



**EMISSION COMPLIANCE TEST
FOR THE
SIEMENS, SGE-56SL, UNITS #1-6
PREPARED FOR
LIVWELL
AT THE
LIVWELL CULTIVATION BUSINESS CENTER
WARREN, MACOMB COUNTY, MICHIGAN
FEBRUARY 14-16, 2024**

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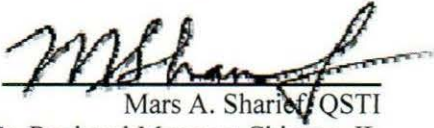

Gavin Dolky, QI
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I, 
Mars A. Sharif, QSTI
Sr. Regional Manager-Chicago, IL
certify that this testing was conducted and
this report was created in conformance
with the requirements of ASTM D7036

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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.



Mars A. Sharief, QSTI
Sr. Regional Manager-Chicago, IL
Air Hygiene International, Inc.

February 16, 2024
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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**Emission Compliance Test
Siemens, SGE-56SL, Units #1-6
LivWell
LivWell Cultivation Business Center
Warren, Macomb County, Michigan
February 14-16, 2024**

1.0 INTRODUCTION

Air Hygiene International, Inc. (Air Hygiene) has completed the Emission Compliance Test for nitrogen oxides (NO_x), carbon monoxide (CO), total hydrocarbons/volatile organic compounds (THC/VOC), ammonia (NH₃), flow, carbon dioxide (CO₂), and oxygen (O₂) from the exhaust of the Siemens, SGE-56SL, Units #1-6 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 February 14-16, 2024.

1.1 TEST PURPOSE AND OBJECTIVES

The purpose of the test was to conduct a periodic 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 operating permit issued by the Michigan Department of Environment, Great Lakes & Energy (Michigan EGLE) 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_x, CO, THC/NMHC/VOC, NH₃, flow, CO₂, and O₂ from the exhaust of LivWell's Siemens, SGE-56SL, Units #1-6.

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
 - Cultivated Power
 - Air Hygiene
- 1.2.2 Industry
 - Cannabis Cultivation and Production
- 1.2.3 Air Permit
 - Permit Number: 10-20A (P1109)
- 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, Units #1-6

- 1.2.6 Emission Points
 - Exhaust from the Siemens, SGE-56SL, Units #1-6
 - For all gases, one sample point in the exhaust duct from the Siemens, SGE-56SL, Units #1-6, determined after conducting a stratification test
 - For all flow chemistry testing, 12 sampling points in the exhaust duct from the Siemens, SGE-56SL, Units #1-6
- 1.2.7 Emission Parameters Measured
 - NO_x
 - CO
 - THC/NMHC/VOC
 - NH₃
 - Flow
 - H₂O
 - CO₂
 - O₂
- 1.2.8 Dates of Emission Test
 - February 14-16, 2024
- 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 (jim.kelly@cultivatedpower.net)	303-601-5681
Michigan EGLE:	Iranna Konanahalli (Konanahalli@Michigan.gov)	586-596-7630
Michigan EGLE:	Andrew Riley (RileyA8@Michigan.gov)	586-565-7379
Air Hygiene:	Mars Sharief (msharief@airhygiene.com)	918-307-8865
Air Hygiene:	Ben Farley	918-307-8865
Air Hygiene:	Jaxon Twitchwell	918-307-8865
Air Hygiene:	Saud Altamimi	918-307-8865

2.0 SUMMARY OF TEST RESULTS

Results from the sampling conducted on LivWell's Siemens, SGE-56SL, Units #1-6 located at the LivWell Cultivation Business Center on February 14-16, 2024 are summarized in the following table and relate only to the items tested.

TABLE 2.1
SUMMARY OF SIEMENS, SGE-56SL, UNIT #EUGEN1 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)	Unit #6 S#B0D0008 (EUGEN6)	FGCOGEN Emission Limits	40 CFR 60, Subpart JJJJ Limits*
Stack Flow (M2) (DSCFH)	130,912	136,769	142,160	139,174	139,938	146,157	--	--
Power Output (horsepower)	1,237.5	1,235.4	1,235.2	1,229.0	1,232.3	1,212.1	--	--
Engine Load (%)	92	92	92	92	92	91	--	--
Power Output (kilowatts)	922.8	921.2	921.1	916.5	918.9	903.8	--	--
Engine Speed (rpm)	1,800	1,800	1,800	1,800	1,800	1,800	--	--
Air Manifold Pressure (psi)	30.17	30.63	29.57	29.73	31.23	30.87	--	--
Air Manifold Temp (°F)	133.17	133.77	124.47	125.40	128.37	138.67	--	--
Catalyst Inlet Temp (°F)	868	881	885	846	882	885	--	--
Catalyst Outlet Temp (°F)	866	870	862	842	885	876	--	--
ΔP Across the Catalyst (in H ₂ O)	4.8	4.8	6.7	7.7	7.6	4.1	--	--
Urea Injection Rate (lph)	3.1	3.5	3.4	2.8	3.4	4.1	--	--
Natural gas fuel usage (lps)	71.9	74.2	72.7	71.1	75.4	73.6	--	--
NOx (ppmvd)	5.00	7.23	20.09	21.61	22.45	2.43	--	--
NOx (ppmvd@15%O ₂)	2.43	3.47	9.57	10.56	10.79	1.17	--	82
NOx (g/hp*hr)	0.029	0.043	0.125	0.133	0.138	0.016	0.05 ¹ / 0.14 ²	1.0
CO (ppmvd)	0.09	0.03	5.10	6.63	10.13	19.71	--	--
CO (ppmvd@15%O ₂)	0.04	0.01	2.43	3.24	4.86	9.48	--	270
CO (g/hp*hr)	0.000	0.000	0.019	0.025	0.038	0.079	0.036 ³ / 0.45 ⁴	2.0
THC (as C ₃ H ₆) (ppmvd)	219.66	247.35	262.76	302.26	370.04	349.20	--	--
THC (as C ₃ H ₆) (ppmvd@15%O ₂)	106.65	118.68	125.20	147.71	177.86	167.83	--	--
THC (as C ₃ H ₆) (g/hp*hr)	1.204	1.419	1.566	1.774	2.177	2.181	--	--
CH ₄ (ppmvd)	296.17	316.32	312.98	367.22	446.21	409.22	--	--
C ₂ H ₆ (ppmvd)	12.90	13.18	15.38	19.15	21.47	18.05	--	--
NMHC (as C ₃ H ₆) (ppmvd)	0.00	0.00	0.00	0.00	0.00	0.00	--	--
NMHC (as C ₃ H ₆) (ppmvd@15%O ₂)	0.00	0.00	0.00	0.00	0.00	0.00	--	60
NMHC (as C ₃ H ₆) (g/hp*hr)	0.000	0.000	0.000	0.000	0.000	0.000	0.07 ³ / 0.28 ⁴	0.7
NH ₃ (ppmvd)	1.23	0.61	6.18	3.13	6.88	3.56	--	--
NH ₃ (ppmvd@15%O ₂)	0.60	0.29	2.94	1.53	3.31	1.71	5 ³ / 3.5 ⁴	--
NH ₃ (lb/hr)	0.01	0.00	0.04	0.02	0.04	0.02	--	--
NH ₃ (g/hp*hr)	0.003	0.001	0.014	0.007	0.016	0.009	--	--
CO ₂ (%vd)	6.96	7.00	7.20	6.94	6.98	7.01	--	--
O ₂ (%vd)	8.75	8.60	8.52	8.83	8.63	8.62	--	--

Notes: ¹Applicable to Units 1, 2, and 6; ²Applicable to Units 3, 4, and 5; ³Applicable to Units 1 and 2; ⁴Applicable to Units 3, 4, 5, and 6; ⁵Based on 2019 Manufacturing Data

The results of all measured pollutant emissions were below the required limits. All testing was performed without any real or apparent errors. All testing was conducted according to the approved testing protocol.

3.0 SOURCE OPERATION

3.1 PROCESS DESCRIPTION

The units tested were Siemens, SGE-56SL, Units #1-6. 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 one (non-stratified) or three (minimally stratified) sample points determined after conducting stratification tests. During the stratification test six points were traversed from each of the two 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 12 total points. All flow sampling occurred from the same 12 points.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 TEST METHODS

The emission test on the Siemens, SGE-56SL, Units #1-6 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 February 14-16, 2024.

**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	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 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 concentrations certified by the vendor. EPA Protocol No. 1 was used to determine the cylinder concentrations where applicable (i.e., NO_x 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 6 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.

Three test runs of a minimum of 60 minutes each were conducted on the Siemens, SGE-56SL, Units #1-6 for NO_x, CO, THC/NMHC/VOC, NH₃, flow, CO₂, and O₂.

The stack gas analysis for O₂ and CO₂ concentrations was performed in accordance with procedures set forth in EPA Method 3A. The O₂ analyzer uses a paramagnetic cell detector, and the CO₂ analyzer uses a continuous nondispersive infrared analyzer.

EPA Method 7E was used to determine concentrations of NO_x. A chemiluminescent analyzer was used to determine the nitrogen oxides concentration in the gas stream. A NO₂ in air manufacturer-certified gas cylinder was used to verify at least a 90 percent NO₂ 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.

VOC emission concentrations were quantified in conjunction with procedures outlined in EPA Method 18 for Tedlar bag sampling and analysis of methane and ethane content. These results were then subtracted from the THC concentrations to determine VOC concentrations.

A MAX-iR Fourier Transform Infrared (FTIR) spectrometer was used for NH₃, H₂O, methane and ethane analysis per EPA Method 320. The Max Acquisition or Series 2000 MultiGas Analyzer Software collects and processes all the infrared spectral data and uses a Classical Least Squares regression method for the quantitative analysis. The FTIR spectrometer spectral resolution was 0.5 cm⁻¹ with a Medium Norton Beer Apodization. The system employed:

- a silicon carbide infrared source at 1200°C
- a helium neon reference laser
- potassium bromide (KBr), barium fluoride (BaF₂), or zinc selenide (ZnSe) cell window
- potassium bromide (KBr) beam splitter with germanium (Ge) coating
- front-surface optical transfer mirrors
- a 5.11 m multi-pass gas cell

A wide band MCT detector was utilized that allows measurements to be made from 600 - 5,000 cm⁻¹, the detector was cooled with liquid nitrogen to maintain a constant temperature of 77 Kelvin. The MKS 5.11-meter multi-pass "white" cell incorporates aspheric, aberration-correcting mirrors to increase the optical throughput and the detection sensitivity. A Baratron® pressure transducer 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. The 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 approximately 0.2 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.

Daily quality checks included direct pre and post-test Calibration Transfer Standard (CTS) spectra, injecting a compound with known and stable concentration (i.e., CO₂, CH₄, or C₂H₄) through the FTIR to verify the average of five scans was within five percent of the expected concentration. Additional quality checks included, triplicate, dynamic spiking procedure that included a direct measurement of the spike target (i.e., HCHO, CH₄, NH₃, etc. at times with a SF₆ tracer gas) to determine the detectable concentration, followed by alternating four scan samples of native stack gas and spiked stack gas (e.g., stack gas displaced by a 10 percent volume of the known target). A successful dynamic spike returns the target compound between 70 and 130 percent of the expected concentration at a dilution ratio less than 0.1, when feasible.

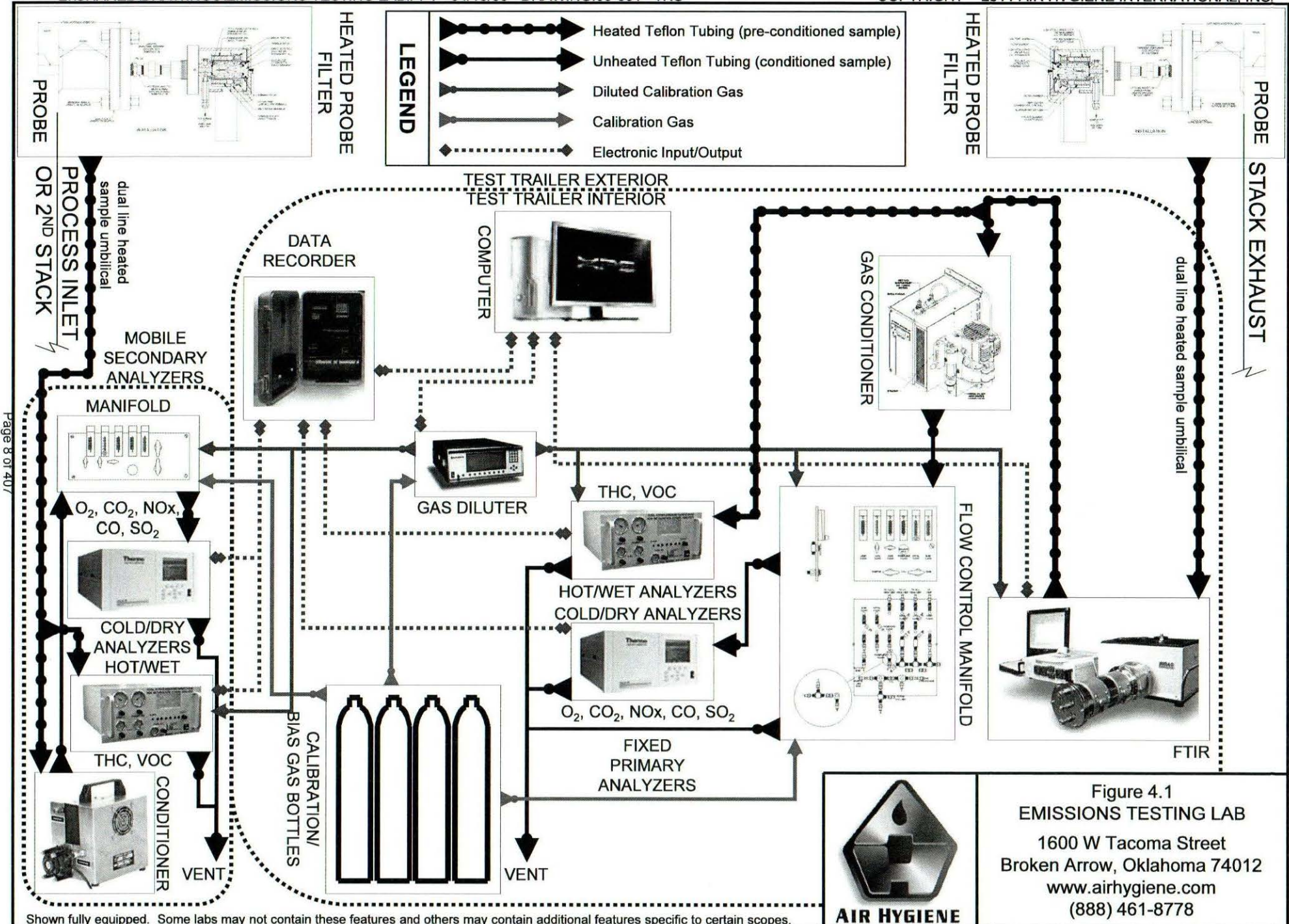
Specific to FTIR QA, the report includes the reference spectra images for each target compound, validation from two runs to quantify target compounds, the results, and sample calculations for the QA spiking procedures. Dynamic spiking direct verification concentrations were determined by filling the FTIR cell directly with the EPA protocol gas, rather than assuming the cylinder stamped concentrations. The results of the sampling system leak check were documented and noted as less than 200 ml/min (System CTS measurements also demonstrate that leaks are not present, and that gas transfer produces independent samples). The results of the instrument leak check were conducted and documented under vacuum and pressure by monitoring pressure changes. Using the larger of the two results the percentage leak volume was calculated and found to be less than or equal to four percent of the FTIR system volume.

Results from the FTIR analysis of methane and ethane were subtracted from the total hydrocarbon (THC) concentrations determined in a standard flame ionization detector (FID) type analyzer, calibrated, and monitored per EPA Method 25A.

**TABLE 4.2
ANALYTICAL INSTRUMENTATION**

Parameter	Manufacturer and Model	Range	Sensitivity	Detection Principle
NO _x	THERMO 42i-HL	User may select up to 5,000 ppm	0.1 ppm	Thermal reduction of NO ₂ to NO. Chemiluminescence of reaction of NO with O ₃ . Detection by PMT. Inherently linear for listed ranges.
CO	THERMO 48i	User may select up to 10,000 ppm	0.1 ppm	Infrared absorption, gas filter correlation detector, microprocessor-based linearization.
CO ₂	THERMO 410i	0-20%	0.1%	Nondispersive infrared
NH ₃ , Methane, Ethane, H ₂ O	MKS 2030	User may select from multiple ranges	0.1 ppm	Fourier Transform Infrared – FTIR
THC	THERMO 51i-HT	User may select up to 10,000 ppm	0.1 ppm	Flame Ionization Detector
O ₂	SERVOMEX 1440	0-25%	0.1%	Paramagnetic cell, inherently linear.

Figure 4.2 represents the sample system used for the flow tests. Flow rates were monitored with manometers.



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



Figure 4.1
EMISSIONS TESTING LAB
 1600 W Tacoma Street
 Broken Arrow, Oklahoma 74012
 www.airhygiene.com
 (888) 461-8778

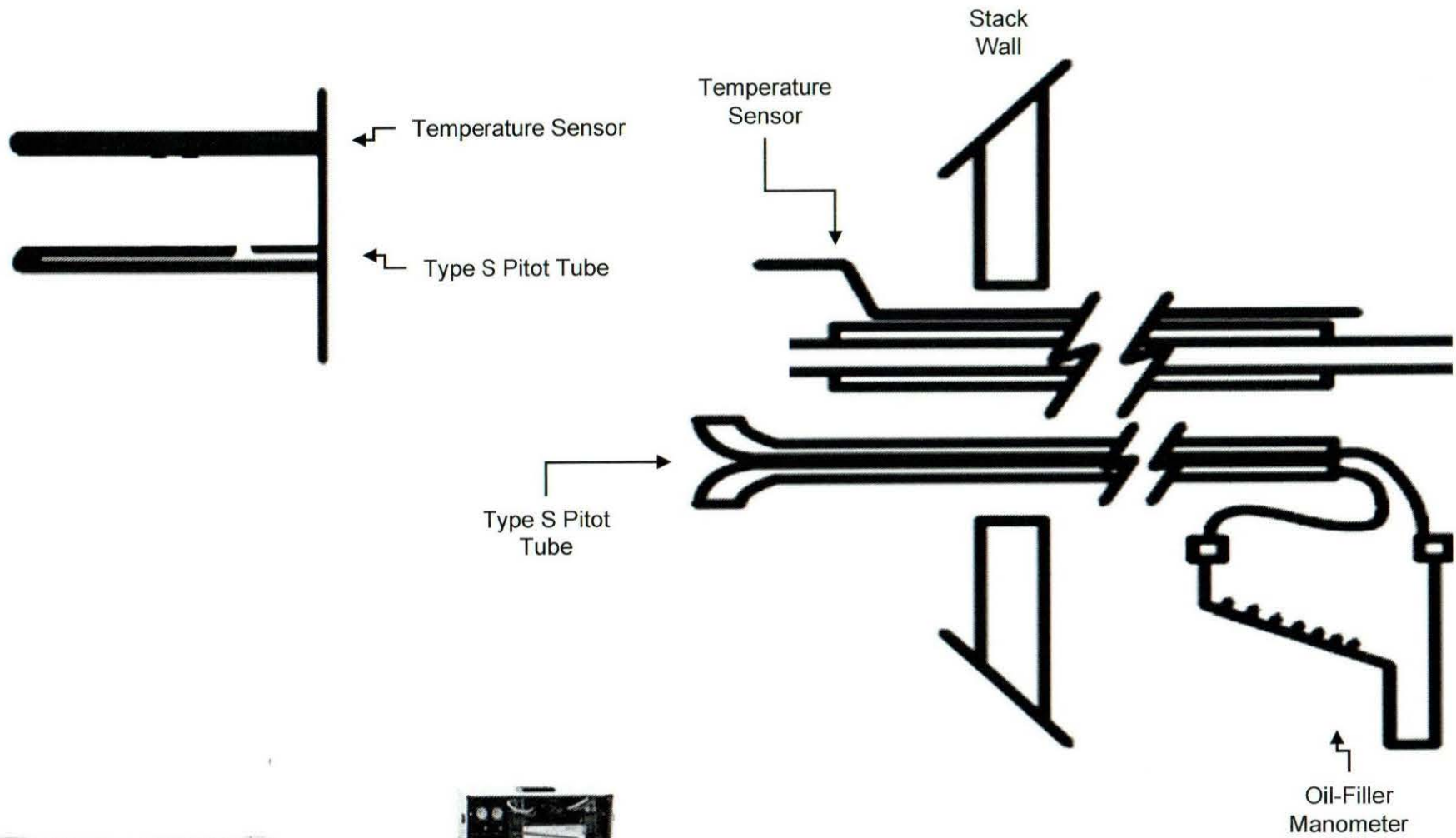


Figure 4.2
FLOW ASSEMBLY
1600 W Tacoma Street
Broken Arrow, Oklahoma 74012
www.airhygiene.com
(888) 461-8778