AL-TR-91-0021

COMPLIANCE TESTING OF GRISSOM AFB CENTRAL HEATING PLANT COAL-FIRED BOILERS 3, 4 AND 5 GRISSOM AFB IN

Ronald W. Vaughn, Captain, USAF, BSC

OCCUPATIONAL AND ENVIRONMENTAL
HEALTH DIRECTORATE
Brooks Air Force Base, Texas 78235-5000

March 1991

Final Technical Report for Period 3 December 1990 – 13 December 1990

AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235-5601

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At the request of HQ SAC/SGPB, source compliance testing (particulate and visible emissions) of boiler 3, 4 and 5 in the Grissom AFB Central Heating Plant was accomplished 3-13 Dec 90. The survey was conducted to determine compliance with regards to Indiana Administrative Code, Title 325 - Air Pollution Control Board, Article 5, Opacity Regulations, and Article 6, Particulate Regulations. The boilers were all tested through the bypass stack.

Visible emissions from the three boilers met applicable opacity regulations. However, particulate emissions from the three boilers were above their applicable emission standards.

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I. INTRODUCTION

On 3 to 13 Dec 1990, source emission testing for particulate and visible emissions was conducted on coal-fired boilers 3, 4 and 5 at the Grissom AFB Central Heating Plant by the Air Quality Function of the Air Force Occupational and Environmental Health Laboratory (AFOEHL). This survey was requested by 305th CSG/DE through HQ SAC/SGPB to determine particulate emission compliance status with regards to Indiana Administrative Code, Title 325 - Air Pollution Control Board, Article 5, Opacity Regulations (325 IAC 5), and Article 6, Particulate Regulations (325 IAC 6). (Appendix A) Personnel involved with on-site testing are listed in Appendix B.

II. DISCUSSION

A. Background

On 7 Nov 1986, the Director, Air and Radiation Division, U.S. Environmental Protection Agency (EPA), Region V, issued a notice of violation (NOV) to Grissom AFB for violation of 325 IAC 5, Opacity Regulations. The NOV was based on information submitted by the State of Indiana Department of Environmental Management and the EPA. Observations indicated that oil-fired boiler 1 and coal-fired boilers 3 and 4 (boiler 5 was out of service during the State Observations) were out of compliance with respect to visible emissions.

To demonstrate and maintain compliance with 325 IAC 5 and other rules set forth by the Indiana Air Pollution Control Board, EPA, Region V required Grissom AFB to: (1) conduct stack particulate emission testing on boilers 3, 4 and 5 (when operational) as specified in Title 40, Code of Federal Regulations, Part 60 (40 CFR 60), Appendix A, Reference Method 5, (2) determine visible emissions from boilers 1-4 and 5 (when operational) as specified in 40 CFR 60, Appendix A, Reference Method 9 and (3) request stack testing following future major modifications to the central heating plant.

On 30 Nov 1990, a modification to the heating plant's boilers 3, 4 and 5 was completed. This compliance testing project met the Indiana Air Pollution Control Board requirement to test after major modifications to the central heating plant. Secondly, Grissom AFB was notified by the State that the emission limits specified during previous AFOEHL testing (Nov 87, Mar 88 and Feb 89) were erroneous. The correct emission limits are presented in paragraph C.

B. Site Description

The Central Heating Plant operates a total of five boilers for steam production:

Note: This report was accomplished by the Air Force Occupational and Environmental Health Laboratory (AFOEHL), which is now the Armstrong Laboratory, Occupational and Environmental Health Directorate.

Boiler No. Manufacturer	Steam Capacity (lb/hr)	Year Installed	Fuel
1 Springfield Boiler Co.	40,000	1955	oil
2 Springfield Boiler Co.	40,000	1955	oil
3 Springfield Boiler Co.	40,000	1955	coal
4 E. Keeler Co.	40,000	1960	coal
5 Zurn Ind.	65,000	1980	coal

Coal-fired boilers 3, 4 and 5 are spreader-stoker fired units, each having forced-draft and induced-draft fans and mechanical fly ash collection systems. Each unit is fitted with a steam-operated soot blower to remove fly ash and soot from the heat exchanger tubing. Boiler 5 is also fitted with an economizer to further increase operating efficiency by preheating the feed water using exhaust gas heat.

Air pollution control consists of individual multiclone dust collectors on each boiler and an optional wet scrubber common to the three coal-fired boilers. The multiclone dust collectors on boilers 3, 4 and 5 were manufactured by Western Precipitation Division - Joy Manufacturing Co. The collector on both boiler 3 and 4 is a model 9VM-10 and consists of 36 nine-inch diameter cyclonic collectors operating in parallel. The collector on boiler 5 is a model 9VMU-10 and consists of 48 nine-inch diameter cyclonic collectors operating in parallel. Each unit is located in the boiler exhaust duct upstream of the induced-draft fan. Ash collected by the multiclones is carried by gravity to a hopper.

The exhaust effluent from each boiler is ducted to a common breeching and can be routed to the wet-scrubber or to a bypass stack. The scrubber is a double-alkali flue-gas desulfurization system using soda ash (sodium carbonate) in the scrubbing fluid and lime (calcium hydroxide) slurry for regeneration of the scrubbing liquid. The primary purpose of the unit is to remove sulfur from the flue gas; a secondary purpose is to remove particulates from the flue gas. The system has two identical scrubber units, A and B, each designed to handle 50% of the flue gas from the three coal-fired boilers. Each unit has a 5 foot (ft) diameter stack and terminates about 70 feet above the ground. There is no requirement at this time to use the scrubber system because of the low-sulfur coal being used by the plant. The bypass stack has a 5.5 ft diameter and terminates approximately 70 ft above ground level. The scrubber stacks and the bypass stack can be seen in Figure 1. A flue gas flow diagram is shown in Figure 2.

C. Applicable Standards

The monitoring requirements, opacity regulations and particulate regulations are defined under 325 IAC 3, 5 and 6, respectively. Article 3 states that emissions test shall be conducted in accordance with procedures and analysis methods specified in chapter 40, Code of Federal Regulations, Part 60, Appendix A. EPA Methods 1-5 were used for the determination of particulate emissions and Method 9 for visible emissions.

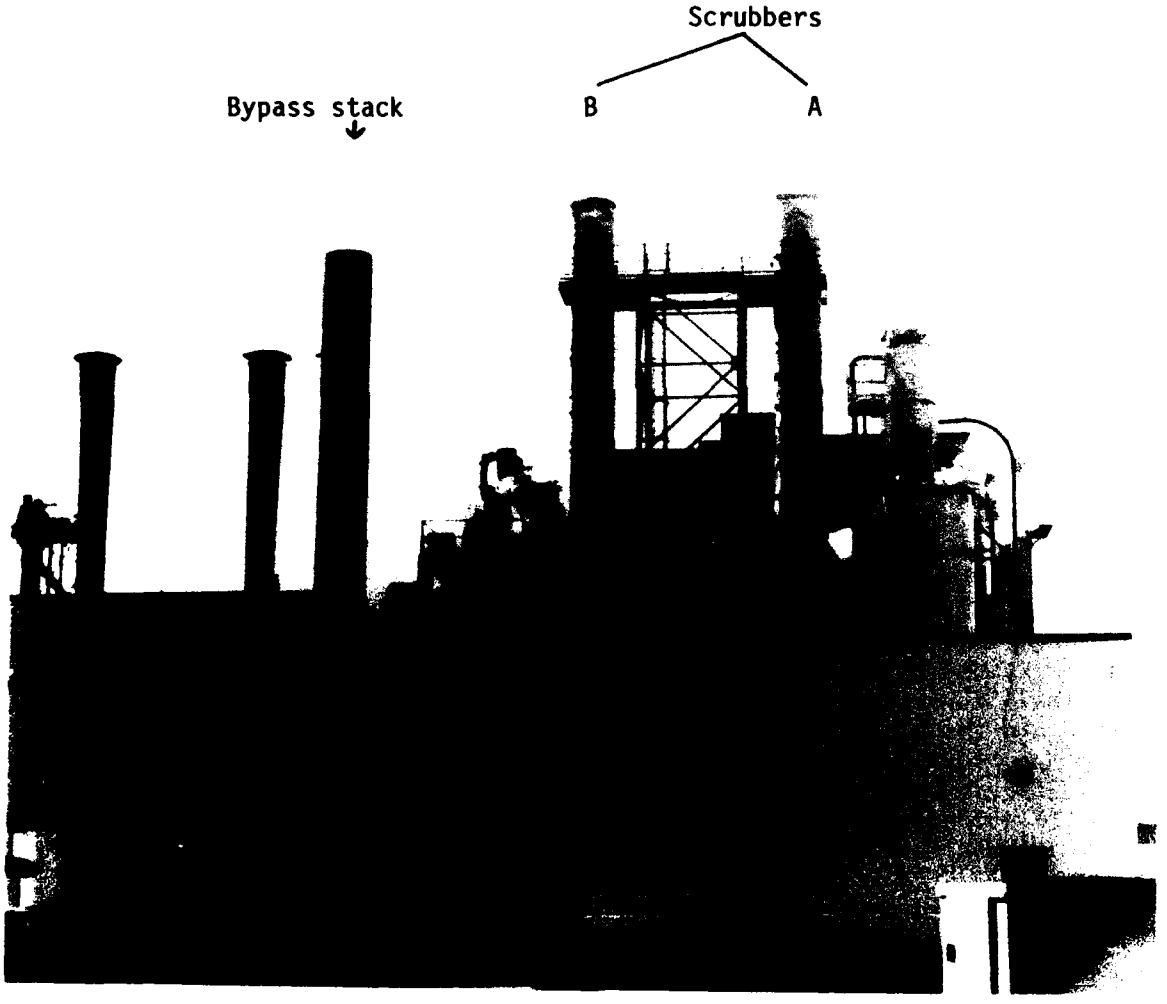

Figure 1. View of Scrubbers and Bypass Stack

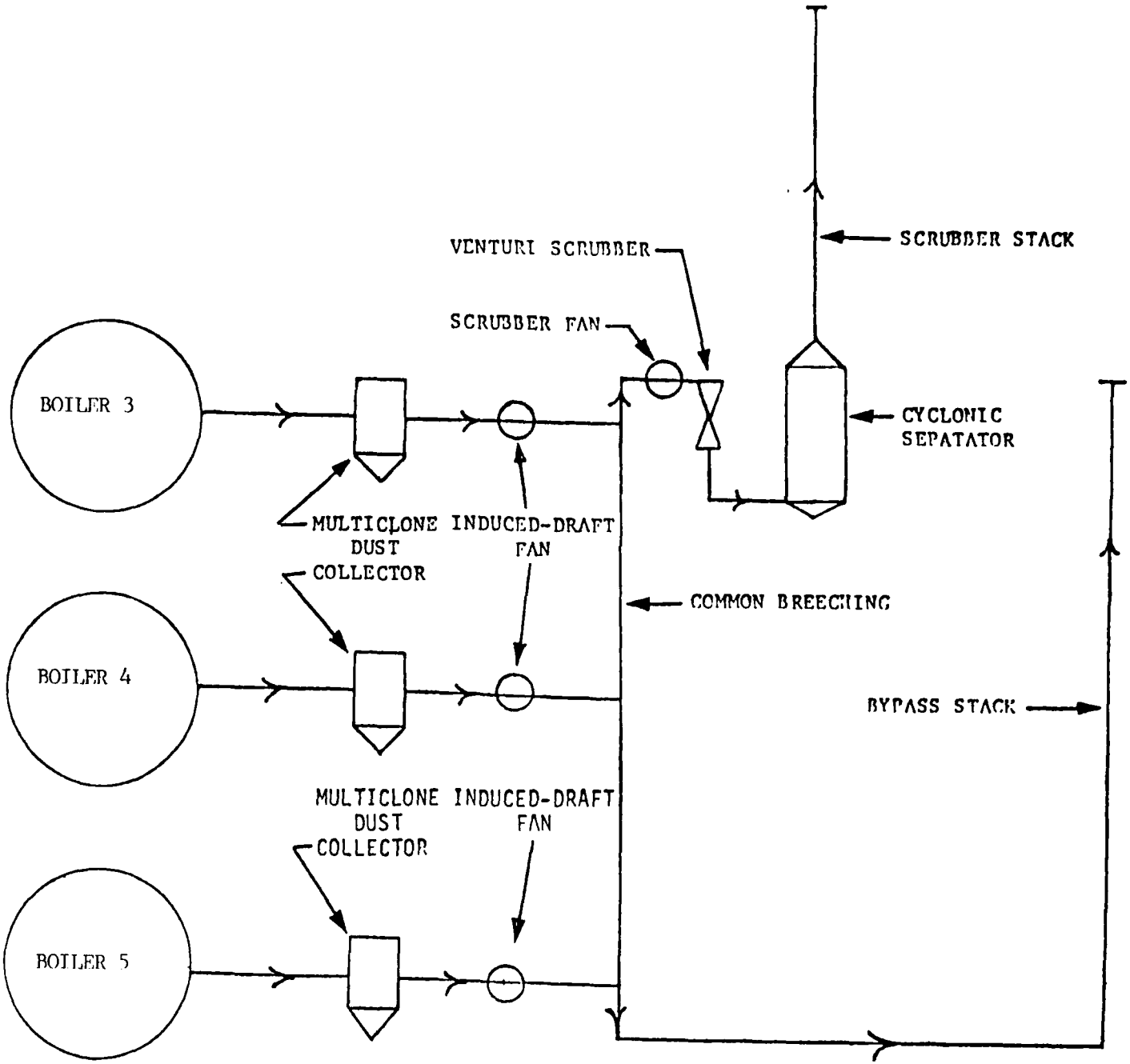

Figure 2. Flue Gas Flow Diagram

Article 5 states that visible emissions shall not exceed an average of 40% opacity in 24 consecutive readings or 60% opacity for more than a cumulative total of 15 minutes (60 readings) in a 6-hour period. When conducting a soot blowing operation, visible emissions may exceed these standards except that visible emissions may not exceed 60% opacity nor shall visible emissions in excess of the standards continue for more than 5 minutes in any 60 minute period.

Under 325 IAC 6, the maximum allowable particulate emission rate from combustion of fuel for indirect heating facilities (either existing and in operation or with permits to construct prior to the effective date of 325 IAC 6, 26 Sep 1980) is determined by the following equation:

$$Pt = \frac{C \times a \times h}{76.5 \times Q0.75 \times N0.25}$$

Where:

Pt = Pounds of particulate matter emitted per million BTU heat input (lb/mmBTU).

C = Maximum ground level concentration with respect to distance from the point source at the "critical" wind speed for level terrain (50 micrograms per cubic meter - provided in standard).

Q = Total source maximum operating capacity rating in million BTU per hour (mmBTU/hr) heat input.

N = Number of stacks in fuel burning operation.

a = Plume rise factor (0.67 is used for Q less than or equal to 1,000 mmBTU/hr heat input).

h = Stack height in feet.

The limits on particulate emissions determined by the equation and values of the variables applicable to this facility are 0.47 lb/mmBTU for boilers 3 and 4 (operating prior to 8 Jun 1972) and 0.37 lb/mmBTU for boiler 5 (constructed after 8 Jun 1972). State regulations are presented in Appendix C.

D. Sampling Methods and Procedures

Boilers 3, 4 and 5 were tested through the bypass stack. Coordination was made with plant personnel to try and operate each boiler at 95% capacity or greater during testing. One of the three runs which comprised a complete test included a soot blow; this is indicated on the field data sheets. Boiler operating logs for the test periods are provided in Appendix D. These logs indicate hourly steam output and coal usage. Laboratory results for the coal analysis are provided in Appendix E. Each coal sample represents an integrated sample collected over a particular one hour test run as noted on the analysis sheet.

325 IAC 3 requires that all emissions tests be conducted in accordance with the procedures and analysis methods specified in 40 CFR 60, Appendix A,

Methods 1-5. Therefore, test methods, equipment, sample train preparations, sampling and recovery, calibration requirements and quality assurance were done in accordance with the methods and procedures outlined in 40 CFR 60, Appendix A.

Sampling ports were in place on the bypass stack and were located 2 stack diameters upstream from the stack exit and 7 stack diameters downstream from the nearest disturbance (common breeching inlet). Based on a 5.5 ft inside stack diameter, port location and type of sample (particulate), a total of 12 traverse points were determined for emission evaluation. The sampling time for each sampling run was 60 minutes, and the the sample time per traverse point was 5 minutes. Illustration showing port locations and sampling points is provided in Appendix F.

Prior to each emission test, 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 values of the flow angles taken at each traverse point must be less than or equal to 20 degrees. The resulting flow angles in the bypass stack for boilers 3, 4 and 5 were 6, 6 and 5 respectively.

During each sample run, a flue gas sample for ORSAT analysis (measures oxygen, and carbon dioxide for stack gas molecular determination and emissions correction) was taken. ORSAT sampling and analysis equipment are shown in Figures 3 and 4. Flue gas moisture content, also needed for determination of gas molecular weight, was determined during particulate sampling.

Particulate samples were collected using the the sampling train shown in Figure 5. 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 could be sampled isokinectically; in other words, the velocity at the nozzle tip was the same as the 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 10-inch inclined-vertical manometer. Type K thermocouples were used to measure flue gas as well as sampling train temperatures. The probe was heated to minimize moisture condensation. The heated filter was used to collect particulate materials. The impinger train consisted of the following components.

a. first, third and fourth impingers: modified Greenburg-Smith type

b. second impinger: standard Greenburg-Smith was used as a condenser to collect stack gas moisture. The pumping and metering system was used to control and monitor the sample gas flow rate. Equipment calibration data is presented in Appendix J.

Particulate emissions 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. Emissions calculations from the EPA programs are found in Appendix K.

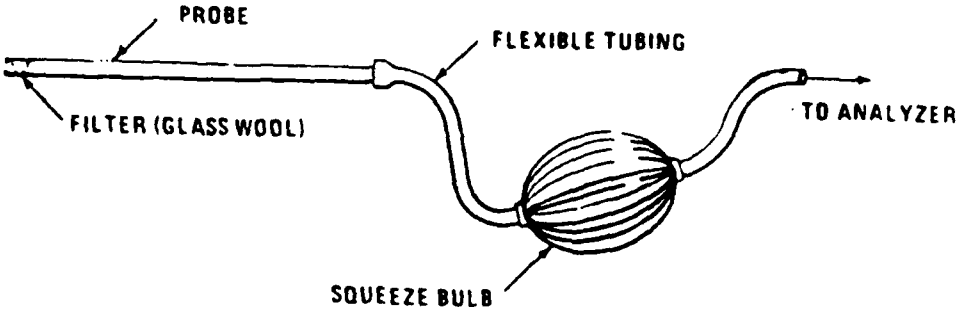

Figure 3. Orsat Sampling Train

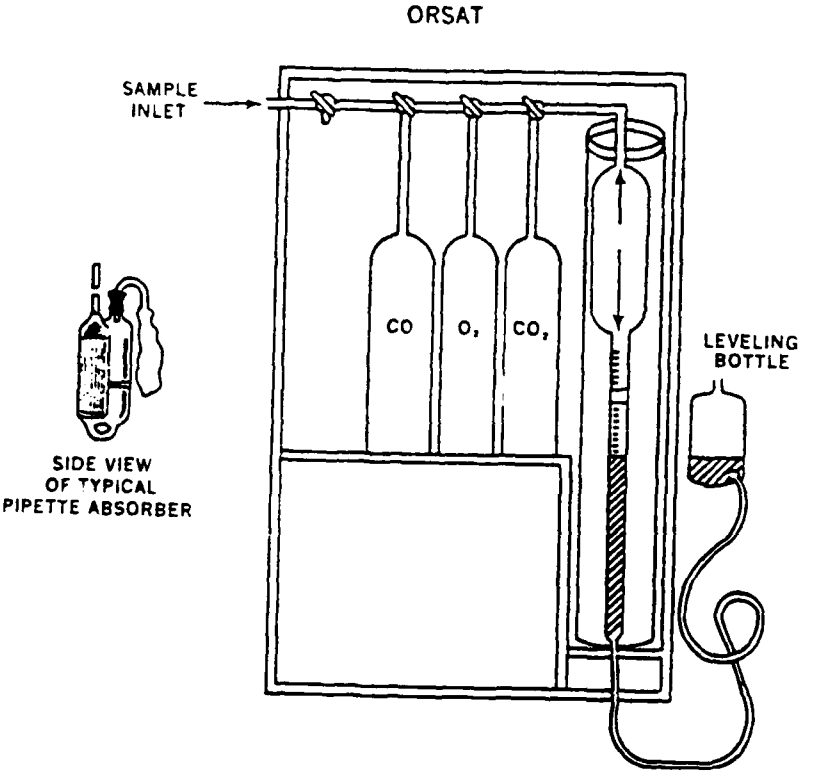

Figure 4. Orsat Apparatus

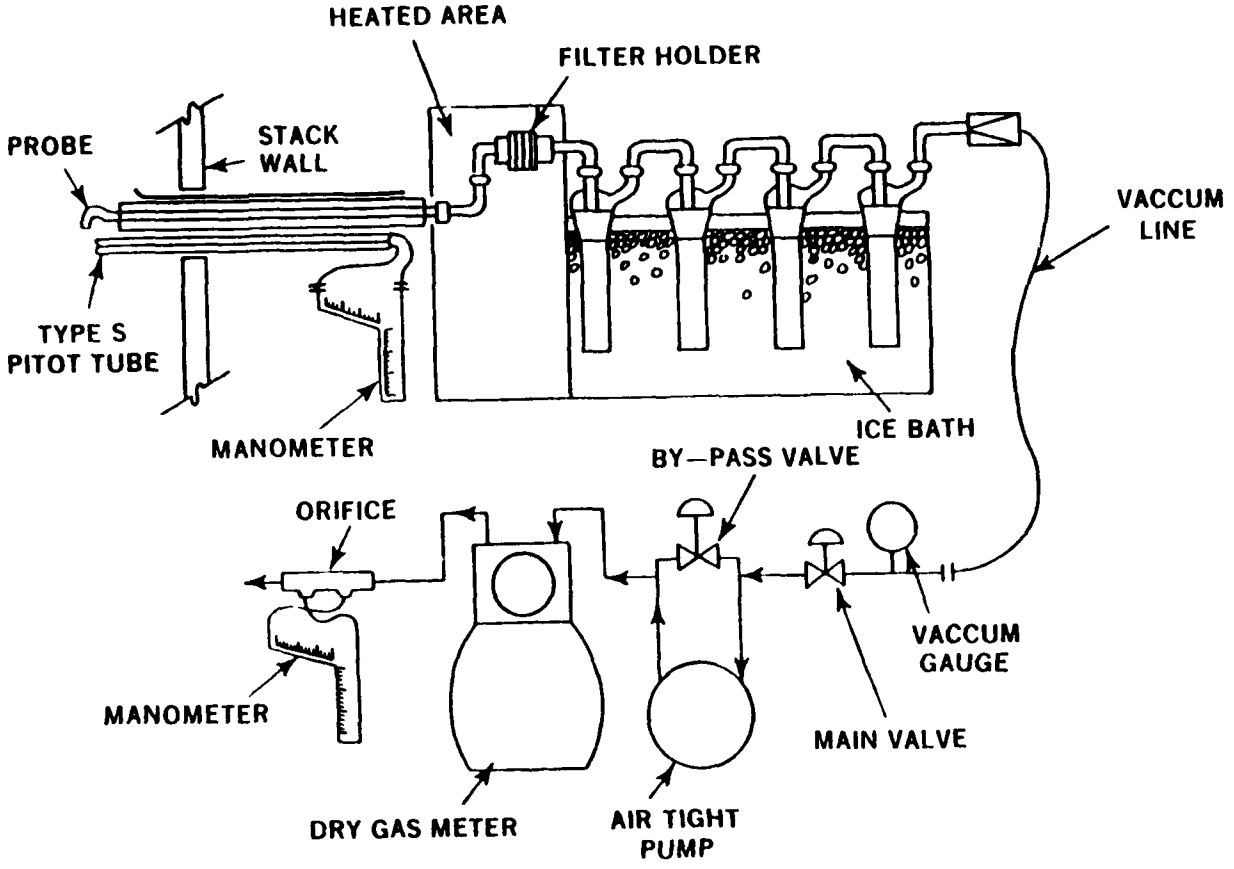

Figure 5. Particulate Sampling Train

Visible emissions determinations were accomplished during each sample run. Visible emissions results are presented in Appendixes G through I.

III. CONCLUSIONS

Visible emissions averaged less than 40% for all runs except for time periods where soot blows occurred. Soot blows did cause opacity to exceed 60% but not for more than a five-minute period.

The table provides operating parameters for boilers 3, 4, and 5 during testing and the resultant particulate emission rates determined from these tests. Results indicate the three boilers emission rates were above their applicable emission standards.

We believe that many factors contributed to the boilers not meeting their applicable standards:

1. The heating plant's automation project had not been completed. Therefore, plant personnel were unable to monitor and/or control the plant's operating parameters.

2. Incomplete combustion of coal. This is possibly caused by too much excess oxygen or the physical size of the coal.

3. Mechanical problems with the multiclone dust collectors on each boiler.

IV. RECOMMENDATIONS

It is our recommendation that boilers 3, 4, and 5 be retested after the heating plant's automation project is completed and operation optimized. All aspects of the system (boiler, particulate control devices, etc.) should be evaluated for proper operation prior to testing.

Table. Emission Survey Results

DATE	TIME (MILITARY)	BOILER NO.	RUN	BOILER OPERATING CAPACITY (%)	SOOT BLOW	COAL HEAT VALUE (BTU/lb)	COAL USE (lb/hr)	HEAT INPUT (mmBTU/hr)	PM EMISSIONS* (lb/hr)	% CO_2 IN FLUE GAS	PM EMISSIONS CORRECTED TO 12% CO_2 (lb/mmBTU)	VISIBLE EMISSIONS (% OPACITY)
6 Dec 90	1025	3	1	95.0	X	11677	3814	44.5	122.4	7.8	4.23	17.2
6 Dec 90	1505	3	2	94.9		11363	3814	43.3	21.6	5.7	1.05	30.2
6 Dec 90	1710	3	3	93.5		11901	3814	45.4	17.8	5.0	0.94	27.7
			AVG	94.3					AVG 53.9		AVG 2.07	
10 Dec 90	0805	4	1	75	X	11641	3339	38.9	33.4	8.7	1.18	11.4
10 Dec 90	1025	4	2	77.2		11614	3339	38.8	12.4	7.8	0.49	19.4
10 Dec 90	1235	4	3	78.4		11334	3339	37.8	15.2	8.5	0.57	4.8
			AVG	76.9					AVG 20.3		AVG 0.75	
11 Dec 90	0915	5	1	108	X	12152	5733	69.7	73.6	8.3	1.53	8.2
11 Dec 90	1320	5	2	85.9		11931	5733	68.4	70.7	6.8	1.82	10.2
11 Dec 90	1525	5	3	85.3		12117	5733	69.5	119.1	7.3	2.82	16.4
			AVG	93.1					AVG 87.8		AVG 2.06	

* PARTICULATE EMISSIONS

REFERENCES

1. "Standards of Performance for New Stationary Sources," Title 40, Part 60, Code of Federal Regulations, July 1, 1989.

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 the Hewlett-Packard 41 Calculators. U.S. Environmental Protection Agency, EPA-340/1-85-018, Research Triangle Park, North Carolina, May 1987.

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APPENDIX A

Letters of Request

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 305TH COMBAT SUPPORT GROUP (SAC)
GRISSOM AIR FORCE BASE, INDIANA 46971-5000

REPLY TO ATTN OF DEEV

22 AUG 1990

SUBJECT Request to Reschedule Heat Plant Stack Testing

TO AF OEHL/EQA
Brooks AFB TX 78235

1. Thank you for scheduling our heat plant stack emissions tests for 24 Oct 90. However, circumstances force us to request you reschedule your tests until after 30 Nov 90 and up to 1 Mar 91. Construction delays in the installation of new heat plant controls make testing before 30 Nov 90 unworkable.

2. Our POC is Mr. Ruel Burns, DSN 928-4596.

ROBERT J. BECK, Colonel, USAF
Commander

cc: 305 AREFW/JA
305 CES/DEEC
305 STRAT Clinic/SGPB

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS STRATEGIC AIR COMMAND
OFFUTT AIR FORCE BASE, NEBRASKA 68113-5001

REPLY TO ATTN. OF: SGPB

18 MAR 1990

SUBJECT: Request for Emergency Heat Plant Emissions Testing

TO: AFOEHL/CC

We support the request from the 305th CSG/DE and request you give priority to sampling the three coal-fired boilers by November 1990. Please contact Mr. Ruel Burns, AUTOVON 928-2225, to make the initial arrangements so all the boilers can be operating during your visit. Please respond directly to the 305th CSG/DE and 305th Strat Clinic/SGPB. Please forward to me an information copy of your acceptance.

Ronald L. Schiller

RONALD L. SCHILLER, Colonel, USAF, BSC
Chief, Bioenvironmental Engineering Division
Office of the Surgeon

1 Atch
305th CSG/DE Ltr, 2 Mar 90

cc: HQ AFSC/SGPB w/Atch
AFOEHL/EQ w/Atch
305th Strat Clinic/SGPB w/Atch
305th CSG/DE w/o Atch

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900330
M-2327

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 305TH COMBAT SUPPORT GROUP (SAC)
GRISSOM AIR FORCE BASE, INDIANA 46971-5000

REPLY TO ATTN OF DE

2 MAR 1990

SUBJECT Request for Emergency Heat Plant Emissions Testing

TO 305 STRAT CLINIC/SGPB
HQ SAC/SGPB
AF OEHL/CC
IN TURN

1. Request the Air Force Occupational and Environmental Health Laboratory (AFOEHL) conduct particulate matter stack sampling of the Grissom AFB heat plant's three coal-fired boilers by November 1990. Sampling is necessary to demonstrate compliance with the Indiana Air Pollution Control Board rules for particulate emissions and the recently proposed operating permit from the Indiana Department of Environmental Management.

2. Contrary to previous test reports, past AFOEHL sampling demonstrated the plant emissions aren't in compliance with particulate emission limits imposed by the Indiana Air Pollution Control Board rules. These stricter limits were specifically placed in the most recent draft operating permit from the state. We believe the plant can operate within the proposed limits, but testing in November 1990 is necessary to demonstrate our compliance. We have requested the state approve a delay in testing until 15 November 1990.

3. Our POC is Mr. Ruel Burns, 22225.

ROBERT J. BECK, Colonel, USAF
Commander

cc: HQ SAC/DEVC
305 AREFW/JA
305 CSG/DEM

APPENDIX B

Personnel Information

1. AFOEHL Test Team

Maj Ramon Cintron, Chief, Air Quality Function
Capt Ronald Vaughn, Consultant, Environmental Quality
Capt Linda Albrecht, Consultant, Environmental Quality
Capt Robert O'Brien, Consultant, Environmental Quality
Sgt Stanley Dabney, Bioenvironmental Engineering Technician

AFOEHL/EQ
Brooks AFB TX 78235-5000

Phone: DSN 240-3305
Commercial (512) 536-3305

2. Grissom AFB on-site representatives

Lt Col David McCarthy	305 Strat Clinic/SG
Lt Ed Laferty	305 Strat Clinic/SGPB DSN 928-3017 Commercial (317) 689-3017
David Hughes	305 CSG/DE
Marlene Seneca	305 CSG/DEEV DSN 928-4592 Commercial (317) 689-4592
Smedley Graham Jim Williams	305 CES/DEMMHZ DSN 928-3253 Commercial (317) 689-3253

APPENDIX C

State Regulations

period over which they are limited must be consistent with existing applicable state rules but no longer than twenty-four (24) consecutive hours.

326 IAC 2-4-3 Compliance determination; guidelines

Sec. 3. (a) Compliance will be determined based on the emission limitations and conditions established in the permits issued in conjunction with the bubble. Compliance tests shall be performed in accordance with the test methods specified in individual rules under this title (326 IAC).

(b) Records must be kept in accordance with sub-section (f) of this section and with 326 IAC 2-4-2(a)(9). These records must be kept for a period of the length of the permit unless the commissioner requires they be kept for a longer period of time.

(c) The owner or operator of an emission source under a bubble shall make available copies of reports to the commissioner or its authorized representatives upon written request, at any reasonable time, which include but are not limited to, the nature, specific emission points, and total quantities of all emission.

(d) The bubble shall not exempt any owner, operator from complying with any other applicable rule.

(e) No owner or operator under the bubble is relieved the responsibility for achieving and maintaining a reduction of emissions as expeditiously as practicable, but no later than the compliance date required under the applicable regulation, unless the commissioner grants a later compliance date.

(f) VOC emission sources subject to this rule (326 IAC 2-4) shall maintain records which include as a minimum all data and production information necessary to determine compliance of the process, equipment, or process line under the bubble. This shall include, but not be limited to the following:

(1) type of VOC materials applied;

(2) VOC content of materials applied;

(3) amount of VOC material used; and

(4) estimated emission rates.

326 IAC 2-4-4 SIP revisions

Sec. 4. (a) The following types of bubbles shall be incorporated in the permits and submitted to U.S. EPA as SIP revisions:

(1) Bubbles which do not have fixed emission limitations for the emission points within the bubble but will have single overall emission limit for each pollutant for the entire bubble.

(2) Bubbles including fugitive emissions (defined in 326 IAC 2-2-1).

(3) Bubbles which will include sources that are subject to a federal enforcement action. Federal enforcement action means an order issued under 42 USC, Section 7413(a), a civil action under 42 USC, Section 7413(c), a notice imposing noncompliance penalties under 42 USC, Section 7604.

(4) Bubbles resulting in extension of compliance dates.

(5) Bubbles not exempt from dispersion modeling under 326 IAC 2-4-2(a)(4)(A) and 326 IAC 2-4-2(a)(4)(B).

326 IAC 2-4-5 Public notice; comment procedure

Sec.5. All bubble submittals shall be subject to public notice and comment procedures as specified in 326 IAC 2-1-5(a)(1) and 326 IAC 2-1-5(a)(3), and in the Clean Air Act, 42 USC, Section 7410(a)(2)(H). All bubble proposals received by the state shall be submitted to the U.S. EPA for its comments. However, only the bubbles submitted to the U.S. EPA pursuant to 326 IAC 2-4-4 shall constitute SIP revisions. All bubbles approved by the commissioner will become effective after they are approved by U.S. EPA.

326 IAC 2-4-6 Effect of future emission limitation requirements

Sec. 6. Should a new or more restrictive emission limitation, as required by the board, become applicable to any source included in a bubble under this rule (326 IAC 2-4) the source's permit shall be modified to demonstrate reductions in total bubble emissions equal to the reduction required by the new emission standards.

326 IAC 2-4-7 Enforceability

Sec. 7. All bubbles shall be enforced by the department and may be enforced by the U.S. EPA as part of the SIP.

ARTICLE 3. MONITORING REQUIREMENTS

Rule 1. Continuous Monitoring of Emissions

326 IAC 3-1-1 Applicability of rule

Sec. 1. (a) Sources in the following categories shall continuously monitor and record emissions of air pollutants in accordance with this rule (326 IAC 3-1).

(1) Fossil fuel-fired steam generators of greater than two hundred fifty (250) million Btu per hour heat input capacity.

(2) Nitric acid plants of greater than three hundred (300) tons per day production capacity, the production capacity being expressed at one hundred percent (100%) acid.

(3) Sulfuric acid plants of greater than three hundred (300) tons per day production capacity, the production capacity being expressed at one hundred percent (100%) acid.

(4) Petroleum refinery catalyst regenerators for fluid bed catalytic cracking units of greater than twenty thousand (20,000) barrels (eight hundred forty thousand (840,000) gallons) per day fresh feed capacity.

(b) Other monitoring requirements are contained in 326 IAC 2-1-3(h) and 326 IAC 7-1.

326 IAC 3-1-2 Compliance date

Sec. 2. All sources must be in compliance with this rule (326 IAC 3-1) by July 1, 1978.

326 IAC 3-1-3 Scope of rule

Sec. 3. This rule (326 IAC 3-1) sets forth the minimum requirements for continuous emission monitoring and recording. These requirements include the source categories to be affected; emission monitoring, recording, and reporting requirements for those sources; performance specifications for accuracy, reliability, and durability to acceptable monitoring systems; and techniques to convert emission data to units of the applicable state emission standard. Such data must be reported to the commissioner as an indication of whether proper maintenance and operating procedures are being utilized by source operators to maintain emission levels at or below emission standards. Such data may be used directly or indirectly for compliance determination or any other purpose deemed appropriate by the commissioner.

326 IAC 3-1-4 Monitoring requirements for applicable pollutants

Sec. 4. (a) The owner or operator of an emission source in a category listed in this rule (326 IAC 3-1) shall:

(1) install, calibrate, operate, and maintain all monitoring equipment necessary for continuously monitoring the pollutants specified in this rule (326 IAC 3-1) for the applicable source category; and

(2) complete the installation and performance tests of such equipment and begin monitoring and recording by July 1, 1978.

(b) The source categories and the respective monitoring requirements are listed below:

(1) Fossil fuel-fired steam generators, as specified in 326 IAC 3-1-8(1), shall be monitored for opacity, nitrogen oxides emissions, sulfur dioxide emissions, and oxygen or carbon dioxide.

(2) Fluid bed catalytic cracking unit catalyst regenerators, as specified in 326 IAC 3-1-8(4), shall be monitored for opacity.

(3) Sulfuric acid plants, as specified in 326 IAC 3-1-8(3), shall be monitored for sulfur dioxide emissions.

(4) Nitric acid plants, as specified in 326 IAC 3-1-8(2), shall be monitored for nitrogen oxides emissions.

326 IAC 3-1-5 Monitoring requirements; exemptions

Sec. 5. Exemptions from the monitoring requirements of 326 IAC 3-1-4 shall be granted by the commissioner to any source which is

(1) subject to new source performance standards promulgated in 40 CFR 60, pursuant to Section 111 of the Clean Air Act; or

(2) not subject to an applicable emission standard of the state implementation plan (SIP); or

(3) scheduled for retirement by October 6, 1980, provided that adequate evidence and guarantees are provided that clearly show that the source will cease operations prior to such date.

326 IAC 3-1-6 Extensions of time

Sec. 6. Extensions of the time provided for installation of monitors may be granted by the board for facilities unable to meet the prescribed timeframe (compliance by July 1, 1978) provided the owner or operator of such facility demonstrates that good faith efforts have been made to obtain and install such devices within such prescribed timeframe.

326 IAC 3-1-7 Monitoring system malfunction; report

Sec. 7. When a malfunction of any monitoring system lasts more than one (1) hour, the commissioner or the commissioner's appointed representative shall be notified by telephone, or telegraph, as soon as practicable but in no event later than four (4) daytime business hours after the beginning of said occurrence. Information of the scope and expected duration of the malfunction shall be provided. A temporary exemption from the monitoring and reporting requirement of this rule (326 IAC 3-1) may be granted, provided that the owner or operator shows, to the satisfaction of the commissioner, that the malfunction was unavoidable and is being repaired as expeditiously as practicable.

326 IAC 3-1-8 Minimum monitoring requirements

Sec. 8. The sources listed in 326 IAC 3-1-4 shall, as a minimum, meet the following basic requirements:

(1) Each fossil fuel-fired steam generator, except as provided in the following subparagraphs, with an annual average capacity factor of greater than thirty percent (30%), as reported to the Federal Power Commission for calendar year 1974 or as otherwise demonstrated to the commissioner by the owner or operator, shall conform with the following monitoring requirements when such facility is subject to an emission standard of the SIP for the pollutant in question.

(A) A continuous monitoring system for the measurement of opacity which meets the performance specifications of 326 IAC 3-1-9(1)(A) of this rule shall be installed, calibrated, maintained, and operated in accordance with the procedures of this rule (326 IAC 3-1) by the owner or operator of any such steam generator of greater than two hundred fifty (250) million BTU per hour heat input except where:

(i) gaseous fuel is the only fuel burned; or

(ii) oil or a mixture of gas and oil are the only fuels burned and the source is able to comply with 326 IAC 5-1 and 326 IAC 6-2 without utilization of particulate matter collection equipment, and where the source has never been found, through any administrative or judicial proceedings, to be in violation of 326 IAC 5-1.

(B) a continuous monitoring system for the measurement of sulfur dioxide which meets the performance specifications of 326 IAC 3-1-9(1)(C) shall be installed, calibrated, maintained, and operated on any fossil fuel-fired steam generator of greater than two hundred fifty (250) million BTU per hour heat input which has installed sulfur dioxide pollutant control equipment.

(C) A continuous monitoring system for the measurement of nitrogen oxides which meets the performance specifications of 326 IAC 3-1-9(1)(B) shall be installed, calibrated, maintained, and operated on fossil fuel-fired steam generators or greater than one thousand (1,000) million BTU per hour heat input when such facility is located in an air quality control region (AQCR) where the administrator of the U.S. EPA has specifically determined that a control strategy for nitrogen dioxide is necessary to attain the national standards, unless the source owner or operator demonstrates during source compliance tests as required by the commissioner that such a source emits nitrogen oxides at levels thirty percent (30%) or more below the emission standard set forth in 326 IAC 12.

(D) A continuous monitoring system for the measurement of the percent oxygen or carbon dioxide which meets the performance specifications of 326 IAC 3-1-9(1)(D) or 326 IAC 3-1-9(1)(E) shall be installed, calibrated, operated, and maintained on all fossil fuel-fired steam generators where measurements of oxygen or carbon dioxide in the flue gas are required to convert either sulfur dioxide or nitrogen oxides continuous monitoring data, or both, to units of the emission standard in the SIP.

(2) Each nitric acid plant of greater than three hundred (300) tons per day production capacity, the production capacity being expressed as one hundred percent (100%) acid, located in an AQCR where the administrator of the U.S. EPA has specifically determined that a control strategy for nitrogen dioxide is necessary to attain the national standard shall install, calibrate, maintain, and operate a continuous monitoring system for the measurements of nitrogen oxides which meets the performance specifications of 326 IAC 3-1-9(1)(B) for each nitric acid producing facility within such plant.

(3) Each sulfuric acid plant of greater than three hundred (300) tons per day production capacity, the production capacity being expressed as one hundred percent (100%) acid, shall install, calibrate, maintain, and operate a continuous monitoring system for the measurement of sulfur dioxide which meets the performance specifications of 326 IAC 3-1-9(1)(C) for each sulfuric acid producing facility within such plant.

(4) Each catalyst regenerator for fluid bed catalytic cracking units of greater than twenty thousand (20,000) barrels per day of fresh feed capacity shall install, calibrate, maintain, and operate a continuous monitoring system for the measurement of opacity which meets the performance specifications of 326 IAC 3-1-9(1)(A).

326 IAC 3-1-9 Minimum performance specifications; alternative procedures

Sec. 9. Owners and operators of monitoring equipment installed to comply with this rule (326 IAC 3-1) except as provided in subdivision (2) of this section shall demonstrate compliance with the following performance specifications.

(1) Performance specifications: The performance specifications set forth in 40 CFR 60, Appendix B, are incorporated herein by reference, and shall be used to determine acceptability of monitoring equipment installed pursuant to this rule (326 IAC 3-1) except that where reference is made to the "Administrator" in 40 CFR 60, Appendix B, the term "commissioner" should be inserted for the purpose of this rule (326 IAC 3-1). Performance specifications to be used with each type of monitoring system are listed below.

(A) Continuous monitoring systems for measuring opacity shall comply with Performance Specification 1.

(B) Continuous monitoring systems for measuring nitrogen oxides shall comply with Performance Specification 2.

(C) Continuous monitoring systems for measuring sulfur dioxide shall comply with Performance Specification 2.

(D) Continuous monitoring systems for measuring oxygen shall comply with Performance Specification 3.

(E) Continuous monitoring systems for measuring carbon dioxide shall comply with Performance Specification 3.

(2) Any source which has purchased an emission monitoring system(s) prior to September 11, 1974, may be granted an exemption by the commissioner from meeting such test procedures prescribed in 40 CFR 60, Appendix B, for a period not to extend past October 1, 1981.

(3) For nitrogen oxides monitoring systems installed on fossil fuel-fired steam generators the pollutant gas used to prepare calibration gas mixtures (40 CFR 60, Section 2.1, Performance Specification 2, Appendix B) shall be nitrogen oxide (NO). For nitrogen oxides monitoring systems installed in nitric acid plants the pollutant gas used to prepare calibration gas mixtures (40 CFR 60, Section 2.1, Performance Specification 2, Appendix B) shall be nitrogen dioxide (NO_2). This gas shall also be used for daily checks under subdivision (7) of this section as applicable. For sulfur dioxide monitoring systems installed on fossil fuel-fired steam generators or sulfuric acid plants the pollutant gas used to prepare calibration gas mixtures (40 CFR 60, Section 2.1, Performance Specification 2, Appendix B) shall be sulfur dioxide (SO_2). Span and zero gases should be traceable to National Bureau of Standards reference gases whenever these reference gases are available. Every six (6) months from date of manufacture, span and zero (0) gases shall be reanalyzed by conducting triplicate analyses using the reference methods in 40 CFR 60, Appendix A, as follows: for sulfur dioxide, use Reference Method 6; for nitrogen oxide, use Reference Method 7; and for carbon dioxide or oxygen, use Reference Method 3. The gases may be analyzed at less frequent intervals if longer shelf lives are guaranteed by the manufacturer.

(4) Cycling times include the total time a monitoring system requires to sample, analyze, and record an emission measurement.

(A) Continuous monitoring systems for measuring opacity shall complete a minimum of one (1) cycle of operation sampling, analyzing, and data recording for each successive ten (10) second period.

(B) Continuous monitoring systems for measuring oxides of nitrogen, carbon dioxide, oxygen, or sulfur dioxide shall complete a minimum of one (1) cycle of operation (sampling, analyzing, and data recording) for each successive fifteen (15) minute period.

(5) All continuous monitoring systems or monitoring devices shall be installed such that representative measurements of emissions or process parameters (i.e., oxygen, or carbon dioxide) from the affected facility are obtained. Additional guidance for location of continuous monitoring systems to obtain representative samples are contained in the applicable 40 CFR 60, Performance Specifications of Appendix B.

(6) When the effluents from two (2) or more affected facilities of similar design and operating characteristics are combined before being released to the atmosphere, the commissioner may allow monitoring systems to be installed on the combined effluent, if the owner or operator shows that measurement of the combined effluents is at least as accurate as simultaneous measurement of each effluent prior to their combining in their common stack.

(7) Owners or operators of all continuous monitoring systems installed in accordance with the requirements of this rule (326 IAC 3-1) shall record the zero (0) and span drift in accordance with the method prescribed by the manufacturer of such instruments; subject the instruments to the manufacturer's recommended zero (0) and span check at least once daily unless the manufacturer has recommended adjustments at shorter intervals, in which case such recommendations should be followed; adjust the zero (0) and span whenever the twenty-four (24) hour zero (0) drift or twenty-four (24) hour calibration drift limits of the applicable performance specifications in 40 CFR 60, Appendix B are exceeded; and adjust continuous monitoring systems referenced by subsection (2) of this section whenever the twenty-four (24) hour calibration drift exceeds ten percent (10%) of the emission standard.

(8) Instrument span should be approximately two hundred percent (200%) of the expected instrument data display output corresponding to the emission standard for the source.

(9) Alternative procedures and requirements:

(A) Alternative locations for installing continuous monitoring systems or monitoring devices may be approved by the commissioner when the owner or operator can demonstrate that installation at alternative locations will enable accurate and representative measurements.

(B) Alternative procedures for performing calibration checks may be approved by the commissioner when the owner or operator can demonstrate that such alternate procedures will still result in meeting the specifications set forth in tables 1.1 for opacity, 2.1 for sulfur dioxide and nitrogen oxides, and 3.1 for oxygen and carbon dioxide, as contained in 40 CFR 60, Appendix B.

(C) Alternative continuous monitoring

systems that do not meet the spectral response requirements in 40 CFR 60, Performance Specification 1, Appendix B, but adequately demonstrate a definite and consistent relationship between their measurements and the opacity measurement of a system complying with the requirements in Performance Specification 1 may be approved by the commissioner. The commissioner may require that such demonstration be performed for each affected facility.

326 IAC 3-1-10 Minimum data reporting requirements; retention of records

Sec. 10. (a) Owners or operators of facilities required to install continuous monitoring systems shall submit a written report of excess emissions for each calendar quarter and the nature and cause of the excess emissions, if known. The averaging periods used for data reporting shall be six (6) minutes for opacity and three (3) hours for gaseous measurements. The required report shall include, as a minimum, the data stipulated in this rule (326 IAC 3-1).

(b) For opacity measurements, the summary shall consist of the magnitude in actual percent opacity of all six (6) minute averages of opacity greater than forty percent (40%) opacity for each hour of operation of the facility. Average values may be obtained by integration over six (6) minutes or by arithmetically averaging a minimum of four (4) equally spaced, instantaneous, opacity measurements per minute.

(c) For gaseous measurements the summary shall consist of emission averages, in units of the applicable standard for each three (3) hour period during which the applicable standard was exceeded.

(d) The date and time identifying each period during which the continuous monitoring system was inoperative, except for zero (0) and span checks, and the nature of system repair of adjustments shall be reported. The commissioner may require proof of continuous monitoring system performance whenever system repairs of adjustments have been made.

(e) When no excess emissions have occurred and the continuous monitoring system(s) has not been inoperative, repaired or adjusted, such information shall be included in the report.

(f) Owners or operators of affected facilities shall maintain a file of all information reported in the quarterly summaries, and all other data collected either by the continuous monitoring system or as necessary to convert monitoring data to the units of the applicable standard for a minimum of two (2) years from the date of collection of such data or submission of such summaries.

326 IAC 3-1-11 Reduction; conversion factors

Sec. 11. Owners or operators of affected facilities shall use the following procedures for converting monitoring data to units of the standard where necessary.

(1) For fossil fuel-fired steam generators the following procedures shall be used to convert gaseous emission monitoring data in parts per million (ppm) to pounds per million BTU where necessary.

(A) When the owner or operator of a fossil fuel-fired steam generator elects under 326 IAC 3-1-8(1) to measure oxygen in the flue gases, the measurements of the pollutant concentration and oxygen shall be on a dry basis and the following conversion procedure used:

$$E = CF \frac{(20.9)}{(20.9 - \% O_2)}$$

(B) When the owner or operator elects under 326 IAC 3-1-8(1) to measure carbon dioxide in the flue gases, the measurement of the pollutant concentration and the carbon dioxide concentration shall each be on a consistent basis (wet or dry) and the following conversion procedure used:

$$F = CF_c \frac{(100)}{(\% CO_2)}$$

(C) When the owner or operator elects under 326 IAC 3-1-8(1) to measure sulfur dioxide or nitrogen oxides in the flue gases, the measurement of the pollutant concentration and the sulfur dioxide and/or the nitrogen oxides concentration(s) shall each be on a wet basis and the following conversion procedure used except where wet scrubbers are employed or where moisture is otherwise added to the stack gases:

$$E = C_{ws}F_w \frac{(20.9)}{(20.9(1-B_{wa})-\%O_{2ws})}$$

(D) When the owner or operator elects under 325 IAC 3-1-8(1) to measure sulfur dioxide or nitrogen oxides in the flue gases, the measurement of the pollutant concentration and the sulfur dioxide and/or the nitrogen oxides concentration(s) shall each be on a wet basis and the following conversion procedure used where wet scrubbers or moisture is otherwise present in the stack gases, provided water vapor content of the stack gas is measured at least once every fifteen (15) minutes at the same point as the pollutant and oxygen measurements are made:

$$E = C_{ws}F \frac{(20.9)}{(20.9(1-B_{ws})-\%O_{2ws})}$$

(E) The values used in the equations under this section are derived as follows:

C_{ws} = pollutant concentration at stack conditions, g/wscm (grams/wet standard cubic meter), lb/wscm (pounds/wet standard cubic meter), determined by multiplying the average concentration (ppm) for each one (1) hour period by 4.15×10^{-5} Mg/wscm per ppm (2.59×10^{-9} M

lb/wscm per ppm) where M is pollutant molecular weight, g/g-mole (lb/lb-mole).

M = 64.07 for sulfur dioxide and 46.01 for nitrogen oxides.

C = as above but measured in terms of pounds/dry standard cubic meter (lb/dscm) or grams/dry standard cubic meter (g/dscm).

F, F_c = a factor representing a ratio of the volume of dry flue gases generated to the calorific value of the fuel combusted (F), and a factor representing a ratio of the volume of carbon dioxide generated to the calorific value of the fuel combusted (F_c), respectively. Values of F and Fc are given in 40 CFR 60, Section 60.45(f), as applicable.

F_w = a factor representing a ratio of the volume of wet flue gases generated to the calorific value of the fuel combusted. Values of F_w are:

(i) For anthracite coal as classified according to A.S.T.M. D388-66, F_w = 1.188 wscm/million calories (10580 wscf/million BTU).

(ii) For sub-bituminous and bituminous coal as classified according to A.S.T.M. D388-66, F_w = 1.200 wscm/million calories (10680 wscf/million BTU).

(iii) For liquid fossil fuels including crude, residual, and distillate oils, F_w = 1.164 wscm/million calories (10360 wscf/million BTU).

(iv) For gaseous fossil fuels: for natural gas, F_w = 1.196 wscm/million calories (10650) wscf/million BTU; for propane, F_w = 1.150 wscm/million calories (10240 wscf/million BTU); for butane, F_w = 1.172 wscm/million calories (10430 wscf/million BTU).

B_{wa} = proportion by volume of water vapor in the ambient air.

B_{ws} = proportion by volume of water vapor in the stack gas.

$\%O_2$, $\%CO_2$ = Oxygen or carbon dioxide volume (expressed as percent) determined with equipment specified under 326 IAC 3-1-8.

E = pollutant emission, lb/million BTU.

(2) For sulfuric acid plants the owner or operator shall:

(A) establish a conversion factor three (3) times daily according to the procedures of 40 CFR 60, Section 60.84(b);

(B) multiply the conversion factor by the average sulfur dioxide concentration in the flue gases to obtain average sulfur dioxide emissions in lb/ton; and

(C) report the average sulfur dioxide emission for each three (3) hour period in excess of the emission standard set forth in 326 IAC 7-1, in the quarterly summary.

(3) For nitric acid plants the owner or operator shall:

(A) establish a conversion factor according to the procedures of 40 CFR 60, Section 60.73(b);

(B) multiply the conversion factor by the average nitrogen oxides concentration in the flue gases to obtain nitrogen oxides emissions in lb/ton;

(C) report the average nitrogen oxides for each averaging period in excess of the emission standard set forth in 326 IAC 12, in the quarterly summary.

(4) Alternate data reporting and reduction procedures:

(A) Alternate procedures for computing emission averages that do not require integration of data may be approved by the commissioner if the owner or operator shows that his procedures are at least as accurate as those in this rule (326 IAC 3-1).

(B) Alternative methods of converting pollutant concentration measurements to units of the emission standard may be approved by the commissioner if the owner or operator shows that his procedures are at least as accurate as those in this rule (326 IAC 3-2).

Rule 2. Source Sampling Procedures

326 IAC 3-2-1 Applicability

Sec. 1. This rule (326 IAC 3-2) applies to any emissions testing performed in the state to determine compliance with applicable emission limits contained in this title (326 IAC), or for any other purpose requiring review and approval by the commissioner.

326 IAC 3-2-2 Federal test procedures; adoption

Sec. 2. Emissions tests subject to this rule (326 IAC 3-2) shall be conducted in accordance with the procedures and analysis methods specified in 40 CFR 60, Appendix A and 40 CFR 61, Appendix B. Such test methods, equipment, calibration requirements, and analysis must be strictly followed unless otherwise approved by the commissioner.

326 IAC 3-2-3 Privately conducted protocol tests; prior approval, form

Sec. 3. (a) When a test is to be performed by any person other than staff, a test protocol form shall be completed and received by the commissioner no later than thirty-five (35) days prior to the intended test date. Such test protocol shall be on a form approved by the commissioner. Any special or unique information relative to the scheduled test shall be included with the form.

(b) After evaluating the completed test protocol form, the commissioner may:

(1) Inspect the test site.

(2) Require additional conditions, including, but not limited to the following:

(A) Reasonable modifications to the stack or duct to obtain acceptable test conditions.

(B) A pretest meeting to resolve an acceptable test protocol.

(C) Additional tests to allow for adverse conditions such as interferences, nonsteady or cyclic processes,

(D) The keeping of process operating parameter records, operating logs or charts during the test,

(E) Conditions on control equipment operation to make it representative of future normal operation, or

(F) The recording of specified control equipment operating parameters during the test.

(c) If the commissioner requires modifications to the test methods, analytical methods, operational parameters or other matters included in the test protocol, or if a pretest meeting is required, the source operator and the testing firm shall be notified by letter or telephone at least twenty-five (25) days prior to the proposed test date. The source operator will receive notice of the acceptability of the test protocol from the commissioner within ten (10) days of its receipt. If the source operator or test firm desires to change any previously submitted procedures or conditions, the commissioner must be notified of such change at least twenty-five (25) days prior to intended test date, and such changes cannot be made unless approved by the commissioner prior to the test. Changes in the test protocol that result from emergency conditions must be approved by an authorized on-site staff member.

(d) The commissioner reserves the right to conduct any portion of the reference method tests. In such case, a twenty-five (25) day notice of proper test procedures will be given to the company and their testing representative.

(e) The source operator must notify the commissioner of the actual test date at least two (2) weeks prior to the date.

326 IAC 3-2-4 Required testing conditions; calibration of instruments

Sec. 4. (a) Staff may observe the field test procedures and plant operation during the test.

(b) All tests shall be conducted while the source is operating at between ninety-five (95%) to one hundred percent (100%) of its maximum operating capacity, or under other capacities or conditions specified and approved by the commissioner. For the purpose of this rule (326 IAC 3-2), maximum operating capacity means the maximum design capacity of the source or other maximum operating capacities agreed to by the source and the commissioner.

(c) Sources subject to 326 IAC 12, New Source Performance Standards, shall be tested under conditions as specified in the applicable provision therein.

(d) Calibration results of the various sampling components must be available for examination at the test site. The information must include dates, methods used, data and results. All components requiring calibration must be calibrated within sixty (60) days prior to the actual test date. Post test calibrations must be performed on the components within forty-five (45) days after the actual test date or before the equipments' next field use, whichever comes first. Components requiring calibration are listed in the federal test methods specified in 326 IAC 3-2-2. Calibration need not be done between tests when several facilities at one (1) location are tested in series, as long as the units are calibrated prior to the first test and after the last test in the series which is conducted at that site.

326 IAC 3-2-5 Test results; reports

Sec. 5. (a) All tests shall be reported to the commissioner in the form of a test report containing the following information (which can be kept confidential upon request):

(1) Certification by team leader and reviewer.

(2) Introduction, containing:

(A) date and type of tests;

(B) type of process and control equipment;

(C) plant name and location;

(D) purpose of test; and

(E) test participants and titles.

(3) Results summary, containing:

(A) tabulated data and results of each test run, process weight rate or heat input rate, the stack gas flow rate, the measured emissions given in units consistent with the applicable emission limits, and the visible emissions or average opacity readings; and

(B) allowable emission rate.

(4) Process information, including:

(A) description of process and control device;

(B) process flow diagram;

(C) maximum design capacities;

(D) fuel analysis and heat value for heat input rate determination;

(E) process and control equipment operating conditions during tests;

(F) discussion of variations from normal plant operations; and

(G) stack height, exit diameter, volumetric flow rate (acfm), exit temperature, and exit velocity.

(5) Sampling information, including:

(A) description of sampling methods used;

(B) brief discussion of the analytical procedures with justification for any variance from standard procedures;

(C) specification of the number of sampling points, time per point, and total sampling time per run;

(D) cross sectional diagram showing sampling points, diagram showing stack dimensions, sampling location and distance from the nearest flow disturbance upstream and downstream of the sampling points; and

(E) sampling train diagram.

(6) Appendix, containing:

(A) sampling and analytical procedures;

(B) results and calculations: One (1) complete calculation using actual data for each type of test performed must be shown. Results must be stated in units consistent with the applicable emission limitation;

(C) raw production data signed by plant official;

(D) photocopies of all actual field data or original raw field data;

(E) laboratory report with chain of custody shown;

(F) copies of all calibration data;

(G) applicable regulations showing emission limitation; and

(H) copies of visible emissions observations or opacity monitor readings (for TSP tests).

(b) Unless previously agreed to in writing by the commissioner, all test reports must be received by the commissioner within forty-five (45) days of the completion of the testing.

326 IAC 3-2-6 Special testing procedures; particulate matter; sulfur dioxide; nitrogen oxide; volatile organic chemicals

Sec. 6. (a) Particulate matter tests shall be conducted in accordance with the following procedures:

(1) 40 CFR 60, Appendix A, Method 5, as in effect on December 2, 1981, or other procedures approved by the commissioner shall be used.

(2) Visible emissions (VE) evaluation

shall be performed in conjunction with a particulate emissions test by a qualified observer in accordance with the procedures contained in 326 IAC 5-1-4. VE readings shall be continuously recorded for at least thirty (30) minutes per hour of sampling time for each sampling repetition. A variance from this requirement may be granted by the on-site staff person for one (1) repetition only and provided that adverse conditions exist which would invalidate the VE readings. Sources equipped with continuous opacity monitors may submit the monitor's instantaneous or six (6) minute integrated readings during the sampling period, in lieu of performing VE observations; provided,

(A) The monitoring system meets the Performance Specifications Tests I as specified in 40 CFR 60, Appendix B as in effect on December 2, 1981, and

(B) The monitor readings submitted with the test include a zero (0) and span calibration check at the start and end of each test.

(3) At least three (3) repetitions of the test must be performed under identical source operating conditions unless otherwise allowed by the commissioner.

(4) During each of the repetitions, each sampling point shall be sampled for a minimum of two (2) minutes.

(5) The total test time per repetition shall be no less than sixty (60) minutes.

(6) The total sample volume per repetition shall be no less than thirty (30) dry standard cubic feed (dscf).

(7) The total particulate weight collected from the sampling nozzle, probe, cyclone (if used), filter holder (front half), filter and connecting glassware shall be reported. Particulate analysis of the impinger catch is not required unless specified by commissioner.

(b) Sulfur dioxide (SO_2) tests shall be conducted in accordance with the following procedures:

(1) 40 CFR 60, Appendix A, Method 6 or 40 CFR 60, Appendix A, Method 8, as in effect on December 2, 1981, or other procedures approved by the commissioner, shall be used.

(2) At least three (3) repetitions of two (2) samples, each of 40 CFR 60, Appendix A, Method 6, or three (3) repetitions of 40 CFR 60, Appendix A, Method 8, performed under identical source operating conditions, shall constitute a test.

(3) During each of the repetitions for 40 CFR 60, Appendix A, Method 8, each sampling point shall be sampled for a minimum of two (2) minutes.

(4) The total test time per repetition shall be as follows:

(A) 40 CFR 60, Appendix A, Method 6: a minimum of twenty (20) minutes per run with a thirty (30) minute interval between each run; or

(B) 40 CFR 60, Appendix A, Method 8: a minimum of sixty (60) minutes per run.

(5) The total sample volume per repetition under 40 CFR 60, Appendix A, Method 8, shall be no less than forty (40) dry standard cubic feet (dscf).

(c) Nitrogen oxide tests shall be conducted in accordance with the following procedures:

(1) 40 CFR 60, Appendix A, Method 7, as in effect on December 2, 1981, or other procedures approved by the commissioner, shall be used.

(2) At least three (3) repetitions of four (4) samples each shall constitute a test.

(d) Volatile organic compounds (VOC) emissions tests shall be conducted in accordance with the following procedures:

(1) 40 CFR 60, Appendix A, Method 25, as in effect on December 2, 1981, or other procedures approved by the commissioner, shall be used for the total nonmethane organic (TNMO) emissions.

(2) At least three (3) duplicate samples must be collected and analyzed.

(3) The total test time per repetition shall be a minimum of sixty (60) minutes.

326 IAC 3-2-7 Invalidity of nonconforming tests

Sec. 7. Any tests not meeting the requirements of this rule (326 IAC 3-2) are invalid for purposes of this rule.

326 IAC 3-2-8 Appeals

Sec. 8. A determination by the commissioner may be appealed in accordance with IC 13-1-1-4(f) and IC 4-21.5.

ARTICLE 4. BURNING REGULATIONS

Rule 1. Open Burning

326 IAC 4-1-1 Scope of rule

Sec. 1. The requirements of this rule (326 IAC 4-1) establish standards for the open burning of material which would result in emissions of regulated pollutants. This rule (326 IAC 4-1) applies everywhere in the state, except in areas where acts permitted by 326 IAC 4-1-3 or authorized by variance pursuant to 326 IAC 4-1-4 are prohibited by other state or local laws, regulations, or ordinances.

326 IAC 4-1-2 Prohibition against open burning

Sec. 2. No persons shall open burn any material except as provided in 326 IAC 4-1-3 or 326 IAC 4-1-4, or 326 IAC 4-1-5.

326 IAC 4-1-3 Exemptions

Sec. 3. (a) The following types of fires are permitted:

(1) Fires celebrating Twelfth Night Ceremonies.

(2) Fires celebrating school pep rallies.

(3) Fires celebrating scouting activities.

(4) Fires used for recreational and cooking purposes, i.e., camp fires.

(5) Residential burning; where residence contains four or fewer units. Burning shall be in a noncombustible container sufficiently vented to induce adequate primary combustion air with enclosed sides, a bottom, and a mesh covering with openings no larger than one-fourth inch (1/4") square. Burning is prohibited in apartment complexes and mobile home parks.

(6) Farm burning: wood products derived from the following farm maintenance operations:

(A) Burning of fence rows and fields or materials derived therefrom.

(B) Burning of natural growth derived from clearing a drainage ditch.

(C) Burning of limbs and prunings, but only if so diseased or infected as to present a contamination problem.

(7) Waste oil burning: where the waste oil has been collected in a properly constructed and located pit as prescribed in 310 IAC 7-1-37(A) of the Division of Oil and Gas, Department of Natural Resources. Each oil pit may be burned once every two (2) months and all the oil must be completely burned within thirty (30) minutes after ignition.

(8) Department of natural resources burning: in order to facilitate "prescribed" burning on DNR controlled properties for wildlife habitat maintenance, forestry purposes, and natural area management.

(9) United States Department of the Interior burning: in order to facilitate a National Park Service Fire Management Plan for the Indiana Dunes National Lakeshore.

(b) All exemptions under subsection (a)

of this section shall be subject to the following:

(1) Only wood products shall be burned unless otherwise stated above.

(2) Fires shall be attended at all times until completely extinguished.

(3) If fires create an nuisance or a fire hazard, they shall be extinguished.

(4) All residential, farm and waste oil burning shall occur during daylight hours during which the fires may be replenished, but only in such a manner that nearly all of the burning material is consumed by sunset.

(5) No burning shall be conducted during unfavorable meteorological conditions such as temperature inversions, high winds, air stagnation, etc.

326 IAC 4-1-4 Variances

Sec. 4. (a) Burning with prior approval of the commissioner or the commissioner's designated agent may be authorized for the following:

(1) Emergency burning of spilled petroleum products when all reasonable efforts to recover the spilled material have been made and failure to burn would result in an imminent fire hazard or water pollution problem.

(2) Burning of refuse consisting of material resulting from a natural disaster.

(3) Burning for the purpose of fire training.

(4) Burning of natural growth derived from a clearing operation, i.e., removal of natural growth for change in use of the land.

(5) Burning of highly explosive or other dangerous materials for which no alternative disposal method exists or where transportation of such materials is impossible.

(b) Burning not exempted by 326 IAC 4-1-3 may be permitted with prior receipt of a variance application and approval of the commissioner or the commissioner's designated agent.

326 IAC 4-1-5 Liability for fire

Sec. 5. Any person who allows the accumulation or existence of combustible material which constitutes or contributes to a fire causing air pollution may not refute liability for violation of this rule (326 IAC 4-1) on the basis that said fire was set by vandals, accidental, or an act of God.

Rule 2. Incinerators

326 IAC 4-2-1 Applicability of rule

Sec. 1. This rule (326 IAC 4-2) establishes standards for the use of incinerators which emit regulated pollutants. This rule (326 IAC 4-2) does not apply to incinerators in residential units consisting of four (4) or fewer families. All other incinerators are subject to this rule (326 IAC 4-2).

326 IAC 4-2-2 Stationary incinerators

Sec. 2. All stationary incinerators shall:

(1) Consist of primary and secondary chambers or the equivalent.

(2) Be equipped with a primary burner unless burning wood products.

(3) Comply with 326 IAC 5-1 and 326 IAC 2.

(4) Be maintained properly as specified by the manufacturer and approved by the commissioner or the commissioner's designated agent.

(5) Be operated according to the manufacturer's recommendations and only burn waste approved by the commissioner or its designated agent.

(6) Comply with other state and/or local rules or ordinances regarding installation and operation.

(7) Be operated so that emissions of hazardous material including, but not limited to, viable pathogenic bacteria, dangerous chemicals or gases, or noxious odors are prevented.

(8) Not emit particulate matter in excess of the following:

(A) Incinerators with a maximum refuse-burning capacity of two hundred (200) or more pounds per hour: 0.3 pounds of particulate matter per one thousand (1,000) pounds of dry exhaust gas at standard conditions corrected to fifty percent (50%) excess air.

(B) All other incinerators: 0.5 pounds of particulate matter per one thousand (1,000) pounds of dry exhaust gas at standard conditions corrected to fifty percent (50%) excess air.

(9) Not create a nuisance or a fire hazard. If any of the above result, the burning shall be terminated immediately.

326 IAC 4-2-3 Portable incinerators

Sec. 3. All portable incinerators shall be subject to the following conditions:

(1) Approval of the commissioner or its designated agent must be obtained prior to operation at a new project site.

(2) Only wood products shall be burned.

(3) Merchantable material may be salvaged where practicable.

(4) The local health department shall be notified prior to any burning.

(5) All burning shall be conducted under favorable meteorological conditions.

(6) Burning shall occur during daylight hours and all material shall be consumed by sunset.

(7) If burning creates an air pollution problem, a nuisance or a fire hazard, the burning shall be terminated immediately.

(8) The incinerator shall be maintained and operated according to the manufacturer's recommendations and in a manner approved by the commissioner or its designated agent.

(9) The installation and operation of such an apparatus shall comply with all other state and/or local rules or ordinances.

(10) A portable incinerator shall comply with both 326 IAC 5-1 and 326 IAC 2.

ARTICLE 5. OPACITY REGULATIONS

Rule 1. Opacity Limitations

326 IAC 5-1-1 Applicability of rule

Sec. 1. (a) This rule (326 IAC 5-1) shall apply to all visible emissions (not including condensed water vapor) emitted by or from any facility or source except those sources or facilities for which specific visible emission limitations are established by 326 IAC 11, 326 IAC 12, or 326 IAC 6.

(1) The requirements of 326 IAC 5-1-2(a)(1) shall apply to sources or facilities located in attainment areas for particulate matter, designated in 326 IAC 1-4.

(2) The requirements of 326 IAC 5-1-2(a)(2) shall apply to sources or facilities located in nonattainment areas for particulate matter as designated in 326 IAC 1-4.

326 IAC 5-1-2 Visible emission limitations

Sec. 2. (a) Visible emissions from any source or facility shall not exceed any of the following limitations. Unless otherwise stated, all visible emissions shall be observed in accordance with the procedures set forth in 326 IAC 5-1-4:

(1) Sources or facilities of visible emissions located in attainment areas for particulate matter shall meet the following limitations:

(A) Visible emissions shall not exceed, an average of forty percent (40%) opacity in twenty-four (24) consecutive readings.

(B) Visible emissions shall not exceed sixty percent (60%) opacity for more than a cumulative total of fifteen (15) minutes (sixty (60) readings) in a six (6) hour period.

(2) Sources or facilities of visible emissions located in nonattainment areas shall meet the following limitations:

(A) Visible emissions shall not exceed, an average of thirty percent (30%) opacity in twenty-four (24) readings.

(B) Visible emissions shall not exceed sixty percent (60%) opacity for more than a cumulative total of fifteen (15) minutes (sixty (60) readings) in a six (6) hour period.

(3) Sources and facilities of visible emissions located in both attainment or nonattainment areas, for which an alternate visible emission limitation has been established pursuant to 326 IAC 5-1-5(b), shall comply with said limitations in lieu of the limitations set forth in subsection (a)(1) and (a)(2) of this section.

326 IAC 5-1-3 Temporary exemptions

Sec. 3. (a) Boiler startup and shutdown: When building a new fire in a boiler, or shutting down a boiler, visible emissions may exceed the applicable opacity limit established in 326 IAC 5-1-2(a); however, visible emissions shall not exceed an average of sixty percent (60%) opacity and emissions in excess of the applicable opacity limit shall not continue for more than ten (10) continuous minutes on one (1) occasion in any twenty-four (24) hour period.

(b) Cleaning boilers: When removing ashes from the fuel bed or furnace in a boiler or blowing tubes, visible emissions may exceed the applicable opacity limit established in 326 IAC 5-1-2(a) however, visible emissions shall not exceed sixty percent (60%) opacity and visible emissions in excess of the applicable opacity limit shall not continue for more than five (5) continuous minutes on one (1) occasion in any sixty (60) minute period. Such emissions shall not be permitted on more than three (3) occasions in any twelve (12) hour period.

(c) Facilities not temporarily exempted by subsections (a) and (b) of this section may be granted special temporary exemptions by the commissioner of the same duration and type authorized therein provided that the facility proves to the satisfaction of the commissioner that said exemptions are needed and that during periods of startup and shutdown, owners and operators shall, to the extent practicable, maintain and operate any affected facility including air pollution control equipment in a manner consistent with good air pollution control practice for minimizing emissions. Determination of whether acceptable operating and maintenance procedures are being used will be based on information available to the commissioner, which may include, but is not limited to, monitoring results, opacity observations, review of operating and maintenance procedures and inspection of the source.

(d) Sources or facilities not exempted through subsections (a), (b), or (c) of this section may also be granted special exemptions by the commissioner, provided that the source or facility owner or operator proves to the satisfaction of the commissioner that said exemption is justifiable. Said exemption(s) may be of longer duration and may apply to other types of facilities not provided for in subsections (a) or (b) of this section.

326 IAC 5-1-4 Compliance determination

Sec. 4. (a) Determination of visible emissions from sources or facilities to which this rule (326 IAC 5-1) applies may be made in accordance with subdivisions (1) or (2) below:

(1) Determination of visible emissions by means of a qualified observer shall be made according to the following:

(A) Position: The qualified observer shall stand at a distance sufficient to provide a clear view of the emissions with the sun, if visible, oriented in the 140° sector to his back. Consistent with maintaining the above requirement, the observer shall, as much as possible, make his observations from a position such that his line of vision is approximately perpendicular to the direction of the visible emissions (plume where applicable), and when observing opacity of emissions from rectangular outlets (e.g., monitors, open baghouses, noncircular stacks), approximately perpendicular to the longer axis of the outlet. The observer's line of sight should not include more than one (1) plume at a time when multiple stacks are involved, and in any case the observer should make his observations with his line of sight perpendicular to the longer axis of such a set of multiple stacks (e.g., stub stacks on baghouses).

(B) Field records: The observer shall record the name of the plant, emission location, type of facility, observer's name and affiliation, and the date on a field data sheet. Time, estimated distance to the emission location, approximate wind direction, estimated wind speed, description of the sky conditions (presence and color of clouds), and visible emissions (plume where applicable) background are recorded on a field data sheet at the time opacity readings are initiated and completed.

(C) Observations: Opacity observations shall be made at the point of greatest opacity in that portion of the visible emissions, (plume where applicable) where condensed water vapor is not present. The observer shall not look continuously at the visible emissions, (plume where applicable) but instead shall observe the visible emissions, (plume where applicable) momentarily at fifteen (15) second intervals.

(D) Recording observations: Opacity observations shall be recorded to the nearest five percent (5%) at fifteen (15) second intervals on an observational record sheet. A minimum of twenty-four (24) observations shall be recorded. Each momentary observation shall be deemed to represent the average opacity of emissions for a fifteen (15) second period.

(E) Determination of opacity as an average of twenty-four (24) consecutive observations: Opacity shall be determined as an average of twenty-four (24) consecutive observations recorded at fifteen (15) second intervals. Divide the observations recorded on the record sheet into sets of twenty-four (24) consecutive observations. A set is composed of any twenty-four (24) consecutive observations. Sets need not be consecutive in time and in no case shall two (2) sets overlap. For each set of twenty-four (24) observations, calculate the average by summing the opacity of the twenty-four (24) observations and dividing this sum by twenty-four (24). Record the average opacity on a record sheet. For the purpose of determining an alternative visible emission limit in accordance with 326 IAC 5-1-5(b) following, an average of twenty-four (24) consecutive readings or more may be used to calculate the alternate visible emissions limit.

(F) Determination of opacity as a cu-

mulative total of fifteen (15) minutes: For emissions from intermittent sources, opacity shall be determined in accordance with clause (A), (B), (C), and the first sentence of (D). Each momentary observation shall be deemed to represent the average opacity of emissions for a fifteen (15) second period. All readings greater than the specified limit in 326 IAC 5-1-2 shall be accumulated as fifteen (15) second segments for comparison with the limit.

(G) Attached steam plumes: When condensed water vapor is present within the plume as it emerges from the emission outlet, opacity observations shall be made beyond the point in the plume at which condensed water vapor is no longer visible. The observer shall record the approximate distance from the emission outlet to the point in the plume at which the observations are made.

(H) Detached steam plumes: When water vapor in the plume condenses and becomes visible at a distinct distance from the emission outlet, the opacity of emissions should be evaluated at the emission outlet prior to the condensation of water vapor and the formation of the steam plume

(2) Determination of compliance with visible emission limitations established in this rule (326 IAC 5-1) may also be made in accordance with a source's or facility's continuous monitoring equipment, for any source or facility in compliance with the requirements of 326 IAC 3-1.

(b) If the compliance determination procedures set forth in subsections (a)(1) and (a)(2) of this section results in any conflict in visible emission readings, the determination made in accordance with subsection (a)(2) of this section shall prevail for the purpose of compliance, provided that it can be shown that the continuous monitor has met the performance specifications as set forth in the 40 CFR 60, specifically Performance Specification 1.

326 IAC 5-1-5 Violations

Sec. 5. (a) A violation of this rule (326 IAC 5-1) shall constitute prima facie evidence of a violation of other applicable particulate emission control regulations. A violation of any such rule may be refuted by a performance test conducted in accordance with subsection (b) of this section. Such test shall refute the mass emission violation only if the source is shown to be in compliance with the allowable mass emission limit. An exceedance of the allowable opacity emission limit will not be treated as a violation if, during the test described in subsection (b) of this section, the source demonstrates compliance with the allowable mass emission limit while simultaneously having visible emissions more than or equal to the reading at which the exceedance was originally observed.

(b) The owner or operator of a source or facility which believes it can operate in compliance with the applicable mass emission limitation, but exceeds the limits specified in 326 IAC 5-1-2, may submit a written petition to the commissioner requesting that an alternate opacity limitation be established pursuant to the following provisions. Additionally, if the commissioner has issued a notice of violation to an owner or operator of a source or facility for violation of the applicable opacity limitation, such owner or operator may, propose in notice of violation resolution, to disprove said violation by establishing an alternate opacity limit pursuant to the following provisions. This alternate limit shall be based upon a mass emission performance test conducted according to a method designated by the commissioner, and a visible emission test conducted simultaneously, according to 326 IAC 5-1-4. Where the commissioner determines there is no acceptable test method available, a request for an alternate visible emission limit shall be denied.

(1) The alternate emission limit shall be equal to that level of opacity at which the source or facility will be able, as indicated by the performance and opacity tests, to meet the opacity standard at all times during which the source or facility is meeting the mass emission limitation. However, the commissioner shall also reserve the right to determine the alternate visible emissions limit in the following manner:

(A) If a performance test of a source or facility demonstrates:

(i) that said source or facility is in compliance with the allowable mass emissions limit (as defined in 326 IAC 1-2) at the time that the test is done; and

(ii) simultaneously, said source's or facility's test demonstrates that the allowable opacity emission limit is being exceeded, then, the enforceable opacity limitation shall be equal to that level of opacity at which the source or facility will be able as indicated by the performance and opacity tests to meet the opacity standard at all times during which the source or facility is meeting the mass emission limitation.

(B) If a performance test of a source or facility demonstrates:

(i) that said source or facility is in compliance with the allowable mass emission limit, and the test mass emission rate is within ten percent (10%) of the allowable emissions limit for that source or facility; and

(ii) simultaneously, said source's or facility's test demonstrates that the opacity observed is below the allowable opacity emission limit, the enforceable opacity limitation shall be equal to that level of opacity at which the source or facility will be able, as indicated by the performance and opacity tests, to meet the opacity standard at all times during which the source or facility is meeting the mass emission limitation.

(C) If a performance test of a source or facility demonstrates:

(i) that said source or facility is in compliance with the allowable mass emission limit, and the test mass emission rate is less than ninety percent (90%) of the allowable emissions limit; and

(ii) simultaneously, said source's or facility's test demonstrates that the opacity observed is below the allowable opacity emission limit, the enforceable opacity limitation shall remain the existing allowable opacity emission limitation for that source or facility.

(2) Compliance with 326 IAC 6-1, 326 IAC 6-2, 326 IAC 6-3, and 326 IAC 11-1, and other applicable rules must be demonstrated by the performance test.

(3) The commissioner may require a performance test in any case where it is necessary to determine the compliance status for a facility. However, the commissioner will not request a performance test for any facility which is known to be in compliance with the allowable opacity limitation.

(4) All alternate visible emission limits shall be established on a source or facility-specific basis. No limitation for any facility or source shall be established by reference to a similar or identical facility or source.

(5) The owner or operator of the source or facility shall notify the commissioner at

least fifteen (15) days prior to conducting a test for the purposes of demonstrating an alternate visible emission limit.

(6) A staff member who is a qualified observer, approved by the commissioner or other consultant approved by the commissioner shall be present during any performance tests.

(7) The cost of the performance test shall be at the expense of the owner or operator.

(8) Any alternate visible emission limit established for any source or facility shall not become effective until said limitation is established in the applicable operating permit. Said limitation will be incorporated, by amendment, into the operating permit for said source or facility and submitted to the U.S. EPA as a SIP revision.

(9) Where a visible emission limitation is based upon a new source performance standard, any new limitation must comply with the provisions of said standard.

326 IAC 5-1-6 Compliance schedule

Sec. 6. Sources newly subject to more stringent limitations on August 27, 1980, by 326 IAC 5-1-2 shall comply with the compliance schedule of 326 IAC 6-1.

326 IAC 5-1-7 State implementation plan revisions

Sec. 7. Any exemptions given or provisions granted to this rule (326 IAC 5-1) by the commissioner under 326 IAC 5-1-3(c), 326 IAC 5-1-3(d), or 326 IAC 5-1-5(b), shall be submitted to the U.S. EPA as a SIP revision.

ARTICLE 6. PARTICULATE RULES

Rule 1. Nonattainment Area Limitations

326 IAC 6-1-1 Applicability of rule

Sec. 1. Sources or facilities specifically listed in 326 IAC 6-1-7 shall comply with the limitations contained therein. Sources or facilities that are (1) located in the nonattainment counties listed in 326 IAC 6-1-7, (2) but which sources or facilities are not specifically listed in 326 IAC 6-1-7, and (3) have the potential to emit one hundred (100) tons or more of particulate matter per year or have actual emissions of ten (10) tons or more of particulate matter per year, shall comply with the limitations of 326 IAC 6-1-2.

326 IAC 6-1-2 Particulate emission limitations; fuel combustion steam generators, asphalt concrete plant, grain elevators, foundaries, mineral aggregate operations; modification by commissioner

Sec. 2. (a) General sources: Facilities not limited by subsections (b) through (g) of this section shall not allow or permit discharge to the atmosphere of any gases which contain particulate matter in excess of 0.07 gram per dry standard cubic meter (g/dscm) (0.03 grain per dry standard cubic foot (dscf)). Where this limitation is more stringent than the applicable limitations of subsections (b) through (g) of this section, for facilities in existence prior to the applicability dates, or of a size not applicable to said subsections, emission limitations for those facilities shall be determined by the commissioner and will be established in accordance with the procedures set forth in subsection (h) of this section.

(b) Fuel combustion steam generators: No person shall operate a fossil fuel combustion steam generator (any furnace or boiler used in the process of burning solid, liquid, or gaseous fuel or any combination thereof for the purpose of producing steam by heat transfer) so as to discharge or cause to be discharged any gases unless such gases are limited to:

(1) A particulate matter content of no greater than 0.18 grams per million calories (0.10 pounds per million Btu) for solid fuel fired generators of greater than sixty-three million (63,000,000) kilocalories (kcal) per hour heat input (two hundred fifty (250) million Btu);

(2) A particulate matter content of no greater than 0.63 grams per million calories (0.35 pounds per million Btu) for solid fuel fired generators of equal to or greater than 6.3 but less than or equal to sixty-three million (63,000,000) kcal per hour heat input (twenty-five (25) but less than or equal to two hundred fifty (250) million Btu);

(3) A particulate matter content of no greater than 1.08 grams per million calories (0.6 pounds per million Btu) for solid fuel fired generators of less than 6.3 million kcal per hou heat input (twenty-five (25) million Btu);

(4) A particulate matter content of no greater than 0.27 grams per million kcal (0.15 pounds per million Btu) for all liquid fuel fired steam generators.

(5) A particulate matter content of no greater than .01 grains per dry standard cubic foot for all gaseous fuel-fired steam generators.

(c) Asphalt concrete plants: The requirements of this provision shall apply to any asphalt concrete plant (any facility used to manufacture asphalt concrete by heating and drying aggregate and mixing with asphalt cement). An asphalt concrete plant is deemed to consist only of the following: driers, systems for screening, handling, storing, and weighing hot aggregate; systems for loading, transferring, and storing mineral filler; systems for mixing asphalt concrete; and the loading, transfer, and storage systems associated with emission control systems.

(1) No person shall operate the affected facilities of an asphalt concrete plant which existed on or prior to June 11, 1973, so as to discharge or cause to be discharged into the atmosphere any gases unless such gases are limited to:

(A) A particulate matter content of no greater than 230 mg per dscm (0.10 grain per dscf).

(d) Grain Elevators: No person shall operate a grain elevator (a grain elevator is defined as any plant or installation at which grain is unloaded, handled, cleaned, dried, stored or loaded) without meeting the provisions of this subsection. Subdivision (1) of this subsection shall apply to any grain storage elevator located at any grain processing source which has a permanent grain storage capacity of thirty-five thousand two hundred (35,200) cubic meters (one (1) million U.S. bushels) and any grain terminal elevator which has a permanent grain storage capacity of eighty-eight thousand one hundred (88,100) cubic meters (two and one-half (2.5) million U.S. bushels). All grain elevators subject to this rule (326 IAC 6-1) shall comply with the requirements of subdivision (2) of this section.

(1) No owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any affected facility except a grain dryer any process emission unless such emissions are limited to a particulate matter content of no greater than 0.07 gram per dry standard cubic meter (dscm)(0.03 grain per dry standard cubic foot (dscf)) for said facilities for which construction or modification commenced prior to January 13, 1977.

(2) Grain elevators subject to this subdivision shall provide for good housekeeping and good maintenance procedures. Good housekeeping and maintenance is defined

Rule 2 Participate Emission Limitations for Sources of Indirect Heating

326 IAC 6-2-1 Applicability

Sec. 1. This rule (326 IAC 6-2) establishes limitations for sources of indirect heating:

(a) Particulate emissions from the combustion of fuel for indirect heating from all facilities located in Lake, Porter, Marion, Boone, Hamilton, Hendricks, Johnson, Morgan, Shelby, and Hancock Counties which were existing and in operation or which received permit to construct prior to September 21, 1983, shall be limited by 326 IAC 6-2-2.

(b) Particulate emissions from the combustion of fuel for indirect heating from all facilities not specified in subsection (a) of this section which were existing and in operation or which received permits to construct prior to September 21, 1983 shall be limited by 326 IAC 6-2-3.

(c) Particulate emissions from the combustion of fuel for indirect heating from all facilities receiving permits to construct on or after September 21, 1983 shall be limited by 326 IAC 6-2-4.

(d) If any limitation established by this rule (326 IAC 6-2) is inconsistent with applicable limitations contained in 326 IAC 6-1, then the limitations contained in 326 IAC 6-1 prevail.

(e) If any limitation established by this rule (326 IAC 6-2) is inconsistent with applicable limitations contained in 326 IAC 12, New Source Performance Standards, then the limitations contained in 326 IAC 12 prevail.

(f) If any limitation established by this rule (326 IAC 6-2) is inconsistent with a limitation contained in a facility's construction or operation permit as issued pursuant to 326 IAC 2, Permit Review Regulations, then the limitations contained in the source's current permits prevail.

(g) If any limitation established by this rule (326 IAC 6-2) is inconsistent with a limitation required by 326 IAC 2, Permit Review Regulations, to prevent a violation of the ambient air quality standards set forth in 326 IAC-1-4, then the limitations required by 326 IAC 2 prevail.

(h) The addition of a new facility at a source does not affect the limitations of the existing facilities unless such changes in the limitations are required by the provisions of 326 IAC 2 or 326 IAC 6-1.

326 IAC 6-2-2 Emission limitations for facilities specified in 326 IAC 6-2-1(a)

Sec. 2. (a) Particulate emissions from existing indirect heating facilities located in the specified counties shall be limited by the following equation:

$$Pt = \frac{0.87}{Q^{0.16}}$$

Where:

Pt = Pounds of particulate matter emitted per million Btu (lb/mmBtu) heat input.

Q = Total source maximum operating capacity rating in million Btu per hour (mmBtu/hr) heat input. The maximum operating capacity rating is defined as the maximum capacity at which the facility is operated or the nameplate capacity, whichever is specified in the facility's operation permit application, except when some lower capacity is contained in the facility's operation permit, in which case, the capacity specified in the operation permit shall be used.

For Q less than 10 mmBtu/hr, Pt shall not exceed 0.6. For Q greater than or equal to 10,000 mmBtu/hr, Pt shall not exceed 0.2. Figure 1 may be used to estimate allowable emissions.

(b) The emission limitations for those indirect heating facilities which were existing and in operation on or before June 8, 1972, shall be calculated using the equation contained in subsection (a) of this section where: Q shall reflect the total source capacity on June 8, 1972. The resulting Pt is the emission limitation for each facility existing on that date and will not be affected by the addition of any subsequent facility. The particulate emissions from all of the facilities which were in existence on June 8, 1972, may be allocated in any way among these facilities provided that they will not result in a significantly greater air quality impact level at any receptor than that which would result if the particulate emissions from each of these facilities were limited to Pt; and provided that the emission limitations for each facility are specified in its operation permit. Significant impact levels are defined in 326 IAC 2-3(d).

(c) The emission limitations for those indirect heating facilities which began operation after June 8, 1972, and before September 21, 1983, and those facilities which receive permits to construct prior September 21, 1983 shall be calculated using the equation contained in subsection (a) of this section where: Q includes the capacity for the facility in question and the capacities for those facilities which were previously constructed or received prior permits to construct. The limitations for all previously permitted facilities do not change. The Q and Pt for each facility at a source which begins operation or receives a construction permit during this time period will be different.

326 IAC 6-2-3 Emission limitations for facilities specified in 326 IAC 6-2-1(b)

Sec. 3. (a) Particulate emissions from indirect heating facilities existing and in operation before September 21, 1983, shall be limited by the following equation:

$$Pt = \frac{C \times a \times h}{76.5 \times Q^{0.75} \times N^{0.25}}$$

Where:

C = Maximum ground level concentration with respect to distance from the point source at the "critical" wind speed for level terrain. This shall equal 50 migrograms per cubic meter (μ/m^3) for a period not to exceed a sixty (60) minute time period.

Pt = Pounds of particulate matter emitted per million Btu heat input (lb/mmBtu).

Q = Total source maximum operating capacity rating in million Btu per hour (mmBtu/hr) heat input. The maximum operating capacity rating is defined as the maximum capacity at which the facility is operated or the nameplate capacity, whichever is specified in the facility's operation permit application, except when some lower capacity is contained in the facility's operation permit; in which case, the capacity specified in the operation permit shall be used.

N = Number of stacks in fuel burning operation.

a = Plume rise factor which is used to make allowance for less than theoretical plume rise. The value 0.67 shall be used for Q less than or equal to 1,000 mmBtu/hr heat input. The value 0.8 shall be used for Q greater than 1,000 mmBtu/hr heat input.

h = Stack height in feet. If a number of stacks of different heights exist, the average stack height to represent "N" stacks shall be calculated by weighing each stack height with its particulate matter emission rate as follows:

$$h = \frac{\sum_{i=1}^{N} H_i \times pa_i \times Q}{\sum_{i=1}^{N} pa_i \times Q}$$

Where:

pa = the actual controlled emission rate in lb/mmBtu using the emission factor from AP-42 or stack test data. Stacks constructed after January 1, 1971, shall be credited with GEP stack height only. GEP stack height shall be calculated as specified in 326 IAC 1-7.

(b) The emission limitations for those indirect heating facilities which were existing and in operation on or before June 8, 1972, shall be calculated using the equation contained in subsection (a) of this section where: Q, N, and h shall include the parameters for all facilities in operation on June 8, 1972. The resulting Pt is the emission limitation for each facility existing on that date and will not be affected by the addition of any subsequent facility. The particulate emissions from all of the facilities which were in existence on June 8, 1972, may be allocated in any way among these facilities provided that they will not result in a significantly greater air quality impact level at any receptor than that which would result if the particulate emissions from each of these facilities were limited to Pt; and provided that the emission limitations for each facility are specified in its operation permit. Significant impact levels are defined in 326 IAC 2-3-2(d).

(c) The emission limitations for those indirect heating facilities which began operation after June 8, 1972, and before September 21, 1983, and those facilities which receive permits to construct prior to to September 21, 1983, shall be calculated using the equation contained in subsection (a) of this section where: Q, N, and h shall include the parameters for the facility in question and for those facilities which were previously constructed or received prior permits to construct. The limitations for all previously permitted facilities do not change. The Q, N, h, and Pt for each facility at a source which begins operation or receives a construction permit during this time period will be different.

(d) Particulate emissions from all facilities used for indirect heating purposes which were existing and in operation on or before June 8, 1972, shall in no case exceed 0.8 lb/mmBtu heat input.

(e) Particulate emissions from any facility used for indirect heating purposes which has 250 mmBtu/hr heat input or less and which began operation after June 8, 1972, shall in no case exceed 0.6 lb/mmBtu heat input.

326 IAC 6-2-4 Emission limitations for facilities specified in 326 IAC 6-2-1(c)

Sec. 4. (a) Particulate emissions from indirect heating facilities constructed after September 21, 1983 shall be limited by the following equation:

$$Pt = \frac{1.09}{Q^{0.26}}$$

Where:

Pt = Pounds of particulate matter emitted per million Btu (lb/mm Btu) heat input.

Q = Total source maximum operating capacity rating in million Btu per hour (mmBtu/hr) heat input. The maximum operating capacity rating is defined as the maximum capacity at which the facility is operated or the nameplate capacity, whichever is specified in the facility's permit application, except when some lower capacity is contained in the facility's operation permit; in which case, the capacity specified in the operation permit shall be used.

For Q less than 10 mmBtu/hr, Pt shall not exceed 0.6. for Q greater than or equal to 10,000 mmBtu/hr, Pt shall not exceed 0.1. Figure 2 may be used to estimate allowable emissions.

(b) As each new indirect heating facility is added to a plant Q will increase. As a result, the emission limitation for each progressively newer facility will be more stringent until the total plant capacity reaches 10,000 mmBtu/hr after which the emmission limit for each newer facility will be 0.1 lb/mmBtu heat input. The rated capacities for facilities regulated by 326 IAC 12, New Source Performance Standards, shall be included when calculating Q for subsequent facilities.

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APPENDIX D

Plant Operating Logs

BOILER NUMBER 3 DAILY REPORT

12/06/90

TIME	STEAM FLOW PPH	COAL FLOW PPH	AIR FLOW PCT	OXYGEN PCT.	FURNACE PRESSURE	DRUM LEVEL	DRUM PRESSURE	WINDBOX PRESSURE	UPTAKE PRESSURE	FLUE GAS TEMP. F	GRATE TEMP. F	GRATE TEMP. F
00:30	19578	0.0	53	6.5	-0.19	17.4	111.8	0.03	-0.58	519.3	80.8	122.1
01:30	22453	400.6	63	6.4	-0.18	18.5	112.2	0.20	-0.61	536.2	80.0	123.2
03:30	29393	400.0	85	5.4	-0.01	18.1	114.5	0.62	-0.80	598.0	79.2	127.8
04:30	28944	398.7	82	4.1	-0.16	18.3	114.9	0.45	-0.89	598.0	79.2	126.4
05:30	28085	800.0	79	3.2	-0.26	17.3	114.7	0.29	-1.00	585.2	78.9	118.9
06:30	35751	401.9	82	2.5	-0.05	19.3	116.7	0.56	-0.84	605.8	78.4	125.6
07:30	36504	800.0	86	3.0	-0.03	22.8	112.5	0.63	-0.80	615.2	77.8	126.7
08:30	36632	0.0	84	1.6	0.00	17.8	111.6	0.69	-0.76	614.7	78.4	125.9
09:30	38561	400.3	84	0.9	-0.00	18.1	112.1	0.69	-0.76	615.9	78.4	126.2
10:30	37734	0.0	83	2.3	0.00	18.2	108.8	0.64	-0.77	611.1	78.4	124.5
11:30	39088	399.6	85	2.6	-0.00	18.1	114.2	0.67	-0.77	620.5	78.1	124.3
12:30	36116	400.6	82	1.4	0.04	17.7	109.9	0.71	-0.70	611.3	68.2	133.4
13:30	38951	0.0	92	10.0	0.03	18.0	113.8	0.71	-0.70	624.4	66.5	130.2
14:30	37232	400.3	88	5.0	0.03	17.9	111.4	0.70	-0.73	616.4	67.4	129.9
15:30	37938	0.0	82	2.6	0.05	18.0	111.0	0.68	-0.71	616.4	66.5	131.0
16:30	37823	800.0	81	4.8	0.04	17.8	112.0	0.70	-0.72	618.1	66.0	128.6
17:30	36715	0.0	81	2.5	0.05	17.5	112.4	0.72	-0.70	618.1	66.8	127.0
18:30	37600	0.0	80	1.4	0.06	17.9	106.9	0.70	-0.69	616.2	67.6	128.3
19:30	34216	400.0	82	0.9	0.06	17.7	115.4	0.69	-0.71	614.2	63.3	128.0
20:30	33642	400.9	66	0.9	-0.19	18.0	115.1	0.22	-0.81	589.1	63.6	125.1
21:30	24539	0.0	78	1.4	-0.14	16.0	111.8	0.49	-0.85	581.9	60.6	125.9
22:30	29037	0.0	59	2.3	-0.21	18.4	110.5	0.14	-0.70	558.7	60.4	121.3
23:30	27579	399.3	61	3.0	-0.20	18.0	112.6	0.17	-0.66	552.1	76.5	113.0
	764 KP	6802 LB	78	3.2	-0.05	18.1	112.4	0.52	-0.75	597.2	72.2	125.7

BOILER NUMBER 4 DAILY REPORT

12/10/90

TIME	STEAM FLOW PPH	COAL FLOW PPH	AIR FLOW PCT	OXYGEN PCT.	FURNACE PRESSURE	DRUM LEVEL	DRUM PRESSURE	WINDBOX PRESSURE	UPTAKE PRESSURE	FLUE GAS TEMP. F	GRATE TEMP. F	GRATE TEMP. F
00:30	17419	799.3	41	4.8	-0.20	7.9	113.0	0.06	-0.47	567.1	86.1	0.0
01:30	18155	0.0	40	4.2	-0.17	10.1	114.0	0.06	-0.47	567.8	87.0	0.0
03:30	22587	0.0	41	4.1	-0.17	11.5	116.0	0.05	-0.51	581.4	88.6	0.0
04:30	25173	0.0	48	1.7	-0.03	7.8	116.4	0.35	-0.34	623.9	88.3	0.0
05:30	28559	400.0	49	0.4	-0.06	7.4	117.1	0.30	-0.39	607.7	87.5	0.0
06:30	29187	0.0	49	0.2	-0.03	10.6	116.7	0.33	-0.37	615.9	88.0	0.0
07:30	24069	0.0	48	0.9	-0.17	8.6	120.9	0.14	-0.49	611.6	89.4	0.0
08:30	29981	396.1	47	2.8	-0.09	12.6	120.4	0.19	-0.45	613.5	89.9	0.0
09:30	25974	400.3	44	1.0	-0.23	9.5	116.4	0.06	-0.54	594.2	92.9	0.0
10:30	30886	400.3	45	3.9	-0.25	8.4	112.3	0.13	-0.53	603.1	95.0	0.0
11:30	28944	0.0	43	1.1	-0.25	9.9	117.6	0.10	-0.51	601.2	105.8	0.0
12:30	31349	400.0	44	0.4	-0.20	10.9	121.9	0.13	-0.51	608.9	110.9	0.0
13:30	28061	400.0	43	0.3	-0.15	9.6	111.3	0.15	-0.48	604.3	118.1	0.0
14:30	24648	0.0	42	0.5	-0.18	8.9	114.6	0.06	-0.49	587.4	105.5	0.0
15:30	21065	0.0	40	1.5	-0.19	10.0	115.4	0.02	-0.48	572.4	105.5	0.0
16:30	23261	400.0	39	2.6	-0.18	10.2	116.6	0.03	-0.44	569.8	109.2	0.0
17:30	16851	0.0	39	3.2	-0.18	7.9	113.4	0.01	-0.45	560.6	108.7	0.0
18:30	15262	399.6	39	3.6	-0.19	8.9	112.3	0.00	-0.45	562.0	107.9	0.0
19:30	19732	0.0	40	3.6	-0.17	11.6	113.8	0.00	-0.48	563.0	108.4	0.0
20:30	17167	0.0	40	4.2	-0.22	8.6	112.8	0.00	-0.47	547.8	105.5	0.0
21:30	23145	0.0	40	4.7	-0.18	9.8	115.3	0.02	-0.46	554.8	102.5	0.0
22:30	20203	0.0	40	4.7	-0.19	9.2	114.2	0.05	-0.39	545.4	99.3	0.0
23:30	16325	399.6	40	4.8	-0.18	9.4	111.8	0.00	-0.43	542.9	97.7	0.0
	538 KP	4395 LB	42	2.5	-0.16	9.5	115.4	0.09	-0.46	582.9	99.0	0.0

BOILER NUMBER 5 DAILY REPORT 12/11/90

TIME	STEAM FLOW PPH	COAL FLOW PPH	AIR FLOW PCT	OXYGEN PCT.	FURNACE PRESSURE	DRUM LEVEL	DRUM PRESSURE	WINDBOX PRESSURE	UPTAKE PRESSURE	FLUE GAS TEMP. F	GRATE TEMP. F	GRATE TEMP. F
00:31	5243	0.0	51	10.0	-0.16	24.0	96.8	2.86	0.59	420.7	183.9	80.2
01:31	54887	0.0	60	10.0	0.01	21.3	125.5	5.20	0.93	545.8	143.0	68.9
03:31	49902	0.0	56	10.0	-0.07	20.2	123.8	5.11	1.84	533.5	111.4	91.1
04:31	55231	0.0	58	10.0	-0.01	19.5	125.7	23:52:43	LOW	B125	P102.PRES.	
	-0.4 INWC											
5.10	1.84	546.6	107.9	91.8								
05:31	52585	0.0	61	10.0	-0.01	19.2	125.0	4.32	1.89	538.4	107.3	84.7
06:31	67242	0.0	60	10.0	-0.19	21.9	131.6	4.28	2.31	571.7	104.4	76.6
07:31	62045	0.0	59	10.0	-0.18	19.9	127.1	4.21	1.96	564.7	103.1	82.8
08:31	75000	0.0	63	10.0	-0.22	19.0	137.9	4.29	2.27	558.2	110.2	83.4
09:31	65073	0.0	60	10.0	-0.21	19.2	128.0	5.25	2.14	573.2	106.0	96.9
10:31	60913	0.0	57	10.0	-0.22	18.9	126.9	5.10	1.92	543.9	104.7	99.2
11:31	37516	0.0	51	10.0	-0.25	18.6	117.2	5.08	1.25	491.7	105.3	100.2
12:31	33112	0.0	49	10.0	-0.16	18.9	121.1	5.11	1.65	484.9	106.9	99.2
13:31	52829	0.0	56	10.0	-0.14	19.7	109.5	5.05	1.89	516.6	127.9	92.4
14:31	58788	0.0	59	10.0	-0.18	19.1	109.8	5.15	2.03	530.9	124.7	98.9
15:31	50941	0.0	59	10.0	-0.21	19.3	104.2	23:52:58	NORM	B125	P102.PRES.	
	-0.3 INWC											
4.99	1.97	509.3	118.5	102.4								
16:31	59917	0.0	61	10.0	-0.20	19.3	106.9	4.95	2.11	534.7	114.3	110.8
17:31	40871	0.0	55	10.0	-0.14	18.7	102.1	5.03	2.57	495.6	112.4	118.9
18:31	28208	0.0	53	10.0	-0.18	18.5	102.4	4.98	2.21	459.3	112.4	112.7
19:31	25722	0.0	53	10.0	-0.19	18.8	120.1	5.28	1.73	458.1	113.1	113.7
20:31	20561	0.0	53	10.0	-0.02	18.6	119.8	5.32	1.44	441.2	114.3	116.9
21:31	11943	0.0	54	10.0	-0.19	18.4	113.6	4.99	1.64	407.4	114.0	119.5
23:53:01	LOW B125	P102.PRES.				-0.4	INWC					
22:31	4541	0.0	31	10.0	-0.18	18.9	109.9	0.00	0.43	325.4	114.7	106.3
23:31	4726	0.0	31	10.0	-0.21	19.0	105.5	0.00	0.44	307.8	114.0	97.9
	977 KP	023:53:12	NORM	B125	P102.PRES.				-0.3	INWC		
LB 1250	10.0	-0.15	19.5	116.9	4.41	1.69	493.8	116.2	97.6			

APPENDIX E

Coal Analysis

Branch Code 44

Lab. No. 8678

Date Rec'd. 01/21/91

Date Sampled --------

Sampled By YOURSELVES

STANDARD LABORATORIES, INC.

305 CSG/DEMPH
BLDG. 223 - HEAT PLANT
ATTN: MR GRAHAM
GRISSOM AFB, IN 46971-5320

SAMPLE IDENTIFICATION

P.O. #F1261791MV137
BOILER #3
RUN #1
CAN # 2030
12/06/90

	% Moisture	% Ash	% Volatile	% Fixed Carbon	B.T.U./LB.	% Sulfur
As Rec'd.	13.59	6.14	33.41	46.86	11677	1.00
Dry Basis	-----	7.11	38.66	54.23	13514	1.16
M-A-Free					14549	

FOR YOUR PROTECTION THIS DOCUMENT HAS BEEN PRINTED ON CONTROLLED PAPER STOCK. NOT VALID IF ALTERED.

Respectfully Submitted, Mark M. Smith

MARK M. SMITH

Branch Code 44

Lab. No. 8679

Date Rec'd 01/21/91

Date Sampled --------

Sampled By YOURSELVES

STANDARD LABORATORIES, INC.

305 CSG/DEMPH
BLDG. 223 - HEAT PLANT
ATTN: MR GRAHAM
GRISSOM AFB, IN 46971-5320

SAMPLE IDENTIFICATION

P.O. #F1261791MV137
BOILER #3
RUN #2
CAN # 1473
12/06/90

	% Moisture	% Ash	% Volatile	% Fixed Carbon	BTU/LB	% Sulfur
As Rec'd.	14.31	6.96	32.54	46.19	11363	0.92
Dry Basis	-----	8.12	37.97	53.91	13261	1.08
M-A-Free					14433	

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Respectfully Submitted, Mark M. Smith

MARK M. SMITH

Branch Code 44

Lab. No. 8680

Date Rec'd 01/21/91

Date Sampled --------

Sampled By YOURSELVES

STANDARD LABORATORIES, INC.

305 CSG/DEMPH
BLDG. 223 - HEAT PLANT
ATTN: MR GRAHAM
GRISSOM AFB, IN 46971-5320

SAMPLE IDENTIFICATION

P.O. #F1261791MV137
BOILER #3
RUN #3
CAN # 1284
12/06/90

	% Moisture	% Ash	% Volatile	% Fixed Carbon	B.T.U./LB	% Sulfur
As Rec'd.	11.20	7.31	34.11	47.38	11901	1.05
Dry Basis	-----	8.23	38.41	53.36	13402	1.18
M-A-Free					14605	

Respectfully Submitted, Mark M. Smith

MARK M. SMITH

Branch Code 44

Lab. No. 8681

Date Rec'd 01/21/91

Date Sampled --------

Sampled By YOURSELVES

STANDARD LABORATORIES, INC.

305 CSG/DEMPH
BLDG. 223 - HEAT PLANT
ATTN: MR GRAHAM
GRISSOM AFB, IN 46971-5320

SAMPLE IDENTIFICATION

P.O. #F1261791MV137
BOILER #4
RUN #1
CAN # 4740
12/10/90

	% Moisture	% Ash	% Volatile	% Fixed Carbon	B.T.U./LB.	% Sulfur
As Rec'd.	12.18	7.70	32.00	48.12	11641	0.95
Dry Basis	-----	8.77	36.43	54.80	13256	1.08
M-A-Free					14530	

Respectfully Submitted, Mark M. Smith

MARK M. SMITH

Branch Code 44

Lab. No. 8682

Date Rec'd 01/21/91

Date Sampled --------

Sampled By YOURSELVES

STANDARD LABORATORIES, INC.

305 CSG/DEMPH
BLDG. 223 - HEAT PLANT
ATTN: MR GRAHAM
GRISSOM AFB, IN 46971-5320

SAMPLE IDENTIFICATION

P.O. #F1261791MV137
BOILER #4
RUN #2
CAN # 909
12/10/90

	% Moisture	% Ash	% Volatile	% Fixed Carbon	B.T.U./LB.	% Sulfur
As Rec'd.	13.11	6.98	32.81	47.10	11614	0.98
Dry Basis	-----	8.04	37.76	54.20	13367	1.13
M-A-Free					14535	

Respectfully Submitted, Mark M. Smith

MARK M. SMITH

Branch Code 44

Lab. No. 8683

Date Rec'd 01/21/91

Date Sampled --------

Sampled By YOURSELVES

STANDARD LABORATORIES, INC.

305 CSG/DEMPH
BLDG. 223 - HEAT PLANT
ATTN: MR GRAHAM
GRISSOM AFB, IN 46971-5320

SAMPLE IDENTIFICATION

P.O. #F1261791MV137
BOILER #4
RUN #3
CAN # 0332
12/10/90

	% Moisture	% Ash	% Volatile	% Fixed Carbon	BTU./LB	% Sulfur
As Rec'd	14.39	7.26	31.84	46.51	11334	0.94
Dry Basis	-----	8.48	37.19	54.33	13239	1.10
M-A-Free					14466	

Respectfully Submitted, Mark M. Smith

MARK M. SMITH

Branch Code: 44

Lab. No. 8684

Date Rec'd 01/21/91

Date Sampled --------

Sampled By YOURSELVES

STANDARD LABORATORIES, INC.

305 CSG/DEMPH
BLDG. 223 - HEAT PLANT
ATTN: MR GRAHAM
GRISSOM AFB, IN 46971-5320

SAMPLE IDENTIFICATION

P.O. #F1261791MV137
BOILER #5
RUN #1
CAN # 1756
12/11/90

	% Moisture	% Ash	% Volatile	% Fixed Carbon	B.T.U./LB.	% Sulfur
As Rec'd	11.09	6.38	35.61	46.92	12152	1.09
Dry Basis	-----	7.18	40.05	52.77	13668	1.22
M-A-Free					14724	

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Respectfully Submitted, Mark M. Smith

MARK M. SMITH

Branch Code 44

Lab. No. 8685

Date Rec'd 01/21/91

Date Sampled --------

Sampled By YOURSELVES

STANDARD LABORATORIES, INC.

305 CSG/DEMPH
BLDG. 223 - HEAT PLANT
ATTN: MR GRAHAM
GRISSOM AFB, IN 46971-5320

SAMPLE IDENTIFICATION

P.O. #F1261791MV137
BOILER #5
RUN #2
CAN # 4120
12/11/90

	% Moisture	% Ash	% Volatile	% Fixed Carbon	B.T.U./LB.	% Sulfur
As Rec'd.	11.95	6.74	34.20	47.11	11931	0.76
Dry Basis	-----	7.65	38.85	53.50	13549	0.86
M-A-Free					14672	

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Respectfully Submitted, Mark M. Smith

MARK M. SMITH

Branch Code 44

Lab. No. 8686

Date Rec'd 01/21/91

Date Sampled --------

Sampled By YOURSELVES

STANDARD LABORATORIES, INC.

305 CSG/DEMPH
BLDG. 223 - HEAT PLANT
ATTN: MR GRAHAM
GRISSOM AFB, IN 46971-5320

SAMPLE IDENTIFICATION

P.O. #F1261791MV137
BOILER #5
RUN #3
CAN # 2819
12/11/90

	% Moisture	% Ash	% Volatile	% Fixed Carbon	B.T.U./LB.	% Sulfur
As Rec'd	11.59	6.19	34.98	47.24	12117	1.12
Dry Basis	-----	7.00	39.57	53.43	13705	1.27
M-A-Free					14737	

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Respectfully Submitted, Mark M. Smith

MARK M. SMITH

APPENDIX F

Port Locations and Sampling Points

DETERMINATION OF MINIMUM NUMBER OF TRAVERSE POINTS

Stack ID: BYPASS **Stack diameter at ports:** 5.5 **(ft)**

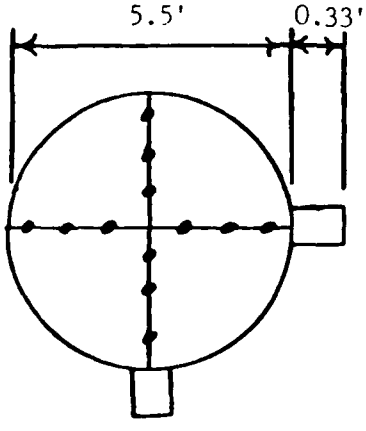
Distance A (ft) 11.5 **(duct diameters)** 2.1

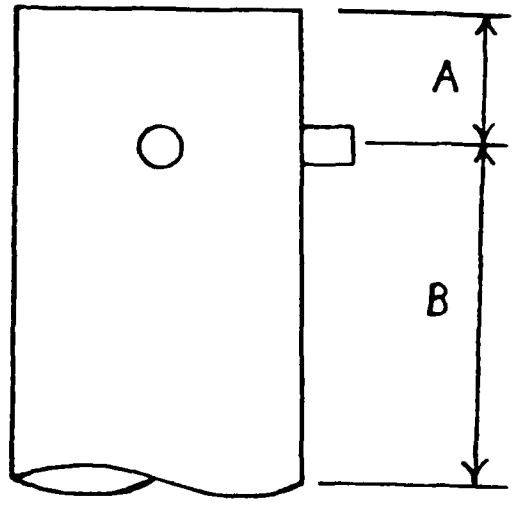
Recommended number of traverse points as determined by distance A: 12

Distance B (ft) 39.5 **(duct diameters)** 7.2

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

Number of traverse points used: 12





APPENDIX G

Boiler 3 Field Data

PRELIMINARY SURVEY DATA SHEET NO. 1

(Stack Geometry)

BASE: Grissom AFB	PLANT: Heating Plant Bypass stack
DATE: 5 Dec 70	SAMPLING TEAM: AFOEHL
SOURCE TYPE AND MAKE:	
SOURCE NUMBER:	INSIDE STACK DIAMETER: 66 Inches
RELATED CAPACITY:	TYPE FUEL:
DISTANCE FROM OUTSIDE OF NIPPLE TO INSIDE DIAMETER: 4" nipple Inches	
NUMBER OF TRAVERSES: 2	NUMBER OF POINTS/TRAVERSE: 6

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			6.9
2			13.7
3			23.5
4			50.5
5			60.3
6			67.1

PRELIMINARY SURVEY DATA SHEET NO. 2

(Velocity and Temperature Traverse)

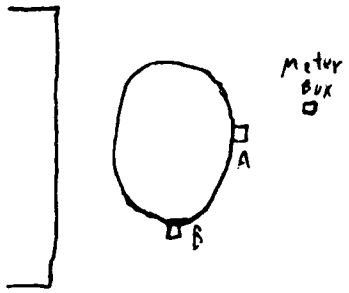
BASE: Grissom AFB	DATE: 6 Dec 90
BOILER NUMBER: 3	
INSIDE STACK DIAMETER: 66"	Inches
STATION PRESSURE: 29.101	In Hg
STACK STATIC PRESSURE: − 0.12	In H20
SAMPLING TEAM:	

TRAVERSE POINT NUMBER	VELOCITY HEAD, V_p IN H20	$\sqrt{V_p}$	STACK TEMPERATURE (^{0}F)
1	0.065		403
2	0.07		416
3	0.08		420
4	0.11		422
5	0.11		420
6	0.1		418
	$\overline{FPS} = 22$		$\overline{T_s} = 417$
	$\overline{FPM} = 1298$		
	calculated nozzle dia = 0.4343		
AVERAGE			

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: Run #1
DATE: 6 Dec 90
PLANT: Heating Plant — Boiler 3
BASE: Grissom AFB
SAMPLE BOX NUMBER:
METER BOX NUMBER: Nutech #2
Qw/Qm:
Co:

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

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

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

pre pitot leak check - ok
pre train leak check (17" H_g) - ok

post pitot leak check - ok
post train leak check (15 in H_g) - ok

AMBIENT TEMP: 33 °F
STATION PRESS: 29.101 in Hg
HEATER BOX TEMP: °F
PROBE HEATER SETTING:
PROBE LENGTH: 8 ft
NOZZLE AREA (A) dia: 0.381 in
Cp: 0.84
DRY GAS FRACTION (Fd):

009.272

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1 A	0 (1025)	1 VAC	335		0.055	0.75	~~009.272~~	42		41	240	37
2	5	1	348		0.065	0.88	011.52	47		42	255	38
3	16	1	388		0.075	0.97	013.89	50		43	259	39
4	15	2	403		0.11	1.40	016.45	51		44	255	39
5	20	2.2	412		0.11	1.39	019.41	54		44	259	39
6	~~25~~	2.5	408		0.10	1.27	022.43	55		45	268	39
	30						025.375					
1 B	36	2	278		0.06	0.89	025.560	46		45	215	35
2	35	3.5	330		0.091	1.26	028.67	49		45	236	36
3	41	3.7	380		0.10	1.31	030.90	53		46	240	36
4	45	4.1	403		0.097	1.24	033.86	55		46	248	39
5	50	4.6	413		0.095	1.20	036.80	56		47	251	40
6	55	5.0	410		0.092	1.17	039.67	57		48	263	41
	60						042.506					
			$\bar{T}_s = 376$		$\overline{\sqrt{Vp Ts}} = 8.5158$	$\overline{\Delta H} = 1.14$			$\bar{T}_m = 48$			

Total vol = 33.049 ft³

1100 - stopped in between port holes to adjust umbilical cord

pitot leak check and sampling train leak check (15 in Hg) - OK

OEMI FORM 19

VISIBLE EMISSION OBSERVATION FORM

No. Run #1

COMPANY NAME: Grissom AFB - Boiler #3 - Heating Plant		
STREET ADDRESS: Bldg 223		
CITY: Grissom AFB	STATE: IN	ZIP: 46971
PHONE (KEY CONTACT):	SOURCE ID NUMBER:	

PROCESS EQUIPMENT: Boiler #3	OPERATING MODE: 95-100%
CONTROL EQUIPMENT: By-Pass - None	OPERATING MODE:

DESCRIBE EMISSION POINT: Steel Stack - 66" Diameter

HEIGHT ABOVE GROUND LEVEL: 100 ft	HEIGHT RELATIVE TO OBSERVER: Start 100ft End ✓
DISTANCE FROM OBSERVER: Start 50' End ✓	DIRECTION FROM OBSERVER: Start NW End ✓

DESCRIBE EMISSIONS: Start Lofting End Lofting

EMISSION COLOR: Start Brown End ✓	IF WATER DROPLET PLUME: Attached ☐ Detached ☐

POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Start 3' End ✓

DESCRIBE PLUME BACKGROUND: Start Clouds End ✓

BACKGROUND COLOR: Start Gray End ✓	SKY CONDITIONS: Start OVC End ✓
WIND SPEED: Start 6 Knots End ✓	WIND DIRECTION: Start 270° End 270°
AMBIENT TEMP: Start 34°F End 34°F	WET BULB TEMP: 33°F / RH, percent: 92%

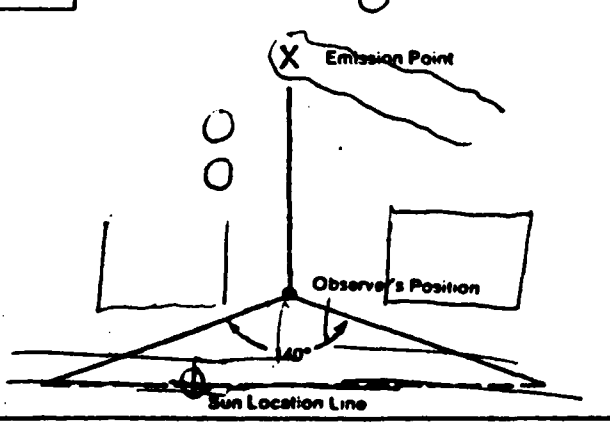
SOURCE LAYOUT SKETCH

Draw North Arrow

Stack with Plume

Sun

Wind



ADDITIONAL INFORMATION

55

OBSERVATION DATE	START TIME	END TIME
6 Dec 1990	1025	1055

SEC / MIN	0	15	30	45	COMMENTS
1	25	25	25	20	
2	25	25	20	25	
3	20	80	80	80	500+ blow
4	20	20	20	15	
5	15	10	10	5	
6	15	15	10	5	
7	15	20	10	15	
8	20	15	20	25	
9	20	20	30	20	
10	10	15	20	15	
11	5	5	10	15	
12	15	10	15	15	
13	20	20	25	30	
14	25	25	30	30	
15	30	30	25	25	
16	30	30	25	30	
17	25	20	15	10	
18	10	10	10	15	
19	20	20	15	15	
20	10	20	20	20	
21	20	20	15	15	
22	15	15	15	10	
23	10	10	10	10	
24	10	10	10	10	
25	10	15	15	20	
26	20	30	20	20	
27	30	35	30	30	
28	30	30	25	25	
29	20	20	25	20	
30	20	15	20	15	

OBSERVER'S NAME (PRINT): Ramon A. Cintron	
OBSERVER'S SIGNATURE: Ramon A. Cintron	DATE: 6 Dec 199
ORGANIZATION: USAF OEHL	
CERTIFIED BY: Texas Air Control Board	DATE

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Grissom AFB	6 Dec 90	Run #1

BUILDING NUMBER	SOURCE NUMBER
	Boiler 3

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.5292	0.2873	0.2419
ACETONE WASHINGS *(Probe, Front Half Filter)*	105.6285	104.1243	1.5042
BACK HALF *(If needed)*			Ø
	Total Weight of Particulates Collected		1.7461 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	210 ml	200 ml	10
IMPINGER 2 *(H20)*	218 ml	200 ml	18
IMPINGER 3 *(Dry)*	1 ml	0 ml	1
IMPINGER 4 *(Silica Gel)*	209.6	200	9.6
	Total Weight of Water Collected		28.6 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	7.6 %	7.8 %	7.8 %		7.8 %
VOL % O_2	11.8 %	12.0 %	12.0 %		12.0 %
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: Run # 2

DATE: 6 Dec 96

PLANT: Heating Plant Boiler 3

BASE: Grissom AFB

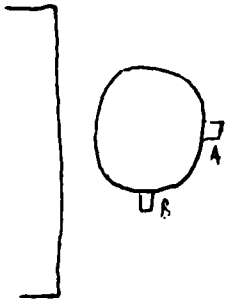
SAMPLE BOX NUMBER:

METER BOX NUMBER: Nutech # 2

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$^{o}R = {}^{o}F + 460$

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

pre S. tot leak check - ok

pre train leak check (15 in Hg) - ok

post pitot leak check - ok

post train leak check (15 in Hg) - ok

AMBIENT TEMP: 38 °F

STATION PRESS: 29.101 in Hg

HEATER BOX TEMP: °F

PROBE HEATER SETTING:

PROBE LENGTH: 8 Ft m

NOZZLE AREA ~~(A)~~ A: 0.380 ~~sq ft~~ in

Cp: 0.84

DRY GAS FRACTION (Fd):

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1 A	0 1505	1.2 VAC	250		0.06	0.92	043.122	44		43	226	36
2	5	1.8	350		0.07	0.94	045.57	48		44	231	38
3	10	2	382		0.075	0.97	048.10	51		44	243	39
4	15	3	402		0.093	1.19	050.08	53		45	243	39
5	20	4.2	416		0.11	1.38	053.44	55		45	248	39
6	25	5	413		0.103	1.30	056.43	56		46	255	41
	30						059.438					
1 B	30	3.2	135		0.035	0.65	054.430	47		47	243	38
2	35	5.5	230		0.075	1.20	061.57	52		48	254	39
3	40	6.1	367		0.09	1.20	064.23	55		48	265	41
4	45	6.6	403		0.092	1.18	067.09	57		49	248	42
5	50	7.2	414		0.085	1.03	069.94	57		49	253	44
6	55	7.7	411		0.093	1.06	072.69	57		49	254	45
	60						075.408					
			$\bar{T}_s = 348$			$\bar{\Delta H} = 1.07$			$\bar{T}_m = 50$			
					$\sqrt{\Delta P}\bar{T}_s = 8.057$							
							Total V_m = 32.286 Ft^3					

OEHL FORM 18

VISIBLE EMISSION OBSERVATION FORM

No. Run # 2

COMPANY NAME: Grissom AFB - Heating Plant		
STREET ADDRESS: Bldg 223		
CITY: Grissom AFB	STATE: IN	ZIP: 46971
PHONE (KEY CONTACT):	SOURCE ID NUMBER:	

PROCESS EQUIPMENT: Boiler #3	OPERATING MODE: 95 %
CONTROL EQUIPMENT: None	OPERATING MODE:

DESCRIBE EMISSION POINT: Steel Stack - 66" in diameter

HEIGHT ABOVE GROUND LEVEL: 100 ft ✓	HEIGHT RELATIVE TO OBSERVER: Start 100 ft End ✓
DISTANCE FROM OBSERVER: Start 75' End ✓	DIRECTION FROM OBSERVER: Start N End ✓

DESCRIBE EMISSIONS: Start Lofting End ✓

EMISSION COLOR: Start Brown End ✓	IF WATER DROPLET PLUME: Attached ☐ Detached ☐

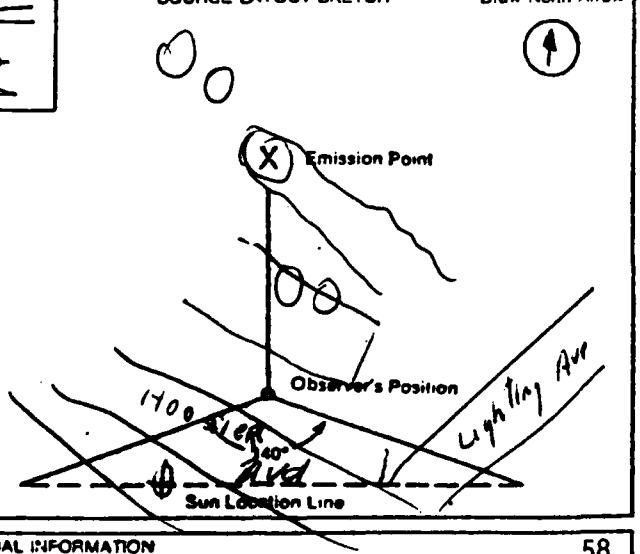
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Start 3' End ✓

DESCRIBE PLUME BACKGROUND: Start Clouds End ✓

BACKGROUND COLOR: Start Gray End ✓	SKY CONDITIONS: Start OVC End ✓	
WIND SPEED: Start 5 knots End ✓	WIND DIRECTION: Start 320° End	
AMBIENT TEMP: Start 36°F End	WET BULB TEMP: 32°F	RH, percent: 81%

Stack with Plume
Sun
Wind

SOURCE LAYOUT SKETCH — Draw North Arrow



ADDITIONAL INFORMATION

OBSERVATION DATE	START TIME	END TIME
6 Dec 1990	1546	

SEC / MIN	0	15	30	45	COMMENTS
1	15	30	30	35	
2	30	25	25	25	
3	20	20	20	20	
4	25	25	25	20	
5	15	15	20	25	
6	20	25	30	30	
7	35	35	20	15	
8	10	10	10	15	
9	15	20	20	25	
10	25	25	20	25	
11	25	30	30	30	
12	35	30	35	30	
13	30	30	20	20	
14	20	25	35	40	
15	40	40	40	35	
16	40	30	25	35	
17	35	30	40	40	
18	30	25	30	30	
19	25	30	20	20	
20	20	20	25	20	
21	25	20	15	20	
22	30	30	25	25	
23	20	25	30	35	
24	40	35	40	45	
25	40	40	40	35	
26	35	30	40	35	
27	35	30	30	25	
28	20	15	20	15	
29	15	15	10	15	
30	15	20	25	30	

OBSERVER'S NAME (PRINT): Ramon A. Cintron	
OBSERVER'S SIGNATURE: Ramon A. Cintron	DATE: 6 Dec 1990
ORGANIZATION: AFOEAL	
CERTIFIED BY: Texas Air Control Board	DATE

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Grissom AFB	6 Dec 90	Run #2

BUILDING NUMBER	SOURCE NUMBER
	Boiler 3

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.4578	0.2893	0.1685
ACETONE WASHINGS (Probe, Front Half Filter)	98.8971	98.7596	0.1375
BACK HALF (If needed)			Ø
	Total Weight of Particulates Collected		0.3060 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H20)	218 ml	200 ml	18
IMPINGER 2 (H20)	210 ml	200 ml	10
IMPINGER 3 (Dry)	1 ml	0 ml	1
IMPINGER 4 (Silica Gel)	209.0	200	9
	Total Weight of Water Collected		30 gm

III. GASES (Dry)

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	5.8 %	5.6 %	5.4 % ★	5.7 %	5.7 %
VOL % O_2	14.4 %	14.6 %	14.6 %	14.4 %	14.5 %
VOL % CO					
VOL % N_2					

★ not included in average Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: Run #3

DATE: 6 Dec 90

PLANT: Heating Plant — Boiler 3

BASE: Grissom AFB

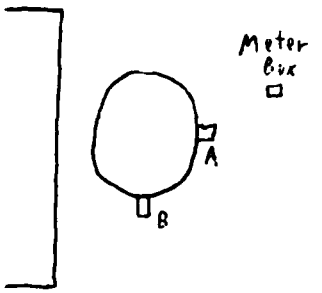
SAMPLE BOX NUMBER:

METER BOX NUMBER: NuTech #2

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$^{o}R = {}^{o}F + 460$

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

pre pitot leak check - ok

pre train leak check (15 in H_g) - ok

post pitot leak check - ok

post train leak check (17 in H_g) - ok

AMBIENT TEMP: 35 °F

STATION PRESS: 29.101 in Hg

HEATER BOX TEMP: °F

PROBE HEATER SETTING:

PROBE LENGTH: 8 ft

NOZZLE AREA (~~A~~) dia: 0.380 in — sq ft

Cp: 0.84

DRY GAS FRACTION (Fd):

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H_2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1 A	0 (17.1)	1 VAC	240		0.64	0.62	075.705	44		44	229	36
2	5	1	283		0.665	0.96	077.81	47		45	242	36
3	10	1.8	375		0.675	0.98	080.26	50		45	253	37
4	15	2.9	400		0.10	1.28	082.86	53		46	248	37
5	20	3.5	418		0.11	1.38	085.74	55		46	252	35
6	25	4	417		0.11	1.39	088.76	56		47	260	40
	30						091.815					
1 B	30	2.2	78		0.07	0.41	091.815	49		47	236	38
2	35	4	256		0.68	1.24	093.94	52		48	241	38
3	40	4.2	379		0.695	1.25	096.56	55		49	239	40
4	45	5	407		0.690	1.15	099.49	57		49	238	42
5	50	5.2	413		0.685	1.08	102.32	57		49	243	43
6	55	5.5	408		0.68	1.02	105.10	57		49	240	44
	60						107.815					
			$\overline{Ts}$ = 339			$\overline{\Delta H}$ = 1.06			$\overline{Tm}$ = 50			
					$\sqrt{Ps\,Ts}$ = 7.8836							
						Total Vol = 32.1106						

VISIBLE EMISSION OBSERVATION FORM

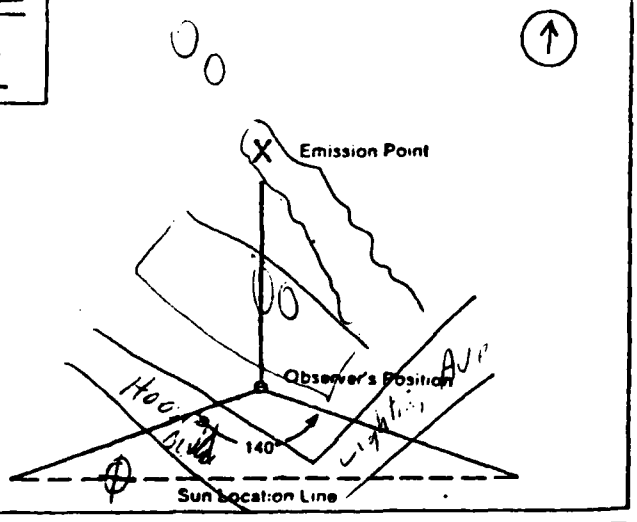
No. Run #3

COMPANY NAME	Grissom AFB - Heating Plant
STREET ADDRESS	Bldg 223
CITY	Grissom AFB
STATE	IN
ZIP	46971
PHONE (KEY CONTACT)	
SOURCE ID NUMBER	
PROCESS EQUIPMENT	Boiler #3
OPERATING MODE	95%
CONTROL EQUIPMENT	None
OPERATING MODE	
DESCRIBE EMISSION POINT	Steel Stack - 60' in Diameter
HEIGHT ABOVE GROUND LEVEL	100 ft
HEIGHT RELATIVE TO OBSERVER Start	100
HEIGHT RELATIVE TO OBSERVER End	
DISTANCE FROM OBSERVER Start	75'
DISTANCE FROM OBSERVER End	✓
DIRECTION FROM OBSERVER Start	N
DIRECTION FROM OBSERVER End	
DESCRIBE EMISSIONS Start	Lofting
DESCRIBE EMISSIONS End	✓
EMISSION COLOR Start	Brown
EMISSION COLOR End	✓
IF WATER DROPLET PLUME	Attached ☐ Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED Start	3'
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED End	
DESCRIBE PLUME BACKGROUND Start	Clouds
DESCRIBE PLUME BACKGROUND End	✓
BACKGROUND COLOR Start	Gray
BACKGROUND COLOR End	✓
SKY CONDITIONS Start	OVC
SKY CONDITIONS End	✓
WIND SPEED Start	
WIND SPEED End	
WIND DIRECTION Start	
WIND DIRECTION End	
AMBIENT TEMP Start	
AMBIENT TEMP End	
WET BULB TEMP	
RH, percent	

Stack with Plume
Sun
Wind

SOURCE LAYOUT SKETCH

Draw North Arrow



OBSERVATION DATE	START TIME	END TIME
6 Dec 1990	1711	1541

SEC / MIN	0	15	30	45	COMMENTS
1	30	30	30	35	
2	40	35	40	40	
3	30	30	30	25	
4	20	20	15	15	
5	15	10	25	30	
6	30	25	30	35	
7	35	25	25	35	
8	30	25	30	25	
9	20	20	20	20	
10	20	20	15	20	
11	20	20	15	20	
12	25	25	30	30	
13	20	20	20	15	
14	10	5	5	5	
15	5	5	5	10	
16	15	10	15	20	
17	20	20	20	20	
18	20	20	20	15	
19	20	25	15	15	
20	10	5	5	10	
21	5	10	10	10	
22	15	20	20	25	
23	30	30	35	40	
24	35	40	35	30	
25	35	25	15	10	
26	10	10	10	5	
27	15	15	10	15	
28	15	20	20	20	
29	15	10	5	5	
30	15	15	15	20	

OBSERVER'S NAME (PRINT)	Ramon A. Linton
OBSERVER'S SIGNATURE	Ramon A. Linton
DATE	6 Dec 1990
ORGANIZATION	AFOEHL
CERTIFIED BY	Texas Air Control Board
DATE	

ADDITIONAL INFORMATION

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Grissom	6 Dec 90	Run #3

BUILDING NUMBER	SOURCE NUMBER
	Boiler 3

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.4442	0.2942	0.1500
ACETONE WASHINGS *(Probe, Front Half Filter)*	93.7342	93.6290	0.1052
BACK HALF *(If needed)*			Ø
	Total Weight of Particulates Collected		0.2552 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	218 ml	200 ml	18 ml
IMPINGER 2 *(H20)*	208 ml	200 ml	8 ml
IMPINGER 3 *(Dry)*	1 ml	0 ml	1 ml
IMPINGER 4 *(Silica Gel)*	211.4	200	11.4
	Total Weight of Water Collected		38.4 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	5.0 %	5.1 %	4.9 %		5.0 %
VOL % O_2	15.6 %	15.7 %	15.7 %		15.7 %
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

APPENDIX H

Boiler 4 Field Data

PRELIMINARY SURVEY DATA SHEET NO. 2

(Velocity and Temperature Traverse)

BASE: Grissom AFB	DATE: 7 Dec 90
BOILER NUMBER: 4	
INSIDE STACK DIAMETER: 66	Inches
STATION PRESSURE: 29.265	In Hg
STACK STATIC PRESSURE: -0.138	In H20
SAMPLING TEAM	

TRAVERSE POINT NUMBER	VELOCITY HEAD, V_p IN H20	$\sqrt{V_p}$	STACK TEMPERATURE (^{0}F)
1	0.040		155
2	0.085		315
3	0.103		344
4	0.102		341
5	0.035		338
6	0.036		332
	$\overline{FPS}$ = 19.6		$\bar{T}_s$ = 304
	$\overline{FPM}$ = 1176		
		θ = 0.4283	
AVERAGE			

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: 1

DATE: 10 Dec 90

PLANT: Heating Plant Baker 4

BASE: Grissom

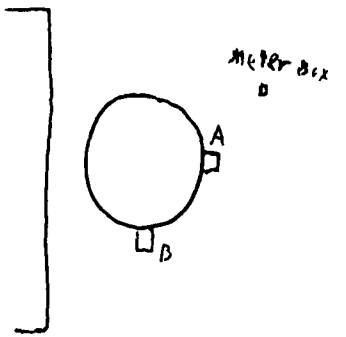
SAMPLE BOX NUMBER:

METER BOX NUMBER:

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$°R = °F + 460$

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

pre pitot check – ok

pre train check (15 in Hg) – ok

post pitot check – ok

post train check (15 in Hg) – ok

AMBIENT TEMP: 35 °F

STATION PRESS: 29.260 in Hg

HEATER BOX TEMP: °F

PROBE HEATER SETTING:

PROBE LENGTH: 8 ft m

NOZZLE AREA ~~(in)~~ dia: 0.38 in ~~sq ft~~

Cp: 0.84

DRY GAS FRACTION (Fd):

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O) VAC	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1 A	0 0805	1.5	100		0.035	0.67	108.075	52		53	225	37
2	5	3	250		0.068	1.06	110.02	49		52	237	37
3	10	3	343		0.075	1.03	112.64	52		52	249	37
4	15	3.3	313		0.085	1.13	115.31	53		51	258	38
5	20	3.5	382		0.078	1.03	118.10	55		51	245	39
6	25	3.4	379		0.070	0.92	120.81	55		50	237	38
	30						123.375					
1 B	30	3	80		0.038	0.77	123.375	49		48	235	38
2	35	4.2	240		0.070	1.10	125.67	52		49	235	38
3	40	4.2	334		0.080	1.11	128.33	54		49	238	39
4	45	4.8	373		0.085	1.13	131.12	56		49	258	40
5	50	5	380		0.085	1.12	133.92	57		50	238	42
6	55	8	376		0.082	1.13	136.71	58		50	241	43
	60						139.508					
					$\sqrt{PsTs} = 73.427$							
			$\overline{Ts} = 301$			$\Delta H = 1.02$			$\overline{Tm} =$	52		
							Total $V_m = 31.413$ ft³					

OEHL FORM 18

VISIBLE EMISSION OBSERVATION FORM

No. One

COMPANY NAME	Grissom AFB - Heating Plant
STREET ADDRESS	Bldg 223
CITY	Grissom AFB
STATE	IN
ZIP	46971
PHONE (KEY CONTACT)	
SOURCE ID NUMBER	

PROCESS EQUIPMENT	Boiler #4
OPERATING MODE	
CONTROL EQUIPMENT	None
OPERATING MODE	

DESCRIBE EMISSION POINT	Steel Stack 66' diameter
HEIGHT ABOVE GROUND LEVEL	100'
HEIGHT RELATIVE TO OBSERVER	Start 100' End
DISTANCE FROM OBSERVER	Start 150' End
DIRECTION FROM OBSERVER	Start NW End ✓

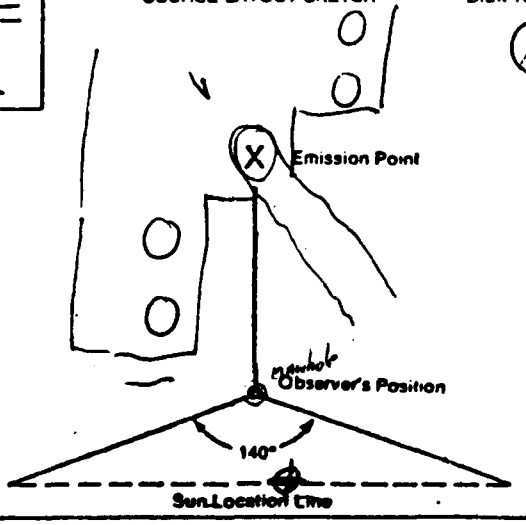
DESCRIBE EMISSIONS	Start Lofting End Lofting
EMISSION COLOR	Start brown End ✓
IF WATER DROPLET PLUME	Attached ☐ Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	Start 5' End ✓

DESCRIBE PLUME BACKGROUND	Start Blue sky (no clouds) End ✓	
BACKGROUND COLOR	Start blue End ✓	
SKY CONDITIONS	Start clear End ✓	
WIND SPEED	Start 2 Kts End ✓	
WIND DIRECTION	Start 290° End ✓	
AMBIENT TEMP	Start 33°F End ✓	
WET BULB TEMP	32°F	
RH, percent	92%	

Stack with Plume
Sun
Wind

SOURCE LAYOUT SKETCH

Draw North Arrow



OBSERVATION DATE	START TIME	END TIME
10 Dec 1990	0844	0914

SEC / MIN	0	15	30	45	COMMENTS
1	5	10	10	10	
2	10	10	10	15	
3	20	20	15	10	
4	15	10	15	15	
5	15	10	15	15	
6	10	15	10	10	
7	10	10	10	10	
8	5	10	10	10	
9	10	15	15	15	
10	15	10	10	10	
11	15	15	10	15	
12	20	20	20	20	
13	20	15	15	15	
14	15	10	15	15	
15	15	10	10	15	
16	10	10	10	15	
17	10	10	15	10	
18	15	10	5	10	
19	5	10	10	10	
20	10	10	5	10	
21	10	10	5	10	
22	10	15	15	10	
23	10	10	10	10	
24	60	60	80	80	soot blow
25	80	75	70	50	
26	65	70	50	70	
27	60	55	50	40	
28	20	10	10	5	
29	5	5	10	5	
30	5	10	5	5	

OBSERVER'S NAME (PRINT)	Ramon A. Clinton
OBSERVER'S SIGNATURE	Ramon A. Clinton
DATE	10 Dec 1990
ORGANIZATION	AFOEHL
CERTIFIED BY	Texas Air Control Board
DATE	

ADDITIONAL INFORMATION

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Grissom AFB	10 Dec 70	#1

BUILDING NUMBER	SOURCE NUMBER
	Boiler 4

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	0.4107	.2893	0.3214
ACETONE WASHINGS *(Probe, Front Half Filter)*	100.2181	100.0550	0.1631
BACK HALF *(If needed)*			Ø
	Total Weight of Particulates Collected		0.4845 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	226 ml	200 ml	26
IMPINGER 2 *(H20)*	208 ml	200 ml	8
IMPINGER 3 *(Dry)*	~~201~~ 1 ml	~~200~~ 0 ml	1
IMPINGER 4 *(Silica Gel)*	208	209	8
	Total Weight of Water Collected		43 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	8.6%	8.7%	8.7%		8.7%
VOL % O_2	11.0%	11.0%	11.0%		11.0%
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: 2

DATE: 10 Dec 96

PLANT: Hunting Plant Boiler 4

BASE: Grissom AFB

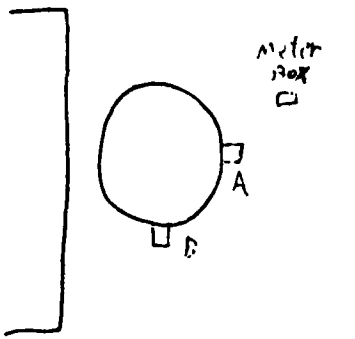
SAMPLE BOX NUMBER:

METER BOX NUMBER:

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

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

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

pre pitot check – ok

pre train check (15 in Hg) – ok

post pitot check – ok

post train check (10 in Hg) – ok

AMBIENT TEMP: 38 °F

STATION PRESS: 29.260 in Hg

HEATER BOX TEMP: °F

PROBE HEATER SETTING:

PROBE LENGTH: 8 Ft / m

NOZZLE AREA ~~(A)~~ d_{14}: 0.38 in ~~sq ft~~

Cp: 0.84

DRY GAS FRACTION (Fd):

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O) VAC	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1 A	0 10:25	1	200		0.055	0.92	139.800	54		51	228	39
2	5	1.2	351		0.065	0.89	142.29	58		53	230	39
3	10	1.5	367		0.065	0.88	144.80	62		54	238	40
4	15	2	368		0.065	0.88	147.31	65		56	248	41
5	20	2.1	381		0.055	0.74	149.82	68		58	249	42
6	25	2.1	377		0.045	0.61	152.17	69		60	243	43
	30						154.307					
1 B	30	1.5	100		0.018	0.37	154.307	68		64	242	44
2	35	1.8	235		0.045	0.74	156.17	70		65	247	44
3	40	3	344		0.055	0.78	158.39	72		67	242	42
4	45	3	375		0.055	0.75	160.78	74		67	246	43
5	50	3	379		0.050	0.68	163.13	72		67	244	45
6	55	2.5	374		0.030	0.41	165.37	71		67	251	46
	67.5						169.887					
			$\overline{T_s}$ = 321			$\overline{\Delta H}$ = 0.72			$\overline{T_m}$ =	64		
				$\sqrt{P_s T_s}$ = 6.2137								
							Total V_m = 30.087					

OEHL FORM 18

VISIBLE EMISSION OBSERVATION FORM

No. Two

COMPANY NAME: Grissom AFB - Heating Plant		
STREET ADDRESS: Bldg 223		
CITY: Grissom AFB	STATE: IN	ZIP: 46971
PHONE (KEY CONTACT):	SOURCE ID NUMBER:	

PROCESS EQUIPMENT: Boiler #4	OPERATING MODE:
CONTROL EQUIPMENT: None	OPERATING MODE:

DESCRIBE EMISSION POINT: Steel Stack - 66" Dia

HEIGHT ABOVE GROUND LEVEL: 100'	HEIGHT RELATIVE TO OBSERVER: Start 100' End
DISTANCE FROM OBSERVER: Start 150 End	DIRECTION FROM OBSERVER: Start NW End

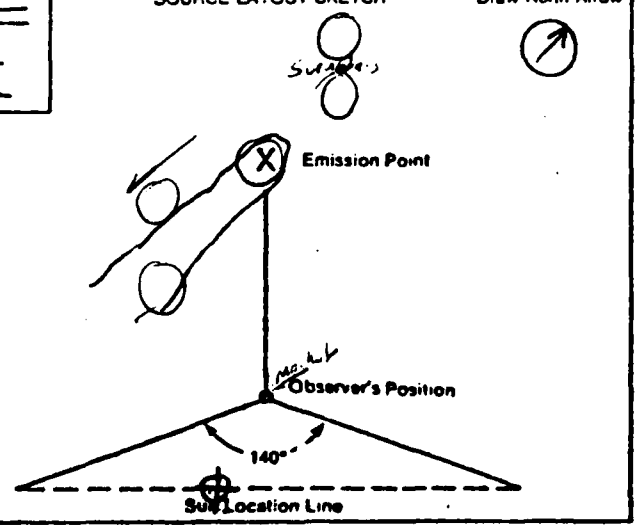
DESCRIBE EMISSIONS: Start Lifting End ✓	
EMISSION COLOR: Start brown End ✓	IF WATER DROPLET PLUME: Attached ☐ Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Start 5' End ✓	

DESCRIBE PLUME BACKGROUND: Start clear sky End ✓		
BACKGROUND COLOR: Start blue End ✓	SKY CONDITIONS: Start clear End ✓	
WIND SPEED: Start 4 Knots End ✓	WIND DIRECTION: Start 030 End	
AMBIENT TEMP: Start 34 End ✓	WET BULB TEMP: 35°	RH, percent: 70%

Stack with Plume
Sun
Wind

SOURCE LAYOUT SKETCH

Draw North Arrow



ADDITIONAL INFORMATION

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OBSERVATION DATE	START TIME	END TIME
10 Dec 1990	1055	1125

SEC / MIN	0	15	30	45	COMMENTS
1	20	15	20	15	
2	20	15	15	20	
3	20	20	25	25	
4	20	20	15	10	
5	5	10	10	15	
6	20	25	30	25	
7	25	20	30	25	
8	20	25	25	25	
9	20	15	15	15	
10	10	5	5	5	
11	5	5	5	5	
12	5	5	5	5	
13	5	5	10	5	
14	10	10	10	5	
15	5	5	5	5	
16	5	5	5	5	
17	5	5	5	5	
18	0	5	0	0	
19	0	5	0	5	
20	0	0	0	0	
21	5	0	0	0	
22	0	5	5	10	
23	15	20	10	10	
24	10	10	15	5	
25	5	5	5	0	
26	5	5	5	5	
27	5	5	5	0	
28	5	0	0	5	
29	0	0	5	5	
30	5	10	5	10	

OBSERVER'S NAME (PRINT): Ramon A. Cintron

OBSERVER'S SIGNATURE: Ramon A. Cintron — DATE: 10 Dec 1990

ORGANIZATION: AFOEHL

CERTIFIED BY: Texas Air Quality Board — DATE:

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Grissom AFB	10 Dec 90	#2

BUILDING NUMBER	SOURCE NUMBER
	Boiler 4

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.4395	.2884	0.1511
ACETONE WASHINGS (*Probe, Front Half Filter*)	102.3713	102.3189	0.0524
BACK HALF (*If needed*)			Ø
	Total Weight of Particulates Collected		0.2035 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (*H20*)	224 ml	200 ml	24
IMPINGER 2 (*H20*)	204 ml	200 ml	4
IMPINGER 3 (*Dry*)	0 ml	0 ml	0
IMPINGER 4 (*Silica Gel*)	208.7	200	8.7
	Total Weight of Water Collected		36.7 gm

III. GASES (*Dry*)

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	7.8%	7.8%	7.8%		7.8 %
VOL % O_2	11.8%	11.8%	11.9%		11.8 %
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: 3

DATE: 10 Dec 96

PLANT: Heating Plant

BASE: Grissom AFB — Boiler 4

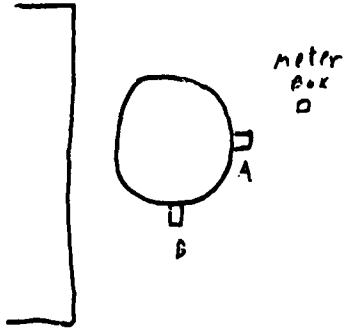
SAMPLE BOX NUMBER:

METER BOX NUMBER:

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

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

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

pre pitot check - ok

pre train check (15 in Hg) - ok

post pitot check - ok

post train check (10 in Hg) - ok

AMBIENT TEMP: 46 °F

STATION PRESS: 29.60 in Hg

HEATER BOX TEMP: °F

PROBE HEATER SETTING:

PROBE LENGTH: 8 ft

NOZZLE AREA ~~(A)~~ dia: 0.380 ~~sq~~ in

Cp: 0.84

DRY GAS FRACTION (Fd):

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1 A	0 (1235)	1 VAC	142		0.028	0.52	170.153	54		53	225	41
2	5.5	1.9	180		0.040	0.69	172.22	56		54	239	41
3	11.0	2.5	340		0.06	0.84	174.65	58		54	245	42
4	16.5	3	373		0.065	0.87	177.30	60		55	269	43
5	22.0	3	382		0.058	0.77	180.03	61		55	278	43
6	27.5	3	379		0.053	0.71	182.64	61		55	237	45
	33.0						185.132					
1 B	33.0	~~2.0~~ 2.1	80		0.02	0.41	185.132	56		54	261	46
2	38.5	3.4	183		0.043	0.74	187.13	59		56	255	45
3	44.0	3.8	338		0.055	0.77	189.56	62		56	248	46
4	49.5	4.2	372		0.062	0.84	192.16	65		57	258	48
5	55	4.2	380		0.055	0.74	194.83	66		58	256	48
6	60.5	4	378		0.045	0.61	197.42	66		58	246	51
	66.0						200.182					
			$T_s = 244$			$\overline{\Delta H} = 0.71$			$T_m =$	58		
					$\sqrt{P_s T_s} = 6.0334$							
							Total $V_{m1} = 30.029$					

OEHL FORM 1R

VISIBLE EMISSION OBSERVATION FORM

No. Three

COMPANY NAME: Grissom AFB - Heating Plant		
STREET ADDRESS: Bldg 223		
CITY: Grissom AFB	STATE: IN	ZIP: 46971
PHONE (KEY CONTACT):	SOURCE ID NUMBER:	

PROCESS EQUIPMENT: Boiler #4	OPERATING MODE:
CONTROL EQUIPMENT: None	OPERATING MODE:

DESCRIBE EMISSION POINT: Steel Stack

HEIGHT ABOVE GROUND LEVEL: 100'	HEIGHT RELATIVE TO OBSERVER: Start 100' End
DISTANCE FROM OBSERVER: Start 150' End	DIRECTION FROM OBSERVER: Start End

DESCRIBE EMISSIONS: Start Lofting End ✓

EMISSION COLOR: Start Brown End ✓	IF WATER DROPLET PLUME: Attached ☐ Detached ☐

POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Start 3' End ✓

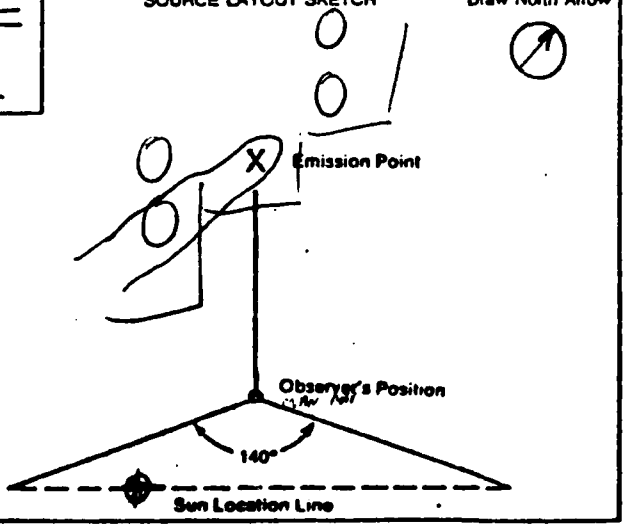
DESCRIBE PLUME BACKGROUND: Start Sky End

BACKGROUND COLOR: Start blue End ✓	SKY CONDITIONS: Start clear End ✓
WIND SPEED: Start 5 Knots End ✓	WIND DIRECTION: Start 070 End
AMBIENT TEMP: Start 48° End	WET BULB TEMP: 34 / RH, percent: 53%

Stack with Plume
Sun
Wind

SOURCE LAYOUT SKETCH

Draw North Arrow



OBSERVATION DATE	START TIME	END TIME
10 Dec 1990	1317	1347

SEC / MIN	0	15	30	45	COMMENTS
1	5	5	5	5	
2	5	5	5	5	
3	5	5	5	5	
4	5	5	5	5	
5	5	5	5	5	
6	5	5	5	0	
7	5	5	5	0	
8	0	5	0	0	
9	0	0	5	0	
10	0	5	0	5	
11	5	5	0	5	
12	0	5	5	5	
13	5	5	5	0	
14	0	0	0	0	
15	5	5	0	0	
16	5	0	5	5	
17	5	5	5	5	
18	5	5	5	5	
19	5	5	5	5	
20	5	5	5	5	
21	0	5	5	0	
22	5	5	5	0	
23	5	5	0	5	
24	5	10	5	5	
25	5	5	5	5	
26	5	5	0	5	
27	5	0	0	0	
28	5	5	5	0	
29	5	5	5	5	
30	5	5	5	5	

OBSERVER'S NAME (PRINT): Ramon A. Cintron

OBSERVER'S SIGNATURE: [signature] DATE: 10 Dec 1990

ORGANIZATION: ~~Texas Air Quality Board~~ AFOEHL

CERTIFIED BY: Texas Air Quality Board DATE:

ADDITIONAL INFORMATION

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Grissom AFB	7 Dec 90	#3

BUILDING NUMBER	SOURCE NUMBER
	Boiler 4

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.4310	.2921	0.1389
ACETONE WASHINGS *(Probe, Front Half Filter)*	98.9630	98.8525	0.1105
BACK HALF *(If needed)*			Ø
	Total Weight of Particulates Collected		0.2494 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	220 ml	200 ml	20
IMPINGER 2 *(H20)*	206 ml	200 ml	6
IMPINGER 3 *(Dry)*	0	0	0
IMPINGER 4 *(Silica Gel)*	208.5	200	8.5
	Total Weight of Water Collected		34.5 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	8.6%	8.5%	8.5%		8.5%
VOL % O_2	11.2%	11.1%	11.2%		11.2%
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

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APPENDIX I

Boiler 5 Field Data

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PRELIMINARY SURVEY DATA SHEET NO. 2

(Velocity and Temperature Traverse)

BASE: Grissom AFB	DATE: 11 Dec 90
BOILER NUMBER: 5	
INSIDE STACK DIAMETER:	Inches
STATION PRESSURE: 29.217	In Hg
STACK STATIC PRESSURE: − 0.125	In H20
SAMPLING TEAM:	

TRAVERSE POINT NUMBER	VELOCITY HEAD, V_p IN H20	$\sqrt{V_p}$	STACK TEMPERATURE (°F)
1	~~0.12~~ 0.10		195
2	0.125		292
3	0.155		293
4	~~0.135~~ 0.14		291
5	0.13		286
6	0.12		271
	$\overline{FPS}$ = 24		$\overline{T_s}$ = 270
	$\overline{FPM}$ = 1430		
	calculated nozzle dia = 0.3786		

AVERAGE

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: 1

DATE: 11 Dec 40

PLANT: Heating Plant (Boiler 5)

BASE: Griffiss AFB

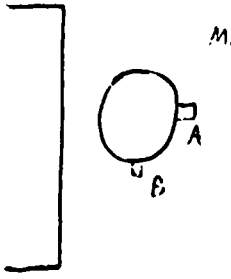
SAMPLE BOX NUMBER:

METER BOX NUMBER:

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

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

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

Pre pitot check – ok

pre train check (15 in Hg) – ok

post pitot check – ok

post train check (17 in Hg) – ok

static pressure = −0.125

AMBIENT TEMP: 42 °F

STATION PRESS: 29.217 in Hg

HEATER BOX TEMP: °F

PROBE HEATER SETTING:

PROBE LENGTH: 8 ~~Ft~~ ~~m~~

NOZZLE AREA ~~(A)~~ dia: 0.38 ~~sq ft~~ in

Cp: 0.84

DRY GAS FRACTION (Fd):

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H20)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1 A	0 0915	1.8 VAC	180		0.11	1.87	200.407	45		41	227	37
2	5	3	250		0.155	2.39	203.78	50		44	227	40
3	10	4.4	296		0.165	2.41	207.73	56		45	232	42
4	15	5.1	307		0.152	2.20	211.77	59		47	254	43
5	20	5.8	310		0.12	1.73	215.68	60		48	253	45
6	25	6	306		0.105	1.53	219.22	61		50	251	46
	30						222.512					
1 B	30	5.1	80		0.065	1.34	222.512	58		55	223	40
2	35	7.5	169		0.11	1.96	225.42	62		55	233	41
3	40	10.5	279		0.145	2.21	229.99	66		56	220	43
4	45	13.5	305		0.160	2.36	232.90	68		57	210	47
5	50	13.5	304		0.155	2.29	236.93	68		59	213	52
6	55	14.1	300		0.145	2.16	240.96	69		59	205	55
	60						244.897					
				$\overline{\sqrt{Ts}}$ = 9.7054								
			$\overline{Ts}$ = 257			$\overline{\Delta H}$ = 2.04			$\overline{Tm}$ =	56		
							Total Vol = 44.49					

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OPTIONAL FORM

VISIBLE EMISSION OBSERVATION FORM

No. One

COMPANY NAME: Grissom AFB - Heating Plant		
STREET ADDRESS: Bldg 223		
CITY: Grissom AFB	STATE: IN	ZIP: 46971
PHONE (KEY CONTACT):	SOURCE ID NUMBER:	

PROCESS EQUIPMENT: Boiler #5	OPERATING MODE:
CONTROL EQUIPMENT: None - by Pass	OPERATING MODE:

DESCRIBE EMISSION POINT: Steel Stack 66" - diameter

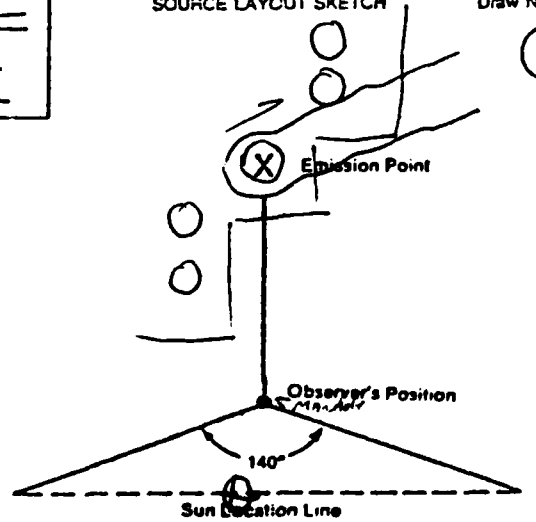
HEIGHT ABOVE GROUND LEVEL: 100 ft	HEIGHT RELATIVE TO OBSERVER: Start 100 ft End
DISTANCE FROM OBSERVER: Start 150 ft End	DIRECTION FROM OBSERVER: Start NW End

DESCRIBE EMISSIONS: Start lofting	End ✓
EMISSION COLOR: Start brown End ✓	IF WATER DROPLET PLUME: Attached ☐ Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Start 3'	End

DESCRIBE PLUME BACKGROUND: Start clear sky	End ✓	
BACKGROUND COLOR: Start blue End blue	SKY CONDITIONS: Start clear End —	
WIND SPEED: Start 5 Knots End —	WIND DIRECTION: Start 170° End ✓	
AMBIENT TEMP: Start 58°F End ✓	WET BULB TEMP: 35°F	RH, percent: 62%

Stack with Plume
Sun
Wind

SOURCE LAYOUT SKETCH — Draw North Arrow



OBSERVATION DATE	START TIME	END TIME
11 Dec 1990	1005	1035

SEC / MIN	0	15	30	45	COMMENTS
1	5	5	5	5	
2	5	5	5	5	
3	5	5	5	5	
4	5	5	5	5	
5	5	5	5	5	
6	5	5	5	5	
7	5	5	5	5	
8	5	5	5	5	
9	5	5	5	5	
10	5	5	5	5	
11	5	5	5	5	
12	5	5	5	55	soot blow
13	60	75	70	80	
14	50	40	45	50	
15	40	50	60	40	
16	25	50	50	65	
17	70	50	35	40	
18	45	40	25	20	
19	25	15	25	20	
20	25	25	40	35	
21	20	10	10	5	
22	5	5	5	5	
23	5	5	5	5	
24	5	5	5	5	
25	5	5	5	5	
26	5	5	5	5	
27	5	5	5	5	
28	5	5	5	0	
29	0	0	5	0	
30	0	0	5	5	

OBSERVER'S NAME (PRINT): Ramon A. Cintron	
OBSERVER'S SIGNATURE: Ramon Cintron	DATE: 11 Dec 1990
ORGANIZATION: AFOEHL/EQA	
CERTIFIED BY: Texas Air Control Board	DATE

ADDITIONAL INFORMATION

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Grissom AFB		1

BUILDING NUMBER	SOURCE NUMBER
	Boiler 5

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	0.8240	2909	0.5331
ACETONE WASHINGS (Probe, Front Half Filter)	95.3771	94.8325	0.5446
BACK HALF (If needed)			Ø
	Total Weight of Particulates Collected		1.0777 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H20)	225 ml	200 ml	25
IMPINGER 2 (H20)	222 ml	200 ml	22
IMPINGER 3 (Dry)	3 ml	0 ml	3
IMPINGER 4 (Silica Gel)	216.5	200	16.5
	Total Weight of Water Collected		66.5 gm

III. GASES (Dry)

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	8.2	8.4	8.2		8.3
VOL % O_2	10.8	11.6	11.6		11.7
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: 2

DATE: 11 Dec 90

PLANT: Heating Plant Boiler 5

BASE: Grissom AFB

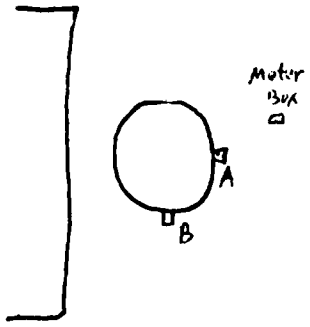
SAMPLE BOX NUMBER:

METER BOX NUMBER:

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

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

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

pre pitot check - ok

pre train check (15 in H_2) - ok

post pitot check - ok

post train check (11 in H_2) - ok

static pressure = -0.125

AMBIENT TEMP: 53 °F

STATION PRESS: 29.217 in Hg

HEATER BOX TEMP: °F

PROBE HEATER SETTING:

PROBE LENGTH: 8 Ft

NOZZLE AREA (A) .314: 0.38 sq ft

Cp: 0.84

DRY GAS FRACTION (Fd):

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1 A	0 (1320)	2.9 VAC	115		0.06	1.16	245.499	56		55	232	44
2	5	4	245		0.10	1.59	248.39	60		56	248	44
3	10	4	269		0.10	1.54	251.64	66		57	263	46
4	15	4.9	289		0.12	1.81	254.94	68		58	252	47
5	20	4.9	295		0.11	1.65	258.47	70		59	245	48
6	25	4	290		0.085	1.24	261.90	72		60	247	48
	30						264.970	~~73~~		~~0~~		
1 B	30	4.7	232		0.10	1.63	264.970	63		61	250	46
2	35	5.2	259		0.11	1.74	268.28	70		62	249	45
3	40	6	292		0.12	1.82	271.77	74		63	253	48
4	45	7	302		0.135	2.02	275.31	75		64	245	49
5	50	8	305		0.14	2.09	279.05	75		65	246	50
6	55	6.9	300		0.11	1.66	282.87	76		65	249	53
	60						286.321					
				$\sqrt{P_s T_s}$ = 8.8111								
			$\bar{T}_s$ = 266			$\bar{\Delta H}$ = 1.67			$\bar{T}_m$ =	65		
							Total Vol = 40.822					

OEHL FORM 18

VISIBLE EMISSION OBSERVATION FORM

No. Two.

COMPANY NAME: Grissom AFB - Heating Plant		
STREET ADDRESS: Bldg 223		
CITY: Grissom AFB	STATE: IN	ZIP: 46971
PHONE (KEY CONTACT):	SOURCE ID NUMBER:	

PROCESS EQUIPMENT: Boiler #5	OPERATING MODE:
CONTROL EQUIPMENT: None - By-pass	OPERATING MODE:

DESCRIBE EMISSION POINT: Steel Stack - 66 - Diameter

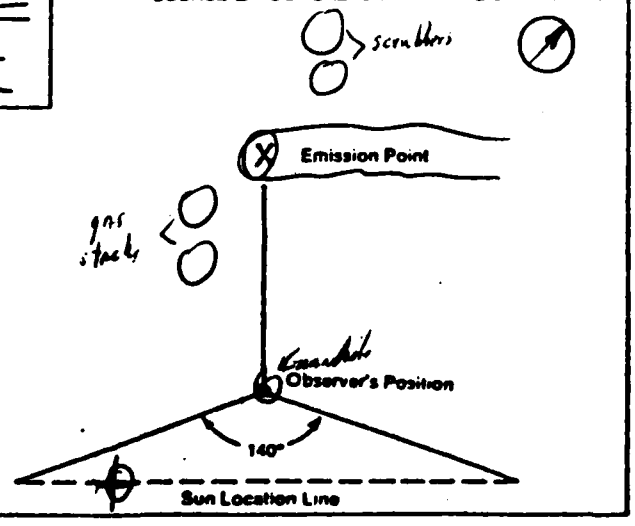
HEIGHT ABOVE GROUND LEVEL: 100'	HEIGHT RELATIVE TO OBSERVER: Start 100' End
DISTANCE FROM OBSERVER: Start 150' End	DIRECTION FROM OBSERVER: Start NW End

DESCRIBE EMISSIONS: Start lofting	End ✓
EMISSION COLOR: Start brown End ✓	IF WATER DROPLET PLUME: Attached ☐ Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Start 3'	End ✓

DESCRIBE PLUME BACKGROUND: Start clear sky	End —	
BACKGROUND COLOR: Start blue End ✓	SKY CONDITIONS: Start clear End	
WIND SPEED: Start 8 Knots End ✓	WIND DIRECTION: Start 220 End	
AMBIENT TEMP: Start 54 End	WET BULB TEMP: 49	RH, percent: 66%

SOURCE LAYOUT SKETCH — Draw North Arrow

Stack with Plume
Sun
Wind



ADDITIONAL INFORMATION

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OBSERVATION DATE	START TIME	END TIME
11 Dec 1990	1357	1427

SEC / MIN	0	15	30	45	COMMENTS
1	5	10	10	10	
2	10	10	10	5	
3	5	10	10	10	
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6	5	10	10	10	
7	10	10	10	10	
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25	5	10	5	5	
26	5	10	10	10	
27	5	5	5	10	
28	10	10	10	10	
29	5	10	10	10	
30	5	10	10	10	

OBSERVER'S NAME (PRINT): Ramon A. Cintron	
OBSERVER'S SIGNATURE: Ramon A. Cintron	DATE: 11 Dec 1990
ORGANIZATION: AFOEHL/EQA	
CERTIFIED BY: Texas Air Quality Board	DATE:

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Grissom AFB		2

BUILDING NUMBER	SOURCE NUMBER
	Boiler 5

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.8429	.2892	0.5537
ACETONE WASHINGS *(Probe, Front Half Filter)*	98.0319	97.5622	0.4697
BACK HALF *(If needed)*			Ø
	Total Weight of Particulates Collected		1.0234 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	226	200	26
IMPINGER 2 *(H20)*	207	200	7
IMPINGER 3 *(Dry)*	1	0	1
IMPINGER 4 *(Silica Gel)*	210.8	200	10.8
	Total Weight of Water Collected		44.8 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	6.8	6.8	6.8		6.8
VOL % O_2	13.2	13.2	13.1		13.2
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: 3

DATE: 11 Dec 90

PLANT: Heating Plant — Boiler 5

BASE: Grissom AFB

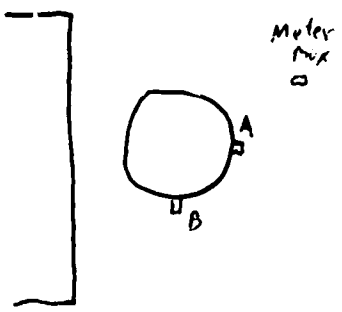
SAMPLE BOX NUMBER:

METER BOX NUMBER:

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$^{o}R = {}^{o}F + 460$

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

pre pitot check – OK

pre train check (15 in Hg) – OK

post pitot check – ok

post train check (13 in Hg) – ok

static pressure = -0.125

AMBIENT TEMP: 57 °F

STATION PRESS: 29.217 in Hg

HEATER BOX TEMP: °F

PROBE HEATER SETTING:

PROBE LENGTH: 8 ft

NOZZLE AREA (A) .314: 0.38 in sq ft

Cp: 0.84

DRY GAS FRACTION (Fd):

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1 A	0 (1525)	2.9 VAC	190		0.075	1.35	286.553	66		67	230	42
2	5	4.3	242		.125	2.03	289.68	69		67	238	42
3	10	4.5	280		0.115	1.78	293.35	73		67	250	45
4	15	5	291		0.13	1.98	296.93	75		67	259	47
5	20	5.5	296		0.13	1.98	300.66	77		67	265	48
6	25	4.5	292		0.095	1.45	304.42	76		68	235	50
	31						307.716					
1 B	36	6	180		0.115	2.04	307.716	66		66	254	46
2	35	6.1	281		0.125	1.92	311.45	71		66	257	46
3	40	6.4	292		0.13	1.98	315.18	74		67	252	48
4	45	8	303		0.145	2.18	318.92	75		66	251	50
5	50	9.2	307		0.155	2.31	322.86	74		66	254	50
6	55	7	302		0.115	1.73	326.93	73		60	253	51
	60						330.506					
				$\overline{\sqrt{P_s T_s}}$ = 9.382								
			$\overline{T_s}$ = 270			$\overline{\Delta H}$ = 1.89			$\overline{T_m}$ =	70		
							Total Vol = 43.453					

OEHL FORM 18

VISIBLE EMISSION OBSERVATION FORM

No. Three

COMPANY NAME: Grissom AFB - Heating Plant		
STREET ADDRESS: Bldg 223		
CITY: Grissom AFB	STATE: IN	ZIP:
PHONE (KEY CONTACT):	SOURCE ID NUMBER:	

PROCESS EQUIPMENT: Boiler #5	OPERATING MODE:
CONTROL EQUIPMENT: None - By-pass	OPERATING MODE:

DESCRIBE EMISSION POINT: Steel Stack

HEIGHT ABOVE GROUND LEVEL: 100'	HEIGHT RELATIVE TO OBSERVER: Start 100' End
DISTANCE FROM OBSERVER: Start 150' End	DIRECTION FROM OBSERVER: Start N End

DESCRIBE EMISSIONS: Start Lofting End ✓

EMISSION COLOR: Start brown End ✓	IF WATER DROPLET PLUME: Attached ☐ Detached ☐

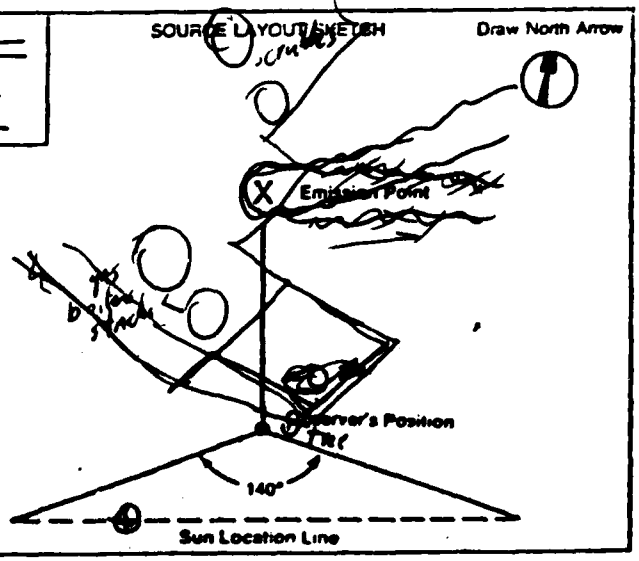
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Start 3' End ✓

DESCRIBE PLUME BACKGROUND: Start sky (blue) End ✓

BACKGROUND COLOR: Start blue End	SKY CONDITIONS: Start clear End	
WIND SPEED: Start 9 Knots End ✓	WIND DIRECTION: Start 200° End	
AMBIENT TEMP: Start 56° End	WET BULB TEMP: 50°	RH, percent: 67%

SOURCE LAYOUT SKETCH — Draw North Arrow

Stack with Plume
Sun
Wind



OBSERVATION DATE	START TIME	END TIME
11 Dec 1990	1530	1600

SEC / MIN	0	15	30	45	COMMENTS
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24	10	10	5	5	
25	5	5	5	5	
26	5	5	5	5	
27	5	5	5	5	
28	5	5	5	10	
29	5	5	10	10	
30	10	10	10	10	

OBSERVER'S NAME (PRINT): Ramon H. Cintron

OBSERVER'S SIGNATURE: Ramon H. Cintron — DATE: 11 Dec 90

ORGANIZATION: AFOEHL/EQA

CERTIFIED BY: Texas Air Control Board — DATE:

ADDITIONAL INFORMATION

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Grissom AFB		3

BUILDING NUMBER	SOURCE NUMBER
	Boiler 5

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	1.1708	2869	0.8839
ACETONE WASHINGS *(Probe, Front Half Filter)*	95.3153	94.4525	0.8628
BACK HALF *(If needed)*			Ø
	Total Weight of Particulates Collected		1.7467 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	230	200	30
IMPINGER 2 *(H20)*	210	200	10
IMPINGER 3 *(Dry)*	1	0	1
IMPINGER 4 *(Silica Gel)*	212.2	200	12.2
	Total Weight of Water Collected		53.2 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	7.2	7.4	7.3		7.3
VOL % O_2	12.7	12.7	12.6		12.7
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

OEHL FORM MAY 78 20

APPENDIX J

Calibration Data

NOZZLE CALIBRATION DATA FORM

Date 6 Dec 90 Calibrated by Capt O'Brien

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.)		
	0.380 in	0.380	0.379	0.001	0.380

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 mm) 0.004 in.

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

Boiler 3 calculated nozzle dia 0.4343

TYPE S PITOT TUBE INSPECTION DATA FORM

#8A

Pitot tube assembly level? ✓ yes _____ no

Pitot tube openings damaged? _____ yes (explain below) ✓ no

α_1 = 1 ° (<10°), α_2 = 2 ° (<10°), β_1 = ∅ ° (<5°),

β_2 = 2 ° (<5°)

γ = 1 °, θ = 1 °, A = 15/16 (0.938) cm (in.)

z = A sin γ = 0.0164 cm (in.); <0.32 cm (<1/8 in.), 0.1250

w = A sin θ = 0.0164 cm (in.); <.08 cm (<1/32 in.)

P_A 15/32 (0.469) cm (in.) P_b 15/32 (0.469) 0.0313 cm (in.)

D_t = 3/8 (.375) cm (in.)

Comments: CONSTRUCTED IAW 40 CFR 60, APP A, METH 2, FIG 2.2 ASSIGNED BASELINE COEFFICIENT = 0.84

Calibration required? _____ yes ✓ no

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Primary Standard calibrated 19 July 90

Date 13 Aug 90 Vac = 5.0 Meter box number Nutech 2

Barometric pressure, P_b = 30.12 in. Hg Calibrated by Scott & Vaughn

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	5	4.984	79 85 542.0	77 88 543.5	76 81 538.5	541.0	13.1	1.0001	~~1.948~~ 1.948
1.0	5	5.006	85 82 543.5	88 89 548.5	87 81 541.0	544.8	9.2	0.9987	1.932
1.5	10	10.080	82 82 542.0	89 94 551.5	81 84 542.5	547.0	15.0	0.9976	1.908
2.0	10	10.225	82 83 542.5	94 97 555.5	84 86 545	550.25	13.1	0.9871	1.932
3.0	10	10.175	83 83 543.0	97 100 558.5	86 88 547	552.75	10.7	0.9932	1.928
Vac =7.0 4.0	10	10.280	83 83 543.0	100 103 560	89 87 549	554.5	9.2	0.9838	1.8747
							Avg	0.993	1.924

.999 1.006

$$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)} \qquad \Delta H@_i = \frac{0.0317\ \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\ \theta}{V_w} \right]^2$$

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	Y_i =	$\Delta H@_i$ =
0.5	0.0368	$\frac{(5)(30.12)(541)}{(4.984)(30.1568)(542.0)}$	$\frac{(.0317)(0.5)}{(30.12)(541)} \left[\frac{(542.0)(13.1)}{5} \right]^2$ = ~~1.947~~ 1.948
1.0	0.0737	$\frac{(5)(30.12)(544.75)}{(5.006)(30.1937)(543.5)}$	$\frac{(.0317)(1.0)}{(30.12)(544.8)} \left[\frac{(543.5)(9.2)}{5} \right]^2$ = 1.932
1.5	0.110	$\frac{(10)(30.12)(547.0)}{(10.08)(30.230)(542.0)}$	$\frac{(.0317)(1.5)}{(30.12)(547)} \left[\frac{(542)(15)}{10} \right]^2$ = 1.9076
2.0	0.147	$\frac{(10)(30.12)(550.25)}{(10.225)(30.267)(542.5)}$	$\frac{(.0317)(2.0)}{(30.12)(550.25)} \left[\frac{(542.5)(13.1)}{10} \right]^2$ = 1.9320
3.0	0.221	$\frac{(10)(30.12)(552.75)}{(10.175)(30.341)(543.0)}$	$\frac{(.0317)(3.0)}{(30.12)(552.75)} \left[\frac{(543)(10.7)}{10} \right]^2$ = 1.9288
4.0	0.294	$\frac{(10)(30.12)(554.5)}{(10.28)(30.414)(543)}$	$\frac{(.0317)(4)}{(30.12)(554.5)} \left[\frac{(543)(9.2)}{10} \right]^2$

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

Quality Assurance Handbook M4-2.3A (front side)

7

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Pre Grissom AFB

Test number One Date 20 Sep 90 Meter box number Nutech 2 Plant Post Hill AFB

Barometric pressure, P_b = 29.23 in. Hg Dry gas meter number _____ Pretest Y 0.993

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F / °R	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average[a] (t_d), °F °R	Time (θ), min	Vacuum setting, in. Hg	Y_i	$Y_i \cdot \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
3.0	10	9.89	79 79 / 539	89 89	79 79	544	10.55	11.9	1.0129	$\frac{10(29.23)(544)}{9.89(29.23+\frac{3.0}{13.6})539}$
3.0	10	9.942	79 78 / 538.5	90 93	79 81	545.75	10.55	11.9	1.0117	$\frac{10(29.23)(545.75)}{9.942(29.23+\frac{3.0}{13.6})538.5}$
3.0	10	9.97	78 77 / 537.5	93 94	81 83	547.75	10.57	11.9	1.0145	$\frac{10(29.23)(547.75)}{9.97(29.23+\frac{3.0}{13.6})537.5}$
									Y = 1.0130	

[a] 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, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °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}, °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 ±0.05Y. 0.993 ± 0.04965 0.9434 ← Y_{post} → 1.0427

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number _____ Date 28 Jan 91 Meter box number Nutech 2 Plant Post Grissom

Barometric pressure, P_b = 29.130 in. Hg Dry gas meter number _____ Pretest Y 0.993

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average (t_d)[a], °F R	Time (θ), min	Vacuum setting, in. Hg	Y_i	$Y_i \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
1.5	10	9.678	74 75 535	74 84 539	73 76 535	537	14.63	5	1.033	$\frac{10(29.12)(537)}{9.678(29.12+1.5/13.6)(535)}$
1.5	10	9.695	75 76 536	84 86 546	76 79 538	542	14.71	5	1.039	$\frac{10(29.12)(542)}{9.695(29.12+1.5/13.6)(536)}$
1.5	10	9.735	74 75 536	88 90 549	77 81 540	545	14.73	5	1.041	$\frac{10(29.12)(545)}{9.735(29.12+1.5/13.6)(536)}$
									Y =	1.038

[a] 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.

0.943 ← Y → 1.043

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

t_w = Temperature of the gas in the wet test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °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}, °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 ±0.05Y.

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

NUTECH #2

Date 3 JAN 89 Thermocouple number INLET/OUTLET

Ambient temperature 26 °C Barometric pressure _____ in. Hg

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

other _____

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] ±°C *
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

[a] Type of calibration system used.

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

Quality Assurance Handbook M5-2.5

* MUST BE WITHIN 3°C OF REFERENCE

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 19/20 OCT 88 Thermocouple number IMPINGER D1

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

* MUST BE WITHIN 1°C OF REF

Quality Assurance Handbook M2-2.10

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 20 OCT 88 (19) Thermocouple number IMPINGER D2

Ambient temperature 26° °C Barometric pressure 29.175 / 29.232 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 *
0	ICE BATH	0	0	—
—	ROOM TEMP	26.0	26.6	0.6

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

[b] Type of calibration system used.

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

* MUST BE WITHIN 1°C OF REF

Quality Assurance Handbook M2-2.10

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

IMPINGER

Date 19/20 OCT 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] *°C*
C	ICE BATH	0	0.6	0.6
—	ROOM TEMP	25.8	25.6	0.2

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

[b] Type of calibration system used.

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

* MUST BE WITHIN 1°C OF REF

Quality Assurance Handbook M2-2.10

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

IMPINGER

Date 19/20 Oct 88 Thermocouple number D4

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 *
0	ICE BATH	0	0.6	0.6
—	ROOM TEMP	25.5	25.6	0.1

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

[b] Type of calibration system used.

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

* MUST BE WITHIN 1°C OF REF

Quality Assurance Handbook M2-2.10

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

IMPINGER

Date 19/Oct 88 Thermocouple number D5

Ambient temperature 26 °C Barometric pressure 29.175 (29.232) 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 *
0	ICE BATH	0	0.6	0.6
—	ROOM TEMP	26	25.5	0.5

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

[b] Type of calibration system used.

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

* MUST BE WITHIN 1°C OF REF

Quality Assurance Handbook M2-2.10

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 19/20 Oct 88 Thermocouple number IMPINGER D6

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 *
0	ICE BATH	0	0.6	0.6
—	ROOM TEMP	26	25.5	0.5

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

[b] Type of calibration system used.

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

* MUST BE WITHIN 1°C OF REF

Quality Assurance Handbook M2-2.10

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 19/20 Oct 88 Thermocouple number IMPINGER D7

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 *
0	ICE BATH	0	0.6	0.6
—	ROOM TEMP	26	25.5	0.5

[a] Every 30°C (55°F) for each reference point.

[b] Type of calibration system used.

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

* 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%

P5	273.30	274.10	Regression Output:
	371.90	373.60	Constant -3.03
	447.60	450.80	Std Err of Y Est 0.37
			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) = 1.08%
P6	273.30	273.30	Regression Output:
	371.90	373.60	Constant -5.03
	447.60	450.80	Std Err of Y Est 0.09
			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) = 1.37%
P7	273.30	273.30	Regression Output:
	371.90	373.60	Constant -5.03
	447.60	450.80	Std Err of Y Est 0.09
			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) = 1.37%
P8	273.60	273.60	Regression Output:
	371.80	373.00	Constant -4.75
	449.40	452.40	Std Err of Y Est 0.39
			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%

APPENDIX K

EPA Computer Program Emissions Calculations

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XROM "METH 5"

RUN NUMBER
ONE Boiler 3
RUN

METER BOX Y?
0.9930 RUN
DELTA H?
1.1400 RUN
BAR PRESS ?
29.1010 RUN
METER VOL ?
33.0490 RUN
MTR TEMP F?
49.0000 RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
RUN
STATIC HOH IN ?
-.1200 RUN
STACK TEMP.
375.0000 RUN
ML. WATER ?
29.[illegible] RUN
IMP. % HOH = 3.[illegible]

% HOH=3.9

% CO2?
7.8000 RUN
% OXYGEN?
12.0000 RUN
% CO ?
RUN
MOL WT OTHER?
RUN

MWd =29.73
MW WET=29.27

SQRT PSTS ?
8.5158 RUN
TIME MIN ?
60.0000 RUN
NOZZLE DIA ?
.3800 RUN
STK DIA INCH ?
66.0000 RUN

* VOL MTR STD = 33.271
STK PRES ABS = 29.09
VOL HOH GAS = 1.35
% MOISTURE = 3.89
MOL DRY GAS = 0.961
% NITROGEN = 80.20
MOL WT DRY = 29.73
MOL WT WET = 29.27
VELOCITY FPS = 20.96
STACK AREA = 23.76
STACK ACFM = 29,877.
* STACK DSCFM = 17,[illegible].
% ISOKINETIC = 94.[illegible]

XROM "METH 5"

RUN NUMBER
TWO Boiler 3
RUN

METER BOX Y?
0.9930 RUN
DELTA H?
1.0900 RUN
BAR PRESS ?
29.1010 RUN
METER VOL ?
32.2860 RUN
MTR TEMP F?
50.0000 RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
RUN
STATIC HOH IN ?
-.1200 RUN
STACK TEMP.
349.0000 RUN
ML. WATER ?
30.0000 RUN
IMP. % HOH = 4.[illegible]

% HOH=4.2

% CO2?
5.7000 RUN
% OXYGEN?
14.5000 RUN
% CO ?
RUN
MOL WT OTHER?
RUN

MWd =29.49
MW WET=29.01

SQRT PSTS ?
8.0572 RUN
TIME MIN ?
60.0000 RUN
NOZZLE DIA ?
0.3800 RUN
STK DIA INCH ?
66.0000 RUN

* VOL MTR STD = 32.372
STK PRES ABS = 29.09
VOL HOH GAS = 1.41
% MOISTURE = 4.18
MOL DRY GAS = 0.958
% NITROGEN = 79.80
MOL WT DRY = 29.49
MOL WT WET = 29.01
VELOCITY FPS = 19.92
STACK AREA = 23.76
STACK ACFM = 28,390.
* STACK DSCFM = 17,[illegible].
% ISOKINETIC = 94.[illegible]

XROM "METH 5"

RUN NUMBER
THREE Boiler 3
RUN

METER BOX Y?
0.9930 RUN
DELTA H?
1.0600 RUN
BAR PRESS ?
29.1010 RUN
METER VOL ?
32.1100 RUN
MTR TEMP F?
50.0000 RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
RUN
STATIC HOH IN ?
-.1200 RUN
STACK TEMP.
339.0000 RUN
ML. WATER ?
38.4000 RUN
IMP. % HOH = 5.7

% HOH=5.3

% CO2?
5.0000 RUN
% OXYGEN?
15.7000 RUN
% CO ?
RUN
MOL WT OTHER?
RUN

MWd =29.43
MW WET=28.82

SQRT PSTS ?
7.8836 RUN
TIME MIN ?
60.0000 RUN
NOZZLE DIA ?
.3800 RUN
STK DIA INCH ?
66.0000 RUN

* VOL MTR STD = 32.193
STK PRES ABS = 29.09
VOL HOH GAS = 1.81
% MOISTURE = 5.32
MOL DRY GAS = 0.947
% NITROGEN = 79.30
MOL WT DRY = 29.43
MOL WT WET = 28.82
VELOCITY FPS = 19.55
STACK AREA = 23.76
STACK ACFM = 27,87[illegible].
* STACK DSCFM = 15,[illegible]6.
% ISOKINETIC = 95.5[illegible]

```
          XROM "MASSFLO"

RUN NUMBER
           3.1000    RUN

VOL MTR STD ?
          33.2710    RUN
STACK DSCFM ?
      17,632.0000    RUN
FRONT 1/2 MG ?
       1,746.1000    RUN
BACK 1/2 MG ?
           0.0000    RUN


F  GR/DSCF = 0.8099
F  MG/MMM = 1,853.3190
F  LB/HR = 122.4005
F  KG/HR = 55.5209

RUN NUMBER
           3.3000    RUN

VOL MTR STD ?
          32.1930    RUN
STACK DSCFM ?
      16,956.0000    RUN
FRONT 1/2 MG ?
         255.2000    RUN
BACK 1/2 MG ?
           0.0000    RUN


F  GR/DSCF = 0.1227
F  MG/MMM = 279.9498
F  LB/HR = 17.7796
F  KG/HR = 8.0643


RUN NUMBER
             3.20    RUN

VOL MTR STD ?
           32.372    RUN
STACK DSCFM ?
        17,285.00    RUN
FRONT 1/2 MG ?
           306.00    RUN
BACK 1/2 MG ?
             0.00    RUN


F  GR/DSCF = 0.15
F  MG/MMM = 333.61
F  LB/HR = 21.61
F  KG/HR = 9.80
```

```
          XROM "METH 5
RUN NUMBER?
ONE  Boiler 4
                         RUN
METER BOX Y?
          .9930          RUN
DELTA H?
         1.0200          RUN
BAR PRESS ?
         29.2600         RUN
METER VOL ?
         31.4130         RUN
MTR TEMP F?
         52.0000         RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                         RUN
STATIC H2O IN ?
         -.1300          RUN
STACK TEMP.
        301.0000         RUN
ML. WATER ?
         37.0000         RUN
IMP. % H2O = 5.7

% H2O=6.0


% CO2?
          8.7000         RUN
% OXYGEN?
         11.0000         RUN
% CO ?
                         RUN
MOL WT OTHER?
                         RUN

MWd =29.83
MW WET=29.12


SQRT PSTS ?
          7.3427         RUN
TIME MIN ?
         60.0000         RUN
NOZZLE DIA ?
          .3800          RUN
STK DIA INCH ?
         66.0000         RUN

* VOL MTR STD = 31.539
  STK PRES ABS = 29.25
  VOL H2O GAS = 2.02
  % MOISTURE = 6.03
  MOL DRY GAS = 0.940
  % NITROGEN = 80.30
  MOL WT DRY = 29.83
  MOL WT WET = 29.12
  VELOCITY FPS = 18.07
  STACK AREA = 23.76
  STACK ACFM = 25.756.
* STACK DSCFM = 15.416.
  % ISOKINETIC =  96.34
```

```
          XROM "METH 5
RUN NUMBER
TWO  Boiler 4
                         RUN
METER BOX Y?
          .9930          RUN
DELTA H?
          .7200          RUN
BAR PRESS ?
         29.2600         RUN
METER VOL ?
         30.0870         RUN
MTR TEMP F?
         64.0000         RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                         RUN
STATIC H2O IN ?
         -.1300          RUN
STACK TEMP.
        321.0000         RUN
ML. WATER ?
         36.7000         RUN
IMP. % H2O = 5.7

% H2O=5.5


% CO2?
          7.9000         RUN
% OXYGEN?
         11.8000         RUN
% CO ?
                         RUN
MOL WT OTHER?
                         RUN

MWd =29.72
MW WET=29.07


SQRT PSTS ?
          6.2137         RUN
TIME MIN ?
         67.5000         RUN
NOZZLE DIA ?
          .3900          RUN
STK DIA INCH ?
         66.0000         RUN

* VOL MTR STD = 29.494
  STK PRES ABS = 29.25
  VOL H2O GAS = 1.73
  % MOISTURE = 5.53
  MOL DRY GAS = 0.945
  % NITROGEN = 80.40
  MOL WT DRY = 29.72
  MOL WT WET = 29.07
  VELOCITY FPS = 15.30
  STACK AREA = 23.76
  STACK ACFM = 21.813.
* STACK DSCFM = 13.619.
  % ISOKINETIC =  96.94
```

```
          XROM "METH 5
RUN NUMBER
THREE  Boiler 4
                         RUN
METER BOX Y?
          .9930          RUN
DELTA H?
          .7100          RUN
BAR PRESS ?
         29.2600         RUN
METER VOL ?
         30.0290         RUN
MTR TEMP F?
         58.0000         RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                         RUN
STATIC H2O IN ?
         -.1300          RUN
STACK TEMP.
        294.0000         RUN
ML. WATER ?
         34.5000         RUN
IMP. % H2O = 5.2

% H2O=5.2


% CO2?
          8.5000         RUN
% OXYGEN?
         11.2000         RUN
% CO ?
                         RUN
MOL WT OTHER?
                         RUN

MWd =29.81
MW WET=29.20


SQRT PSTS ?
          6.0339         RUN
TIME MIN ?
         67.0000         RUN
NOZZLE DIA ?
          .3800          RUN
STK DIA INCH ?
         66.0000         RUN

* VOL MTR STD = 29.777
  STK PRES ABS = 29.25
  VOL H2O GAS = 1.62
  % MOISTURE = 5.17
  MOL DRY GAS = 0.948
  % NITROGEN = 80.30
  MOL WT DRY = 29.81
  MOL WT WET = 29.20
  VELOCITY FPS = 14.83
  STACK AREA = 23.76
  STACK ACFM = 21,136.
* STACK DSCFM = 13.721.
  % ISOKINETIC =  97.77
```

```
          XROM "MASSFLO"

RUN NUMBER
             4.10    RUN

VOL MTR STD ?
            31.539   RUN
STACK DSCFM ?
          16,416.00  RUN
FRONT 1/2 MG ?
            484.50   RUN
BACK 1/2 MG ?
             0.00    RUN


F  GR/DSCF = 0.24
F  MG/MMM = 542.49
F  LB/HR = 33.36
F  KG/HR = 15.13

          XROM "MASSFLO"

RUN NUMBER
             4.2000  RUN

VOL MTR STD ?
            29.4940  RUN
STACK DSCFM ?
        13,619.0000  RUN
FRONT 1/2 MG ?
           203.5000  RUN
BACK 1/2 MG ?
             0.0000  RUN


F  GR/DSCF = 0.1065
F  MG/MMM = 243.6563
F  LB/HR = 12.4235
F  KG/HR = 5.6380
          XROM "MASSFLO"

RUN NUMBER
             4.30    RUN

VOL MTR STD ?
            29.777   RUN
STACK DSCFM ?
          13,721.00  RUN
FRONT 1/2 MG ?
            249.40   RUN
BACK 1/2 MG ?
             0.00    RUN


F  GR/DSCF = 0.13
F  MG/MMM = 295.75
F  LB/HR = 15.20
F  KG/HR = 6.90
```

```
          XEQM "METH 5"
RUN NUMBER
ONE  Boiler 5                    RUN
METER BOX Y?
          .9930                  RUN
DELTA H?
          2.0400                 RUN
BAR PRESS ?
          29.2170                RUN
METER VOL ?
          44.4900                RUN
MTR TEMP F?
          56.0000                RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                                 RUN
STATIC H2H IN ?
          -.1250                 RUN
STACK TEMP.
          257.0000               RUN
ML. WATER ?
          66.5000                RUN
IMP. % H2O = 5.0

% H2O=6.6


% CO2?
          8.3000                 RUN
% OXYGEN?
          11.7000                RUN
% CO ?
                                 RUN
MOL WT OTHER?
                                 RUN

MWd =29.80
MW WET=29.62


SQRT PSTS ?
          8.7854                 RUN
TIME MIN ?
          60.0000                RUN
NOZZLE DIA ?
          .3800                  RUN
STK DIA INCH ?
          66.0000                RUN

* VOL MTR STD = 44.378
  STK PRES ABS = 29.21
  VOL H2O GAS = 3.13
  % MOISTURE = 6.59
  MOL DRY GAS = 0.934
  % NITROGEN = 80.00
  MOL WT DRY = 29.80
  MOL WT WET = 29.32
  VELOCITY FPS = 23.94
  STACK AREA = 23.76
  STACK ACFM = 34,106.
* STACK DSCFM = 22,916.
  % ISOKINETIC =  97.41
```

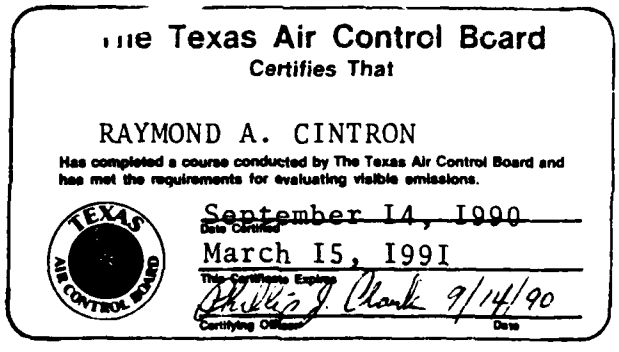
```
          XEQM "METH 5"
RUN NUMBER
TWO  Boiler 5                    RUN
METER BOX Y?
          .9930                  RUN
DELTA H?
          1.6700                 RUN
BAR PRESS ?
          29.2170                RUN
METER VOL ?
          40.8220                RUN
MTR TEMP F?
          65.0000                RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                                 RUN
STATIC H2H IN ?
          -.1250                 RUN
STACK TEMP.
          266.0000               RUN
ML. WATER ?
          44.5000                RUN
IMP. % H2O = 5.0

% H2O=5.0


% CO2?
          6.9000                 RUN
% OXYGEN?
          13.3000                RUN
% CO ?
                                 RUN
MOL WT OTHER?
                                 RUN

MWd =29.62
MW WET=29.03


SQRT PSTS ?
          8.9111                 RUN
TIME MIN ?
          60.0000                RUN
NOZZLE DIA ?
          .3800                  RUN
STK DIA INCH ?
          66.0000                RUN

* VOL MTR STD = 39.977
  STK PRES ABS = 29.21
  VOL H2O GAS = 2.11
  % MOISTURE = 5.01
  MOL DRY GAS = 0.950
  % NITROGEN = 80.00
  MOL WT DRY = 29.62
  MOL WT WET = 29.03
  VELOCITY FPS = 21.73
  STACK AREA = 23.76
  STACK ACFM = 30,973.
* STACK DSCFM = 20,888.
  % ISOKINETIC =  96.39
```

```
          XEQM "METH 5"
RUN NUMBER
THREE  Boiler 5                  RUN
METER BOX Y?
          .9930                  RUN
DELTA H?
          1.9900                 RUN
BAR PRESS ?
          29.2170                RUN
METER VOL ?
          47.9530                RUN
MTR TEMP F?
          70.0000                RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                                 RUN
STATIC H2H IN ?
          -.1250                 RUN
STACK TEMP.
          270.0000               RUN
ML. WATER ?
          53.3000                RUN
IMP. % H2O = 5.5

% H2O=5.5


% CO2?
          7.3000                 RUN
% OXYGEN?
          12.7000                RUN
% CO ?
                                 RUN
MOL WT OTHER?
                                 RUN

MWd =29.68
MW WET=29.03


SQRT PSTS ?
          9.3833                 RUN
TIME MIN ?
          60.0000                RUN
NOZZLE DIA ?
          .3800                  RUN
STK DIA INCH ?
          66.0000                RUN

* VOL MTR STD = 42.661
  STK PRES ABS = 29.21
  VOL H2O GAS = 2.50
  % MOISTURE = 5.54
  MOL DRY GAS = 0.945
  % NITROGEN = 80.00
  MOL WT DRY = 29.68
  MOL WT WET = 29.03
  VELOCITY FPS = 23.14
  STACK AREA = 23.76
  STACK ACFM = 32,984.
* STACK DSCFM = 21,998.
  % ISOKINETIC =  97.54
```

```
          XROM "MASSFLO"

RUN NUMBER
          5.1000    RUN

VOL MTR STD ?
         44.3700    RUN
STACK DSCFM ?
      22,916.0000   RUN
FRONT 1/2 MG ?
       1,077.7000   RUN
BACK 1/2 MG ?
          0.0000    RUN


F  GR/DSCF = 0.3748
F  MG/MMM = 857.7394
F  LB/HR = 73.6250
F  KG/HR = 33.3963

          XROM "MASSFLO"

RUN NUMBER
          5.2000    RUN

VOL MTR STD ?
         39.9770    RUN
STACK DSCFM ?
      20,888.0000   RUN
FRONT 1/2 MG ?
       1,023.4000   RUN
BACK 1/2 MG ?
          0.0000    RUN


F  GR/DSCF = 0.3951
F  MG/MMM = 904.0285
F  LB/HR = 70.7311
F  KG/HR = 32.0826

                    CL"
          XROM "MASSFLO"

RUN NUMBER
          5.3000    RUN

VOL MTR STD ?
         42.6610    RUN
STACK DSCFM ?
      21,998.0000   RUN
FRONT 1/2 MG ?
       1,746.7000   RUN
BACK 1/2 MG ?
          0.0000    RUN


F  GR/DSCF = 0.6318
F  MG/MMM = 1,445.8865
F  LB/HR = 119.1376
F  KG/HR = 54.0409
```

APPENDIX L

EPA Method 9 Certification



The Texas Air Control Board
Certifies That

RAYMOND A. CINTRON

Has completed a course conducted by The Texas Air Control Board and has met the requirements for evaluating visible emissions.

TEXAS AIR CONTROL BOARD

Date Certified: September 14, 1990

This Certificate Expires: March 15, 1991

Certifying Officer: Phillis J. Clark 9/14/90

Date

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