AFOEHL REPORT 89-128EQ0013LEF

Source Emission Testing of Hospital Pathological Waste Incinerator, Beale AFB CA

ROBERT W. VAUGHN, Capt, USAF, BSC

December 1989

Final Report

Distribution is unlimited; approved for public release

AF Occupational and Environmental Health Laboratory (AFSC)
Human Systems Division
Brooks Air Force Base, Texas 78235-5501

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At the request of HQ SAC/SGPB, source testing for particulate, chloride and visible emissions was conducted on the hospital Pathological Waste Incinerator. Testing was accomplished on 30 Aug 89. The survey was conducted to determine if the incinerator will meet the hospital's future needs. Incinerator usage will increase due to the closure of Mather AFB. Results indicate that the incinerator met both particulate and visible emissions standards. There is no standard for chloride emissions in the Yuba Air Pollution Control District. However, the incinerator will not be capable of handling an increased workload. A long term disposal method for pathological waste needs to be developed.

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22a. NAME OF RESPONSIBLE INDIVIDUAL: Capt Ronald W. Vaughn

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Illustrations

I. INTRODUCTION

On 30 Aug 89, source emission testing for particulates, chloride, and visible emissions was conducted at the 9 Strategic Hospital pathological incinerator at Beale AFB by personnel from the Air Quality Function of the AF Occupational and Environmental Health Laboratory (AFOEHL). This survey was requested by the 9 Strategic Hospital Commander to determine if the incinerator will meet their future needs. Increased incinerator use is anticipated due to the closure of Mather AFB. Personnel involved with on-site testing are listed in Appendix A.

II. DISCUSSION

A. Background

The 9 Strategic Hospital Commander has become concerned about the environmental impact of a hospital expansion. The mission of the hospital is expected to increase due to the projected closure of Mather AFB and the transfer of navigator training to Beale AFB. Pathological waste is presently incinerated in the hospital pathological incinerator. Hospital administrators are concerned the incinerator may become overburdened if the mission increases.

B. Site Description

The pathological waste incinerator is located inside a small building behind the hospital. The exhaust stack extends through the roof. A photograph of the exhaust stack is shown in Figure 1. The incinerator was manufactured by Bayco (Model PR2B-100) and was designed for Type 4 waste (defined as human and animal solid refuse consisting of carcasses and organs from hospitals, laboratories, and slaughterhouses). The unit does not have any air pollution control equipment and has the following operational parameters:

1. two-chamber design

2. propane fired

3. 100 pounds per hour(lb/hr) load capacity

The incinerator is operated on a batch cycle at about 100 lb per burn. The burn time is about one hour. Approximately 14 batches of waste are burned per week.

C. Applicable Standards: Local standards applicable to incinerators used for disposal of pathological waste are defined under the County of Yuba, Air Pollution Control District Regulation III, Prohibition - Stationary Emission Sources, Rules 3.0 and 3.2. These regulations, detailed in Appendix B, address two areas:

1. "Rule 3.0 - Visible emissions: Prohibits emissions from any single source which are as dark or darker as that designated as No. 2 on the Ringelmann Chart or equivalent opacity of 40%."

Figure 1. Pathological Waste Incinerator, Beale AFB CA

2. "Rule 3.2 - Particulate Matter Concentration: prohibits the emission of particulate matter in excess of 0.3 grains of particulate matter per dry cubic foot of exhaust gas (gr/dscf), corrected to 12% carbon dioxide (CO_2), from any source involving a combustion process."

D. Sampling Methods and Procedures

Present regulations require that all emissions testing be conducted in accordance with Appendix A to Title 40, Code of Federal Regulations, Part 60 (40 CFR 60). Therefore, sample train preparation, sampling and recovery, calculations and quality assurance were done in accordance with the methods and procedures outlined in 40 CFR 60, Appendix A and California Method 421.

Two sampling ports were installed at right angles in the stack. Two traverses of the stack cross section were completed. These ports were installed approximately 8 duct diameters downstream and 7 duct diameters upstream from any flow disturbance. Based on the inside stack diameter, port location and type of sample (particulate), 12 traverse points (6 per diameter) were used to collect a representative particulate sample. Appendix C shows port locations and sampling points.

Prior to every sample run, cyclonic flow was determined by using the Type S pitot tube and measuring the stack gas rotational angle at each traverse point. Flow conditions were considered acceptable when the arithmetic average of the rotational angles was 20 degrees or less. A preliminary velocity pressure traverse was also accomplished at this time.

A grab sample for ORSAT analysis (measures oxygen and carbon dioxide for stack gas molecular weight determination) was taken during each sample run. ORSAT sampling and analysis equipment are shown in Figures 2 and 3. Flue gas moisture content, needed for determination of flue gas molecular weight determination, was obtained during particulate sampling.

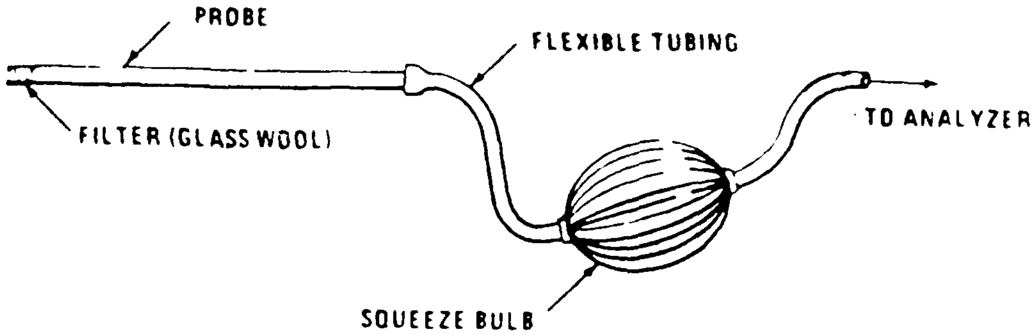

Figure 2. Grab Sampling Train

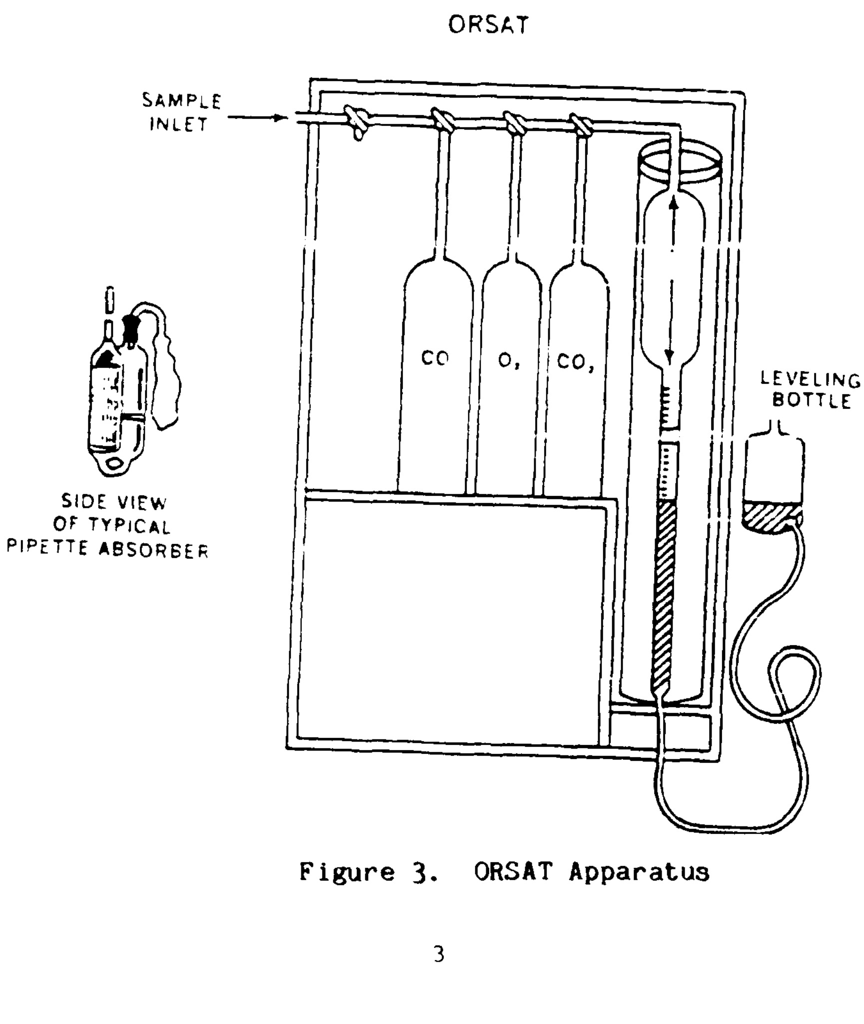

Figure 3. ORSAT Apparatus

Particulate and HCl samples were collected using the sampling train shown in Figure 4. The train consisted of a buttonhook probe nozzle, heated inconel probe, heated glass filter, impingers and a pumping and metering device. The nozzle was sized prior to each sample run so that the gas stream could be sampled isokinectically (the velocity at the nozzle tip was the same as the stack gas velocity at each point sampled). Flue gas velocity pressure was measured at the nozzle tip using a Type S pitot tube connected to a 10-inch inclined-vertical manometer. Type K thermocouples were used to measure flue gas and sampling train temperatures. The probe liner was heated to minimize moisture condensation. The heated filter was used to collect particulates. The impinger train consisted of the following components:

1. First, third and fourth impingers: Modified Greenburg-Smith type.

2. Second impinger: Standard Greenburg-Smith design. The apparatus was used as a condenser to collect stack gas moisture and hydrochloric acid (HCl). California Method 421 was used to collect HCl; the distilled water normally used in the first two impingers was replaced with known quantities of 0.003M sodium carbonate and 0.0024M sodium bicarbonate to remove water from the gas sample, as well as act as the collection media for the HCl. The pumping and metering system was used to control and monitor the sample gas flow rate. Equipment calibration data are found in Appendix D.

All calculations were made using the Environmental Protection Agency publication entitled "Source Test Calculation and Check Programs for Hewlett-Packard 41 Calculators", (EPA-340/1-85-013) and associated software programs. Particulate samples were analyzed according to the methods specified in Method 5. HCl samples were analyzed by ion chromatography.

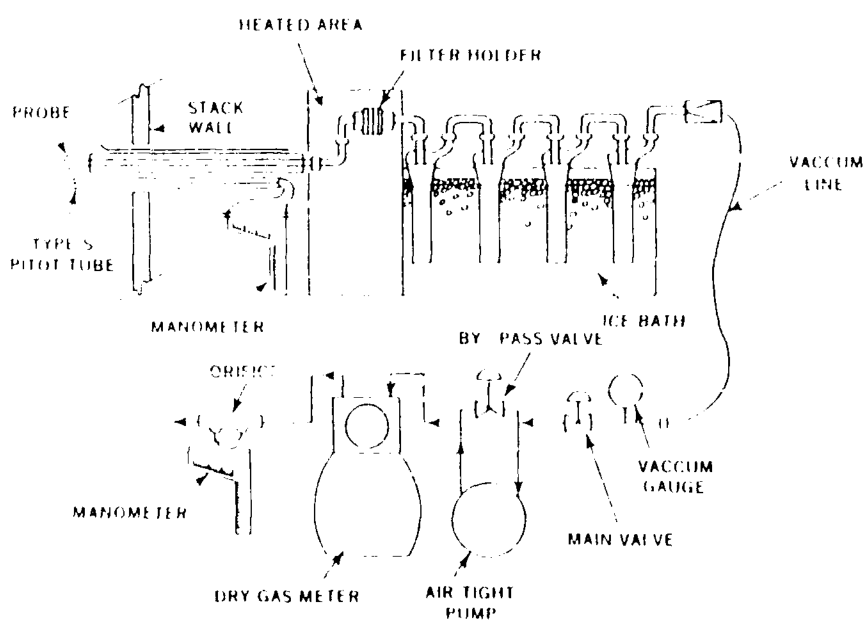

Figure 4. Particulate Sampling Train

E. Results

1. Visible Emissions: Visible emissions averaged less than 40% for all runs. Flames were seen shooting from the top of the incinerator during loading. This probably resulted from excess propane.

2. Particulate Emissions: Gravimetric analysis of the front half of the collector or filterable particulate matter (material collected on sampling train surfaces up to and including the filter) was determined for compliance purposes. Field data sheets are found in Appendix C and the resulting particulate emission calculations are presented in Appendix E. Table 1 provides the final particulate emissions test results. Particulate emissions averaged 0.443 lb/hr. This complies with the applicable limits. This corresponds to an average of 0.25 gr/dscf, below the limit of 0.3 gr/dscf.

3. HCl Emissions: Table 2 presents the final HCl emissions test results. HCl calculations are found in Appendix F. At this time, there are no State standards for HCl emissions.

Table 1. Particulate Emission Test Results

	STACK GAS		TOTAL		EMISSIONS	
			CATCH			CORRECTED TO 12% CO-
Run	$\%CO_2$	$\%O_2$	(mg)		(gr/dscf)	(gr/dscf)
1	7.2	10.0	236.8		0.089	0.148
2	7.4	9.8	449.8		0.159	0.258
3	8.4	8.4	695.0		0.259	0.370
				AVG =	0.169	0.259

Table 2: Hydrogen Chloride Emission Test Results

Run #	TOTAL HCL COLLECTED (mg)	SAMPLE VOLUME (dscf)	STACK GAS FLOW RATE (dscfm)		EMISSIONS (gr/dscf)	EMISSIONS (lb/hr)
1	34.9	40.9	313.0		0.013	0.035
2	13.8	43.5	359.0		0.005	0.015
3	45.4	41.5	337.0		0.017	0.049
				AVG =	0.012	0.033

Abbreviations used in Tables 1 and 2

mg = milligrams
gr/dscf = grains per dry standard cubic foot
dscf = dry standard cubic foot
dscfm = dry standard cubic foot per minute

III. CONCLUSIONS

Compliance testing results indicate the incinerator is in compliance with applicable Yuba County visible and particulate emissions standards. However, the following problems were observed during operation of the incinerator:

1. Flames were seen shooting from the top of the incinerator during loading; the stack refractory glowed red throughout the test; and, the stack temperature was observed to reach above 2200°F on several occasions before testing began. These problems were probably the result of excess propane (Figure 5). In addition, the high temperatures precipitated other problems:

   a. low residence time and uncombusted material being blown out of the stack,

   b. increasing the possibility of the formation of dioxins and furans which are carcinogens, and

   c. a hole being burned through the refractory and incinerator wall.

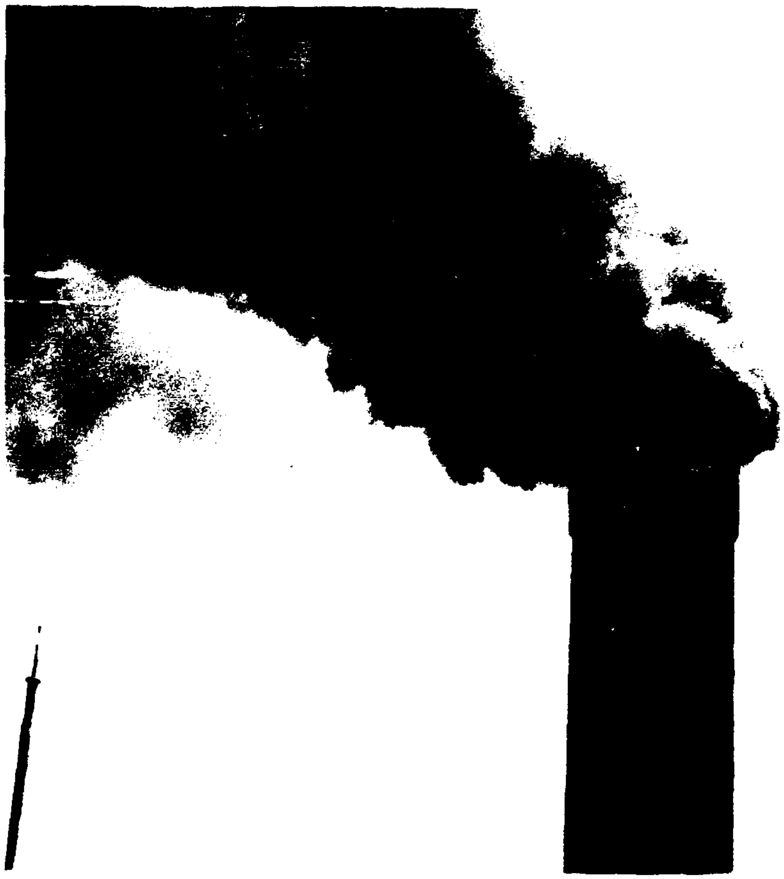

Figure 5. Visible Emission

2. During operation, fugitive emissions leaked from the incinerator door. This exposed the operator to potentially hazardous pollutants.

3. There were no devices for monitoring the primary and secondary chamber temperatures.

4. Although visible emissions met limits, opacity was greater than 40% during loading. The overloading of the incinerator resulted in reduced air circulation and high opacity readings.

The hospital incinerator is presently operating at a capacity that barely meets particulate emission limits. An increase in the incinerator workload will probably increase particulate emissions above the 0.3 gr/dscf limit and cause the visible emissions to exceed the 40% opacity limit (averaged over three minutes). Alternative methods of disposal of pathological waste should be investigated to meet the base's future needs. Two acceptable methods would be contract disposal or procurement of a new incinerator capable of handling the increased workload.

In the interim, the hole in the refractory and incinerator wall should be fixed and thermocouples installed on the primary and secondary chambers. The incinerator's operational components should also be checked, their operation verified, and the unit operated according to good engineering practices. Good engineering practices for pathological waste incinerators are:

1. primary chamber temperatures between 1000 - 1200°F,

2. secondary chamber temperatures between 1600 - 1800°F, and

3. residence time in the secondary chamber of 0.5 seconds.

IV. RECOMMENDATIONS

The pathological waste incinerator will not meet the hospital's future needs. A long term disposal method for pathological waste needs to be developed. AFOEHL will remain active in supporting the base's present and future needs.

REFERENCES

1. Standards of Performance for New Stationary Sources, Title 40, Part 60, Code of Federal Regulations, July 1, 1984.

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, April 1977.

3. Source Test Calculations and Check Programs for Hewlett-Packard 41 Calculators, U.S. Environmental Protection Agency, EPA-340/1-85-018, Research Triangle Park, North Carolina, September 1985.

4. California Air Resources Board Method 421, Determination of Hydrochloric Acid Emissions from Stationary Sources, adopted 18 March 1987.

APPENDIX A

Personnel Information

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1. AFOEHL Test Team

Capt Paul Scott, Chief, Air Quality Function
Capt Ronald Vaughn, Consultant, Air Quality Engineer
Capt David Goldblum, Consultant, Environmental Quality
1Lt Charles Attebery, Consultant, Air Quality Engineer

AFOEHL/EQE
Brooks AFB TX 78235-5501

Phone: AUTOVON 240-2891
Commercial (512) 536-2891

2. Beale AFB on-site representatives

Capt Christopher Sherman, 9 Strat Hosp/SGPB
SSgt Maria Ares-Banez, 9 Strat Hosp/SGPB
Phone: AUTOVON 368-2635
Commercial (916) 634-2635

Mr Jack Wise
9 Strat Hosp/SGAL
Phone: AUTOVON 368-2328
Commercial (916) 634-2328

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APPENDIX B

State Regulations

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County of Yuba

Air Pollution Control District

DATE AUGUST 10, 1989

PERMIT

NO: BE-01-42

IS HEREBY GRANTED TO

UNITED STATES AIR FORCE - BEALE AIR FORCE BASE

TO OPERATE

SUBJECT TO THE FOLLOWING CONDITIONS

SEE ATTACHED FOR SPECIFIC CONDITIONS:

This permit does not authorize the emission of air contaminates in excess of those allowed by the State of California or the Rules and Regulations of the Air Pollution Control District. This Permit expires one (1) year from date of issuance and must be renewed before the expiration date.

By [signature]
Air Pollution Control Officer

938 14th Street
Marysville, California

REVOCABLE AND NOT TRANSFERABLE

BEALE AIR FORCE BASE PERMIT CONDITIONS

1. This permit is valid for one year from date of issue and must be renewed by permittee.

2. This permit does not guarantee that the equipment will comply with the "Rules and Regulations Governing Air Pollution Control in Yuba County" or any applicable state or federal regulations.

3. All equipment, including both process and pollution abatement equipment must be maintained in good working order at all times. In the absence of specific permit conditions to the contrary, the throughputs, fuel and material consumptions, capacities, and hours of operation described in the permit application will be considered maximum allowable limits.

4. The Air Pollution Control Office must be notified of any upset/breakdown or removal of air pollution equipment within 24-hours of such event(s).

5. Prior to adding a new emission source or making any modification to an existing source, permittee must first obtain an approved "Authorization to Construct" from the Yuba County Air Pollution Control Office.

REGULATION III

PROHIBITION - STATIONARY EMISSION SOURCES

Rule 3.0 Visible Emissions: As provided by Section 41701 of the California Health and Safety Code, a person shall not discharge into the atmosphere from any single source of emissions whatsoever, any air contaminants for a period or periods aggregating more than three minutes in any one hour which is:

a. As dark or darker in shade as that designated as No. 2 on the Ringlemen Chart, as published by the United States Bureau of Mines: or
b. Of such opacity as to obscure an observers view to a degree equal to or greater than does smoke described in Subsection 'a' above.

Rule 3.1 Exceptions to Rule 3.0: In accordance with Section 41704 of the California Health and Safety Code, nothing in Rule 3.0 shall be construed to prohibit:

a. Open burning as authorized un Rule 2.1:
b. The use or orchard and citrus grove heaters which are in compliance with Rule 2.15:
c. Emissions resulting from food preparation, heating or comfort fires in single or two-family dwellings, providing prohibited materials as outlined in Rule 2.9 of these Rules and Regulations. are not burned.
d. Emissions from Tee Pee burners or from forestry/agricultural residue burners used to produce energy when such emissions result from start up or shut down of the process or from the malfunction of emission control equipment providing:
    1) These emissions shall not exceed a period or periods of time aggregating more than 30 minutes in any 24 hour period.
    2) The emissions do not result from the failure to operate and maintain in good working order any emission control equipment.
    3) Fuels used are forestry and/or agricultural residue with supplementary fossil fuels.

Rule 3.2 Particulate Matter Concentration: A person shall not discharge into the atmosphere from any source, except as allowed by Rule 3.1. section 'a' and 'c' of these Rules and Regulations, particulate matter in excess of 0.3 grains per cubic foot of gas at standard conditions.

When the source involves a combustion process, the concentration must be calculated to 12 per cent carbon dioxide (CO_2). In measuring the combustion contaminants from incinerators used to dispose of combustible refuse by burning the carbon dioxide (CO_2) produced by combustion of any liquid or gaseous fuels shall be excluded from the calculation to 12 percent of Carbon Dioxide (CO_2).

Rule 3.3 Dust and Fumes: A person shall not discharge in any one hour from any source whatsoever, except as provided by Rule 3.1. section 'a' and 'c' of these Rules and Regulations, dust or fumes in total quantities in excess of the amounts shown in the following table:

To use the following table, take the process weight per hour as such is defined in the attached definitions. Then find this figure on the table opposite which is the maximum number of pounds of contaminants which may be discharged into the atmosphere in any one hour. As an example: if "A" has a process which emits contaminants into the atmosphere and which process takes four (4) hours to complete, he will divide the weight of all materials in the specific process, in this example, 2,400 lbs., by '4', giving a process weight per hour of 600 lbs. The table shows that "A" may not discharge more than 1.83 lbs., in any one hour during the process. Interpolation of the data in the table for process weights up to 60.000 pounds/hour shall be accomplished by use of the equation:

$$E = 4.10\ p^{0.67}$$

and interpolation and extrapolation of the data for process weight rates in excess of 60.000 pounds/hour shall be accomplished by use of the equation:

$$E = (55.0\ p^{0.11}) - 40$$

E = Rate of emission in pounds/hour;
P = Process weight rate in ton/hour.

ALLOWABLE RATE OF EMISSION BASED ON PROCESS WEIGHT RATE

Process Weight Rate		Rate of Emission	Process Weight Rate		Rate of Emission
Lb. Hr.	Ton Hr.	Lb. Hr.	Lb. Hr.	tons Hr.	Lb. Hr
100	0.15	0.551	16,000	8.00	16.5
200	0.10	0.877	18,000	9.00	17.9
400	0.20	1.40	20,000	10.00	19.2
600	0.30	1.83	30,000	15.	25.2
800	0.40	2.22	40,000	20.	30.5
1,000	0.50	2.58	50,000	25.	35.4
1,500	0.75	3.38	60,000	30.	40.0
2,000	1.00	4.10	70,000	35.	41.3
2,500	1.25	4.70	80,000	40.	42.5
3,000	1.50	5.38	90,000	45.	43.6
3,500	1.75	5.96	100,000	50.	44.6
4,000	2.00	6.52	120,000	60.	46.3
5,000	2.50	7.58	140,000	70.	47.8
6,000	3.00	8.56	180,000	80.	49.0
7,000	3.50	9.49	200,000	100.	51.2
8,000	4.00	10.4	1,000,000	500.	69.0
9,000	4.50	11.2	2,000,000	1,000.	77.6
10,000	5.00	12.0	6,000,000	3,000.	92.7
12,000	6.00	13.6			

Table for Rule 3.3

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APPENDIX C

Field Data

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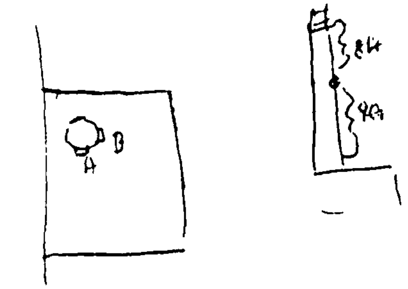
PARTICULATE SAMPLING DATA SHEET

1.91

RUN NUMBER	one
DATE	30 Aug 89
PLANT	Hosp Incinerator
BASE	Beale
SAMPLE BOX NUMBER	one
METER BOX NUMBER	two
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 good
Pre Leak good 15 in Hg
Post Pitot good?
Post Leak at 15 in Hg good

$MW_D = 29$
ΔP_s -.065

AMBIENT TEMP	76 °F
STATION PRESS	29.65 in Hg
HEATER BOX TEMP	°F
PROBE HEATER SETTING	
PROBE LENGTH	8' in
NOZZLE AREA (A)	.654 sq ft
Cp	.84
DRY GAS FRACTION (Fd)	

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	VAC ~~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)
A 1	0	2.0	1986		.02	1.30	745.775	71		69	225	68
2	5	2.0	1356		.02	1.20		75		71	249	68
3	10	2.0	1516		.03	1.65		80		72	224	68
4	15	2.5	1731		.05	2.5		85		75	247	68
5	20	2.5	1703		.05	2.56		87		76	245	68
6	27	2.5	1685		.04	2.07		89		77	256	67
	post											
B 1	0	2.0	1211		.02	1.32	766.493	82		80	247	68
2	5	7.0	1248		.03	1.96		91		83	248	68
3	10	10.0	1192		.035	2.37		93		83	256	68
4	15	14.0	1361		.04	2.47		97		85	247	68
5	20	11.0	1474		.04	2.33		95		86	247	68
6	25	10.0	1560		.03	1.68		98		87	247	67
	30											
							788.090					
		$T_M = 83$	$\Delta H = 1.9$				101 cu ft = 42.15					
		$T_S = 1437$	$\sqrt{\Delta P_s T_s} = 7.9409$									

OEHL FORM MAY 78 18

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Beale AFB	30 AUG 19[illegible]	

BUILDING NUMBER	SOURCE NUMBER
HOSPITAL	Run 1

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	0.4167	.2939	0.1228
ACETONE WASHINGS (*Probe, Front Half Filter*)	93.8744	93.[illegible]	0.1140
BACK HALF (*If needed*)			
	Total Weight of Particulates Collected		0.2368 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (*H20*)	252.5	200	52.5
IMPINGER 2 (*H20*)	225.0	200	25.0
IMPINGER 3 (*Dry*)	2.0	Ø	2.0
IMPINGER 4 (*Silica Gel*)	217.5	200	17.5
	Total Weight of Water Collected		97.0 gm

III. GASES (*Dry*)

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	7.2	7.2	7.4	—	7.2
VOL % O_2	9.8	10.0	10.0	—	10.0
VOL % CO					
VOL % N_2					

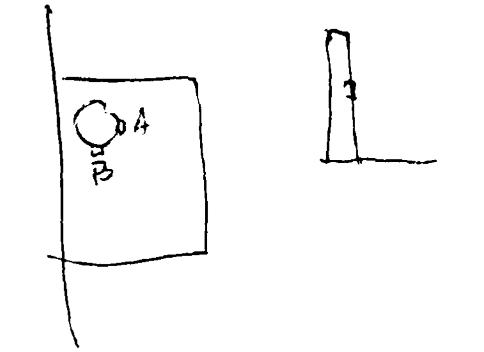
Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

AMD FORM FEB 84 651 REPLACES OEHL 20, MAY 78, WHICH IS OBSOLETE.

PARTICULATE SAMPLING DATA SHEET 1.91

RUN NUMBER	TWO
DATE	30 Aug 89
PLANT	Hospital Waste
BASE	Beale
SAMPLE BOX NUMBER	
METER BOX NUMBER	2
Qw/Qm	
Co	

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$^oR = ^oF + 460$

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

Pre Pitot Good
Pre Leak at 15in good
Post leak at 23 in Hg - good
Post Pitot good

AMBIENT TEMP	82 °F
STATION PRESS	29.65 in Hg
HEATER BOX TEMP	°F
PROBE HEATER SETTING	
PROBE LENGTH	8' in
NOZZLE AREA (A)	.0654 sq ft
Cp	.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)
A 1	0	2	1111		.02	1.59	798.405	88		85	226	67
2	5	3	1152		.04	2.72		92		86	241	66
3	10	4	1242		.05	3.27		92		86	247	69
4	15	6	1466		.05	2.85		96		87	246	67
5	20	18	1684		.07	3.59		97		87	246	68
6	25	18	1691		.06	3.07		97		88	247	68
	30	stop										
B 1	0	12.0	1220		.02	1.29	811.890	87		86	255	64
2	5	17.5	1229		.035	2.27		91		87	253	66
3	10	19.0	1285		.040	2.51		93		87	261	67
4	15	20.0	1402		.040	2.36		97		87	235	68
5	20	20.0	1550		.040	2.19		91		87	234	68
6	25	20.5	1588		.040	2.14	833.715	91		87	233	68
	30											
		$\bar{T}m$=89			$\overline{\Delta H}$=2.47		45.310 cu ft					
		$\bar{T}s$=1385			$\sqrt{\Delta Ps}$=8.7317							

OEHL FORM MAY 78 18

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
BEALE AFB	30 AUG 1977	

BUILDING NUMBER	SOURCE NUMBER
HOSPITAL	TWO

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	0.530[illegible]	.2858	0.24[illegible]
ACETONE WASHINGS *(Probe, Front Half Filter)*	110.7367	110.5320	.2047
BACK HALF *(If needed)*			0
	Total Weight of Particulates Collected		0.4493 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	227.0	200.0	27.0
IMPINGER 2 *(H20)*	226.4	200.0	26.4
IMPINGER 3 *(Dry)*	9.6	Ø	9.6
IMPINGER 4 *(Silica Gel)*	221.0	200.0	21.0
	Total Weight of Water Collected		84.0 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	7.4	7.4	7.6	—	7.4
VOL % O_2	9.8	9.8	9.8	—	9.9
VOL % CO					
VOL % N_2					

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

AMD FORM FEB 84 651 REPLACES OEHL 20, MAY 78, WHICH IS OBSOLETE.

PARTICULATE SAMPLING DATA SHEET

ΔH@ = 1.91

RUN NUMBER	THREE
DATE	30 Aug 89
PLANT	Hosp Incinerator
BASE	Beale
SAMPLE BOX NUMBER	
METER BOX NUMBER	2
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 - good

Pre leak at 18 in Hg - good

O_2 - 10

CO_2 - 7.3

Mwd = 29.

ΔP_s = .0165

AMBIENT TEMP	°F
STATION PRESS	29.65 in Hg
HEATER BOX TEMP	°F
PROBE HEATER SETTING	
PROBE LENGTH	8' in
NOZZLE AREA (A)	.654 sq ft
Cp	.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)
A 1	0	2	1098		.02	1.40	834.945	90		85	224	67
2	5	18	1245		.03	1.94		93		90	230	67
3	10	21	1333		.05	3.08		97		90	245	68
4	15	21	1472		.05	2.86		97		90	238	68
5	20	21	1466		.05	2.87		98		91	241	68
6	25	21	1594		.05	2.69	855.364	99		91	241	68
	30 Stop					int leak check at 22	← change filter					
						int leak check at 23						
B 1	0	2	1014		.02	1.50	856.305	95		92	240	68
2	5	3	1298		.03	1.90		97		92	238	68
3	10	3	1368		.035	2.13		102		94	238	68
4	15	14	1516		.04	2.26		103		93	241	68
5	20	12	1604		.04	2.29		103		96	240	68
6	25	13	1613		.05	2.69	879.521	104		93	240	68
			Tm = 95		ΔH = 2.30		43.635 ft³					
			Ts = 1375		√1375 = 8.3796							

OEHL FORM MAY 78 18

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
BEALE AFB	30 AUG 1987	

BUILDING NUMBER	SOURCE NUMBER
Hospital	THREE

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER 3.2	0.5321	.2858	0.2463
FILTER NUMBER 3.1	0.5682	.2881	0.3301
ACETONE WASHINGS *(Probe, Front Half Filter)*	100.2777	100.[illegible]	0.1626
BACK HALF *(If needed)*			Ø
	Total Weight of Particulates Collected		0.6750 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	265.5	200.0	65.5
IMPINGER 2 *(H20)*	220.5	200.0	20.5
IMPINGER 3 *(Dry)*	3.2	0	3.2
IMPINGER 4 *(Silica Gel)*	221.0	200.0	21.0
	Total Weight of Water Collected		110.2 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	8.6	8.4	8.4	—	8.4
VOL % O_2	8.4	8.4	8.2	—	8.4
VOL % CO					
VOL % N_2					

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

AMD FORM FEB 84 651 REPLACES OEHL 20, MAY 78, WHICH IS OBSOLETE.

PRELIMINARY SURVEY DATA SHEET NO. 1
(Stack Geometry)

BASE	PLANT
DATE 29 Aug 89	SAMPLING TEAM OEHL
SOURCE TYPE AND MAKE 2 Chamber Type 4 Incinerator	
SOURCE NUMBER —	INSIDE STACK DIAMETER 14" Inches
RELATED CAPACITY 100 lbs/hr	TYPE FUEL propane
DISTANCE FROM OUTSIDE OF NIPPLE TO INSIDE DIAMETER 8 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
2			2.1
3			4.1
4			9.9
5			11.9
6			13.4

OEHL FORM APR 78 15

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

BASE	DATE

BOILER NUMBER

INSIDE STACK DIAMETER — Inches

STATION PRESSURE: 29.65 In Hg

STACK STATIC PRESSURE: -.015 in H_2O — In H20

SAMPLING TEAM

520, 50?

TRAVERSE POINT NUMBER	VELOCITY HEAD, V_p IN H20	$\sqrt{V_p}$ ∠	STACK TEMPERATURE (°F)
1	.02	0	1800
2	.02	5	1800
3	.025	6	1884
4	.03	8	1884
5	.05	1	1885
6	.04	3	1886
		FPS = 20	
		$\bar{T}$ = 1857	
		.716 θ	
AVERAGE			

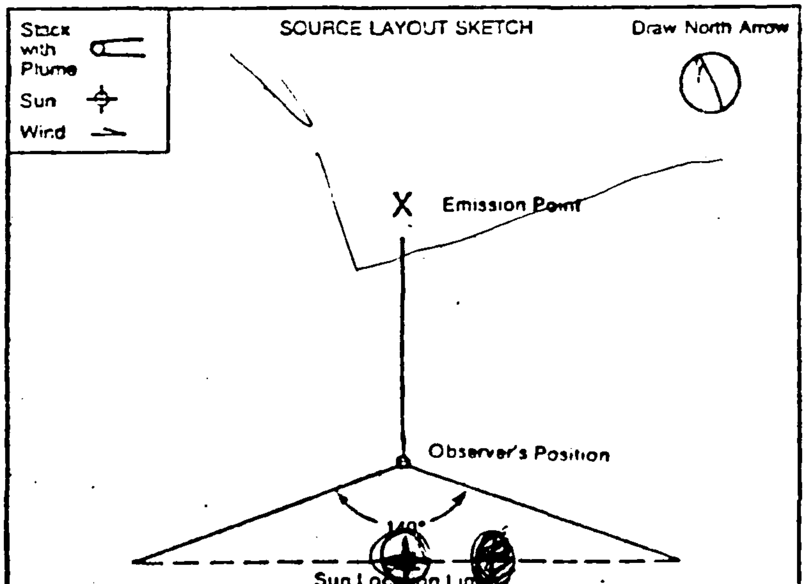
OEHL FORM APR 78 16

VISIBLE EMISSION OBSERVATION FORM

No. 3

COMPANY NAME	USAF
STREET ADDRESS	BEALE AFB
CITY	Yuba City
STATE	CA
ZIP	
PHONE (KEY CONTACT)	Capt Chris Sherman
SOURCE ID NUMBER	
PROCESS EQUIPMENT	Pathological Incinerator
OPERATING MODE	High Fire
CONTROL EQUIPMENT	None
OPERATING MODE	
DESCRIBE EMISSION POINT	STACK extending 10' FROM TOP OF ROOF
HEIGHT ABOVE GROUND LEVEL	30'
HEIGHT RELATIVE TO OBSERVER	Start 30' End ✓
DISTANCE FROM OBSERVER	Start 100' End ✓
DIRECTION FROM OBSERVER	Start NNE End ✓
DESCRIBE EMISSIONS	Start Clear lifting End
EMISSION COLOR	Start Clear End ✓
IF WATER DROPLET PLUME	Attached ☐ n/A Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	Start 0-5' End ✓
DESCRIBE PLUME BACKGROUND	Start Sky End ✓
BACKGROUND COLOR	Start Blue End ✓
SKY CONDITIONS	Start Clear End ✓
WIND SPEED	Start 0-5 mph End ✓
WIND DIRECTION	Start SE End ✓
AMBIENT TEMP	Start 85 End
WET BULB TEMP	
RH, percent	30

SOURCE LAYOUT SKETCH — Draw North Arrow



ADDITIONAL INFORMATION

OBSERVATION DATE	START TIME	END TIME
30 AUG 87	1321	1333

MIN \ SEC	0	15	30	45	COMMENTS
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	ADDED FUEL
5	0	0	0	(60)	
6	55	55	50	50	
7	50	40	40	30	
8	20	25	25	20	
9	15	10	5	5	
10	0	0	0	0	
11	0	0	0	0	
12	0	0	0	0	
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

OBSERVER'S NAME (PRINT)	CHARLES W. ATTEBERY
OBSERVER'S SIGNATURE	Charles W. Attebery
DATE	30 AUG 87
ORGANIZATION	AFOEHL/ECQE
CERTIFIED BY	Texas Air Control Board
DATE	17 [illegible]

VISIBLE EMISSION OBSERVATION FORM

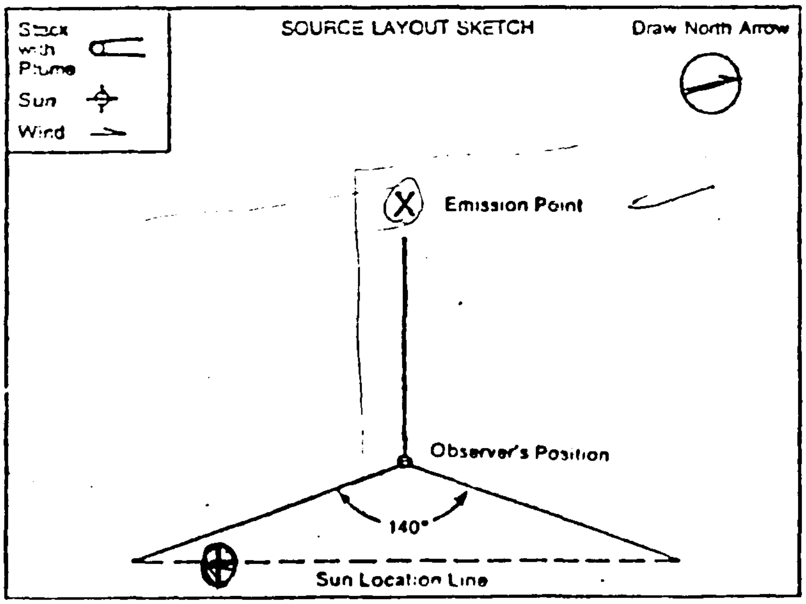
No. 2

COMPANY NAME	BEALE AFB CLINIC
STREET ADDRESS	BEALE AFB
CITY	Yuba City
STATE	CA
ZIP	
PHONE (KEY CONTACT)	Capt. Chris Sherman
SOURCE ID NUMBER	

PROCESS EQUIPMENT	Pathological Incinerator
OPERATING MODE	High Fire
CONTROL EQUIPMENT	None
OPERATING MODE	

DESCRIBE EMISSION POINT	Stack extending 10' From TOP of building
HEIGHT ABOVE GROUND LEVEL	30'
HEIGHT RELATIVE TO OBSERVER	Start 6' End ✓
DISTANCE FROM OBSERVER	Start 20' End ✓
DIRECTION FROM OBSERVER	Start W End ✓
DESCRIBE EMISSIONS	Start Clear lofting End ✓
EMISSION COLOR	Start CLEAR End ✓
IF WATER DROPLET PLUME	Attached ☐ N/A Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	Start 0 - 5' End ✓
DESCRIBE PLUME BACKGROUND	Start sky End ✓
BACKGROUND COLOR	Start BLUE End
SKY CONDITIONS	Start CLEAR End
WIND SPEED	Start 0 - 5 mph End ✓
WIND DIRECTION	Start S End ✓
AMBIENT TEMP	Start 80 End ✓
WET BULB TEMP	
RH, percent	30

SOURCE LAYOUT SKETCH



ADDITIONAL INFORMATION

OBSERVATION DATE	START TIME	END TIME
30 AUG 89	1130	1138

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

OBSERVER'S NAME (PRINT)	CHARLES W ATTEBERY
OBSERVER'S SIGNATURE	Charles W. Atteb...
DATE	30 AUG 89
ORGANIZATION	AFOEHL/ECQE
CERTIFIED BY	Texas Air Control Board
DATE	12 Mar 89

VISIBLE EMISSION OBSERVATION FORM

No. 1

COMPANY NAME: Beale AFB CLINIC

STREET ADDRESS: BEALE AFB

CITY: Yuba City | STATE: CA | ZIP:

PHONE (KEY CONTACT): CAPT CHRIS SHERMAN | SOURCE ID NUMBER:

PROCESS EQUIPMENT: PATHOLOGICAL INCINERATOR | OPERATING MODE: HIGH FIRE

CONTROL EQUIPMENT: NONE | OPERATING MODE:

DESCRIBE EMISSION POINT: STACK EXTENDING 10' FROM TOP OF BUILDING.

HEIGHT ABOVE GROUND LEVEL: 30'

HEIGHT RELATIVE TO OBSERVER: Start 6' End 6'

DISTANCE FROM OBSERVER: Start 20' End 20'

DIRECTION FROM OBSERVER: Start W End ✓

DESCRIBE EMISSIONS: Start CLEAR / HEAT lofting End ✓

EMISSION COLOR: Start CLEAR End ✓

IF WATER DROPLET PLUME: Attached ☐ N/A Detached ☐

POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Start 0-5' End ✓

DESCRIBE PLUME BACKGROUND: Start SKY End ✓

BACKGROUND COLOR: Start BLUE End ✓

SKY CONDITIONS: Start CLEAR End ✓

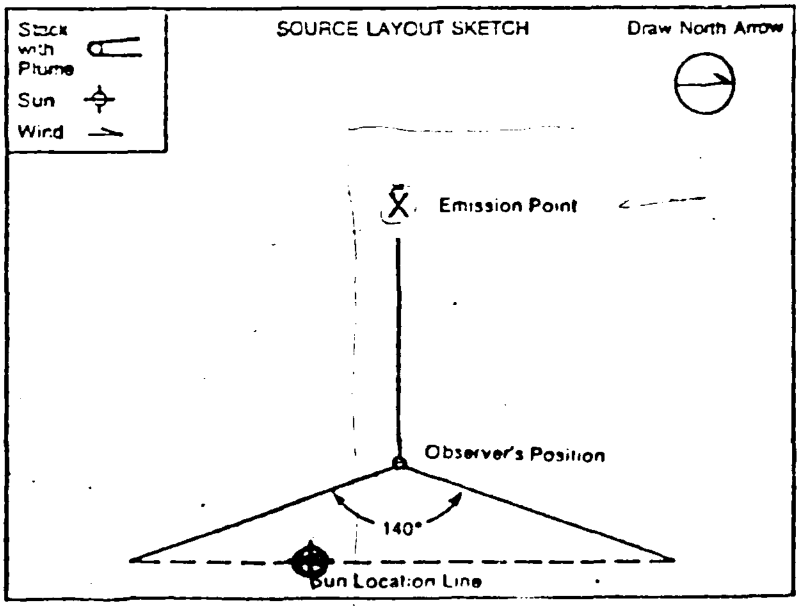
WIND SPEED: Start 0-5 mph End ✓

WIND DIRECTION: Start SOUTH End ✓

AMBIENT TEMP: Start 75 End ✓

WET BULB TEMP:

RH, percent: 30



ADDITIONAL INFORMATION

OBSERVATION DATE: 30 Aug 89 | START TIME: 0930 | END TIME: 0938

MIN \ SEC	0	15	30	45	COMMENTS
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	5	0	
5	0	0	0	0	
6	0	5	0	0	
7	0	5	5	5	
8	0	0	0	0	
9					
10					
11					
12					
13					
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26					
27					
28					
29					
30					

OBSERVER'S NAME (PRINT): CHARLES W ATTEBERY

OBSERVER'S SIGNATURE: [signature] | DATE: 30 Aug 89

ORGANIZATION: USAF OCCUPATIONAL & ENVIRONMENTAL HEALTH

CERTIFIED BY: TEXAS AIR CONTROL BOARD | DATE: 17 MAR 89

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APPENDIX D

Calibration Data

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METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 21 Nov 88 Meter box number Nutech #2

Barometric pressure, P_b = 30.02 in. Hg Calibrated by Scott & Vaughn

VAC	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
4.0	0.5	5	5.057	75 / 75 535	77 / 82	75 / 77	537.75	12.40	0.9926	1.73
4.0	1.0	5	5.031	76 / 76 536	84 / 89	77 / 80	542.5	9.14	1.0034	1.87
4.0	1.5	10	10.101	77 / 77 537	90 / 96	81 / 84	547.75	15.35	1.0061	1.97
4.0	2.0	10	10.230	78 / 78 538	97 / 99	85 / 87	552.0	13.45	0.9981	2.00
4.0	3.0	10	10.170	78 / 78 538	100 / 103	87 / 89	554.75	10.92	1.0065	1.97
4.0	4.0	10	10.191	78 / 78 538	103 / 105	89 / 91	557.0	9.35	1.0061	1.92
								Avg	1.002	1.91

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)}$	$\Delta H@_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\theta}{V_w}\right]^2$
0.5	0.0368	(5)(30.02)(537.75) / (5.057)(30.02 + .5/13.6)(535)	(.0317)(.5) / (30.02)(537.75) [(535)(12.4) / (5)]^2
1.0	0.0737	(5)(30.02)(542.5) / (5.031)(30.02 + 1/13.6)(536)	(.0317)(1.0) / (30.02)(542.5) [(536)(9.14) / 5]^2
1.5	0.110	(10)(30.02)(547.75) / (10.101)(30.02 + 1.5/13.6)(537)	(.0317)(1.5) / (30.02)(547.75) [(537)(15.35) / 10]^2
2.0	0.147	(10)(30.02)(552) / (10.23)(30.02 + 2.0/13.6)(538)	(.0317)(2.0) / (30.02)(552) [(538)(13.45) / 10]^2
3.0	0.221	(10)(30.02)(554.75) / (10.17)(30.02 + 3/13.6)(538)	(.0317)(3.0) / (30.02)(554.75) [(538)(10.92) / 10]^2
4.0	0.294	(10)(30.02)(557) / (10.19)(30.02 + 4/13.6)(538)	(.0317)(4.0) / (30.02)(557) [(538)(9.35) / 10]^2

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

Re Beale AFB

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number One Date 23 Jun 89 Meter box number Nutech 2 Post Plant Clear & Eielson

Barometric pressure, P_b = 29.123 in. Hg Dry gas meter number ______ Pretest Y 1.002

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[a] (t_d), °F	Time (θ), min	Vacuum setting, in. Hg	Y_i	$Y_i = \dfrac{V_w P_b (t_d + 460)}{V_d \left(P_b + \dfrac{\Delta H}{13.6}\right)(t_w + 460)}$
1.4	10	10.212	80 80 540	87 93 550	85 85 545	547.5	15.67	4.0	[illegible]	[illegible] 540
1.4	10	10.223	81 81 541	93 93 554	85 87 546	550	15.83	4.0	[illegible]	[illegible] 541
1.4	10	10.347	81 81 541	95 96 555.5	87 88 547.5	551.5	16.12	4.0	0.963	[illegible] 551.5
									Y = .991	

[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 $\pm 0.05Y$.

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

Quality Assurance Handbook M4-2.4A

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units) Post Beale AFB

Date 28 Sept 89 Meter box number Nutech 2

Barometric pressure, P_b = 29.82 in. Hg Calibrated by Scott & Vaughn

IAC	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), °R	Temperature: Dry gas meter Inlet (t_{d_i}), °R	Temperature: Dry gas meter Outlet (t_{d_o}), °R	Temperature: Dry gas meter Avg[a] (t_d), °R	Time (Θ), min	Y_i	$\Delta H@_i$ in. H_2O
✓	0.5	5	5.060	78 78 538	79 84 541.5	77 79 538	539.8	12.9	0.990	1.897
✓	1.0	5	5.060	79 79 539	87 ? 549	80 81 540.5	544.8	9.0	0.996	1.837 ~~1.840~~
✓	1.5	10	10.150	80 79 539.5	96 98 557	86 87 546.5	551.8	15.2	1.004	1.943
✓	2.0	10	10.195	79 ~~79~~ 539	98 100 559	87 89 549	553.5	13.2	1.002	1.944
✓	3.0	10	10.155	79 80 539.5	101 104 562.5	90 91 550.5	556.5	10.7	1.008	1.910
✓	4.0	10	10.025 ~~10.139~~	80 77 538.5	80 89 544.5	74 77 535.5	540	10.0	0.991	2.283
								Avg	0.999	1.969

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 460)}$	$\Delta H@_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\Theta}{V_w}\right]^2$
0.5	0.0368	$y_1 = \frac{(5)(29.82)(539.8)}{(5.06)(29.82 + 0.5/13.6)(538)}$	$H@_1 = \frac{(0.0317)(.5)}{(29.82)(539.8)}\left[\frac{(538)(12.9)}{5}\right]^2$
1.0	0.0737	$y_2 = \frac{(5)(29.82)(544.8)}{(5.06)(29.82 + 1/13.6)(539)}$	$H@_2 = \frac{(.0317)(1)}{(29.82)(544.8)}\left[\frac{(539.0)(9.0)}{5}\right]^2$
1.5	0.110	$y_3 = \frac{(10)(29.82)(551.8)}{(10.15)(29.82 + 1.5/13.6)(539.5)}$	$H@_3 = \frac{(.0317)(1.5)}{(29.82)(551.8)}\left[\frac{(539.5)(15.2)}{10}\right]^2$
2.0	0.147	$y_4 = \frac{(10)(29.82)(553.5)}{(10.195)(29.82 + 2.0/13.6)(539)}$	$H@_4 = \frac{(.0317)(2.0)}{(29.82)(553.5)}\left[\frac{(539)(13.2)}{10}\right]^2$
3.0	0.221	$y_5 = \frac{(10)(29.82)(556.5)}{(10.155)(29.82 + 3/13.6)(539.5)}$	$H@_5 = \frac{(.0317)(3.0)}{(29.82)(556.5)}\left[\frac{(539.5)(10.7)}{10}\right]^2$
4.0	0.294	$y_6 = \frac{(10)(29.82)(540)}{(10.025)(29.82 + 4/13.6)(538.5)}$	$H@_6 = \frac{(.0317)(4.0)}{(29.82)(540)}\left[\frac{(538.5)(10.0)}{10}\right]^2$

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

Y Range = 1.0521 ⟷ 0.9519

Quality Assurance Handbook M4-2.3A (front side)

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 ~~19~~ 20 OCT 88 Thermocouple number IMPINGER D2

Ambient temperature 26° °C Barometric pressure 29.232/ 29.175 in. Hg

Calibrator GARRISON/ SCOTT Reference: mercury-in-glass NBS

other ______

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

Date 19/20 OCT 88 Thermocouple number IMPINGER 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	C	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 DY

Ambient temperature 26 °C Barometric pressure 29.732 / 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 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%

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

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

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

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.) 0.0313

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

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

Comments: CONSTRUCTED IAW 40CFR60, APP A, METH 2, FIG 2.2 ASSIGNED BASELINE COEFFICIENT = 0.84

Calibration required? ______ yes ✓ no

Quality Assurance Handbook M2-1.7

NOZZLE CALIBRATION DATA FORM

Date 30 Aug 89 Calibrated by Smith

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.)		
7	.653	.654	654	.001	.654

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.

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

APPENDIX E

Acetone Blank Results and
Particulate Emissions Results

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BLANK ANALYTICAL DATA FORM

Plant Beale AFB

Sample location Blank

Relative humidity —

Liquid level marked and container sealed —

Density of acetone (ρ_a) 0.78 g/ml

Blank volume (V_a) 100 ml

Date and time of wt 15 Sept 0900 hr Gross wt 104.8797 mg

Date and time of wt 21 Sept 1445 hr Gross wt 104.8809 mg

Average gross wt 104.8809 mg

Tare wt 104.8797 mg

Weight of blank (m_{ab}) .0012 mg

$$C_a = \frac{m_{ab}}{V_a \rho_a} = \frac{(.0012)}{(100)\ (0.78)} = 0.0000154 \text{ mg/g}$$

Note: In no case should a blank residue greater than 0.01 mg/g (or 0.001% of the blank weight) be subtracted from the sample weight.

Filters

Filter number ________

Date and time of wt ________ Gross wt ________ mg

Date and time of wt ________ Gross wt ________ mg

Average gross wt ________ mg

Tare wt ________ mg

Difference wt ________ mg

Note: Average difference must be less than ±5 mg or 2% of total sample weight whichever is greater.

Remarks ________

Signature of analyst Ronald W. Vaughn

Signature of reviewer ________

Quality Assurance Handbook M5-5.4

XROM "METH 5"

RUN NUMBER
ONE
RUN

METER BOX Y?
1.0020 RUN
DELTA H?
1.9100 RUN
BAR PRESS ?
29.6500 RUN
METER VOL ?
42.1150 RUN
MTR TEMP F?
63.0000 RUN
STATIC HOH IN ?
-.0650 RUN
STACK TEMP.
1,437.0000 RUN
ML. WATER ?
97.0000 RUN

IMP. % HOH = 10.1

% HOH=10.1

% CO2?
7.2000 RUN
% OXYGEN?
10.0000 RUN
% CO ?
0.0000 RUN

MWd =29.55
MW WET=28.39

SQRT PSTS ?
7.9404 RUN
TIME MIN ?
60.0000 RUN
NOZZLE DIA ?
.6540 RUN
STK DIA INCH ?
14.0000 RUN

* VOL MTR STD = 40.856
STK PRES ABS = 29.65
VOL HOH GAS = 4.57
% MOISTURE = 10.05
MOL DRY GAS = 0.899
% NITROGEN = 82.80
MOL WT DRY = 29.55
MOL WT WET = 28.39
VELOCITY FPS = 19.65
STACK AREA = 1.07
STACK ACFM = 1,261.
* STACK DSCFM = 313.
% ISOKINETIC = 99.34

XROM "METH 5"

RUN NUMBER
TWO
RUN

METER BOX Y?
1.0020 RUN
DELTA H?
2.4700 RUN
BAR PRESS ?
29.6500 RUN
METER VOL ?
45.3100 RUN
MTR TEMP F?
89.0000 RUN
STATIC HOH IN ?
-.0650 RUN
STACK TEMP.
1,385.0000 RUN
ML. WATER ?
84.0000 RUN

IMP. % HOH = 8.3

% HOH=8.3

% CO2?
7.4000 RUN
% OXYGEN?
9.8000 RUN
% CO ?
0.0000 RUN

MWd =29.58
MW WET=28.61

SQRT PSTS ?
8.7310 RUN
TIME MIN ?
60.0000 RUN
NOZZLE DIA ?
.6540 RUN
STK DIA INCH ?
14.0000 RUN

* VOL MTR STD = 43.535
STK PRES ABS = 29.65
VOL HOH GAS = 3.95
% MOISTURE = 8.33
MOL DRY GAS = 0.917
% NITROGEN = 82.80
MOL WT DRY = 29.58
MOL WT WET = 28.61
VELOCITY FPS = 21.53
STACK AREA = 1.07
STACK ACFM = 1,381.
* STACK DSCFM = 359.
% ISOKINETIC = 92.69

XROM "MASSFLO"

RUN NUMBER
ONE RUN

VOL MTR STD ?
40.8560 RUN
STACK DSCFM ?
313.0000 RUN
FRONT 1/2 MG ?
236.8000 RUN
BACK 1/2 MG ?
0.0000 RUN

F GR/DSCF = 0.0894
F MG/MMM = 204.6788
F LB/HR = 0.2400
F KG/HR = 0.1088

XROM "MASSFLO"

RUN NUMBER
TWO RUN

VOL MTR STD ?
43.5350 RUN
STACK DSCFM ?
359.0000 RUN
FRONT 1/2 MG ?
449.8000 RUN
BACK 1/2 MG ?
0.0000 RUN

F GR/DSCF = 0.1594
F MG/MMM = 364.8613
F LB/HR = 0.4906
F KG/HR = 0.2225

```
           XROM "METH 5"
RUN NUMBER


THREE                    RUN
METER BOX Y?
           1.0020    RUN
DELTA H?
           2.3000    RUN
BAR PRESS ?
          29.6500    RUN
METER VOL ?
          43.6350    RUN
MTR TEMP F?
          95.0000    RUN
STATIC HOH IN ?
          -.0650     RUN
STACK TEMP.
      1,375.0000     RUN
ML. WATER ?
         110.2000    RUN




IMP. % HOH = 11.1

% HOH=11.1


% CO2?
           8.4000    RUN
% OXYGEN?
           8.4000    RUN
% CO ?
           0.0000    RUN

MWd =29.68
MW WET=28.38


SQRT PSTS ?
           8.3796    RUN
TIME MIN ?
          60.0000    RUN
NOZZLE DIA ?
            .6540    RUN
STK DIA INCH ?
          14.0000    RUN

* VOL MTR STD = 41.455
  STK PRES ABS = 29.65
  VOL HOH GAS = 5.19
  % MOISTURE = 11.12
  MOL DRY GAS = 0.889
  % NITROGEN = 83.20
  MOL WT DRY = 29.68
  MOL WT WET = 28.38
  VELOCITY FPS = 20.75
  STACK AREA = 1.07
  STACK ACFM = 1,331.
* STACK DSCFM = 337.
  % ISOKINETIC =  93.96
```

```
           XROM "MASSFLO"

RUN NUMBER
THREE                    RUN

VOL MTR STD ?
          41.4550    RUN
STACK DSCFM ?
         337.0000    RUN
FRONT 1/2 MG ?
         695.0000    RUN
BACK 1/2 MG ?
           0.0000    RUN


F  GR/DSCF = 0.2587
F  MG/MMM = 592.0451
F  LB/HR = 0.7473
F  KG/HR = 0.3390
```

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APPENDIX F

Hydrogen Chloride Emissions Calculations

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```
XROM "MASSFLO"

RUN NUMBER
ONE HCL              RUN

VOL MTR STD ?

        40.8560    RUN
STACK DSCFM ?
       313.0000    RUN
FRONT 1/2 MG ?
        34.9200    RUN
BACK 1/2 MG ?
         0.0000    RUN


F  GR/DSCF = 0.0132
F  MG/MMM = 30.1832
F  LB/HR = 0.0354
F  KG/HR = 0.0161
```

```
XROM "MASSFLO"

RUN NUMBER
TWO HCL              RUN

VOL MTR STD ?
        43.5350    RUN
STACK DSCFM ?
       359.0000    RUN
FRONT 1/2 MG ?
        13.7750    RUN
BACK 1/2 MG ?
         0.0000    RUN


F  GR/DSCF = 0.0049
F  MG/MMM = 11.1738
F  LB/HR = 0.0150
F  KG/HR = 0.0068
```

```
XROM "MASSFLO"

RUN NUMBER
THREE HCL            RUN

VOL MTR STD ?
        41.4550    RUN
STACK DSCFM ?
       337.0000    RUN
FRONT 1/2 MG ?
        45.3600    RUN
BACK 1/2 MG ?
         0.0000    RUN


F  GR/DSCF = 0.0169
F  MG/MMM = 38.6405
F  LB/HR = 0.0488
F  KG/HR = 0.0221
```

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