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AFOEHL REPORT 89-098EQ0144HEF



AD-A216 690

Boiler Emission Compliance Survey Norton AFB CA

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AUGUST 1989

Final Report

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Human Systems Division
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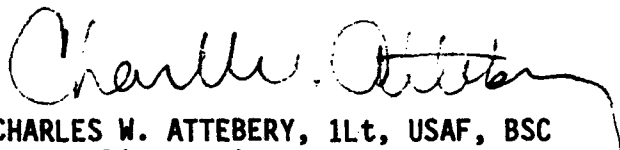
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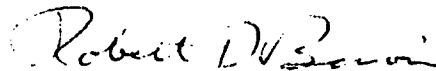
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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED			1b. RESTRICTIVE MARKINGS NA		
2a. SECURITY CLASSIFICATION AUTHORITY NA			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE NA					
4. PERFORMING ORGANIZATION REPORT NUMBER(S) AFOEHL Report 89-098EQ0144HEF			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZATION AF Occupational and Environmental Health Laboratory		6b. OFFICE SYMBOL (If applicable) EQE	7a. NAME OF MONITORING ORGANIZATION		
6c. ADDRESS (City, State, and ZIP Code) Brooks AFB TX 78235-5501			7b. ADDRESS (City, State, and ZIP Code)		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Same as 6a		8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
8c. ADDRESS (City, State, and ZIP Code) Same as 6c			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO	PROJECT NO	TASK NO
11. TITLE (Include Security Classification) Boiler Emission Compliance Survey, Norton AFB CA					
12. PERSONAL AUTHOR(S) Charles W. Attebery, 1Lt, USAF, BSC and Ronald W. Vaughn, Capt, USAF, BSC					
13a. TYPE OF REPORT Final		13b. TIME COVERED FROM _____ TO _____		14. DATE OF REPORT (Year, Month, Day) August 1989	
15. PAGE COUNT					
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	Compliance Testing, Norton, Air Pollution, Attebery Source Emission Testing, Stack Sampling, Vaughn Particulates, Carbon Monoxide, Oxides of Nitrogen. (SR)		
19. ABSTRACT (Continue on reverse if necessary and identify by block number)					
At the request of USAF Clinic/SGPB, Norton AFB and HQ MAC/SGPB, compliance testing (carbon monoxide and oxides of nitrogen) of emissions from three Norton AFB boilers was conducted on 17-29 April 1989. Testing was performed to determine compliance with regards to the newly adopted Rule #1146 of the South Coast Air Quality Management District. In anticipation of further regulation, particulate emissions were also determined. Results show that none of the boiler emissions meet the 40 ppm limit for oxides of nitrogen but all meet the 400 ppm limit for carbon monoxide emissions.					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL C. Attebery, 1Lt, USAF, BSC			22b. TELEPHONE (Include Area Code) (512) 536-3305		22c. OFFICE SYMBOL AFOEHL/EQE

DD Form 1473, JUN 86

Previous editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

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I. INTRODUCTION

On 17-29 April 1989, compliance emission testing for carbon monoxide (CO), oxides of nitrogen (NO_x) and particulate emissions was conducted at Norton AFB on three boilers by personnel of the Air Quality Function of the Air Force Occupational and Environmental Health Laboratory (AFOEHL). This survey was requested by USAF Clinic Norton/SGPB through HQ MAC/SGPB to determine compliance status with regards to newly adopted Rule #1146 of the South Coast Air Quality Management District (SCAQMD). Personnel involved with on-site testing are listed in Appendix A. SCAQMD Rule #1146 is presented in Appendix B.

II. DISCUSSION

A. Background

On 25 Oct 1988 Norton AFB requested that the AFOEHL determine the carbon monoxide and oxides of nitrogen emission compliance status of three boilers with respect to the newly adopted Rule #1146. In order to maximize the benefit of our visit, we were also tasked to determine the particulate emissions in anticipation of further regulation. The boilers in buildings 249 and 672 were each tested once. Boiler number 4 in building 716 was tested twice utilizing natural gas and then diesel #2 as fuels.

To demonstrate and maintain compliance with SCAQMD Rule #1146, Norton AFB requested AFOEHL assistance to: (1) determine carbon monoxide emissions from each boiler as specified in 40 CFR 60, Appendix A, Reference Method 10, and (2) determine the oxides of nitrogen emissions from each boiler as specified in 40 CFR 60, Appendix A, Reference Method 7, and for additional information (3) determine particulate emissions from each boiler as specified in 40 CFR 60, Appendix A, Reference Methods 1-5.

B. Site Description

A total of three boilers were tested for compliance status with regards to SCAQMD Rule #1146 (Table 1):

Table 1. Boiler Information

Boiler No./ Manufacturer	Fuel	Size
Bldg 672 #1 Ajax Boiler Co.	Natural Gas	5-10 million BTU/hr
Bldg 249 #1/ Kewanee Scotch Generator	Natural Gas	5-10 million BTU/hr
Bldg 716 #4/ Erie City Iron Works	Natural Gas or Oil	> 10 million BTU/hr

The water jacket type boilers are used intermittently, depending on demand, to produce steam and water. Steam/hot water had to be vented/discharged from the boilers during the tests to maintain constant operation. Sampling ports were installed prior to the arrival of the survey team.

Boiler No. 1, located in building 672 (Figure 1), produces hot water for an adjacent aircraft washrack. Since the boiler works on an intermittent demand schedule, hot water had to be continuously discharged through the washrack to maintain uninterrupted high-fire operation while testing was in progress. Sampling ports were located approximately 0.5 stack diameters upstream of the stack outlet and 4 stack diameters downstream of the boiler.

Boiler No. 1, located in building 249 (Figure 2), produces steam for the Photo Processing Lab complex. Since this boiler also works on an intermittent demand schedule, steam had to be continuously vented through safety valves to maintain uninterrupted high-fire operation while testing was in progress. Sampling ports were located approximately 6 stack diameters upstream of the stack outlet and 2 stack diameters downstream of the nearest airflow obstruction.

Boiler No. 4, located in building 716, produces hot water for much of the main base. Since this boiler also works on an intermittent demand schedule, steam had to be continuously vented through safety valves to maintain uninterrupted high-fire operation while testing was in progress. Sampling ports were located approximately 2 stack diameters upstream of the stack outlet and 3 stack diameters downstream of the nearest airflow obstruction. This boiler was tested twice utilizing different fuels: natural gas and fuel oil. Natural gas is the normal fuel, however, fuel oil is available as a backup.

Gaseous discharge from building 716 boiler No. 4 stack was found to have cyclonical flow with an average rotation angle of 21.6 degrees. Since applicable test methods require that the rotation angle be 20 degrees or less, this condition had to be corrected by installing temporary straighteners before testing could be conducted. Straighteners made from sheet metal were fashioned and installed by Mr Frank Sage and his crew. After modification the average rotation angle was found to be in compliance with the test method criteria.

C. Applicable Limits

The limits identified in SCAQMD Rule #1146 along with the applicable compliance dates are presented in Table 2.



Figure 1. Boiler Stack During Testing, Bldg 672

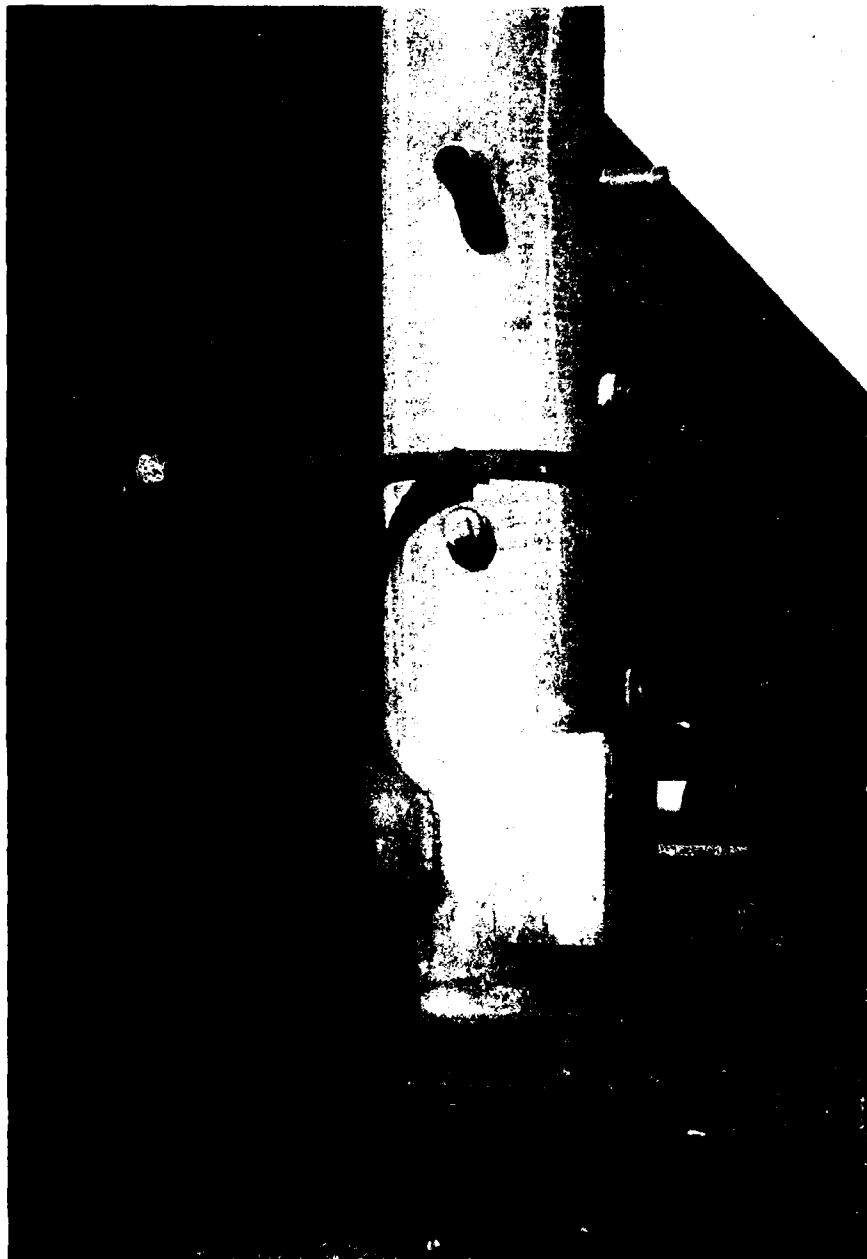


Figure 2. Boiler Stack, Bldg 249

Table 2. SCAQMD Rule #1146 Standards

Boiler	Applicable Standard	Compliance Date
Bldg 672 #1	NO _x - 40 ppm CO - 400 ppm	1 Mar 92
Bldg 249 #1	NO _x - 40 ppm CO - 400 ppm	1 Mar 92
Bldg 716 #4	NO _x - 40 ppm CO - 400 ppm	1 Sep 91

D. Sampling Methods and Procedures

The SCAQMD Rule #1146 requires that all emissions tests be conducted in accordance with the procedures and analytical methods specified in 40 CFR 60, Appendix A, Methods 1-5, 7 and 10. Therefore, test methods, equipment, sample train preparation, sampling and recovery, calibration requirements, and quality assurance were done in accordance with the methods and procedures outlined in 40 CFR 60, Appendix A.

The boiler exhaust stack, in each of the three cases, was a straight duct. Sampling ports were already in place and met the minimum standards for method 1. Based on the port location, stack diameter and type of sample (particulate), a maximum of 24 traverse points were used for each emission evaluation.

Particulate samples were collected using the sampling train shown in Figure 3. The train consisted of a buttonhook probe nozzle, heated inconel probe, heated glass filter, impingers, and pumping and metering device. The nozzle was sized prior to each test so that the gas stream could be sampled isokinetically; in other words, the velocity of the gas at the nozzle tip was the same as the stack gas velocity at each point sampled. Flue gas velocity pressure was measured at the nozzle tip, using a Type-S pitot tube connected to a 10-inch inclined-vertical manometer.

Type K thermocouples were used to measure flue gas and sampling train temperatures. The probe and filter were heated to minimize moisture condensation. The heated filter was used to collect particulate material. The impinger train (first, third, and fourth impingers were modified Greenburg-Smith type; the second impinger was a standard Greenburg-Smith design) acted as a condenser to collect stack gas moisture. The pumping and metering system was used to control and monitor the flue gas flow rate as well as the sampling rate.

Each sampling run lasted 60 minutes; therefore, the sampling time for each of the 24 traverse points was 2.5 minutes. These sample times were applicable for all runs. All runs were within the required isokinetic rate.

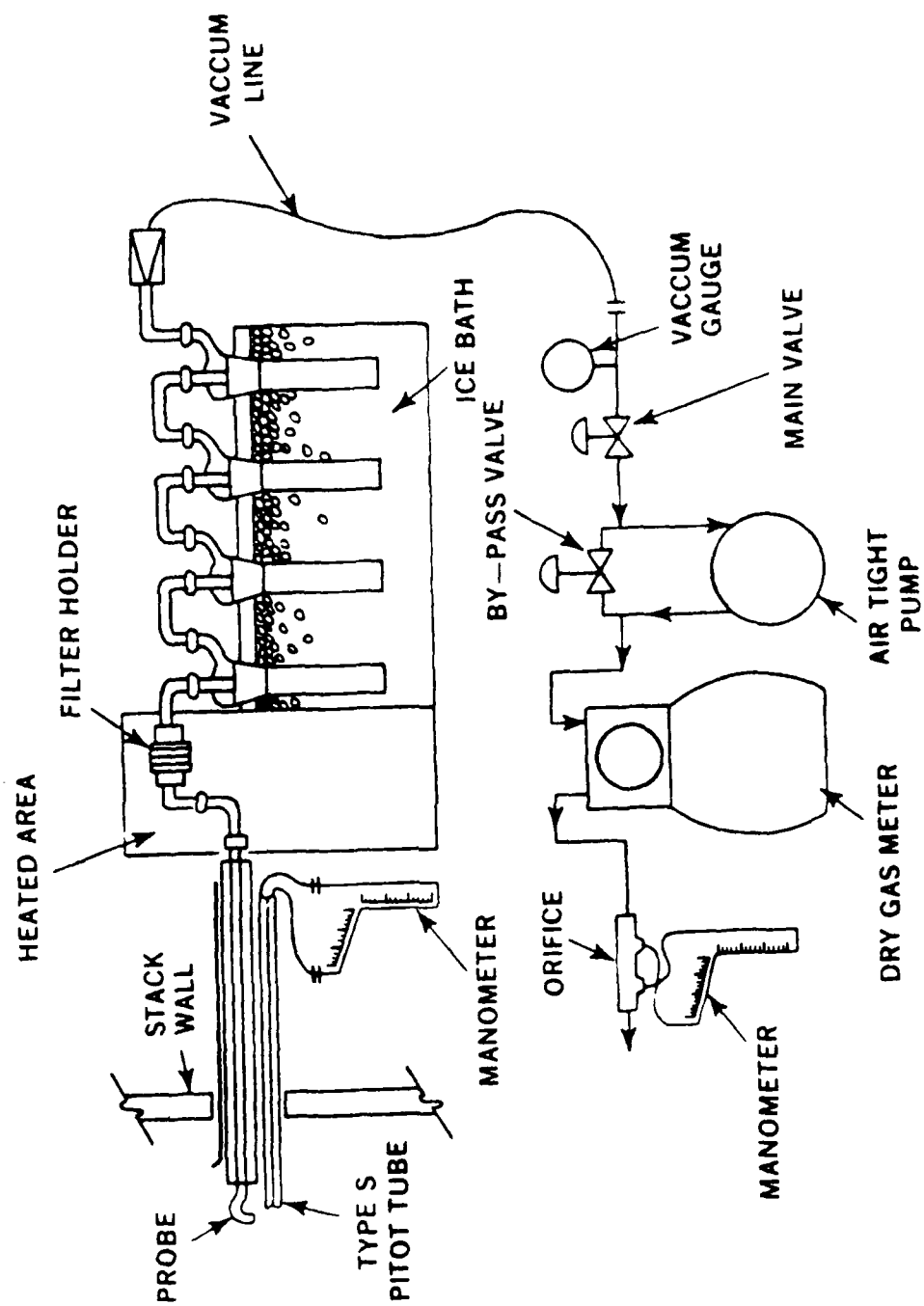


Figure 3. Particulate Sampling Train

Prior to each sample run on a stack, a preliminary velocity pressure traverse was accomplished and cyclonic flow was determined. For acceptable flow conditions to exist in a stack, the average of the absolute value of the flow angle (cyclonicity) taken at each traverse point must be less than or equal to 20 degrees. The flow angle for the boilers located in buildings 672, 249 and 716 were 7.6, 5.4, and 6.5 (after modification), respectively.

During each sample run, a flue gas grab sample for ORSAT analysis (measures oxygen and carbon dioxide for stack gas molecular weight determination and emissions correction) was taken. ORSAT sampling and analysis equipment are shown in Figures 4 and 5. Flue gas moisture content, also needed for determination of gas molecular weight, was obtained during particulate sampling.

Emission calculations were done using "Source Test Calculation and Check Programs for Hewlett-Packard 41 Calculators" (EPA-340/1-85-018) developed by the EPA Office of Air Quality Planning and Standards, Research Triangle Park NC. This is our standard method for calculating emissions data. Calibration data are presented in Appendix I.

Oxides of nitrogen samples were collected using the sampling train shown in Figure 6. The train consisted of a glass probe packed with glass wool and wrapped with a heating system, T-bore stopcocks, 2-Liter flask, vacuum gauge, squeeze bulb, and evacuation pump. The sample is removed by a grab sampling technique. It is captured in a 2-Liter flask which has been evacuated and contains an absorbing solution of hydrogen peroxide and sulfuric acid. The absorbing solution converts the NO_x (except nitrous oxide (N_2O)) in the captured gas to nitric acid (HNO_3) in solution. NO_x sampling was conducted concurrently with particulate sampling. Type K thermocouples were used to measure the sample temperature. Calibration Data are presented in Appendix I.

Carbon monoxide samples were collected using the sampling train shown in Figure 7. The train consisted of a stainless steel sample probe packed with glass wool, a condenser, a rotometer, a sample bag, an evacuation container and evacuation pump. An integrated sample was collected by evacuating the evacuation container, which caused a negative pressure, pulling a sample into the sample bag. The rate of flow into the sample bag was monitored and adjusted (using the evacuation pump) to remain proportional to the stack flowrate. Prior to connecting the sample bag to the probe, the probe was purged with stack gases. Calibration data are presented in Appendix I.

III. CONCLUSIONS

1. Particulate Emission Rate (EPA Method 5)

Table 3 provides the particulate emission rates determined from these tests. Results indicate the three runs conducted on boiler 716/4 utilizing fuel oil emitted approximately five times the particulates generated by the three runs which used natural gas. However, the emission levels for all the tests were low and should not cause the base any problems. Calculations for particulate emissions are presented in Appendix H.

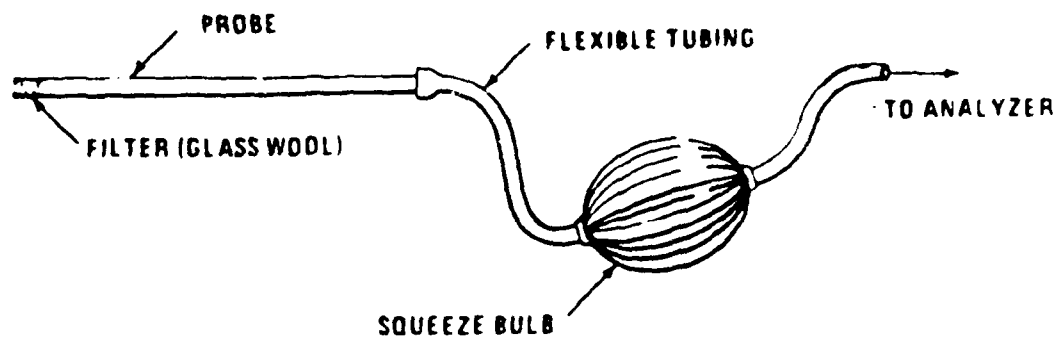


Figure 4. ORSAT Grab Sampling Train

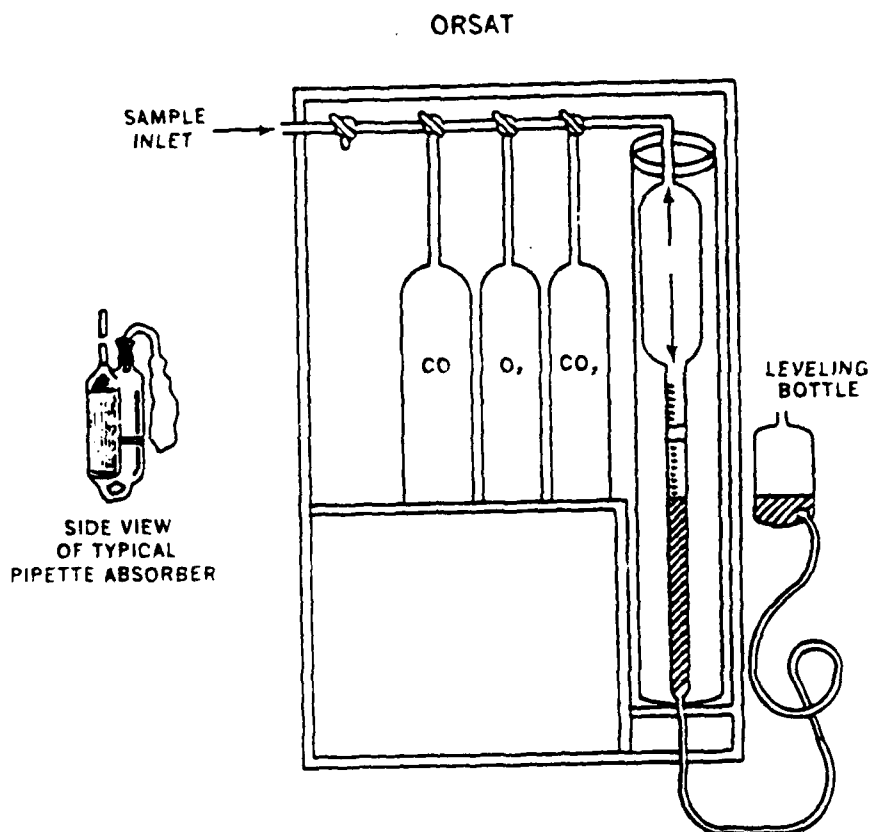


Figure 5. ORSAT Apparatus

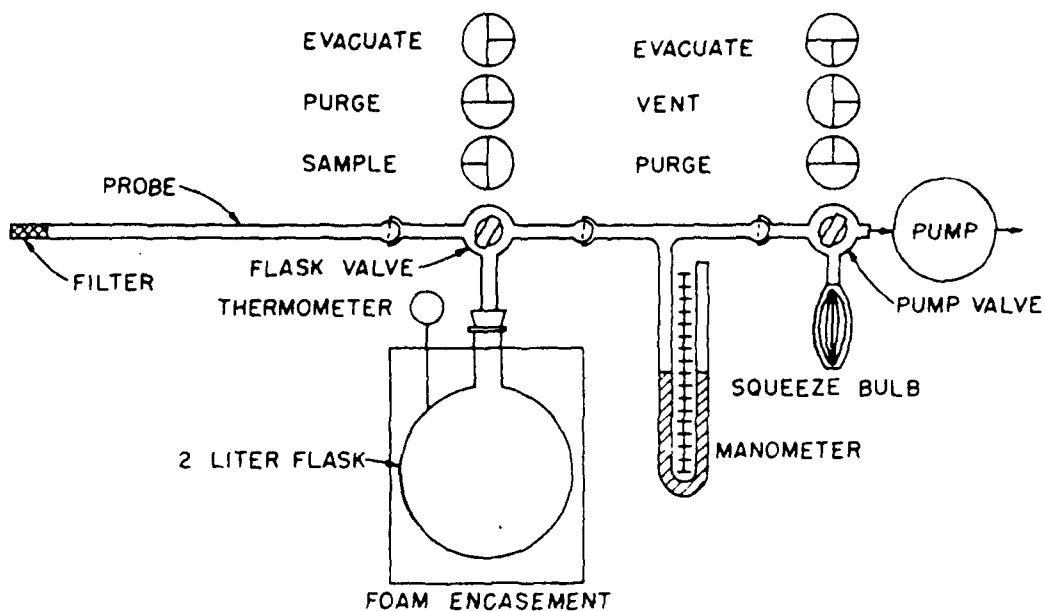


Figure 6. Sampling Train for Oxides of Nitrogen

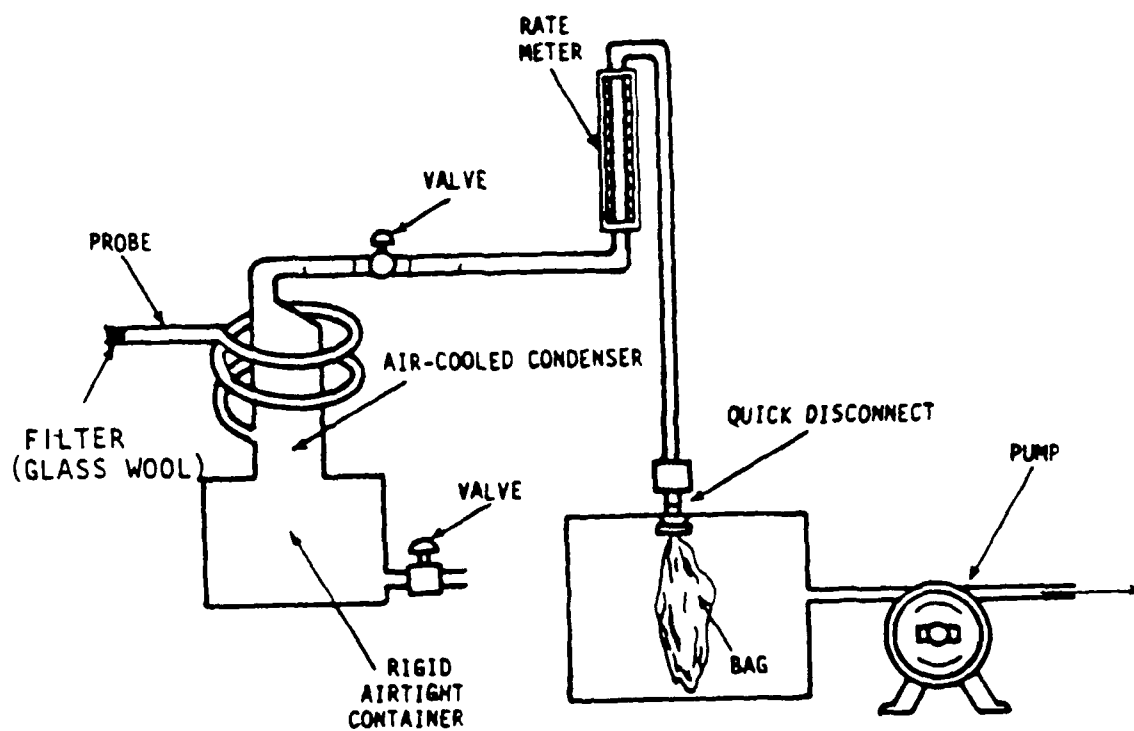


Figure 7. Carbon Monoxide Sampling Train

Table 3. Stack Emission Particulate Test Results

Date	Boiler No.	Run No.	(gr/dscf)	Particulate (mg/m ³)	Emissions (lb/hr)	(kg/hr)
19 APR 89	672/1	1	3.2998E-6	0.0076	0.0001	2.5454E-5
20 APR 89	672/1	2	2.1580E-6	0.0049	3.4479E-5	1.5640E-5
20 APR 89	672/1	3	2.2852E-6	0.0052	3.5101E-5	1.5922E-5
Average of Runs 1,2,3			2.5810E-6	0.0059	5.6526E-5	1.9005E-5
24 APR 89	249/1	1	2.3241E-6	0.0053	3.3506E-5	1.5198E-5
24 APR 89	249/1	2	1.6322E-6	0.0037	2.2426E-5	1.0172E-5
24 APR 89	249/1	3	1.5729E-6	0.0036	2.1450E-5	9.7296E-6
Average of Runs 1,2,3			1.8431E-6	0.0042	2.5794E-5	1.1700E-5
27 APR 89	716/4 ¹	1	4.5218E-6	0.0103	0.0002	0.0001
27 APR 89	716/4 ¹	2	2.7274E-6	0.0062	0.0001	0.0001
27 APR 89	716/4 ¹	3	2.8044E-6	0.0064	0.0001	0.0001
Average of Runs 1,2,3			3.3512E-6	0.0076	0.0001	0.0001
28 APR 89	716/4 ²	1	1.6523E-5	0.0378	0.0007	0.0003
28 APR 89	716/4 ²	2	1.7848E-5	0.0408	0.0008	0.0004
28 APR 89	716/4 ²	3	1.6095E-5	0.0368	0.0007	0.0003
Average of Runs 1,2,3			1.6822E-5	0.0385	0.0007	0.0003

Note: gr/dscf = grains per dry standard cubic foot
 mg/m³ = milligrams per cubic meter
 lb/hr = pounds per hour
 kg/hr = kilograms per hour
 1 = natural gas burned as fuel
 2 = diesel fuel #2 burned as fuel

2. Carbon Monoxide (EPA Method 10)

Table 4 provides the carbon monoxide emission concentrations determined from these tests. Results indicate that carbon monoxide emissions from the third run conducted on boiler 716/4 (utilizing natural gas as a fuel) did not meet the limit of 400 ppm. However, this is of little consequence since the average of three runs constitutes one test. The average of the three runs, 197.72 ppm, was well below the standard. All other boiler emissions were found to be well below the SCAQMD Rule #1146 limit of 400 ppm. Calculations for carbon monoxide emissions are presented in Appendix H.

Table 4. Stack Emission Carbon Monoxide Test Results

Date	Boiler No.	Run No.	Concentration CO ₂ (percent)	Conc. CO (ppm)	Conc. Corrected CO (ppm)	Average
19 Apr	672/1	1	4.3	10	9.57	
20 Apr	672/1	2	7.0	10	9.30	
20 Apr	672/1	3	7.0	10	9.30	9.39
24 Apr	249/1	1	6.0	<10	<9.40	
24 Apr	249/1	2	5.2	<10	<9.48	
24 Apr	249/1	3	5.6	<10	<9.44	9.44
27 Apr	716/4 ¹	1	9.0	65	59.15	
27 Apr	716/4 ¹	2	7.0	10	9.31	
27 Apr	716/4 ¹	3	9.0	570	518.70	195.72
28 Apr	716/4 ²	1	10.4	<10	<8.96	
28 Apr	716/4 ²	2	10.0	<10	<9.00	
28 Apr	716/4 ²	3	9.0	<10	<9.10	9.02

note: 1 = natural gas burned as fuel
 2 = diesel fuel #2 burned as fuel

3. Oxides of Nitrogen (EPA Method 7)

Table 5 provides the oxides of nitrogen emission concentrations determined from these tests. Results show that emissions from all boilers tested do not meet the SCAQMD Rule #1146 limit of 40 ppm. Further, the burning of diesel fuel #2 in boiler 716 produced 83 percent more NO_x than the burning of natural gas. Conditions which favor NO_x formation are high flame temperature, long residence time and excess oxygen. Calculations for oxides of nitrogen emissions are presented in Appendix H.

Two methods of reducing NO_x emissions are to change fuels and/or modify the combustion system. As can be seen in Table 5, gas combustion produces the least NO_x emissions. An obvious combustion modification for NO_x control is to reduce excess air. This will reduce NO_x formation from nitrogen found in the air. Reducing combustion temperature will lower NO_x formation from nitrogen found in the fuel itself. Reduction of combustion temperature can be accomplished by: (1) eliminating "hot spots" in the combustion gases where rapid mixing of fuels and air occur; (2) reducing rate of combustion by reducing fuel rate or load; and, (3) recirculating flue gas (acts as heat sink to reduce temperature). Although this may cause effluent CO concentration levels to rise, the initial CO concentrations (10-200 ppm) are low compared to the standard (400 ppm).

Table 5. Stack Emission NO_x Test Results

Date	Boiler No.	Run No.	Concentration NO _x (ppm)	Average Concentration
19 Apr	672/1	1	45	
20 Apr	672/1	2	42	
20 Apr	672/1	3	41	43
24 Apr	249/1	1	38	
24 Apr	249/1	2	41	
24 Apr	249/1	3	45	41
27 Apr	716/4 ¹	1	75	
27 Apr	716/4 ¹	2	56	
27 Apr	716/4 ¹	3	53	62
28 Apr	716/4 ²	1	113	
28 Apr	716/4 ²	2	107	
28 Apr	716/4 ²	3	110	110

note: 1 = natural gas used as fuel
 2 = diesel fuel #2 burned as fuel

IV. RECOMMENDATIONS

We recommend that each boiler be retested with the operational parameters such as flame temperature and excess oxygen decreased to retard NO_x formation.

References

1. "Standards of Performance for New Stationary Sources," Title 40, Part 60, Code of Federal Regulations, July 1, 1987.
2. Quality Assurance Handbook for Air Pollution Measurement Systems - Volume III, Stationary Source Specific Methods, U.S. Environmental Protection Agency, EPA-600/4-77-027-b, Research Triangle Park, North Carolina, December 1984.
3. Source Test Calculation and Check Programs for Hewlett-Packard 41 Calculators. U.S. Environmental Protection Agency, EPA-340/1-85-018, Research Triangle Park, North Carolina, May 1987.
4. Brenchly, D.L., et al, "Industrial Source Sampling," Ann Arbor Science Publishers Co., Ann Arbor, Michigan, 1973.

APPENDIX A
PERSONNEL INFORMATION

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List of TDY Personnel

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1Lt Charles W. Attebery, Consultant Environmental Quality
1Lt Ali Y. Ali, Consultant, Industrial Hygiene
Sgt Robert P. Davis, Technician, Environmental Quality
Sgt Harrold D. Casey, Technician, Environmental Quality

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2Lt Krista Wenzel, USAF Clinic/SGPB
Mr Frank Sage, 63 CES/DEMUH

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APPENDIX B
South Coast Air Quality Management
District Rule No. 1146

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(Adopted September 9, 1988)

RULE 1146. EMISSIONS OF OXIDES OF NITROGEN FROM INDUSTRIAL, INSTITUTIONAL AND COMMERCIAL BOILERS, STEAM GENERATORS, AND PROCESS HEATERS

(a) Definitions

- (1) Annual Heat Input means the actual amount of heat released by fuels burned in a unit during a calendar year.
- (2) Boiler or Steam Generator means any combustion equipment fired with liquid and/or gaseous fuel and used to produce steam or to heat water and that is not used exclusively to produce electricity for sale. Boiler or Steam Generator does not include any waste heat recovery boiler that is used to recover sensible heat from the exhaust of a combustion turbine or any unfired waste heat recovery boiler that is used to recover sensible heat from the exhaust of any combustion equipment.
- (3) BTU means British thermal unit.
- (4) Heat Input means the chemical heat released due to fuel combustion in a unit, using the higher heating value of the fuel. This does not include the sensible heat of incoming combustion air.
- (5) NO_x Emissions means the sum of nitric oxides and nitrogen dioxide in the flue gas, collectively expressed as nitrogen dioxide and averaged over a period of 15 minutes.
- (6) Process Heater means any combustion equipment fired with liquid and/or gaseous fuel and which transfers heat from combustion gases to water or process streams. Process Heater does not include any kiln or oven used for drying, baking, cooking, calcining, or vitrifying; or any unfired waste heat recovery heater that is used to recover sensible heat from the exhaust of any combustion equipment.
- (7) Rated Heat Input Capacity means the heat input capacity specified on the nameplate of the combustion unit. If the combustion unit has been altered or modified such that its maximum heat input is different than the heat input capacity specified on the nameplate, the new maximum heat input shall be considered as the rated heat input capacity.
- (8) Therm means 100,000 Btu's.

- (9) Unit means any boiler, steam generator, or process heater as defined in subparagraph (2) or (6) of this paragraph.

(b) Applicability

With the exception of boilers used by electric utilities to generate electricity, and boilers and process heaters with a rated heat input greater than 40 million Btu per hour that are used in petroleum refineries, this rule applies to boilers, steam generators, and process heaters used in all industrial, institutional, and commercial operations.

(c) Requirements

- (1) The owner or operator of any unit(s) shall not discharge into the atmosphere oxides of nitrogen, expressed as nitrogen dioxide (NO₂), in excess of the concentrations shown in the following table.

Rated Heat Input Capacity	Annual Heat Input	Gaseous or Liquid Fuels
Equal to or greater than 5 million Btu's per hour	And	Greater than 9 x 10 ⁹ Btu's per yr (90,000 Therms)
		40 ppm (0.05 lb per 106 Btu's of heat input)

Carbon monoxide (CO) emissions from unit(s) subject to this subparagraph shall not exceed 400 ppm.

- (2) Any unit(s) with a rated heat input capacity greater than or equal to 5 million Btu per hour and an annual heat input less than or equal to 9.0 x 10⁹ Btu per year shall:
- (A) be operated in a manner that maintains stack gas oxygen concentrations at less than or equal to 3 percent on a dry basis for any 15-consecutive-minute averaging period; or
 - (B) be operated with a stack gas oxygen trim system; or
 - (C) be tuned at least twice per year, once during the Spring and once during the Autumn, by a technician who is qualified, to the

satisfaction of the Executive Officer, to perform a tune-up in accordance with the procedure described in Attachment 1. The owner or operator of any unit(s) who specifies the semi-annual tune-up option shall submit an annual report verifying that the tune-up has been performed. The report shall contain any other information or documentation that the Executive Officer determines to be necessary; or

- (D) be operated in compliance with the applicable emission levels specified in subparagraph (c)(1).
- (3) The owner or operator of any unit(s) subject to subparagraph (c)(2) shall submit for the approval of the Executive Officer a plan that demonstrates compliance with subparagraph (c)(2). Such plan shall contain:
 - (A) A list of all units with the rated heat input capacity and anticipated annual heat input.
 - (B) For each unit listed, a selection of one of the four options specified in subparagraph (c)(2) to achieve compliance with this rule.
- (4) Any unit(s) with a rated heat input capacity greater than or equal to 40 million Btu per hour and an annual heat input greater than 200×10^9 Btu per year, or any units that are part of an Alternative Emission Control Plan, shall have a continuous in-stack nitrogen oxides monitor or equivalent verification system as approved by the Executive Officer. Records shall be maintained and made accessible for a period of two years in a form and manner as specified by the Executive Officer.
- (d) Alternative Emission Control Plan
 - (1) An owner or operator may achieve compliance with paragraph (c) by achieving equivalent nitrogen oxides emissions reductions obtained by alternative control methods provided the applicant submits an Alternative Emission Control Plan that is enforceable by the District and receives approval of the Plan in writing from the Executive Officer prior to implementation. The Alternative Emission Control Plan shall:
 - (A) Contain, as a minimum, all data, records, and other information necessary to determine eligibility for alternative emission control, including but not limited to:



- (i) A list of equipment subject to alternative emission control;
 - (ii) Daily hours of utilization for applicable equipment;
 - (iii) Estimated emission of nitrogen oxides for each operation;
 - (iv) Rated capacity; and
 - (v) Historical and projected fuel use.
- (B) Present the methodology for estimation of equivalency of emission reductions under the proposed Alternative Emission Control Plan as compared to either the emission reductions otherwise required by the rule or to actual emissions, whichever is less.
- (C) Demonstrate that the permit units subject to the specified rule emission limitations are in compliance with or on an approved schedule for compliance with all applicable District rules.

(2) Revision of Control Plan

A revised control plan may be submitted by the owner or operator, along with any required permit applications. Such a plan shall adhere to the emissions limits and the final compliance dates of this rule. New units, including functionally identical replacement units, shall not be incorporated into the plan.

(e) Exemptions

- (1) To qualify for an exemption from the provisions of subparagraph (c)(1), based on annual heat input, the owner or operator of any unit(s) shall:
- (A) install by February 1, 1989 or at the time the unit is constructed, a totalizing meter for each fuel that demonstrates that the unit(s) operated at or below the applicable heat input levels; and
 - (B) have available for inspection by the Executive Officer by March 1, 1989, and March 1, of each year thereafter, annual fuel use data for the preceding calendar year. Records shall be maintained and made accessible to the Executive Officer for a period of two years.
- (2) An exemption granted for any unit will become null and void if that unit operates for one calendar year at an annual heat input greater than the annual applicable heat input levels.

- (3) Sulfur plant reaction boilers are exempt from the provisions of this rule.

(f) Compliance Determination

- (1) An owner or operator of any unit(s) shall have the option of complying with either the pound per million Btu or parts per million emission limits specified in subparagraph (c)(1).
- (2) All emission determinations shall be made in the as-found operating condition, except no compliance determination shall be established during start-up, shutdown, or under breakdown conditions.
- (3) All parts per million emission limits specified in paragraph (c) are referenced at 3 percent volume stack gas oxygen on a dry basis averaged over a minimum of 15 consecutive minutes.
- (4) Compliance with the NOx emission requirements and the stack gas oxygen concentration requirement of paragraph (c) shall be determined in a manner approved by the Executive Officer.

(g) Compliance Schedule

The owner or operator of units subject to this rule shall meet the following increments of progress:

- (1) For owners or operators of units subject to subparagraph (c)(2), submit, by September 1, 1989, a plan pursuant to subparagraph (c)(3) and by March 1, 1990, demonstrate final compliance with subparagraph (c)(2).
- (2) For owners or operators utilizing the Alternative Emission Control Plan, pursuant to paragraph (d), by September 1, 1989, submit a control plan.
- (3) For owners or operators of units with a rated heat input capacity equal to or greater than 10 million Btu per hour that are subject to subparagraph (c)(1), including those with an approved Alternative Emission Control Plan;
 - (A) By March 1, 1990, submit required applications for permits to construct and operate.
 - (B) By September 1, 1991 demonstrate compliance with subparagraph (c)(1) and, if applicable, subparagraph (c)(4).



Rule 1146 (Cont.)

(Adopted September 9, 1988)

- (4) For owners or operators of units with a rated heat input capacity equal to or greater than 5 million Btu per hour, but less than 10 million Btu per hour, that are subject to subparagraph (c)(1):
 - (A) By March 1, 1991, submit required applications for permits to construct and operate.
 - (B) By March 1, 1992, demonstrate compliance with subparagraph (c)(1).

ATTACHMENT 1

Equipment Tuning Procedure¹

Nothing in this Equipment Tuning Procedure shall be construed to require any act or omission that would result in unsafe conditions or would be in violation of any regulation or requirement established by Factory Mutual, Industrial Risk Insurers, National Fire Prevention Association, the California Department of Industrial Relations (Occupational Safety and Health Division), the Federal Occupational Safety and Health Administration, or other relevant regulations and requirements.

1. Operate the unit at the firing rate most typical of normal operation. If the unit experiences significant load variations during normal operation, operate it at its average firing rate.
2. At this firing rate, record stack gas temperature, oxygen concentration, and CO concentration (for gaseous fuels) or smoke-spot number² (for liquid fuels), and observe flame conditions after unit operation stabilizes at the firing rate selected. If the excess oxygen in the stack gas is at the lower end of the range of typical minimum values³, and if CO emissions are low and there is not smoke, the unit is probably operating at near optimum efficiency - at this particular firing rate.

1. This tuning procedure is based on a tune-up procedure developed by KVB, Inc. for the EPA. This procedure is included in Appendix D.

2. The smoke-spot number can be determined with ASTM Test Method D-2156 or with the Bacharach method. ASTM Test Method D-2156 is included in a tuneup kit that can be purchased from the Bacharach Company.

3. Typical minimum oxygen levels for boilers at high firing rates are:

1. For natural gas: 0.5% - 3%
2. For liquid fuels: 2% - 4%



However, complete the remaining portion of this procedure to determine whether still lower oxygen levels are practical.

3. Increase combustion air flow to the furnace until stack gas oxygen levels increase by one to two percent over the level measured in Step 2. As in Step 2, record the stack gas temperature, CO concentration (for gaseous fuels) or smoke-spot number (for liquid fuels), and observe flame conditions for these higher oxygen levels after boiler operation stabilizes.
4. Decrease combustion air flow until the stack gas oxygen concentration is at the level measured in Step 2. From this level gradually reduce the combustion air flow, in small increments. After each increment, record the stack gas temperature, oxygen concentration, CO concentration (for gaseous fuels) and smoke-spot number (for liquid fuels). Also observe the flame and record any changes in its condition.
5. Continue to reduce combustion air flow stepwise, until one of these limits is reached:
 - a. Unacceptable flame conditions - such as flame impingement on furnace walls or burner parts, excessive flame carryover, or flame instability.
 - b. Stack gas CO concentrations greater than 400 ppm.
 - c. Smoking at the stack.
 - d. Equipment-related limitations - such as low windbox/furnace pressure differential, built in air-flow limits, etc.
6. Develop an O₂/CO curve (for gaseous fuels) or O₂/smoke curve (for liquid fuels) similar to those shown in Figures 1 and 2 using the excess oxygen and CO or smoke-spot number data obtained at each combustion air flow setting.
7. From the curves prepared in Step 6, find the stack gas oxygen levels where the CO emissions or smoke-spot number equal the following values:

<u>Fuel</u>	<u>Measurement</u>	<u>Value</u>
Gaseous	CO Emissions	400 ppm
#1 and #2 oils	smoke-spot number	number 1
#4 oil	smoke-spot number	number 2
#5 oil	smoke-spot number	number 3
Other oils	smoke-spot number	number 4



The above conditions are referred to as the CO or smoke thresholds, or as the minimum excess oxygen level.

Compare this minimum value of excess oxygen to the expected value provided by the combustion unit manufacturer. If the minimum level found is substantially higher than the value provided by the combustion unit manufacturer, burner adjustments can probably be made to improve fuel and air mixing, thereby allowing operation with less air.

8. Add 0.5 to 2.0 percent of the minimum excess oxygen level found in Step 7 and reset burner controls to operate automatically at this higher stack gas oxygen level. This margin above the minimum oxygen level accounts for fuel variations, variations in atmospheric conditions, load changes, and nonrepeatability or play in automatic controls.
9. If the load of the combustion unit varies significantly during normal operation, repeat Steps 1-8 for firing rates that represent the upper and lower limits of the range of the load. Because control adjustments at one firing rate may affect conditions at other firing rates, it may not be possible to establish the optimum excess oxygen level at all firing rates. If this is the case, choose the burner control settings that give best performance over the range of firing rates. If one firing rate predominates, settings should optimize conditions at that rate.
10. Verify that the new settings can accommodate the sudden load changes that may occur in daily operation without adverse effects. Do this by increasing and decreasing load rapidly while observing the flame and stack. If any of the conditions in Step 5 result, reset the combustion controls to provide a lightly higher level of excess oxygen at the affected firing rates. Next, verify these new settings in a similar fashion. Then make sure that the final control settings are recorded at steady-state operating conditions for future reference.

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APPENDIX C
BUILDING 672 BOILER 1 FIELD DATA

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DETERMINATION OF MINIMUM NUMBER OF TRAVERSE POINTS

Stack ID: Bld 672 #1 Stack diameter at ports: 2 (ft)

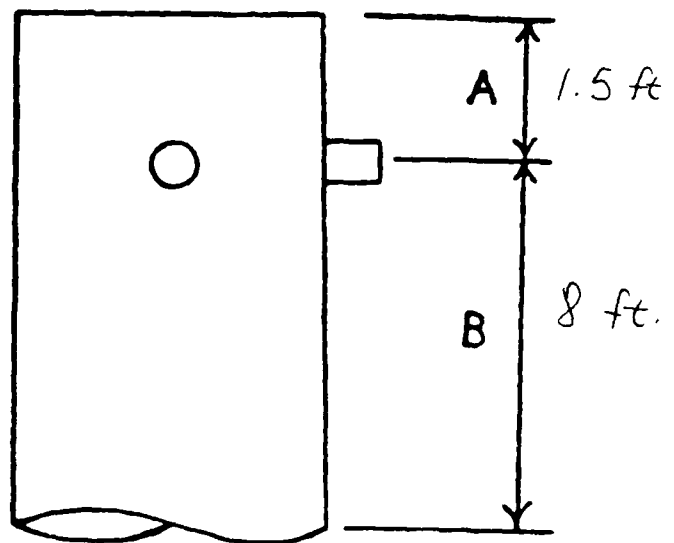
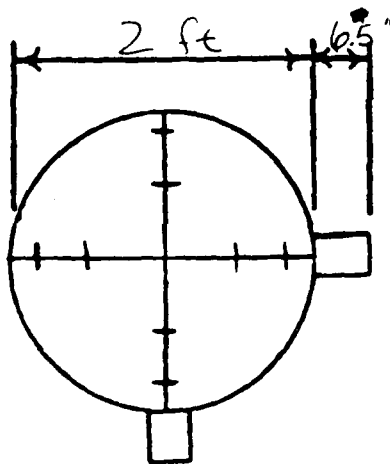
Distance A (ft) 1.5 (duct diameters) 0.75

Recommended number of traverse points as determined by
distance A: 24

Distance B (ft) 8 (duct diameters) 4

Recommended number of traverse points as determined by
distance B: 24

Number of traverse points used: 24



PRELIMINARY SURVEY DATA SHEET NO. 2
(Velocity and Temperature Traverse)

BASE

Norton AFB

DATE _____

19 APR 89

BOILER NUMBER

bld 672

INSIDE STACK DIAMETER

24"

Inches

STATION PRESSURE

28.73

In Hg

STACK STATIC PRESSURE

11

In H₂O

SAMPLING TEAM

CEHL

TRAVERSE POINT NUMBER	VELOCITY HEAD, V_p IN H ₂ O	α ~~DATA~~	STACK TEMPERATURE (°F)
1	.075	~~2~~	243
2	.08	~~10~~	335
3	.08	~~14~~	400
4	.08	~~16~~	412
5	.08	~~10~~	421
6	.08	~~13~~	424
7	.085	~~2~~	427
8	.085	~~7~~	429
9	.09	~~5~~	428
10	.09	~~4~~	428
11	.09	~~4~~	427
12	.08	~~4~~	427
		~~26~~	
	STATIC H ₂ O	(4) .11	
	$\Delta p = .08$		
	$\overline{FPS} = 21$		
	$\overline{T} = 400$		
	NOTED:	.4512 $\rightarrow$ $\alpha \times .497$	
	AVERAGE		

PRELIMINARY SURVEY DATA SHEET NO. 1
(Stack Geometry)

BASE NORTON	PLANT BLDG 672 HOT WATER BOILER
DATE 19 APR 89	SAMPLING TEAM CEHL

SOURCE TYPE AND MAKE	
SOURCE NUMBER BOILER, BLDG 672	INSIDE STACK DIAMETER 24 Inches
RELATED CAPACITY	TYPE FUEL NATURAL GAS

DISTANCE FROM OUTSIDE OF NIPPLE TO INSIDE DIAMETER 6 1/2" Inches	
NUMBER OF TRAVERSES 2	NUMBER OF POINTS/TRAVERSE 12

LOCATION OF SAMPLING POINTS ALONG TRAVERSE

POINT	PERCENT OF DIAMETER	DISTANCE FROM INSIDE WALL (Inches)	TOTAL DISTANCE FROM OUTSIDE OF NIPPLE TO SAMPLING POINT (Inches)
1		0.5	7.0
2		1.6	8.1
3		2.8	9.3
4		4.3	10.8
5		6.0	12.5
6		8.5	15.0
7		15.5	22.0
8		18.0	24.5
9		19.7	26.2
10		21.2	27.7
11		22.4	28.9
12		23.5	30.0

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER 1		DATE 19 Apr 87		FLANT bld 612		BASE Norted		SAMPLE BOX NUMBER Natick 2		METER BOX NUMBER Natick 2		Q _{avg} /Q _m		C _p		DRY GAS FRACTION (F _d)	
SCHEMATIC OF STACK CROSS SECTION														EQUATIONS			
														$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
$\Delta R = \Delta T + 460$														$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H ₂ O)	STACK TEMP		VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (in)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP			SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
			(°F)	(°F)				IN (°F)	AVG (T _m) (°F)	OUT (°F)		
1	0	4.1	250		.05	2.60	446.420	112		106	245	113
2	2.5	4.1	376		.06	2.74		110		105	244	89
3	5.0	4.2	379		.065	2.76		114		107	245	72
4	7.5	4.2	404		.065	2.78		118		107	245	74
5	10.0	4.2	413		.065	2.76		118		108	245	98
6	12.5	4.5	420		.07	2.96		119		108	247	101
7	15.0	4.5	422		.075	3.16		119		108	246	103
8	17.5	5.0	422		.08	3.38		120		109	246	103
9	20.0	5.0	421		.08	3.38		120		110	245	105
10	22.5	5.0	420		.075	3.18		120		110	247	106
11	25.0	5.0	421		.075	3.18		121		111	247	106
12	27.5	5.0	423		.075	3.17	444.904	121		111	247	106
13	30.0 (2000)											
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RUN #

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE <i>Norton</i>	DATE <i>19 April 89</i>	RUN NUMBER <i>1</i>
-----------------------	----------------------------	------------------------

BUILDING NUMBER <i>BLDG 672</i>	SOURCE NUMBER <i>HOT WATER BOILER GAS-MIXED</i>
------------------------------------	--

I. PARTICULATES			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	<i>.2890</i>	<i>0.2885</i>	<i>0.0005</i>
ACETONE WASHINGS (Probe, Front Half Filter)	<i>97.8320</i>	<i>97.8216</i>	<i>0.0104</i>
BACK HALF (if needed)	<i>Ø</i>	<i>Ø</i>	<i>Ø</i>
Total Weight of Particulates Collected			<i>.0109 gm</i>

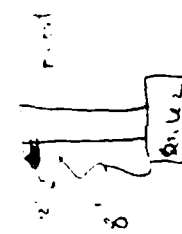
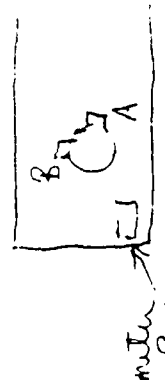
II. WATER			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER [*] (gm)
IMPINGER 1 (H ₂ O)	<i>234</i>	<i>200</i>	<i>34</i>
IMPINGER 2 (H ₂ O)	<i>250</i>	<i>200</i>	<i>50</i>
IMPINGER 3 (Dry)	<i>9</i>	<i>0</i>	<i>9</i>
IMPINGER 4 (Silica Gel)	<i>221.9</i>	<i>200</i>	<i>21.9</i>
Total Weight of Water Collected			<i>114.9 gm</i>

III. GASES (Dry)					
ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO ₂	<i>4.2</i>	<i>4.4</i>	<i>4.2</i>		<i>4.3</i>
VOL % O ₂	<i>13.6</i>	<i>13.8</i>	<i>13.8</i>		<i>13.7</i>
VOL % CO					
VOL % N ₂					

$$\text{Vol \% N}_2 = (100\% - \% \text{CO}_2 - \% \text{O}_2 - \% \text{CO})$$

W. J. R. 4380 1 of 2

WHT- GAS - FIRED				PARTICULATE SAMPLING DATA SHEET			
RUN NUMBER				SCHEMATIC OF STACK CROSS SECTION			
DATE				EQUATIONS			
PLANT				$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
BASE				$0R = 0F + 460$			
SAMPLE BOX NUMBER				$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
METER BOX NUMBER				$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
Qm/Qm				$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
Co				$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
2	20 APR 89	bl'd 672	Norton AFB	$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
1	2.5	3.5	Nuttech 2	$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
2	5.0	4.0	Nuttech 2	$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
3	7.5	4.0	Nuttech 2	$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
4	10.0	4.0	Nuttech 2	$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
5	12.5	4.0	Nuttech 2	$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
6	15.0	4.0	Nuttech 2	$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
7	17.5	4.0	Nuttech 2	$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
8	20.0	4.0	Nuttech 2	$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
9	22.5	4.0	Nuttech 2	$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
10	25.0	4.0	Nuttech 2	$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
11	27.5	4.0	Nuttech 2	$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
12	30.0 (ground)	4.0	Nuttech 2	$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			
Total				$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$			



Start 1230

1300

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OEHL FORM 18
MAY 78

KUN d 17

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE NORTON	DATE 20 APR 89	RUN NUMBER 2
----------------	-------------------	-----------------

BUILDING NUMBER BLDG 672	SOURCE NUMBER BOILER HOT WATER GAS-FIRED
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I. PARTICULATES			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	0.2898	0.2898	Ø
ACETONE WASHINGS (Probe, Front Half Filter)	110.5405	110.5338	0.0067
BACK HALF (if needed)	Ø	Ø	Ø
Total Weight of Particulates Collected			0.0067 gm

II. WATER			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H2O)	223	200	23
IMPINGER 2 (H2O)	247	200	47
IMPINGER 3 (Dry)	19.4	0	19.4
IMPINGER 4 (Silica Gel)	230.7	200	30.7
Total Weight of Water Collected			120.1 gm

III. GASES (Dry)					
ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO ₂	7.0	7.0	7.0		7.0
VOL % O ₂	8.6	8.6	8.6		8.6
VOL % CO					
VOL % N ₂					

$$\text{Vol \% N}_2 = (100 - \% \text{CO}_2 - \% \text{O}_2 - \% \text{CO})$$

1 of 4

NAT. GAS - FIRES		DIN = 1.91		PARTICULATE SAMPLING DATA SHEET	
SCHEMATIC OF STACK CROSS SECTION		EQUATIONS		AMBIENT TEMP	
TRaverse POINT NUMBER	SAMPLING TIME (min)	STACK TEMP (°F)	VELOCITY HEAD (Vp)	GAS METER TEMP (°F)	IMPINGER OUTLET TEMP (°F)
		(°F)	(Vp)	IN (°F)	OUT (°F)
1	0	250	1.05	108	107
2	2.5	310	1.06	107	107
3	5.0	365	1.065	107	107
4	7.5	420	1.055	109	107
5	10.0	430	1.06	112	108
6	12.5	408	1.06	112	107
7	15.0	413	1.06	112	107
8	17.5	419	1.06	114	107
9	20.0	420	1.065	115	108
10	22.5	426	1.065	115	109
11	25.0	424	1.065	117	109
12	27.5	424	1.065	118	110
20.0 (Total)					

Run Number	DATE	PLANT	BASE	SAMPLE BOX NUMBER	METER BOX NUMBER	Co
3	20 APR 87	Mid 672	Norton	Nutcrack 2	Nutcrack 2	

STATION PRESS	HEATER BOX TEMP	PROBE HEATER SETTING	PROBE LENGTH	NOZZLE AREA (in²)	Cp	DRY GAS FRACTION (Fd)
28.73	250	250	48	.499	.84	

$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co} \right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$
 $OR = OF + 460$

pitot tube check - 2080
 probe check @ 15" Hg - 2080
 post check @ 15" Hg - 2080

40

2 of 2

$\text{Total } f_6^3 = 51,383$

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE NORTON		DATE 20 APR 89		RUN NUMBER 3	
BUILDING NUMBER BLDG 762			SOURCE NUMBER BOILER HOT WATER GAS FIRED		
I. PARTICULATES					
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)		
FILTER NUMBER	0.2897	0.2896	0.0001		
ACETONE WASHINGS (Probe, Front Half Filter)	100.1160	100.1093	0.0067		
BACK HALF (If needed)	Ø	Ø	Ø		
			Total Weight of Particulates Collected 0.0068 gm		
II. WATER					
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER [*] (gm)		
IMPINGER 1 (H ₂ O)	211	200	14		
IMPINGER 2 (H ₂ O)	310	200	110		
IMPINGER 3 (Dry)	2	0	2		
IMPINGER 4 (Silica Gel)	213.6	200	13.6		
			Total Weight of Water Collected 139.6 gm		
III. GASES (Dry)					
ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO ₂	7.0	7.0	7.0		7.0
VOL % O ₂	9.0	9.0	9.0		9.0
VOL % CO					
VOL % N ₂					
Vol % N ₂ = (100% - % CO ₂ - % O ₂ - % CO)					

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 19 APR 89
 Sample location BLD 672 RUN 1
 Barometric pressure, mm (in.) Hg 28.73
 Ambient temperature, °F 70 Stack temperature, °F 392
 Initial leak check good Final leak check good
 Operator LT ALI

TRAVERSE Clock time, 24 h POINT	Rotameter setting, l/min (ft ³ /min)	CO conc, ppm (dry basis)	CO ₂ , %	Comments
1	1.0		4.3	
2	1.0			
3	1.0			
4	1.0			
5	1.1			
6	1.1			
7	1.1			
8	1.1			
9	1.1			
10	0.9			
11	1.0			
12	1.0			
13	1.0			
14	1.0			
15	1.0			
16	1.0			
17	1.0			
18	1.0			
19	1.0			
20	1.1			
21	1.1			
22	1.0			
23	1.0			
24	1.0			

Quality Assurance Handbook M10-4.2

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON APB Date 20 APR 89
 Sample location BUD 672 RUN 2
 Barometric pressure, mm (in.) Hg 28.73
 Ambient temperature, ~~°C~~ (°F) 90 Stack temperature, ~~°C~~ (°F) 401
 Initial leak check good Final leak check good
 Operator LT ALI

TRAVERSE Clock Time, 24 h POINT	Rotameter setting, l/min (ft ³ /min)	CO conc, ppm (dry basis)	CO ₂ , %	Comments
1	1.0		7.0	
2	1.0			
3	1.0			
4	1.0			
5	1.0			
6	1.0			
7	1.1			
8	1.1			
9	1.1			
10	1.1			
11	1.2			
12	1.2			
13	1.1			
14	1.2			
15	1.2			
16	1.0			
17	1.1			
18	1.1			
19	1.1			
20	1.1			
21	1.1			
22	1.1			
23	1.1			
24	1.1			

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FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON APL Date 20 APR 89
 Sample location BLD 672 RUN 3
 Barometric pressure, mm (in.) Hg 28.73
 Ambient temperature, °C (°F) 90 Stack temperature, °C (°F) 389
 Initial leak check good Final leak check good
 Operator LT ALI

TRAVERSE Clock time, 24 h POINT	Rotameter setting, l/min (ft ³ /min)	CO conc, ppm (dry basis)	CO ₂ , %	Comments
1	1.0		7.0	
2	1.1			
3	1.1			
4	1.0			
5	1.0			
6	1.0			
7	1.0			
8	1.0			
9	1.1			
10	1.1			
11	1.1			
12	1.1			
13	1.0			
14	1.0			
15	1.0			
16	0.9			
17	0.9			
18	1.0			
19	1.1			
20	1.2			
21	1.2			
22	1.2			
23	1.2			
24	1.2			

Quality Assurance Handbook M10-4.2

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB Heating Plant City
 Sample location Room 673 Date 17 APR 89
 Operator Capt. Langley Barometric pressure (P_{bar}) 30.73 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_f), ml	Initial pressure mm Hg			Initial temperature	
						Leg A.	Leg B.	P_i^*	°F (t_i)	°R (T_i)
1-1	Port B	~~1200~~ 1230	~~1624~~ 335	1	2085			62	165	
1-1	Port B	~~1315~~ 1335	185	2	2054			72	105	
1-2	Port B	1335	185	3	2075			70	117	
1-3	Port A	1405	184	4	2070			60	115	
1-4	Port A	1420	238							

$$^*P_i = P_{bar} - (A_i + B_i)$$

$$^*T_i = t_i + 460^{\circ}\text{F.}$$

Run # 1-1 $\rightarrow$ sample #

NO. Sample Recovery and Integrity Data Form (English units)

Plant Winter AFB Heating Plant Date 20 Apr 84 Bidy 072
 Sample recovery personnel Capt Vandyke Barometric pressure, (P_{bar}) _____ in. Hg
 Person with direct responsibility for recovered samples Capt Vandyke

Sample number	Final Pressure, mm Hg			Final temperature, °R (T _f) ^a		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A ₁	Leg B ₁	P ₁ ^b	°R (T _f)	°R (T _f) ^b				
1-1			682	22		0815	10	✓	
1-2			718	22		0845	10	✓	
1-3			711	22		0900	10	✓	
1-4			682	22		0915	10	✓	

^a P₁ = P_{bar} - (A₁ + B₁)

^b T₁ = t₁ + 460°F

Lab person with direct responsibility for recovered samples _____

Date recovered samples received _____ Analyst _____

All samples identifiable? _____ All liquids at marked level? _____

Remarks _____

Signature of lab sample trustee _____

Quality Assurance Handbook M7-4.2A

1-1
 Run 1-1 Sample #

Run #2

5-01-79

5

Section 3.6.12

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB City Bldg 672
 Sample location 1 Date 20 Apr 88
 Operator _____ Barometric pressure (P_{bar}) 28.73 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature °F	Flask and valve number	Volume of flask and valve (V _{fl}) ml	Initial pressure in Hg		Initial temperature	
						Leg A.	Leg B.	°F (t.)	°R (T _g)
2-1	A	1215	121	5	2090			117	
2-2	A	1255	145	6	2072			117	
2-3	B	1330	122	7	2066			115	
2-4	E	1350	119	8	2070			112	

$^{\circ}P_i = P_{bar} - (A_i + B_i)$

$^{\circ}T_i = t_i + 460^{\circ}F$

2-1
 Run # sample #

NO. Sample Recovery and Integrity Data Form
(English units)

Plant N. to 413 Bldg 672 Date 21 Apr. 87

Sample recovery personnel Capt Vandy Barometric pressure, (P_{bar}) _____ in. Hg

Person with direct responsibility for recovered samples _____

Sample number	Final Pressure, mm. Hg			Final temperature.		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A ₁	Leg B ₁	P_1^a	$9F(t_1)$ °C	$^{\circ}R(t_1)^b$				
2-1			677	21		0930	10	✓	
2-2			685	22		0945	10	✓	
2-3			682	22		0955	10	✓	
2-4			689	22		1005	10	✓	

$$^a P_1 = P_{bar} - (A_1 + B_1)$$

$$^b T_1 = t_1 + 460^{\circ}F$$

Lab person with direct responsibility for recovered samples _____

Date recovered samples received _____ Analyst _____

All samples identifiable? _____ All liquids at marked level? _____

Remarks _____

Signature of lab sample trustee _____

Run # 3

Nitrogen Oxide Field Data Form
(English units)

Plant Wootton AFB Bldg 672 City
 Sample location Date 20 Apr. 87
 Operator Barometric pressure (P_{bar}) 28.73 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V _{fl}), ml	Initial pressure in mm Hg			Initial temperature	
						Leg A.	Leg B.	P.*	°F (t.)	°R (T,) ^b
3-1	P ₀ +B	1440	160	9	2087			59	107	
3-2	P ₀ +B	1455	240	10	2080			72	111	
3-3	P ₀ +A	1520	210	11	2084			71	116	
3-4	P ₀ +A	1535	230	12	2072			72	118	

*P_i = P_{bar} - (A_i + B_i)

^bT_i = t_i + 460°F

NO_x Sample Recovery and Integrity Data Form
(English units)

Plant Aurora AFB Bldg 672 Date 21 Apr 89
 Sample recovery personnel Capt. K. K. K. Barometric pressure, (P_{bar}) _____ in Hg
 Person with direct responsibility for recovered samples _____

Sample number	Final Pressure, mm Hg			Final temperature, °R (T _f) ^a		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A _i	Leg B _i	P _i ^b	°R (T _f)	°R (T _f) ^b				
3-1			670	22		1020	10	✓	
3-2			680	23		1030			
3-3			680	23		1040	10	✓	
3-4			674	23		1050	10	✓	

^a P_i = P_{bar} - (A_i + B_i)

^b T_f = t_f + 460°F

Lab person with direct responsibility for recovered samples _____

Date recovered samples received _____ Analyst _____

All samples identifiable? _____ All liquids at marked level? _____

Remarks _____

Signature of lab sample trustee _____

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APPENDIX D
BUILDING 249 BOILER 1 FIELD DATA

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DETERMINATION OF MINIMUM NUMBER OF TRAVERSE POINTS

Stack ID: Bld 249 #1 Stack diameter at ports: 1.58 (ft)

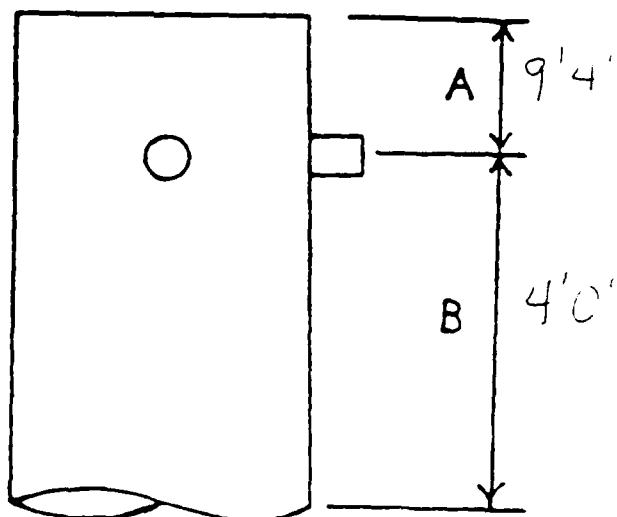
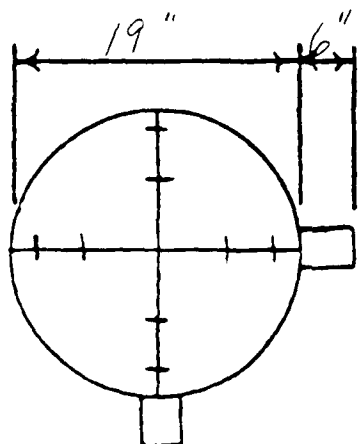
Distance A (ft) 9'4" (duct diameters) 5.9

Recommended number of traverse points as determined by
distance A: 12

Distance B (ft) 4' (duct diameters) 2.5

Recommended number of traverse points as determined by
distance B: 24

Number of traverse points used: 24



PRELIMINARY SURVEY DATA SHEET NO. 1

(Stack Geometry)

ASE Norton AFB	PLANT BLD # 249
ATE 24 APR 89	SAMPLING TEAM
SOURCE TYPE AND MAKE Boiler	
SOURCE NUMBER	INSIDE STACK DIAMETER 19" Inches
RELATED CAPACITY	TYPE FUEL NAT. GAS
DISTANCE FROM OUTSIDE OF NIPPLE TO INSIDE DIAMETER 6" Inches	
NUMBER OF TRAVERSES 2	NUMBER OF POINTS/TRAVERSE 12

LOCATION OF SAMPLING POINTS ALONG TRAVERSE

POINT	PERCENT OF DIAMETER	DISTANCE FROM INSIDE WALL (Inches)	TOTAL DISTANCE FROM OUTSIDE OF NIPPLE TO SAMPLING POINT (Inches)
1			6.5
2			7.3
3			8.2
4			9.4
5			10.8
6			12.8
7			18.2
8			20.3
9			21.6
10			22.8
11			23.7
12			24.5

PRELIMINARY SURVEY DATA SHEET NO. 2
(Velocity and Temperature Traverse)

BASE <i>Norton</i>		DATE <i>24 APR 89</i>		
BOILER NUMBER <i>64d 249</i>				
INSIDE STACK DIAMETER <i>19</i> Inches				
STATION PRESSURE <i>28.705</i> In Hg				
STACK STATIC PRESSURE <i>0.05</i> In H2O				
SAMPLING TEAM				
TRAVERSE POINT NUMBER	VELOCITY HEAD, V_p IN H2O	α <i>Wg</i>		STACK TEMPERATURE ($^{\circ}$ F)
<i>1</i>	<i>.12</i>	<i>10</i>	<i>12</i>	~~<i>170</i>~~
<i>2</i>	<i>.13</i>	<i>5</i>	<i>12</i>	~~<i>270</i>~~
<i>3</i>	<i>.13</i>	<i>8</i>	<i>10</i>	<i>380</i>
<i>4</i>	<i>.13</i>	<i>8</i>	<i>8</i>	<i>390</i>
<i>5</i>	<i>.12</i>	<i>3</i>	<i>5</i>	<i>395</i>
<i>6</i>	<i>.10</i>	<i>0</i>	<i>3</i>	<i>397</i>
<i>7</i>	<i>.09</i>	<i>4</i>	<i>0</i>	<i>399</i>
<i>8</i>	<i>.11</i>	<i>0</i>	<i>0</i>	<i>400</i>
<i>9</i>	<i>.13</i>	<i>10</i>	<i>3</i>	<i>401</i>
<i>10</i>	<i>.14</i>	<i>0</i>	<i>5</i>	<i>402</i>
<i>11</i>	<i>.16</i>	<i>11</i>	<i>5</i>	<i>402</i>
<i>12</i>	<i>.16</i>	<i>5</i>	<i>3</i>	<i>402</i>
STATIC H₂O = <i>.05</i> FPS = <i>29</i> $\overline{DP}$ = <i>.13</i> $\overline{T_s}$ = <i>367</i> Nozzle = <i>.3767</i> W_g =				
AVERAGE				

1 of 2

NAT GAS FIELDS		DATE		PLANT		BASE		SAMPLE BOX NUMBER		METER BOX NUMBER		Qw/gm		Co	
1		24 April 87		bld 249		Nur ton		Nutech 2		Nutech 2					
Run Number: 1 Date: 24 April 87 Plant: bld 249 Base: Nur ton Sample Box Number: Nutech 2 Meter Box Number: Nutech 2 Qw/gm: 1127 Co: 58 Particulate Sampling Data Sheet Station Press: 28.705 in Hg Heater Box Temp: 250 OF Probe Heater Setting: 250 Probe Length: 48 in Nozzle: 3767 (.375) in Cp: .84 Dry Gas Fraction (Fg):															
Equations: $OR = 9F + 460$ $H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co} \right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$ potot tube check - good pre check check @ 15" Hg = good post check check @ 20" Hg = good															
TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H ₂ O)	STACK TEMP (°F) (°R)		VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (in H ₂ O)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP (°F) (°R)		SAMPLE BOX TEMP (°F)	IMPIGGER OUTLET TEMP (°F)				
1	4.0	3.0	264		.12	1.67	551.439	73	730	244	71				
2	2.5	3.0	288		.15	2.02		74	72	244	58				
3	5.0	3.0	266		.15	2.08		75	71	255	52				
4	2.5	2.5	375		.13	1.57		77	72	252	54				
5	10.0	2.5	462		.12	1.40		79	72	232	57				
6	12.5	2.4	402		.11	1.28		79	72	232	58				
7	15.0	2.0	409		.10	1.17		79	72	243	61				
8	17.5	2.0	408		.11	1.28		79	72	242	62				
9	20.0	2.0	407		.11	1.67		80	73	257	64				
10	22.5	2.5	408		.16	1.87		81	73	244	66				
11	25.0	3.0	409		.17	1.99		82	73	244	67				
12	27.5	3.0	408		.16	1.88		83	74	246	70				
	30.0	3.0					572.358								

2 of 2

59 St 1132

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE WORTON	DATE 24 MAR 89	RUN NUMBER 1
-----------------------	--------------------------	------------------------

BUILDING NUMBER 249	SOURCE NUMBER BOILER #1, GAS FIRED
-------------------------------	--

I. PARTICULATES			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	0.2944	0.2944	Ø
ACETONE WASHINGS (Probe, Front Half Filter)	104.8893	104.8834	0.0059
BACK HALF (if needed)	Ø	Ø	Ø
Total Weight of Particulates Collected			0.0059 gm

II. WATER			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H2O)	235	200	35
IMPINGER 2 (H2O)	241	200	41
IMPINGER 3 (Dry)	10	0	10
IMPINGER 4 (Silica Gel)	214.6	200	14.6
Total Weight of Water Collected			100.6 gm

III. GASES (Dry)					
ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO ₂	6.0	6.0	6.0		6.0
VOL % O ₂	9.8	9.8	9.8		9.8
VOL % CO					
VOL % N ₂					

$$\text{Vol \% N}_2 = (100\% - \% \text{CO}_2 - \% \text{O}_2 - \% \text{CO})$$

PARTICULATE SAMPLING DATA SHEET											
EQUATIONS											
$H = \left[\frac{5130 \cdot F \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m \cdot V_p}{T_s}$											
$^{\circ}R = ^{\circ}F + 460$											
NAT. GAS - FIRE 1 of 2 1											
AMBIENT TEMP 75 STATION PRESS 28.705 HEATER BOX TEMP 250 PROBE HEATER SETTING 250 PROBE LENGTH 48 NOZZLE ANGLE (deg) 37.5 Cp .84 DRY GAS FRACTION (F_d)											
SCHEMATIC OF STACK CROSS SECTION 											
pitot tube check - good. preleak check @ 15" Hg = good. post leak check @ 14" Hg = good.											
Q_m/Q_m C_o											
TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in. H ₂ O)	STACK TEMP		VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP		SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
			(°F)	(T _s) (°R)				IN (°F)	AVG (T _m) (°R)	OUT (°F)	
1	15.0	2.0	230		.15	2.22	593.423	79	79	230	68
2	25	5.0	250		.19	2.73		80	80	233	57
3	5.0	4.5	345		.19	2.41		82	80	236	57
4	7.5	4.5	394		.19	2.28		85	80	236	56
5	10.0	4.5	405		.17	2.02		88	81	239	59
6	12.5	3.5	411		.155	1.60		90	82	240	63
7	15.0	2.5	406		.08	0.95		92	83	240	68
8	17.5	2.5	408		.08	0.96		92	84	240	73
9	20.0	2.5	404		.08	0.96		92	84	240	74
10	22.5	2.5	403		.08	0.96		91	84	240	77
11	25.0	2.5	402		.08	0.96		91	84	241	79
12	27.5	2.5	401		.08	0.96		91	84	241	81
							613.473				

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE NORTON	DATE 24 APR 89	RUN NUMBER 2
--	---	---

BUILDING NUMBER 249	SOURCE NUMBER BOILER #1, GAS-FIRED
--	---

I. PARTICULATES			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	0.2889	0.2885	0.0004
ACETONE WASHINGS (Probe, Front Half Filter)	95.0703	95.0667	0.0036
BACK HALF (if needed)	Ø	Ø	Ø
Total Weight of Particulates Collected			0.0040 gm

II. WATER			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H2O)	252	200	52
IMPINGER 2 (H2O)	243	200	43
IMPINGER 3 (Dry)	10	Ø	10
IMPINGER 4 (Silica Gel)	223.6	200	23.6
Total Weight of Water Collected			128.6 gm

III. GASES (Dry)					
ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO ₂	5.2	5.2	5.2		5.2
VOL % O ₂	10.6	10.6	10.6		10.6
VOL % CO					
VOL % N ₂					

Vol % N₂ = (100% - % CO₂ - % O₂ - % CO)

WAT. CLK - FIELD

RUN NUMBER

3

DATE _____

24 APR 89

PLANT

619 249

BASE

Alatun

SAMPLE BOX NUMBER

Aufsch 2

METER BOX NUMBER

Nutack 2

$$\frac{\sigma_w}{\sigma_m}$$

3

SCHEMATIC OF STACK CROSS SECTION

EQUATIONS

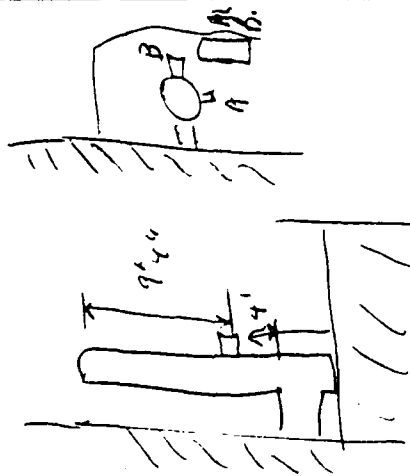
$$^{\circ}\text{R} = ^{\circ}\text{F} + 460$$

$$H = \left[\frac{5130 \cdot F \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$$

[] pitot tube check - good.

preludichuck @ 15th 16th - 9000

post bank check @ 11⁰⁰ 4y - good!



UAC
STATIC
- PASSA
(MAY 26)

[illegible]

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE NORTON	DATE 24 APR 89	RUN NUMBER 3
-----------------------	--------------------------	------------------------

BUILDING NUMBER 249	SOURCE NUMBER BOILER #1, GAS-FIRED
-------------------------------	--

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	0.2898	0.2894	0.0004
ACETONE WASHINGS (Probe, Front Half Filter)	97.0768	97.0732	0.0036
BACK HALF (if needed)	Ø	Ø	0.0040
Total Weight of Particulates Collected			0.0040 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H2O)	282	200	82
IMPINGER 2 (H2O)	234	200	34
IMPINGER 3 (Dry)	14	0	14
IMPINGER 4 (Silica Gel)	219.7	200	19.7
Total Weight of Water Collected			149.7 gm

III. GASES (Dry)

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO ₂	5.6	5.6	5.6		5.6
VOL % O ₂	9.8	9.8	9.8		9.8
VOL % CO					
VOL % N ₂					

$$\text{Vol \% N}_2 = (100\% - \% \text{CO}_2 - \% \text{O}_2 - \% \text{CO})$$

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 24 APR 89
 Sample location BCD 249 RUN 1
 Barometric pressure, mm (in.) Hg 28.705
 Ambient temperature, °F 75 Stack temperature, °F 369
 Initial leak check good Final leak check good
 Operator LT AL

TRAVERSE Clock time, 24 h POINT	Rotameter setting, l/min (ft ³ /min)	CO conc, ppm (dry basis)	CO ₂ , %	Comments
1	1.0		6.0	
2	1.2			
3	1.2			
4	1.0			
5	1.0			
6	0.9			
7	0.8			
8	0.8			
9	1.0			
10	1.1			
11	1.0			
12	1.1			
13	1.3			
14	1.8			
15	1.7			
16	1.3			
17	1.1			
18	1.0			
19	0.7			
20	0.7			
21	0.7			
22	0.7			
23	0.7			
24	0.7			

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FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 24 APR 89
 Sample location BLD 249 RVN 2
 Barometric pressure, mm (in.) Hg 28.705
 Ambient temperature, °C (°F) 75 Stack temperature, °C (°F) 377
 Initial leak check good Final leak check good
 Operator LT ALI

TRAVERSE Clock time, 24 H POINT	Rotameter setting, l/min (ft ³ /min)	CO conc, ppm (dry basis)	CO ₂ , %	Comments
1	1.0		5.2	
2	1.2			
3	1.1			
4	1.0			
5	0.9			
6	0.7			
7	0.5			
8	0.5			
9	0.5			
10	0.5			
11	0.5			
12	0.5			
13	0.8			
14	0.9			
15	0.9			
16	0.8			
17	0.8			
18	0.6			
19	0.6			
20	0.8			
21	0.8			
22	0.9			
23	0.9			
24	0.9			

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FIELD SAMPLING DATA FORM FOR CO

Plant name NORTHON AFB Date 24 APR 89
 Sample location BLD 249 RUN 3
 Barometric pressure, mm (in.) Hg 28.705
 Ambient temperature, °C (°F) 75 Stack temperature, °C (°F) 377
 Initial leak check good Final leak check good
 Operator LT ALI

TRAVERSE Clock Time, 24 h POINT	Rotameter setting, l/min (ft ³ /min)	CO conc, ppm (dry basis)	CO ₂ , %	Comments
1	1.0		5.6	
2	1.0			
3	1.0			
4	1.0			
5	0.9			
6	0.8			
7	0.8			
8	0.9			
9	1.0			
10	1.0			
11	1.1			
12	1.1			
13	1.0			
14	1.7			
15	1.3			
16	1.3			
17	1.2			
18	1.0			
19	0.7			
20	0.7			
21	0.7			
22	0.7			
23	0.7			
24	0.7			

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Run #1

5-01-79

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Section 3.6.12

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB City
 Sample location Blk 249 Date 21 Apr 81
 Operator Barometric pressure (P_{bar}) 23.705 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_t), ml	Initial pressure M_{bar} Hg			Initial temperature	
						Leg A.	Leg B.	P_i^*	°F (t_i)	°R (T_i)
1-1	$P_{ort B}$	1055	229	13	2059			55	72	
1-2	$P_{ort B}$	1115	310	14	2080			56	69	73
1-3	$P_{ort A}$	1135	194	15	2082			54	74	
1-4	$P_{ort A}$	1150	194	16	2043			53	75	

 $*P_i = P_{bar} - (A_i + B_i)$ $^{\circ}T_i = t_i + 460^{\circ}F$

NO. Sample Recovery and Integrity Data Form
(English units)

Plant Norfolk AF Bldg 247 Date 25 Apr 89 Barometric pressure, (P_{bar}) _____ in. Hg
 Sample recovery personnel _____
 Person with direct responsibility for recovered samples Capt V. V. V.

Sample number	Final Pressure, mm Hg			Final temperature, °R (T _f) ^a		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A ₁	Leg B ₁	P _f ^b	°C (t _f)	°R (T _f) ^a				
1-1			707	17		0900	10	✓	
1-2			703	18		0915	10	✓	
1-3			712	18		0925	10	✓	
1-4			715	19		0935	10	✓	

$$^a P_f = P_{bar} - (A_1 + B_1)$$

$$^b T_f = t_f + 460^\circ F.$$

Lab person with direct responsibility for recovered samples _____

Date recovered samples received _____ Analyst _____

All samples identifiable? _____ All liquids at marked level? _____

Remarks _____

Signature of lab sample trustee _____

Run # 2

5-01-79

5

Section 3.6.12

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB City
 Sample location Bldg 249 Date 24 Apr 88
 Operator Barometric pressure (P_{bar}) 28.265 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V _f), ml	Initial pressure in Hg			Initial temperature	
						Leg A,	Leg B,	P _o	°F (t _i)	°R (T _i)
2-1	Port A	1250	313	17	2066			58	79	
2-2	Port A	1305	140	18	2074			61	79	
2-3	Port B	1330	301	19	2061			54	83	
2-4	Port B	1345	255	20	2102			61	76	

°P_o = P_{bar} - (A + B).

°T_i = t_i + 460°F.

Run #2

NO. Sample Recovery and Integrity Data Form
(English units)

Plant No. 100 AF13 Date 25 Apr 87
 Sample recovery personnel _____ Barometric pressure, (P_{bar}) _____ in. Hg
 Person with direct responsibility for recovered samples W. J. K. K. K.

Sample number	Final Pressure, mm. Hg			Final temperature, °R (T_f) ^a		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A _i	Leg B _i	P _i ^b	°F (t_f)	°R (T_f) ^a				
2-1			694	18		0950	10	✓	
2-2			694	19		1000	10	✓	
2-3			716	19		1010	10	✓	
2-4			711	20		1020	10	✓	

^a $P_i = P_{bar} - (A_i + B_i)$

^b $T_i = t_i + 460^\circ F$

Lab person with direct responsibility for recovered samples _____
 Date recovered samples received _____ Analyst _____
 All samples identifiable? _____ All liquids at marked level? _____
 Remarks _____
 Signature of lab sample trustee _____

Run # 3

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB City
 Sample location Bldg 2417 Date 24 Apr 89
 Operator Barometric pressure (P_{bar}) 29.705 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V _l), ml	Initial pressure mm Hg			Initial temperature	
						Leg A,	Leg B,	P ^a	°F (t _i)	°R (T _i) ^b
3-1	Port B	1510	184	21	2060			56	90	
3-2	Port B	1525	292	22	2062			58	82	
3-3	Port A	1545	200	23	2086			57	85	
3-4	Port A	1645	110	24 27	2066			53	72	

^a $P_i = P_{bar} - (A_i + B_i)$ ^b $T_i = t_i + 460^\circ\text{F}$

Run # 3

8-01-79

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Section 3.6.12

NO. Sample Recovery and Integrity Data Form
(English units)

Plant North Airy Bldg 249 Date 25 Apr 89
 Sample recovery personnel _____ Barometric pressure, (P_{bar}) _____ in. Hg
 Person with direct responsibility for recovered samples Capt Young

Sample number	Final Pressure, mm Hg			Final temperature, °F (°C)		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A _i	Leg B _i	P _i *	°F (°C)	°R (T _i)°				
3-1			796	19		1030	10	✓	
3-2			695	19		1040	10	✓	
3-3			704	19		1050	10	✓	
3-11			716	19		1100	10	✓	

* $P_i = P_{bar} - (A_i + B_i)$

° $T_i = t_i + 460°\text{F}$

Lab person with direct responsibility for recovered samples _____

Date recovered samples received _____ Analyst _____

All samples identifiable? _____ All liquids at marked level? _____

Remarks _____

Signature of lab sample trustee _____

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APPENDIX E
BUILDING 716 BOILER 4
(NATUARL GAS) FIELD DATA

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DETERMINATION OF MINIMUM NUMBER OF TRAVERSE POINTS

Stack ID: Bld 716 #1 Stack diameter at ports: 3.3 (ft)

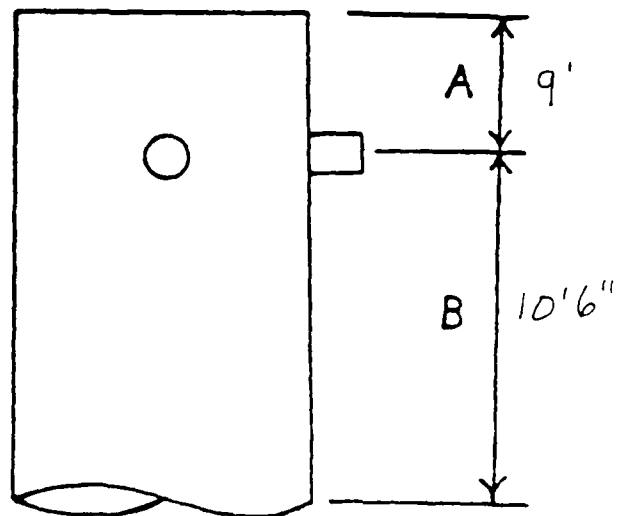
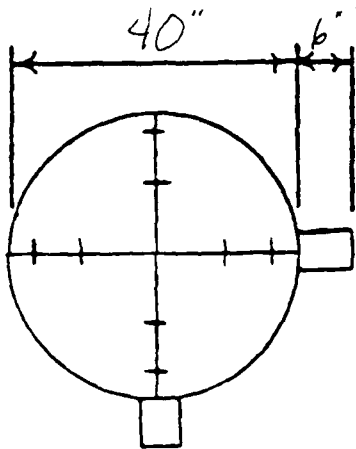
Distance A (ft) 9' (duct diameters) 2.7

Recommended number of traverse points as determined by
distance A: 12

Distance B (ft) 10'6" (duct diameters) 3.15

Recommended number of traverse points as determined by
distance B: 24

Number of traverse points used: 24



(Stack Geometry)

[illegible]

PRELIMINARY SURVEY DATA SHEET NO. 2
(Velocity and Temperature Traverses)

BASE NORTON	DATE 26 APR 89 / 27 APR
BOILER NUMBER BLDG 716, BOILER #4	
INSIDE STACK DIAMETER 40 Inches	
STATION PRESSURE ~~28.880~~ / 28.865 In Hg	
STACK STATIC PRESSURE 0.045 In H2O	
SAMPLING TEAM	

TRAVERSE POINT NUMBER	VELOCITY HEAD, V_p IN H ₂ O	α ~~23 APR~~ ~~26 APR~~	STACK TEMPERATURE (°F)
1	.04	4 11 9 33 ~~11 13~~	~~170~~ 170
2	.055	3 9 13 19 ~~7 -1~~	199
3	.065	2 12 22 9 ~~2 -11~~	498
4	.07	2 2 16 16 ~~4 -4~~	504
5	.07	7 3 9 15 ~~11 -5~~	504
6	~~.07~~ .065	7 8 18 19 ~~2 -1~~	503
7	.065	9 3 1 6 ~~19 -14~~	502
8	.06	2 3 18 15 ~~2 -5~~	501
9	.06	4 3 33 18 ~~13 -2~~	501
10	.06	13 2 43 28 ~~13 18~~	502
11	.05	13 9 48 28 ~~12 18~~	502
12	.05	14 12 48 31 ~~12 11~~	501
		good bad bad	
		AVG: 6.9 AVG: 21.5	
STATIC H ₂ O .045		-56 -43	-99 +27
		+56 +40	+126 AVE = 21
FPS = 18			
$\overline{DP} = .06$			
$\overline{TS} = 449$		Nozzle = .4999	
		.499 / .499	.501 = .500
AVERAGE			

2.1.2

[illegible]

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE NORTON	DATE 28 APR 89	RUN NUMBER 1
BUILDING NUMBER 716		SOURCE NUMBER BOILER #4

I. PARTICULATES			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.2950	.2939	0.0011
ACETONE WASHINGS (Probe, Front Half Filter)	97.5492	97.5365	0.0127
BACK HALF (if needed)	Ø	Ø	Ø
Total Weight of Particulates Collected			0.0138 gm

II. WATER			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H2O)	3.48 ml/s	200	148 ml
IMPINGER 2 (H2O)	262	200	62 ml
IMPINGER 3 (Dry)	2.3 ml/s	0	2.3 ml
IMPINGER 4 (Silica Gel)	204.6	200	4.6
Total Weight of Water Collected			208.9 gm

III. GASES (Dry)					
ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO ₂	9.0	9.0	9.0	9.0	9.0
VOL % O ₂	4.0	4.2	4.0	N/A	4.0
VOL % CO					
VOL % N ₂					

$$\text{Vol \% N}_2 = (100\% - \% \text{CO}_2 - \% \text{O}_2 - \% \text{CO})$$

20f2

OEHL FORM 18

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE WORTON		DATE 26 APR 89		RUN NUMBER 2	
BUILDING NUMBER 716			SOURCE NUMBER BOILER #4		

I. PARTICULATES			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.2920	.2897	0.0023
ACETONE WASHINGS (Probe, Front Half Filter)	94.7822	94.7757	0.0065
BACK HALF (If needed)	Ø	Ø	Ø
Total Weight of Particulates Collected			0.0088 gm

II. WATER			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H2O)	300 ml/s	200	100 ml/s
IMPINGER 2 (H2O)	258 ml/s	200	58 ml/s
IMPINGER 3 (Dry)	18.2 ml/s	0	18.2 ml/s
IMPINGER 4 (Silica Gel)	225.8	200	25.8
Total Weight of Water Collected			202.0 gm

III. GASES (Dry)					
ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO ₂	7.0	7.0	7.0	N.A.	7.0
VOL % O ₂	5.8	5.8	5.8	N/A	5.8
VOL % CO					
VOL % N ₂					

$$\text{Vol \% N}_2 = (100\% - \% \text{CO}_2 - \% \text{O}_2 - \% \text{CO})$$

2.82

89

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE MORTON	DATE 28 APR 89	RUN NUMBER 3
-----------------------	--------------------------	------------------------

BUILDING NUMBER 716	SOURCE NUMBER BOILER #4
-------------------------------	-----------------------------------

I. PARTICULATES			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.2964	.2936	0.0028
ACETONE WASHINGS (Probe, Front Half Filter)	96.8854	96.8796	0.0058
BACK HALF (If needed)	Ø	Ø	Ø
Total Weight of Particulates Collected			0.0086 gm

II. WATER			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H2O)	364 ml/s	200	164 ml/s
IMPINGER 2 (H2O)	230 ml/s	200	30
IMPINGER 3 (Dry)	3.6 ml/s	0	3.6 ml/s
IMPINGER 4 (Silica Gel)	211.8	200	11.8
Total Weight of Water Collected			209.4 gm

III. GASES (Dry)					
ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO ₂	1.0	5.2	5.0		5.0
VOL % O ₂	3.0	3.2	3.0		3.0
VOL % CO					
VOL % N ₂					

$$\text{Vol \% N}_2 = (100\% - \% \text{CO}_2 - \% \text{O}_2 - \% \text{CO})$$

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 27 APR 89
 Sample location BLD 716 RUN 1 (GAS FLOW)
 Barometric pressure, mm (in.) Hg 28.865
 Ambient temperature, ~~°C~~ (°F) 78 Stack temperature, ~~°C~~ (°F) 449
 Initial leak check good Final leak check good
 Operator W. A. L.

TRAVERSE Clock time, 24 h POINT	Rotameter setting, l/min (ft ³ /min)	CO conc, ppm (dry basis)	CO ₂ , %	Comments
1	1.0		9.0	
2	1.0			
3	1.0			
4	1.4			
5	1.5			
6	1.5			
7	1.7			
8	1.8			
9	2.0			
10	2.2			
11	2.2			
12	2.2			
13	1.1			
14	1.7			
15	1.7			
16	1.8			
17	2.9			
18	2.0			
19	2.0			
20	1.9			
21	1.5			
22	1.2			
23	1.1			
24	1.0			

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FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 27 APR 89
 Sample location BLO 716 RUN 2 (GAS FIRED)
 Barometric pressure, mm (in.) Hg 28.865
 Ambient temperature, °X (°F) 78 Stack temperature, °X (°F) 404
 Intital leak check good Final leak check good
 Operator LT M1

TRAVERSE Clock time, 24 h POINT	Rotameter setting, l/min (ft ³ /min)	CO conc, ppm (dry basis)	CO ₂ , %	Comments
1	1.0		7.0	
2	1.4			
3	1.3			
4	1.4			
5	1.4			
6	1.5			
7	1.2			
8	1.0			
9	1.0			
10	1.0			
11	0.9			
12	0.9			
13	0.5			
14	0.9			
15	0.9			
16	0.9			
17	1.0			
18	1.4			
19	1.5			
20	1.6			
21	1.6			
22	1.5			
23	1.5			
24	1.3			

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FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 27 APR 89
 Sample location Bld 716 RUN 3 (GAS FIRED)
 Barometric pressure, mm (in.) Hg 28.865
 Ambient temperature, °X (°F) 78 Stack temperature, °X (°F) 449
 Intital leak check good Final leak check good
 Operator LT ALI

TRAVERSE Clock time, 24 hr POINT	Rotameter setting, l/min (ft ³ /min)	CO conc, ppm (dry basis)	CO ₂ , %	Comments
1	1.0		9.0	
2	1.5			
3	1.9			
4	1.9			
5	2.0			
6	2.1			
7	2.6			
8	3.3			
9	3.7			
10	4.0			
11	3.7			
12	3.3			
13	2.0			
14	3.0			
15	2.6			
16	2.6			
17	2.5			
18	2.5			
19	2.0			
20	2.0			
21	1.9			
22	1.9			
23	1.9			
24	1.9			

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Nitrogen Oxide Field Data Form
(English units)

Plan Norfolk AFB Bldg 716 City Portsmouth
 Sample location Bldg 716 Bldg #14 Date 27 Apr 89
 Operator _____ Barometric pressure (P_{bar}) 29.880 in Hg 28.865

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V _{fl}), ml	Initial pressure mm Hg			Initial temperature	
						Leg A,	Leg B,	P ^a	°F (T _i)	°R (T _i) ^b
1-1	Port B	0920	260	1	2085			56	75.2	
1-2	Port B	0935	330	2	2054			52	74.2	
1-3	Port A	0955	144	3	2075			55	83	
1-4	Port A	1015	153	4	2070			56	86.4	

^aP_i = P_{bar} - (A + B)

^bT_i = T_i + 460°F

Run #1
Gruas

5-01-79

7

Section 3.6.12

NO. Sample Recovery and Integrity Data Form
(English units)

Plant Norton AF-13 Bldg 714 Date 28 Apr 89
 Sample recovery personnel Capt Vargha Barometric pressure, (P_{bar}) _____ in Hg
 Person with direct responsibility for recovered samples _____

Sample number	Final Pressure, in. Hg			Final temperature,		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A _i	Leg B _i	P _i ^a	$^{\circ}\text{C}$ $\mathcal{F}$ (t_i)	$^{\circ}\text{R}$ (T_i) ^b				
1-1			725	21		1355	10	✓	
1-2			720	23		1405	10	✓	
1-3			723	24		1415	10	✓	
1-4			712	23		1420	10	✓	

$$P_i = P_{bar} - (A_i + B_i)$$

$$^{\circ}\text{T}_i = t_i + 460^{\circ}\text{F.}$$

Lab person with direct responsibility for recovered samples _____

Date recovered samples received _____ Analyst _____

All samples identifiable? _____ All liquids at marked level? _____

Remarks _____

Signature of lab sample trustee _____

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Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB Bldg 716

City

Sample location Boiler # 2

Date 27 Apr 89

Operator

Barometric pressure (P_{bar}) 29.865 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_t), ml	Initial pressure mm Hg			Initial temperature	
						Leg A,	Leg B,	P_t^*	°F (t _i)	°R (t _i) ^b
2-1	Port A	1110	189	5	2070			55	85	
2-2	Port A	1125	202	6	2072			56	80	
2-3	Port B	1135	172	7	2066			56	76	
2-4	Port B	1150	249	8	2070			55	87	

* $P_t = P_{bar} - (A_t + B_t)$

^b $T_i = t_i + 460^\circ F$

Fun
6005

Run #2
6945

5-01-79

7

Section 3.6.12

NO. Sample Recovery and Integrity Data Form
(English units)

Plant Norfolk EFB Date 28 Apr 87
 Sample recovery personnel _____ Barometric pressure, (P_{bar}) _____ in. Hg
 Person with direct responsibility for recovered samples _____

Sample number	Final Pressure, mm. Hg			Final temperature,		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A ₁	Leg B ₁	P ₁ ^a	°F (t ₁)	°R (T ₁) ^b				
2-1			710	23		1435	10	✓	
2-2			712	23		1450	10	✓	
2-3			713	23		1500	10	✓	
2-4			712	23		1510	10	✓	

$$^a P_1 = P_{\text{bar}} - (A_1 + B_1)$$

$$^b T_1 = t_1 + 460^{\circ}\text{F.}$$

Lab person with direct responsibility for recovered samples _____
 Date recovered samples received _____ Analyst _____
 All samples identifiable? _____ All liquids at marked level? _____
 Remarks _____
 Signature of lab sample trustee _____

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Nitrogen Oxide Field Data Form
(English units)

Plant Walter HFB Bldg 716 City
 Sample location Bldg 714 Boiler # 4 Date 27 April 89
 Operator Barometric pressure (P_{bar}) 28.265 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_F), ml	Initial pressure mm Hg		Initial temperature	
						Leg A, mm	Leg B, mm	°F (L)	°R (T, P)
3-1	Port B	1225	319	9	2089			81	
3-2	Port B	1240	230	10	2080			88	
3-3	Port A	1300	225	11	2084			89	
3-4	Port A	1320	210	12	2072			88	

$$^*P_i = P_{bar} - (A_i + B_i)$$

$$^*T_i = t_i + 460^{\circ}\text{F}$$

Run # 3
GWS

5-01-79

7

Section 3.6.12

NO, Sample Recovery and Integrity Data Form
(English units)

Plant Newton AFB Bldg 714 Date 28 Apr 83
 Sample recovery personnel Capt. [Signature] Barometric pressure, (P_{bar}) _____ in Hg
 Person with direct responsibility for recovered samples _____

Sample number	Final Pressure, in. Hg			Final temperature, °R (T _f) ^b		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A _i	Leg B _i	P _i ^a	°C (T _f)	°R (T _f) ^b				
3-1			715	23		1520	10	✓	
3-2			716	23		1535	10	✓	
3-3			704	23		1540	10	✓	
3-4			702	23		1550	10	✓	

^aP_i = P_{bar} - (A_i + B_i)

^bT_i = t_i + 460° F.

Lab person with direct responsibility for recovered samples _____
 Date recovered samples received _____ Analyst _____
 All samples identifiable? _____ All liquids at marked level? _____
 Remarks _____
 Signature of lab sample trustee _____

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APPENDIX F
BUILDING 716 BOILER 4
(FUEL OIL) FIELD DATA

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DETERMINATION OF MINIMUM NUMBER OF TRAVERSE POINTS

Stack ID: Bld 716 #1 Stack diameter at ports: 3.3 (ft)

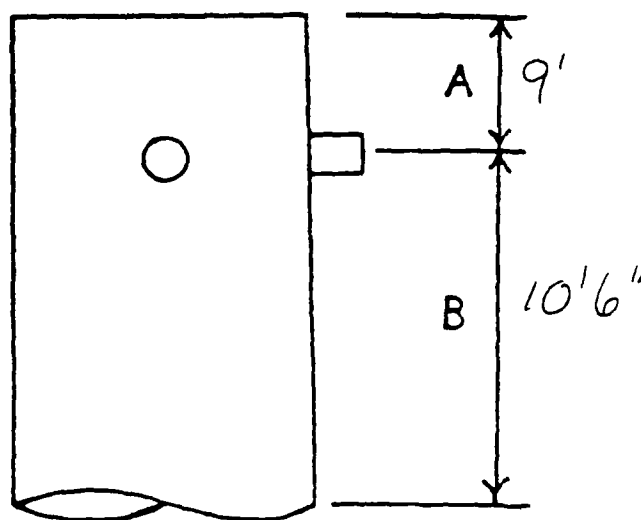
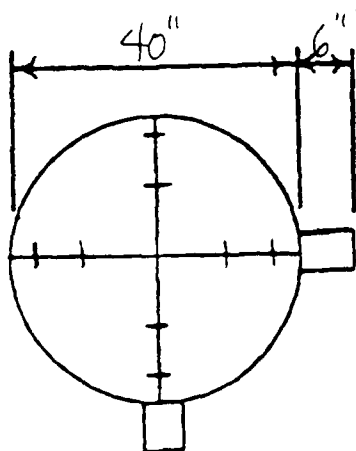
Distance A (ft) 9' (duct diameters) 2.7

Recommended number of traverse points as determined by
distance A: 12

Distance B (ft) 10' 6" (duct diameters) 3.15

Recommended number of traverse points as determined by
distance B: 24

Number of traverse points used: 24



oil

BAS

DATE _____

28 APR 89

BOILER NUMBER

4

INSIDE STACK DIAMETER

40

Inches

STATION PRESSURE

28.775

In Hg

STACK STATIC PRESSURE

In H2O

SAMPLING TEAM

(15% moisture)

TRAVERSE POINT NUMBER	VELOCITY HEAD, V_p IN H ₂ O	$\sqrt{V_p}$	STACK TEMPERATURE (°F)
1	.05		85
2	.07		150
3	.07		455
4	.08		480
5	.075		483
6	.07		483
7	.08		484
8	.08		484
9	.07		484
10	.065		485
11	.06		485
12	.06		485
	STATIC H ₂ O -	.11	
	FPS = 19		
	$\bar{T}_s = 420$		
	$\Delta p = 0.07$		
		Nozzle = .4902	
		we = ~~.490~~ .500	
	AVERAGE		

PARTICULATE SAMPLING DATA SHEET			
ROW NUMBER	1	SCHEMATIC OF STACK CROSS SECTION	
DATE	28 APR 89	$\Delta H_{\text{stack}} = 1.91$ 	
PLANT	hld 716	$Q_R = 0^\circ F + 460$ $H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m \cdot V_p}{T_s}$	
BASE	Norton	pilot tube check good. pre link check @ 15" Hg - good post link check @ 8" Hg - good.	
SAMPLE BOX NUMBER	Nutech 2	Q_w / Q_m	
METER BOX NUMBER	Nutech 2	C_p	
Qw/Qm		C_p	
Co		C_p	
TRAVERSE POINT NUMBER		SAMPLING TIME (min)	
1		3.0	
2		2.5	
3		5.0	
4		7.5	
5		10.0	
6		12.5	
7		15.0	
8		17.5	
9		20.0	
10		22.5	
11		25.0	
12		27.5	
13		30.0 (1500)	
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2. f 21

RUN NUMBER	1
DATE	28 APR 87
PLANT	bld 766
BASE	Norton
SAMPLE BOX NUMBER	Nutch 2
METER BOX NUMBER	Nutch 2
Q _w /Q _m	
C _o	

see 1

SCHEMATIC OF STACK CROSS SECTION	
$H = \left[\frac{5130 \cdot F_d \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$	
$^{\circ}\text{R} = ^{\circ}\text{F} + 460$	

EQUATIONS	
AMBIENT TEMP	80
STATION PRESS	28.775
HEATER BOX TEMP	250
PROBE HEATER SETTING	250
PROBE LENGTH	72
NOZZLE AREA (IN)	.500
C _p	.84
DRY GAS FRACTION (F _d)	

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H ₂ O)	STACK TEMP		VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP			SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
			(°F)	(Tg) (°R)				IN (°F)	AVG (Tm) (°R)	OUT (°F)		
1	A 0	2.0	185		.02	1.07	86.5777	101		94	242	82
2	2.5	2.5	180		.03	1.42		102		94	244	73
3	5.0	2.5	405		.05	1.76		102		95	241	70
4	7.5	2.5	480		.05	1.62		103		96	241	70
5	10.1	3.0	483		.05	1.62		104		97	241	70
6	12.5	3.0	491		.06	1.92		104		97	240	70
7	15.0	4.0	491		.07	2.25		105		98	241	71
8	17.5	4.5	491		.08	2.58		107		100	242	72
9	20.0	5.5	492		.10	3.22		107		100	242	74
10	22.5	6.5	492		.11	3.54		108		100	243	75
11	25.0	6.0	491		.10	3.23		108		100	240	77
12	27.5	6.0	492		.10	3.22		109		100	242	78
	30.0 (STOP)						885.706					
			Ts = 425						96			
			TH = 2.30									
			VPS = 7.6731									
						Total P _t = 48.704						

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE NORTON		DATE 28 APR 89		RUN NUMBER 1	
BUILDING NUMBER 716			SOURCE NUMBER BOILER #4, OIL-FIRED		

I. PARTICULATES			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.2984	.2886	.0098
ACETONE WASHINGS (Probe, Front Half Filter)	88.4736	88.3696	0.1040* (0.0382)
BACK HALF (if needed)	Ø	Ø	Ø
Total Weight of Particulates Collected			0.0480 gm

II. WATER			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H2O)	240ms	200	40ms
IMPINGER 2 (H2O)	207ms	200	7ms
IMPINGER 3 (Dry)	7.9 m/s	0	7.9ms
IMPINGER 4 (Silica Gel)	219.8	200	19.8
Total Weight of Water Collected			gm

III. GASES (Dry)					
ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO ₂	10.4	10.4	10.2		10.4
VOL % O ₂	4.4	4.4	4.6		4.4
VOL % CO					
VOL % N ₂					

$$\text{Vol \% N}_2 = (100\% - \% \text{CO}_2 - \% \text{O}_2 - \% \text{CO})$$

OEHL FORM 20
MAY 78

* sample contaminated: used run #2 results for calculations.

2. f. 2

SCHEMATIC OF STACK CROSS SECTION										EQUATIONS				AMBIENT TEMP			
TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in. H ₂ O)	STACK TEMP		VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (in)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP		SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)						
			(°F)	(T _s) (°R)				IN (°F)	AVG (T _{lm}) (°R)			OUT (°F)					
1	8.0	3.0	160		.04	2.20	713.174	108		243	77						
2	2.5	4.5	150		.06	3.04		110		244	72						
3	5.0	3.5	420		.06	2.11		111		245	72						
4	7.5	3.5	480		.07	2.30		112		244	74						
5	10.0	3.5	481		.07	2.30		111		244	74						
6	12.5	3.0	435		.06	1.96		112		244	76						
7	15.0	4.5	489		.08	2.61		112		243	78						
8	17.5	4.5	488		.08	2.61		112		243	77						
9	20.0	4.0	491		.07	2.28		112		244	78						
10	22.5	3.5	491		.06	1.95		113		246	80						
11	25.0	3.0	490		.06	1.96		113		245	82						
12	27.5	3.0	486		.055	1.80		112		245	83						
							977.691										
									107								
			T _s = 419														
			ΔH = 2.32														
			GAS = 7.5413														
			Total P ₂ = 49.041														

28 APR 89

2

DATE

28

APR

89

2

PLANT

2

BASE

2

SAMPLE BOX NUMBER

2

METER BOX NUMBER

2

Qw/Qm

2

Co

2

28.775

250

72

500

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AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE HORTON	DATE 28 APR 89	RUN NUMBER 2
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BUILDING NUMBER 716	SOURCE NUMBER BOILER #4, OIL-FIRED
-------------------------------	--

I. PARTICULATES			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.3034	.2904	0.0130
ACETONE WASHINGS (Probe, Front Half Filter)	97.7986	98.7604	0.0382
BACK HALF (If needed)	Ø	Ø	Ø
Total Weight of Particulates Collected			0.0512 gm

II. WATER			
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H2O)	244 ml	200	44 ml
IMPINGER 2 (H2O)	235 ml	200	35 ml
IMPINGER 3 (Dry)	8.4	0	8.4
IMPINGER 4 (Silica Gel)	218.5	200	18.5
Total Weight of Water Collected			gm

III. GASES (Dry)					
ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO ₂	12.0	10.0	10.0	10.0	10.5
VOL % O ₂	4.8	4.4	4.4	4.6	4.5
VOL % CO					
VOL % N ₂					

$$\text{Vol \% N}_2 = (100\% - \% \text{CO}_2 - \% \text{O}_2 - \% \text{CO})$$

62

DATE = 1.91

PARTICULATE SAMPLING DATA SHEET

1 of 2

RUN NUMBER

3

DATE

28 Apr 87

PLANT

kd m

BASE

kd m

SAMPLE BOX NUMBER

Unit 2

METER BOX NUMBER

Unit 2

Qw/Qm

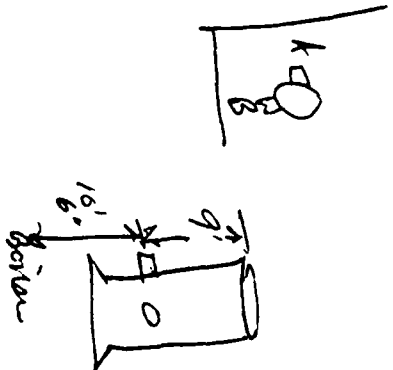
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SCHEMATIC OF STACK CROSS SECTION

EQUATIONS

$$Q_R = Q_F + 460$$

$$H = \left[\frac{5130 \cdot F \cdot C_p \cdot A}{C_o} \right]^2 \cdot \frac{T_m}{T_s} \cdot V_p$$



Pitot tube check - good.
 you leak check @ 15" Hg - good.
 port leak check @ 10" Hg - good.

AMBIENT TEMP

80

STATION PRESS

28.735

HEATER BOX TEMP

250

PROBE HEATER SETTING

250

PROBE LENGTH

72

NOZZLE PRETEXT

500

Cp

84

DRY GAS FRACTION (Fd)

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in Hg)	STACK TEMP		VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (in Hg)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP			SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
			(°F)	(°R)				IN (°F)	AVG (Tm) (°R)	OUT (°F)		
1	8.0	4.0	155		1.05	2.464	938.240	97		97	228	87
2	2.5	6.0	150		1.07	3.48		97		97	232	70
3	5.0	5.0	445		1.08	2.70		103		97	237	19
4	7.5	5.0	480		1.08	2.41		107		100	238	60
5	10.0	5.0	483		1.07	2.46		109		101	240	61
6	12.5	4.5	492		1.07	2.26		110		101	241	62
7	15.0	5.0	491		1.09	2.90		112		104	242	62
8	17.5	5.0	496		1.08	2.58		112		102	241	62
9	20.0	4.5	495		1.07	2.26		113		103	245	63
10	22.5	4.5	494		1.07	2.27		113		103	243	62
11	25.0	4.0	493		1.06	1.94		112		103	243	62
12	27.5	4.0	499		1.06	1.95		110		102	242	62
13	30.0	3.0					965.152					

2022

$$\text{total } f_3 = 52.349$$

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE NORTON		DATE 28		RUN NUMBER 3	
BUILDING NUMBER 716			SOURCE NUMBER BOILER #4, OIL+FIRES		
I. PARTICULATES					
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)		
FILTER NUMBER	.3029	.2917	0.0112		
ACETONE WASHINGS (Probe, Front Half Filter)	97.9253	97.8571	0.0682* (0.0382)		
BACK HALF (if needed)	Ø	Ø	Ø		
			0.0494 gm		
II. WATER					
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)		
IMPINGER 1 (H2O)	399 ml	200	199 ml		
IMPINGER 2 (H2O)	216 ml	200	16 ml		
IMPINGER 3 (Dry)		0	1 ml		
IMPINGER 4 (Silica Gel)	214.8	200	14.8		
			gm		
III. GASES (Dry)					
ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO ₂	8.8	9.0	9.0		9.0
VOL % O ₂	4.4	4.5	4.4		4.4
VOL % CO					
VOL % N ₂					
Vol % N ₂ = (100 - % CO ₂ - % O ₂ - % CO)					

OEHL FORM 20
MAY 78

* Sample contaminated: used run #2 results for calculations.

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 28 APR 89
 Sample location BLD 716 RUN 1 (OIL FIELD)
 Barometric pressure, mm (in.) Hg 29.775
 Ambient temperature, °X (°F) 90 Stack temperature, °X (°F) 425
 Initial leak check good Final leak check good
 Operator LT ALI

TRAVERSE Clock time, 24 h POINT	Rotameter setting, l/min (ft ³ /min)	CO conc, ppm (dry basis)	CO ₂ , %	Comments
1	1.0		10.4	
2	1.3			
3	0.7			
4	0.9			
5	0.7			
6	0.7			
7	1.0			
8	1.0			
9	0.7			
10	0.6			
11	0.6			
12	0.6			
13	0.4			
14	0.5			
15	0.6			
16	0.6			
17	0.7			
18	0.8			
19	1.0			
20	1.3			
21	1.4			
22	1.3			
23	1.3			
24	1.3			

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FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 28 JUL 89
 Sample location ALO 716 RUN 2 (oil field)
 Barometric pressure, mm (in.) Hg 28.775
 Ambient temperature, °X (°F) 80 Stack temperature, °X (°F) 419
 Initial leak check good Final leak check good
 Operator LT MUI

TRAVEL & Clock time, 24 hr JOINT	Rotameter setting, l/min (ft ³ /min)	CO conc, ppm (dry basis)	CO ₂ , %	Comments
1	1.0		10.0	
2	1.1			
3	1.2			
4	1.2			
5	1.2			
6	1.4			
7	1.7			
8	1.9			
9	2.4			
10	2.7			
11	2.7			
12	2.4			
13	1.7			
14	2.3			
15	1.6			
16	1.7			
17	1.7			
18	1.5			
19	1.9			
20	1.9			
21	1.7			
22	1.6			
23	1.6			
24	1.5			

Quality Assurance Handbook M10-4.2

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 28 APR 89
 Sample location BLD 716 RUN 3 (oil field)
 Barometric pressure, mm (in.) Hg 28.775
 Ambient temperature, °C (°F) 80 Stack temperature, °C (°F) 427
 Initial leak check good Final leak check good
 Operator LT ALL

TRAVERSE Clock time, 24 h POINT	Rotameter setting, l/min (ft ³ /min)	CO conc, ppm (dry basis)	CO ₂ , %	Comments
1	1.0		9.0	
2	1.3			
3	1.0			
4	1.0			
5	1.0			
6	0.9			
7	1.1			
8	1.0			
9	0.9			
10	0.9			
11	0.8			
12	0.8			
13	0.7			
14	0.8			
15	0.8			
16	0.8			
17	0.8			
18	0.8			
19	1.0			
20	1.1			
21	1.2			
22	1.3			
23	1.3			
24	1.2			

Run # 1
011

5-01-79

5

Section 3.6.12

Nitrogen Oxide Field Data Form
(English units)

Plant Newton AFB Bldg 716 City
 Sample location Bldg 716 Date 28 Apr 81
 Operator Barometric pressure (P_{bar}) 24.775 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V _{fl}) ml	Initial pressure mm Hg		Initial temperature	
						Leg A,	Leg B,	°F (t _i)	°R (T _i)
1-1	P _{0.1} + A	0915	340	13	~~2059~~ 2059			85	
1-2	P _{0.1} + A	0930	325	14	2080			82	
1-3	P _{0.1} + B	0945	335	15	2082			80	
1-4	P _{0.1} + B	1005	210	14	2043			80	

* P_i = P_{bar} - (A + B)

* T_i = t_i + 460°F

Run #1
0.1

5-01-79

7

Section 3.8.12

NO. Sample Recovery and Integrity Data Form
(English units)

Plant Nuclear AFB Bldg 716 Date 29 Apr 89
 Sample recovery personnel Barometric pressure, (P_{bar}) in. Hg
 Person with direct responsibility for recovered samples Capt V. A. W. G.

Sample number	Final Pressure, mm Hg			Final temperature, °R (T_1), °F (T_1) ^a		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A ₁	Leg B ₁	P ₁ ^b	°F (T_1)	°R (T_1) ^a				
1-1			712	20		0855	10	✓	
1-2			711	20		0910	10	✓	
1-3			711	20		0920	10	✓	
1-4			712	20		0925	10	✓	

^a $P_1 = P_{bar} - (A_1 + B_1)$

^b $T_1 = t_1 + 460^\circ\text{F}$

Lab person with direct responsibility for recovered samples

Date recovered samples received Analyst

All samples identifiable? All liquids at marked level?

Remarks

Signature of lab sample trustee

Quality Assurance Handbook M7-4.2A

Run # 2
011

5-01-79

5

Section 3.6.12

Nitrogen Oxide Field Data Form
(English units)

Plant Newton AFB Bldg 716 City
 Sample location Bldg 716 Date 28 Apr 89
 Operator Barometric pressure (P_{bar}) 29.775 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V _{fl}) ml	Initial pressure mm Hg			Initial temperature	
						Leg A,	Leg B,	P _i	°F (t _i)	°R (T _i)
2-1	Port B	1105	300	17	2066			60	84	
2-2	Port B	1120	390	18	2074			57	88	
2-3	Port A	1140	290	19	2061			59	88	
2-4	Port A	1155	275	20	2102			64	91	

$$P_i = P_{\text{bar}} - (A_i + B_i)$$

$$T_i = t_i + 460^\circ\text{F}$$

Run # 2

oil

5-01-79

7

Section 3.6.12

NO. Sample Recovery and Integrity Data Form
(English units)

Plant Norfolk AFB Bldg 716 Date 29 Apr 89
 Sample recovery personnel Capt Vaughn Barometric pressure, (P_{bar}) _____ in. Hg
 Person with direct responsibility for recovered samples _____

Sample number	Final Pressure, mm. Hg			Final temperature,		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A ₁	Leg B ₁	P ₁ ^a	°F (t ₁)	°R (T ₁) ^b				
2-1			708	20		0935	10	✓	
2-2			705	20		0945	10	✓	
2-3			696	20		0955	10	✓	
2-4			692	20		1005	10	✓	

^a $P_1 = P_{bar} - (A_1 + B_1)$ ^b $T_1 = t_1 + 460^\circ F.$

Lab person with direct responsibility for recovered samples _____

Date recovered samples received _____ Analyst _____

All samples identifiable? _____ All liquids at marked level? _____

Remarks _____

Signature of lab sample trustee _____

Quality Assurance Handbook M7-4.2A

Run #3
0.1

5-01-79

5

Section 3.6.12

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB Bldg 716 City
 Sample location Bldg 716 Date 28 Apr 81
 Operator Barometric pressure (P_{bar}) 29.775 in. Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V _{fl}) ml	Initial pressure mm Hg			Initial temperature	
						Leg A,	Leg B,	P _i ^a	°F (t _i)	°R (T _i) ^b
3-1	Port A	1225	220	21	2080			60	93	
3-2	Port A	1245	286	22	2062			63	94	
3-3	Port B	1305	320	26	2054 ~~2066~~			64	91	
3-4	Port B	1320	330	27	2059			63	86	

^aP_i = P_{bar} - (A + B)

^bT_i = t_i + 460°F

Run # 3

0.1

5-01-79

7

Section 3.6.12

NO. Sample Recovery and Integrity Data Form
(English units)

Plant Norfolk AF3 Bldg 716 Date 29 Apr 89
Sample recovery personnel _____ Barometric pressure. (P_{bar}) _____ in. Hg

Person with direct responsibility for recovered samples _____

Sample number	Final Pressure, mm Hg			Final temperature, °R (T_f) ^a		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A ₁	Leg B ₁	P ₁ ^b	°F (t_f)	°R (T_f) ^a				
3-1			700	20		1020	10	✓	
3-2			696	20		1030	10	✓	
3-3			698	20		1040	10	✓	
3-4			701	22		1050	10	✓	

^a $P_1 = P_{bar} - (A_1 + B_1)$

^b $T_1 = t_1 + 460^\circ F.$

Lab person with direct responsibility for recovered samples _____

Date recovered samples received _____ Analyst _____

All samples identifiable? _____ All liquids at marked level? _____

Remarks _____

Signature of lab sample trustee _____

Quality Assurance Handbook M7-4.2A

APPENDIX G
ACETONE BLANK RESULTS

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AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE <i>Norton AFB</i>		DATE <i>03 MAY 89</i>		RUN NUMBER <i>Acetone Blank</i>	
BUILDING NUMBER			SOURCE NUMBER		
I. PARTICULATES					
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)		
FILTER NUMBER					
ACETONE WASHINGS (Probe, Front Half Filter)	<i>103.7766</i>	<i>103.7776</i>	<i>(-) .0010</i>		
BACK HALF (If needed)					
	Total Weight of Particulates Collected		<i>(-) .0010 gm</i>		
II. WATER					
ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)		
IMPINGER 1 (H2O)					
IMPINGER 2 (H2O)					
IMPINGER 3 (Dry)					
IMPINGER 4 (Silica Gel)					
	Total Weight of Water Collected		<i>gm</i>		
III. GASES (Dry)					
ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO ₂					
VOL % O ₂					
VOL % CO					
VOL % N ₂					
Vol % N ₂ = (100 - % CO ₂ - % O ₂ - % CO)					

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APPENDIX H
EMISSIONS CALCULATIONS

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XROM "METH 5"

RUN NUMBER
BOILER, BLDG 672, RUN 1

METER BOX Y? RUN
1.0020 RUN

DELTA H? RUN
3.0500 RUN

BAR PRESS ? RUN
28.7300 RUN

METER VOL ? RUN
56.5540 RUN

MTR TEMP F? RUN
108.0000 RUN

% OTHER GAS
REMOVED BEFORE
DRY GAS METER ? RUN

STATIC HOH IN ? RUN
.1100 RUN

STACK TEMP. RUN
392.0000 RUN

ML. WATER ? RUN
114.9000 RUN

IMP. % HOH = 9.6

% HOH=9.6

% CO2? RUN
4.3000 RUN

% OXYGEN? RUN
13.7000 RUN

% CO ? RUN

MOL WT OTHER? RUN

MWd =29.24
MW WET=28.16

SQRT PSTS ? RUN
7.7461 RUN

TIME MIN ? RUN
60.0000 RUN

NOZZLE DIA ? RUN
.4990 RUN

STK DIA INCH ? RUN
24.0000 RUN

* VOL MTR STD = 50.976
STK PRES ABS = 28.74
VOL HOH GAS = 5.41
% MOISTURE = 9.59
MOL DRY GAS = 0.904
% NITROGEN = 82.00
MOL WT DRY = 29.24
MOL WT WET = 28.16
VELOCITY FPS = 19.55
STACK AREA = 3.14
STACK AREA = 3.538
STACK ISOCPM = 1.984
% ISOINETIC = 99.14

XROM "METH 5"

RUN NUMBER
BOILER, BLDG 672, RUN 2

METER BOX Y? RUN
1.0020 RUN

DELTA H? RUN
2.6100 RUN

BAR PRESS ? RUN
28.7300 RUN

METER VOL ? RUN
52.9330 RUN

MTR TEMP F? RUN
105.0000 RUN

% OTHER GAS
REMOVED BEFORE
DRY GAS METER ? RUN

STATIC HOH IN ? RUN
.1100 RUN

STACK TEMP. RUN
401.0000 RUN

ML. WATER ? RUN
120.1000 RUN

IMP. % HOH = 10.6

% HOH=10.6

% CO2? RUN
7.0000 RUN

% OXYGEN? RUN
8.6000 RUN

% CO ? RUN

MOL WT OTHER? RUN

MWd =29.46
MW WET=28.25

SQRT PSTS ? RUN
7.4475 RUN

TIME MIN ? RUN
60.0000 RUN

NOZZLE DIA ? RUN
.4990 RUN

STK DIA INCH ? RUN
24.0000 RUN

* VOL MTR STD = 47.912
STK PRES ABS = 28.74
VOL HOH GAS = 5.65
% MOISTURE = 10.55
MOL DRY GAS = 0.894
% NITROGEN = 84.40
MOL WT DRY = 29.46
MOL WT WET = 28.25
VELOCITY FPS = 18.77
STACK AREA = 3.14
STACK AREA = 3.538
* STACK ISOCPM = 1.984
% ISOINETIC = 99.14

XROM "METH 5"

RUN NUMBER
BOILER, BLDG 672, RUN 3

METER BOX Y? RUN
1.0020 RUN

DELTA H? RUN
2.4400 RUN

BAR PRESS ? RUN
28.7300 RUN

METER VOL ? RUN
51.3830 RUN

MTR TEMP F? RUN
112.0000 RUN

% OTHER GAS
REMOVED BEFORE
DRY GAS METER ? RUN

STATIC HOH IN ? RUN
.1100 RUN

STACK TEMP. RUN
389.0000 RUN

ML. WATER ? RUN
139.6000 RUN

IMP. % HOH = 12.5

% HOH=12.5

% CO2? RUN
7.0000 RUN

% OXYGEN? RUN
9.0000 RUN

% CO ? RUN

MOL WT OTHER? RUN

MWd =29.48
MW WET=28.04

SQRT PSTS ? RUN
7.1984 RUN

TIME MIN ? RUN
60.0000 RUN

NOZZLE DIA ? RUN
.4990 RUN

STK DIA INCH ? RUN
24.0000 RUN

* VOL MTR STD = 45.920
STK PRES ABS = 28.74
VOL HOH GAS = 6.57
% MOISTURE = 12.52
MOL DRY GAS = 0.875
% NITROGEN = 84.00
MOL WT DRY = 29.48
MOL WT WET = 28.04
VELOCITY FPS = 18.19
STACK AREA = 3.14
STACK AREA = 3.429
* STACK ISOCPM = 1.793
% ISOINETIC = 99.57

XROM "MASSFLO"

RUN NUMBER
BOILER, BLDG 672, RUN 1
RUN

VOL MTR STD ?

50.9760 RUN

STACK DSCFM ?

1,984.0000 RUN

FRONT 1/2 MG ?

.0109 RUN

BACK 1/2 MG ?

0.0000 RUN

F GR/DSCF = 3.2998E-6

F MG/MMH = 0.0076

F LB/HR = 0.0001

F KG/HR = 2.5454E-5

XROM "MASSFLO"

RUN NUMBER
BOILER BLDG 672, RUN 2
RUN

VOL MTR STD ?

47.9120 RUN

STACK DSCFM ?

1,864.0000 RUN

FRONT 1/2 MG ?

.0067 RUN

BACK 1/2 MG ?

0.0000 RUN

F GR/DSCF = 2.1500E-6

F MG/MMH = 0.0049

F LB/HR = 3.4479E-5

F KG/HR = 1.5640E-5

XROM "MASSFLO"

RUN NUMBER
BOILER, BLDG 672, RUN 3
RUN

VOL MTR STD ?

45.9200 RUN

STACK DSCFM ?

1,792.0000 RUN

FRONT 1/2 MG ?

.0068 RUN

BACK 1/2 MG ?

0.0000 RUN

F GR/DSCF = 2.2852E-6

F MG/MMH = 0.0052

F LB/HR = 3.5101E-5

F KG/HR = 1.5922E-5

XROM "METH 5"
 RUN NUMBER
 BOILER 1, BLD 249, RUN 1
 RUN
 METER BOX Y?
 1.0020 RUN
 DELTA H?
 1.6500 RUN
 BAR PRESS ?
 28.7050 RUN
 METER VOL ?
 41.3510 RUN
 MTR TEMP F?
 78.0000 RUN
 % OTHER GAS
 REMOVED BEFORE
 DRY GAS METER ?
 RUN
 STATIC HOH IN ?
 .0500 RUN
 STACK TEMP.
 369.0000 RUN
 ML. WATER ?
 100.6000 RUN
 IMP. % HOH = 10.8
 % HOH=10.8
 % CO2?
 6.0000 RUN
 % OXYGEN?
 9.8000 RUN
 % CO ?
 RUN
 MOL WT OTHER?
 RUN
 MWD =29.35
 MW WET=28.13

SORT PSTS ?
 10.3360 RUN
 TIME MIN ?
 60.0000 RUN
 NOZZLE DIA ?
 .3750 RUN
 STK DIA INCH ?
 19.0000 RUN

* VOL MTR STD = 29.177
 STK PRES ABS = 28.71
 VOL HOH GAS = 4.74
 % MOISTURE = 10.78
 MOL DRY GAS = 0.892
 % NITROGEN = 84.20
 MOL WT DRY = 29.35
 MOL WT WET = 28.13
 VELOCITY FPS = 26.13
 STACK AREA = 1.97
 STACK ACFM = 3.018
 * STACK ISOCFM = 1.600
 % ISOINETIC = 100.94

XROM "METH 5"
 RUN NUMBER
 BOILER 1, BLD 249, RUN 2
 RUN
 METER BOX Y?
 1.0020 RUN
 DELTA H?
 1.6000 RUN
 BAR PRESS ?
 28.7050 RUN
 METER VOL ?
 40.5920 RUN
 MTR TEMP F?
 87.0000 RUN
 % OTHER GAS
 REMOVED BEFORE
 DRY GAS METER ?
 RUN
 STATIC HOH IN ?
 .0500 RUN
 STACK TEMP.
 377.0000 RUN
 ML. WATER ?
 128.6000 RUN
 IMP. % HOH = 13.8
 % HOH=13.8
 % CO2?
 5.2000 RUN
 % OXYGEN?
 10.6000 RUN
 % CO ?
 RUN
 MOL WT OTHER?
 RUN
 MWD =29.26
 MW WET=27.70

SORT PSTS ?
 10.2150 RUN
 TIME MIN ?
 60.0000 RUN
 NOZZLE DIA ?
 .3750 RUN
 STK DIA INCH ?
 19.0000 RUN

* VOL MTR STD = 37.820
 STK PRES ABS = 28.71
 VOL HOH GAS = 6.05
 % MOISTURE = 13.80
 MOL DRY GAS = 0.862
 % NITROGEN = 84.20
 MOL WT DRY = 29.26
 MOL WT WET = 27.70
 VELOCITY FPS = 26.01
 STACK AREA = 1.97
 STACK ACFM = 3.070
 * STACK ISOCFM = 1.600
 % ISOINETIC = 100.94

XROM "METH 5"
 RUN NUMBER
 BOILER 1, BLD 249, RUN 3
 RUN
 METER BOX Y?
 1.0020 RUN
 DELTA H?
 1.6000 RUN
 BAR PRESS ?
 28.7050 RUN
 METER VOL ?
 42.0440 RUN
 MTR TEMP F?
 86.0000 RUN
 % OTHER GAS
 REMOVED BEFORE
 DRY GAS METER ?
 RUN
 STATIC HOH IN ?
 .0500 RUN
 STACK TEMP.
 377.0000 RUN
 ML. WATER ?
 149.7000 RUN
 IMP. % HOH = 15.2
 % HOH=15.2
 % CO2?
 5.6000 RUN
 % OXYGEN?
 9.8000 RUN
 % CO ?
 RUN
 MOL WT OTHER?
 RUN
 MWD =29.29
 MW WET=27.57

SORT PSTS ?
 10.2800 RUN
 TIME MIN ?
 60.0000 RUN
 NOZZLE DIA ?
 .3750 RUN
 STK DIA INCH ?
 19.0000 RUN

* VOL MTR STD = 39.245
 STK PRES ABS = 28.71
 VOL HOH GAS = 7.05
 % MOISTURE = 15.22
 MOL DRY GAS = 0.848
 % NITROGEN = 84.60
 MOL WT DRY = 29.29
 MOL WT WET = 27.57
 VELOCITY FPS = 26.24
 STACK AREA = 1.97
 STACK ACFM = 3.100
 * STACK ISOCFM = 1.590
 % ISOINETIC = 100.90

XROM "MASSFLO"

RUN NUMBER
 BOILER 1, BLD 249, RUN 1
 RUN

VOL MTR STD ?
 39.1770 RUN
 STACK DSCFM ?
 1.682.0000 RUN
 FRONT 1/2 MG ?
 .0059 RUN
 BACK 1/2 MG ?
 0.0000 RUN

F GR/DSCF = 2.3241E-6
 F MG/MMH = 0.0053
 F LB/HR = 3.3506E-5
 F KG/HR = 1.5198E-5

XROM "MASSFLO"

RUN NUMBER
 BOILER 2, BLD 249, RUN 2
 RUN

VOL MTR STD ?
 37.8200 RUN
 STACK DSCFM ?
 1.603.0000 RUN
 FRONT 1/2 MG ?
 .0040 RUN
 BACK 1/2 MG ?
 0.0000 RUN

F GR/DSCF = 1.6322E-6
 F MG/MMH = 0.0037
 F LB/HR = 2.2426E-5
 F KG/HR = 1.0172E-5

XROM "MASSFLO"

RUN NUMBER
 BOILER 1, BLD 249, RUN 3
 RUN

VOL MTR STD ?
 39.2450 RUN
 STACK DSCFM ?
 1.591.0000 RUN
 FRONT 1/2 MG ?
 .0040 RUN
 BACK 1/2 MG ?
 0.0000 RUN

F GR/DSCF = 1.5729E-6
 F MG/MMH = 0.0036
 F LB/HR = 2.1450E-5
 F KG/HR = 9.7296E-6

NATURAL GAS RUN

XROM -METH 5-

RUN NUMBER
 BOIL. 4, BLD 716, RUN 1
 METER BOX Y?
 1.0020 RUN
 DELTA H?
 2.4500 RUN
 BAR PRESS ?
 28.8650 RUN
 METER VOL ?
 49.7940 RUN
 MTR TEMP F?
 83.0000 RUN
 % OTHER GAS
 REMOVED BEFORE
 DRY GAS METER ?
 RUN
 STATIC HOH IN ?
 .0450 RUN
 STACK TEMP.
 449.0000 RUN
 ML. WATER ?
 208.9000 RUN
 IMP. % HOH = 17.3
 % HOH=17.3
 % CO2?
 9.0000 RUN
 % OXYGEN?
 4.0000 RUN
 % CO ?
 RUN
 MOL WT OTHER?
 RUN
 MWD =29.60
 MW WET=27.60

SOFT PSTS ?
 7.0857 RUN
 TIME MIN ?
 60.0000 RUN
 NOZZLE DIA ?
 .5000 RUN
 STK DIA INCH ?
 40.0000 RUN

* VOL MTR STD = 47.097
 STK PRES ABS = 28.87
 VOL HOH GAS = 9.83
 % MOISTURE = 17.27
 MOL DRY GAS = 0.827
 % NITROGEN = 87.00
 MOL WT DRY = 29.60
 MOL WT WET = 27.60
 VELOCITY FPS = 20.06
 STACK AREA = 8.73
 STACK ACFM = 10.525.
 STACK ISCVM = 4.571.
 % ISOINETIC = 100.20

XROM -METH 5-

RUN NUMBER
 BOIL. 4, BLD 716, RUN 2
 METER BOX Y?
 1.0020 RUN
 DELTA H?
 2.6400 RUN
 BAR PRESS ?
 28.8650 RUN
 METER VOL ?
 53.7810 RUN
 MTR TEMP F?
 95.0000 RUN
 % OTHER GAS
 REMOVED BEFORE
 DRY GAS METER ?
 RUN
 STATIC HOH IN ?
 .0450 RUN
 STACK TEMP.
 404.0000 RUN
 ML. WATER ?
 202.0000 RUN
 IMP. % HOH = 16.0
 % HOH=16.0
 % CO2?
 7.0000 RUN
 % OXYGEN?
 5.8000 RUN
 % CO ?
 RUN
 MOL WT OTHER?
 RUN
 MWD =29.35
 MW WET=27.53

SOFT PSTS ?
 7.6686 RUN
 TIME MIN ?
 60.0000 RUN
 NOZZLE DIA ?
 .5000 RUN
 STK DIA INCH ?
 40.0000 RUN

* VOL MTR STD = 49.792
 STK PRES ABS = 28.87
 VOL HOH GAS = 9.51
 % MOISTURE = 16.03
 MOL DRY GAS = 0.840
 % NITROGEN = 87.20
 MOL WT DRY = 29.35
 MOL WT WET = 27.53
 VELOCITY FPS = 19.53
 STACK AREA = 8.73
 STACK ACFM = 10.328.
 * STACK DSCFM = 5.064.
 % ISOINETIC = 104.25

XROM -METH 5-

RUN NUMBER
 BOIL. 4, BLD 716, RUN 3
 METER BOX Y?
 1.0020 RUN
 DELTA H?
 2.6000 RUN
 BAR PRESS ?
 28.8650 RUN
 METER VOL ?
 51.7660 RUN
 MTR TEMP F?
 102.0000 RUN
 % OTHER GAS
 REMOVED BEFORE
 DRY GAS METER ?
 RUN
 STATIC HOH IN ?
 .0450 RUN
 STACK TEMP.
 436.0000 RUN
 ML. WATER ?
 209.4000 RUN
 IMP. % HOH = 17.2
 % HOH=17.2
 % CO2?
 9.0000 RUN
 % OXYGEN?
 3.0000 RUN
 % CO ?
 RUN
 MOL WT OTHER?
 RUN
 MWD =29.56
 MW WET=27.57

SOFT PSTS ?
 7.8690 RUN
 TIME MIN ?
 60.0000 RUN
 NOZZLE DIA ?
 .5000 RUN
 STK DIA INCH ?
 40.0000 RUN

* VOL MTR STD = 47.324
 STK PRES ABS = 28.87
 VOL HOH GAS = 9.86
 % MOISTURE = 17.24
 MOL DRY GAS = 0.828
 % NITROGEN = 88.00
 MOL WT DRY = 29.56
 MOL WT WET = 27.57
 VELOCITY FPS = 20.03
 STACK AREA = 8.73
 STACK ACFM = 10.499.
 * STACK DSCFM = 4.536.
 % ISOINETIC = 102.57

XROM "MASSFLO"

RUN NUMBER
BOIL. 4, BLD 716, RUN 1
RUN

VOL MTR STD ?
47.0970 RUN
STACK DSCFM ?
4,871.0000 RUN
FRONT 1/2 MG ?
.0138 RUN
BACK 1/2 MG ?
0.0000 RUN

F GR/DSCF = 4.5218E-6
F MG/MMH = 0.0103
F LB/HR = 0.0002
F KG/HR = 0.0001

XROM "MASSFLO"

RUN NUMBER
BOIL. 4, BLD 716, RUN 2
RUN

VOL MTR STD ?
49.7920 RUN
STACK DSCFM ?
5,064.0000 RUN
FRONT 1/2 MG ?
.0088 RUN
BACK 1/2 MG ?
0.0000 RUN

F GR/DSCF = 2.7274E-6
F MG/MMH = 0.0062
F LB/HR = 0.0001
F KG/HR = 0.0001

XROM "MASSFLO"

RUN NUMBER
BOIL. 4, BLD 716, RUN 3
RUN

VOL MTR STD ?
47.3240 RUN
STACK DSCFM ?
4,936.0000 RUN
FRONT 1/2 MG ?
.0086 RUN
BACK 1/2 MG ?
0.0000 RUN

F GR/DSCF = 2.8044E-6
F MG/MMH = 0.0064
F LB/HR = 0.0001
F KG/HR = 0.0001

FUEL OIL RUN

XROM -METH 5-

RUN NUMBER
BOIL. 4. OIL RUN 1

METER BOX Y? RUN
1.0020 RUN

DELTA H? RUN
2.3000 RUN

BAR PRESS ? RUN
28.7750 RUN

METER VOL ? RUN
48.7040 RUN

MTR TEMP F? RUN
96.0000 RUN

% OTHER GAS
REMOVED BEFORE
DRY GAS METER ? RUN

STATIC HOH IN ? RUN
.1100 RUN

STACK TEMP. RUN
425.0000 RUN

ML. WATER ? RUN
87.7000 RUN

IMP. % HOH = 8.4

% HOH=8.4

% CO2? RUN
10.4000 RUN

% OXYGEN? RUN
4.4000 RUN

% CO ? RUN

MOL WT OTHER? RUN

MWd =29.84
MW WET=28.84

SORT PSTS ? RUN
7.6731 RUN

TIME MIN ? RUN
60.0000 RUN

NOZZLE DIA ? RUN
.5000 RUN

STK DIA INCH ? RUN
40.0000 RUN

* VOL MTR STD = 44.832
STK PRES ABS = 28.78
VOL HOH GAS = 4.13
% MOISTURE = 8.43
MOL DRY GAS = 0.916
% NITROGEN = 85.20
MOL WT DRY = 29.84
MOL WT WET = 28.84
VELOCITY FPS = 19.12
STACK AREA = 8.77
STACK ACFM = 10.013
STACK DSCFM = 5.263
% ISOINETIC = 90.97

XROM -METH 5-

RUN NUMBER
BOIL. 4. OIL RUN 2 RUN

METER BOX Y? RUN
1.0020 RUN

DELTA H? RUN
2.3200 RUN

BAR PRESS ? RUN
28.7750 RUN

METER VOL ? RUN
49.0410 RUN

MTR TEMP F? RUN
107.0000 RUN

% OTHER GAS
REMOVED BEFORE
DRY GAS METER ? RUN

STATIC HOH IN ? RUN
.1100 RUN

STACK TEMP. RUN
419.0000 RUN

ML. WATER ? RUN
105.9000 RUN

IMP. % HOH = 10.1

% HOH=10.1

% CO2? RUN
10.0000 RUN

% OXYGEN? RUN
4.5500 RUN

% CO ? RUN

MOL WT OTHER? RUN

MWd =29.78
MW WET=28.59

SORT PSTS ? RUN
7.5915 RUN

TIME MIN ? RUN
60.0000 RUN

NOZZLE DIA ? RUN
.5000 RUN

STK DIA INCH ? RUN
40.0000 RUN

* VOL MTR STD = 44.269
STK PRES ABS = 28.78
VOL HOH GAS = 4.98
% MOISTURE = 10.12
MOL DRY GAS = 0.899
% NITROGEN = 85.45
MOL WT DRY = 29.78
MOL WT WET = 28.59
VELOCITY FPS = 19.00
STACK AREA = 8.73
STACK ACFM = 9.951
STACK DSCFM = 5.168
% ISOINETIC = 91.43

XROM -METH 5-

RUN NUMBER
BOIL. 4. OIL RUN 3 RUN

METER BOX Y? RUN
1.0020 RUN

DELTA H? RUN
2.5300 RUN

BAR PRESS ? RUN
28.7750 RUN

METER VOL ? RUN
52.3490 RUN

MTR TEMP F? RUN
106.0000 RUN

% OTHER GAS
REMOVED BEFORE
DRY GAS METER ? RUN

STATIC HOH IN ? RUN
.1100 RUN

STACK TEMP. RUN
427.0000 RUN

ML. WATER ? RUN
150.8000 RUN

IMP. % HOH = 13.0

% HOH=13.0

% CO2? RUN
9.0000 RUN

% OXYGEN? RUN
4.4000 RUN

% CO ? RUN

MOL WT OTHER? RUN

MWd =29.62
MW WET=28.10

SORT PSTS ? RUN
8.0032 RUN

TIME MIN ? RUN
60.0000 RUN

NOZZLE DIA ? RUN
.5000 RUN

STK DIA INCH ? RUN
40.0000 RUN

* VOL MTR STD = 47.364
STK PRES ABS = 28.78
VOL HOH GAS = 7.10
% MOISTURE = 13.03
MOL DRY GAS = 0.870
% NITROGEN = 86.60
MOL WT DRY = 29.62
MOL WT WET = 28.10
VELOCITY FPS = 20.21
STACK AREA = 8.73
STACK ACFM = 10.561
STACK DSCFM = 5.265
% ISOINETIC = 95.97

XROM "MASSFLO"

RUN NUMBER
 BOIL. 4, OIL 716 RUN 3
 RUN

VOL MTR STD ?
 47.3640 RUN

STACK DSCFM ?
 5.269.0000 RUN

FRONT 1/2 MG ?
 .0494 RUN

BACK 1/2 MG ?
 0.0000 RUN

F GR/DSCF = 1.6095E-5
 F MG/MMM = 0.0368
 F LB/HR = 0.0007
 F KG/HR = 0.0003

XROM "MASSFLO"

RUN NUMBER
 BOIL. 4, OIL 716 RUN 2
 RUN

VOL MTR STD ?
 44.2690 RUN

STACK DSCFM ?
 5.168.0000 RUN

FRONT 1/2 MG ?
 .0512 RUN

BACK 1/2 MG ?
 0.0000 RUN

F GR/DSCF = 1.7848E-5
 F MG/MMM = 0.0408
 F LB/HR = 0.0008
 F KG/HR = 0.0004

XROM "MASSFLO"

RUN NUMBER
 BOIL. 4, OIL 716 RUN 1
 RUN

VOL MTR STD ?
 44.8320 RUN

STACK DSCFM ?
 5.263.0000 RUN

FRONT 1/2 MG ?
 .0480 RUN

BACK 1/2 MG ?
 0.0000 RUN

F GR/DSCF = 1.6523E-5
 F MG/MMM = 0.0378
 F LB/HR = 0.0007
 F KG/HR = 0.0003

LABORATORY ANALYSIS REPORT AND RECORD (General)

DATE

16 May 89

TO:

FROM:

USAF OEH L/SA
BROOKS AFB TX 78235-5501

SAMPLE IDENTITY

GY 890017 thru GY 890028, air samples

DATE RECEIVED

9 May 89

SAMPLE FROM

B/672

LAB CONTROL/IN

26503 thru 26514

TEST FOR

Carbon Monoxide

METHODOLOGY: Infrared Spectrograph, ED X-ray; Gas Chromatograph; Other; *San Cell*
closed cup Flash Pt. Tester: pH measurement; Atomic AbsorptionOEH L
NOBASE
NO

RESULTS PPM

26503 890017 10

26504 890018 10

26505 890019 10

26506 890020 < 10

26507 890021 < 10

26508 890022 < 10

26509 890023 65

26510 890024 10

26511 890025 570

26512 890026 < 10

26513 890027 < 10

26514 890028 < 10

REQUESTING AGENCY (Mailing Address)

AF OEH L / EC Q
Capt VaughanJ.D. Hillsberry 17
J.D. HILLSBERRY, GS-12
Chief, Industrial Products and
Compressed Gas Analyses Section

CARBON MONOXIDE CALCULATION FORM

Plant NORTON AFB Date 20 MAY 89
 Sample location BLD 672
 Test number 1, 2, 3
 Bag number GN890017, GN890018, GN890019
 Operator LT ALI

CO Concentration

$$C_{CO_NDIR} = \frac{10, 10, 10}{---} \text{ ppm (dry basis).}$$

$$F_{CO_2} = \frac{4.3, 7.0, 7.0}{---} \% \div 100 = \frac{.043, .07, .07}{---}$$

$$C_{CO_stack} = C_{CO_NDIR} (1 - F_{CO_2}).$$

$$= \frac{10, 10, 10}{---} (1 - \frac{.043, .07, .07}{---}) = \frac{9.57, 9.3, 9.3}{---} \text{ ppm (dry basis).}$$

AVERAGE CO CONCENTRATION = 9.39 ppm (dry basis).

Errors:

CARBON MONOXIDE CALCULATION FORM

Plant NORTON AFB Date 20 MAY 89
 Sample location BLD 249
 Test number 1, 2, 3
 Bag number GN890020, GN890021, GN890022
 Operator LT MCI

CO Concentration

$$C_{CO_NDIR} = \overset{110, 110, 110}{\text{---}} \text{ ppm (dry basis).}$$

$$F_{CO_2} = \overset{6.0, 5.2, 5.6}{\text{---}} \% \div 100 = \overset{.06, .052, .056}{0. \text{---}}$$

$$C_{CO_stack} = C_{CO_NDIR} (1 - F_{CO_2}).$$

$$= \overset{10, 10, 10}{\text{---}} (1 - \overset{0.06, .052, .056}{0. \text{---}}) = \overset{9.4, 9.48, 9.44}{\text{---}} \text{ ppm (dry basis).}$$

AVERAGE CO CONCENTRATION = 9.44 ppm (dry basis).

Errors:

CARBON MONOXIDE CALCULATION FORM

Plant NORTON AFB Date 20 MAY 89
 Sample location BLD 716 (GAS FIRED)
 Test number 1, 2, 3
 Bag number GN 890023, GN 890024, GN 890025
 Operator LT ALI

CO Concentration

$$C_{CO_{NDIR}} = \frac{65, 10, 570}{- - -} \text{ ppm (dry basis).}$$

$$F_{CO_2} = \frac{9.0, 7.0, 9.0}{- - -} \% \div 100 = \frac{0.09, .07, .09}{0. - -}$$

$$C_{CO_{stack}} = C_{CO_{NDIR}} (1 - F_{CO_2}).$$

$$\frac{65, 10, 570}{- - -} \cdot \frac{.09, .07, .09}{0. - - -} = \frac{59.15, 9.30, 518.7}{- - -} \text{ ppm (dry basis).}$$

AVERAGE CO CONCENTRATION: 195. ppm (dry basis).

Errors:

CARBON MONOXIDE CALCULATION FORM

Plant NOXTON AFB Date 28 APR 89
 Sample location BLD 716 (Oil Field)
 Test number 1, 2, 3
 Bag number GN 890026, GN 890027, GN 890028
 Operator LT AZI

CO Concentration

$$C_{CO_{NDIR}} = \overset{11.0, 11.0, 11.0}{\text{---}} \text{ ppm (dry basis).}$$

$$F_{CO_2} = \overset{10.4, 10.0, 9.0}{\text{---}} \% \div 100 = \overset{.104, .100, .090}{0. \text{---}}$$

$$C_{CO_{stack}} = C_{CO_{NDIR}} (1 - F_{CO_2}).$$

$$= \overset{10, 10, 10}{\text{---}} (1 - \overset{.104, .100, .090}{0. \text{---}}) = \overset{8.96, 9.00, 9.10}{\text{---}} \text{ ppm (dry basis).}$$

AVERAGE CO CONCENTRATION: 9.02

Errors:

. LABORATORY ANALYSIS REPORT AND RECORD (General)		DATE 29 JUN 1989
TO:	FROM:	
SAMPLE IDENTITY Air/Impinger Solution		DATE RECEIVED 11 MAY 89
SAMPLE FROM BLDG 672		LAB CONTROL NR 27125 - 174
TEST FOR Nitrogen Oxides		
REFERENCED METHOD: Method #7, 42 CFR, #160, Part II ANALYSIS DATE: June 8, 1989		
<u>LAB #</u>	<u>OEHL #</u>	<u>BASE #</u>
		<u>ANALYTICAL RESULTS</u> (µg NO ₂)
Quantitation Limit		100
89-05-294-01	27125	GX890029
89-05-294-02	27126	GX890030
89-05-294-03	27127	GX890031
89-05-294-04	27128	GX890032
89-05-294-05	27129	GX890033
89-05-294-06	27130	GX890034
89-05-294-07	27131	GX890035
89-05-294-08	27132	GX890036
89-05-294-09	27133	GX890037
89-05-294-10	27134	GX890038
89-05-294-11	27135	GX890039
89-05-294-12	27136	GX890040
89-05-294-13	27137	GX890041
89-05-294-14	27138	GX890042
89-05-294-15	27139	GX890043
89-05-294-16	27140	GX890044
89-05-294-17	27141	GX890045
89-05-294-18	27142	GX890046
89-05-294-19	27143	GX890047
89-05-294-20	27145	GX890049
89-05-294-21	27146	GX890050
89-05-294-22	27148	GX890052
89-05-294-23	27149	GX890053
89-05-294-24	27150	GX890054
89-05-294-25	27151	GX890055
89-05-294-26	27152	GX890056
89-05-294-27	27153	GX890057
REQUESTING AGENCY (Mailing Address)		
AFOEHL / ECR ATT CAPT VANGHAN		
		Analyzed by Biospherics Incorporated

LABORATORY ANALYSIS REPORT AND RECORD (General)			DATE
TO:		FROM:	
SAMPLE IDENTITY Air/Impinger Solution			DATE RECEIVED
SAMPLE FROM			LAB CONTROL NR
TEST FOR Nitrogen Oxides			
REFERENCED METHOD: Method #7, 42 CFR, #160, Part II ANALYSIS DATE: June 8, 1989			
<u>LAB #</u>	<u>OEHL #</u>	<u>BASE #</u>	<u>ANALYTICAL RESULTS</u> ($\mu\text{g NO}_2$)
Quantitation Limit			100
89-05-294-28	27154	GX890058	200
89-05-294-29	27155	GX890059	210
89-05-294-30	27156	GX890060	190
89-05-294-31	27157	GX890061	200
89-05-294-32	27158	GX890062	190
89-05-294-33	27159	GX890063	170
89-05-294-34	27160	GX890064	150
89-05-294-35	27161	GX890065	320
89-05-294-36	27162	GX890066	410
89-05-294-37	27163	GX890067	450
89-05-294-38	27164	GX890068	330
89-05-294-39	27165	GX890069	380
89-05-294-40	27166	GX890070	340
89-05-294-41	27167	GX890071	310
89-05-294-42	27168	GX890072	370
89-05-296-01	27169	GX890073	340
89-05-296-02	27170	GX890074	350
89-05-296-03	27171	GX890075	340
89-05-296-04	27172	GX890076	400
89-05-296-05	27173	BK890077	*
89-05-296-06	27174	BK890078	*
*Sample broken during analysis. <i>Andrew Richardson</i> ANDREW RICHARDSON, III, GS-12 Chief, IH Analysis Section			
REQUESTING AGENCY (Mailing Address)			
Analyzed by Biospherics Incorporated			

1. Nitrogen Concentration Calculations

A. Calculation for sample volume, dry basis, corrected to standard conditions:

$$V_{sc} = K_1 (V_f - 25 \text{ ml}) \left(\frac{P_f}{T_f} - \frac{P_i}{T_i} \right)$$

where:

$$K_1 = 0.3858 \text{ K / mm Hg}$$

B. Sample concentration, dry basis, corrected to standard conditions:

$$C = K_2 \frac{m}{V_{sc}}$$

where:

$$K_2 = 10^3 \frac{\text{mg/m}^3}{\text{ug/ml}}$$

units:

- m = mass of NO₂ as NO₂ in gas sample, ug.
- P_f = final absolute pressure of flask, mm Hg.
- P_i = initial absolute pressure of flask, mm Hg.
- P_{std} = standard absolute pressure, 760 mm Hg.
- T_f = final absolute temperature of flask, K.
- T_i = initial absolute temperature of flask, K.
- T_{std} = standard absolute temperature, 293 K.
- V_{sc} = sample volume at standard conditions (dry basis), ml.
- V_f = volume of flask and valve, ml.

Bldg. 672

<u>Run - Sample</u>	<u>Vf</u>	<u>Pf</u>	<u>Pi</u>	<u>Tf</u>	<u>Ti</u>	<u>Vsc</u>
1 - 1	2085	682	62	295	314	1,680
1 - 2	2085	718	72	295	314	1,752
1 - 3	2054	711	70	295	320	1,715
1 - 4	2075	682	60	295	319	1,679
2 - 1	2090	677	62	294	320	1,680
2 - 2	2072	685	65	295	320	1,673
2 - 3	2066	682	64	295	319	1,662
2 - 4	2070	689	61	295	317	1,690
3 - 1	2089	678	59	295	316	1,681
3 - 2	2080	680	72	296	317	1,641
3 - 3	2084	680	71	296	320	1,648
3 - 4	2072	674	72	296	321	1,621

Bldg. 672

<u>Run - Sample</u>	<u>Vsc</u>	<u>n</u>	<u>C</u>
1 - 1	1,680	130	41
1 - 2	1,752	140	42
1 - 3	1,715	140	43
1 - 4	1,679	170	<u>53</u>
		ave	45
2 - 1	1,680	150	47
2 - 2	1,673	140	44
2 - 3	1,662	110	35
2 - 4	1,690	140	<u>44</u>
		ave	42
3 - 1	1,681	110	34
3 - 2	1,641	150	48
3 - 3	1,648	130	41
3 - 4	1,621	120	<u>39</u>
		ave	41

Average of 3 runs 43

Bldg. 249

<u>Run - Sample</u>	<u>Vf</u>	<u>Pf</u>	<u>Pi</u>	<u>Tf</u>	<u>Ti</u>	<u>Vsc</u>
1 - 1	2059	707	55	290	295	1,766
1 - 2	2080	708	56	291	296	1,778
1 - 3	2082	712	54	291	296	1,796
1 - 4	2043	715	53	291	297	1,773
2 - 1	2066	699	58	291	299	1,738
2 - 2	2074	694	61	292	299	1,717
2 - 3	2061	716	54	292	301	1,785
2 - 4	2102	711	61	293	297	1,779
3 - 1	2080	696	56	292	305	1,744
3 - 2	2062	695	58	292	301	1,719
3 - 3	2086	704	57	292	302	1,766
3 - 4	2066	716	53	292	295	1,789

Bldg. 249

<u>Run - Sample</u>	<u>Vsc</u>	<u>m</u>	<u>C</u>
1 - 1	1,766	120	36
1 - 2	1,778	130	38
1 - 3	1,796	120	35
1 - 4	1,773	150	<u>44</u>
		ave	38
2 - 1	1,738	140	42
2 - 2	1,717	140	43
2 - 3	1,785	130	38
2 - 4	1,779	135	<u>40</u>
		ave	41
3 - 1	1,744	150	45
3 - 2	1,719	150	46
3 - 3	1,766	150	45
3 - 4	1,789	150	<u>44</u>
		ave	45

average of 3 runs 41

Bldg. 716 Gas

<u>Run - Sample</u>	<u>Vf</u>	<u>Pf</u>	<u>Pi</u>	<u>Tf</u>	<u>Ti</u>	<u>Vsc</u>
1 - 1	2085	725	56	294	297	1,809
1 - 2	2054	728	52	296	296	1,787
1 - 3	2075	723	55	297	301	1,780
1 - 4	2070	712	56	296	303	1,751
2 - 1	2090	710	55	296	302	1,765
2 - 2	2072	712	56	296	300	1,752
2 - 3	2066	713	56	296	297	1,748
2 - 4	2070	712	55	296	304	1,755
3 - 1	2089	715	59	296	300	1,766
3 - 2	2080	716	54	296	304	1,776
3 - 3	2084	704	61	296	305	1,730
3 - 4	2072	702	55	296	304	1,730

Bldg. 716 gas

<u>Run - Sample</u>	<u>Vsc</u>	<u>m</u>	<u>C</u>
1 - 1	1,809	270	79
1 - 2	1,787	290	86
1 - 3	1,780	240	71
1 - 4	1,751	220	<u>66</u>
		ave	75
2 - 1	1,765	150	45
2 - 2	1,752	200	60
2 - 3	1,748	210	63
2 - 4	1,755	190	<u>57</u>
		ave	56
3 - 1	1,766	200	60
3 - 2	1,776	190	56
3 - 3	1,730	170	52
3 - 4	1,730	150	<u>46</u>
		ave	53

average of 3 runs 62

Bldg. 716 Oil

<u>Run - Sample</u>	<u>Vf</u>	<u>Pf</u>	<u>Pi</u>	<u>Tf</u>	<u>Ti</u>	<u>Vsc</u>
1 - 1	2059	712	54	293	302	1,766
1 - 2	2080	711	56	293	301	1,776
1 - 3	2082	711	57	293	300	1,774
1 - 4	2043	712	55	293	300	1,749
2 - 1	2066	708	60	293	302	1,746
2 - 2	2074	705	57	293	304	1,753
2 - 3	2061	696	59	293	304	1,713
2 - 4	2102	692	64	293	306	1,724
3 - 1	2080	700	60	293	307	1,739
3 - 2	2062	696	63	293	307	1,705
3 - 3	2059	698	64	293	306	1,705
3 - 4	2059	701	63	295	303	1.701

Bldg 716 oil

<u>Run - Sample</u>	<u>Vsc</u>	<u>m</u>	<u>C</u>
1 - 1	1,766	320	96
1 - 2	1,776	410	122
1 - 3	1,774	450	134
1 - 4	1,749	330	<u>100</u>
		ave	113
2 - 1	1,746	380	115
2 - 2	1,753	340	103
2 - 3	1,713	310	96
2 - 4	1,724	370	<u>114</u>
		ave	107
3 - 1	1,739	340	103
3 - 2	1,705	350	109
3 - 3	1,705	340	105
3 - 4	1,701	400	<u>124</u>
		ave	110

average of 3 runs 110

SERIAL # 11000903
ENERAC MODEL 2000
COMBUSTION TEST RECORD

FOR: WESTINGHOUSE CA.

TIME: 12:52:16
DATE: 04/28/89

FUEL #2 OIL: 19360 BTU/LB

COMBUSTION EFFICIENCY:	93.7	%
AMBIENT TEMPERATURE:	92	°F
STACK TEMPERATURE:	112	°F
OXYGEN:	006.0	%
CARBON MONOXIDE:	30	PPM
CARBON DIOXIDE:	11.3	%
COMBUSTIBLE GASES:	0.00	%
STACK DRAFT (INCHES H2O):	+ 00.0	
EXCESS AIR:	36	%
OXIDES of NITROGEN:	120	PPM
SULFUR DIOXIDE:	32	PPM
CARBON MONOXIDE ALARM:	600	PPM

MODE:PPM OXY_REF=TRUE%

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APPENDIX I
CALIBRATION DATA

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STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

NOTECH #2

Date 3 JAN 89

Thermocouple number INLET/OUTLET

Ambient temperature 26 °C Barometric pressure _____ in. Hg

Calibrator GARRISON Reference: mercury-in-glass ASTM 63 F
SCOTT other _____

Reference point number	Source ^a (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference, °C ^b *
INLET				
-	HOT WATER BATH	43.5	43	.5
-	ROOM TEMP	26	26	0
OUTLET				
-	HOT WATER BATH	43.5	42	1
-	ROOM TEMP	26	26.5	.5

^aType of calibration system used.

^b
$$\left[\frac{(\text{ref temp, } ^\circ\text{C} + 273) - (\text{test thermom temp, } ^\circ\text{C} + 273)}{\text{ref temp, } ^\circ\text{C} + 273} \right] 100 \leq 1.5\%$$

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* MUST BE WITHIN 3°C OF REFERENCE

#60

Pitot tube assembly level? ☒ yes ☐ no

Pitot tube openings damaged? ☐ yes (explain below) ☒ no

$\alpha_1 = 0^\circ (<10^\circ)$, $\alpha_2 = 0^\circ (<10^\circ)$, $\beta_1 = 0^\circ (<5^\circ)$,

$\beta_2 = 1^\circ (<5^\circ)$

$\gamma = 3^\circ$, $\theta = 0^\circ$, $A = 29/32$ in.

$z = A \sin \gamma = .047$ in.; <0.32 cm ($<1/8$ in.),

$w = A \sin \theta = 0$ in.; $<.08$ cm ($<1/32$ in.)

$P_A = 29/64$ in. $P_D = 29/64$ in.

$D_t = .375$ in.

Comments: CONSTRUCTED IN W 40 C/P R 60, APPA, METI-2
FIG 2.2 ASSIGNED BASELINE COEFFICIENT = 0.84

Calibration required? ☐ yes ☒ no

#6B

Pitot tube assembly level? ☒ yes ☐ noPitot tube openings damaged? ☐ yes (explain below) ☒ no $\alpha_1 = 0^\circ (<10^\circ)$, $\alpha_2 = 0^\circ (<10^\circ)$, $\beta_1 = 0^\circ (<5^\circ)$, $\beta_2 = 1^\circ (<5^\circ)$

(1.0625)

 $\gamma = 0^\circ$, $\theta = 0^\circ$, $A = 1/16$ in. (in.) $z = A \sin \gamma = 0.0$ in. (in.); <0.32 cm ($<1/8$ in.), $w = A \sin \theta = 0.0$ in. (in.); $<.08$ cm ($<1/32$ in.)
0.0313 $P_A = 17/32 (0.53)$ in. (in.) $P_b = 17/32 (0.53)$ in. (in.) $D_t = 0.375$ in. (in.)Comments: CONSTRUCTED 19W 40 CFR 60, APP A, METH 2,
FIG 2.2. ASSIGNED BASELINE COEFFICIENT = 0.84Calibration required? ☐ yes ☒ no

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

IMPINGER

Date 19/10/88 Thermocouple number D3
 Ambient temperature 26 °C Barometric pressure 29.232/29.175 in. Hg
 Calibrator GARRISON/SCOTT Reference: mercury-in-glass NBS
 other _____

Reference point number ^a	Source ^b (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference, °C *OC*
C	ICE BATH	0	0.6	0.6
—	ROOM TEMP	25.8	25.6	0.2

^aEvery 30°C (50°F) for each reference point.

^bType of calibration system used.

^c
$$\left[\frac{(\text{ref temp, } ^\circ\text{C} + 273) - (\text{test thermom temp, } ^\circ\text{C} + 273)}{\text{ref temp, } ^\circ\text{C} + 273} \right] 100 \leq 1.5\%$$

* MUST BE WITHIN 1°C OF REF

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STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 19³⁰ OCT 88 Thermocouple number 1MPINGER D2
 Ambient temperature 26° °C Barometric pressure 29.232/29.175 in. Hg
 Calibrator GARRISON/SCOTT Reference: mercury-in-glass NBS
 other

Reference point number ^a	Source ^b (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference, °C ^c % °C *
0	ICE BATH	0	0	—
—	ROOM TEMP	26.0	26.6	0.6

^aEvery 30°C (50°F) for each reference point.

^bType of calibration system used.

^c
$$\left[\frac{(\text{ref temp, } ^\circ\text{C} + 273) - (\text{test thermom temp, } ^\circ\text{C} + 273)}{\text{ref temp, } ^\circ\text{C} + 273} \right] 100 \leq 1.5\%.$$

* MUST BE WITHIN 1°C OF REF

Quality Assurance Handbook M2-2.10

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 19/10/88 Thermocouple number DI IMPINBER
 Ambient temperature 26 °C Barometric pressure 29.232 in. Hg
 Calibrator GARRISON/ Reference: mercury-in-glass NBS
SCOTT other

Reference point number ^a	Source ^b (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference, °C ^c
0	ICE BATH	0	0	—
—	ROOM TEMP	25.5	26.1	0.6

^a Every 30°C (50°F) for each reference point.

^b Type of calibration system used.

^c
$$\left[\frac{(\text{ref temp, } ^\circ\text{C} + 273) - (\text{test thermom temp, } ^\circ\text{C} + 273)}{\text{ref temp, } ^\circ\text{C} + 273} \right] 100 \leq 1.5\%$$

* MUST BE WITHIN 1°C OF REF

Quality Assurance Handbook M2-2.10

STACK SENSOR CALIBRATION: 19-20 Oct 88

SENSOR #	REFERENCE TEMPERATURE (deg K) X axis	TEST TEMPERATURE (deg K) Y axis
-------------	---	--

P1	273.30	273.60
	371.90	373.60
	447.00	450.20

Regression Output:

Constant	-4.30
Std Err of Y Est	0.20
R Squared	1.00
No. of Observations	3.00
Degrees of Freedom	1.00

X Coefficient(s)	1.02
Std Err of Coef.	0.00

% Deviation @ 2000 F(1093.3 K) = 1.29%

P2	273.30	273.60
	371.80	373.60
	447.60	450.80

Regression Output:

Constant	-4.27
Std Err of Y Est	0.11
R Squared	1.00
No. of Observations	3.00
Degrees of Freedom	1.00

X Coefficient(s)	1.02
Std Err of Coef.	0.00

% Deviation @ 2000 F(1093.3 K) = 1.25%

P3	273.30	274.10
	371.90	374.10
	447.60	450.80

Regression Output:

Constant	-2.96
Std Err of Y Est	0.03
R Squared	1.00
No. of Observations	3.00
Degrees of Freedom	1.00

X Coefficient(s)	1.01
Std Err of Coef.	0.00

% Deviation @ 2000 F(1093.3 K) = 1.11%

P4	273.30	273.60
	371.80	373.60
	447.60	450.80

Regression Output:

Constant	-4.27
Std Err of Y Est	0.11
R Squared	1.00
No. of Observations	3.00
Degrees of Freedom	1.00

X Coefficient(s)	1.02
Std Err of Coef.	0.00

% Deviation @ 2000 F(1093.3 K) = 1.27%

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test numbers _____ Date 22 Mar 89 Meter box number Nutech 2 Plant Post Ex/lin/Pre New-kow
 Barometric pressure, $P_b = 29.920$ in. Hg Dry gas meter number Nutech 2 Pretest $Y = 1.042$

Orifice manometer setting, (ΔH), in. H_2O	Gas volume		Temperature				Time (θ), min	Vacuum setting, in. Hg	Y_i	Y_i $V_w P_b (t_d + 460)$ $V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)$
	Wet test meter (V_w), ft^3	Dry gas meter (V_d), ft^3	Wet test meter (t_w), $^{\circ}F$	Dry gas meter		Average (t_d), $^{\circ}F$				
				Inlet (t_{d_i}), $^{\circ}F$	Outlet (t_{d_o}), $^{\circ}F$					
<u>.90</u>	10	9.594	76-77 78	81.5 84	75 77	78.75	18.67	10.0	1.043	$(10 \times 29.92) (538.75)$ $(9.594 \times 29.92 + \frac{9}{13.6}) (532)$
<u>.90</u>	10	9.626	76-78 78	84.5 86	79 80	81.50	18.71	10.0	1.043	$(10 \times 29.92) (541.5)$ $(9.626 \times 29.92 + \frac{9}{13.6}) (538)$
<u>.90</u>	10	9.671	77-78.5 76	86.5 87	80 81	83.40	18.75	10.0	1.044	$(10 \times 29.92) (543)$ $(9.671 \times 29.92 + \frac{9}{13.6}) (538.5)$
									$Y = 1.043$	

* If there is only one thermometer on the dry gas meter, record the temperature under t_d .

V_w = Gas volume passing through the wet test meter, ft^3 . $Y = 1.042$
 V_d = Gas volume passing through the dry gas meter, ft^3 .
 t_w = Temperature of the gas in the wet test meter, $^{\circ}F$. 95.19 $\longleftrightarrow$ 1.6521
 t_{d_i} = Temperature of the inlet gas of the dry gas meter, $^{\circ}F$.
 t_{d_o} = Temperature of the outlet gas of the dry gas meter, $^{\circ}F$.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o} , $^{\circ}F$.
 ΔH = Pressure differential across orifice, in H_2O .
 Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.
 Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs;
 tolerance = pretest $Y \pm 0.05Y$

P_b = Barometric pressure, in. Hg.
 θ = Time of calibration run, min.

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POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number 12 MAY 87 Meter box number Nutech 2 Plant Paul Norton
 Barometric pressure, $P_b = 29.065$ in. Hg Dry gas meter number 1.002 Pretest $Y = 1.002$

Orifice manometer setting, (ΔH), in. H_2O	Gas volume		Temperature				Time (θ), min	Vacuum setting, in. Hg	Y_i	Y_i
	Wet test meter, (V_w), ft^3	Dry gas meter (V_d), ft^3	Wet test meter (t_w), $^{\circ}F$	Dry gas meter		Average (t_d), $^{\circ}F$				
				Inlet (t_{d_i}), $^{\circ}F$	Outlet (t_{d_o}), $^{\circ}F$					
2.0	10	10.100	75	75	75	543.5	13.25	8.0	1.0008	$\frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6} \right) (t_w + 460)}$ $\frac{10(29.065)(543.5)}{10.100(29.065 + 2/13.6)(535)}$
2.0	10	10.146	75	75	71	545.0	13.28	8.0	.9990	$\frac{10(29.065)(546.5)}{10.146(29.065 + 2/13.6)(535)}$
2.0	10	10.176	75	75	71	546.5	13.30	8.0	.9988	$\frac{10(29.065)(546.5)}{10.176(29.065 + 2/13.6)(535)}$
$Y = .9995$										0.9519

* If there is only one thermometer on the dry gas meter, record the temperature under t_d where

V_w = Gas volume passing through the wet test meter, ft^3 .

V_d = Gas volume passing through the dry gas meter, ft^3 .

t_w = Temperature of the gas in the wet test meter, $^{\circ}F$.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, $^{\circ}F$.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, $^{\circ}F$.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o} , $^{\circ}F$.

ΔH = Pressure differential across orifice, in. H_2O .

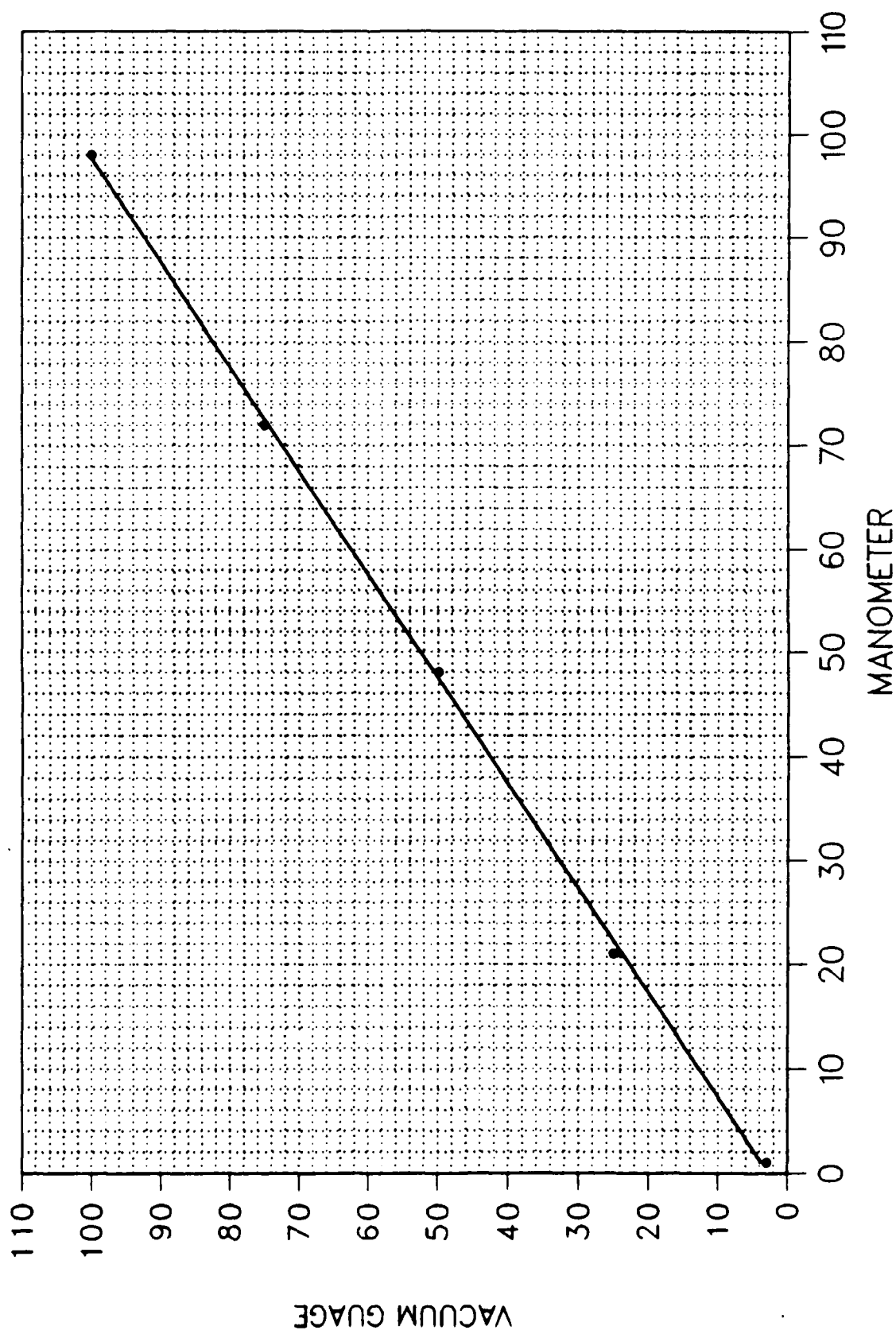
Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest $Y \pm 0.05Y$.

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

VACUUM GUAGE CALIBRATION (inches of Hg)



VACUUM GAUGE mm. Hg	MANOMETER mm. Hg			DELTA
	Leg A	Leg B	P	
3	828	90	1	2
25	818	100	21	4
50	805	114	48	2
75	793	126	72	3
100	780	139	98	2

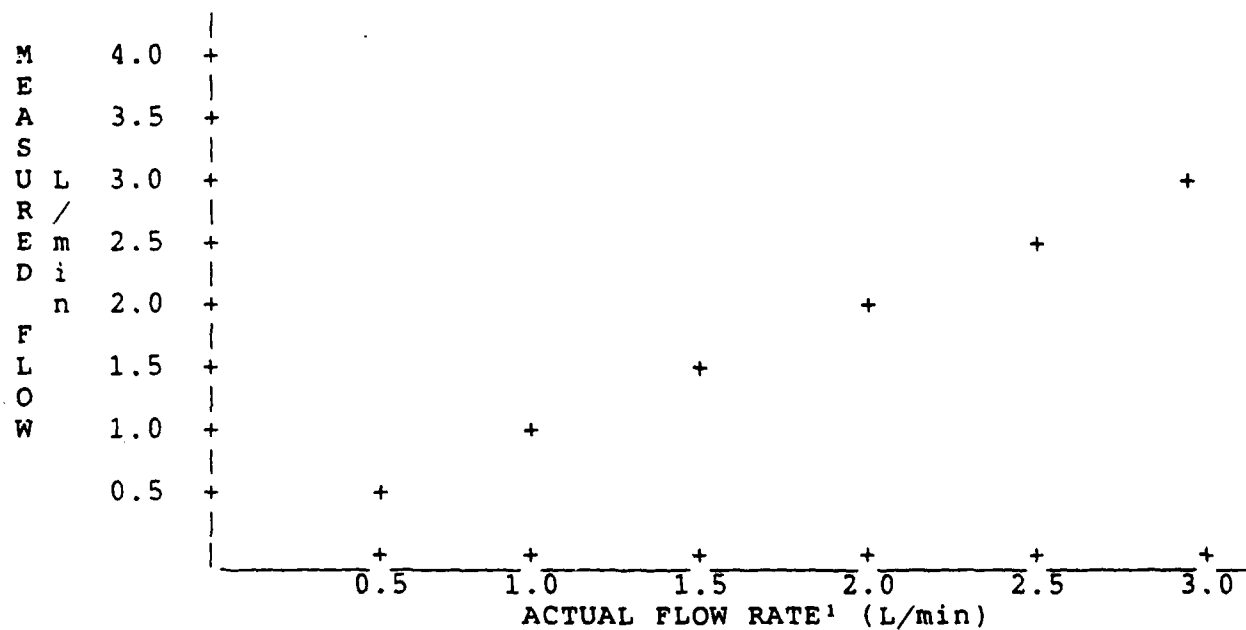
Barometric Pressure 739 mm Hg

VOLUMES OF NOX FLASKS WITH VALVES

(ml)

1)	2085	17)	2066
2)	2054	18)	2074
3)	2075	19)	2061
4)	2070	20)	2102
5)	2090	21)	2080
6)	2072	22)	2062
7)	2066	23)	2086
8)	2070	24)	2066
9)	2089	25)	2070
10)	2080	26)	2059
11)	2084	27)	2059
12)	2072	28)	2083
13)	2059	29)	2065
14)	2080	30)	2063
15)	2082	31)	2074
16)	2043	32)	2086

Calibration of Rotometer



note: ¹ = Buck Bubble Tube Calibrator used to establish actual flow rate.

NOZZLE CALIBRATION DATA FORM

Date 19 APR 89 Calibrated by JAMES GARRISON

Nozzle identification number	Nozzle Diameter ^a			ΔD , ^b mm (in.)	D_{avg} ^c
	D_1 , mm (in.)	D_2 , mm (in.)	D_3 , mm (in.)		
# 6	.498	.500	.499	.002	.499
# 3	.375	.376	.375	.001	.375
# 6	.499	.499	.501	.002	.500

where:

^a $D_{1,2,3}$ = three different nozzles diameters, mm (in.); each diameter must be within (0.025 mm) 0.001 in.

^b ΔD = maximum difference between any two diameters, mm (in.),
 $\Delta D \leq (0.10 \text{ mm}) 0.004 \text{ in.}$

^c D_{avg} = average of D_1 , D_2 , and D_3 .

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