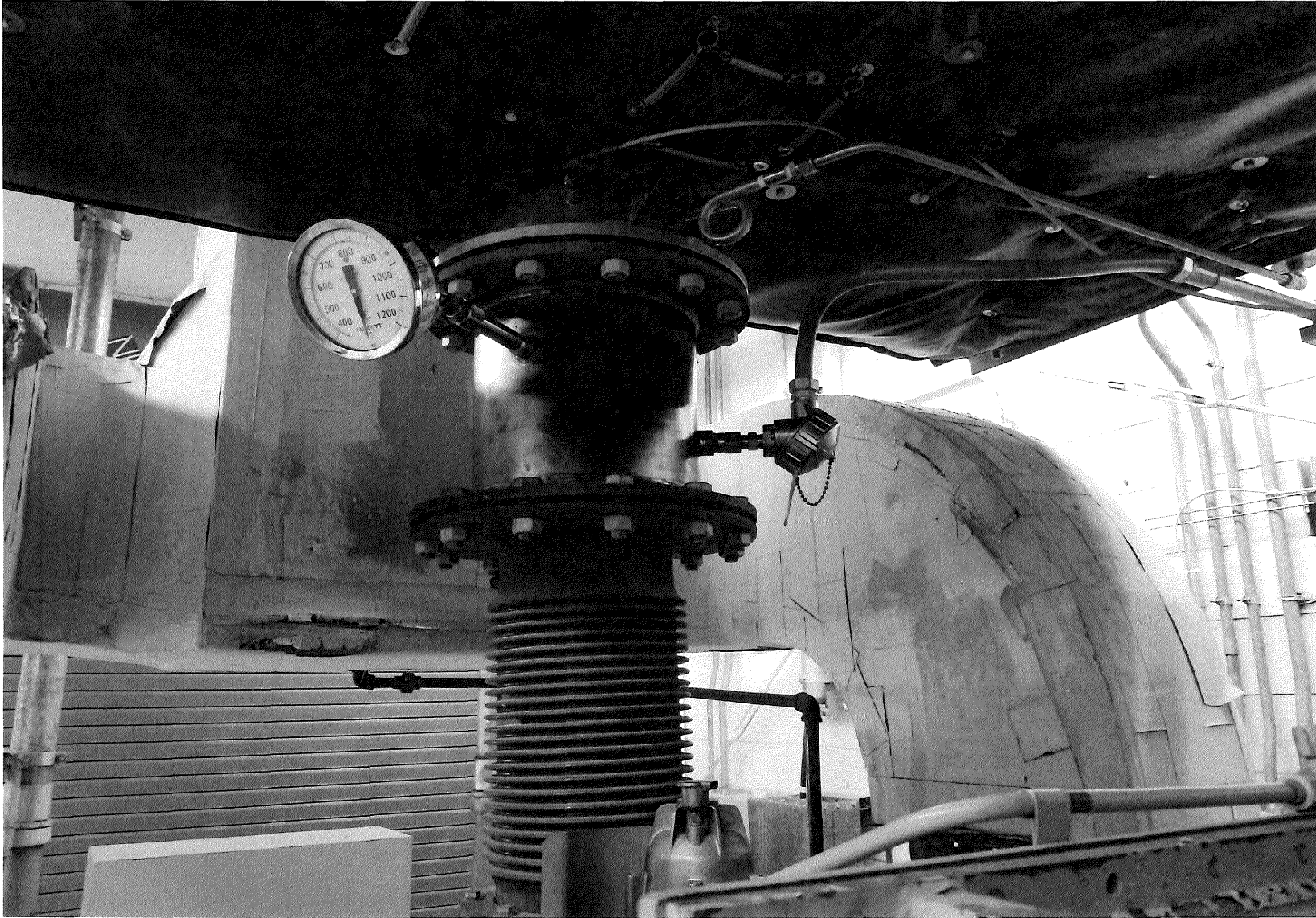
5.3 QUALITY STATEMENT

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).

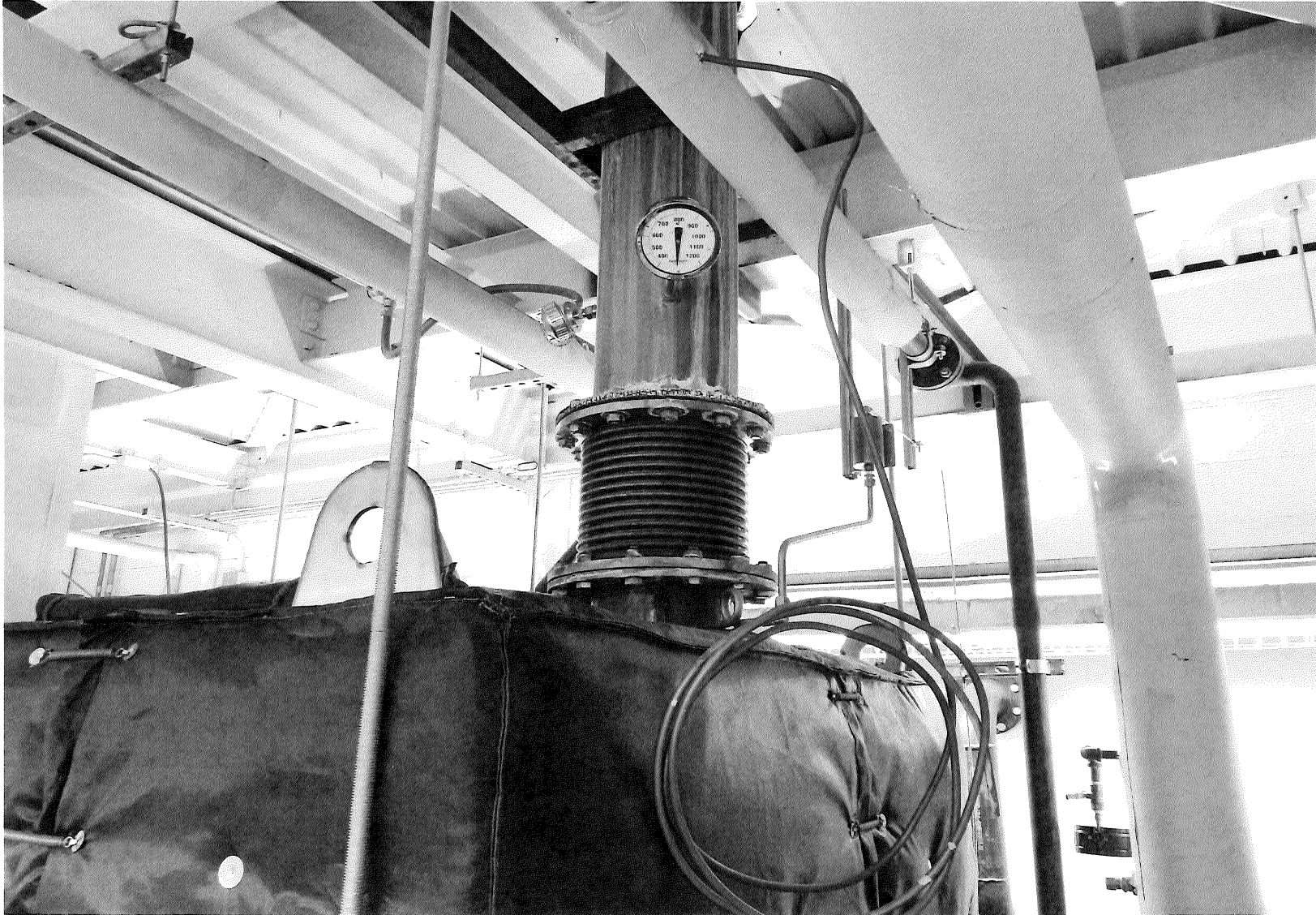
APPENDIX A FIELD DATA AND CALCULATIONS

EU-02-PEAKGEN SAMPLING LOCATION SCHEMATIC





INLET DUCT



EXHAUST STACK

