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AP-42 Section 9.12.1
Reference 17
Report Sect. 4
Reference 26

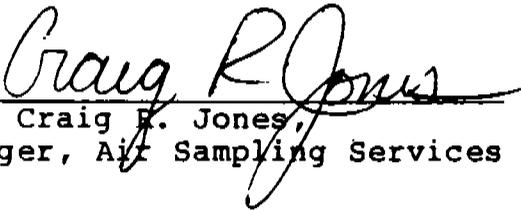
EMISSION TEST REPORT
DRYERS #1 AND #4
ANHEUSER-BUSCH, INC.
COLUMBUS, OHIO

Prepared for:

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by

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December 20, 1983
PCS PN 85.010

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1.0 EXECUTIVE SUMMARY

Pollution Control Science performed particulate emission tests on the Ducon scrubber which controls particulate emissions from dryer #1 at the Anheuser-Busch brewery in Columbus, Ohio. A total of five tests were made on dryer #1 at two operating rates. The emission tests scheduled for dryer #4 were cancelled because of operating problems with the dryer.

The results of these tests are as follows:

RUN #	PROCESS CONDITION	INLET (lb/hr)	OUTLET (lb/hr)
1	MAXIMUM	29.2	22.3
2	MAXIMUM	23.1	16.1
3	NORMAL	14.3	3.1
4	MAXIMUM	22.2	18.8
5	NORMAL	10.6	2.6

2.0 INTRODUCTION

Pollution Control Science, Inc. was retained by Anheuser-Busch to perform particulate emission tests on two grain dryers at the Anheuser-Busch brewery in Columbus, Ohio. The tests were conducted to determine compliance with OEPA regulations restricting particulate emissions from stationary sources. Particulate emission samples were taken at the inlet and outlet of the Ducon scrubber which controls particulate emissions from dryer #1. The dryer was operated at two conditions during the test period. Three tests were conducted while the dryer was at its maximum rate of 28,000 lb/hr and two tests were made while the dryer was running at its normal rate of approximately 18,000 lb/hr. The test protocol also called for three tests to be conducted on dryer #4, however operational problems were encountered with the dryer and the tests were cancelled until a later date. The sampling was conducted during the week of October 31, 1983.

In addition to particulate emissions rates, measurements were also made of stack gas flow rate, temperature, moisture, and dry molecular weight.

Mr. Don DeHart and Mr. Gerald Moeslein of Anheuser-Busch were in attendance during the field sampling and provided PCS with process samples and process rate data. Representatives of the OEPA were on site periodically to witness test procedures and to verify process operations.

3.0 PROCESS DESCRIPTION

Anheuser-Busch operates four rotary grain dryers to dry spent grain from the brewing process. Dryers #1, #2, and #3, identical Heil units, are used as the primary dryers. Dryer #4 is an older Aeroglide model and is used as a standby unit only. The dryers fire natural gas or fuel oil depending upon availability and economic considerations. The primary fuel is natural gas and the dryers were firing natural gas during the test periods.

The rated capacity of each dryer is 28,000 lb/hr, however during normal operations, Anheuser Busch restricts the process rate to approximately 18,000 lb/hr to meet the temperature requirements of the Permit To Operate.

Process emissions from the dryers are initially exhausted through a cyclone and heat recovery system. After emerging from the cyclone, the gas from each dryer passes through individual but identical I.D. fans and Ducon multivane, type L gas scrubbers.

The mist eliminator vane in the top of these scrubbers directs entrained liquid droplets against the sides of the scrubber. The water droplets with trapped particulate matter coalesce on the walls of the scrubber and drain to the bottom of the unit where the slurry is removed through the sludge outlet. The action of the eliminator vane on the gas stream induces cyclonic flow in the exhaust stack. Previous tests confirmed the presence of cyclonic flow in the outlet stacks. The scrubber

liquor flow rate during the test period ranged from 100 to 112 gallons per minute (gpm) at a pressure of 6-8 psig.

The inlet sampling site was located 8 feet 4 inches (2.3 diameters) upstream and 11 feet (3 diameters) downstream of the nearest flow disturbance. The outlet sampling site was located 17 feet 10 inches (3.2 diameters) upstream and 20 feet 5 inches (3.7 diameters) downstream of the nearest flow disturbance. Diagrams of the inlet and outlet sampling sites are included in Figure 3.1 and 3.2.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

The sampling and analytical procedures used in this test series conform to the requirements of USEPA Reference Methods published in the Federal Register, 40 CFR 60, and subsequent revisions.

The following procedures were used:

- a. Measurement Sites
Location of measurement sites and the number of traverse points were determined as specified in USEPA Reference Method 1, "Sample and Velocity Traverses for Stationary Sources."
- b. Flow Rate and Temperature
Stack gas flow rate and temperature were determined using USEPA Reference Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)." Velocities were measured with type 'S' pitot tubes and temperatures were measured with thermocouples.
- c. Dry Molecular Weight
Dry Molecular Weight was determined using USEPA Reference Method 3, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight. Several grab samples were collected during each test and analyzed directly with Fyrite combustion gas analyzers.

Pollution Control Science, Inc.

6015 Manning Road, Miamisburg, Ohio 45342
(513) 866-5908/TLX 288348

JOB NAME: ANHEUSER BUSCH

JOB NO. 85-010 PAGE 1 OF 1

CALCULATED BY CRAIG JONES DATE 9/8/83

VERIFIED BY _____ DATE _____

SCALE NONE

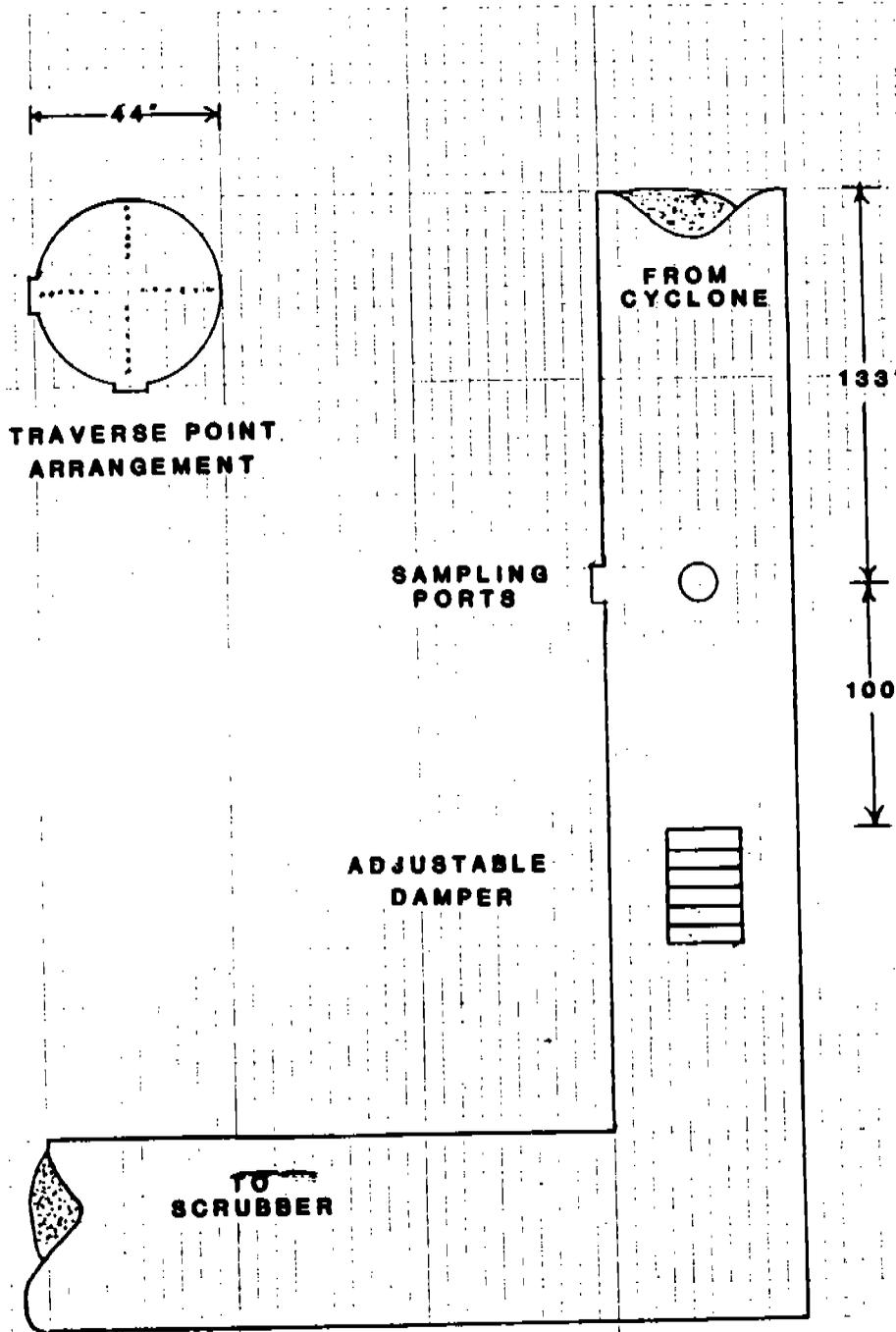


FIGURE 3.1 INLET SAMPLING SITE DETAIL

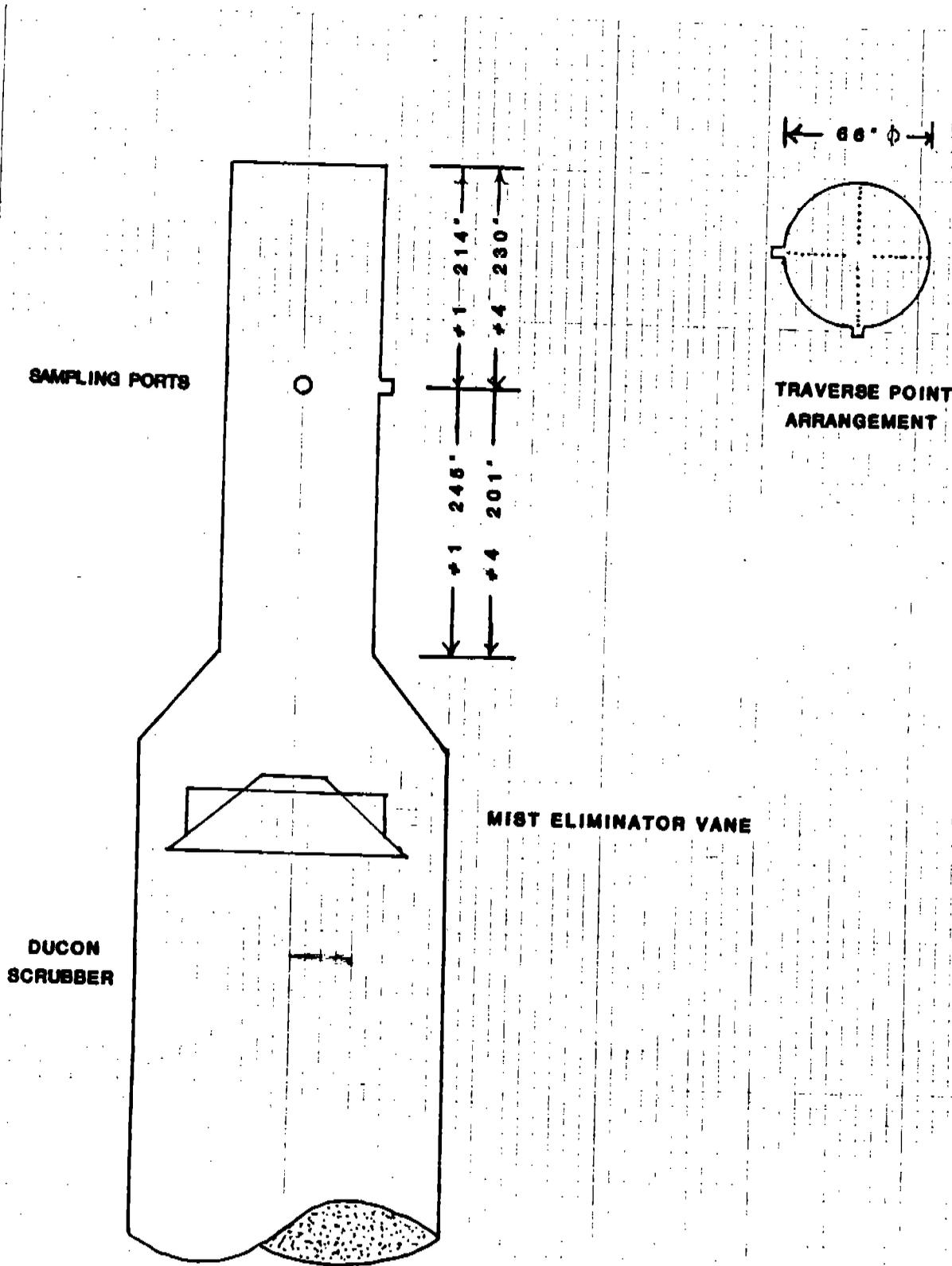


FIGURE 3.2 OUTLET SAMPLING SITE DETAIL

- d. Moisture
Moisture content was determined using USEPA Reference Method 4, "Determination of Moisture Content in Stack Gases."
- e. Particulate
Particulate emissions were determined using USEPA Reference Method 5, "Determination of Particulate Emissions From Stationary Sources." The probe and filter temperature were maintained at $248^{\circ} \pm 25$.

The "alignment approach" was used to compensate for cyclonic flow in the outlet stack. This method was published in a paper by the Texas Air Control Board which appeared in Compliance Testing Quality Assurance Procedures Workshop, Selected Papers on Particulate Sampling In Cyclonic Flow, USEPA, JULY, 1980. A copy of this paper has been included in Appendix C.

The alignment approach requires rotation of the sampling nozzle and pitot tube into the angle of flow and weighting the sampling time by the cosine of the flow angle at each traverse point. The angle of flow is established by inserting the pitot tube into the stack at each traverse point and rotating it until the null position (zero manometer deflection) is obtained. The pitot tube is then rotated 90° and the velocity pressure is measured. The angle between this position and the "normal" pitot tube alignment is the angle of flow. This angle is measured with a degree indicating level and recorded during the preliminary velocity traverse. (A copy of the preliminary traverse is included in Appendix A). Isokinetic sampling is performed by rotating the nozzle and pitot tube into the flow angle and sampling in a normal manner for the calculated sampling time.

5.0 TEST RESULTS

The process weight rates presented in Table 5.1 were determined by Mr. DeHart. The conveyor which carries product to the dryers was opened for about 20 seconds allowing the grain to drop out onto the floor. The product was recovered and weighed to the nearest pound. Two measurements were made before and after each test and the results were averaged to arrive at an average process rate expressed as pounds per hour. (Only the pre-test weights were made during the fourth test because of operating problems with the dryer at the conclusion of the test). Samples of the grain at the inlet and outlet of the dryer and also samples of the wet grain were taken and analyzed for % solids (by weight). The results of these analyses appear in Appendix D. It should be noted that no concentrate was added during the test period.

The flow rates and other stack gas conditions measured at the #1 scrubber sampling sites are summarized in Table 5.2 and Table 5.3. The flow rate measured at the outlet site was consistently greater than the flow rate at the inlet sampling site. Air flow measurements taken in cyclonic flow conditions may not be as accurate as flow measurements under laminar flow conditions and in this case the inlet air flow data may be more representative of the actual conditions in the scrubber. Some of this increased air flow could have entered the scrubber through the adjustment damper located downstream of the inlet sampling site. However, considering that the damper has weighted louvers and has an area of about one square foot when fully open, it is

TABLE 5.1 SUMMARY OF PROCESS WEIGHT RATE^a

DRYER #	RUN #	REPORTED WEIGHT (lb/hr)	AVERAGE RATE (lb/hr)
1	1	28,100/30,375/26,516/27,000	28,000
1	2	32,779/27,700/27,639/29,000	29,280
1	3	13,865/15,429/17,657/16,500	15,860
1	4	27,148/26,900	27,020
1	5	14,900/15,545/15,618/16,438	15,630

^a Refer to Appendix D for process rate certification

Table 5.2 SUMMARY OF STACK GAS CONDITIONS AT MAXIMUM OPERATING RATE

SITE/ RUN #	FLOW RATE (acfm) ^a	FLOW RATE (dscfm) ^b	TEMP. (°F)	MOISTURE %	O ₂ %	CO ₂ %
<u>INLET</u>						
1-I-1	35,564	17,157	217	37.2	15.8	3.0
1-I-2	32,399	15,157 ^{53%}	220	36.6	16.1	4.7
1-I-4	32,188	15,934	219	34.7	17.2	3.2
AVERAGE	33,383	16,083	219	36.2	16.4	3.6
<u>OUTLET</u>						
1-O-1	36,195	20,574	160	32.3	17.9	2.8
1-O-2	34,500	19,359	161	32.9	17.8	3.3
1-O-4	33,155	19,828	158	32.4	17.5	2.8
AVERAGE	34,617	19,920	160	32.5	17.7	3.0

a Actual cubic feet per minute at stack conditions

b Dry standard cubic feet per minute at 68°F and 29.92" Hg

Table 5.3 SUMMARY OF STACK GAS CONDITIONS AT NORMAL OPERATING RATE

SITE/ RUN #	FLOW RATE		TEMP. (°F)	MOISTURE %	O ₂ %	CO ₂ %
	(acfm) ^a	(dscfm) ^b				
<u>INLET</u>						
1-I-3	32,207	20,684	210	16.6	19.3	1.3
1-I-5	32,679	21,191	211	15.6	17.2	3.2
AVERAGE	32,443	20,938	211	16.1	18.3	2.3
<u>OUTLET</u>						
1-O-3	39,081	27,762	136	18.2	19.8	1.3
1-O-5	40,112	29,005	130	17.4	20.0	1.0
AVERAGE	39,597	28,384	133	17.8	19.9	1.2

^a Actual cubic feet per minute at stack conditions

^b Dry standard cubic feet per minute at 68°F and 29.92" Hg

difficult to envision the large measured air flow discrepancy entering the scrubber through this damper.

The flow rate at the scrubber inlet averaged 33,383 acfm (16,083 dscfm) at 219°F and 36.2% water vapor at the maximum process rate. The outlet data at the maximum rate showed an average flow rate of 34,617 acfm (19,920 dscfm) at 160°F and 32.5% moisture. The discrepancy between air flow measurements at the normal operating rate was even greater. At the lower process rate, the average measured air flow at the inlet was 32,443 acfm (20,938 dscfm) at 211°F and 16.1% moisture. The outlet flow rate was 39,597 acfm (28,384 dscfm) at 133°F and 17.8% moisture.

The emission rate data at the maximum process rate is presented in Table 5.4 and the data from the normal rate is summarized in Table 5.5. While operating at the maximum rate, the average particulate concentration at the inlet was 2.56 E-05 lb/dscf or a mass emission rate of 25.0 lb/hr. The particulate concentration at the outlet under these conditions was 1.59 E-05 lb/dscf or a mass rate of 19.1 lb/hr. These data represent an average removal rate of 24%.

The emission rates that were measured while operating at the normal process rate of 18,000 lb/hr show dramatic increases in the efficiency of the scrubber. At the lower rate, the inlet concentration of particulate matter averaged 9.93 E-06 lb/dscf or a mass rate of 12.5 lb/hr. The average concentration at the outlet was 1.68 E-06 lb/dscf or 2.9 lb/hr. Based on these data the scrubber removes 76.8% of the particulate. However, if the mass emission rate at the outlet is calculated on the basis of

Table 5.4 SUMMARY OF PARTICULATE EMISSIONS AT MAXIMUM OPERATING RATE

SITE RUN#	PROCESS WEIGHT (lb/hr)	CONCENTRATION (gr/dscf)	MASS EMISSION RATE (lb/hr)	ALLOWABLE EMISSION RATE (lb/hr)	EMISSION RATE (lb/hr)
<u>INLET</u>					
1-I-1	28,000	0.2022	2.89 E-05	---	29.2 27.7
1-I-2	29,280	0.1730	2.47 E-05	---	23.1
1-I-4	27,020	0.1623	2.32 E-05	---	22.2
AVERAGE	28,100	0.1792	2.56 E-05	---	25.0
<u>OUTLET</u>					
1-O-1	28,000	0.1262	1.80 E-05	24.0	22.2 a
1-O-2	29,280	0.0969	1.38 E-05	24.8	16.1 0
1-O-4	27,020	0.1105	1.58 E-05	23.5	18.8
AVERAGE	28,100	0.1112	1.59 E-05	19.1 0	4.4

^a Based on process weight: $E = 4.10 (P)^{0.67}$, where E = emission rate, lb/hr and P = process weight, T/hr

^b Based on uncontrolled emission rate: A = 0.20 U, where A = allowable emission rate, lb/hr and U = uncontrolled emission rate, lb/hr

TABLE 5.5 SUMMARY OF PARTICULATE EMISSIONS AT NORMAL OPERATING RATE

SITE RUN#	PROCESS WEIGHT (lb/hr)	CONCENTRATION (gr/dscf)	CONCENTRATION (lb/dscf)	MASS EMISSION RATE (lb/hr)	ALLOWABLE EMISSION RATE (lb/hr) ^a	EMISSION RATE (lb/hr) ^b
<u>INLET</u>						
1-I-3	15,860	0.0806	1.15 E-05	14.3	----	----
1-I-5	15,630	0.0584	8.35 E-06	10.6	----	----
AVERAGE	15,745	0.0695	9.93 E-06	12.5		
<u>OUTLET</u>						
1-O-3	15,860	0.0130	1.85 E-06	3.1	16.4	2.9
1-O-5	15,630	0.0106	1.51 E-06	2.6	16.3	2.1
AVERAGE	15,745	0.0118	1.68 E-06	2.9		

a Based on process weight: $E = 4.10 (P)^{0.67}$, where E = emission rate, lb/hr and P = process weight, T/hr

b Based on uncontrolled emission rate: A = 0.20 U, where A = allowable emission rate, lb/hr and U = uncontrolled emission rate, lb/hr

the inlet flow data then the average mass rate is 2.1 lb/hr or a scrubber efficiency of 83.2% which meets the compliance restrictions of OEPA.

The balance of this report contains the field data sheets, the laboratory data, calculations, process rate data, calibration data, and a copy of the cyclonic flow sampling procedures.

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APPENDIX A
Field Data Sheets

Client Anheuser Busch PN 85-010
 Plant _____ Source # 1 inlet
 City Columbus Run No. _____
 Operator FM

Barometric Pressure, in. Hg	P_b	<u>29.53</u>
Stack Static Pressure, in. H ₂ O	P_g	<u>-0.77</u>
Calibrated Pressure Differential Across Orifice, in. H ₂ O	ΔH_g	<u>2.3</u>
Average Meter Temperature (Ambient + 20°F), °F	T_m avg	<u>90</u>
Percent Moisture in Gas Stream by Volume	B_{wo}	<u>40</u>
Meter Pressure, in. Hg ($P_b + 0.073 \times \Delta H_g$)	P_m	<u>29.70</u>
Absolute Stack Pressure, in. Hg ($P_b \pm 0.073 P_g$)	P_s	<u>29.47</u>
Ratio of Absolute Stack Pressure to Meter Pressure	P_s/P_m	<u>0.99</u>
Average Stack Temperature, °F	T_s avg.	<u>225</u>
Average Velocity Head, in. H ₂ O	ΔP avg.	<u>0.67</u>
Maximum Velocity Head, in. H ₂ O	ΔP max.	<u>1.1</u>
C Factor		<u>0.6</u>
Calculated Nozzle Diameter, in.		<u>0.275</u>
Actual Nozzle Diameter, in.		<u>0.300</u>
Reference Δp , in. H ₂ O		<u>0.46</u>

5107 x 10 4

EMISSION TEST 6 FIELD DATA

PLANT ADHEUSER - BUSCH
 DATE 11-1-83 PN 85.010
 SAMPLING LOCATION SCRUBBER NO. 1
INLET DRYER NO. 1
 SAMPLE TYPE PART - EPA 5
 RUN NUMBER 1-I-1
 OPERATOR EM TF
 AMBIENT TEMPERATURE 73 °F
 BAROMETRIC PRESSURE 29.53 "Hg
 STATIC PRESSURE, (P_s) -0.77 "H₂O
 FILTER NUMBER (S) 5005

CO₂ 30, 2.5, 3.5
 O₂ 16.0, 16.0, 15.5

PROBE LENGTH AND TYPE 5' PYREX HEATED
 NOZZLE I.D. 0.300 STACK DIMENSIONS 44.0 φ
 ASSUMED MOISTURE, % 40
 SAMPLE BOX NUMBER _____
 METER BOX NUMBER FM-1
 PITOT TUBE NO. & C_p 0.84
 METER ΔH_a 2.30 Y 1.004 / 10
 C FACTOR 0.60 REF. ΔP 0.46
 PRE-TEST LEAK RATE 0 CFM @ 15 "Hg
 POST-TEST LEAK RATE 0.002 CFM @ 10.5 "Hg
 STACK THERMOCOUPLE _____
 OVEN THERMOCOUPLE _____
 IMPINGER THERMOCOUPLE _____

STACK DETAIL

RECORD DATA EVERY 2.5 MINUTES

Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. V _{mft} ³	Velocity Head ΔP "H ₂ O	Diff. Press. Meter Orifice ΔH "H ₂ O		Pump Vacuum "Hg	Temperatures, °F											
					Desired	Actual		Stack	Probe	Filter	Imp. Out	Meter In	Meter Out						
N-1	0	1400	797.012																
2	3.5		801.167	0.92	3.55	3.55	5.6	202	-	252	58	70	70						
3	5.0		803.287	0.90	3.50	3.50	8.2	211	-	248	58	71	70						
4	7.5		805.610	1.00	3.90	3.90	10.0	220	-	252	62	72	70						
5	10.0		807.960	1.00	3.90	3.90	8.0	220	-	249	63	74	70						
6	12.5		810.262	0.98	3.80	3.80	7.8	221	-	244	64	75	71						
7	15.0		812.509	0.92	3.55	3.55	7.4	220	-	245	65	77	71						
8	17.5		814.624	0.81	3.15	3.15	6.5	221	-	243	67	79	71						
9	20.0		816.660	0.75	2.90	2.90	6.0	220	-	247	68	80	71						
10	22.5		818.700	0.75	2.90	2.90	6.0	219	-	248	68	81	72						
11	25.0		820.717	0.73	2.85	2.85	6.0	219	-	247	69	83	71						
12	27.5		822.748	0.71	2.60	2.60	6.2	218	-	250	72	84	72						
	30.0	1430	824.682	0.67	2.60	2.60	5.4	217	-	250	68	84	72						
E-1	32.5	1448	826.123	0.42	1.35	1.35													
2	35.0		827.619	0.42	1.65	1.65	3.2	194	-	268	59	75	73						
							3.5	217	-	258	57	75	73						

Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. VMft ³	Velocity Head ΔP"H ₂ O	Diff. Press. Meter Orifice ΔH"H ₂ O		Pump Vacuum "Hg	Stack	Probe	Filter	Temperatures, °F		Meter In	Meter Out
					Desired	Actual					Imp. Out	Imp. Out		
E-3	35.0		827.619		1.65	1.65	3.8	216	-	247	56	78	73	
4	37.5		829.128	0.42	1.80	1.80	4.2	218	-	245	57	80	74	
5	40.0		830.700	0.46	1.90	1.90	4.8	219	-	252	61	81	74	
6	42.5		832.340	0.48	1.80	1.80	4.7	219	-	253	61	81	74	
7	45.0		833.947	0.46	2.40	2.40	5.4	220	-	255	63	84	75	
8	47.5		835.788	0.62	2.60	2.60	6.7	219	-	259	67	83	74	
9	50.0		837.685	0.66	2.60	2.67	7.5	220	-	261	73	84	73	
10	52.5		839.599	0.67	2.35	2.35	7.5	220	-	251	70	84	74	
11	55.0		841.445	0.60	2.15	2.15	7.0	219	-	239	71	84	74	
12	57.5		843.220	0.55	2.00	2.00	6.8	222	-	241	70	84	74	
	60.0	1518	844.962	0.52										
TOTAL	60.0		45.950	NAP 0.8151	3.65	3.65		217		250	64	79	72	
													76	

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant A-B Sample Date 11-1-83
 City COLUMBUS, OHIO Run No. 1-I-1
 Sample Recovery Person D. THOMAS Recovery Date 11-1-83
 Filter(s) No. 5005 Box 2

MOISTURE

Impinger Number

	1	2	3	4	5	Total
Weight, gm						
Final	775.0	823.6	517.3	697.5		
Initial	584.6	532.6	458.1	670.9		
Net	190.4	291.0	59.2	26.6		567.2

Color of Silica Gel USED — PINK
 Description of Particulate on Filter DARK BROWN

RECOVERED SAMPLE

Filter Container No. _____ Sealed _____

Description of Particulate on Filter _____

Acetone Rinse Container No. _____ Liquid Level Marked _____

Acetone Blank Container No. _____ Liquid Level Marked _____

Samples Stored and Locked _____

Remarks _____

Date of Laboratory Custody _____

Remarks _____

EMISSION TEST FIELD DATA

PLANT ANHEUSER - BUSCH
 DATE 11-2-83 PN 85.010
 SAMPLING LOCATION SCRUBBER NO. 1
DULET - DRYER NO. 1
 SAMPLE TYPE PART - EPAS
 RUN NUMBER 1-I-2
 OPERATOR FM
 AMBIENT TEMPERATURE 63 °F
 BAROMETRIC PRESSURE 29.46 "Hg
 STATIC PRESSURE, (P_s) -0.77 "H₂O
 FILTER NUMBER(S) 5003

PROBE LENGTH AND TYPE 5' PYREX HEATED
 NOZZLE I.D. 0.300 STACK DIMENSIONS 44.0" φ
 ASSUMED MOISTURE, % 40
 SAMPLE BOX NUMBER 2
 METER BOX NUMBER FM-1
 PIVOT TUBE NO. & C_p 0.84
 METER ΔH_a 2.27 Y 1.004
 C FACTOR 0.60 REF. ΔP 0.46
 PRE-TEST LEAK RATE 0.001 CFM @ 15.0 "Hg
 POST-TEST LEAK RATE 0.001 CFM @ 8.0 "Hg
 STACK THERMOCOUPLE
 OVEN THERMOCOUPLE
 IMPINGER THERMOCOUPLE

O₂ 16.3, 16.8, 15.3
 CO₂ 4.5, 4.6, 5.5

STACK DETAIL

Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. Vmft ³	Velocity Head AP "H ₂ O	Diff. Press. Meter Orifice ΔH "H ₂ O		Pump Vacuum "Hg	Temperatures, °F					
					Desired	Actual		Stack	Probe	Filter	Imp. Out	Meter In	Meter Out
N-1	0	0915	845.116				4.7	195	-	244	52	65	65
2	2.5		847.012	0.72	2.75	2.75	6.7	221	-	248	49	67	63
3	5.0		849.221	0.93	3.55	3.55	7.4	221	-	244	53	68	63
4	7.5		851.516	1.00	3.85	3.85	7.6	223	-	246	61	69	64
5	10.0		853.807	0.97	3.75	3.75	6.7	221	-	248	65	71	64
6	12.5		856.027	0.90	3.45	3.45	5.5	224	-	248	65	73	65
7	15.0		858.050	0.73	2.80	2.80	3.7	222	-	250	63	73	64
8	17.5		859.691	0.47	1.85	1.85	3.0	222	-	255	60	75	67
9	20.0		861.170	0.40	1.50	1.50	3.0	223	-	260	57	76	66
10	22.5		862.607	0.35	1.40	1.40	2.9	220	-	262	56	76	67
11	25.0		863.964	0.32	1.25	1.25	2.7	217	-	253	54	77	67
12	27.5		865.270	0.30	1.20	1.20	2.7	220	-	249	54	77	67
	30.0		866.475	0.25	1.00	1.00							
F-1	32.5		867.734	0.28	1.10	1.10	2.4	196	-	240	53	73	69
2	35.0		869.180	0.38	1.50	1.50	3.3	219	-	245	52	75	69

Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. V_{mfc}^3	Velocity Head ΔP "H ₂ O	Diff. Press. Meter Orifice ΔH " H ₂ O		Pump Vacuum "Hg	Stack	Temperatures, °F				
					Desired	Actual			Probe	Filter	Imp. Out	Meter In	Meter Out
E-3	35.0		869.180		1.90	1.90	4.1	222	256	53	77	69	
4	37.5		870.811	0.50	1.90	1.90	4.2	218	256	56	77	69	
5	40.0		872.485	0.50	2.00	2.00	4.3	220	247	60	79	69	
6	42.5		874.150	0.51	2.00	2.00	4.4	221	228	62	80	70	
7	45.0	* 1007/1017	875.676	0.52	2.50	2.50	5.1	227	241	58	75	71	
8	47.5		877.750	0.64	2.65	2.65	6.1	225	243	56	77	71	
9	50.0		879.721	0.68	2.80	2.80	6.2	227	256	59	77	71	
10	52.5		881.708	0.72	2.40	2.40	5.6	228	251	61	77	71	
11	55.0		883.600	0.62	2.40	2.40	5.6	226	255	63	79	72	
12	57.5		885.446	0.62	2.40	2.40	5.6	226	263	65	81	72	
	60.0	1032	887.287	0.60	2.30	2.30	5.5	224					
TOTAL	60.0	77	43.171	NAP 0.7476	2.24	2.24		220	250	58	75	68	
												712	

POLLUTION CONTROL SCIENCE, INC. * Box HEATER HOOSE STOPPED @ 11007 Restarted 1017

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant A-B Sample Date 11-1-83
 City COLUMBUS Run No. 1-I-2
 Sample Recovery Person FM Recovery Date 11-1-83
 Filter(s) No. 5003 Box 2

MOISTURE

Impinger Number

	1	2	3	4	5	Total
Weight, gm						
Final 781.3	826.8	826.8	468.8	668.8		
Initial 565.1	653.3	556.3	459.5	653.3		
Net	216.2	270.5	9.3	14.9		510.9

Color of Silica Gel 2/3 pink
 Description of Particulate on Filter gray dust

RECOVERED SAMPLE

Filter Container No. _____ Sealed _____
 Description of Particulate on Filter _____

Acetone Rinse Container No. _____ Liquid Level Marked _____

Acetone Blank Container No. _____ Liquid Level Marked _____

Samples Stored and Locked _____

Remarks _____

Date of Laboratory Custody _____

Remarks _____

EMISSION TEST; FIELD DATA

PLANT Anheuser-Busch - Columbus
 DATE 11/2/83 PN 85.010
 SAMPLING LOCATION SCRUBBER NO. 1
INLET - DRYER NO. 1
 SAMPLE TYPE PART - EPA 5
 RUN NUMBER 1-I-3
 OPERATOR FMM
 AMBIENT TEMPERATURE 71 °F
 BAROMETRIC PRESSURE 29.29 "Hg
 STATIC PRESSURE, (Ps) -0.77 "H₂O
 FILTER NUMBER(S) 5001
 PAGE 1 OF 2
 RECORD DATA EVERY 2.5 MINUTES

NORMAL LOAD 750°F

NOTE! NOMOGRAPH DATA CHANGED

O₂ 20.0, 20.0, 18.0
 CO₂ 1.0, 1.0, 2.0

PROBE LENGTH AND TYPE 5' PYREX - HEATED
 NOZZLE I.D. 0.249 ~~0.380~~ STACK DIMENSIONS YY.0 "Ø"
 ASSUMED MOISTURE, % #20
 SAMPLE BOX NUMBER 2
 METER BOX NUMBER Fm-1
 PITOT TUBE NO. & Cp 0.84
 METER ΔH_a 2.27 Y 1.004
 C FACTOR 0.1206 REF. ΔP 0.66
 PRE-TEST LEAK RATE 0.001 CFM @ 10.0 "Hg
 POST-TEST LEAK RATE 0.001 CFM @ 9.5 "Hg
 STACK THERMOCOUPLE
 OVEN THERMOCOUPLE
 IMPINGER THERMOCOUPLE

STACK DETAIL

"Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. Vmft ³	Velocity Head ΔP "H ₂ O	Diff. Press. Meter Orifice ΔH "H ₂ O		Pump Vacuum "Hg	Temperatures, °F										
					Desired	Actual		Stack	Probe	Filter	Imp. Out	Meter In	Meter Out					
E-1	0	1311	887.397															
2	2.5		888.551	0.32	0.90	0.90	1.5	212	-	253	59	73	73					
3	5.0		889.970	0.52	1.42	1.42	2.2	209	-	247	57	73	73					
4	7.5		891.437	0.52	1.42	1.42	2.2	211	-	241	53	73	73					
5	10.0	1321/1341	892.950	0.57	1.55	1.55	2.4	210	-	223	53	74	73					
6	12.5	1343.5	894.460	0.55	1.50	1.50	2.3	179	-	243	51	74	73					
7	15.0	1413	895.947	0.57	1.55	1.55	2.3	216	-	247	62	74	73					
8	17.5		897.652	0.72	2.00	2.00	3.0	213	-	261	50	74	73					
9	20.0	1418	899.457	0.80	2.20	2.20	3.3	204	-	268	49	76	73					
10	22.5		901.260	0.80	2.20	2.20	3.4	207	-	269	50	76	73					
11	25.0	1423	903.065	0.80	2.20	2.20	3.4	218	-	268	52	76	73					
12	27.5		904.805	0.72	2.00	2.00	3.1	212	-	266	54	79	73					
	30.0	1428	906.410	0.62	1.70	1.70	2.5	211	-	260	56	81	73					
		1432	907.182															
N-1	32.5			0.15	0.42	0.42	1.0	210	-	260	60	79	73					
2	35.0			0.95	2.70	2.70	4.0	210	-	259	54	81	75					

POLLUTION CONTROL SCIENCE, INC. * POST BOX HEAT DOWN 1321 - RESTRICT 1341
 † Process upset shut down @ 13.4 minutes into test - No. 0. 0. 0. test 1412

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant AB Sample Date 11-2-83
 City Columbus, OH Run No. 1-I-3
 Sample Recovery Person FM Recovery Date 11-2-83
 Filter(s) No. 5001 Box 2

MOISTURE

Impinger Number

	1	2	3	4	5	Total
Weight, gm						
Final	696.0	573.8	470.7	693.3		
Initial	573.8	554.3	468.8	684.8		
Net	122.2	19.5	1.9	8.5		152.1

Color of Silica Gel 1/3 EXPIRED

Description of Particulate on Filter _____

RECOVERED SAMPLE

Filter Container No. _____ Sealed _____

Description of Particulate on Filter _____

Acetone Rinse Container No. _____ Liquid Level Marked _____

Acetone Blank Container No. _____ Liquid Level Marked _____

Samples Stored and Locked _____

Remarks _____

Date of Laboratory Custody _____

Remarks _____

Client AB PN 85.010
 Plant Columbus Source SCRUBBER NO.1 INLET
 City Columbus, OH Run No. 1-I-4
 Operator F. Meadows

Barometric Pressure, in. Hg	P_b	<u>29.25</u>
Stack Static Pressure, in. H ₂ O	P_g	<u>-0.77</u>
Calibrated Pressure Differential Across Orifice, in. H ₂ O	ΔH_g	<u>2.27</u>
Average Meter Temperature (Ambient + 20°F), °F	T_m avg	<u>75</u>
Percent Moisture in Gas Stream by Volume	B_{wo}	<u>36</u>
Meter Pressure, in. Hg ($P_b + 0.073 \times \Delta H_g$)	P_m	<u>29.42</u>
Absolute Stack Pressure, in. Hg ($P_b \pm 0.073 P_g$)	P_s	<u>29.19</u>
Ratio of Absolute Stack Pressure to Meter Pressure	P_s/P_m	<u>0.992</u>
Average Stack Temperature, °F	T_s avg.	<u>220</u>
Average Velocity Head, in. H ₂ O	ΔP avg.	<u>.7</u>
Maximum Velocity Head, in. H ₂ O	ΔP max.	<u>0.63</u>
C Factor		<u>0.30</u>
Calculated Nozzle Diameter, in.		<u>0.43</u>
Actual Nozzle Diameter, in.		
Reference Δp , in. H ₂ O		

EMISSION TEST FIELD DATA

PLANT AMHEUSER-BUSCH, INC
 DATE 11-3-82 PN FS.010
 SAMPLING LOCATION SCRUBBER NO. 1
INLET - GRAIN DRYER NO. 1
 SAMPLE TYPE PART - EPA 5
 RUN NUMBER 1-I-4
 OPERATOR FM
 AMBIENT TEMPERATURE 63 °F
 BAROMETRIC PRESSURE 29.25 "Hg
 STATIC PRESSURE, (Ps) -0.77 "H₂O
 FILTER NUMBER(S) 5013
 PAGE 1 OF 2
 RECORD DATA EVERY 2.5 MINUTES

O₂ 17.5, 17.0, 17.0
 CO₂ 3.0, 3.0, 3.5

PROBE LENGTH AND TYPE 5' PYLEX - HEATED
 NOZZLE I.D. .300 STACK DIMENSIONS 44.0" Ø
 ASSUMED MOISTURE, % 36
 SAMPLE BOX NUMBER 2
 METER BOX NUMBER FM-1
 PITOT TUBE NO. & Cp 0.84
 METER ΔH_a 2.27 γ 1.004
 C FACTOR 0.63 REF. ΔP 0.43
 PRE-TEST LEAK RATE 0.001 CFM @ 12.0 "Hg
 POST-TEST LEAK RATE 0.001 CFM @ 10.0 "Hg
 STACK THERMOCOUPLE
 OVEN THERMOCOUPLE
 IMPINGER THERMOCOUPLE

STACK DETAIL

Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. Vmft ³	Velocity Head ΔP "H ₂ O	Diff. Press. Meter Orifice ΔH "H ₂ O		Pump Vacuum "Hg	Temperatures, °F					
					Desired	Actual		Stack	Probe	Filter	Imp. Out	Meter In	Meter Out
N-1	0	0839	984.678	0.23	0.96	0.96	1.5	214	-	255	55	64	64
2	2.5		925.870	0.93	3.90	3.90	7.0	214	-	246	49	64	64
3	5.0		928.152	1.05	4.40	4.40	9.2	220	-	248	47	66	64
4	7.5		930.661	1.05	4.40	4.40	9.3	220	-	249	50	67	64
5	10.0	0855	933.200	0.97	4.10	4.10	8.3	220	-	249	55	68	64
6	12.5		935.660	0.80	3.40	3.40	6.9	221	-	249	59	69	64
7	15.0	0900	937.896	0.48	2.05	2.05	4.3	220	-	249	59	70	64
8	17.5		939.681	0.40	1.70	1.70	3.6	222	-	247	58	70	64
9	20.0	0905	941.283	0.40	1.55	1.55	3.4	221	-	247	59	72	64
10	22.5		942.820	0.37	1.40	1.40	3.1	219	-	248	59	73	65
11	25.0	0910	944.272	0.33	1.25	1.25	2.8	219	-	249	61	73	65
12	27.5		945.637	0.30	1.15	1.15	2.7	219	-	248	63	73	65
	30.0	0915	946.931	0.27	1.15	1.15	2.7	219	-	248	63	73	65
		0926	-	-	-	-	-	-	-	-	-	-	-
E-1	32.5		948.270	0.30	1.25	1.25	2.8	202	-	249	64	68	66
2	35.0	0931	949.774	0.37	1.55	1.55	3.5	214	-	250	66	69	65

* STOPPED DUE TO RAIN

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant Anheuser Busch Sample Date 11-3-83
 City Columbus, OH Run No. 1-I-4
 Sample Recovery Person FM Recovery Date 11-3-83
 Filter(s) No. 50B BOX 2 (INLET)

MOISTURE

Impinger Number

	1	2	3	4	5	Total
Weight, gm						
Final	777.2	763.3	481.9	708.7		
Initial	569.4	514.4	470.7	686.7		
Net	207.8	248.9	11.2	22.0		489.9

Color of Silica Gel 1/2 EXPIRED
 Description of Particulate on Filter _____

RECOVERED SAMPLE

Filter Container No. _____ Sealed _____
 Description of Particulate on Filter _____

Acetone Rinse Container No. _____ Liquid Level Marked _____

Acetone Blank Container No. _____ Liquid Level Marked _____

Samples Stored and Locked _____

Remarks _____

Date of Laboratory Custody _____

Remarks _____

Client Anheuser Busch PN 85,010
 Plant _____ Source #1 Inlet
 City Columbus Run No. 1-I-5
 Operator F. MEADOWS

Barometric Pressure, in. Hg	P_b	<u>29.30</u>
Stack Static Pressure, in. H ₂ O	P_g	<u>-0.77</u>
Calibrated Pressure Differential Across Orifice, in. H ₂ O	ΔH_e	<u>2.27</u>
Average Meter Temperature (Ambient + 20°F), °F	T_m avg	<u>75</u>
Percent Moisture in Gas Stream by Volume	B_{wo}	<u>16</u>
Meter Pressure, in. Hg ($P_b + 0.073 \times \Delta H_e$)	P_m	<u>29.47</u>
Absolute Stack Pressure, in. Hg ($P_b \pm 0.073 P_g$)	P_s	<u>29.24</u>
Ratio of Absolute Stack Pressure to Meter Pressure	P_s/P_m	<u>0.99</u>
Average Stack Temperature, °F	T_s avg.	<u>220</u>
Average Velocity Head, in. H ₂ O	ΔP avg.	<u>0.7</u>
Maximum Velocity Head, in. H ₂ O	ΔP max.	<u>1.02</u>
C Factor		<u>0.249</u>
Calculated Nozzle Diameter, in.		<u>0.60</u>
Actual Nozzle Diameter, in.		
Reference Δp , in. H ₂ O		

EMISSION TEST FIELD DATA

PLANT ANITEUSOR - BUSCH, PUC
 DATE 11-3-83 PN 85.010
 SAMPLING LOCATION SCRUBBER NO. 1
INLET - DRYER NO. 1
 SAMPLE TYPE PART - EPA 5
 RUN NUMBER 1-I-5
 OPERATOR FM
 AMBIENT TEMPERATURE 59 °F
 BAROMETRIC PRESSURE 29.30 Hg
 STATIC PRESSURE, (P_s) -0.77 "H₂O
 FILTER NUMBER(S) 5014

NORM LOAD 750°F
 CO₂ 3.0, 3.0, 3.5
 O₂ 17.5, 17.0, 17.0

PROBE LENGTH AND TYPE 5' PYREX-HEATED
 NOZZLE I.D. 0.249 STACK DIMENSIONS 44.0" x
 ASSUMED MOISTURE, % 16
 SAMPLE BOX NUMBER 2
 METER BOX NUMBER FM-1
 PITOT TUBE NO. & Cp 0.84
 METER ΔH_a 2.27 Y 1.00Y
 C FACTOR 1.02 REF. ΔP 0.60
 PRE-TEST LEAK RATE 0 CFM @ 15.0 "Hg
 POST-TEST LEAK RATE 0 CFM @ 10.0 "Hg
 STACK THERMOCOUPLE

PAGE 1 OF 2
 RECORD DATA EVERY 2.5 MINUTES

STACK DETAIL

OVEN THERMOCOUPLE
 IMPINGER THERMOCOUPLE

Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. V _{mft} ³	Velocity Head ΔP "H ₂ O	Diff. Press. Meter Orifice ΔH "H ₂ O		Pump Vacuum "Hg	Temperatures, °F					
					Desired	Actual		Stack	Probe	Filter	Imp. Out	Meter In	Meter Out
5-1	0	12 23	968.713	0.30	0.92	0.92	1.8	191	-	252	57	60	59
2	4.5	12 28	969.882	0.48	1.45	1.45	2.8	209	-	251	53	60	59
3	7.5	12 33	972.813	0.52	1.45	1.45	3.0	218	-	250	52	61	59
4	10.0	12 33	974.343	0.60	1.60	1.60	3.2	207	-	247	49	61	59
5	12.5	12 38	975.967	0.50	1.80	1.80	3.6	222	-	251	50	61	59
6	15.0	12 43	977.482	0.72	1.52	1.52	2.3	221	-	251	52	62	59
7	17.5	12 43	979.262	0.80	2.20	2.20	4.5	206	-	254	51	62	59
8	20.0	12 48	981.170	0.80	2.50	2.50	5.1	220	-	256	51	63	59
9	22.5	12 48	983.100	0.78	2.50	2.50	5.2	219	-	251	52	63	59
10	25.0	13 03	984.980	0.70	2.40	2.40	5.1	206	-	249	52	63	59
11	27.5	13 03	986.747	0.63	2.10	2.10	4.5	215	-	245	52	64	60
12	30.0	13 00	988.429	-	1.90	1.90	4.2	216	-	246	52	64	60
N-1	32.5	13 05	989.980	0.53	-	-	-	-	-	-	-	-	-
2	35.0	13 05	992.040	1.05	1.62	1.62	3.5	208	-	236	50	62	60
					3.20	3.20	6.6	211	-	238	49	62	60

Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. V _{mft} ³	Velocity Head ΔP"H ₂ O	Diff. Press. Meter Orifice ΔH" H ₂ O		Pump Vacuum "Hg	Stack	Temperatures, °F				
					Desired	Actual			Probe	Filter	Imp. Out	Meter In	Meter Out
N-3	35.0	1305	992.040	1.05	3.20	3.20	6.8	212	247	50	62	60	
4	37.5	1310	994.300	1.05	3.20	3.20	6.8	212	255	52	63	60	
5	40.0	1315	996.352	1.00	3.05	3.05	6.5	212	251	54	63	60	
6	42.5	1315	998.454	0.88	2.70	2.70	5.8	210	241	55	63	60	
7	45.0	1315	1000.437	0.53	1.60	1.60	3.8	213	259	56	63	60	
8	47.5	1320	1002.005	0.45	1.35	1.35	3.4	214	252	56	63	60	
9	50.0	1320	1003.437	0.43	1.30	1.30	3.3	208	249	56	63	60	
10	52.5	1325	1004.833	0.40	1.20	1.20	3.0	207	257	57	63	61	
11	55.0	1325	1006.162	0.35	1.05	1.05	2.9	207	260	58	63	61	
12	57.5	1330	1007.412	0.30	0.90	0.90	2.5	207	261	58	63	61	
	60.0		1008.573										
DIAL	60.0		39.860 ✓	NOT	1.95 ✓	1.95 ✓		211	250	53	62	60	

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant Anheuser-Busch, Inc Sample Date 11-3-83
 City Columbus, OH Run No. 1-I-5
 Sample Recovery Person FM Recovery Date 11-3-83
 Filter(s) No. 5014 Box 2 (JULET)

MOISTURE

Impinger Number

	1	2	3	4	5	Total
Weight, gm						
Final	708.2	561.0	484.4	702.6		
Initial 586.0	542.1	542.1	481.9	689.0		
Net	122.2	18.9	2.5	13.6		157.2

Color of Silica Gel 1/3 EXPIRED
 Description of Particulate on Filter TAN - SOME LARGE FRAGMENTS

RECOVERED SAMPLE

Filter Container No. _____ Sealed _____
 Description of Particulate on Filter _____

Acetone Rinse Container No. _____ Liquid Level Marked _____

Acetone Blank Container No. _____ Liquid Level Marked _____

Samples Stored and Locked _____

Remarks _____

Date of Laboratory Custody _____

Remarks _____

SCRUBBER #1 OUTLET - MEASURED ANGLE OF FLOW AND WEIGHTED SAMPLING TIME

PORT/ TRAVERSE POINT	ANGLE OF FLOW	COSINE	SAMPLING TIME (Cosine x 6.0 min)
<u>SOUTHWEST PORT</u>			
1	C 55°	0.574	3.4
2	C 55°	0.574	3.4
3	C 45°	0.707	4.2
4	C 50°	0.643	3.9
5	> 90°	N/A	0
6	> 90°	N/A	0
7	CC 80°	0.174	1.0
8	CC 65°	0.423	2.5
9	CC 65°	0.423	2.5
10	CC 60°	0.500	3.0
11	CC 55°	0.574	3.4
12	CC 55°	0.574	3.4

SCRUBBER #1 OUTLET - MEASURED ANGLE OF FLOW AND WEIGHTED SAMPLING TIME (cont)

PORT/ TRAVERSE POINT	ANGLE OF FLOW	COSINE	SAMPLING TIME (Cosine x 6.0 min)
<u>SOUTHEAST PORT</u>			
1	C 25°	0.906	5.4
2	C 35°	0.819	4.9
3	C 40°	0.766	4.6
4	C 45°	0.707	4.2
5	C 50°	0.643	3.9
6	C >90°	N/A	N/A
7	C >90°	N/A	N/A
8	CC 80°	0.174	1.0
9	CC 70°	0.342	2.1
10	CC 65°	0.423	2.5
11	CC 60°	0.500	3.0
12	CC 60°	0.500	3.0

Client Anheuser Busch PN 85-010
 Plant _____ Source # 1 outlet
 City Columbus Run No. 1-0-1
 Operator CS

Barometric Pressure, in. Hg	P_b	<u>29.53</u>
Stack Static Pressure, in. H ₂ O	P_g	<u>- 0.54</u>
Calibrated Pressure Differential Across Orifice, in. H ₂ O	ΔH_g	<u>1.7</u>
Average Meter Temperature (Ambient + 20°F), °F	T_m avg	<u>90</u>
Percent Moisture in Gas Stream by Volume	B_{wo}	<u>28%</u>
Meter Pressure, in. Hg ($P_b + 0.073 \times \Delta H_g$)	P_m	<u>29.66</u>
Absolute Stack Pressure, in. Hg ($P_b \pm 0.073 P_g$)	P_s	<u>29.49</u>
Ratio of Absolute Stack Pressure to Meter Pressure	P_s/P_m	<u>0.99</u>
Average Stack Temperature, °F	$T_{s\text{ avg.}}$	<u>160</u>
Average Velocity Head, in. H ₂ O	$\Delta P_{\text{ avg.}}$	<u>0.7</u>
Maximum Velocity Head, in. H ₂ O	$\Delta P_{\text{ max.}}$	<u>0.9</u>
C Factor		<u>0.6</u>
Calculated Nozzle Diameter, in.		<u>0.27</u>
Actual Nozzle Diameter, in.		<u>0.302</u>
Reference Δp , in. H ₂ O		<u>0.40</u>

EMISSION TEST FIELD DATA

PLANT Amhansen - Busch
 DATE 11/1/83 PN 85-010
 SAMPLING LOCATION # 1 Outlet
 SAMPLE TYPE Method 5
 RUN NUMBER 1-0-1
 OPERATOR CJ DT
 AMBIENT TEMPERATURE 55 °F
 BAROMETRIC PRESSURE 29.53 Hg
 STATIC PRESSURE, (P_s) -0.13 "H₂O
 FILTER NUMBER(S) 5017

PROBE LENGTH AND TYPE 8' Inconel
 NOZZLE I.D. 0.502 STACK DIMENSIONS 66" φ
 ASSUMED MOISTURE, % 28
 SAMPLE BOX NUMBER 3
 METER BOX NUMBER J-1
 PITOT TUBE NO. & C_p 0.84
 METER ΔH_a 1.7 Y 0.999
 C FACTOR 0.6 REF. ΔP 0.4
 PRE-TEST LEAK RATE 0.010 CFM @ 10 "Hg
 POST-TEST LEAK RATE 0.006 CFM @ 15 "Hg
 STACK THERMOCOUPLE

(HIGH TEMP. CONDITION)
 O₂ → 18%, 17.75%
 CO₂ → 2.5%, 3.0

OVEN THERMOCOUPLE 0.3
 IMPINGER THERMOCOUPLE I-3

STACK DETAIL

PAGE 1 OF 2 MINUTES

"Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. Vmft ³	Velocity Head ΔP "H ₂ O	Diff. Press. Meter Orifice ΔH "H ₂ O		Pump Vacuum "Hg	Temperatures, °F					
					Desired	Actual		Stack	Probe	Filter	Imp. Out	Meter In	Meter Out
SW-1	0	1400	34.195	0.43	2.0	2.0	2.0	159	100%	232	55	78	78
2	3.4	3.4	34.723	0.55	2.6	2.6	3.5	160		225	53	78	78
3	4.2	1411	42.558	0.63	2.8	2.8	5.0	160		224	60	80	78
4	3.9	14.9	47.165	0.63	2.8	2.8	5.0	160		258	60	78	78
5	-	-	-	-	-	-	-	-		-	-	-	-
6	-	-	-	-	-	-	-	-		-	-	-	-
7	1.0	15.9	47.869	0.25	1.2	1.2	2.0	160		251	63	79	78
8	2.5	17.4	48.800	0.28	1.3	1.3	2.0	160		250	61	80	78
9	2.5	20.9	51.200	0.32	1.3	1.3	3.0	160		249	60	80	78
10	3.0	22.9	52.230	0.28	1.3	1.3	4.0	161		235	60	80	78
11	3.4	27.3	55.600	0.24	1.6	1.6	4.0	141		246	65	81	78
12	3.4	30.7	58.315	0.44	2.1	2.1	4.5	160		240	66	83	78

1411 STOP - OVEN HEAT DOWN

Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. Vmft ³	Velocity Head ΔP" H ₂ O	Diff. Press. Meter Orifice ΔH" H ₂ O		Pump Vacuum "Hg	Stack	Probe	Filter	Temperatures, °F		Meter In	Meter Out
					Desired	Actual					Imp. Out	Out		
SE-1	5.4	36.1	61.803	0.30	1.4	1.4	2.0	160	100%	243	65	80	78	
2	4.9	41.0	66.520	0.65	3.0	3.0	6.0	162		240	63	81	78	
3	4.6	45.6	70.950	0.64	2.9	2.9	7.5	163		228	62	82	79	
4	4.2	49.8	74.700	0.63	2.8	2.8	8.0	163		226	63	82	79	
5	3.9	53.7	78.300	0.57	2.6	2.6	8.0	169		230	63	85	80	
6	-	-	-	-	-	-	-	-	-	-	-	-	-	
7	-	-	-	-	-	-	-	-	-	-	-	-	-	
8	1.0	54.7	79.210	0.63	2.8	2.8	8.0	160		230	64	85	80	
9	2.1	56.8	81.391	0.73	3.5	3.5	9.0	161		228	65	85	80	
10	2.5	57.3	84.210	0.82	3.8	3.8	10.0	151		229	66	85	80	
11	3.0	62.3	87.325	0.73	3.5	3.5	6.0	157		235	66	85	80	
12	3.0	65.3	90.256	0.64	3.0	3.0	6.0	157	✓	239	65	85	80	
20	65.3	76	56.061	0.117	2.43	2.43		160	✓					
				orc				620		237	62	80	540	

Checked 11/24/83 JH

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant A-13 Sample Date 11-1-83
 City COLUMBUS, OHIO Run No. 1-0-1
 Sample Recovery Person _____ Recovery Date 11/1/83
 Filter(s) No. 5017 BOX 3

MOISTURE

Impinger Number

	1	2	3	4	5	Total
Weight, gm						
Final	791.6	834.7	516.5	642.0		
Initial	573.4	591.9	446.9	66 622.4		
Net	218.2	242.8	69.6	19.6		550. ✓

Color of Silica Gel USED
 Description of Particulate on Filter DARK BROWN

RECOVERED SAMPLE

Filter Container No. _____ Sealed _____
 Description of Particulate on Filter _____

Acetone Rinse Container No. _____ Liquid Level Marked yes

Acetone Blank Container No. _____ Liquid Level Marked _____

Samples Stored and Locked _____

Remarks _____

Date of Laboratory Custody _____

Remarks checked 11/22/83 JB

Client Anheuser-Busch PN 85-010
 Plant Source #1 OUTLET
 City Columbus, OH Run No. 1-0-2
 Operator Craig Jones

Barometric Pressure, in. Hg	P_b	<u>29.29</u>
Stack Static Pressure, in. H ₂ O	P_g	<u>-0.33</u>
Calibrated Pressure Differential Across Orifice, in. H ₂ O	ΔH_g	<u>1.7</u>
Average Meter Temperature (Ambient + 20°F), °F	T_m avg	<u>85</u>
Percent Moisture in Gas Stream by Volume	B_{wo}	<u>32%</u>
Meter Pressure, in. Hg ($P_b + 0.073 \times \Delta H_g$)	P_m	<u>29.42</u>
Absolute Stack Pressure, in. Hg ($P_b \pm 0.073 P_g$)	P_s	<u>29.27</u>
Ratio of Absolute Stack Pressure to Meter Pressure	P_s/P_m	<u>0.99</u>
Average Stack Temperature, °F	T_s avg.	<u>160</u>
Average Velocity Head, in. H ₂ O	$\Delta P_{avg.}$	<u>0.65</u>
Maximum Velocity Head, in. H ₂ O	$\Delta P_{max.}$	<u>0.84</u>
C Factor		<u>0.56</u>
Calculated Nozzle Diameter, in.		<u>0.27</u>
Actual Nozzle Diameter, in.		<u>0.302</u>
Reference Δp , in. H ₂ O		<u>0.44</u>

Pollution Control Science, Inc.

8015 Manning Road, Miamisburg, Ohio 45342

(513) 866-5808/TLX 288-348

EMISSION TESTING FIELD DATA

PLANT A-B
 DATE 11/2/83 PN 85-010
 SAMPLING LOCATION # 1 outlet
 SAMPLE TYPE Method 5
 RUN NUMBER 1-0-2
 OPERATOR CJ DT
 AMBIENT TEMPERATURE 55 °F
 BAROMETRIC PRESSURE 29.46 "Hg
 STATIC PRESSURE, (P_s) -0.35 "H₂O
 FILTER NUMBER(S) 5004

PROBE LENGTH AND TYPE 8' inconnel
 NOZZLE I.D. 0.30 STACK DIMENSIONS 66" d
 ASSUMED MOISTURE, % 32%
 SAMPLE BOX NUMBER 3
 METER BOX NUMBER J-1
 PITOT TUBE NO. & C_p 0.84
 METER ΔH_a 1.7 Y 0.999
 C FACTOR 0.56 REF. ΔP 0.44
 PRE-TEST LEAK RATE 0.019 CFM @ 15 "Hg
 POST-TEST LEAK RATE 0.009 CFM @ 11 "Hg
 STACK THERMOCOUPLE
 OVEN THERMOCOUPLE 0-3
 IMPINGER THERMOCOUPLE J-3

(HIGH TEMP. CONDITION)
 O₂ 18%, 17 1/2
 CO₂ 3%, 3 1/2

STACK DETAIL

PAGE 1 OF 2
 RECORD DATA EVERY ~ MINUTES

Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. V _{mft} ³	Velocity Head ΔP "H ₂ O	Diff. Press. Meter Orifice ΔH "H ₂ O		Pump Vacuum "Hg	Temperatures, °F										
					Desired	Actual		Stack	Probe	Filter	Imp. Out	Meter In	Meter Out					
	0	0915	90.657															
SW-1	34	34	93.030	0.38	1.6	1.6	2.5	161	100%	270	54	65	65					
2	24	6.8	95.720	0.53	2.1	2.1	4.0	159		250	52	67	65					
3	4.2	11.0	99.345	0.62	2.5	2.5	5.5	141		252	57	70	65					
4	3.9	14.9	102.932	0.64	2.6	2.6	5.5	159		264	58	72	65					
5	-	-	-	-	-	-	-	-		-	-	-	-					
6	-	-	-	-	-	-	-	-		-	-	-	-					
7	1.0	15.9	103.665	0.46	1.9	1.9	4.0	161		259	56	72	65					
8	2.5	18.4	105.720	0.57	2.3	2.3	5.5	159		260	58	72	65					
9	2.5	20.9	107.875	0.55	2.3	2.3	5.5	161		259	59	72	65					
10	3.0	23.9	110.000	0.40	1.6	1.6	4.0	159		260	59	72	65					
11	5.8	27.3	112.420	0.38	1.6	1.6	4.0	159		259	59	73	66					
12	3.4	30.7	114.800	0.38	1.6	1.6	4.0	160	✓	256	58	75	67					

Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. V _{mf} 3	Velocity Head ΔP"H ₂ O	Diff. Press. Meter Orifice ΔH"H ₂ O		Pump Vacuum "Hg	Stack	Probe	Filter	Temperatures, °F		Meter In	Meter Out
					Desired	Actual					Imp. Out	Imp. In		
1	54	26.1	118.140	0.32	1.3	1.3	3.0	163	100%	270	53	70	68	
2	49	41.0	122.245	0.58	2.3	2.3	5.0	158		260	53	74	68	
3	46	45.6	126.350	0.60	2.2	2.5	6.5	159		252	57	75	69	
4	42	49.8	130.090	0.62	2.5	2.5	6.5	162		248	60	75	69	
5	39	52.7	134.489	0.62	2.5	2.5	7.0	161		247	62	78	76	
6	-	-	-	-	-	-	-	-		-	-	-	-	
7	-	-	-	-	-	-	-	-		-	-	-	-	
8	10	54.7	134.100	0.29	1.2	1.2	4.0	162		244	62	78	70	
9	21	56.8	135.370	0.30	1.2	1.2	4.0	161		244	62	78	70	
10	25	59.2	137.300	0.47	2.0	2.0	2.5	161		256	63	80	71	
11	30	62.3	139.410	0.36	1.5	1.5	5.5	163		255	64	80	71	
12	30	65.3	141.242	0.30	1.2	1.2	4.5	163	↓	249	66	90	71	
20	65.3	80 min	50.585	0.678	1.92	1.92		161°F		256°	59°	71°F	531°F	

55p
6210R

checked 11/2/83 M

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant A-13 Sample Date 11-2-83
 City COLUMBUS, OHIO Run No. 8 1-0-2
 Sample Recovery Person FM Recovery Date 11-2-83
 Filter(s) No. 5004 Box 3

MOISTURE

Impinger Number

	1	2	3	4	5	Total
Weight, gm			(496.0)			
Final	833.8	794.7	460.3	686.2		
Initial	561.8	582.6	448.4	665.5		
Net	272.0	212.1	11.9	20.7		516.7

Color of Silica Gel 3/4 spent
 Description of Particulate on Filter BLACK

RECOVERED SAMPLE

Filter Container No. _____ Sealed _____
 Description of Particulate on Filter _____

Acetone Rinse Container No. _____ Liquid Level Marked _____

Acetone Blank Container No. _____ Liquid Level Marked _____

Samples Stored and Locked _____

Remarks _____

Date of Laboratory Custody _____

Remarks _____

checked 11/22/83 JB

EMISSION TEST FIELD DATA

PLANT Amherster-Busch
 DATE 11/2/83 PN 85-010
 SAMPLING LOCATION # 1 outlet
 SAMPLE TYPE Method 5
 RUN NUMBER 1-0-3 (750')
 OPERATOR CJ DT
 AMBIENT TEMPERATURE 60 °F
 BAROMETRIC PRESSURE 29.29 "Hg
 STATIC PRESSURE, (Ps) -0.30 "H₂O
 FILTER NUMBER(S) 5002
 PAGE 1 OF 2 J.
 RECORD DATA EVERY ~ MINUTES

C = 0.74
 T_s = 140
 D_e = 0.25
 D_s = ~~0.25~~ 0.245
 Ref ΔP = ~~0.32~~ 0.75
 O₂ 19.5%, 20.0
 CO₂ 1 1/2%, 1.0
 (Low temp. condition)

PROBE LENGTH AND TYPE 8' inconnel
 NOZZLE I.D. 0.245 STACK DIMENSIONS 66" φ
 ASSUMED MOISTURE, % 18%
 SAMPLE BOX NUMBER 3
 METER BOX NUMBER J-1
 PITOT TUBE NO. & Cp 0.84
 METER ΔH_a 1.7 Y 0.999
 C FACTOR 0.74 REF. ΔP 0.75
 PRE-TEST LEAK RATE 0.005 CFM @ 12 "Hg
 POST-TEST LEAK RATE 0.012 CFM @ 19 "Hg
 STACK THERMOCOUPLE
 OVEN THERMOCOUPLE 0-3
 IMPINGER THERMOCOUPLE J-3

STACK DETAIL

Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. Vmft ³	Velocity Head ΔP "H ₂ O	Diff. Press. Meter Orifice ΔH "H ₂ O		Pump Vacuum "Hg	Temperatures, °F										
					Desired	Actual		Stack	Probe	Filter	Imp. Out	Meter In	Meter Out					
561	0	1314	142.657															
1	3.4	3.4	144.880	0.65 (0.3)	1.4	1.7	5.5	139	100%	240	54	71	71					
2	3.4	6.8	147.090	0.58	1.4	1.4	5.5	135		252	56	72	71					
3	4.2	11.0	150.060	0.65	1.6	1.6	6.0	135		261	55	75	71					
4	3.9	14.9	152.950	0.68	1.7	1.7	7.0	136		247	57	76	71					
5	-	-	-	0.2	-	-	-	-		-	-	-	-					
6	-	-	-	-	-	-	-	-		-	-	-	-					
7	1.0	15.4	153.600	0.52	1.3	1.3	6.0	139		252	58	75	72					
8	2.5	18.4	155.283	0.63	1.5	1.5	6.0	139		251	56	77	71					
9	2.5	20.9	157.200	0.81	2.0	2.0	7.0	136		224	55	72	72					
10	3.0	23.9	159.415	0.73	1.8	1.8	7.0	133		234	52	73	72					
11	3.4	27.3	161.940	0.69	1.7	1.7	7.2	135		248	53	75	72					
12	3.4	30.7	164.292	0.60	1.5	1.5	6.5	133	↓	246	57	75	72					

PROCESS stream @ ~~1345~~ 1345

POLLUTION CONTROL SCIENCE, INC. RE-START @ 1416

Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. Vmft ³	Velocity Head ΔP"H ₂ O	Diff. Press. Meter Orifice ΔH" H ₂ O		Pump Vacuum "Hg	Stack	Probe	Filter	Temperatures, °F		Meter In	Meter Out
					Desired	Actual					Imp. Out	Imp. In		
SE-1	36.1	1432	167.430	0.46	1.1	1.1	5.0	128	100%	270	54	76	73	
2	4.9		170.800	0.59	1.5	1.5	6.0	133		252	53	80	75	
3	4.6		172.995	0.65	1.6	1.6	6.5	122		274	53	81	75	
4	4.2		177.075	0.70	1.7	1.7	7.0	137		267	54	82	75	
5	34		179.908	0.68	1.7	1.7	7.0	138		269	55	81	75	
6	-		-	-	-	-	-	-	-	-	-	-	-	
7	-		-	-	-	-	-	-	-	-	-	-	-	
8	1.0		180.600	0.58	1.4	1.4	6.0	142	100%	270	56	80	75	
9	2.1		182.800	0.68	1.7	1.7	7.0	144		260	57	80	75	
10	25		184.315	0.77	1.9	1.9	8.0	137		262	56	80	75	
11	30		186.310	0.75	1.9	1.9	8.0	138		254	57	80	75	
12	30	1507	188.517	0.67	1.7	1.7	7.5	139		254	58	80	75	
20	65.3	113	45.860	0.804	1.61	1.61		136°F		254	55	75	75°F	

596°R

Checked 11/2/83

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant AB Sample Date 11-2-83
 City COLUMBUS Run No. 1-0-3
 Sample Recovery Person FM Recovery Date 11/2/83
 Filter(s) No. 5002 Box 3

MOISTURE

Impinger Number

	1	2	3	4	5	Total
Weight, gm						
Final	711.0	580.8	462.8	720.0		
Initial	541.1	558.2	460.3	708.2		
Net	169.9	22.6	2.5	11.8		206.8

Color of Silica Gel 1/3 EXPIRED

Description of Particulate on Filter BROWN-YELLOW DUST

RECOVERED SAMPLE

Filter Container No. _____ Sealed _____

Description of Particulate on Filter _____

Acetone Rinse Container No. _____ Liquid Level Marked _____

Acetone Blank Container No. _____ Liquid Level Marked _____

Samples Stored and Locked _____

Remarks _____

Date of Laboratory Custody _____

Remarks _____

Checked 11/2/83 FM

EMISSION TEST. FIELD DATA

PLANT Anderson-Busch
 DATE 11/3/83 PN 85-010
 SAMPLING LOCATION # 1 Outlet
 SAMPLE TYPE Method 5
 RUN NUMBER 1-0-4 (High Load)
 OPERATOR CS DT
 AMBIENT TEMPERATURE 60 °F
 BAROMETRIC PRESSURE 29.25 Hg
 STATIC PRESSURE, (P_s) -0.30 "H₂O
 FILTER NUMBER(S) 5012

PROBE LENGTH AND TYPE 8' inconnel
 NOZZLE I.D. 0.302 STACK DIMENSIONS 66" φ
 ASSUMED MOISTURE, % 30%
 SAMPLE BOX NUMBER 3
 METER BOX NUMBER J-1
 PIVOT TUBE NO. & Cp 0.84
 METER ΔH_a 1.17 Y 0.999
 C FACTOR 0.54 REF. ΔP 0.44
 PRE-TEST LEAK RATE 0.010 CFM @ 20 "Hg
 POST-TEST LEAK RATE 0.004 CFM @ 18 "Hg
 STACK THERMOCOUPLE
 OVEN THERMOCOUPLE 0-3
 IMPINGER THERMOCOUPLE I-3

O₂ 17 1/2
 CO₂ 2 1/2

STACK DETAIL

PAGE 1 OF 2
 RECORD DATA EVERY - MINUTES

Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. Vmft ³	Velocity Head ΔP "H ₂ O	Diff. Press. Meter Orifice ΔH "H ₂ O		Pump Vacuum "Hg	Temperatures, °F											
					Desired	Actual		Stack	Probe	Filter	Imp. Out	Meter In	Meter Out						
500-1	0	0848	188.822																
2	3.4	3.4	191.184	0.38	1.6	1.6	6.0	158	100%	241	47	60	60						
3	6.8	6.8	193.565	0.38	1.6	1.6	6.0	152		255	46	61	60						
4	11.0	11.0	196.970	0.58	2.4	2.4	8.0	154		258	48	62	60						
5	14.9	0905	200.825	0.64	2.7	2.7	12.0	154		255	49	62	60						
6	-	-	-	-	-	-	-	-		-	-	-	-						
7	15.9	-	201.385	0.52	2.1	2.1	11.0	158		248	53	62	60						
8	18.4	-	203.765	0.60	2.5	2.5	11.0	158		246	54	62	60						
9	20.9	-	204.054	0.70	2.9	2.9	14.0	157		247	54	65	62						
10	23.9	-	208.655	0.47	2.7	2.7	14.0	159		254	54	65	62						
11	27.3	-	211.730	0.43	2.7	2.7	13.0	159		260	54	65	62						
12	30.7	0922	214.577	0.52	2.1	2.1	11.5	157		256	54	68	63						

Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. V _{mft} ³	Velocity Head ΔP "H ₂ O	Diff. Press. Meter Orifice ΔH" H ₂ O		Pump Vacuum "Hg	Stack	Temperatures, °F				
					Desired	Actual			Probe	Filter	Imp. Out	Meter In	Meter Out
SE-1	5.4	36.1	318.205	0.35	1.5	1.5	7.0	158	100%	262	50	66	63
2	4.9	41.0	221.590	0.35	1.5	1.5	9.0	159		250	50	69	65
3	4.6	46.6	224.485	0.32	1.2	1.2	8.5	160		242	51	69	64
4	4.2	49.8	227.595	0.30(49)	2.0	2.0	18.0	160		235	51	70	64
5	3.9	52.7	220.672	0.45	1.9	1.9	13.5	161		227	53	70	65
6	-	-	-	-	-	-	-	-		-	-	-	-
7	-	-	-	-	-	-	-	-		-	-	-	-
8	1.0	54.7	231.162	0.30	1.3	1.3	8.5	159		249	55	70	65
9	2.1	56.8	228.175	0.33	1.4	1.4	10.0	159		252	56	69	64
10	3.5	59.3	-	0.41	1.8	1.8	11.8	160		230	56	69	64
11	3.0	62.3	-	0.52	2.2	2.2	16.8	160		230	-	69	64
12	3.0	65.3	224.103	0.32	2.2	2.2	16.0	161		229	-	69	64
20	65.3	76	50.281	0.690	2.02	2.02	-	159°F		246	52°	64	64°F

618°R

1000

* Heavy rains began at 11:45 AM. WINDS NORTHERLY 10-15 MPH

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant Anheuser Busch Sample Date 11/3/83
 City Columbus, OH Run No. 1-0-4
 Sample Recovery Person F. Meadows, C. Jones Recovery Date 11/3/83
 Filter(s) No. 5012

MOISTURE

Impinger Number

	1	2	3	4	5	Total
Weight, gm						
Final	820.9	776.9	457.1	649.9		
Initial	541.4	580.7	444.3	631.6		
Net	279.5	196.2	12.8	18.3		506.8

Color of Silica Gel 3/4 spent 488.5

Description of Particulate on Filter _____

RECOVERED SAMPLE

Filter Container No. _____ Sealed _____

Description of Particulate on Filter _____

Acetone Rinse Container No. _____ Liquid Level Marked _____

Acetone Blank Container No. _____ Liquid Level Marked _____

Samples Stored and Locked _____

Remarks _____

Date of Laboratory Custody _____

Remarks _____

EMISSION TEST FIELD DATA

PLANT Anheuser-Busch
 DATE 11/3/83 PN 85-010
 SAMPLING LOCATION #1 stack
 SAMPLE TYPE Method 5 (particulate)
 RUN NUMBER 1-0-5
 OPERATOR CJ DT
 AMBIENT TEMPERATURE 55 °F
 BAROMETRIC PRESSURE 29.30 "Hg
 STATIC PRESSURE, (P_s) -0.30 "H₂O
 FILTER NUMBER(S) 5015
 PAGE 1 OF 2
 RECORD DATA EVERY 2 MINUTES

(LOW TEMP. CONDITIONS)
 O₂ 20.0% 20%
 CO₂ 1.0 1.0

PROBE LENGTH AND TYPE 8' incoel
 NOZZLE I.D. 0.245 STACK DIMENSIONS 66" φ
 ASSUMED MOISTURE, % 18.0%
 SAMPLE BOX NUMBER 3
 METER BOX NUMBER J-1
 PITOT TUBE NO. & C_p 0.84
 METER ΔH_a 1.7 Y 0.999
 C FACTOR 0.74 REF. ΔP 0.75
 PRE-TEST LEAK RATE 0.003 CFM @ 2.2 "Hg
 POST-TEST LEAK RATE 0.000 CFM @ 1.2 "Hg
 STACK THERMOCOUPLE
 OVEN THERMOCOUPLE 0-3
 IMPINGER THERMOCOUPLE J-3

STACK DETAIL

Traverse Point No.	Sampling Time Mins.		Clock Time 24 hr.	Dry Gas Sample Vol. Vmft ³	Velocity Head ΔP "H ₂ O	Diff. Press. Meter Orifice ΔH" H ₂ O		Pump Vacuum "Hg	Temperatures, °F					
	0	30				Desired	Actual		Stack	Probe	Filter	Imp. Out	Meter In	Meter Out
5W-1	0	0	1225	239.404		1.0	1.0	1.0	132	100%	265	49	55	55
2	3.4	3.4		241.295	0.40	1.4	1.4	2.0	134		270	48	56	55
3	4.2	11.0		246.610	0.70	1.7	1.7	3.0	129		265	47	60	55
4	7.9	14.9		249.350	0.68	1.6	1.6	2.5	130		237	50	61	56
5	-	-		-	-	-	-	-	-		-	-	-	-
6	-	-		-	-	-	-	-	-		-	-	-	-
7	1.0	15.9		250.000	0.57	1.4	1.4	2.0	127	100%	236	53	61	55
8	2.5	18.4		-	0.78	1.9	1.9	3.5	130		230	52	62	56
9	2.6	20.9		253.810	0.58	2.0	2.0	4.0	131		238	53	64	56
10	3.0	23.9		256.085	0.80	2.0	2.0	4.0	131		240	53	65	56
11	3.4	27.3		258.720	0.75	1.8	1.8	4.5	128		258	55	63	56
12	3.4	30.7		261.470	0.82	2.0	2.0	4.5	131		269	56	63	56

Traverse Point No.	Sampling Time Mins.	Clock Time 24 hr.	Dry Gas Sample Vol. V _{MFL} ³	Velocity Head ΔP"H ₂ O	Diff. Press. Meter Orifice ΔH" H ₂ O		Pump Vacuum "Hg	Stack	Probe	Filter	Temperatures, °F		Meter In	Meter Out
					Desired	Actual					Imp. Out	Imp. In		
5F-1	54	36.1	265.403	0.70	1.7	1.7	4.0	128	100%	251	55	60	58	
2	49	41.0	268.795	0.61	1.5	1.5	4.0	129		233	55	61	58	
3	46	43.6	272.000	0.60	1.5	1.5	3.5	127		226	58	61	58	
4	42	49.8	274.890	0.57	1.4	1.4	3.0	122		228	58	61	57	
5	39	52.7	271.328	0.55	1.3	1.3	3.0	129		225	62	61	55	
6	-	-	-	-	-	-	-	-	-	-	-	-	-	
7	-	-	-	-	-	-	-	-	-	-	-	-	-	
8	1.0	54.7	-	0.68	1.6	1.6	3.0	129		223	63	61	55	
9	2.1	26.9	279.825	0.85	2.1	2.1	4.5	132		232	64	61	55	
10	2.5	59.3	281.720	0.91	2.2	2.2	5.0	128		255	64	60	55	
11	3.0	62.3	284.062	0.80	2.0	2.0	5.5	128		253	64	60	55	
12	3.0	63.3	286.390	0.75	1.9	1.9	5.5	132		252	64	60	55	
20	65.3	73	46.986	0.930	1.70	1.70		130°F		244°F	56°F		58°F	
								590°R					518°R	

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant A-B Sample Date 11/3/93
 City Columbus Run No. 1-0-5
 Sample Recovery Person C. Jones Recovery Date 11/3/93
 Filter(s) No. 5015

MOISTURE

Impinger Number

	1	2	3	4	5	Total
Weight, gm			(1935)			
Final	736.4	606.4	447.7	668.1		
Initial	562.1	588.7	446.2	651.0		
Net	174.3	17.7	1.5	17.1		210.6

Color of Silica Gel 1/2 spent
 Description of Particulate on Filter _____

RECOVERED SAMPLE

Filter Container No. _____ Sealed _____
 Description of Particulate on Filter _____

Acetone Rinse Container No. _____ Liquid Level Marked _____

Acetone Blank Container No. _____ Liquid Level Marked _____

Samples Stored and Locked _____

Remarks _____

Date of Laboratory Custody _____

Remarks _____



APPENDIX B
Laboratory Data

POLLUTION CONTROL SCIENCE, INC.

Date Received: 11/7/83 LAB Chargeable Time To: _____
 Sample No.: _____ Purchase Order No./Invoice No.: _____
 Client: Anheuser-Busch Date Report Mailed: _____

Page 1 of 5

# 37485	Run # 1-I-1	
	Filter # 5005	} 592.6 mg
	Acetone rinse	
37486	Run # 1-0-1	
	Filter # 5017	} 445.5 mg
	Acetone rinse	
37487	Run # 1-I-2	
	Filter # 5003	} 462.1 mg
	Acetone rinse	
37488	Run # 1-0-2	
	Filter # 5004	} 312.6 mg
	Acetone blank rinse	
37489	Run # 1-I-3	
	Filter # 5001	} 188.8 mg
	Acetone blank rinse	

Copy of Analytical Results Sheet To: _____

Requested Analytical Results COMPLETION Date _____ By _____

POLLUTION CONTROL SCIENCE, INC.

Date Received: _____ LAB Chargeable Time To: _____

Sample No.: _____ Purchase Order No./Invoice No.: _____

Client: Anheuser-Busch Date Report Mailed: _____

37490	Run # 1-0-3	
	Filter # 5002	} 37.4 mg
	Acetone rinse	
37491	Run # 0-1-4 1-I-4	
	Filter # 5013	} 457.0 mg
	Acetone rinse	
37492	Run # 1-0-4	
	Filter # 5012	} 356.7 mg
	Acetone rinse	
37493	Run # 1-I-5	
	Filter # 5014	} 151.4 mg
	Acetone rinse	
37494	Run # 1-0-5	
	Filter # 5015	} 32.3 mg
	Acetone rinse	

Copy of Analytical Results Sheet To: _____

Requested Analytical Results COMPLETION Date _____ By _____

POLLUTION CONTROL SCIENCE, INC.

Date Received: _____ LAB Chargeable Time To: _____

Sample No.: _____ Purchase Order No./Invoice No.: _____

Client: _____ Date Report Mailed: _____

IN
MUT
FEED

37495	Acetone blank	0.0007 mg/g
37496	AB #1 34.3%	% SOLIDS
37497	AB #2	
	95.77%	% SO
37498	AB #3	
	24.9%	
37499	AB #4	
	33.7%	
37500	AB #5	
	95.3%	
37501	AB #6 ??	
	33.7%	
37502	AB #7	
	36.2%	
37503	AB #8	
	95.8%	
37504	AB #9	
	23.6%	
37505	AB #10	
	33.9%	
37506	AB #11 96.4%	

Copy of Analytical Results Sheet To: _____

Requested Analytical Results COMPLETION Date _____ By _____

POLLUTION CONTROL SCIENCE, INC.

Date Received: _____ LAB Chargeable Time To: _____
 Sample No.: _____ Purchase Order No./Invoice No.: _____
 Client: _____ Date Report Mailed: _____

Page 4 of 5

37507	AB # 12	
% Solids	22.3%	
37508	AB # 13	
	42.7%	
37509	AB # 14	
	95.4%	
37510	AB # 15	
	22.3%	
37511	AB # 16	
	34.7%	
37512	AB # 17	
	94.1%	
37513	AB # 18	
	21.5%	
37514	AB # 19	
	35.1%	
37515	AB # 20	
	95.7%	
37516	AB # 21	
	25.9%	
37517	AB # 25	
	39.1%	
37518	AB # 26	
	96.5%	

Copy of Analytical Results Sheet To: _____

Requested Analytical Results COMPLETION Date _____ By _____

EPA METHOD 5 ANALYTICAL PARTICULATE DATA

Plant Ambuser Busch Run No. 1-1-1
 City Columbus Project No. 83-010
 Density of Acetone (pa) 0.7852 g/ml

Sample Type	PCS Sample No.	Liquid Level Marked and/or Container Sealed
Acetone Rinse	32485	
Filter (s) No.	"	

Acetone Rinse Volume (Vaw) 655 ml
 Acetone Blank Residue Concentration (ca) 0.0007 mg/g

Date and Time of Wt. 11-15-83 8:30 AM Gross Wt. 108809.7 mg
 Date and Time of Wt. 11-16-83 8:30 AM Gross Wt. 108809.6 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 108809.7 mg

Tare Wt. 108581.8 mg

Less Acetone Blank, $W_a = C_a V_{aw} p_a = (0.0007) (655) (0.7852) = \underline{.4}$ mg

Weight of Particulate in Acetone Rinse 227.5 mg

Filter(s) No. 5005

Date and Time Dessicated 11-8-83 12:30 pm

Date and Time of Wt. 11-15-83 8:20 AM Gross Wt. 758.3 mg
 Date and Time of Wt. 11-16-83 8:20 AM Gross Wt. 752.8 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 758.1 mg

Tare Wt. 393.0 mg

Weight of Particulate on Filter (s) 365.1 mg

Weight of Particulate in Acetone Rinse 227.5 mg

Total Weight of Particulate 592.6 mg

Note: $C_a = \frac{\text{mass of residue (mg)}}{\text{vol. blank (ml)} \times p_a} = \frac{0.4}{(175)(0.7852)} = \underline{0.0007}$ mg/g

In no case shall a blank residue greater than 0.01 mg/g be subtracted from the sample weight.

Remarks : _____

Analyst Signature Coral Lee Moody Reviewer _____

Blank Data, page No. 11 Page 1 of 11

EPA METHOD 5 ANALYTICAL PARTICULATE DATA

Plant Amberco-Busch Run No. 1-I-2
 City Columbus Project No. 85-010
 Density of Acetone (pa) 0.7852 g/ml

Sample Type	PCS Sample No.	Liquid Level Marked and/or Container Sealed
Acetone Rinse	37487	
Filter (s) No.		

Acetone Rinse Volume (Vaw) 605 ml
 Acetone Blank Residue Concentration (ca) 0.0007 mg/g

Date and Time of Wt.	<u>11-15-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>94725.7</u>	mg
Date and Time of Wt.	<u>11-16-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>94725.8</u>	mg
Date and Time of Wt.			Gross Wt.		mg

Average Gross Wt. 94725.8 mg

Tare Wt. 94511.1 mg

Less Acetone Blank, $W_a = C_a V_{aw} p_a = (0.0007) (605) (0.7852) =$.3 mg

Weight of Particulate in Acetone Rinse 214.4

Filter(s) No. 5003

Date and Time Dessicated 11-8-83 12:30 pm

Date and Time of Wt.	<u>11-15-83</u>	<u>8:20 AM</u>	Gross Wt.	<u>645.5</u>	mg
Date and Time of Wt.	<u>11-16-83</u>	<u>8:20 AM</u>	Gross Wt.	<u>645.0</u>	mg
Date and Time of Wt.			Gross Wt.		mg

Average Gross Wt. 645.3 mg

Tare Wt. 392.6 mg

Weight of Particulate on Filter (s) 252.7 mg

Weight of Particulate in Acetone Rinse 214.4 mg

Total Weight of Particulate 467.1 mg

Note: $C_a = \frac{\text{mass of residue (mg)}}{\text{vol. blank (ml)} \times p_a} = \frac{0.1}{(175)(0.7852)} =$ 0.0007 mg/g

In no case shall a blank residue greater than 0.01 mg/g be subtracted from the sample weight.

Remarks : _____

Analyst Signature Coral Lee Moody Reviewer _____

Blank Data, page No. 11 Page 3 of 11

EPA METHOD 5 ANALYTICAL PARTICULATE DATA

Plant Amherst - Beach Rin No. 1-2-3
 City Columbus Project No. 85-010
 Density of Acetone (pa) 0.7852 g/ml

Sample Type	PCS Sample No.	Liquid Level Marked and/or Container Sealed
Acetone Rinse	37489	
Filter (s) No.	"	

Acetone Rinse Volume (Vaw) 545 ml
 Acetone Blank Residue Concentration (ca) 0.0007 mg/g

Date and Time of Wt. 11-15-83 8:30 AM Gross Wt. 96629.4 mg
 Date and Time of Wt. 11-16-83 8:30 AM Gross Wt. 96629.4 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 96629.4 mg
 Tare Wt. 46485.2 mg

Less Acetone Blank, $W_a = C_a V_{aw} p_a = (0.0007) (545) (0.7852) = .3$

Weight of Particulate in Acetone Rinse 143.9 mg

Filter(s) No. 5001

Date and Time Dessicated 11-8-83 12:30 pm

Date and Time of Wt. 11-15-83 8:20 AM Gross Wt. 437.7 mg
 Date and Time of Wt. 11-16-83 8:20 AM Gross Wt. 437.5 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 437.6 mg
 Tare Wt. 392.7 mg

Weight of Particulate on Filter (s) 44.9 mg

Weight of Particulate in Acetone Rinse 143.9 mg

Total Weight of Particulate 188.8 mg

Note: $C_a = \frac{\text{mass of residue (mg)}}{\text{vol. blank} \times p_a} = \frac{0.1}{(175)(0.7852)} = 0.0007$ mg/g

In no case shall a blank residue greater than 0.01 mg/g be subtracted from the sample weight.

Remarks : _____

Analyst Signature Carol Lee Mandy Reviewer _____

Blank Data, page No. 11 Page 5 of 11

EPA METHOD 5 ANALYTICAL PARTICULATE DATA

Plant Quincy Branch Run No. 1-I-4
 City Columbus Project No. 85-010
 Density of Acetone (pa) 0.7852 g/ml

Sample Type	PCS Sample No.	Liquid Level Marked and/or Container Sealed
Acetone Rinse	37491	
Filter (s) No.	11	

Acetone Rinse Volume (Vaw) 685 ml
 Acetone Blank Residue Concentration (ca) 0.0007 mg/g

Date and Time of Wt. 11-15-83 8:30 AM Gross Wt. 84308.9 mg
 Date and Time of Wt. 11-16-83 8:30 AM Gross Wt. 84308.7 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 84308.8 mg

Tare Wt. 84106.8 mg

Less Acetone Blank, $W_a = C_a V_{aw} p_a = (0.0007) (685) (0.7852) = 0.3$

Weight of Particulate in Acetone Rinse 201.7 mg

Filter(s) No. 5013

Date and Time Dessicated 11-8-83 12:30 PM

Date and Time of Wt. 11-15-83 8:20 AM Gross Wt. 642.1 mg
 Date and Time of Wt. 11-16-83 8:20 AM Gross Wt. 641.7 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 641.9 mg

Tare Wt. 386.6 mg

Weight of Particulate on Filter (s) 255.3 mg

Weight of Particulate in Acetone Rinse 201.7 mg

Total Weight of Particulate 457.0 mg

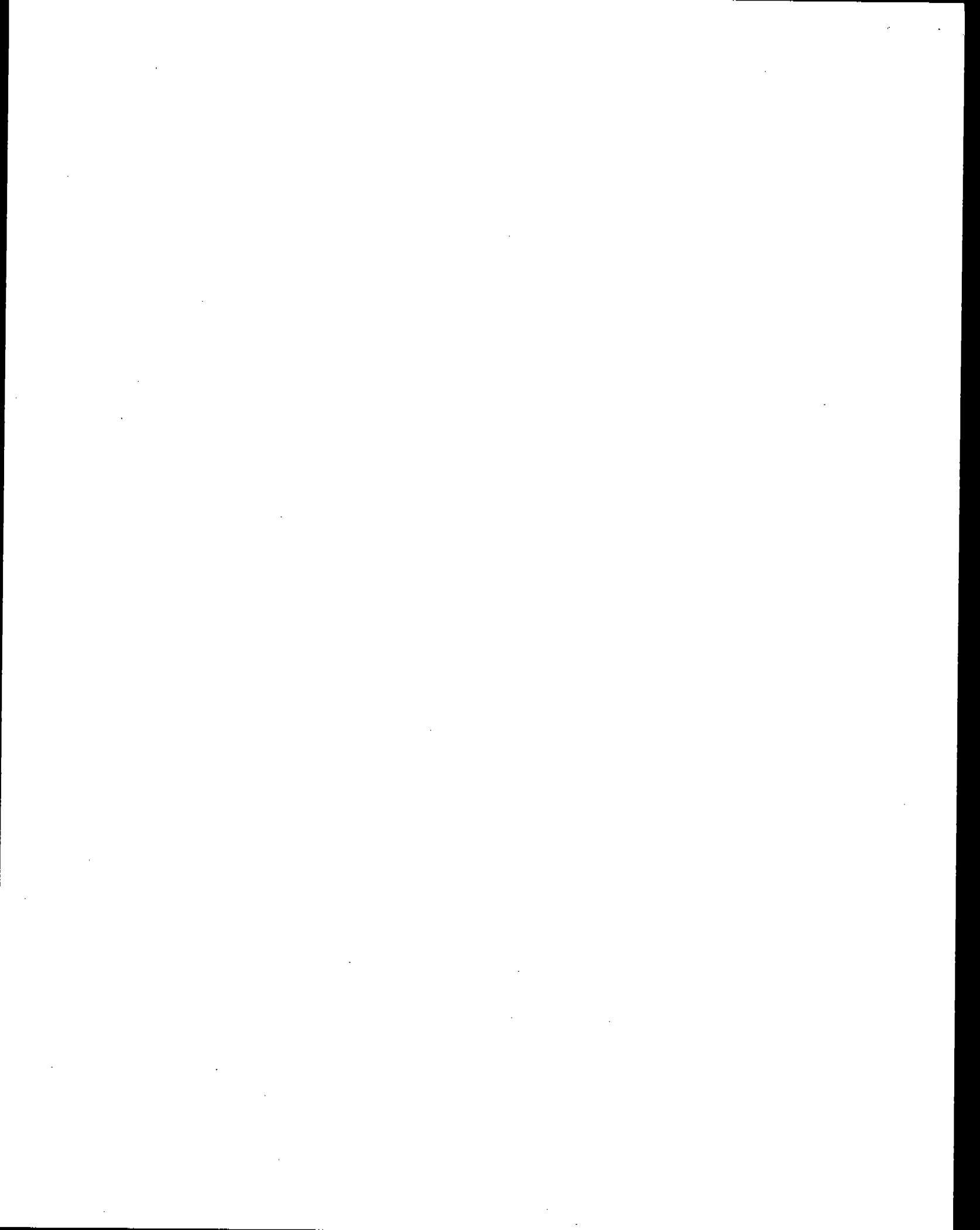
Note: $C_a = \frac{\text{mass of residue (mg)}}{\text{vol. blank} \times p_a} = \frac{0.1}{(175)(0.7852)} = 0.0007$ mg/g

In no case shall a blank residue greater than 0.01 mg/g be subtracted from the sample weight.

Remarks : _____

Analyst Signature Coral Lee Moody Reviewer _____

Blank Data, page No. 11 Page 7 of 11



TEPA METHOD 5 ANALYTICAL PARTICULATE DATA

Plant Columbus Beach Run No. 1-I-5
 City Columbus Project No. 83-010
 Density of Acetone (pa) 0.7852 g/ml

Sample Type	PCS Sample No.	Liquid Level Marked and/or Container Sealed
Acetone Rinse	37493	
Filter (s) No.	6	

Acetone Rinse Volume (Vaw) 430 ml
 Acetone Blank Residue Concentration (ca) 0.0007 mg/g

Date and Time of Wt. 11-15-83 8:30 AM Gross Wt. 108319.6 mg
 Date and Time of Wt. 11-16-83 8:30 AM Gross Wt. 108319.3 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 108319.5 mg

Tare Wt. 108208.4 mg

Less Acetone Blank, $W_a = C_a V_{aw} p_a = (0.0007) (430) (0.7852) = \underline{1.2}$

Weight of Particulate in Acetone Rinse 110.9

Filter(s) No. 5014

Date and Time Dessicated 11-8-83 12:30 pm

Date and Time of Wt. 11-15-83 8:20 AM Gross Wt. 429.7 mg
 Date and Time of Wt. 11-16-83 8:20 AM Gross Wt. 429.5 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 429.6 mg

Tare Wt. 389.1 mg

Weight of Particulate on Filter (s) 40.5 mg

Weight of Particulate in Acetone Rinse 110.9 mg

Total Weight of Particulate 151.4 mg

Note: $C_a = \frac{\text{mass of residue (mg)}}{\text{vol. blank (ml)} p_a} = \frac{0.1}{(175)(0.7852)} = \underline{0.0007}$ mg/g

In no case shall a blank residue greater than 0.01 mg/g be subtracted from the sample weight.

Remarks : _____

Analyst Signature Carol Lee Moody Reviewer _____

Blank Data, page No. 11 Page 9 of 11

TEPA METHOD 5 ANALYTICAL PARTICULATE DATA

Plant Ambroseville Bellch Run No. 1-0-1
 City Columbia Project No. 85-010
 Density of Acetone (pa) 0.7852 g/ml

Sample Type	PCS Sample No.	Liquid Level Marked and/or Container Sealed
Acetone Rinse	37486	
Filter (s) No.		

Acetone Rinse Volume (Vaw) 595 ml
 Acetone Blank Residue Concentration (Ca) 0.0007 mg/g

Date and Time of Wt. 11-15-83 8:30 AM Gross Wt. 100961.1 mg
 Date and Time of Wt. 11-16-83 8:30 AM Gross Wt. 100961.0 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 100961.1 mg

Tare Wt. 100931.4 mg

Less Acetone Blank, $W_a = C_a V_{aw} p_a = (0.0007) (595) (0.7852) = 0.3$

Weight of Particulate in Acetone Rinse 29.0 mg

Filter(s) No. 5017

Date and Time Dessicated 11-8-83 12:30 pm

Date and Time of Wt. 11-15-83 8:20 AM Gross Wt. 800.4 mg
 Date and Time of Wt. 11-16-83 8:20 AM Gross Wt. 800.6 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 800.5 mg

Tare Wt. 384.0 mg

Weight of Particulate on Filter (s) 416.5 mg

Weight of Particulate in Acetone Rinse 29.0 mg

Total Weight of Particulate 445.5 mg

Note: $C_a = \frac{\text{mass of residue (mg)}}{\text{vol. blank (ml)} \times p_a} = \frac{0.1}{(175)(0.7852)} = 0.0007$ mg/g

In no case shall a blank residue greater than 0.01 mg/g be subtracted from the sample weight.

Remarks : _____

Analyst Signature Coral Lee Moody Reviewer _____

Blank Data, page No. 11 Page 2 of 11

EPA METHOD 5 ANALYTICAL PARTICULATE DATA

Plant Amherst Beach Run No. 1-0-2
 City California Project No. 85-010
 Density of Acetone (pa) 0.7852 g/ml

Sample Type	PCS Sample No.	Liquid Level Marked and/or Container Sealed
Acetone Rinse	37488	
Filter (s) No.	11	

Acetone Rinse Volume (Vaw) 485 ml
 Acetone Blank Residue Concentration (ca) 0.0007 mg/g

Date and Time of Wt. 11-15-83 8:30 AM Gross Wt. 101275.7 mg
 Date and Time of Wt. 11-16-83 8:30 AM Gross Wt. 101275.3 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 101275.5 mg

Tare Wt. 101256.4 mg

Less Acetone Blank, $W_a = C_a V_{aw} p_a = (0.0007) (485) (0.7852) = .3$

Weight of Particulate in Acetone Rinse 18.8 mg

Filter(s) No. 5004

Date and Time Dessicated 11-8-83 12:30 PM

Date and Time of Wt. 11-15-83 4:20 AM Gross Wt. 682.8 mg
 Date and Time of Wt. 11-16-83 8:20 AM Gross Wt. 683.3 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 683.1 mg

Tare Wt. 389.3 mg

Weight of Particulate on Filter (s) 293.8 mg

Weight of Particulate in Acetone Rinse 18.8 mg

Total Weight of Particulate 312.6 mg

Note: $C_a = \frac{\text{mass of residue (mg)}}{\text{vol. blank (ml)} \times p_a} = \frac{0.1}{(175)(0.7852)} = 0.0007$ mg/g

In no case shall a blank residue greater than 0.01 mg/g be subtracted from the sample weight.

Remarks : _____

Analyst Signature Coral Lee Moody Reviewer _____

Blank Data, page No. 11 Page 4 of 11

EPA METHOD 5 ANALYTICAL PARTICULATE DATA

Plant Amherst - Beach Run No. 1-0-3
 City Columbus Project No. 8-010
 Density of Acetone (pa) 0.7852 g/ml

Sample Type	PCS Sample No.	Liquid Level Marked and/or Container Sealed
Acetone Rinse	37490	
Filter (s) No.		

Acetone Rinse Volume (Vaw) 555 ml
 Acetone Blank Residue Concentration (ca) 0.0007 mg/g

Date and Time of Wt. 11-15-83 8:30 AM Gross Wt. 104122.1 mg
 Date and Time of Wt. 11-16-83 7:30 AM Gross Wt. 104121.7 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 104121.9 mg
 Tare Wt. 104107.0 mg

Less Acetone Blank, $W_a = C_a V_{aw} p_a = (0.0007) (555) (0.7852) = 0.3$ mg

Weight of Particulate in Acetone Rinse 14.6 mg

Filter(s) No. 5002

Date and Time Dessicated 11-8-83 12:30 pm

Date and Time of Wt. 8-15-83 8:20 AM Gross Wt. 414.7 mg
 Date and Time of Wt. 8-16-83 8:20 AM Gross Wt. 414.9 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 414.8 mg
 Tare Wt. 392.0 mg

Weight of Particulate on Filter (s) 22.8 mg

Weight of Particulate in Acetone Rinse 14.6 mg

Total Weight of Particulate 37.4 mg

Note: $C_a = \frac{\text{mass of residue (mg)}}{\text{vol. blank (ml)} \times p_a} = \frac{0.1}{(175)(0.7852)} = 0.0007$ mg/g

In no case shall a blank residue greater than 0.01 mg/g be subtracted from the sample weight.

Remarks : _____

Analyst Signature Carol Lee Moody Reviewer _____

Blank Data, page No. 11 Page 6 of 11

EPA METHOD 5 ANALYTICAL PARTICULATE DATA

Plant Ch. H. ... - Beach Run No. 104
 City Calumet, Ill. Project No. 85-010
 Density of Acetone (pa) 0.7852 g/ml

Sample Type	PCS Sample No.	Liquid Level Marked and/or Container Sealed
Acetone Rinse	37492	
Filter (s) No.		

Acetone Rinse Volume (Vaw) 380 ml
 Acetone Blank Residue Concentration (ca) 0.0007 mg/g

Date and Time of Wt. 11-15-83 8:30 AM Gross Wt. 109125.4 mg
 Date and Time of Wt. 11-16-83 8:30 AM Gross Wt. 109125.3 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 109125.4 mg

Tare Wt. 109111.4 mg

Less Acetone Blank, $W_a = C_a V_{aw} p_a = (0.0007) (380) (0.7852) = .2$

Weight of Particulate in Acetone Rinse 13.8 mg

Filter(s) No. 5012

Date and Time Dessicated 11-8-83 12:30 pm

Date and Time of Wt. 11-15-83 8:20 AM Gross Wt. 733.3 mg
 Date and Time of Wt. 11-16-83 8:20 AM Gross Wt. 733.2 mg
 Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 733.3 mg

Tare Wt. 390.4 mg

Weight of Particulate on Filter (s) 342.9 mg

Weight of Particulate in Acetone Rinse 13.8 mg

Total Weight of Particulate 356.7 mg

Note: $C_a = \frac{\text{mass of residue (mg)}}{\text{vol. blank (ml)} \times p_a} = \frac{0.1}{(175)(0.7852)} = 0.0007$ mg/g

In no case shall a blank residue greater than 0.01 mg/g be subtracted from the sample weight.

Remarks : _____

Analyst Signature Carol Lee Mandy Reviewer _____

Blank Data, page No. 11 Page 8 of 11

Plant Cinco de Mayo Beach
City Columbia
Density of Acetone (pa) 0.7852
Run No. 105
Project No. 85-010
g/ml

Sample Type	PCS Sample No.	Liquid Level Marked and/or Container Sealed
Acetone Rinse	3794	
Filter (s) No.		

Acetone Rinse Volume (Vaw) 365 ml
Acetone Blank Residue Concentration (ca) 0.0007 mg/g
Date and Time of Wt. 11-15-83 8:30 AM Gross Wt. 102.009.1 mg
Date and Time of Wt. 11-16-83 8:30 AM Gross Wt. 102.009.0 mg
Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 102.009.1 mg
Tare Wt. 101.997.9 mg

Less Acetone Blank, $W_a = C_a V_{aw} p_a = (0.0007) (365) (0.7852) = .2$

Weight of Particulate in Acetone Rinse 11.0 mg

Filter(s) No. 5015

Date and Time Dessicated 11-8-83 12:30 pm

Date and Time of Wt. 11-15-83 8:20 AM Gross Wt. 412.0 mg
Date and Time of Wt. 11-16-83 8:20 AM Gross Wt. 412.2 mg
Date and Time of Wt. _____ Gross Wt. _____ mg

Average Gross Wt. 412.1 mg
Tare Wt. 390.8 mg

Weight of Particulate on Filter (s) 21.3 mg

Weight of Particulate in Acetone Rinse 11.0 mg

Total Weight of Particulate 32.3 mg

Note: $C_a = \frac{\text{mass of residue (mg)}}{\text{vol. blank (ml)}} = \frac{0}{(175)(0.7852)} = 0.0007$ mg/g

In no case shall a blank residue greater than 0.01 mg/g be subtracted from the sample weight.

Remarks : _____

Analyst Signature Coral Lee Moody Reviewer _____

Blank Data, page No. 11 Page 10 of 11

Plant Ch. Agency Beach Rin No. Blank
City Camden Project No. 85 010
Density of Acetone (pa) 0.7852 g/ml

Sample Type	PCS Sample No.	Liquid Level Marked and/or Container Sealed
Acetone Rinse	<u>37495</u>	
Filter (s) No.	<u>N/A</u>	

Acetone Rinse Volume (Vaw) 175 ml
Acetone Blank Residue Concentration (ca) 0.0007 mg/g

Date and Time of Wt.	<u>11-15-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>108295.2</u> mg
Date and Time of Wt.	<u>11-16-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>108294.8</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. 108295.0 mg

Tare Wt. 108294.9 mg

Less Acetone Blank, $W_a = C_a V_{aw} p_a = () () () =$ _____ mg

Weight of Particulate in Acetone Rinse .1 mg

Filter(s) No. N/A

Date and Time Dessicated _____

Date and Time of Wt.	_____	Gross Wt.	_____ mg
Date and Time of Wt.	_____	Gross Wt.	_____ mg
Date and Time of Wt.	_____	Gross Wt.	_____ mg

Average Gross Wt. _____ mg

Tare Wt. _____ mg

Weight of Particulate on Filter (s) _____ mg

Weight of Particulate in Acetone Rinse _____ mg

Total Weight of Particulate _____ mg

Note: $C_a = \frac{\text{mass of residue (mg)}}{\text{vol. blank (ml)} \times p_a} = \frac{0.1}{(175)(0.7852)} = 0.0007$ mg/g

In no case shall a blank residue greater than 0.01 mg/g be subtracted from the sample weight.

Remarks : _____

Analyst Signature _____ Reviewer _____

Blank Data, page No. 11 Page 11 of 11

Filter(s) No. 5000

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>393.2</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>393.4</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. _____ mg

Filter(s) No. 5001 (45-010 A-B #37489)

Date and Time Dessicated 10-26-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>392.5</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>392.8</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. 392.7 mg

Filter(s) No. 5002 (45-010 A-B #37490)

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>391.9</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>392.1</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. 392.0 mg

Filter(s) No. 5003 (45-010 A-B #37487)

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>392.5</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>392.6</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. 392.6 mg

Filter(s) No. 5004 (45-010 A-B #37488)

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>389.1</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>389.4</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. 389.3 mg

Filter(s) No. 5005 (85-010 A-B #37485)

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30AM</u>	Gross Wt.	<u>392.9</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>393.0</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. 393.0 mg

Filter(s) No. 5006

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30AM</u>	Gross Wt.	<u>387.0</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>388.7</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. _____ mg

Filter(s) No. 5007

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30AM</u>	Gross Wt.	<u>391.7</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>392.1</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. _____ mg

Filter(s) No. 5008

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30AM</u>	Gross Wt.	<u>386.9</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>387.1</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. _____ mg

Filter(s) No. 5009

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30AM</u>	Gross Wt.	<u>388.7</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>389.1</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. _____ mg

Filter(s) No. 5010

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>385.9</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>386.0</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. _____ mg

Filter(s) No. 51011 destroyed

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>386.5</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>386.9</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. _____ mg

Filter(s) No. 5012 (85-010 A-B # 37492)

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>390.2</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>390.5</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. 390.4 mg

Filter(s) No. 5013 (85-010 A-B # 37491)

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>386.5</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>386.7</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. 386.6 mg

Filter(s) No. 5014 (85-010 A-B # 37493)

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>389.0</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>389.2</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. 389.1 mg

Filter(s) No. 5015 (85-010 A-B #37474)

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>390.7</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>390.8</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. 390.8 mg

Filter(s) No. 5016 destroyed

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>389.5</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>389.4</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. _____ mg

Filter(s) No. 5017 (85-010 A-B #37486)

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>383.9</u> mg
Date and Time of Wt.			Gross Wt.	<u>384.0</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. 384.0 mg

Filter(s) No. 5018

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>387.4</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>387.3</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. _____ mg

Filter(s) No. 5019

Date and Time Dessicated 10-20-83

Date and Time of Wt.	<u>10-26-83</u>	<u>8:30 AM</u>	Gross Wt.	<u>389.3</u> mg
Date and Time of Wt.	<u>10-27-83</u>		Gross Wt.	<u>389.5</u> mg
Date and Time of Wt.			Gross Wt.	_____ mg

Average Gross Wt. _____ mg

CLIENT						
SAMPLE DESCRIPTION						
PCS #						

CALCULATION

METHOD OF ANALYSIS _____

$$\text{mg/l} = \frac{\text{dry mg} \times 1000}{\text{mls sample}}$$

DATE 11-16-83 ANALYST C. Mearns

ANALYSIS % Solids

Page 1 of 1

COMMENTS: _____

SOLIDS									
SAMPLE I.D.	PCS #	FLASK #	mls	TARE	TARE & wet	Tare DRY g	DRY mg	% mg/l	REPORTED
A-B	37496			1.3153	4.6431	2.4571		34.3	
	37497			1.3086	7.7914	3.6866		95.77	
	37498			1.3051	4.6587	2.1409		24.9	
	37499			1.3079	5.2960	2.6530		33.7	
	37500			1.2421	7.2265	4.0872		95.3	
	37501			1.2332	4.2620	2.6528		33.7	
	37502			1.2346	4.5765	2.1457		36.2	
	37503			1.2383	5.2924	5.1218		95.8	
	37504			1.2408	6.1272	2.5935		23.6	
	37505			1.2457	6.1935	2.7209		33.9	
	37506			1.2529	5.1913	5.0725		96.4	
	37507			1.2517	7.9703	2.7520		22.3	

STANDARDS									
dry	37521			1.2786	4.8836	4.7209		95.5	
	37520			1.2702	5.6588	3.2184		44.4	

CLIENT						
SAMPLE DESCRIPTION						
PCS #						

CALCULATION

METHOD OF ANALYSIS _____

$$\text{mg/l} = \frac{\text{dry mg} \times 1000}{\text{mls sample}}$$

DATE 11-16-83 ANALYST CL Morley

ANALYSIS % Solid

Page 2 of 2

COMMENTS: _____

(90)
SOLIDS

SAMPLE I.D.	PCS #	FLASK #	mls	TARE	TARE &	Tare + DRY g	DRY mg	mg/l	REPORTED
A-13	37508			1.2512	7.0555	3.7288		42.7	
	37509			1.2527	6.1605	5.9346		95.4	
	37510			1.2702	9.7095	3.1509		22.3	
	37511			1.2652	6.3194	3.0122		34.7	
	37512			1.2574	5.6109	5.3517		94.1	
	37513			1.2758	8.4818	2.8271		21.5	
	37514			1.2780	5.9417	2.9137		35.1	
	37515			1.2876	4.4377	4.3021		95.7	
	37516			1.2963	8.6352	3.1949		25.9	
	37517			1.2740	5.6750	2.9761		39.1	
	37518			1.2718	4.5077	4.3951		96.5	
✓	37519			1.3059	8.3981	3.1240		25.6	

A-B	37520			1.3127	5.2984	3.1035		45.3	44.4) 14.9
	37521			1.3117	4.1689	4.0367		95.4	95.5) 95.5
✓	37522			1.3013	9.0955	2.9816		23.4	24.1
dry	37522			1.2873	7.7283	2.9796		24.7	



APPENDIX C
Emission Rate Calculations

DEFINITION OF TERMS

An	Cross-sectional area of nozzle, ft ²
B _{ws}	Water vapor in the gas stream, proportion by volume
C _p	Pitot tube coefficient (Type S = 0.84, STD. = 0.99)
C _s	Concentration of particulate matter in stack gas, dry basis, at 68°F and 29.92" Hg, gr/dscf
C' _s	Concentration of particulate matter in stack gas, dry basis, at 68° and 29.92" Hg, lb/dscf
d	Diameter of circular duct, in.
EA	Percent excess air
E _r	Particulate mass emission rate, lb/hr
ΔH	Average pressure differential across the orifice meter, in. H ₂ O
I	Percent of isokinetic sampling
L	Length of rectangular duct, in.
La	Maximum acceptable leakage rate for either a pretest leak check or for a leak check following a component change; equal to 0.02 cfm or 4 percent of the average sampling rate, whichever is less
Lp	Leakage rate observed during the post-test leak check, cfm
Mn	Total amount of particulate matter collected, mg
Md	Dry molecular weight, lb/lb mole
Ms	Wet molecular weight, lb/lb mole
Pb	Standard absolute pressure, 29.92" Hg
ΔP	Velocity head measured by a pitot tube, in. H ₂ O
Ps	Absolute stack gas pressure, in. Hg
Qa	Actual volumetric stack gas flow rate at stack conditions, acfm
Q _{STD}	Dry volumetric stack gas flow rate at 68°F and 29.92" Hg, dscfm
Tm	Absolute average dry gas meter temperature, °R
Ts	Absolute average stack gas temperature, °R

V_f Final weight of condenser water, gm

V_i Initial weight of condenser water, gm

V_{lc} Total weight of liquid collected in condenser and silica gel, gm

V_m Volume of gas sample as measured by the dry gas meter, dcf

V_{mc} Volume of gas sample as measured by the dry gas meter, corrected for leakage, dcf

$V_{s_{avg}}$ Average stack gas velocity, ft/sec

$V_{m_{STD}}$ Volume of gas sample measured by the dry gas meter, at 68°F and 29.92" Hg, dscf

V_{wc} Volume of water vapor condensed, at 68°F and 29.92" Hg, scf

V_{wsg} Volume of water vapor collected in silica gel, scf

$V_{w_{STD}}$ Total volume of water vapor condensed and collected in silica gel, scf

W Width of rectangular duct, in

Y Dry gas meter calibration factor

θ Total sampling time, min.

USEPA METHODS 1 THROUGH 5 CALCULATIONS

1. Volume Metered, corrected for leakage (if >0.02 cfm)

$$V_{m_c} = V_m - [(L_p - L_a)\theta]$$

2. Volume Metered, standard conditions

$$V_{m_{std}} = (17.64) V_{m_c} Y \frac{P_{bar} + (\Delta H \div 13.6)}{T_m}$$

3. Volume Water Vapor Collected, standard conditions

$$V_{w_c} = 0.04707 (V_f - V_i)$$

$$V_{w_{sg}} = 0.04707 (W_f - W_i)$$

$$V_{w_{std}} = W_{w_c} + V_{w_{sg}}$$

4. Percent Moisture, by volume

$$B_{ws} = \frac{V_{w_{std}}}{V_{w_{std}} + V_{m_{std}}}$$

5. Molecular Weight

$$M_d = 0.440(\%CO_2) + 0.320(\%O_2) + 0.280(\%N_2 + \%CO)$$

$$M_s = M_d (1 - B_{ws}) + 18.0 (B_{ws})$$

6. Excess Air

$$\% EA = \frac{\%O_2 - 0.5 \%CO}{0.264 \%N_2 - (\%O_2 - 0.5 \%CO)} \quad (100)$$

7. Stack Gas Velocity, average

$$V_{s_{ave}} = (85.49) C_p (\sqrt{\Delta P})_{ave} \sqrt{\frac{T_s}{P_s M_s}}$$

USEPA METHODS 1 THROUGH 5 CALCULATIONS (Cont'd)

8. Stack Volumetric Flow Rate, actual conditions

$$Q_a \text{ (circular)} = (60) V_{S_{ave}} (5.454 \times 10^{-3}) d^2$$

$$Q_a \text{ (rectangular)} = (60) V_{S_{ave}} L W (6.944 \times 10^{-3})$$

9. Stack Volumetric Flow Rate, dry standard conditions

$$Q_{std} = (17.64) Q_a (1 - B_{ws}) \frac{P_s}{T_s}$$

10. Emission Rates

$$C'_s = (0.0154 \text{ gr/mg}) (M_n \div V_{m, std})$$

$$C_s = (1.429 \times 10^{-4} \text{ lb/gr}) C'_s$$

$$E_r = (60) C_s Q_{std}$$

11. Isokinetic Variation

$$\%I = \frac{100 T_s [(0.002669 V_{lc}) + (V_m \div T_m) Y (P_{bar} + (\Delta H - 13.6))]}{60 \theta V_s P_s A_n}$$

PARTICULATE EMISSION TEST CALCULATIONS

PLANT AB Columbus, OH SOURCE/RUN L-I-1 DATE 11/1/83

1. Leakage Correction for Volume Metered

$$V_{m_c} = V_m - (L_p - I_a)\theta = V_m - (L_p - 0.02)\theta = (\quad) - (\quad - 0.02) (\quad)$$

$$V_{m_c} = \underline{45,950 \text{ ft}^3}$$

2. Volume Metered, Standard Conditions (68°F, 29.92 in.Hg)

$$V_{m_{std}} = 17.64 V_{m_c} Y \left(\frac{P_{bar} + \Delta H / 13.6}{T_m} \right) = 17.64 (45,95) (1.004) \frac{(29.53) + (2.65) / 13.6}{(536)}$$

$$V_{m_{std}} = \underline{45,131} \text{ dscf}$$

3. Volume Water Vapor Collected, Standard Conditions

$$\text{Impingers} = V_{wc} = 0.04707 (V_f - V_i) = 0.04707 (\quad) = \underline{\quad} \text{ scf}$$

$$\text{Silica Gel} = V_{wsg} = 0.04797 (W_f - W_i) = 0.04797 (567.2) = \underline{26.698} \text{ scf}$$

$$V_{w_{std}} = V_{wc} + V_{wsg} = \underline{26.698} \text{ scf}$$

4. Percent Moisture, By Volume

$$B_{ws} = \frac{V_{w_{std}}}{V_{w_{std}} + V_{m_{std}}} = \frac{(26.698)}{(26.698) + (45,131)} = \underline{0.3717}$$

5. Molecular Weight, Stack Gas

$$\text{Dry Molecular Weight, } M_d = 0.440 (\%CO_2) + 0.320 (\%O_2) + 0.280 (\%N_2 + \%CO)$$

$$= 0.440 (3.0) + 0.320 (15.2) + 0.280 (81.2)$$

$$M_d = \underline{29.11} \text{ lb/lb-mole}$$

Percent Excess Air, %EA =

$$\left[\frac{\%O_2 - 0.5 \%CO}{0.264 (\%N_2) - (\%O_2 - 0.5 \%CO)} \right] \times 100 \left[\frac{(\quad) - 0.5 (\quad)}{0.264 (\quad) - (\quad) - 0.5 (\quad)} \right] \times 100$$

$$\%EA = \underline{\quad}$$

$$M_s = M_d (1 - B_{ws}) + 18.0 (B_{ws}) = (29.11) (1 - 0.3717) + 18.0 (0.3717) = \underline{24.98} \text{ lb/lb-mole}$$

6. Stack Gas Velocity, Average

$$V_{s_{avg}} = 85.49 C_p (\sqrt{\Delta P})_{avg} \sqrt{\frac{T_s}{P_s M_s}} = 85.49 (1.84) (0.815) \sqrt{\frac{(677)}{(29.47)(24.98)}}$$

$$V_{s_{avg}} = \underline{56.13} \text{ ft/s}$$

PARTICULATE EMISSION TEST CALCULATIONS (Cont'd)

7. Stack Volumetric Flow Rate, Actual Conditions (Stack Temperature and Pressure)

$$Q_a(\text{circular}) = \left(\frac{60 \times V_s (\pi d^2/4)}{144} \right) = 60 \times V_s (5.454 \times 10^{-3}) (d^2)$$

$$= 60 \times \underline{56.13} (5.454 \times 10^{-3}) (\underline{44.0})^2$$

"or" $Q_a(\text{rectangular}) = 60 \times V_s \left(\frac{L \times W}{144} \right) = 60 \times V_s (L \times W) 6.944 \times 10^{-3}$

$$= 60 \times \underline{\hspace{2cm}} (\underline{\hspace{2cm}} \times \underline{\hspace{2cm}}) 6.944 \times 10^{-3}$$

$Q_a = \underline{35,562}$ acfm

8. Stack Volumetric Flow Rate, Standard Conditions (68°F, 29.92 in. Hg)

$$Q_{\text{std}} = 17.64 Q_a (1 - B_{ws}) \left(\frac{P_s}{T_s} \right) = 17.64 (35,562) (1 - 0.3717) \left(\frac{29.47}{677} \right)$$

$$Q_{\text{std}} = \underline{17,157}$$
 dscfm

9. Emissions

$$C'_s = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{M_n}{V_{m\text{std}}} = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{(592.6)}{(45.131)} = \underline{0.2022}$$
 gr/dscf

$$C_s = 1.429 \times 10^{-4} \times C'_s = 1.429 \times 10^{-4} (\underline{0.2022}) = \underline{2.89 E - 05}$$
 lb/dscf

$$E_r = 60 C_s Q_{\text{std}} = 60 (2.89 E - 05) (17,157) = \underline{29.7}$$
 lb/hr

10. Isokinetic Variation

$$\%I = 100 T_s \left[\frac{0.002669 \times V_{1c} + \frac{V_m}{T_m} \times Y \left(P_{\text{bar}} + \frac{\Delta H}{13.6} \right)}{60 \times Q \times V_s \times P_s \times A_n} \right]$$

$$= 100 \times \underline{677} \left[\frac{0.002669 (567.2) + \frac{(45.950)}{(536)} (1.004) \left(\frac{29.53}{13.6} + \frac{2.65}{13.6} \right)}{60 \times (40 \times 56.13) \times (29.47) \times (4.908) \times 10^{-4}} \right]$$

$$= \underline{94.3} \%$$

PARTICULATE EMISSION TEST CALCULATIONS

PLANT AB - Columbus, OH SOURCE/RUN 1- I-2 DATE 11/2/83

1. Leakage Correction for Volume Metered

$$V_{mC} = V_m - (L_p - L_a)\theta = V_m - (L_p - 0.02)\theta = (\quad) - (\quad - 0.02) (\quad)$$

$$V_{mC} = \underline{42,171} \text{ ft}^3$$

2. Volume Metered, Standard Conditions (68°F, 29.92 in.Hg)

$$V_{mstd} = 17.64 V_{mC} Y \left(\frac{P_{bar} + \Delta H / 13.6}{T_m} \right) = 17.64 (42,171) (1.004) \frac{(29.46) + (2.24) / 13.6}{(532)}$$

$$V_{mstd} = \underline{41,590} \text{ dscf}$$

3. Volume Water Vapor Collected, Standard Conditions

$$\text{Impingers} = V_{wc} = 0.04707 (V_F - V_i) = 0.04707 (\quad) = \underline{\quad} \text{ scf}$$

$$\text{Silica Gel} = V_{wsg} = 0.04797 (W_F - W_i) = 0.04707 (510.9) = \underline{24.048} \text{ scf}$$

$$V_{wstd} = V_{wc} + V_{wsg} = \underline{24.048} \text{ scf}$$

4. Percent Moisture, By Volume

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = \frac{(24.048)}{(24.048) + (41,590)} = \underline{.3664}$$

5. Molecular Weight, Stack Gas

$$\text{Dry Molecular Weight, } M_d = 0.440 (\%CO_2) + 0.320 (\%O_2) + 0.280 (\%N_2 + \%CO)$$

$$= 0.440 (4.7) + 0.320 (6.1) + 0.280 (79.2)$$

$$M_d = \underline{29.40} \text{ lb/lb - mole}$$

Percent Excess Air, %EA =

$$\left[\frac{\%O_2 - 0.5 \%CO}{0.264 (\%N_2) - (\%O_2 - 0.5 \%CO)} \right] \times 100 \left[\frac{(\quad) - 0.5 (\quad)}{0.264 (\quad) - 0.5 (\quad)} \right] \times 100$$

$$\%EA = \underline{\quad}$$

$$M_g = M_d (1 - B_{ws}) + 18.0 (B_{ws}) = (29.40) (1 - .3664) + 18.0 (.3664) = \underline{25.22} \text{ lb/lb-mole}$$

6. Stack Gas Velocity, Average

$$V_{savg} = 85.49 C_p (\sqrt{\Delta P})_{avg} \sqrt{\frac{T_s}{P_s M_s}} = 85.49 (1.776) (1.84) \sqrt{\frac{(680)}{(29.40) (25.22)}}$$

$$V_{savg} = \underline{51.41} \text{ ft/s}$$

PARTICULATE EMISSION TEST CALCULATIONS (Cont'd)

7. Stack Volumetric Flow Rate, Actual Conditions (Stack Temperature and Pressure)

$$Q_a(\text{circular}) = \left(\frac{60 \times V_s (\pi d^2/4)}{144} \right) = 60 \times V_s (5.454 \times 10^{-3}) (d^2)$$

$$= 60 \times \underline{51.41} (5.454 \times 10^{-3}) (\underline{44})^2$$

"or" $Q_a(\text{rectangular}) = 60 \times V_s \left(\frac{L \times W}{144} \right) = 60 \times V_s (L \times W) 6.944 \times 10^{-3}$

$$= 60 \times \underline{\hspace{2cm}} (\underline{\hspace{2cm}} \times \underline{\hspace{2cm}}) 6.944 \times 10^{-3}$$

$$Q_a = \underline{32570} \text{ acfm}$$

8. Stack Volumetric Flow Rate, Standard Conditions (68°F, 29.92 in. Hg)

$$Q_{\text{std}} = 17.64 Q_a (1 - B_{ws}) \left(\frac{P_s}{T_s} \right) = 17.64 (32570) (1 - .3664) \left(\frac{29.40}{68} \right)$$

$$Q_{\text{std}} = \underline{15,556} \text{ dscfm}$$

9. Emissions

$$C'_s = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{M_n}{V_{m\text{std}}} = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{(467.1)}{(41.590)} = \underline{0.173} \text{ gr/dscf}$$

$$C_s = 1.429 \times 10^{-4} \times C'_s = 1.429 \times 10^{-4} (\underline{0.1730}) = \underline{2.47 \text{ E}^{-05}} \text{ lb/dscf}$$

$$E_r = 60 C_s Q_{\text{std}} = 60 (2.47 \text{ E}^{-05}) (15,556) = \underline{23.1} \text{ lb/hr}$$

10. Isokinetic Variation

$$\%I = 100 T_s \left[\frac{0.002669 \times V_{1c} + \frac{V_m}{T_m} \times Y \left(P_{\text{bar}} + \frac{\Delta H}{13.6} \right)}{60 \times 0 \times V_s \times P_s \times A_n} \right]$$

$$= 100 \times \underline{680} \left[\frac{0.002669 (510.9) + \frac{(42.171)}{(532)} (1.004) \left(\frac{29.46 + 2.24}{13.6} \right)}{60 \times (60 \times 51.41) \times (29.40) \times (4.908 \text{ E}^{-04})} \right]$$

$$= \underline{94.8} \%$$

PARTICULATE EMISSION TEST CALCULATIONS

PLANT AB - Columbus, OH SOURCE/RUN 1-I-3 DATE 11/2/83

1. Leakage Correction for Volume Metered

$$V_{mC} = V_m - (Lp - La)\theta = V_m - (Lp - 0.02)\theta = (\quad) - (\quad - 0.02) (\quad)$$

$$V_{mC} = \underline{37.197} \text{ ft}^3$$

2. Volume Metered, Standard Conditions (68°F, 29.92 in.Hg)

$$V_{mstd} = 17.64 V_{mC} Y \left(\frac{P_{bar} + \Delta H / 13.6}{T_m} \right) = 17.64 (37.197) (1.004) \frac{(29.29) + (1.71) / 13.6}{(537)}$$

$$V_{mstd} = \underline{36.087} \text{ dscf}$$

3. Volume Water Vapor Collected, Standard Conditions

Impingers = $V_{wc} = 0.04707 (V_F - V_I) = 0.04707 (\quad) = \underline{\quad} \text{ scf}$

Silica Gel = $V_{wsg} = 0.04797 (W_F - W_I) = 0.04707 (152.1) = \underline{7.159} \text{ scf}$

$$V_{wstd} = V_{wc} + V_{wsg} = \underline{7.159} \text{ scf}$$

4. Percent Moisture, By Volume

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = \frac{(7.159)}{(36.087) + (7.159)} = \underline{0.1655}$$

5. Molecular Weight, Stack Gas

Dry Molecular Weight, $M_d = 0.440 (\%CO_2) + 0.320 (\%O_2) + 0.280 (\%N_2 + \%CO)$

$$= 0.440 (13) + 0.320 (9.3) + 0.280 (79.4)$$

$$M_d = \underline{28.98} \text{ lb/lb - mole}$$

Percent Excess Air, %EA =

$$\left[\frac{\%O_2 - 0.5 \%CO}{0.264 (\%N_2) - (\%O_2 - \quad)} \right] \times 100 \left[\frac{(\quad) - 0.5 (\quad)}{0.264 (\quad) - 0.5 (\quad)} \right] \times 100$$

$$\%EA = \underline{\quad}$$

$$M_s = M_d (1 - B_{ws}) + 18.0 (B_{ws}) = (28.98) (1 - 0.1655) + 18.0 (0.1655) = \underline{27.16} \text{ lb/lb-mole}$$

6. Stack Gas Velocity, Average

$$V_{savg} = 85.49 C_p (\sqrt{\Delta P})_{avg} \sqrt{\frac{T_s}{P_s M_s}} = 85.49 (0.7706) (0.84) \sqrt{\frac{(670)}{(29.23)(27.16)}}$$

$$V_{savg} = \underline{50.84} \text{ ft/s}$$

PARTICULATE EMISSION TEST CALCULATIONS (Cont'd)

7. Stack Volumetric Flow Rate, Actual Conditions (Stack Temperature and Pressure)

$$Q_a(\text{circular}) = \left(\frac{60 \times V_s (\pi d^2/4)}{144} \right) = 60 \times V_s (5.454 \times 10^{-3}) (d^2)$$

$$= 60 \times \underline{50.84} (5.454 \times 10^{-3}) (\underline{44.0})^2$$

"or" $Q_a(\text{rectangular}) = 60 \times V_s \left(\frac{L \times W}{144} \right) = 60 \times V_s (L \times W) 6.944 \times 10^{-3}$

$$= 60 \times \underline{\hspace{2cm}} (\underline{\hspace{2cm}} \times \underline{\hspace{2cm}}) 6.944 \times 10^{-3}$$

$Q_a = \underline{32207}$ acfm

8. Stack Volumetric Flow Rate, Standard Conditions (68°F, 29.92 in. Hg)

$$Q_{\text{std}} = 17.64 Q_a (1 - B_{ws}) \left(\frac{P_s}{T_s} \right) = 17.64 (32207) (1 - 0.1655) \left(\frac{29.73}{670} \right)$$

$Q_{\text{std}} = \underline{20684}$ dscfm

9. Emissions

$$C'_s = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{M_n}{V_{m\text{std}}} = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{(188.8)}{(36.087)} = \underline{0.0806} \text{ gr/dscf}$$

$$C_s = 1.429 \times 10^{-4} \times C'_s = 1.429 \times 10^{-4} (\underline{0.0806}) = \underline{1.15 \text{ E-05}} \text{ lb/dscf}$$

$$E_r = 60 C_s Q_{\text{std}} = 60 (1.15 \text{ E-05}) (20,684) = \underline{14.3} \text{ lb/hr}$$

10. Isokinetic Variation

$$\%I = 100 T_s \left[\frac{0.002669 \times V_{1c} + \frac{V_m}{T_m} \times Y \left(P_{\text{bar}} + \frac{\Delta H}{13.6} \right)}{60 \times 0 \times V_s \times P_s \times A_n} \right]$$

$$= 100 \times \underline{670} \left[\frac{0.002669 (152.1) + \frac{(37.197)}{(537)} (1.004) \left(\frac{29.29}{13.6} + \frac{1.71}{13.6} \right)}{60 \times (60 \times 50.84) \times (29.23) \times (3.382) \times 10^{-4}} \right]$$

$$= \underline{90.8} \%$$

PARTICULATE EMISSION TEST CALCULATIONS

PLANT AB - Columbus SOURCE/RUN 1-I-4 DATE 11-3-83

1. Leakage Correction for Volume Metered

$$V_{m_c} = V_m - (L_p - L_a)\theta = V_m - (L_p - 0.02)\theta = (\quad) - (\quad - 0.02) (\quad)$$

$$V_{m_c} = \underline{43.925} \text{ ft}^3$$

2. Volume Metered, Standard Conditions (68°F, 29.92 in.Hg)

$$V_{m_{std}} = 17.64 V_{m_c} Y \left(\frac{P_{bar} + \Delta H / 13.6}{T_m} \right) = 17.64 (43.925) (1.004) \frac{(29.25) + (2.40) / 13.6}{(528)}$$

$$V_{m_{std}} = \underline{43.356} \text{ dscf}$$

3. Volume Water Vapor Collected, Standard Conditions

Impingers = $V_{wc} = 0.04707 (V_f - V_i) = 0.04707 (\quad) = \underline{\quad} \text{ scf}$

Silica Gel = $V_{wsg} = 0.04797 (W_f - W_i) = 0.04797 (\quad) = \underline{23.060} \text{ scf}$

$V_{w_{std}} = V_{wc} + V_{wsg} = \underline{23.060} \text{ scf}$

4. Percent Moisture, By Volume

$$B_{ws} = \frac{V_{w_{std}}}{V_{w_{std}} + V_{m_{std}}} = \frac{(23.060)}{(23.060) + (43.356)} = \underline{0.3472}$$

5. Molecular Weight, Stack Gas

Dry Molecular Weight, $M_d = 0.440 (\%CO_2) + 0.320 (\%O_2) + 0.280 (\%N_2 + \%CO)$

$$= 0.440 (3.2) + 0.320 (17.2) + 0.280 (79.6)$$

$$M_d = \underline{29.20} \text{ lb/lb-mole}$$

Percent Excess Air, %EA =

$$\left[\frac{\%O_2 - 0.5 \%CO}{0.264 (\%N_2) - (\%O_2 - 0.5 \%CO)} \right] \times 100 \left[\frac{(\quad) - 0.5 (\quad)}{0.264 (\quad) - 0.5 (\quad)} \right] \times 100$$

%EA =

$$M_s = M_d (1 - B_{ws}) + 18.0 (B_{ws}) = (29.20) (1 - 0.3472) + 18.0 (0.3472) = \underline{25.31} \text{ lb/lb-mole}$$

6. Stack Gas Velocity, Average

$$V_{s_{avg}} = 85.49 C_p (\sqrt{\Delta P})_{avg} \sqrt{\frac{T_s}{P_s M_s}} = 85.49 (0.7380) (0.84) \sqrt{\frac{(679)}{(29.19)(25.31)}}$$

$$V_{s_{avg}} = \underline{50.81} \text{ ft/s}$$

PARTICULATE EMISSION TEST CALCULATIONS (Cont'd)

7. Stack Volumetric Flow Rate, Actual Conditions (Stack Temperature and Pressure)

$$Q_a(\text{circular}) = \left(\frac{60 \times \pi d^2/4}{144} \right) = 60 \times V_s (5.454 \times 10^{-3}) (d^2)$$

$$= 60 \times \underline{50.81} (5.454 \times 10^{-3}) (\underline{44.0})^2$$

"or" $Q_a(\text{rectangular}) = 60 \times V_s \left(\frac{L \times W}{144} \right) = 60 \times V_s (L \times W) 6.944 \times 10^{-3}$

$$= 60 \times \underline{\hspace{2cm}} (\underline{\hspace{2cm}} \times \underline{\hspace{2cm}}) 6.944 \times 10^{-3}$$

$Q_a = \underline{32,188}$ acfm

8. Stack Volumetric Flow Rate, Standard Conditions (68°F, 29.92 in. Hg)

$$Q_{\text{std}} = 17.64 Q_a (1 - B_{ws}) \left(\frac{P_s}{T_s} \right) = 17.64 (32188) (1 - .3472) \left(\frac{29.19}{679} \right)$$

$Q_{\text{std}} = \underline{15,934}$ dscfm

9. Emissions

$$C'_s = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{M_n}{V_{m\text{std}}} = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{(457.0)}{(43.356)} = \underline{0.1623}$$
 gr/dscf

$C_s = 1.429 \times 10^{-4} \times C'_s = 1.429 \times 10^{-4} (\underline{0.1623}) = \underline{2.32 \times 10^{-5}}$ lb/dscf

$E_r = 60 C_s Q_{\text{std}} = 60 (2.32 \times 10^{-5}) (15,934) = \underline{22.2}$ lb/hr

10. Isokinetic Variation

$$\%I = \frac{100 T_s \left[0.002669 \times V_{1c} + \frac{V_m}{T_m} \times Y \left(P_{\text{bar}} + \frac{\Delta H}{13.6} \right) \right]}{60 \times Q \times V_s \times P_s \times A_n}$$

$$= \frac{100 \times \underline{679} \left[0.002669 (489.9) + \frac{(43.925)}{(528)} (1.004) \left(\frac{29.25}{13.6} + \frac{2.40}{13.6} \right) \right]}{60 \times (60 \times \underline{50.81}) \times (29.19) \times (4.9075) \times 10^{-4}}$$

$= \underline{97.5} \%$

PARTICULATE EMISSION TEST CALCULATIONS

PLANT AB - Columbus SOURCE/RUN 1-I-5 DATE 11-3-83

1. Leakage Correction for Volume Metered

$$V_{m_c} = V_m - (L_p - I_a)\theta = V_m - (L_p - 0.02)\theta = (\quad) - (\quad - 0.02) (\quad)$$

$$V_{m_c} = \underline{39.860} \text{ ft}^3$$

2. Volume Metered, Standard Conditions (68°F, 29.92 in.Hg)

$$V_{m_{std}} = 17.64 V_{m_c} Y \left(\frac{P_{bar} + \Delta H / 13.6}{T_m} \right) = 17.64 (39.860) (1.004) \frac{(29.30) + (1.95) / 13.6}{(521)}$$

$$V_{m_{std}} = \underline{39.895} \text{ dscf}$$

3. Volume Water Vapor Collected, Standard Conditions

$$\text{Impingers} = V_{w_c} = 0.04707 (V_f - V_i) = 0.04707 (\quad) = \underline{\quad} \text{ scf}$$

$$\text{Silica Gel} = V_{w_{sg}} = 0.04797 (W_f - W_i) = 0.04797 (\quad) = \underline{7.399} \text{ scf}$$

$$V_{w_{std}} = V_{w_c} + V_{w_{sg}} = \underline{7.399} \text{ scf}$$

4. Percent Moisture, By Volume

$$B_{ws} = \frac{V_{w_{std}}}{V_{w_{std}} + V_{m_{std}}} = \frac{(7.399)}{(7.399) + (39.895)} = \underline{.1564}$$

5. Molecular Weight, Stack Gas

$$\text{Dry Molecular Weight, } M_d = 0.440 (\%CO_2) + 0.320 (\%O_2) + 0.280 (\%N_2 + \%CO)$$

$$= 0.440 (3.2) + 0.320 (17.2) + 0.280 (79.6)$$

$$M_d = \underline{29.20} \text{ lb/lb-mole}$$

Percent Excess Air, %EA =

$$\left[\frac{\%O_2 - 0.5 \%CO}{0.264 (\%N_2) - (\%O_2 - 0.5 \%CO)} \right] \times 100 \left[\frac{(\quad) - 0.5 (\quad)}{0.264 (\quad) - 0.5 (\quad)} \right] \times 100$$

$$\%EA = \underline{\quad}$$

$$M_s = M_d (1 - B_{ws}) + 18.0 (B_{ws}) = (29.20) (1 - .1564) + 18.0 (.1564) = \underline{27.45} \text{ lb/lb-mole}$$

6. Stack Gas Velocity, Average

$$V_{s_{avg}} = 85.49 C_p \left(\sqrt{\Delta P} \right)_{avg} \sqrt{\frac{T_s}{P_s M_s}} = 85.49 (7856) (.84) \sqrt{\frac{(671)}{(29.24)(27.45)}}$$

$$V_{s_{avg}} = \underline{51.58} \text{ ft/s}$$

PARTICULATE EMISSION TEST CALCULATIONS (Cont'd)

7. Stack Volumetric Flow Rate, Actual Conditions (Stack Temperature and Pressure)

$$Q_a(\text{circular}) = \left(\frac{60 \times v_s (\pi d^2/4)}{144} \right) = 60 \times v_s (5.454 \times 10^{-3}) (d^2)$$

$$= 60 \times \underline{51.58} (5.454 \times 10^{-3}) (\underline{44.0})^2$$

"or" $Q_a(\text{rectangular}) = 60 \times v_s \left(\frac{L \times W}{144} \right) = 60 \times v_s (L \times W) 6.944 \times 10^{-3}$

$$= 60 \times \underline{\hspace{2cm}} (\underline{\hspace{2cm}} \times \underline{\hspace{2cm}}) 6.944 \times 10^{-3}$$

$Q_a = \underline{32,679}$ acfm

8. Stack Volumetric Flow Rate, Standard Conditions (68°F, 29.92 in. Hg)

$$Q_{\text{std}} = 17.64 Q_a (1 - B_{ws}) \left(\frac{P_s}{T_s} \right) = 17.64 (32,679) (1 - .1564) \left(\frac{29.24}{671} \right)$$

$Q_{\text{std}} = \underline{21,191}$ dscfm

9. Emissions

$$C'_s = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{M_n}{V_{m\text{std}}} = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{(151.4)}{(39.895)} = \underline{0.0584} \text{ gr/dscf}$$

$$C_s = 1.429 \times 10^{-4} \times C'_s = 1.429 \times 10^{-4} (\underline{0.0584}) = \underline{8.35 \text{ E-}06} \text{ lb/dscf}$$

$$E_r = 60 C_s Q_{\text{std}} = 60 (8.35 \text{ E-}06) (21,191) = \underline{10.6} \text{ lb/hr}$$

10. Isokinetic Variation

$$\%I = 100 T_s \left[\frac{0.002669 \times V_{1C} + \frac{V_m}{T_m} \times Y \left(P_{\text{bar}} + \frac{\Delta H}{13.6} \right)}{60 \times Q \times V_s \times P_s \times A_n} \right]$$

$$= 100 \times \underline{671} \left[\frac{0.002669 (157.2) + \frac{(39.860)}{(521)} (1.004) \left(\frac{29.30}{13.6} + \frac{1.95}{13.6} \right)}{60 \times (60) \times (51.58) \times (29.24) \times (3.3816) \times 10^{-4}} \right]$$

$$= \underline{98.0} \%$$

PARTICULATE EMISSION TEST CALCULATIONS

PLANT Anheuser-Busch SOURCE/RUN 1-0-1 DATE 11/1/83

1. Leakage Correction for Volume Metered

$$V_{m_c} = V_m - (L_p - L_a)\theta = V_m - (L_p - 0.02)\theta = () - (-0.02) ()$$

$$V_{m_c} = \underline{56.061} \text{ ft}^3$$

2. Volume Metered, Standard Conditions (68°F, 29.92 in.Hg)

$$V_{m_{std}} = 17.64 V_{m_c} Y \left(\frac{P_{bar} + \Delta H / 13.6}{T_m} \right) = 17.64 (56.061) (0.999) \frac{(29.53) + (2.43) / 13.6}{(540)}$$

$$V_{m_{std}} = \underline{54.352} \text{ dscf}$$

3. Volume Water Vapor Collected, Standard Conditions

Impingers = $V_{wc} = 0.04707 (V_f - V_i) = 0.04707 (530.6) = \underline{24.975} \text{ scf}$

Silica Gel = $V_{wsg} = 0.04797 (W_f - W_i) = 0.04707 (19.6) = \underline{0.923} \text{ scf}$

$V_{w_{std}} = V_{wc} + V_{wsg} = \underline{25.898} \text{ scf}$

4. Percent Moisture, By Volume

$$B_{ws} = \frac{V_{w_{std}}}{V_{w_{std}} + V_{m_{std}}} = \frac{(25.898)}{(25.898) + (54.352)} = \underline{0.323}$$

5. Molecular Weight, Stack Gas

Dry Molecular Weight, $M_d = 0.440 (\%CO_2) + 0.320 (\%O_2) + 0.280 (\%N_2 + \%CO)$

$$= 0.440 (2.8) + 0.320 (17.9) + 0.280 (79.3)$$

$$M_d = \underline{29.16} \text{ lb/lb-mole}$$

Percent Excess Air, %EA =

$$\left[\frac{\%O_2 - 0.5 \%CO}{0.264 (\%N_2) - (\%O_2 - 0.5 \%CO)} \right] \times 100 \left[\frac{() - 0.5 ()}{0.264 () - () - 0.5 ()} \right] \times 100$$

%EA = _____

$$M_s = M_d (1 - B_{ws}) + 18.0 (B_{ws}) = (29.16) (1 - 0.323) + 18.0 (0.323) = \underline{25.56} \text{ lb/lb-mole}$$

6. Stack Gas Velocity, Average

$$V_{s_{avg}} = 85.49 C_p (\sqrt{\Delta P})_{avg} \sqrt{\frac{T_s}{P_s M_s}} = 85.49 (0.84) (0.713) \sqrt{\frac{(620)}{(29.51)(25.56)}}$$

$$V_{s_{avg}} = \underline{46.42} \text{ ft/s}$$

PARTICULATE EMISSION TEST CALCULATIONS (Cont'd)

7. Stack Volumetric Flow Rate, Actual Conditions (Stack Temperature and Pressure)

$$Q_a(\text{circular}) = \left(\frac{60 \times v_s (\pi d^2/4)}{144} \right) = 60 \times v_s (5.454 \times 10^{-3}) (d^2) \left(\frac{P_s - F}{P_s} \right)$$

$$= 60 \times \underline{46.42} (5.454 \times 10^{-3}) \left(\underline{66} \right)^2 (0.547)$$

"or" $Q_a(\text{rectangular}) = 60 \times v_s \left(\frac{L \times W}{144} \right) = 60 \times v_s (L \times W) 6.944 \times 10^{-3}$

$$= 60 \times \underline{\hspace{2cm}} \left(\underline{\hspace{2cm}} \times \underline{\hspace{2cm}} \right) 6.944 \times 10^{-3}$$

$Q_a = \underline{36,195} \checkmark$ acfm

8. Stack Volumetric Flow Rate, Standard Conditions (68°F, 29.92 in. Hg)

$$Q_{\text{std}} = 17.64 Q_a (1 - B_{ws}) \left(\frac{P_s}{T_s} \right) = 17.64 (36,195) (1 - 0.323) \left(\frac{29.51}{620} \right)$$

$Q_{\text{std}} = \underline{20,574} \checkmark$ dscfm

9. Emissions

$$C'_s = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{M_n}{V_{m\text{std}}} = 0.0154 \frac{\text{gr}}{\text{mg}} \left(\frac{445.5}{54.352} \right) = \underline{0.1262} \checkmark \text{ gr/dscf}$$

$$C_s = 1.429 \times 10^{-4} \times C'_s = 1.429 \times 10^{-4} \left(\underline{0.1262} \right) = \underline{1.80 \text{ E } -05} \checkmark \text{ lb/dscf}$$

$$E_r = 60 C_s Q_{\text{std}} = 60 (1.80 \text{ E } -05) (20,574) = \underline{22.3} \checkmark \text{ lb/hr}$$

10. Isokinetic Variation

$$\%I = \frac{100 T_s \left[0.002669 \times V_{1c} + \frac{V_m}{T_m} \times Y \left(P_{\text{bar}} + \frac{\Delta H}{13.6} \right) \right]}{60 \times Q \times V_s \times P_s \times A_n}$$

$$= \frac{100 \times \underline{620} \left[0.002669 (550.2) + \frac{(56.061)}{(540)} (0.999) \left(\frac{29.53}{13.6} + \frac{2.43}{13.6} \right) \right]}{60 \times (65.3) \times (2.42) \times (29.51) \times (\hspace{2cm})}$$

$$= \underline{105.6} \checkmark \%$$

$4.974 \text{ E } -04$

checked 11/22/83 ATO

PARTICULATE EMISSION TEST CALCULATIONS

PLANT Anheuser-Busch SOURCE/RUN 1-0-2 DATE 11/2/83

1. Leakage Correction for Volume Metered

$$V_{m_c} = V_m - (L_p - L_a)\theta = V_m - (L_p - 0.02)\theta = () - () - 0.02 ()$$

$$V_{m_c} = \underline{50.585} \text{ ft}^3$$

2. Volume Metered, Standard Conditions (68°F, 29.92 in.Hg)

$$V_{m_{std}} = 17.64 V_{m_c} Y \left(\frac{P_{bar} + \Delta H / 13.6}{T_m} \right) = 17.64 (50.585) (0.999) \frac{(29.46) + (1.92) / 13.6}{(531)}$$

$$V_{m_{std}} = \underline{49.694} \text{ dscf}$$

3. Volume Water Vapor Collected, Standard Conditions

$$\text{Impingers} = V_{w_c} = 0.04707 (V_f - V_i) = 0.04707 (496.0) = \underline{23.347} \text{ scf}$$

$$\text{Silica Gel} = V_{w_{sg}} = 0.04797 (W_f - W_i) = 0.04797 (20.7) = \underline{0.974} \text{ scf}$$

$$V_{w_{std}} = V_{w_c} + V_{w_{sg}} = \underline{24.321} \text{ scf}$$

4. Percent Moisture, By Volume

$$B_{ws} = \frac{V_{w_{std}}}{V_{w_{std}} + V_{m_{std}}} = \frac{(24.321)}{(24.321) + (49.694)} = \underline{0.329}$$

5. Molecular Weight, Stack Gas

$$\begin{aligned} \text{Dry Molecular Weight, } M_d &= 0.440 (\%CO_2) + 0.320 (\%O_2) + 0.280 (\%N_2 + \%CO) \\ &= 0.440 (3.3) + 0.320 (17.8) + 0.280 (78.9) \end{aligned}$$

$$M_d = \underline{29.247} \text{ lb/lb-mole}$$

Percent Excess Air, %EA =

$$\left[\frac{\%O_2 - 0.5 \%CO}{0.264 (\%N_2) - (\%O_2 - 0.5 \%CO)} \right] \times 100 \left[\frac{() - 0.5 ()}{0.264 () - () - 0.5 ()} \right] \times 100$$

$$\%EA = \underline{\hspace{2cm}}$$

$$M_s = M_d (1 - B_{ws}) + 18.0 (B_{ws}) = (29.27) (1 - 0.329) + 18.0 (0.329) = \underline{25.54} \text{ lb/lb-mole}$$

6. Stack Gas Velocity, Average

$$V_{s_{avg}} = 85.49 C_p \left(\sqrt{\Delta P} \right)_{avg} \sqrt{\frac{T_s}{P_s M_s}} = 85.49 (0.94) (0.678) \sqrt{\frac{(621)}{(29.44) (25.54)}}$$

$$V_{s_{avg}} = \underline{44.25} \text{ ft/s}$$

PARTICULATE EMISSION TEST CALCULATIONS (Cont'd)

7. Stack Volumetric Flow Rate, Actual Conditions (Stack Temperature and Pressure)

$$Q_a(\text{circular}) = \left(\frac{60 \times V_s (\pi d^2/4)}{144} \right) = 60 \times V_s (5.454 \times 10^{-3}) (d^2) \left(\frac{605}{F} \right)$$

$$= 60 \times \frac{44.25^3}{144} (5.454 \times 10^{-3}) \left(\frac{66}{66} \right)^2 (0.547)$$

"or" $Q_a(\text{rectangular}) = 60 \times V_s \left(\frac{L \times W}{144} \right) = 60 \times V_s (L \times W) 6.944 \times 10^{-3}$

$$= 60 \times \text{_____} \left(\text{_____} \times \text{_____} \right) 6.944 \times 10^{-3}$$

$Q_a = \frac{487}{34,500}$ acfm

8. Stack Volumetric Flow Rate, Standard Conditions (68°F, 29.92 in. Hg)

$$Q_{\text{std}} = 17.64 Q_a (1 - B_{ws}) \left(\frac{P_s}{T_s} \right) = 17.64 (34,500) (1 - 0.329) \left(\frac{29.44}{621} \right)$$

$Q_{\text{std}} = \frac{52}{19,359}$ dscfm

9. Emissions

$$C'_s = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{M_n}{V_{m_{\text{std}}}} = 0.0154 \frac{\text{gr}}{\text{mg}} \left(\frac{312.6}{49,694} \right) = \frac{0.0969}{\text{gr/dscf}}$$

$$C_s = 1.429 \times 10^{-4} \times C'_s = 1.429 \times 10^{-4} \left(\frac{0.0969}{\text{gr/dscf}} \right) = \frac{1.38 \text{ E-05}}{\text{lb/dscf}}$$

$$E_r = 60 C_s Q_{\text{std}} = 60 (1.38 \text{ E-05}) (19,359) = \frac{16.1}{\text{lb/hr}}$$

10. Isokinetic Variation

$$\%I = 100 T_s \frac{\left[0.002669 \times V_{1C} + \frac{V_m}{T_m} \times Y \left(P_{\text{bar}} + \frac{\Delta H}{13.6} \right) \right]}{60 \times Q \times V_s \times P_s \times A_n}$$

$$= 100 \times \frac{621}{60 \times (65.3 \times 10^{-3})^3} \times \left[0.002669 (516.7) + \frac{(50.585)}{(531)} (0.999) \left(\frac{29.46}{13.6} + \frac{1.92}{13.6} \right) \right]$$

$$= \frac{7}{102.6} \%$$

checked 11/22/85 *AKO*

PARTICULATE EMISSION TEST CALCULATIONS

PLANT Anheuser Busch SOURCE/RUN 1-0-3 DATE 11/2/83

1. Leakage Correction for Volume Metered

$$V_{m_c} = V_m - (L_p - L_a)\theta = V_m - (L_p - 0.02)\theta = () - () - 0.02 ()$$

$$V_{m_c} = \underline{45.860} \text{ ft}^3$$

2. Volume Metered, Standard Conditions (68°F, 29.92 in.Hg)

$$V_{m_{std}} = 17.64 V_{m_c} Y \left(\frac{P_{bar} + \Delta H / 13.6}{T_m} \right) = 17.64 (45.860) (0.999) \frac{(29.29) + (1.61) / 13.6}{(535)}$$

$$V_{m_{std}} = \underline{44.424} \text{ dscf}$$

3. Volume Water Vapor Collected, Standard Conditions

Impingers = $V_{wc} = 0.04707 (V_f - V_i) = 0.04707 (195.0) = \underline{9.179} \text{ scf}$

Silica Gel = $V_{wsg} = 0.04797 (W_f - W_i) = 0.04797 (11.8) = \underline{0.559} \text{ scf}$

$$V_{w_{std}} = V_{wc} + V_{wsg} = \underline{9.738} \text{ scf}$$

4. Percent Moisture, By Volume

$$B_{ws} = \frac{V_{w_{std}}}{V_{w_{std}} + V_{m_{std}}} = \frac{(9.738)}{(9.738) + (44.424)} = \underline{0.180}$$

5. Molecular Weight, Stack Gas

Dry Molecular Weight, $M_d = 0.440 (\%CO_2) + 0.320 (\%O_2) + 0.280 (\%N_2 + \%CO)$

$$= 0.440 (1.3) + 0.320 (19.8) + 0.280 (78.9)$$

$$M_d = \underline{29.00} \text{ lb/lb-mole}$$

Percent Excess Air, %EA =

$$\left[\frac{\%O_2 - 0.5 \%CO}{0.264 (\%N_2) - (\%O_2 - 0.5 \%CO)} \right] \times 100 \left[\frac{() - 0.5 ()}{0.264 () - () - 0.5 ()} \right] \times 100$$

%EA = _____

$$M_s = M_d (1 - B_{ws}) + 18.0 (B_{ws}) = (29.00) (1 - 0.180) + 18.0 (0.180) = \underline{27.02} \text{ lb/lb-mole}$$

6. Stack Gas Velocity, Average

$$V_{s_{avg}} = 85.49 C_p (\sqrt{\Delta P})_{avg} \sqrt{\frac{T_s}{P_s M_s}} = 85.49 (0.84) (0.904) \sqrt{\frac{(596)}{(29.27)(27.02)}}$$

$$V_{s_{avg}} = \underline{50.12} \text{ ft/s}$$

PARTICULATE EMISSION TEST CALCULATIONS (Cont.'d)

7. Stack Volumetric Flow Rate, Actual Conditions (Stack Temperature and Pressure)

$$Q_a(\text{circular}) = \left(\frac{60 \times V_s (\pi d^2/4)}{144} \right) = 60 \times V_s (5.454 \times 10^{-3}) (d^2)$$

$$= 60 \times \underline{50.12} (5.454 \times 10^{-3}) (\underline{66})^2 (0.547)$$

"or" $Q_a(\text{rectangular}) = 60 \times V_s \left(\frac{L \times W}{144} \right) = 60 \times V_s (L \times W) 6.944 \times 10^{-3}$

$$= 60 \times \underline{\hspace{2cm}} (\underline{\hspace{2cm}} \times \underline{\hspace{2cm}}) 6.944 \times 10^{-3}$$

$Q_a = \underline{39,081}$ acfm

8. Stack Volumetric Flow Rate, Standard Conditions (68°F, 29.92 in. Hg)

$$Q_{\text{std}} = 17.64 Q_a (1 - B_{ws}) \left(\frac{P_s}{T_s} \right) = 17.64 (39,081) (1 - 0.180) \left(\frac{29.27}{596} \right)$$

$Q_{\text{std}} = \underline{27,762}$ dscfm

9. Emissions

$$C'_s = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{M_n}{V_{m\text{std}}} = 0.0154 \frac{\text{gr}}{\text{mg}} \left(\frac{37.4}{44.424} \right) = \underline{0.0130} \text{ gr/dscf}$$

$C_s = 1.429 \times 10^{-4} \times C'_s = 1.429 \times 10^{-4} (\underline{0.0130}) = \underline{1.85 E-06}$ lb/dscf

$E_r = 60 C_s Q_{\text{std}} = 60 (1.85 E-06) (27,762) = \underline{3.1}$ lb/hr

10. Isokinetic Variation

$$\%I = \frac{100 T_s \left[0.002669 \times V_{1c} + \frac{V_m}{T_m} \times Y \left(P_{\text{bar}} + \frac{\Delta H}{13.6} \right) \right]}{60 \times Q \times V_s \times P_s \times A_n}$$

$$= \frac{100 \times \underline{596} \left[0.002669 (206.8) + \frac{(45.860)}{(535)} (0.999) \left(\frac{29.29}{13.6} + \frac{1.61}{13.6} \right) \right]}{60 \times (65.3) \times (50.12) \times (29.27) \times (\hspace{2cm})}$$

$= \underline{97.2} \% \quad \underline{3.274 E-04}$

PARTICULATE EMISSION TEST CALCULATIONS

PLANT Anheuser-Busch SOURCE/RUN I-0-4 DATE 11-3-83

1. Leakage Correction for Volume Metered

$$V_{mC} = V_m - (L_p - L_a)\theta = V_m - (L_p - 0.02)\theta = (\quad) - (\quad - 0.02) (\quad)$$

$$V_{mC} = \underline{50.281} \text{ ft}^3$$

2. Volume Metered, Standard Conditions (68°F, 29.92 in.Hg)

$$V_{mstd} = 17.64 V_{mC} Y \left(\frac{P_{bar} + \Delta H / 13.6}{T_m} \right) = 17.64 (50.281) (0.999) \frac{(29.25) + (2.02) / 13.6}{(524)}$$

$$V_{mstd} = \underline{49.712} \text{ dscf}$$

3. Volume Water Vapor Collected, Standard Conditions

Impingers = $V_{wc} = 0.04707 (V_f - V_i) = 0.04707 (488.5) = \underline{22.994} \text{ scf}$

Silica Gel = $V_{wsg} = 0.04797 (W_f - W_i) = 0.04707 (18.3) = \underline{0.861} \text{ scf}$

$V_{wstd} = V_{wc} + V_{wsg} = \underline{23.855} \text{ scf}$

4. Percent Moisture, By Volume

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = \frac{(23.855)}{(23.855) + (49.712)} = \underline{0.324}$$

5. Molecular Weight, Stack Gas

Dry Molecular Weight, $M_d = 0.440 (\%CO_2) + 0.320 (\%O_2) + 0.280 (\%N_2 + \%CO)$

$$= 0.440 (2.8) + 0.320 (17.5) + 0.280 (79.7)$$

$$M_d = \underline{29.15} \text{ lb/lb-mole}$$

Percent Excess Air, %EA =

$$\left[\frac{\%O_2 - 0.5 \%CO}{0.264 (\%N_2) - (\%O_2 - 0.5 \%CO)} \right] \times 100 \left[\frac{(\quad) - 0.5 (\quad)}{0.264 (\quad) - 0.5 (\quad)} \right] \times 100$$

%EA = _____

$$M_s = M_d (1 - B_{ws}) + 18.0 (B_{ws}) = (29.15) (1 - 0.324) + 18.0 (0.324) = \underline{25.54} \text{ lb/lb-mole}$$

6. Stack Gas Velocity, Average

$$V_{savg} = 85.49 C_p (\sqrt{\Delta P})_{avg} \sqrt{\frac{T_s}{P_s M_s}} = 85.49 (0.94) (0.690) \sqrt{\frac{(619)}{(29.23)(25.54)}}$$

$$V_{savg} = \underline{45.09} \text{ ft/s}$$

PARTICULATE EMISSION TEST CALCULATIONS (Cont'd)

7. Stack Volumetric Flow Rate, Actual Conditions (Stack Temperature and Pressure)

$$Q_a(\text{circular}) = \left(\frac{60 \times V_s (\pi d^2/4)}{144} \right) = 60 \times V_s (5.454 \times 10^{-3}) (d^2)$$

$$= 60 \times \underline{45.09} (5.454 \times 10^{-3}) (\underline{66})^2 (0.547)$$

"or" $Q_a(\text{rectangular}) = 60 \times V_s \left(\frac{L \times W}{144} \right) = 60 \times V_s (L \times W) 6.944 \times 10^{-3}$

$$= 60 \times \underline{\hspace{2cm}} (\underline{\hspace{2cm}} \times \underline{\hspace{2cm}}) 6.944 \times 10^{-3}$$

$Q_a = \underline{33,155}$ acfm

8. Stack Volumetric Flow Rate, Standard Conditions (68°F, 29.92 in. Hg)

$$Q_{\text{std}} = 17.64 Q_a (1 - B_{ws}) \left(\frac{P_s}{T_s} \right) = 17.64 (33,155) (1 - 0.324) \left(\frac{29.23}{618} \right)$$

$$Q_{\text{std}} = \underline{19,828}$$
 dscfm

9. Emissions

$$C'_s = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{M_n}{V_{m\text{std}}} = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{(356.7)}{(49.712)} = \underline{0.1105}$$
 gr/dscf

$$C_s = 1.429 \times 10^{-4} \times C'_s = 1.429 \times 10^{-4} (\underline{0.1105}) = \underline{1.58E-05}$$
 lb/dscf

$$E_r = 60 C_s Q_{\text{std}} = 60 (1.58E-05) (19,828) = \underline{18.8}$$
 lb/hr

10. Isokinetic Variation

$$\%I = \frac{100 T_s \left[0.002669 \times V_{1C} + \frac{V_m}{T_m} \times Y \left(P_{\text{bar}} + \frac{\Delta H}{13.6} \right) \right]}{60 \times Q \times V_s \times P_s \times A_n}$$

$$= 100 \times \underline{619} \left[0.002669 (506.8) + \frac{(50.281)}{(524)} (0.999) \left(\frac{29.25}{13.6} + \frac{2.02}{13.6} \right) \right]$$

$$\frac{60 \times (65.3 \times \underline{\hspace{2cm}}) \times (29.23) \times (4.974E-04)}{}$$

$$= \underline{100.5} \%$$

PARTICULATE EMISSION TEST CALCULATIONS

PLANT Anheuser Busch SOURCE/RUN 1-0-5 DATE 11-3-83

1. Leakage Correction for Volume Metered

$$V_{m_c} = V_m - (L_p - L_a)\theta = V_m - (L_p - 0.02)\theta = (\quad) - (\quad - 0.02) (\quad)$$

$$V_{m_c} = \underline{46.986} \text{ ft}^3$$

2. Volume Metered, Standard Conditions (68°F, 29.92 in.Hg)

$$V_{m_{std}} = 17.64 V_{m_c} Y \left(\frac{P_{bar} + \Delta H / 13.6}{T_m} \right) = 17.64 (46.986) (0.999) \frac{(29.30) + (1.70) / 13.6}{(518)}$$

$$V_{m_{std}} = \underline{47.035} \text{ dscf}$$

3. Volume Water Vapor Collected, Standard Conditions

Impingers = $V_{wc} = 0.04707 (V_f - V_i) = 0.04707 (193.5) = \underline{9.108} \text{ scf}$

Silica Gel = $V_{wsg} = 0.04797 (W_f - W_i) = 0.04707 (17.1) = \underline{0.805} \text{ scf}$

$V_{w_{std}} = V_{wc} + V_{wsg} = \underline{9.913} \text{ scf}$

4. Percent Moisture, By Volume

$$B_{ws} = \frac{V_{w_{std}}}{V_{w_{std}} + V_{m_{std}}} = \frac{(9.913)}{(9.913) + (47.035)} = \underline{0.174}$$

5. Molecular Weight, Stack Gas

Dry Molecular Weight, $M_d = 0.440 (\%CO_2) + 0.320 (\%O_2) + 0.280 (\%N_2 + \%CO)$

$$= 0.440 (1.0) + 0.320 (20.0) + 0.280 (79.0)$$

$$M_d = \underline{28.96} \text{ lb/lb - mole}$$

Percent Excess Air, %EA =

$$\left[\frac{\%O_2 - 0.5 \%CO}{0.264 (\%N_2) - (\%O_2 - 0.5 \%CO)} \right] \times 100 \left[\frac{(\quad) - 0.5 (\quad)}{0.264 (\quad) - 0.5 (\quad)} \right] \times 100$$

%EA = _____

$$M_s = M_d (1 - B_{ws}) + 18.0 (B_{ws}) = (28.96) (1 - 0.174) + 18.0 (0.174) = \underline{27.05} \text{ lb/lb-mole}$$

6. Stack Gas Velocity, Average

$$V_{s_{avg}} = 85.49 C_p (\sqrt{\Delta P})_{avg} \sqrt{\frac{T_s}{P_s M_s}} = 85.49 (0.84) (0.830) \sqrt{\frac{(590)}{(29.28)(27.05)}}$$

$$V_{s_{avg}} = \underline{51.44} \text{ ft/s}$$

PARTICULATE EMISSION TEST CALCULATIONS (Cont'd)

7. Stack Volumetric Flow Rate, Actual Conditions (Stack Temperature and Pressure)

$$Q_a(\text{circular}) = \left(\frac{60 \times V_s (\pi d^2/4)}{144} \right) = 60 \times V_s (5.454 \times 10^{-3}) (d^2)$$

$$= 60 \times \underline{51.44} (5.454 \times 10^{-3}) (\underline{66})^2 (0.547)$$

"or" $Q_a(\text{rectangular}) = 60 \times V_s \left(\frac{L \times W}{144} \right) = 60 \times V_s (L \times W) 6.944 \times 10^{-3}$

$$= 60 \times \underline{\hspace{2cm}} (\underline{\hspace{2cm}} \times \underline{\hspace{2cm}}) 6.944 \times 10^{-3}$$

$Q_a = \underline{40,112}$ acfm

8. Stack Volumetric Flow Rate, Standard Conditions (68°F, 29.92 in. Hg)

$$Q_{\text{std}} = 17.64 Q_a (1 - B_{ws}) \left(\frac{P_s}{T_s} \right) = 17.64 (40,112) (1 - 0.174) \left(\frac{29.28}{590} \right)$$

$$Q_{\text{std}} = \underline{29,005}$$
 dscfm

9. Emissions

$$C'_s = 0.0154 \frac{\text{gr}}{\text{mg}} \frac{M_n}{V_{m\text{std}}} = 0.0154 \frac{\text{gr}}{\text{mg}} \left(\frac{32.3}{47.035} \right) = \underline{0.0106}$$
 gr/dscf

$$C_s = 1.429 \times 10^{-4} \times C'_s = 1.429 \times 10^{-4} (\underline{0.0106}) = \underline{1.51E-06}$$
 lb/dscf

$$E_r = 60 C_s Q_{\text{std}} = 60 (1.51E-06) (29,005) = \underline{2.63}$$
 lb/hr

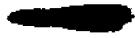
10. Isokinetic Variation

$$\%I = 100 T_s \left[\frac{0.002669 \times V_{1C} + \frac{V_m}{T_m} \times Y \left(P_{\text{bar}} + \frac{\Delta H}{13.6} \right)}{60 \times Q \times V_s \times P_s \times A_n} \right]$$

$$= 100 \times \underline{590} \left[\frac{0.002669(210.6) + \frac{(46.986)}{(518)} (0.999) \left(\frac{29.30}{13.6} + \frac{1.70}{13.6} \right)}{60 \times (65.3 \times 51.44) \times (29.28) \times (3.274E-04)} \right]$$

$$= \underline{98.6} \%$$

—



APPENDIX D
Statement of Process Rate



ANHEUSER-BUSCH COMPANIES

November 30, 1983

Mr. Craig R. Jones
Manager, Air Sampling Sources
Pollution Control Science, Inc.
6015 Manning Road
Miamisburg, OH 45342

Dear Mr. Jones:

Enclosed is a signed Statement of Process Rate for the November dryer tests at the Columbus brewery. Please include this Statement in the emission test report that you are preparing.

If you have any questions concerning this item, please call me. Otherwise, I will be calling you after I have received and reviewed the "draft" test report.

Yours truly,

Donald M. DeHart
Senior Environmental
Engineer

DMD/bkb

Enc.



RECEIVED
POLLUTION CONTROL SCIENCE, INC.

DEC 2 1983

MIAMISBURG, OHIO

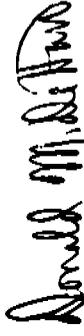
STATEMENT OF PROCESS RATE

FIRM NAME - Anheuser-Busch, Inc.
 ADDRESS - 700 East Schrock Road, Columbus, OH 43229

Date of Test	Process Description	Design Capacity, lb/hr	Test or Run No.	Wet Basis		Test Inputs, Wet Grain		Dry Basis	
				lb/hr	lb/hr	Ave, lb/hr	lb/hr	Ave, lb/hr	lb/hr
11-1-83	Dryer No. 1	28,000	1(A)	28,100/30,375/26,516/27,000	28,000	9,638/10,419/8,936/9,099	9,520	3000	
11-2-83			2(B)	32,779/27,700/27,639/29,000	29,280	11,866/10,027/9,370/9,831	10,270	3000	
11-3-83			4(C)	27,148/26,900/ -- 1)	27,020	9,529/9,442/ --	9,490	3000	
11-2-83	Dryer No. 1	800°F Inlet Temperature	3(N-1)	13,865/15,429/17,657/16,500	15,860	5,920/6,588/6,127/5,725	6,090	3000	
11-3-83			5(N-2)	14,900/15,545/15,618/16,438	15,630	5,826/6,078/7,012/7,381	6,570	3000	
11-4-83	Dryer No. 4	--	2)						

Notes: 1) Process weight input at end of Run 4 was not measured due to dryer instability plus equipment problem that required dryer shutdown.
 2) Could not maintain operation on Dryer No. 4 long enough for test run or process weight measurement.

I certify that the above statement is true to the best of my knowledge and belief.
 Donald M. DeHart
 Senior Environmental Engineer
 Anheuser-Busch Companies, Inc.




ANALYTICAL RESULTS OF PRODUCT SAMPLES

<u>Sample#</u>	<u>Location</u>	<u>% Solids</u>	<u>Sample#</u>	<u>Location</u>	<u>% Solids</u>
1	Dryer Inlet	34.3	16	Dryer Inlet	34.7
2	Dryer Outlet	95.8	17	Dryer Outlet	94.1
3	Wet Feed	24.9	18	Wet Feed	21.5
4	Dryer Inlet	33.7	19	Dryer Inlet	35.1
5	Dryer Outlet	95.3	20	Dryer Outlet	95.7
6	Wet Feed	33.7	21	Wet Feed	25.9
7	Dryer Inlet	36.2	22	Dryer Inlet	N.R.
8	Dryer Outlet	95.8	23	Dryer Outlet	N.R.
9	Wet Feed	23.6	24	Wet Feed	N.R.
10	Dryer Inlet	33.9	25	Dryer Inlet	39.1
11	Dryer Outlet	96.4	26	Dryer Outlet	96.5
12	Wet Feed	22.3	27	Wet Feed	25.6
13	Dryer Inlet	42.7	28	Dryer Inlet	44.9
14	Dryer Outlet	95.4	29	Dryer Outlet	95.5
15	Wet Feed	22.3	30	Wet Feed	24.1

1



2

3

APPENDIX E
CALIBRATION PROCEDURES AND RESULTS

The equipment used in this test series was calibrated according to the procedures outlined in Maintenance, Calibration, and Operation of Isokinetic Source-Sampling Equipment.¹

The nozzles were calibrated on-site by making three separate measurements along different inside diameters and calculating the average. A dial caliper having 0.001" graduations was used for measuring. If a deviation of more than 0.002 inches was found the nozzle was reamed out and remeasured.

Dry Gas Meter and Orifice Meter

Figure E-1 was the set-up used for the initial and post-test calibration. A calibrated dry test meter with a 3.6 feet-per-minute capacity and ± 1 percent accuracy was used as a reference meter in the calibration of meters used in field testing. The information on the calibration sheet was gathered for the initial calibration and then, the ratio of accuracy of the reference test meter to the dry test meter, and the $\Delta H\theta$ were calculated.

Post-Test Meter Calibration Check

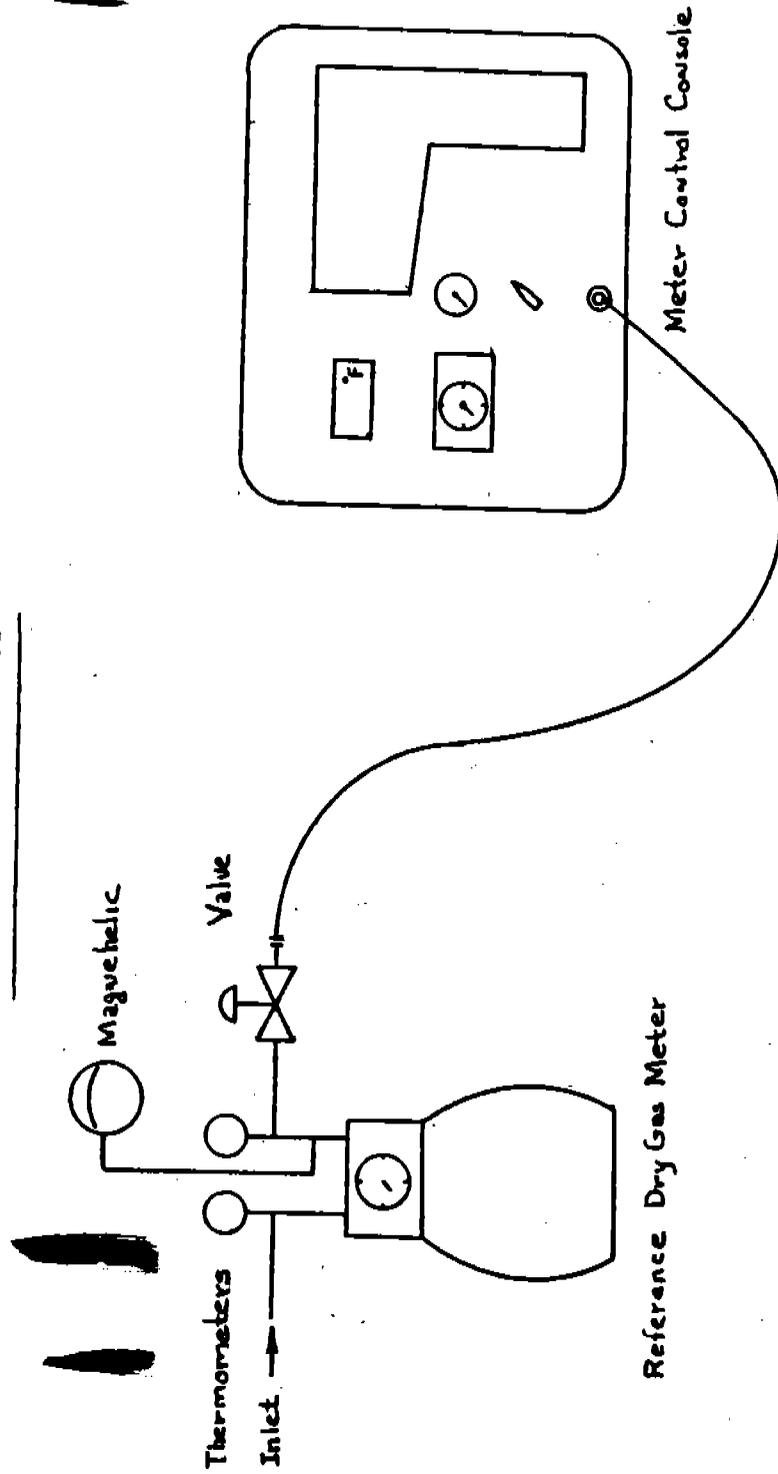
A post-test meter calibration check was made on the meter box used during the test series to check its accuracy against its last calibration check. This post-test calibration must be within ± 5 percent of the initial calibration. The post-test calibration was performed using the same method as the initial calibration. Three calibration runs were made using the average orifice setting obtained during each test run and with the vacuum set at the maximum value obtained during the test series. After running the post-test calibration check all three runs were within the ± 5 percent range allowed by the Federal Register.²

The initial and post-test meter box calibration data are attached.

¹ Office of Air Programs Publication No. APTD-0576

² Federal Register Vol. 42, No. 160, August 18, 1977

CALIBRATION SET-UP



Calibration after modification of meter adjustment of

CALIBRATION
 DRY GAS METER & ORIFICE
 DATE 8-30-83

METER BOX NO. J-1

DRY GAS METER NO. REF

BAROMETRIC PRESSURE 29.55" in. Hg

ORIFICE SETTING ΔH in. H ₂ O	STATIC PRESS. REF. TEST METER P_{SR} in. H ₂ O	GAS VOLUME REF. TEST METER V_R ft ³	GAS VOLUME DRY GAS METER V_d ft ³	REF. TEST METER T_R °F	TEMPERATURES DRY GAS METER			TIME θ min.	VACUUM SETTING in. Hg	γ	ΔH
					INLET T_{di} °F	OUTLET T_{do} °F	AVERAGE T_d °F				
0.5	-0.18	172.439	698.300	83	90	90	91	15.0	0.991	1.752	
		176.548	702.458	83	94	90	93	16.0	0.998		
1.0	-0.20	176.810	702.618	83	95	91	93	16.0	0.999	1.696	
		179.667	705.439	83	95	92	94	15.0	0.999		
1.5	-0.22	180.242	706.013	84	95	91	94	15.0	0.999	1.667	
		183.805	709.513	84	95	92	96	16.0	0.998		
2.0	-0.28	184.033	709.745	84	95	92	94	15.0	0.999	1.697	
		188.179	713.822	84	97	93	97	15.0	0.996		
3.0	-0.36	188.798	714.425	84	98	92	97	15.0	0.996	1.708	
		193.822	719.373	84	99	93	97	15.0	0.996		
4.0	-0.44	194.366	719.913	84	99	94	97	15.0	0.996	1.701	
		200.143	725.610	84	99	95	97	15.0	0.999		
0.5	-0.18	200.382	725.853	85	99	95	97	14.9 AVERAGE $\gamma=1006$ $\Delta H=1.697$	0.999	1.701	
		202.441	727.878	85	99	95	97	5.0	0.999		

DATA POINT WAS RE-RUN BELOW

PRETEST CALIBRATION CALCULATIONS

Meter Box No. J-1

Date 8-30-83 By C. JONES

	$y = Y_R \frac{V_R(T_d+460)(P_b - \frac{P_{SR}}{13.6})}{V_d(T_R+460)(P_b + \frac{\Delta H}{13.6})}$	$\frac{0.0317 \Delta H}{P_b(T_d+460)}$	$\left[\frac{(T_R + 460)\theta}{V_R} \right]^2$
0.5	$y = \frac{(0.97)(2.059)(557)(29.54)}{(2.025)(545)(29.59)}$	$\Delta H\theta = \frac{0.0317(0.5)}{29.55(557)}$	$\left[\frac{(545)(5)}{2.059} \right]^2$
1.0	$y = \frac{(0.97)(2.857)(553)(29.54)}{(2.821)(543)(29.62)}$	$\Delta H\theta = \frac{0.0317(1.0)}{29.55(553)}$	$\left[\frac{(543)(5)}{2.857} \right]^2$
1.5	$y = \frac{(0.97)(3.563)(553)(29.53)}{(3.500)(544)(29.66)}$	$\Delta H\theta = \frac{0.0317(1.5)}{29.55(553)}$	$\left[\frac{(544)(5)}{3.563} \right]^2$
2.0	$y = \frac{(0.97)(4.146)(554)(29.53)}{(4.077)(544)(29.70)}$	$\Delta H\theta = \frac{0.0317(2.0)}{29.55(554)}$	$\left[\frac{(544)(5)}{4.146} \right]^2$
3.0	$y = \frac{(0.97)(5.024)(554)(29.52)}{(4.948)(544)(29.77)}$	$\Delta H\theta = \frac{0.0317(3.0)}{29.55(556)}$	$\left[\frac{(544)(5)}{5.024} \right]^2$
4.0	$y = \frac{(0.97)(5.777)(557)(29.52)}{(5.617)(544)(29.84)}$	$\Delta H\theta = \frac{0.0317(4.0)}{29.55(557)}$	$\left[\frac{(544)(5)}{5.777} \right]^2$

AVERAGE Y 0.999

AVERAGE $\Delta H\theta$ 1.701

POST TEST CALIBRATION CALCULATIONS

Date 11/9/83 Plant A-B
 Barometric pressure, $P_b =$ 29.37 "Hg PROJECT NUMBER 85-010
 Meter Box No. J-1 PROJECT MANAGER C. JONES
 Dry Gas Meter No. REF PRETEST Y 0.999

ΔH SETTING	IN. H ₂ O	STATIC PRESS. REF. METER PSR IN. H ₂ O	GAS VOLUME REF. METER V _R	GAS VOLUME DRY GAS METER V _d	REF. TEST METER Q _F	DRY GAS METER INLET Q _F	DRY GAS METER OUTLET Q _F	AVERAGE METER TEMP T _d	TIME MIN.	VACUUM IN. HG	X
1.7	-0.22		485.396	370.893	59	81	79	80.25	5.0	13.5	0.996
1.7	-0.22		489.098	374.560	59	82	79	81.25	5.0	13.5	1.014
1.7	-0.22		492.727	378.161	60	85	79	82.75	5.0	13.5	1.019
			492.727	378.161	60	85	79				
			496.365	381.763	60	88	79				
											AVERAGE Y

Y = Ratio of accuracy of reference test meter to dry test meter.
 Tolerance = ± 0.01
 V_R = Ratio of accuracy of primary standard to reference test meter.
 V_d = Gas volume passing through dry test meter, ft³.
 T_d = Average temperature of the gas in the dry gas meter, °F.
 T_R = Temperature of the gas in the reference test meter.
 P_b = Barometric pressure, in. Hg.
 PSR = Pressure at exit of reference test meter, in. H₂O.
 ΔH = Pressure differential across orifice, in. H₂O.

$$\text{EQUATION: } Y = \frac{V_R(T_d + 460) \left(P_b - \frac{PSR}{13.6} \right)}{V_d(T_R + 460) \left(P_b + \frac{\Delta H}{13.6} \right)}$$

CALIBRATION
 DRY GAS METER & ORIFICE
 DATE 11/8/83

BAROMETRIC PRESSURE 29.49 in. Hg

METER BOX NO. FM-1

DRY GAS METER NO. REF

ORIFICE SETTING ΔH in. H ₂ O	STATIC PRESS. REF. TEST METER P_{SR} in. H ₂ O	GAS VOLUME REF. TEST METER V_R ft ³	GAS VOLUME DRY GAS METER V_d ft ³	REF. TEST METER T_R °F	TEMPERATURES DRY GAS METER			TIME θ min.	VACUUM SETTING in. Hg	Y	ΔH_e
					INLET T_{di} °F	OUTLET T_{do} °F	AVERAGE T_d °F				
0.5	-0.10	432.302	051.460	58	74	68	71.25	16.0	1.005	2.30	
		435.804	054.858	58	75	68					
1.0	-0.12	436.194	055.230	59	75	68	73.0	15.5	1.008	2.26	
		441.187	060.063	59	80	69					
1.5	-0.17	441.380	060.262	59	80	69	75.5	15.0	1.019	2.15	
		447.606	066.280	59	83	70					
2.0	-0.20	448.186	066.833	59	83	70	76.75	16.5	1.010	2.20	
		451.758	070.296	59	84	70					
3.0	-0.26	452.435	070.945	59	84	70	77.5	15.0	1.013	2.24	
		456.761	075.125	59	85	71					
4.0	-0.32	457.364	075.703	59	85	71	78.0	16.0	1.015	2.25	
		462.354	080.510	59	85	71					

Calibrated by Doug Thomas
 Reviewed by Craig Jones
 AVERAGE 1.012 2.23

PRETEST CALIBRATION CALCULATIONS

Meter Box No. Fm-1

Date 11/8/83 By D-

	$Y = Y_R \frac{V_R (T_d + 460) (P_b - \frac{P_{SR}}{13.6})}{V_d (T_R + 460) (P_b + \frac{\Delta H}{13.6})}$	$\text{EQUATION: } \Delta \text{He} = \frac{0.0317 \Delta H}{P_b (T_d + 460)}$	$\left[\frac{(T_R + 460) \theta}{V_R} \right]^2$
0.50	$Y = \frac{0.97}{3.398} \frac{(3.502)(531.2)(29.53)^{50}}{(3.398)(528)(29.53)}$	$\Delta \text{He} = \frac{(0.0317)(0.5)}{(29.49)(531.25)}$	$\left[\frac{(528)(10)}{(3.502)} \right]^2$
1.0	$Y = \frac{0.97}{4.833} \frac{(4.993)(533)(29.53)^{50}}{(4.833)(529)(29.53)}$	$\Delta \text{He} = \frac{(0.0317)(1.0)}{(29.49)(533)}$	$\left[\frac{(529)(10)}{(4.993)} \right]^2$
1.5	$Y = \frac{0.97}{6.018} \frac{(6.266)(535.5)(29.53)^{50}}{(6.018)(529)(29.60)}$	$\Delta \text{He} = \frac{(0.0317)(1.5)}{(29.49)(535.5)}$	$\left[\frac{(529)(10)}{(6.266)} \right]^2$
2.0	$Y = \frac{0.97}{3.463} \frac{(3.572)(536.75)(29.53)^{50}}{(3.463)(529)(29.64)}$	$\Delta \text{He} = \frac{(0.0317)(2.0)}{(29.49)(536.75)}$	$\left[\frac{(529)(5)}{3.572} \right]^2$
3.0	$Y = \frac{0.97}{4.180} \frac{(4.326)(537.5)(29.53)^{50}}{(4.180)(529)(29.71)}$	$\Delta \text{He} = \frac{(0.0317)(3.0)}{(29.49)(537.5)}$	$\left[\frac{(529)(5)}{4.326} \right]^2$
4.0	$Y = \frac{0.91}{4.807} \frac{(4.992)(538)(29.53)^{50}}{(4.807)(529)(29.78)}$	$\Delta \text{He} = \frac{(0.0317)(4.0)}{(29.49)(538)}$	$\left[\frac{(529)(5)}{4.990} \right]^2$

AVERAGE ΔHe 2.23

AVERAGE Y 1.012

POST TEST CALIBRATION CALCULATIONS

Date 11/7/83

Plant A-B

Barometric pressure, $P_b =$ 29.43 "Hg

PROJECT NUMBER 85-010

Meter Box No. Fm-1

PROJECT MANAGER C. Jones

Dry Gas Meter No. R2F

PRETEST Y 1.004

ΔH SETTING IN. H ₂ O	STATIC PRESS. REF METER IN. H ₂ O	GAS VOLUME REF. METER	GAS VOLUME DRY GAS METER	REF. TEST METER	DRY GAS METER INLET	DRY GAS METER OUTLET	AVERAGE METER TEMP T_d	TIME MIN.	VACUUM IN. HG	Y
2.30	-0.25	404.213	023.310	57	70	63	67.5	10	16.0	1.017
		411.894	030.749	57	73	64				
2.30	-0.25	411.894	030.749	57	73	64	69.5	10	16.0	1.023
		419.585	038.183	57	76	65				
2.30	-0.25	419.585	038.183	57	76	65	71.25	10	16.0	1.021
		427.881	045.658	57	78	66				

Y = Ratio of accuracy of reference test meter to dry test meter.
Tolerance = ± 0.01

Y_R = Ratio of accuracy of primary standard to reference test meter.

V_d = Gas volume passing through dry test meter, ft³.

T_d = Average temperature of the gas in the dry gas meter, $^{\circ}F$.

T_R = Temperature of the gas in the reference test meter.

P_b = Barometric pressure, in. Hg.

P_{SR} = Pressure at exit of reference test meter, in. H₂O.

ΔH = Pressure differential across orifice, in. H₂O.

EQUATION: $Y = Y_R \frac{V_R(T_d+460) \left(P_b - \frac{P_{SR}}{13.6} \right)}{V_d(T_R+460) \left(P_b + \frac{\Delta H}{13.6} \right)}$

AVERAGE Y 1.020

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APPENDIX F
Cyclonic Flow Test Methods

A METHOD FOR STACK SAMPLING CYCLONIC FLOW

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Abstract

This paper presents a method for particulate sampling in stacks with cyclonic flow. Specific procedures and quantitative adjustments to sampling parameters are described. Sampling is performed isokinetically with the nozzle and pitot tubes aligned parallel to the direction of flow and with sampling time at each point weighted by the cosine of the flow angle at that point. The method is specifically applicable to particles with tangential velocity components without consideration of radial velocity components. Comments are made concerning the behavior of particles with radial velocity components as applicable to the accuracy of this method.

Introduction

Accurate sampling results cannot be obtained with conventional sampling procedures from stacks with severe cyclonic flow, i.e. flow with tangential velocity components. Cyclonic flow may exist after cyclones, tangential stack inlets, or other configurations that tend to induce swirling.

Several papers have been written describing and evaluating various procedures for sampling cyclonic flow. This paper presents a method that is currently being used by the Texas Air Control Board staff. One inherent characteristic of this method is that adjustments to the nozzle and pitot tube position are made for tangential velocity components (yaw) but no adjustments for radial velocity components (pitch) are made. This fact and its possible effect on the accuracy of the method are discussed.

The generally accepted criteria for acceptable flow condition for stack sampling requires that the direction of flow be within $\pm 10^\circ$ of the stack axis. If the flow direction is outside this range, special sampling procedures are needed to obtain unbiased results. The angle between the longitudinal axis of the stack and the plane of the pitot tubes when aligned parallel to the flow direction is referred to as the flow angle. It has the same magnitude as the angle between a plane perpendicular to the stack axis and the plane of the pitot tubes at the null (zero manometer reading) position.

The basic attempt of this paper is to describe the method as applicable to determination of pollutant mass flow rates. This requires determination of pollutant concentration as well as volume flow rate. The procedure is not as complex if only pollutant concentration is needed.

Particulate Sampling

A particulate stack sample must be extracted isokinetically at each sampling point, and the volume extracted must be proportional to the stack exit volume from each area increment.

If particulate sampling is performed with the nozzle and pitot tubes in any position other than parallel to the flow stream, various sources of bias are introduced. Distortions of nozzle area and variations of pitot tube reading with flow angles other than zero are sources of bias.¹ The method presented is offered as a procedure to reduce biasing effects.

The volume extracted at a sampling point may be expressed as

$$V_n = (A_n) (v_n) (t) \quad (1)$$

where:

- V_n = Nozzle volume extracted at the point
- A_n = Area of the nozzle
- v_n = Nozzle velocity at the point
- t = Sampling time at the point

Varying nozzle area (A_n) from point to point is not feasible, and nozzle velocity must be equal to the velocity of the flow stream. Therefore, sampling time at each point must be adjusted so that the volume extracted at each sampling point is proportional to the stack exit volume from each area increment. This is accomplished by weighting the sampling time at each point according to the vertical component of velocity at that point (cosine of the flow angle).

Suggested Procedure

Sampling parameters for cyclonic flow sampling are set up in the same manner as for non-cyclonic flow. Preliminary velocity traverse readings are taken with the pitot tubes aligned parallel to the flow at each sampling point. The direction of flow at each point is determined by locating the null position of the pitot tubes (zero manometer reading) and then rotating the pitot tubes 90° to obtain velocity measurements. The flow angle at each sampling point is recorded during the preliminary velocity traverse.

Isokinetic sampling is performed at each sampling point in the normal manner except with the nozzle and pitot tubes aligned parallel to the flow and with sampling time weighted according to the cosine of the flow angle at each point. This may be accomplished by selecting a basic sampling time for each point which may be multiplied by the cosine of the previously measured flow angle for each point. Inspection of the planned sampling times is necessary to insure that total sampling time and volume are sufficient, and that the shortest sampling time is long enough for accurate measurement and recording.

Calculations

Emission calculations on a concentration basis are

$$C = M/V \quad (2)$$

where:

- C = Particulate concentration
- M = Mass of particulate caught
- V = Volume of gas extracted

Consider a particle in a stack with a vertical velocity component, v , a tangential velocity component, v_t , and a radial velocity component, v_r , at a distance R from the center of the stack.

The radial acceleration (A_r) of the particle due to centrifugal effects of v_t is

$$A_r = v_t^2/R \quad (4)$$

If the particle starts from rest at the center of the stack (most restrictive case) and accelerates at A_r , the time (t) required to reach the position, R distance from the center, is

$$t = R/(\frac{1}{2}v_r) \quad (5)$$

and
$$v_r = (A_r)(t) \quad (6)$$

Substituting (4) and (5) into (6)

$$v_r = (v_t^2/R)(R/\frac{1}{2}v_r)$$

Simplifying
$$v_r^2 = 2 v_t^2 \quad (7)$$

At the initial occurrence of cyclonic flow (flow 10° from axial)

$$v_t/v = \tan 10^\circ$$

or
$$v_t = v \tan 10^\circ \quad (8)$$

Substituting (8) into (7)

$$v_r^2 = v^2(2 \tan^2 10^\circ)$$

or
$$v_r = (0.25)v \quad (9)$$

which shows that at the smallest flow angle at which cyclonic flow exists, radial velocity of a particle is one fourth the vertical velocity. Therefore, if the sampling ports are at least two diameters from the entrance to the stack, the particle will reach the stack wall before reaching the ports because it will travel half a diameter in a radial direction while it travels two diameters in a vertical direction. If the particle reaches the stack wall before reaching the ports, no radial component of velocity is possible, and no pitch adjustment of the probe is necessary. This is substantiated by the cyclonic flow work described by Phoenix and Grove.²

"Two 24-point traverses were chosen but, in most cases, points 1, 2, 23, and 24 were not sampled because of an excessive amount of particulate and water droplets at the wall". If the average flow angle in the stack is greater than 10° , the particle reaches the stack wall before travelling two diameters

vertically. If the average flow angle in the stack is less than 10° , sampling is performed in the normal manner with no adjustments necessary.

References

1. J. W. Peeler, "Isokinetic particulate sampling in non-parallel flow systems - cyclonic flow", Entropy Environmentalists, Inc., (1977) (Draft).
2. F. J. Phoenix and D. J. Grove, "Cyclonic flow - characterization and recommended sampling approaches", Entropy Environmentalists, Inc., EPA Contract 68-01-4148, (November, 1977) (Draft).

