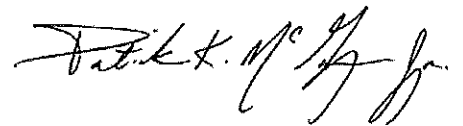


**EMISSION COMPLIANCE TEST  
FOR THE  
SIEMENS, SGE-56SL, UNIT #1-5  
PREPARED FOR  
LIVWELL  
AT THE  
LIVWELL CULTIVATION BUSINESS CENTER  
WARREN, MACOMB COUNTY, MICHIGAN  
NOVEMBER 16-18, 2021**

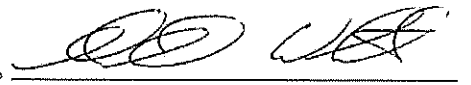
Prepared and Reviewed by:



Patrick K. McGovern, Jr., QSTI  
Sr. Regional Manager-Shreveport, LA



Thomas K. Graham, PE, QSTI  
Director of AHU

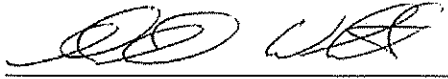
I, 

Michael Whisenhunt, QSTI  
Sr. Project Manager  
certify that this testing was conducted and  
this report was created in conformance  
with the requirements of ASTM D7036

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## CERTIFICATION OF INFORMATION

I certify under penalty of law that I believe the information provided in this document is true, accurate and complete. I am aware that there are significant civil and criminal penalties, including the possibility of fine or imprisonment or both, for submitting false, inaccurate or incomplete information.



Michael Whisenhunt, QSTI  
Sr. Project Manager  
Air Hygiene International, Inc.

December 26, 2021

Date

## FACILITY CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attached documents and, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant civil and criminal penalties, including the possibility of fine or imprisonment or both, for submitting false, inaccurate or incomplete information.

I am the responsible official with direct knowledge and overall responsibility for the information contained in this report.

\_\_\_\_\_  
Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

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## Table of Contents

<b>1.0</b>	<b>INTRODUCTION</b>	<b>1</b>
<b>1.1</b>	<b>TEST PURPOSE AND OBJECTIVES</b>	<b>1</b>
<b>1.2</b>	<b>SUMMARY OF TEST PROGRAM</b>	<b>1</b>
1.2.1	Participating Organizations	1
1.2.2	Industry	1
1.2.3	Air Permit and Federal Requirements	1
1.2.4	Plant Location	1
1.2.5	Equipment Tested	1
1.2.6	Emission Points	2
1.2.7	Emission Parameters Measured	2
1.2.8	Dates of Emission Test	2
1.2.9	Federal Certifications	2
<b>1.3</b>	<b>KEY PERSONNEL</b>	<b>2</b>
<b>2.0</b>	<b>SUMMARY OF TEST RESULTS</b>	<b>2</b>
<b>3.0</b>	<b>SOURCE OPERATION</b>	<b>3</b>
<b>3.1</b>	<b>PROCESS DESCRIPTION</b>	<b>3</b>
<b>3.2</b>	<b>SAMPLING LOCATION</b>	<b>3</b>
<b>4.0</b>	<b>SAMPLING AND ANALYTICAL PROCEDURES</b>	<b>3</b>
<b>4.1</b>	<b>TEST METHODS</b>	<b>3</b>
<b>4.2</b>	<b>INSTRUMENT CONFIGURATION AND OPERATIONS FOR GAS ANALYSIS</b>	<b>4</b>

## APPENDICES

Appendix A	Test Results and Calculations
Appendix B	Emission Data Records
Appendix C	Calibration Gas Certifications
Appendix D	Quality Assurance and Quality Control Data
Appendix E	Stratification Test Data

**Emissions Compliance Test  
Siemens, SGE-56SL, Unit #1-5  
LivWell  
Livwell Cultivation Business Center  
Warren, Macomb County, Michigan  
November 16-18, 2021**

## **1.0 INTRODUCTION**

Air Hygiene International, Inc. (Air Hygiene) has completed the Emissions Compliance Test for nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), total hydrocarbons/non-methane hydrocarbons/volatile organic compounds (THC/NMHC/VOC), and ammonia (NH<sub>3</sub>) from the exhaust of the Siemens, SGE-56SL, Unit #1-5 for LivWell at the Livwell Cultivation Business Center in Warren, Macomb County, Michigan. This report details the background, results, process description, and the sampling/analysis methodology of the stack sampling survey conducted on November 16-18, 2021.

## **1.1 TEST PURPOSE AND OBJECTIVES**

The purpose of the test was to conduct the initial emission test to document levels of selected pollutants at maximum operation levels of the unit. The information will be used to confirm compliance with the air quality permit requirements in addition to the requirements of 40 Code of Federal Regulations, Part 60, Subpart JJJJ. The specific objective was to determine the emission concentration of NO<sub>x</sub>, CO, THC/NMHC/VOC, and NH<sub>3</sub> from the exhaust of LivWell's Siemens, SGE-56SL, Unit #1-5.

## **1.2 SUMMARY OF TEST PROGRAM**

The following list details pertinent information related to this specific project:

- 1.2.1 Participating Organizations
  - Michigan Department of Environment, Great Lakes & Energy (Michigan EGLE)
  - LivWell
  - Air Hygiene
- 1.2.2 Industry
  - Cannabis Cultivation and Production
- 1.2.3 Air Permit and Federal Requirements
  - Permit Number: 10-20A (P1109)
  - 40 CFR 60, Subpart JJJJ
- 1.2.4 Plant Location
  - Livwell Cultivation Business Center in Warren, Macomb County, Michigan
    - GPS Coordinates [Latitude 42.455310, Longitude -83.003680]
    - Physical Address: 21550 Hoover Road, CUP Building, Warren, Michigan 48089
- 1.2.5 Equipment Tested
  - Siemens, SGE-56SL, Unit #1-5

#### 1.2.6 Emission Points

- Exhaust from the Siemens, SGE-56SL, Unit #1-5
- For all gases, three sample points in the exhaust stacks from the Siemens, SGE-56SL, Unit #1-5, at 16.7, 50.0, and 83.3 percent of the diameter
- For all flow testing, 8-12 sampling points in the exhaust stacks from the Siemens, SGE-56SL, Unit #1-5

#### 1.2.7 Emission Parameters Measured

- NO<sub>x</sub>
- CO
- THC/NMHC/VOC
- NH<sub>3</sub>
- Flow
- H<sub>2</sub>O
- CO<sub>2</sub>
- O<sub>2</sub>

#### 1.2.8 Dates of Emission Test

- November 16-18, 2021

#### 1.2.9 Federal Certifications

- Stack Testing Accreditation Council AETB Certificate No. 3796.02
- International Standard ISO/IEC 17025:2005 Certificate No. 3796.01

### 1.3 KEY PERSONNEL

LivWell:	Shannelle Montoya (shannelle.montoya@livwell.com)	720-276-7669
Cultivated Power:	Jim Kelly	303-601-5681
Michigan EGLE:	Lindsey Wells (wells18@michigan.gov)	517-282-2345
Air Hygiene:	Michael Whisenhunt (mwhisenhunt@airhygiene.com)	918-307-8865
Air Hygiene:	Jason Hass	918-307-8865

### 2.0 SUMMARY OF TEST RESULTS

Results from the sampling conducted on LivWell's Siemens, SGE-56SL, Unit #1-5 located at the Livwell Cultivation Business Center on November 16-18, 2021 are summarized in the following table and relate only to the items tested.

The results of all measured pollutant emissions were below the required limits. All testing was performed without any real or apparent errors with the exception that the first two units were measured at incorrect dimensions and flow was conducted from fewer points than required. Michigan EGLE allowed us use of the measurements and correction to the corrected points for the remaining three units. Also, four test runs were performed on Unit #3. All testing was conducted according to the approved testing protocol with the exception that only five of six units were tested.

**TABLE 2.1**  
**SUMMARY OF SIEMENS, SGE-56SL, UNIT #1-5 RESULTS**

Parameter	Unit #1 S#A9B0018 (EUGEN1)	Unit #2 S#A9C0007 (EUGEN2)	Unit #3 S#A9A0027 (EUGEN3)	Unit #4 S#A9B0001 (EUGEN4)	Unit #5 S#A9B0011 (EUGEN5)	FGCOGEN Emission Limits	40 CFR 60, Subpart JJJJ Limits <sup>3</sup>
Date (mm/dd/yy)	11/17/21	11/18/21	11/16/21	11/17/21	11/17/21	--	--
Stack Flow (M2) (DSCFH)	148,133	146,117	103,596	103,942	139,005	--	--
Stack Moisture (% Method 320)	11.8	11.0	11.0	11.4	11.6	--	--
Power Output (kilowatts)	920.0	920.0	920.0	920.0	920.0	--	--
NOx (ppmvd)	6.14	5.10	17.15	15.02	11.97	--	--
NOx (ppm@15%O <sub>2</sub> )	2.87	2.43	8.15	7.34	5.75	--	82
NOx (g/hp*hr)	0.040	0.033	0.078	0.069	0.073	0.05 <sup>1</sup> / 0.14 <sup>2</sup>	1.0
CO (ppmvd)	1.82	1.41	0.00	0.00	0.00	--	--
CO (ppm@15%O <sub>2</sub> )	0.85	0.67	0.00	0.00	0.00	--	270
CO (g/hp*hr)	0.007	0.005	0.000	0.000	0.000	0.036 <sup>1</sup> / 0.45 <sup>2</sup>	2.0
NMHC (as C <sub>3</sub> H <sub>8</sub> ) (ppmvd)	9.85	0.00	27.75	25.03	18.10	--	--
NMHC (as C <sub>3</sub> H <sub>8</sub> ) (ppm@15%O <sub>2</sub> )	4.60	0.00	13.18	12.24	8.69	--	60
NMHC (as C <sub>3</sub> H <sub>8</sub> ) (g/hp*hr)	0.061	0.000	0.121	0.109	0.106	0.07 <sup>1</sup> / 0.28 <sup>2</sup>	0.7
NH <sub>3</sub> (ppmvd)	0.00	0.00	0.00	0.00	0.00	--	--
NH <sub>3</sub> (ppm@15%O <sub>2</sub> )	0.00	0.00	0.00	0.00	0.00	5 <sup>1</sup> / 3.5 <sup>2</sup>	--
NH <sub>3</sub> (g/hp*hr)	0.000	0.000	0.000	0.000	0.000	--	--

Notes: <sup>1</sup>Applicable to Units 1 and 2; <sup>2</sup>Applicable to Units 3, 4, and 5; <sup>3</sup>Based on 2019 Manufacturing Date

### 3.0 SOURCE OPERATION

#### 3.1 PROCESS DESCRIPTION

The units tested were Siemens, SGE-56SL, Unit #1-5. The engines are rated at 1,431 horsepower. The engine emissions are vented to the atmosphere through exhaust systems extending from each engine. The lean burn engines use an oxidation catalyst and ammonia injection between the engine and the exhaust stack.

#### 3.2 SAMPLING LOCATION

The stacks are vertical, circular, and measure 1.1 feet (ft) (13.25 inches) in diameter at the test ports which are approximately 37 ft above grade level with an exit elevation of approximately 42 ft above grade level. The test ports are located approximately 7.5 ft (90 inches) [6.8 dia] downstream and approximately 5.2 ft (62.5 inches) [4.7 dia] upstream from the nearest disturbances. Air Hygiene has field verified the measurable dimensions. Non-field verified dimensions are provided by LivWell. All exhaust samples for gaseous emissions were continuously drawn from the exhaust system at the sample ports from three sample points determined after conducting stratification tests (for some units in conjunction with the first test run). During the stratification test three points were traversed from one of the test ports. The probe was allowed to remain at a point for at least two times the system response time. For flow testing, an initial velocity traverse was performed across the stack from 8-12 total points. All flow sampling occurred from the same 8-12 points.

### 4.0 SAMPLING AND ANALYTICAL PROCEDURES

#### 4.1 TEST METHODS

The emission test on the Siemens, SGE-56SL, Unit #1-5 at the Livwell Cultivation Business Center was performed following United States Environmental Protection Agency (EPA) methods described by the Code of Federal Regulations (CFR). Table 4.1 outlines the specific methods performed on November 16-18, 2021.



**TABLE 4.1**  
**SUMMARY OF SAMPLING METHODS**

Pollutant or Parameter	Sampling Method	Analysis Method
Sample Point Location	EPA Method 1	Equal Area Method
Stack Flow Rate	EPA Method 2	S-Type Pitot Tube
Oxygen	EPA Method 3A	Paramagnetic Cell
Carbon Dioxide	EPA Method 3A	Nondispersive Infrared Analyzer
Nitrogen Oxides	EPA Method 7E	Chemiluminescent Analyzer
Carbon Monoxide	EPA Method 10	Nondispersive Infrared Analyzer
Total Hydrocarbons	EPA Method 25A	Flame Ionization Detector
Ammonia, Methane, Ethane, Carbon Dioxide, and Water	EPA Method 320	Fourier Transform Infrared

## 4.2 INSTRUMENT CONFIGURATION AND OPERATIONS FOR GAS ANALYSIS

The sampling and analysis procedures used during these tests conform with the methods outlined in the Code of Federal Regulations (CFR), Title 40, Part 60, Appendix A, Methods 1, 2, 3A, 7E, 10, 25A; and 40 CFR 63, Appendix A, Method 320.

Figure 4.1 depicts the sample system used for the real-time gas analyzer tests. The gas sample was continuously pulled through the probe and transported, via heat-traced Teflon® tubing, to a heated head pump and into the FTIR then to a stainless-steel minimum-contact condenser designed to dry the sample. Transportation of the sample, through Teflon® tubing, continued into the sample manifold within the mobile laboratory via a stainless steel/Teflon® diaphragm pump. From the manifold, the sample was partitioned to the real-time analyzers through rotameters that controlled the flow rate of the sample. Exhaust samples were routed to the wet based analyzer prior to gas conditioning.

Figure 4.1 shows that the sample system was also equipped with a separate path through which a calibration gas could be delivered to the probe and back through the entire sampling system. This allowed for convenient performance of system bias checks as required by the testing methods.

All instruments were housed in a climate controlled, trailer-mounted mobile laboratory. Gaseous calibration standards were provided in aluminum cylinders with the concentrations certified by the vendor. EPA Protocol No. 1 was used to determine the cylinder concentrations where applicable (i.e., NO<sub>x</sub> calibration gases).

Table 4.2 provides a description of the analyzers used for the instrument portion of the tests. All data from the continuous monitoring instruments were recorded on a Logic Beach Portable Data Logging System which retrieves calibrated electronic data from each instrument every one second and reports an average of the collected data every 30 seconds. For target compounds measured with the Fourier transform infrared (FTIR) spectrometer, interferograms consisting of 30 co-added scans were recorded continuously during the test periods, and provided approximately 30-second average concentrations. Spectral data was analyzed by the MKS MG2000 software.

Figure 4.2 represents the sample system used for the flow tests. A stainless-steel probe was inserted into the sample ports of the stack. Flow rates are monitored with oil filled manometers.

The stack gas analysis for O<sub>2</sub> and CO<sub>2</sub> concentrations was performed in accordance with procedures set forth in EPA Method 3A. The O<sub>2</sub> analyzer uses a paramagnetic cell detector and the CO<sub>2</sub> analyzer uses a continuous nondispersive infrared analyzer.

EPA Method 7E and 20 was used to determine concentrations of NO<sub>x</sub>. A chemiluminescent analyzer was used to determine the nitrogen oxides concentration in the gas stream. A NO<sub>2</sub> in nitrogen certified gas cylinder was used to verify at least a 90 percent NO<sub>2</sub> conversion on the day of the test.

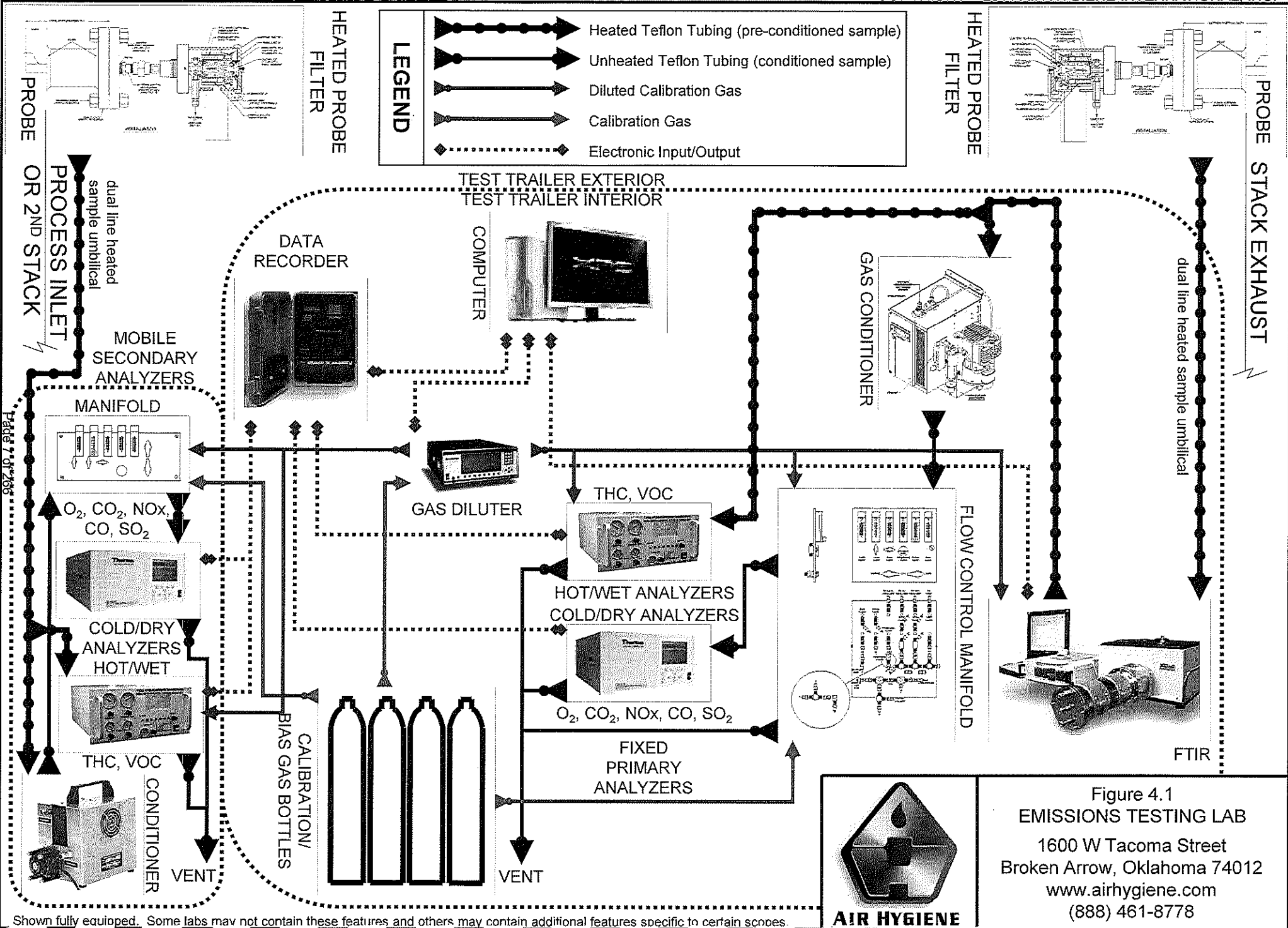
CO emission concentrations were quantified in accordance with procedures set forth in EPA Method 10. A continuous nondispersive infrared (NDIR) analyzer was used for this purpose.

THC emission concentrations were quantified in accordance with procedures set forth in EPA Method 25A. A continuous flame ionization (FID) analyzer was used for this purpose. NMHC emission concentrations were quantified in conjunction with procedures outlined in EPA Method 320 for sampling and analysis of methane content. These results were then subtracted from the THC concentrations to determine NMHC concentrations.

A MKS Instruments - MultiGas™ Fourier Transform Infrared (FTIR) spectrometer was used for ammonia, methane, ethane, carbon dioxide, and moisture analysis per EPA Method 320. The FTIR spectrometer spectral resolution was 0.5 cm<sup>-1</sup>. The system employed a silicon carbide infrared source at 1200°C, a helium neon reference laser, beam splitters, potassium bromide (KBr) cell window, front-surface optical transfer mirrors, and multi-pass absorption cells. MCT detectors were used and cooled with liquid nitrogen in order to maintain a constant temperature of 77 Kelvin. The approximately 5.11-meter multi-pass path cells incorporated aspheric, aberration-correcting mirrors to increase the optical throughput and the detection sensitivity. Transducers and thermocouples were connected directly to the insulated sample cells that provide the pressure and temperatures of the sample streams. During testing, the temperature of the absorption cells was set at 191°C. Elevated temperature prevented gas condensation within the cell and minimized compound adhesion to the cell walls and mirrors. The volume of the absorption cell was 0.5 liters, so at a sample gas flow rate of 4.0 liters per minute, the sample gas in the cell is refreshed approximately four times each minute. Interferograms consisting of 30 co-added scans were recorded continuously during the test periods, and provided approximately 30-second average concentrations.

**TABLE 4.2**  
**ANALYTICAL INSTRUMENTATION**

Parameter	Manufacturer and Model	Range	Sensitivity	Detection Principle
NO <sub>x</sub>	THERMO 42 series	User may select up to 5,000 ppm	0.1 ppm	Thermal reduction of NO <sub>2</sub> to NO. Chemiluminescence of reaction of NO with O <sub>3</sub> . Detection by PMT. Inherently linear for listed ranges.
CO	THERMO 48 series	User may select up to 10,000 ppm	0.1 ppm	Infrared absorption, gas filter correlation detector, microprocessor-based linearization.
CO <sub>2</sub>	SERVOMEX 1440	0-20%	0.1%	Nondispersive infrared
NH <sub>3</sub> , CH <sub>4</sub> , CO <sub>2</sub> , H <sub>2</sub> O	MKS 2030	User may select from multiple ranges	0.1 ppm	Fourier Transform Infrared – FTIR
THC	VIG 210	User may select up to 10,000 ppm	0.1 ppm	Flame Ionization Detector
O <sub>2</sub>	SERVOMEX 1440	0-25%	0.1%	Paramagnetic cell, inherently linear.



Shown fully equipped. Some labs may not contain these features and others may contain additional features specific to certain scopes.

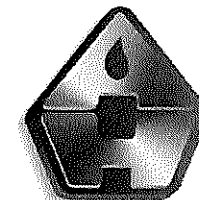


Figure 4.2  
FLOW ASSEMBLY  
1600 W Tacoma Street  
Broken Arrow, Oklahoma 74012  
www.airhygiene.com  
(888) 461-8778

**APPENDIX A**

**TEST RESULTS AND CALCULATIONS**