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Oakland University
Hillcrest Hall
273 Grizzly Lane
Rochester, Michigan 48309

Report

**Performed Moisture, Oxygen, Volatile Organic Compounds,
Nitrogen Oxide and Carbon Monoxide Emissions Testing**

Sampling performed on the Cummins Model GTA28 Generator Outlet

Rochester, MI

Test Date: 8/2/18

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9/6/2018

X *Brian E. Lemasters*

Signed by: Custom Stack Analysis, LLC.

Brian E. Lemasters
Custom Stack Analysis, LLC.

REPORT CERTIFICATION

Custom Stack Analysis, LLC. has used its professional experience and best professional efforts in performing this compliance test. I have reviewed the results of these tests and to the best of my knowledge and belief they are true and correct.

9/6/2018

X *Brian E. Lemasters*

Signed by: Custom Stack Analysis, LLC.
Brian E. Lemasters

EXECUTIVE SUMMARY

Custom Stack Analysis, LLC. conducted emissions sampling using USEPA Methods 1-4, 3A, 7E, 10 and 25A. Testing was conducted on the Cummins Model GTA28 Generator Outlet on August 2nd, 2018. The testing was conducted at Oakland University on the Cummins Model GTA28 Generator Outlet at Hillcrest Hall to determine compliance status with the applicable emission limit standards, 40 CFR 60. Subpart JJJJ (see Table 1.2).

The Custom Stack Analysis, LLC. test crew consisted of Mr. Jonathan Marx and Mr. Brian Lemasters. The testing procedures were coordinated by Ms. Cora Hanson and Mr. Brian Ward of Oakland University and Mr. Bruce Colson of Cummins Bridgeway, LLC. All testing procedures were witnessed by Mr. Mark Dziadosz of the State of Michigan Department of Environmental Quality Air Quality Division Southeast District Office (see Table 1.1).

Table 1.1: Emissions Testing Program Contact Personnel

Name	Company Address	Phone, Fax
Mr. Mark Dziadosz	State of Michigan Department of Environmental Quality Air Quality Division Southeast District Office 27700 Donald Court Warren, Michigan 48092-2793	(586) 753-3745 (Phone) (586) 753-3740 (Fax)
Mr. Brian Ward Ms. Cora Hanson	Oakland University 273 Grizzly Lane Rochester, Michigan 48309	(248) 370-4413 (Phone) (248) 370-4427 (Phone)
Mr. Bruce Colson	Cummins Bridgeway, LLC. 21810 Clessie Court New Hudson, MI 48165	(248) 573-1600 (Phone) (248) 573-1538 (Fax)
Mr. Brian Lemasters Project Manager Mr. Jonathan Marx Project Technician	Custom Stack Analysis, LLC. 14614 Cenfield St. N.E. Alliance, OH 44601	(330) 525-5119 (Phone) (330) 525-7908 (Fax)

Test results are located on page 3. A description of the testing protocol is included on pages 4-8. All testing calculations are located on pages 15-19. Appendix 1 includes field test data. Appendix 2 contains laboratory data from Custom Stack Analysis, LLC. Appendix 3 contains calibration data for the equipment used on test day. Appendix 4 contains monitoring data. Appendix 5 contains production data.

The MDEQ advised us that we should test each exhaust port for 30 minutes and then average the values for the CEMS results.

Table 1.2 demonstrates how Oakland University at Hillcrest Hall in Rochester, MI is operating in compliance with the applicable emission standards at the correct operating parameters for the testing conducted (see Appendix 5).

Table 1.2: Emission Limits and Test Results Summary

Pollutant	Emission Limitations	Test Result Average	Compliance Demonstrated
Carbon Monoxide	270 ppm @ 15% O ²	159.94 ppm @ 15% O ²	Yes
Nitrogen Oxide	82 ppm @ 15% O ²	25.17 ppm @ 15% O ²	Yes
Volatile Organic Compounds	60 ppm @ 15% O ²	0.00 ppm @ 15% O ²	Yes

Test Results

Oakland University Hillcrest Hall - Cummins Model GTA28 Generator Outlet

8/2/2018

Methods 1-4, 3A, 7E, 10 & 25A

	<u>Run #1</u>	<u>Run #2</u>	<u>Run #3</u>	<u>Avg.</u>	<u>Limit</u>
Moisture %	21.40%	21.49%	20.97%	21.28%	
Oxygen %	0.65%	0.74%	0.71%	0.70%	
CO (ppm)	173.99	632.39	835.14	547.18	
CO (ppm @ 15%)	50.68	185.10	244.05	159.94	270
Nox (ppm)	143.78	56.77	58.26	86.27	
Nox (ppm @ 15%)	41.88	16.62	17.02	25.17	82
VOC* (total ppm)	47.64	105.85	114.74	89.41	
VOC* (methane ppm)	47.69	113.94	135.07	98.90	
VOC** (ppm)	0.00	0.00	0.00	0.00	
VOC** (ppm @ 15%)	0.00	0.00	0.00	0.00	60
Operating Engine Horsepower	645	644	643	644	
Max Engine Horsepower	701	701	701	701	
Load %	91.96%	91.87%	91.78%	91.87%	
Megawatt	0.4138	0.4134	0.4130	0.4134	

* VOC concentration dry

** VOC concentration with the Methane removed and Dry.

METHOD 1

Sample and velocity traverses for stationary sources.

To aid in the representative measurement of pollutant emissions and/ or total volumetric flow rate from a stationary source, a measurement site where the effluent stream is flowing in a known direction is selected, and the cross-section of the stack is divided into a number of equal areas. A traverse point is then located within each of these equal areas.

METHOD 2

Determination of stack gas velocity and volumetric flow rate.

The average gas velocity in a stack is determined from the gas density and from measurement of the average velocity head with a Type S (Stausscheibe or reverse type) pitot tube.

METHOD 3

Gas analysis for the determination of dry molecular weight.

This method is applicable for determining carbon dioxide and oxygen concentrations and dry molecular weight of a sample from a gas stream of a fossil-fuel combustion process.

METHOD 4

Determination of moisture content in stack gases.

A gas sample is extracted at a constant rate from the source. It is determined either volumetrically or gravimetrically.

METHOD 3A TESTING DESCRIPTION

A gas sample is continuously extracted from the stack, and a portion of the sample is conveyed to an instrumental analyzer for determination of O₂ gas concentration. The gases pass through a heated sampling probe and filter to prevent condensation. The gases then pass through a calibration valve to a heated sampling line. After the heated sampling line is a Universal Analyzers Model 530 air cooled single sample thermoelectric water condenser with a perostolic pump for moisture removal. The sample is then passed through to a California Analytical Instruments Model 100F for O₂ concentrations. Before the testing procedures commence the analyzer is left to warm up for a 90 minute period. It is then calibrated according to Method 7E specifications. To the extent practicable, the measured emissions should be between 20 to 100 percent of the selected calibration span. Three calibration gases are selected. The High-Level gas concentrations shall be equivalent to 20 to 100 percent of the calibration span. Mid-Level concentrations shall be equivalent to 40 to 60 percent of the calibration span. The Low-Level Gas concentrations of less than 20 percent of the span. Before the first run an analyzer calibration error check is conducted. If the low-level, mid, or high cal gases expected concentrations differ by more than +2% of the span then the procedure needs to be repeated until an acceptable 3 point calibration is obtained. After the analyzer calibration check the upscale and low level calibration gases are introduced to the sampling calibration valve and recorded. System bias calibration must be within 5.0% of the analyzer calibration span for low-scale and upscale calibration gases. At the conclusion of each of the test runs the low-level gas and an upscale gas closest to the concentrations are introduced to the calibration valve assembly. If either the low-level or upscale value exceeds +3% of the span, then the run is considered invalid.

METHOD 7E TESTING DESCRIPTION

A gas sample is continuously extracted from the stack, and a portion of the sample is conveyed to an instrumental analyzer for determination of NO_x gas concentration using a chemiluminescence analyzer. The gases pass through a heated sampling probe and filter to prevent condensation. The gases then pass through a calibration valve to a heated sampling line. After the heated sampling line is a condenser for moisture removal. The sample is then passed through to a Thermo Environmental Instruments Model 42 chemiluminescence analyzer where the gases are analyzed for NO_x concentrations. Before the testing procedures commence the analyzer is left to warm up for a 90 minute period. It is then calibrated according to Method 7E specifications. To the extent practicable, the measured emissions should be between 20 to 100 percent of the selected calibration span. Three calibration gases are selected. The High-Level gas concentrations shall be equivalent to 20 to 100 percent of the calibration span. Mid-Level concentrations shall be equivalent to 40 to 60 percent of the calibration span. The Low-Level Gas concentrations of less than 20 percent of the span. Before the first run an analyzer calibration error check is conducted. If the low-level, mid, or high cal gases expected concentrations differ by more than +2% of the span then the procedure needs to be repeated until an acceptable 3 point calibration is obtained. After the analyzer calibration check the upscale and low level calibration gases are introduced to the sampling calibration valve and recorded. System bias calibration must be within 5.0% of the analyzer calibration span for low-scale and upscale calibration gases. At the conclusion of each of the test runs the low-level gas and an upscale gas closest to the concentrations are introduced to the calibration valve assembly. If either the low-level or upscale value exceeds +3% of the span, then the run is considered invalid.

METHOD 10 TESTING DESCRIPTION

A gas sample is continuously extracted from the stack, and a portion of the sample is conveyed to an instrumental analyzer for determination of CO gas concentration using a Luft-type nondispersive infrared analyzer. The gases pass through a heated sampling probe and filter to prevent condensation. The gases then pass through a calibration valve to a heated sampling line. After the heated sampling line is a Universal Analyzers Model 530 air cooled single sample thermoelectric water condenser with a peristaltic pump for moisture removal. The sample is then passed through an ascarite tube to a Thermo Environmental Instruments Model 48 Luft-type analyzer where the gases are analyzed for CO concentrations. Before the testing procedures commence the analyzer is left to warm up for a 90 minute period. It is then calibrated according to Method 7E specifications. To the extent practicable, the measured emissions should be between 20 to 100 percent of the selected calibration span. Three calibration gases are selected.

The High-Level gas concentrations shall be equivalent to 20 to 100 percent of the calibration span. Mid-Level concentrations shall be equivalent to 40 to 60 percent of the calibration span. The Low-Level Gas concentrations of less than 20 percent of the span.

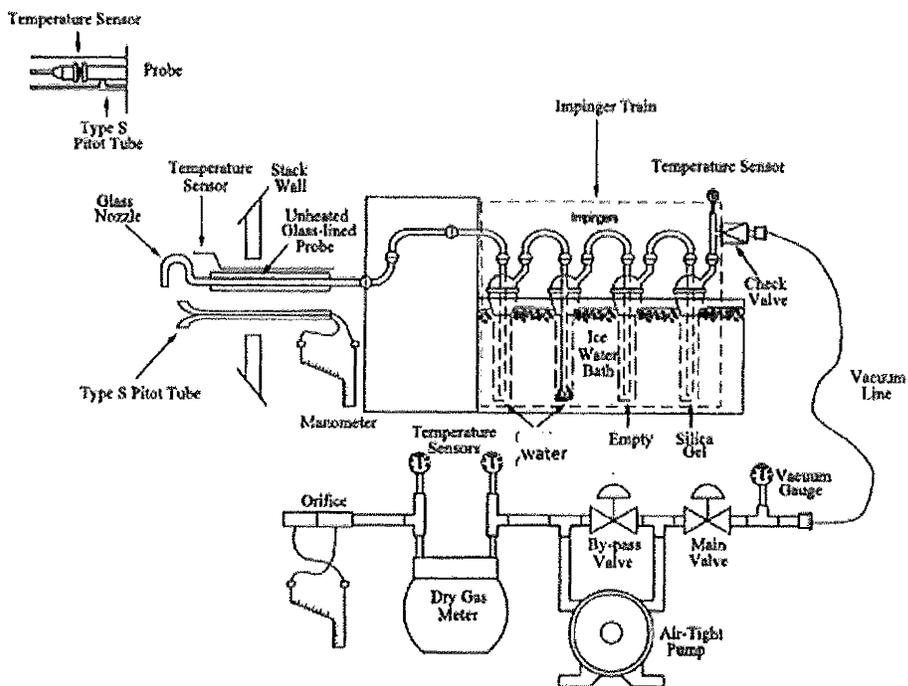
Before the first run an analyzer calibration error check is conducted. If the low-level, mid, or high cal gases expected concentrations differ by more than $\pm 2\%$ of the span then the procedure needs to be repeated until an acceptable 3 point calibration is obtained. After the analyzer calibration check the upscale and low level calibration gases are introduced to the sampling calibration valve and recorded. System bias calibration must be within 5.0% of the analyzer calibration span for low-scale and upscale calibration gases. At the conclusion of each of the test runs the low-level gas and an upscale gas closest to the concentrations are introduced to the calibration valve assembly. If either the low-level or upscale value exceeds $\pm 3\%$ of the span, then the run is considered invalid.

METHOD 25A TESTING DESCRIPTION

This method will be used to measure the total VOC concentration expressed in terms of ppm propane. A gas sample is extracted from the source through a stainless steel probe, through a heated sample line (teflon), to a flame ionization analyzer. The main components of Method 25A are the same as Method 204B with the exception of a non heated sample probe.

The sampling system is heated up to the proper operating temperature. Within two hours of the start of the test the FIA is calibrated. The calibration range or span is selected to be from 1.5 to 2.5 times the expected concentration. Three calibration ranges are then selected as follows: Low level 25-35% of the span, Mid level 45-55% of the span, and a High level 80-90% of the span. A zero and a high level calibration gas is then injected at the valve assembly and the FIA is adjusted to these levels. Then all four gases are introduced into the analyzer and recorded. If the responses are within 5% of the expected values then the analyzer is responding correctly. The sample probe is located in the center of the stack and sealed in place and the test is started. The test lasts for 60 minutes. At the end of the test run a drift check is ran. The zero gas and the mid level calibration gas is injected at the valve assembly. The analyzer responses are then recorded. The drift check is acceptable if the results are within 3% of the span value. These checks are performed before and after each test run.

Method 4 Diagram



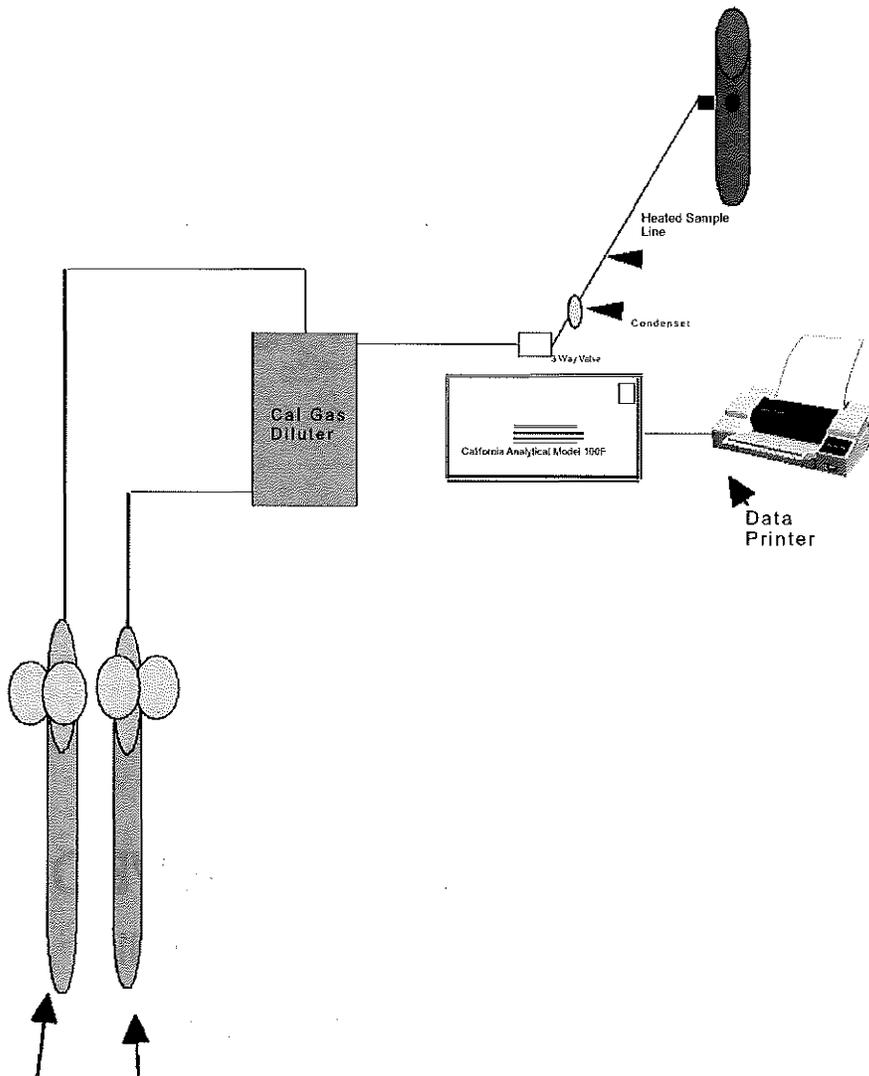
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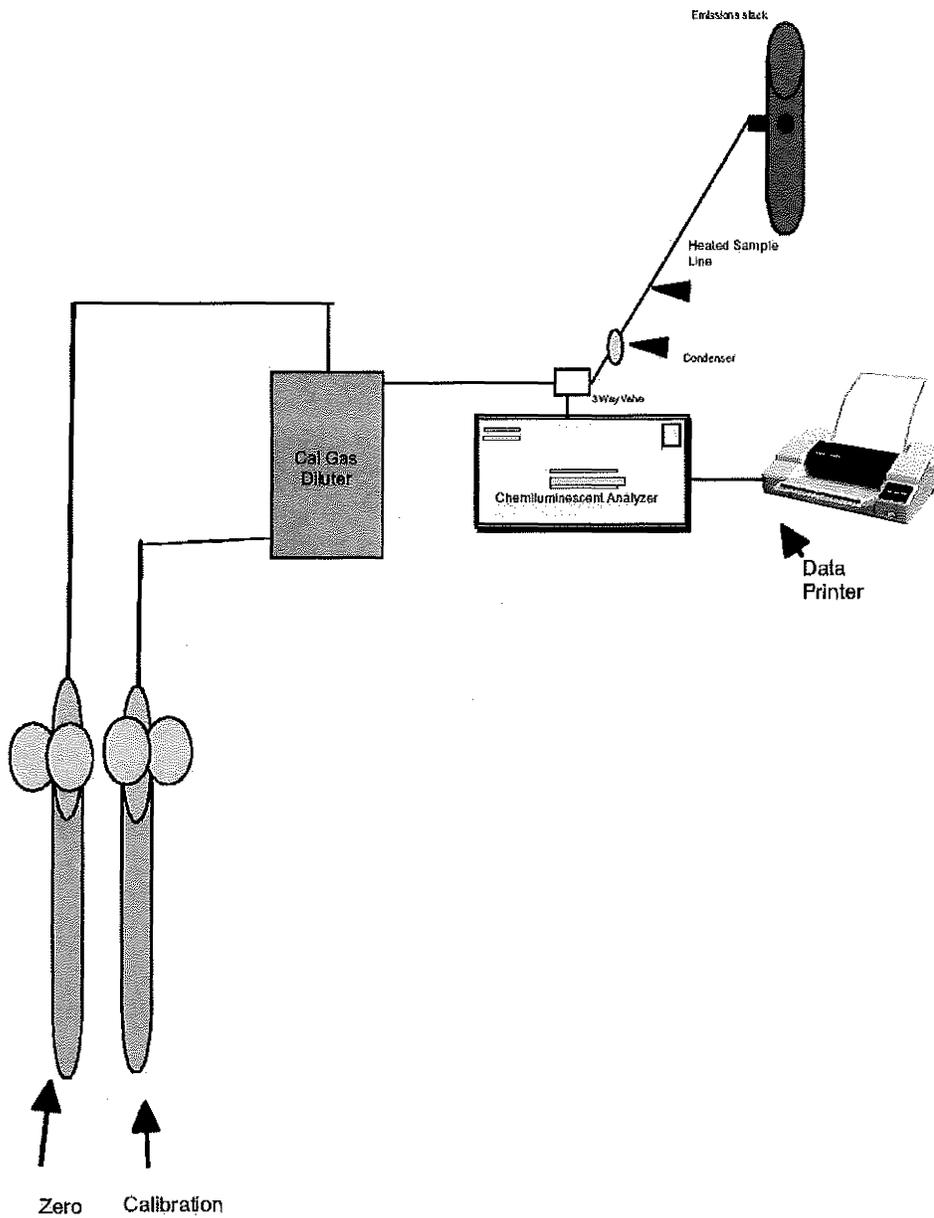
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3A Sampling System

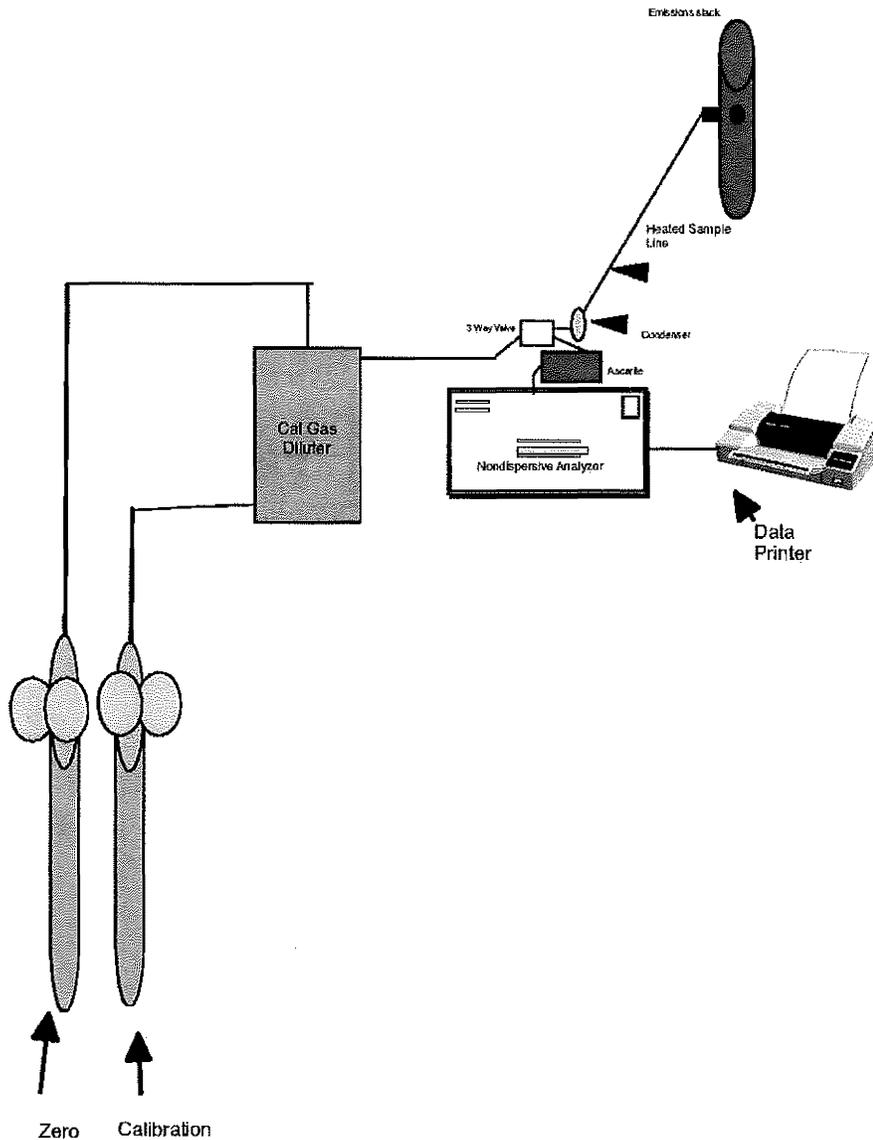
Emissions stack



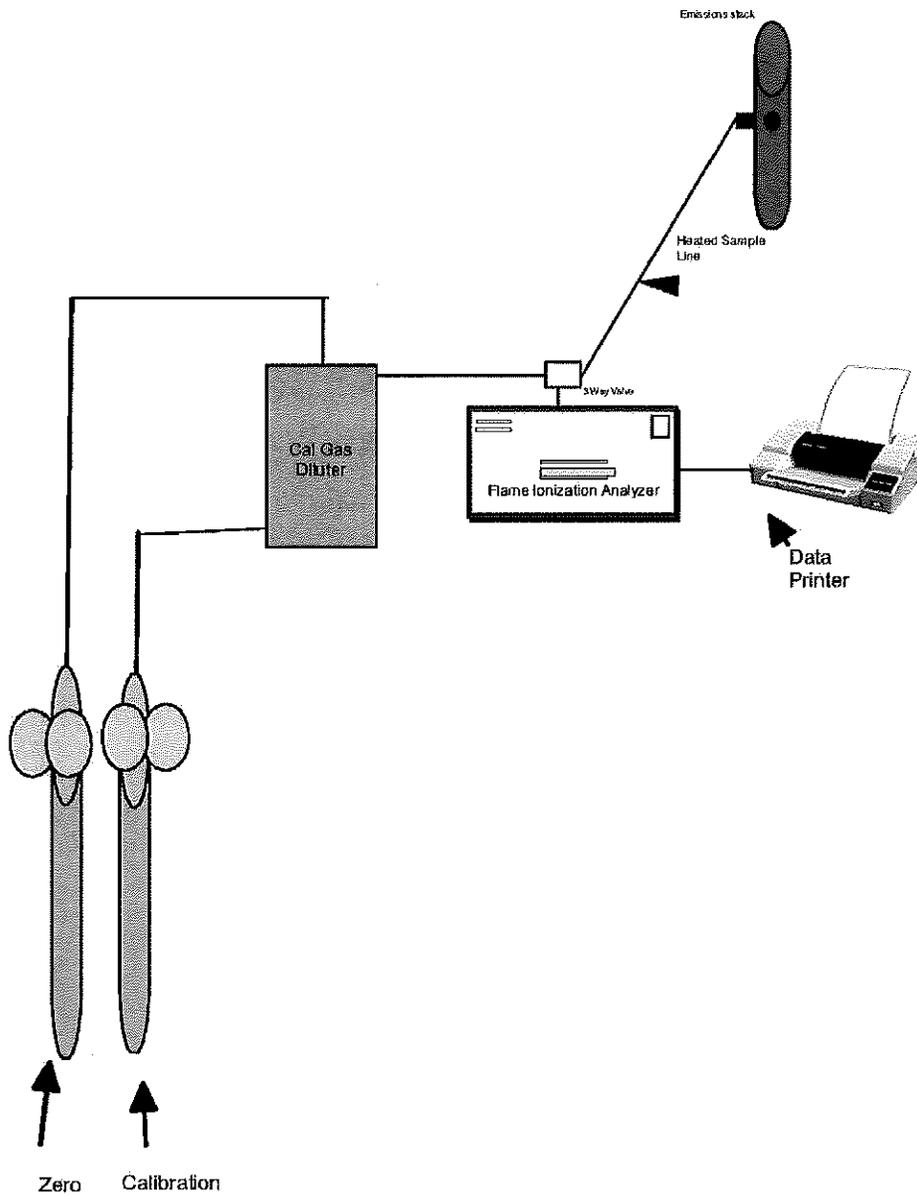
7E Sampling System



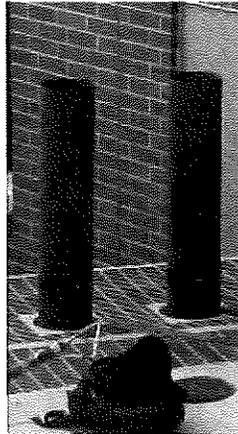
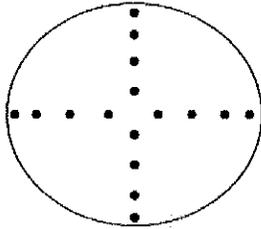
10 Sampling System



25A Sampling System



Location of Sampling Points



Location	Cummins Model GTA28 Generator Outlet
Upstream	12.0 Inches
Downstream	1 Inches
Stack Diameter	8 Inches
Sample Point #	
1	0.3 Inches
2	0.8
3	1.6
4	2.6
5	5.4
6	6.4
7	7.2
8	7.7