Mike - as yo wd.

DIVISION OF ENVIRONMENTAL MANAGEMENT
AIR QUALITY SECTION

August 12, 1987

M E M O R A N D U M

TO: Ken Schuster/David Daniel

FROM: Michael Y. Aldridge M.Y.A.

SUBJECT: Particulate Emissions Test
Source Name - Adams Const. Co.,
Source Location - Benson, North Carolina
Emission Point - Asphalt Plant, Baghouse
Tester - Entropy Environmentalists
Test Date - April 22, 1987.

A report of the subject test has been reviewed and is found to adequately represent the emissions from the subject source at the time of the test.

This plant is rated as a 400 ton per hour plant, however it was producing only 220 to 230 tons per hour during the test. It was suggested that this reduction in operating rate was due to the aggregate being unusually wet, and due to the production of I-2 mix which contains more fines than other mixes, these fines being harder to dry.

At first it seemed that this was too large a drop in production to be attributable to a little rain on the aggregate. However, the attached article from "Highway and Heavy Construction" July, 1987 contains a table, Figure 1, which seems to confirm the suggestion that wetter aggregate can have a greater effect on operating rate than one might expect. It can be shown from this table that 4 or 5 points of moisture increase can cut the production rate of a plant almost in half.

The percent moisture in the sample gas (ranging between 21% and 28%) confirms that a great deal of moisture was being removed from the aggregate (control equipment is a baghouse not a scrubber).

It is this reviewers opinion that this plant was being operated at as high a rate as was possible on the day of the test and that the test results show compliance with applicable standards.

ENTROPY
ENVIRONMENTALISTS INC.

POST OFFICE BOX 12291
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27709-2291
919-781-3550

STATIONARY SOURCE SAMPLING REPORT

EEI REF. NO. 5474

ADAMS CONSTRUCTION COMPANY
BATCH MIX ASPHALT PLANT
BENSON, NORTH CAROLINA

PARTICULATE EMISSIONS AND PLUME OPACITY COMPLIANCE TESTING

ROTARY DRYER BAGHOUSE STACK

APRIL 22, 1987

REPORT CERTIFICATION

The sampling and analysis performed for this report was carried out under my direction and supervision.

Date May 6, 1987 Signature Arthur T. McDonald

Arthur T. McDonald

I have reviewed all testing details and results in this test report and hereby certify that the test report is authentic and accurate.

Date May 6, 1987 Signature

D. James Grove, P.E.

ENTROPY

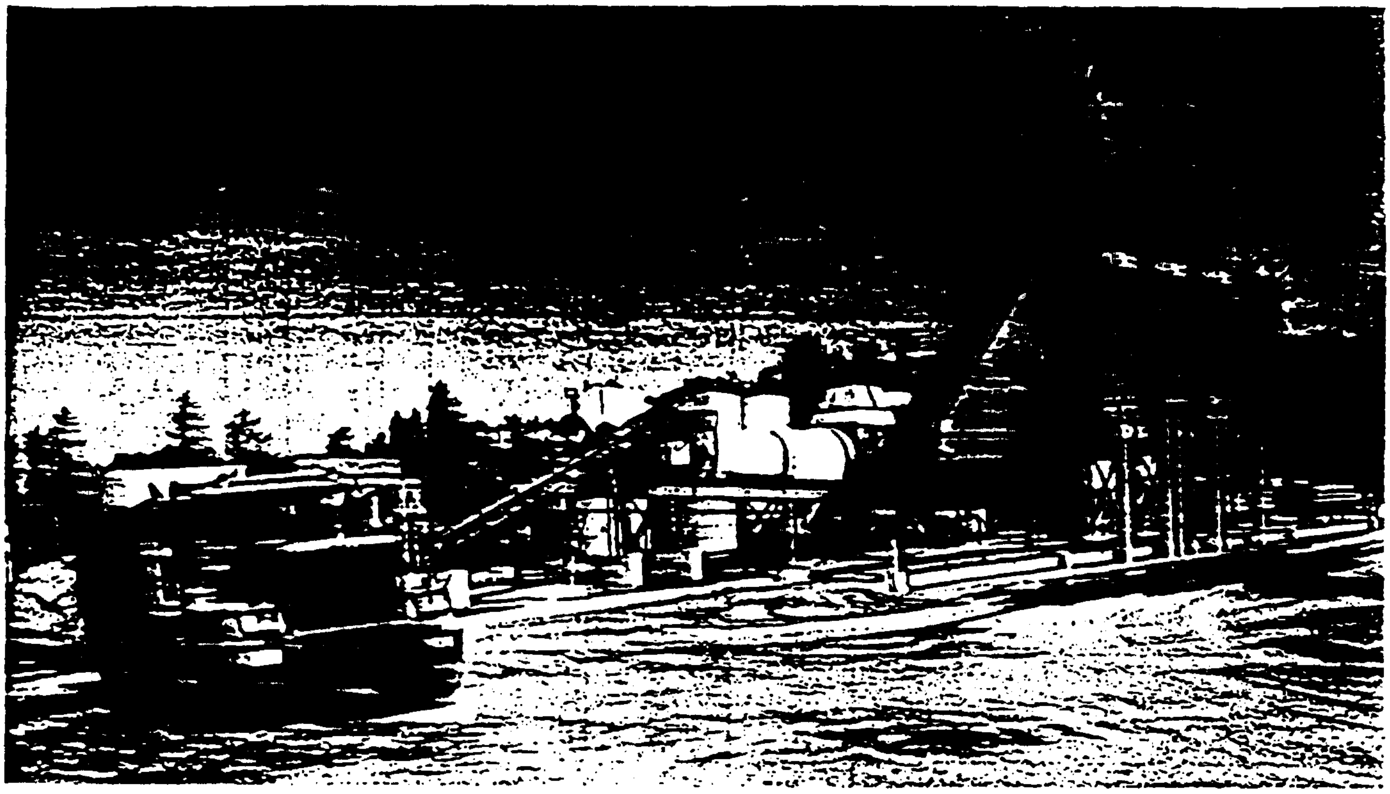
Summary of Compliance Related Parameters

Plant Capacity	400 T/hr
Operating Rate	225 T/hr
Emission Limit (40 CFR 60 Subpart I)	.04 gr/dscf
Opacity Limit (40 CFR 60 Subpart I)	20%
Mass Emission Limit	
At 400 T/hr	68 lb/hr
At 225 T/hr	53 lb/hr
(15NCAC 2D.0506)	
Measured Emissions	
Average Concentration	.023 gr/dscf
Average Mass Rate	6 lb/hr
Highest 6-minute average opacity	0.8%
Highest Single opacity reading	10.0%

/lhb

Enclosure

cc: N. O. Gerald
L. A. Daniel, Jr.



Associated's new plant includes a 9.25-ft. drum, three 200-ton surge bins, 5 cold-feed bins and a baghouse.

Asphalt: Converting to a Drum Mixer

How one firm properly matched air speed, aggregate moisture and production

When Associated Sand and Gravel Co., Everett, Wash., decided about a year ago to switch from batch-plant to drum mixer operations, the company joined a number of others making the same change. This year more than 100 operators across the nation will go to drum mixers, in large part because high maintenance costs at aging batch plants have driven production costs too high.

Associated's 30-year-old Everett plant is one of the firm's 9 asphalt production centers. Located 30 miles north of Seattle in the Puget Sound Basin, the Everett plant serves a variety of public and private projects in Washington state and Alaska. Recently the area's growing demand for asphalt has forced Associated to supplement Everett's production with portable plants at other locations.

"Having two plants do the job of one was obviously hindering progress," says Gary Swanson, Associated's production manager. "We had to keep two crews on the Everett payroll. And there were certain logistical problems with producing mix in separate locations—trucking rock to a second plant, for instance."

Associated needed a drum mixer that could produce 425 tph using an aggregate with 5 percent moisture. The plant needed the capacity to handle 35 percent recycled material, and it had to meet the basin's air pollution rules—0.05 grains per dry standard cubic foot (DSCF), using both the front and back halves of the testing apparatus.

Thorough study

The company spent about 3 months talking to all major drum mixer manufacturers, asking them each a set of 25 questions all based on the same set of field parameters. Four key questions centered on drum mixer performance ratings:

- How big must the drum be?
- How big should the fan be?
- What must the air volume and velocity be?
- What happens when the moisture content of the aggregate changes?

> *"Some manufacturers claimed smaller drums could deliver just as many tph as bigger drums. But smaller drums simply can't do the same job."*

With that data gathered, Swanson applied his knowledge gained in 30 years experience and double-checked manufacturers' claims against standard industry production tables.

"Some manufacturers claimed the smaller drums could deliver just as many tons per hour as bigger drums," Swanson said. "But I knew smaller drums simp can't do the job of bigger ones. An 8-ft. drum, for example, requires extremely high air velocities to match the production of a 9-ft. drum. The smaller drum might perform well for awhile, but high velocities usually mean headaches."

Figuring production

Assume, for example, that an 8-ft. drum with an 1100 fpm air velocity has an air volume of 55,264 acfm (actual cubic ft./min.) The drum can produce 425 tph—as long as aggregate moisture content doesn't exceed 4 percent. But if moisture content rises to 5 percent, the air volume must jump to 63,750 acfm to fully dry the aggregate. To achieve that air volume, an 8-ft. drum needs an air speed of more than 1200 fpm.

Yet industry experts agree that air velocity in a drum mixer never should exceed 1100 fpm. Higher air speeds than that tend to carry aggregates, dust, fines, high temperatures—and sometimes even embers—out of the drum into the baghouse. Such carryover can result in operating and maintenance problems.

So the only ways an 8-ft. drum can compensate are to lower the mix temperature, which specifying agencies won't accept, or to lower the production rate to less than 375 tph.

Using a pair of production charts like Figures 1 and 2, Swanson figured design specifications needed to meet his production requirements. Figure 1 shows that he needed 63,750 acfm to produce 425 tph of asphalt, using aggregate at 5 percent moisture. Inserting the air volume into Figure 2, Swanson saw that to keep air movement below 1100 fpm, he needed a 9-ft. drum.

With those calculations made, Swanson chose a 9-ft. Standard Havens Magnum Drum Mixer with a recycle collar. The mixer's anti-distillation chamber separates the aggregate from the air stream near the end of the mixing process. Aggregate can be mixed with asphalt, additives and fines *outside* the air stream, and blue smoke has no chance to develop.

Figure 1: Air Volume (acfm) Required for Various Moisture Conditions

Tons/ Hour	2%	3%	4%	5%	6%	7%	8%	9%	10%
100	8,197	10,409	12,680	15,000	17,361	20,408	22,222	24,752	27,322
125	10,246	13,012	15,850	18,750	21,701	25,510	27,778	30,941	34,153
150	12,295	15,614	19,019	22,500	26,042	30,612	33,333	37,129	40,984
175	14,344	18,217	22,189	26,250	30,382	35,714	38,889	43,317	47,814
200	16,393	20,819	25,359	30,000	34,722	40,816	44,444	49,505	54,645
225	18,443	23,421	28,529	33,750	39,063	45,918	50,000	55,693	61,475
250	20,492	26,024	31,699	37,500	43,403	51,020	55,556	61,881	68,306
275	22,541	28,626	34,869	41,250	47,743	56,122	61,111	68,069	75,137
300	24,590	31,228	38,039	45,000	52,083	61,224	66,667	74,257	81,967
325	26,639	33,831	41,209	48,750	56,424	66,327	72,222	80,446	88,798
350	28,689	36,433	44,379	52,500	60,764	71,429	77,778	86,634	95,628
375	30,738	39,035	47,549	56,250	65,104	76,531	83,333	92,822	102,459
400	32,787	41,638	50,719	60,000	69,444	81,633	88,889	99,010	109,290
425	34,836	44,240	53,888	63,750	73,785	86,735	94,444	105,198	116,120
450	36,885	46,842	57,058	67,500	78,125	91,837	100,000	111,386	122,951
475	38,934	49,445	60,228	71,250	82,465	96,939	105,556	117,574	129,781
500	40,984	52,047	63,398	75,000	86,806	102,041	111,111	123,762	136,612

Benchmark Conditions:
280° Mix Temperature • 300° Exhaust Temperature • 500-Ft. Elevation • 50% Excess Air • 10% Leakage • No. 2 Oil • 5% AC

The variable having the most marked effect on production rate is the surface moisture of the aggregate. Each 1 percent change in surface moisture will affect the production rate as shown. You must first locate the surface moisture desired across the top axis, then find the air volume of the plant in the column below, then read estimated production at left. To find the effect of 5 percent moisture on a 54,000 cfm plant, you'll see that in the 5 percent moisture column the closest air volume ratings are 52,500 acfm and 56,250 acfm. At left, such a plant can produce between 350 and 375 tph. But if the surface moisture increases to 6 percent, production must drop to between 300 and 325 tph.

Figure 2:

"Available Air" Through the Drum — acfm

(acfm = actual cubic feet per minute)

Drum Diameter				
10.0	70,650	78,500	86,350	94,200
9.5	63,762	70,846	77,931	86,016
9.0	57,227	63,585	69,944	76,302
8.5	51,045	56,716	62,388	68,060
8.0	45,216	50,240	55,264	60,288
7.5	39,741	44,156	48,572	52,988
7.0	34,619	38,465	42,312	46,158
6.5	29,850	33,166	36,483	39,800
6.0	25,434	28,260	31,086	33,912
	900	1,000	1,100	1,200

Air Velocity Through Drum — fpm

Air speed in a drum mixer should never exceed 1100 fpm. This chart helps estimate air speed through any drum, given its diameter and air volume. Drum diameter should be measured at the longest part of the drum, not at the expanded combustion end.

In compliance

Associated installed the plant in July 1986. In its first 8 months of operation, it produced 230,000 tons of asphalt. About 10 percent of that was produced using recycled materials. During 35 percent recycle operations, at a production rate of 425 tph, the plant's average total emissions were just 0.021 grains per DSCF. That easily met the Environmental Protection Agency's standard; in the front half of testing, the average particulate concentration was 0.001 grains and in the back half stack emissions were 0.020 grains per DSCF.

Swanson says the Everett plant now doesn't need to run as many hours to meet production requirements. "The whole system has done better than we calculated it would," he says. ◻

More information on equipment used is available by circling the appropriate Reader Service Number in this issue.
240 Drum mixer

NORTH CAROLINA DIVISION OF ENVIRONMENTAL MANAGEMENT

Air Quality Action Request

Computer ___

Name: ADAMS CONSTRUCTION CO.
Location: SR 1330 Johnson
Reg/Co./Prem. No.: 5/51/00141

Contact: R.C. Bishop, Plant Manager
Telephone: 894-7226

Type Action: CI ___ EE xx SR ___ PC ___ VE ___ PI ___ Other NSPS

Air Program Status 03 09 ___ ___ ___ Class A1P Chg ___

Action Requested By: Address/Phone Rec'd Date

Last Insp. Date ___ Action Date 4/22/87 Next Insp. Date 4/30/88

Permit # 6016 Issued 3/11/87 Expires 3/1/92 Stip # ___ Met Y/N Y

Recommendations: await stack test results

Signature: David Y. Daniel [signature] Date 4/29/87

CENTRAL FILE COPY

Dist: Yellow (Central File) - Blue (Region) - White (Opt.) Specify ___

The plant manufactures asphalt by drying aggregates in a 400 T/hr drum mix plant. The plant is brand new. During the test, the production rate ran about 220-230 T/hr while making I-2 mix. Visible emissions were being read by Mike Kirkman in accordance with Method #9. VE looked to be 0% opacity. Attached for your convenience is an AQ-92. The plant was spotless as far as emissions go. No further action needed at this time.

DYD/jf

SOURCE TEST
OBSERVERS CHECKLIST

N. C. Division of Environmental Management / Air Quality Section

Source Name: Adams Const. Co.	Testing Firm: Entropy
Address: P.O. Box 635 Benson	Address:
Plant Location: SR 1330	Phone:
Source Contact: RC Bishop Plt mgr.	Test Engineer: Tom McDonald
Phone: 894 7226	Assistant: John Eddy

Other Personnel Involved	Affiliation
Jim Thurman	Caterpillar
Mike Kirkman	Entropy – VEE.
Wardell Lee Brown	D.O.T.

Process Description: Drum mix mixing I-2

Process Rate During Test: 225 to 230

Maximum Process Rate: 400 T.P.H.

Burner Sizes (Incin.) Pri: na Sec: na

Soot Blowing Parameters:

A = ____ Hr B = ____ Hr

R = ____ Hr S = ____ Hr

A = Hours of soot blowing during sample(s)
B = Hours not soot blowing during sample(s) containing soot blowing
R = Average hours of operation per 24 hours
S = Average hours of soot blowing per 24 hours

TEST PARAMETERS

Duct Size: 42 3/4 × 57 1/4

Distance Before Ports: 246"

Distance After Ports: ~~[struck]~~ ~~[struck]~~ 61"

Number of Test Points: 20

Number of Runs: 3

Sampling Time Per Run (min.): 60

Pollutant Sampled: Particulate

E. P. A. Method No.: # 5 + 9

If method differs from E. P. A. method, explain:

Stack Temp 270° F.
2 vacuum

For Method 5 sampling train record ΔH@ 1.90
Y .9978

MAY 1987 CENTRAL FILE COPY

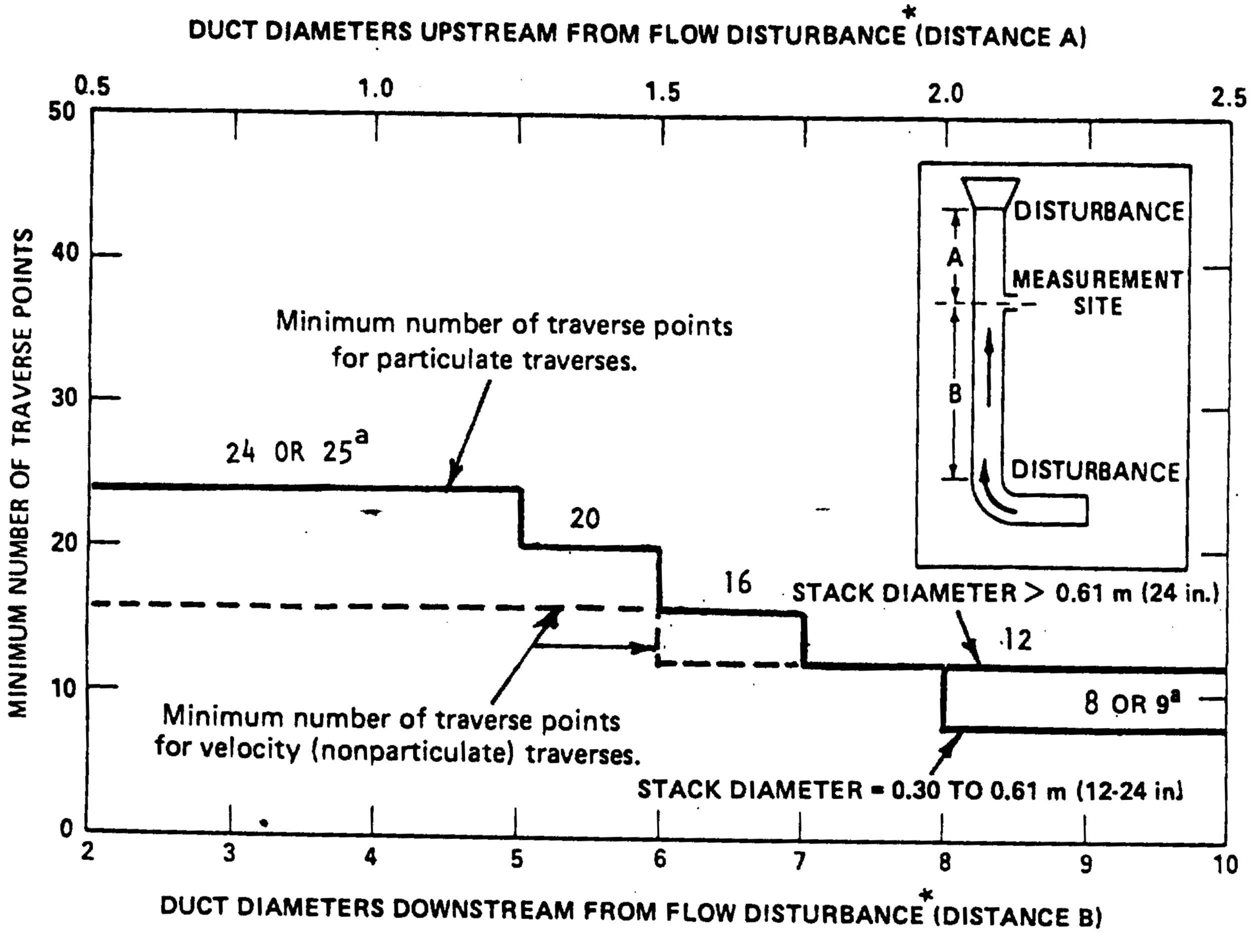
	Run #1	Run #2	Run #3
Leakage Rate (ft^3/min.) (0.02 ft^3/min. or less)	.001 –		
Time Started (24 hr. Clock)	9:04 Am		
Time Ended (24 hr. Clock)			
Test Date(s)	4/22/87	/ /	/ /

See Graph on Reverse Side For Number of Test Points.
Use Reverse Side for Comments.

Request 2 Copies of Report

[signature]
OBSERVERS SIGNATURE

AQ-92 4/1/86 WOCR



[a] HIGHER NUMBER IS FOR RECTANGULAR STACKS OR DUCTS

COMMENTS; March 17, 1987 Sampson Co resurfacing job
214.5 Ton producted, ran 3 hrs.

TABLE OF CONTENTS

INTRODUCTION

1.1 Outline of Test Program. Stationary source sampling was performed for Adams Construction Company at their batch mix asphalt plant near Benson, North Carolina, on April 22, 1987. Three EPA Method 5 particulate runs, with concurrent EPA Method 9 plume opacity determinations were performed at the rotary dryer baghouse stack for compliance purposes.

1.2 Test Participants. Table 1-1 lists the personnel present during the test program.

TABLE 1-1
TEST PARTICIPANTS

Adams Construction Company	Richard Bishop Test Coordinator
North Carolina Department of Natural Resources and Community Development	David Daniels Test Observer
Caterpillar/C.M.I.	David Albright Test Observer
	Jim Thurman Test Observer
Entropy Inc.	A. Thomas McDonald Project Supervisor
	John D. Eddy Engineering Technician
	Michael L. Kirkman Visible Emissions Observer

SUMMARY OF RESULTS

2.1 Presentation. Table 2-1 summarizes the results of the particulate testing performed November 13, 1986, at the rotary dryer baghouse stack. Table 2-2 presents a six-minute average summary of the plume opacity observations. Detailed test results are given in Appendix A; field and analytical data are presented in Appendix B.

2.2 Discussion. The average particulate emission concentration was 0.0233 grains per dry standard cubic foot.

TABLE 2-1

PARTICULATE TESTS SUMMARY OF RESULTS

Rotary Dryer Baghouse Stack

	1	2	3
Run Date	4/22/87	4/22/87	4/22/87
Test Train Parameters:			
Volume of Dry Gas Sampled, SCF*	34.583	32.666	33.423
Percent Isokinetic	102.9	92.4	98.6
Flue Gas Parameters:			
Temperature, Degrees F	275	275	275
Volumetric Air Flow Rates SCFM*, Dry	29,275	30,791	29,536
ACFM, Wet	57,401	55,192	57,208
Method 5 Results:			
Catch, Milligrams	55.8	49.2	47.3
Concentration, Grains/DSCF*	0.02490	0.02324	0.02184
Emission Rate, Lbs/Hour	6.248	6.135	5.529

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

TABLE 2-2

PLUME OPACITY OBSERVATIONS SUMMARY

Rotary Dryer Baghouse Stack

Run Number	1	2	3
Highest 6-Minute Average Opacity, %	0	0.8	0.8
Highest Single Opacity Reading, %	0	10	10

Run 1				Run 2				Run 3			
Set No.	Time Start	Time End	Avg. % Opacity	Set No.	Time Start	Time End	Avg. % Opacity	Set No.	Time Start	Time End	Avg. % Opacity
1	903	909	0	1	1208	1214	0	1	1350	1356	0
2	1027	1033	0	2	1214	1220	0	2	1356	1402	0.6
3	1033	1039	0	3	1220	1226	0	3	1402	1408	0.4
4	1044	1050	0	4	1226	1232	0	4	1408	1414	0.4
5	1050	1056	0	5	1232	1238	0	5	1414	1420	0.6
6	1056	1102	0	6	1238	1244	0.8	6	1420	1426	0
7	1102	1108	0	7	1244	1250	0.4	7	1426	1432	0.8
8	1108	1114	0	8	1250	1256	0	8	1432	1438	0
9	1114	1120	0	9	1256	1302	0	9	1438	1444	0.8
10	1120	1126	0	10	1302	1308	0	10	1452	1458	0.4

PROCESS DESCRIPTION AND OPERATION

3.1 General. Adams Construction Company, near Benson, North Carolina operates a continuous mix process to produce asphalt. A Caterpillar/C.M.I. drum mix dryer is used in the production process. The aggregate is dropped into the drum mix dryer, where it is mixed, dried, and heated; liquid asphalt is then added to the aggregate in the mixing chamber and the product is transferred to a holding silo. The dryer is fired with #2 diesel fuel.

3.2 Process Emissions. Particulates are emitted from the process during drying and mixing due to the release of dust from the surface of the aggregate mix. The exhaust gases from the dryer pass through a mixing chamber, baghouse, and a fan before exiting the stack to the atmosphere, as shown schematically in Figure 3-1.

3.3 Operation During Testing. As reported by plant personnel, approximately 242 tons per hour of asphalt were produced during testing.

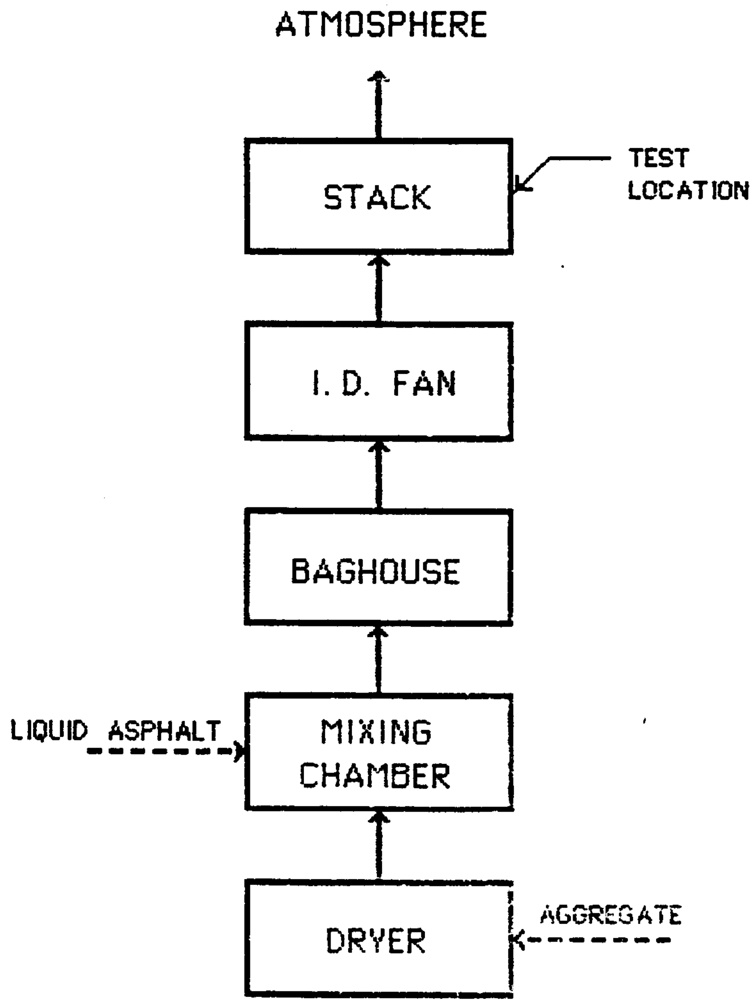


FIGURE 3-1. DRUM MIXER AIR FLOW SCHEMATIC SHOWING TEST LOCATION

SAMPLING AND ANALYTICAL PROCEDURES

4.1 General. All sampling and analytical procedures were those recommended by the United States Environmental Protection Agency and the North Carolina Department of Natural Resources and Community Development. Descriptions of the sampling equipment and procedures (extracted from 40 CFR 60) are provided in Appendix D.

4.2 Sampling Points. The number and location of the sampling points were determined according to EPA Method 1. The stack cross section was divided into 20 equal areas, i.e., five sample points on each of four traverse axes labeled A through D, as shown in Figure 4-1.

4.3 Volumetric Air Flow Rates

4.3.1 Flue Gas Velocity. EPA Method 2 was used to take the velocity measurements during the traverses of the stack cross section.

4.3.2 Flue Gas Composition. During run 1, a multipoint, integrated flue gas sample was collected and analyzed using EPA Method 3; the analytical results were used to determine the flue gas composition and molecular weight for each run.

4.3.3 Flue Gas Moisture. Moisture content was determined by analyzing the sampling train impinger reagents according to the procedures outlined in EPA Method 5.

4.4 Particulate Emissions. EPA Method 5 sampling and analytical procedures were used to determine the particulate emissions. The centroid of each of the 20 equal areas was sampled for three minutes for a net run time of 60 minutes.

4.5 Plume Opacity. The procedures outlined in EPA Method 9 were followed in determining the plume opacity.

4.6 Sampling Equipment. All sampling equipment was manufactured by Nutech Corporation or Entropy. Pertinent calibration data are provided in Appendix C.

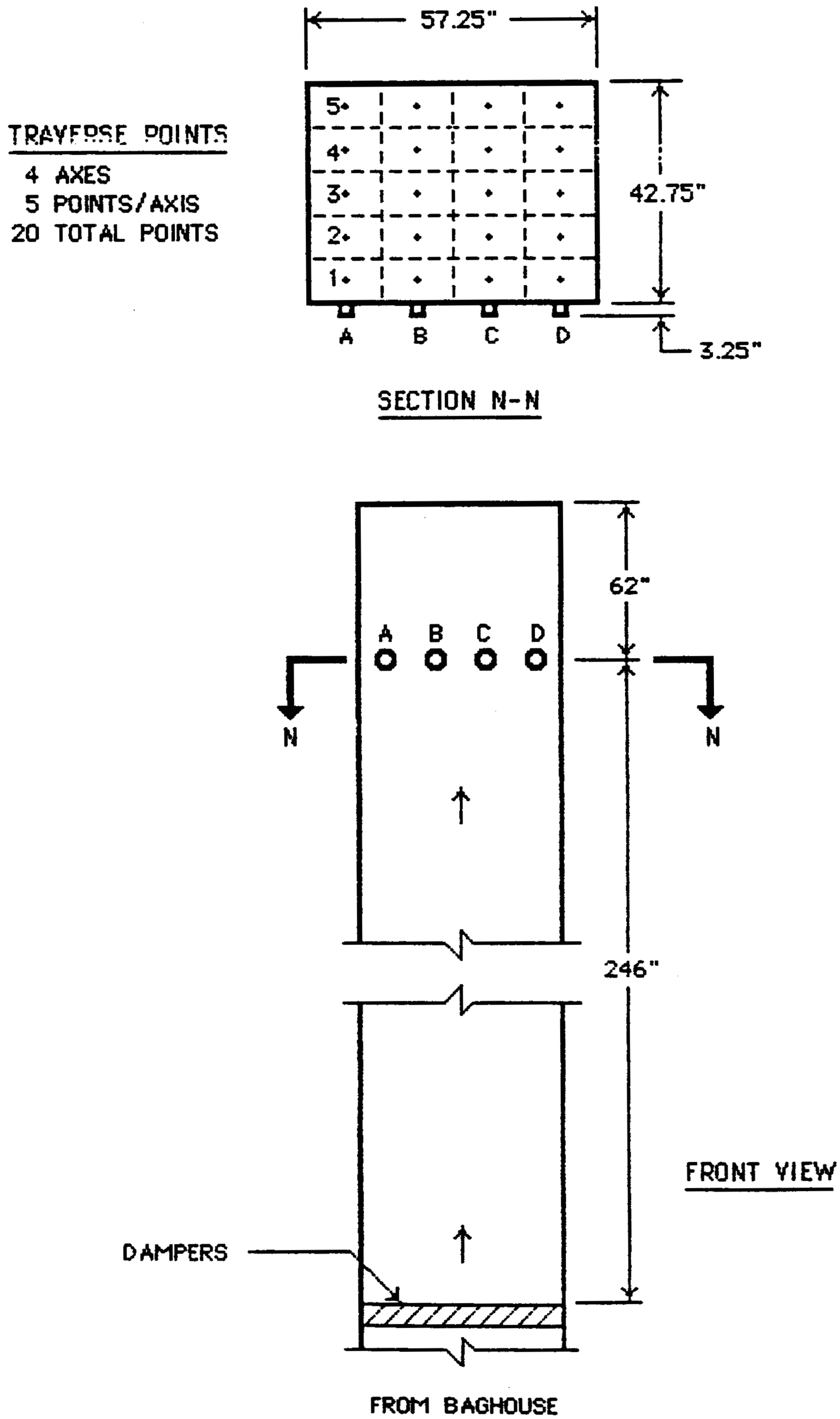


FIGURE 4-1. ROTARY DRYER BAGHOUSE STACK TEST LOCATION

APPENDIX A

TEST RESULTS AND EXAMPLE CALCULATIONS

ADAMS CONSTRUCTION COMPANY
BENSON, NORTH CAROLINA
DRUM MIX ASPHALT PLANT
TEST DATE - APRIL 22, 1987

TEST REVIEW DATE
JULY 10, 1987
REVIEWED BY:
MICHAEL Y. ALDRI

	RUN NUMBER	1
	RUN DATE	04/22/87
	RUN START TIME	0904
	RUN FINISH TIME	1130
N	NUMBER OF SAMPLE POINTS	20
Theta	TEST RUN TIME, MINUTES	60
Dn	NOZZLE DIAMETER, INCHES	0.244
An	NOZZLE AREA, SQ. IN.	0.0468
Cp	PITOT TUBE COEFFICIENT	0.840
Y	GAS METER CAL. FACTOR	0.998
Pbar	BAROMETRIC PRESSURE, IN. HG	29.60
Delta H	AVG. PRESS. DIFFERENTIAL OF ORIFICE METER, IN. H2O	1.204
Vm	ACTUAL METERED GAS VOL. CF	35.665
TmF	GAS METER TEMP,. DEG. F	79
Vm(std)	METERED GAS VOLUME AT DRY STANDARD CONDITIONS, DSCF	34.584
Vwc	VOLUME OF WATER COLLECTED IN IMPINGERS & DESICCANT, ML	288.0
Vwc(std)	VOLUME OF WATER VAPOR, SCF	13.556
%M	MOISTURE, % BY VOLUME	28.2
fm	MOLE FRACTION OF DRY GAS	0.718
%CO2	CO2, % BY VOLUME, DRY	4.5
%O2	O2, % BY VOLUME, DRY	15.0
%CO	CO, % BY VOLUME, DRY	0.0
%N2	N2, % BY VOLUME, DRY	80.5
Md	DRY MOLECULAR WT., #/#-MOLE	29.32

ADAMS CONSTRUCTION COMPANY
BENSON, NORTH CAROLINA
DRUM MIX ASPHALT PLANT
TEST DATE - APRIL 22, 1987

TEST REVIEW DATE
JULY 10, 1987
REVIEWED BY:
MICHAEL Y. ALDRIDGE

	RUN NUMBER	2
Ms	WET MOLECULAR WT., #/#-MOLE	26.13
Pstatic	GAS STATIC PRESS,. IN. H2O	-0.27
Ps	ABSOLUTE GAS PRESS, IN. HG.	29.58
TsF	STACK GAS TEMP., DEG. F	275
SSR DP	SUM OF SQUARE ROOTS OF VELOCITY PRESS. VALUES	16.0801
vs	FLUE GAS VELOCITY, FT/SEC	56.3
Ds	DUCT DIMENSIONS, INCHES	42.75X52.25
As	DUCT AREA, SQUARE INCHES	2447.4
AsF	DUCT AREA, SQUARE FEET	16.996
Qs	GAS FLOW RATE, WET ACFM	57405
Qstd	GAS FLOW RATE, DRY SCFM	29277
mn	SAMPLE WEIGHT, GRAMS	0.0558
cs	PART. CONCENTRATION GR/DSCF	0.0249
pmrc	POLLUTANT MASS RATE CALC. FROM CONCENTRATION, #/HR	6.25
pmra	POLLUTANT MASS RATE CALC. FROM AREA RATIO, #/HR	6.44
%I	% ISOKINETIC	103.0
pmr avg	AVERAGE OF pmra & pmrc	6.34

APPENDIX B.1

B. FIELD AND ANALYTICAL DATA

1. Particulate

Preliminary Field Data

PLANT NAME Adams Const. Co.
LOCATION Benson, NC
SAMPLING LOCATION Baghouse Stack

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 46"
NIPPLE LENGTH 3 1/4"
DEPTH OF DUCT 42 3/4"
WIDTH (RECTANGULAR DUCT) 57 1/4"

EQUIVALENT DIAMETER:

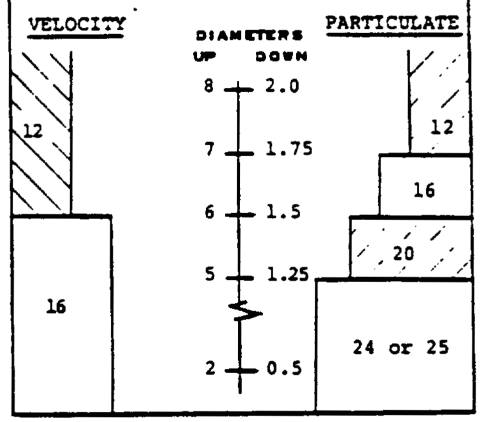
$$D_E = \frac{2 \times DEPTH \times WIDTH}{DEPTH + WIDTH} = \frac{2(42\,3/4)(57\,1/4)}{(42\,3/4 + 57\,1/4)} = 48.9$$

DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE	UPSTREAM	DOWNSTREAM
	246"	62
DIAMETERS	5.03	1.27

STACK AREA = (42.75)(57.25) = 2,447 IN²

DRAW HORIZONTAL LINE THROUGH DIAMETERS

If more than 8 and 2 diameters and if duct dia. is less than 24", use 8 or 9 points.



Point	% OF DUCT DEPTH	DISTANCE FROM INSIDE WALL	DISTANCE FROM OUTSIDE OF PORT
1	10	4 1/4	7 1/2
2	30	12 7/8	16 1/8
3	50	21 3/8	24 5/8
4	70	29 7/8	33 1/8
5	90	38 1/2	41 3/4
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

	4	6	8	10	12	14	16	18	20	22	24
1	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3	75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4	93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5		85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6		95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7			89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8			96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9				91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10				97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11					93.3	85.4	78.0	70.4	61.2	39.3	32.3
12					97.9	90.1	83.1	76.4	69.4	60.7	39.8
13						94.3	87.5	81.2	75.0	68.5	60.2
14						98.2	91.5	85.4	79.6	73.8	67.7
15							95.1	89.1	83.5	78.2	72.8
16							98.4	92.5	87.1	82.0	77.0
17								95.6	90.3	85.4	80.6
18								98.6	93.3	88.4	83.9
19									96.1	91.3	86.8
20									98.7	94.0	89.5
21										96.5	92.1
22										98.9	94.5
23											96.8
24											98.9

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS

	2	3	4	5	6	7	8	9	10	11	12
1	25.0	16.7	12.5	10.0	8.3	7.1	6.3	5.6	5.0	4.5	4.2
2	75.0	50.0	37.5	30.0	25.0	21.4	18.8	16.7	15.0	13.6	12.5
3		83.3	62.5	50.0	41.7	35.7	31.3	27.8	25.0	22.7	20.8
4			87.5	70.0	58.3	50.0	43.8	38.9	35.0	31.8	29.2
5				90.0	75.0	64.3	56.3	50.0	45.0	40.9	37.5
6					91.7	78.6	68.8	61.1	55.0	50.0	45.8
7						92.9	81.3	72.2	65.0	59.1	54.2
8							93.8	83.3	75.0	68.2	62.5
9								94.4	85.0	77.3	70.8
10									95.0	86.4	79.2
11										95.5	87.5
12											95.5

ENTROPY ENVIRONMENTALISTS, INC

ORSAT FIELD DATA

Plant Name Adams Construction Co.

Sampling Location Baghouse Stack Fuel Type ______

Run and/or Sample No. 1 Leak Test? ✓ Date 4/22/87 Operator [illegible]

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	$\%O_2$ B-A	%CO C-B	$\%N_2$ 100-C
904	1140	4.5	19.6	–	15.1		
to	to	4.6	19.6	–	15.0		
1130	1200	4.5	19.5	–	15.0		
	Avg.	4.5		Avg.	15.0		80.5

Run and/or Sample No. ______ Leak Test? ______ Date ______ Operator ______

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	$\%O_2$ B-A	%CO C-B	$\%N_2$ 100-C
	Avg.			Avg.			

Run and/or Sample No. ______ Leak Test? ______ Date ______ Operator ______

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	$\%O_2$ B-A	%CO C-B	$\%N_2$ 100-C
	Avg.			Avg.			

PARTICULATE FIELD DATA

COMPANY NAME: Adams Const. Co — RUN NUMBER: M5-1
ADDRESS: Benson NC — TIME START: 0904
SAMPLING LOCATION: Baghouse Stack — TIME FINISH: 1130
DATE: 4-22-87 — TEAM LEADER: TRS — TECHNICIANS: JDS
BAROMETRIC PRESSURE, IN. HG: 29.6 — STATIC PRESSURE, IN. H_2O: -0.27
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG: 15, 3
SAMPLING TRAIN LEAK RATE, CU. FT./MIN.: 0.001, 0.000

EQUIPMENT CHECKS

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 270 °F

IDENTIFICATION NUMBERS

REAGENT BOX: 0214 — NOZZLE: 306 — DIAMETER: .244
METER BOX: N19 — T/C READOUT: 00015
UMBILICAL: U2 — T/C PROBE: 11-52
SAMPLE BOX: 22 — ORSAT PUMP: SB
PROBE: 6-3 — TEDLAR BAG: 2

FILTER #	TARE
E5228	.4797

NOMOGRAPH SET-UP — NOMOGRAPH # TRS

$\Delta H_@$: 1.90 — C FACTOR: 0.65
METER TEMP: 80 — STACK TEMP: 270
% MOISTURE: 29% — REF. ΔP: 1.00

SAMPLE POINT	CLOCK TIME, MIN.	DRY GAS METER READING, CU. FT.	PITOT READING (ΔP), IN. H_2O	ORIFICE SETTING (ΔH), IN. H_2O IDEAL	ORIFICE SETTING (ΔH), IN. H_2O ACTUAL	GAS METER TEMP. °F	PUMP VACUUM IN. HG GAUGE	FILTER BOX TEMP. °F	IMP. EXIT TEMP. °F	STACK TEMP. °F	LK. CHECK READINGS
A 1	0/0	955.988	0.48	0.88	0.88	64	1	227	43	266	
2	3	957.55	0.51	0.94	0.94	65	1	243	42	270	
3	6	958.95	0.47	0.86	0.86	65	1	248	42	271	
4	9	960.582	0.53	0.98	0.98	76	1	255	45	243	Fyrite = 4.
5	12	962.23	0.62	1.14	1.14	76	1	253	43	244	
B 1	15/0	963.96	0.64	1.18	1.18	76	1	253	45	270	
2	3	965.73	0.63	1.16	1.16	77	1	254	45	277	
3	6	967.49	0.58	1.07	1.07	78	1	254	47	283	
4	9	969.17	0.49	0.90	0.90	78	2	254	48	283	
5	12	970.74	0.52	0.96	0.96	79	2	256	51	278	
C 1	30/0	972.36	0.78	1.44	1.44	79	2	256	51	273	
2	3	974.35	0.80	1.47	1.47	80	2	255	50	279	
3	6	976.29	0.73	1.34	1.34	81	2	251	51	280	
4	9	978.17	0.61	1.12	1.12	84	2	251	53	282	
5	12	979.95	0.49	0.90	0.90	85	2	252	53	280	Fyrite
D 1	45/0	981.50	0.89	1.64	1.64	84	3	250	55	2[illegible]6	4.0%
2	3	983.58	0.91	1.67	1.67	85	3	250	55	283	
3	6	985.68	0.87	1.60	1.60	87	3	248	54	287	
4	9	987.74	0.85	1.56	1.56	88	3	249	54	285	
5	12	989.79	0.69	1.27	1.27	88	3	248	55	284	
	60/off	991.653									

$\Sigma\sqrt{\Delta P} = 16.0801$

V_M	$(\overline{\sqrt{\Delta P}})^2$	ΔH	T_M	T_S
35.665	0.6464	1.204	79	275

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ENTROPY

PARTICULATE FIELD DATA

COMPANY NAME Adams Const. Co.
RUN NUMBER MS-2
ADDRESS Benson, NC
TIME START 1205
SAMPLING LOCATION Baghouse stack
TIME FINISH 1314
DATE 4-22-87 TEAM LEADER (TMS) TECHNICIANS JDE
BAROMETRIC PRESSURE, IN. HG 29.6 STATIC PRESSURE, IN. H_2O -0.32
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 5
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.002 0.009

EQUIPMENT CHECKS

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- — ORSAT SAMPLING SYSTEM
- — TEDLAR BAG
- ✓ THERMOCOUPLE @ 280 °F

IDENTIFICATION NUMBERS

REAGENT BOX 0214 NOZZLE 306 DIAMETER .244
METER BOX N19 T/C READOUT 00015
UMBILICAL U2 T/C PROBE 11-52
SAMPLE BOX 25 ORSAT PUMP —
PROBE 6-3 TEDLAR BAG —

FILTER #	TARE
~~E5225~~	~~.4687~~
E5225	.4680

NOMOGRAPH SET-UP NOMOGRAPH # (TMS)

$\Delta H_@$ 1.90 C FACTOR 0.64
METER TEMP 90 STACK TEMP 280
% MOISTURE 30 REF. ΔP 1.05

SAMPLE POINT	CLOCK TIME, MIN.	DRY GAS METER READING, CU. FT.	PITOT READING (ΔP), IN. H_2O	ORIFICE SETTING (ΔH), IN. H_2O IDEAL	ORIFICE SETTING (ΔH), IN. H_2O ACTUAL	GAS METER TEMP. °F	PUMP VACUUM IN. HG GAUGE	FILTER BOX TEMP. °F	IMP. EXIT TEMP. °F	STACK TEMP. °F	LK. CHEC READINGS
D 1	0/0	991.814	0.92	1.61	1.61	87	1	228	43	268	
2	3	993.87	0.89	1.56	1.56	86	1	239	42	271	
3	6	995.91	0.87	1.52	1.52	86	1	245	44	273	
4	9	997.26	0.82	1.44	1.44	86	1	249	44	274	Fyrite=6.
5	12	999.91	0.71	1.24	1.24	86	1	256	46	272	
C 1	15/0	1001.68	0.83	1.45	1.45	87	1	255	46	276	
2	3	3.67	0.78	1.37	1.37	87	1	255	45	278	
3	6	5.58	0.73	1.28	1.28	88	1	257	46	277	
4	9	7.41	0.60	1.05	1.05	88	1	254	46	276	
5	12	9.11	0.48	0.84	0.84	88	1	256	45	277	
B 1	30/0	10.61	0.65	1.14	1.14	88	1	258	47	280	
2	3	12.38	0.68	1.19	1.19	88	1	258	49	281	
3	6	14.18	0.59	1.03	1.03	88	1	257	48	282	
4	9	15.87	0.52	0.91	0.91	88	1	259	46	277	
5	12	17.47	0.44	0.77	0.77	88	1	259	45	273	Fyrite=
A 1	45/0	18.94	0.46	0.81	0.81	88	1	261	45	272	4.5%
2	3	20.46	0.48	0.84	0.84	88	1	260	47	274	
3	6	21.99	0.42	0.74	0.74	88	1	260	49	273	
4	9	23.44	0.37	0.65	0.65	88	1	259	51	273	
5	12	24.77	0.33	0.58	0.58	88	1	258	51	272	
	60/off	1026.010									

34.196 V_M 0.6150 $(\sqrt{\Delta P})^2$ 1.101 ΔH 87 T_M 275 T_S

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ENTROPY

PARTICULATE FIELD DATA

COMPANY NAME Adams Const. Co. RUN NUMBER MS-3
ADDRESS Benson NC TIME START 1350
SAMPLING LOCATION Baghouse Stack TIME FINISH 1500
DATE 4-22-87 TEAM LEADER (JMS) TECHNICIANS JDS
BAROMETRIC PRESSURE, IN. HG 29.6 STATIC PRESSURE, IN. H_2O -0.19
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 5
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.003 0.001

EQUIPMENT CHECKS

✓ PITOTS, PRE-TEST
— PITOTS, POST-TEST
— ORSAT SAMPLING SYSTEM
— TEDLAR BAG
✓ THERMOCOUPLE @ 280 °F

IDENTIFICATION NUMBERS

REAGENT BOX 0214 NOZZLE 306 DIAMETER .244
METER BOX N19 T/C READOUT 00015
UMBILICAL U2 T/C PROBE 11-52
SAMPLE BOX 21 ORSAT PUMP —
PROBE 6-3 TEDLAR BAG —

FILTER #	TARE
E5227	.4817

NOMOGRAPH SET-UP NOMOGRAPH # (JMS)

ΔH@ 1.90 C FACTOR 0.64
METER TEMP 90 STACK TEMP 280
% MOISTURE 30 REF. ΔP 1.05

SAMPLE POINT	CLOCK TIME, MIN.	DRY GAS METER READING, CU. FT.	PITOT READING (ΔP), IN. H_2O	ORIFICE SETTING (ΔH), IN. H_2O IDEAL	ORIFICE SETTING (ΔH), IN. H_2O ACTUAL	GAS METER TEMP. °F	PUMP VACUUM IN. HG GAUGE	FILTER BOX TEMP. °F	IMP. EXIT TEMP. °F	STACK TEMP. °F	LK. CHEC READINGS
A 1	0/0	26.390	0.47	0.82	0.82	87	1	236	45	271	
2	3	27.92	0.51	0.89	0.89	87	1	244	44	273	
3	6	29.47	0.45	0.79	0.79	87	1	252	44	276	
4	9	30.94	0.43	0.75	0.75	87	1	259	45	271	
5	12	32.39	0.38	0.67	0.67	88	1	258	45	271	
B 1	15/0	33.74	0.64	1.12	1.12	88	1	258	48	279	
2	3	35.49	0.68	1.19	1.19	88	1	263	49	277	
3	6	37.27	0.57	1.00	1.00	88	1	262	49	277	
4	9	38.95	0.49	0.86	0.86	88	1	257	52	276	
5	12	40.47	0.42	0.74	0.74	88	1	255	51	279	
C 1	30/0	41.91	0.78	1.37	1.37	88	1	256	51	273	
2	3	43.87	0.82	1.44	1.44	89	1	253	53	279	
3	6	45.82	0.68	1.19	1.19	89	2	250	55	279	
4	9	47.60	0.59	1.03	1.03	89	2	251	55	279	
5	12	49.32	0.40	0.70	0.70	89	2	253	57	277	
D 1	45/0	50.69	0.91	1.59	1.59	89	2	252	56	272	
2	3	52.75	1.16	2.03	2.03	89	2	252	54	274	
3	6	55.11	1.45	2.54	2.54	90	2	255	54	284	
4	9	57.78	0.79	1.38	1.38	90	3	254	55	265	
5	12	59.66	0.72	1.26	1.26	90	3	251	58	271	
	60/off	61.436									

V_M	$(\sqrt{\Delta P})^2$	ΔH	T_M	T_S
35.046	0.6446	1.168	88	275

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ENTROPY

PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name ADAMS CONSTRUCTION EEI Ref. # 5474

Sampling Location ROTARY DRYER BAGHOUSE STACK

Date Received 4/23 Date Analyzed 4/24 Reagent Box(es) 214

Run Number	MS-1	MS-2	MS-3
Run Date	4/22	4/22	4/22

SUMMARY OF PARTICULATE ANALYSES

Sum of Particulate, mg.	535.8	517.5	529.3
Total Filter Tare mg.	479.7	468.0	481.7
Blank Residue, mg.	(125 mL) 0.3	(150 mL) 0.3	(125 mL) 0.3
TOTAL PARTICULATE CATCH, mg.	55.8	49.2	47.3

ANALYSIS OF MOISTURE CATCH

Reagent 1 (DI H_2O):			
Final Weight, g.	470.0	370.0	455.0
Tared Weight, g.	200.0	200.0	200.0
Water Catch, g.	270.0	170.0	255.0
Reagent 2 ( ):			
Final Weight, g.	—	—	—
Tared Weight, g.	—	—	—
Water Catch, g.	—	—	—
CONDENSED WATER, g.	270.0	170.0	255.0
Silica Gel:			
Final Weight, g.	218.0	219.0	211.5
Tared Weight, g.	200.0	200.0	200.0
ADSORBED WATER, g.	18.0	19.0	11.5
TOTAL WATER COLLECTED, g.	288.0	189.0	266.5

Blank Beaker #	24
Final wt. mg.	109357.5
Tare wt. mg.	109357.1
Residue, mg.	0.4
Volume, mL.	200.0
Concen., mg/mL	.002

--- Legend ---

✓ = Final Weight

L = Loose Particulate

F = Filter D = Dish

R = Rinse P = Pan

Notes and Comments

ENTROPY

LABORATORY SAMPLE WEIGHT CALCULATIONS

Plant Name ADAMS' CONSTRUCTION EEI Ref. # 5474

Run Number	MS-1	MS-2	MS-3
Run Date	4/22	4/22	4/22
Sample ID/Container #	F&R 2112	F&R 2113	F&R 2114
	98.4570	101.5766	96.3447
	98.4568	101.5765	96.3445
Tare Wt., g.	97.9210	101.0590	95.8152
SAMPLE WT., g.	0.5358	0.5175	0.5293

Sample ID/Container #			
Tare Wt., g.			
SAMPLE WT., g.			

Sample ID/Container #			
Tare Wt., g.			
SAMPLE WT., g.			

Sample ID/Container #			
Tare Wt., g.			
SAMPLE WT., g.			

CUSTODY SHEET FOR REAGENT BOX # 0214

Date of Makeup 4/8 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 200 mls. of DI. H_2O

Individual Tare of Reagent: ______ mls. of ______

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Adams Const. Co. - Benson NC

SAMPLING LOCATION Baghouse Stack

Run Number	Date Used	Initials	Locked?	Date Cleanup	% S. Gel Spent	Initials	Locke
MS-1	4-22-87	TMS	✓	4-22-87	20	TMS	✓
MS-2	4-22-87	TMS	✓	4-22-87	60	TMS	✓
MS-3	4-22-87	TMS	✓	4-22-87	20	TMS	✓

	Date	Initials	Locked?
Received in Lab	4/23	J.F.J.	✓

Sampling Method: M5

Zero & Span Balance Initials J.F.J.

Filter #	Tare Weight (mgms)	Used on Test
E5228	.4794	M5-1
E5225	.4650	M5-2
E5227	.4815	M5-3

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

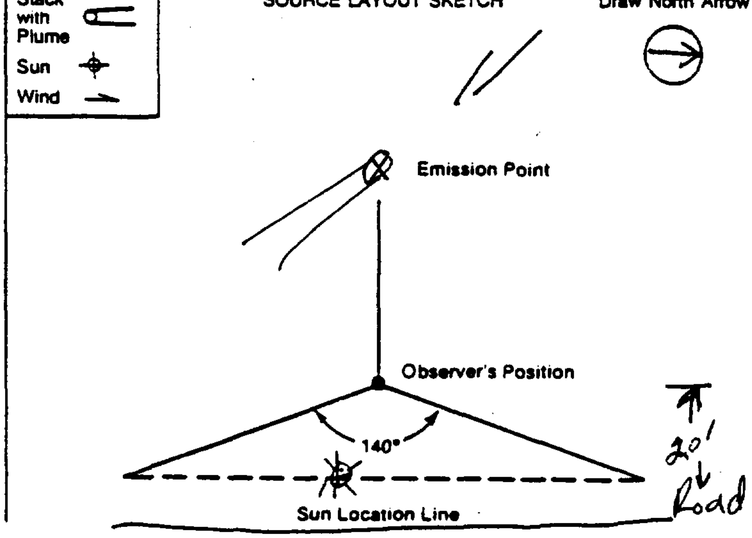
APPENDIX B.2

B. FIELD AND ANALYTICAL DATA

2. Plume Opacity

COMPANY NAME	Adams Construction Co.
STREET ADDRESS	Benson, NC
CITY	
STATE	
ZIP	
PHONE (KEY CONTACT)	
SOURCE ID NUMBER	
PROCESS EQUIPMENT	Asphalt Plant
OPERATING MODE	
CONTROL EQUIPMENT	Baghouse
OPERATING MODE	
DESCRIBE EMISSION POINT	Rectangular Stack
HEIGHT ABOVE GROUND LEVEL	~30'
HEIGHT RELATIVE TO OBSERVER	Start 20' End 20'
DISTANCE FROM OBSERVER	Start 200' End 200'
DIRECTION FROM OBSERVER	Start W End W
DESCRIBE EMISSIONS	Start Detach Steam Plume End Same
EMISSION COLOR	Start NO End NO
IF WATER DROPLET PLUME	Attached ☐ Detached ☒
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	Start Stack Exit End Same
DESCRIBE PLUME BACKGROUND	Start Clouds & Blue Sky End Same
BACKGROUND COLOR	Start Blue-White End Same
SKY CONDITIONS	Start Var. Cloudy End Same
WIND SPEED	Start 5-10mph End Same
WIND DIRECTION	Start NW End Same
AMBIENT TEMP	Start 75 End 80
WET BULB TEMP	
RH, percent	

SOURCE LAYOUT SKETCH



ADDITIONAL INFORMATION

OBSERVATION DATE	START TIME	END TIME
4/22/87	903	1126

MIN \ SEC	0	15	30	45	COMMENTS
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	909
7	~~0~~	~~0~~	~~0~~	~~0~~	
8	~~0~~	~~0~~	~~0~~	~~0~~	
9	~~0~~	~~0~~	~~0~~		Stopped
10	0	0	0	0	Started 1027
11	0	0	0	0	2 of 10
12	0	0	0	0	
13	0	0	0	0	
14	0	0	0	0	
15	0	0	0	0	
16	0	0	0	0	
17	0	0	0	0	3 of 10
18	0	0	0	0	
19	0	0	0	0	
20	0	0	0	0	3 of 10
21	0	0	0	0	
22	0	0	0	0	Stopped
23	0	0	0	0	Started 1045
24	0	0	0	0	
25	0	0	0	0	4 of 10
26	0	0	0	0	
27	0	0	0	0	
28	0	0	0	0	
29	0	0	0	0	
30	0	0	0	0	5 of 10
	0	0	0	0	(cont)

OBSERVER'S NAME (PRINT)	Michael L. Kirkman
OBSERVER'S SIGNATURE	[signature]
DATE	4/22/87
ORGANIZATION	Entropy
CERTIFIED BY	Eastern Tech Assoc
DATE	Nov. 8
CONTINUED ON VEO FORM NUMBER	1-2

COMPANY NAME	
Adams Construction Co.	
STREET ADDRESS	
CITY Benson, NC	STATE / ZIP
PHONE (KEY CONTACT)	SOURCE ID NUMBER

PROCESS EQUIPMENT	OPERATING MODE
CONTROL EQUIPMENT	OPERATING MODE

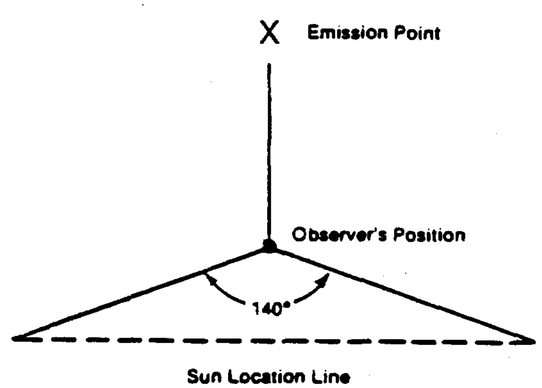
DESCRIBE EMISSION POINT	
HEIGHT ABOVE GROUND LEVEL	HEIGHT RELATIVE TO OBSERVER Start End
DISTANCE FROM OBSERVER Start End	DIRECTION FROM OBSERVER Start End

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

ESCRIBE PLUME BACKGROUND Start End		
BACKGROUND COLOR Start End	SKY CONDITIONS Start End	
WIND SPEED Start End	WIND DIRECTION Start End	
AMBIENT TEMP Start End	WET BULB TEMP	RH, percent

SOURCE LAYOUT SKETCH

Stack with Plume / Sun / Wind — Draw North Arrow



ADDITIONAL INFORMATION

OBSERVATION DATE	START TIME	END TIME
4/22/87		

SEC / MIN	0	15	30	45	COMMENTS
8/10	0	0	0	0	5 of 10
2/11	0	0	0	0	(cont.)
3/12	0	0	0	0	
4/13	0	0	0	0	
5/14	0	0	0	0	6 of 10
6/15	0	0	0	0	
7/16	0	0	0	0	
8/17	0	0	0	0	
9/18	0	0	0	0	
10/19	0	0	0	0	
11/20	0	0	0	0	7 of 10
12/21	0	0	0	0	
13/22	0	0	0	0	
14/23	0	0	0	0	
15/24	0	0	0	0	
16/25	0	0	0	0	
17/26	0	0	0	0	8 of 10
18/27	0	0	0	0	
19/28	0	0	0	0	
20/29	0	0	0	0	
21/30	0	0	0	0	
22/31	0	0	0	0	
23/32	0	0	0	0	
24/33	0	0	0	0	9 of 10
25/34	0	0	0	0	
26/35	0	0	0	0	
27/36	0	0	0	0	
28/37	0	0	0	0	
29/38	0	0	0	0	10 of 10
30/39	0	0	0	0	(cont.)

OBSERVER'S NAME (PRINT)	
OBSERVER'S SIGNATURE [signature]	DATE 4/22/87
ORGANIZATION	
CERTIFIED BY	DATE

CONTINUED ON VEO FORM NUMBER 1-3

COMPANY NAME	Adams Construction Co.
STREET ADDRESS	
CITY	Benson NC
STATE	
ZIP	
PHONE (KEY CONTACT)	
SOURCE ID NUMBER	
PROCESS EQUIPMENT	
OPERATING MODE	
CONTROL EQUIPMENT	
OPERATING MODE	
DESCRIBE EMISSION POINT	
HEIGHT ABOVE GROUND LEVEL	
HEIGHT RELATIVE TO OBSERVER	Start End
DISTANCE FROM OBSERVER	Start End
DIRECTION FROM OBSERVER	Start End
DESCRIBE EMISSIONS	Start End
EMISSION COLOR	Start End
IF WATER DROPLET PLUME	Attached ☐ Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	Start End
ESCRIBE PLUME BACKGROUND	Start End
BACKGROUND COLOR	Start End
SKY CONDITIONS	Start End
WIND SPEED	Start End
WIND DIRECTION	Start End
AMBIENT TEMP	Start End
WET BULB TEMP	
RH, percent	

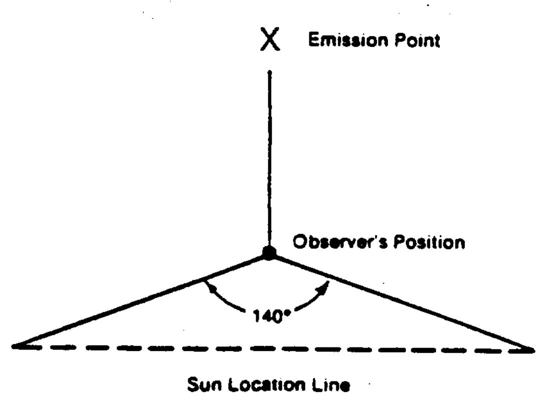
Stack with Plume

Sun

Wind

SOURCE LAYOUT SKETCH

Draw North Arrow



ADDITIONAL INFORMATION

OBSERVATION DATE: 4/22/87

START TIME:

END TIME:

MIN \ SEC	0	15	30	45	COMMENTS
1	0	0	0	0	10 of 10 (cont.)
2	0	0	0	0	
3	0	0	0	0	1120
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

OBSERVER'S NAME (PRINT)

OBSERVER'S SIGNATURE: Michael L Kirkman [signature] DATE: 4/22/87

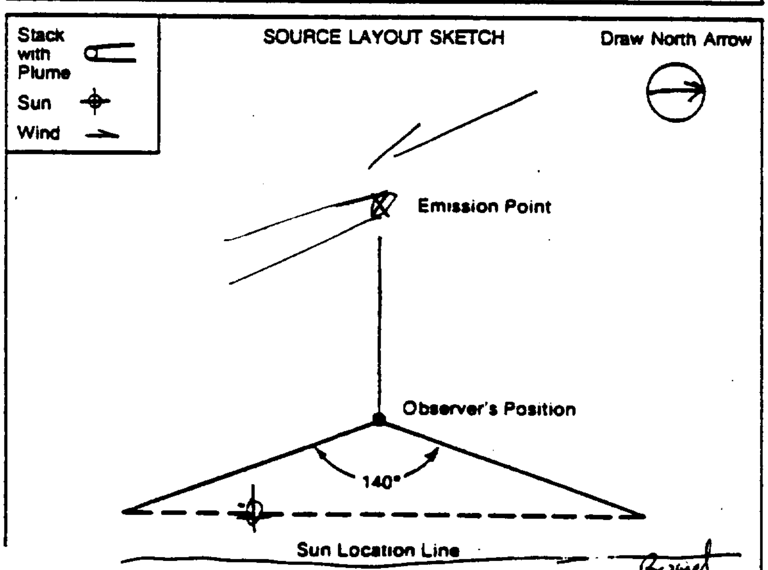
ORGANIZATION

CERTIFIED BY DATE

CONTINUED ON VEO FORM NUMBER: END

COMPANY NAME	Adams Construction Co
STREET ADDRESS	
CITY	Benson
STATE	NC
ZIP	
PHONE (KEY CONTACT)	
SOURCE ID NUMBER	
PROCESS EQUIPMENT	Asphalt Plant
OPERATING MODE	
CONTROL EQUIPMENT	Baghouse
OPERATING MODE	
DESCRIBE EMISSION POINT	Rectangular Stack
HEIGHT ABOVE GROUND LEVEL	30
HEIGHT RELATIVE TO OBSERVER	Start 20 End 20
DISTANCE FROM OBSERVER	Start 175' End 175'
DIRECTION FROM OBSERVER	Start W End W
DESCRIBE EMISSIONS	Start Detached Steam End Same
EMISSION COLOR	Start No End
IF WATER DROPLET PLUME	Attached ☐ Detached ☒
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	Start Stack Exit End Same
DESCRIBE PLUME BACKGROUND	Start White Clouds & Blue Sky End Same
BACKGROUND COLOR	Start White & Blue End Same
SKY CONDITIONS	Start Var. Cloudy End Same
WIND SPEED	Start 5-10 mph End Same
WIND DIRECTION	Start NNW End Same
AMBIENT TEMP	Start 80 End 80
WET BULB TEMP	
RH, percent	

SOURCE LAYOUT SKETCH



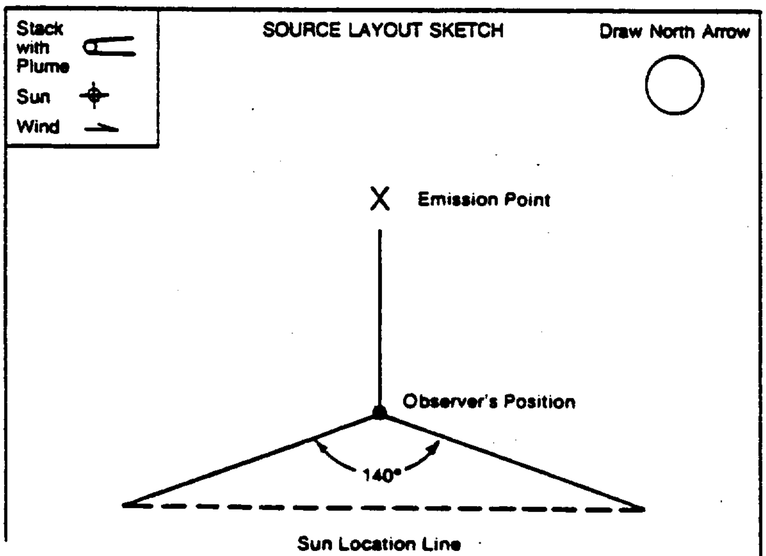
ADDITIONAL INFORMATION

OBSERVATION DATE	START TIME	END TIME
4/22/87	1208	1308

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

OBSERVER'S NAME (PRINT)	Michael L. Kirkman
OBSERVER'S SIGNATURE	Michael L. Kirkman
DATE	4/22/87
ORGANIZATION	Entropy
CERTIFIED BY	Eastern Tech. Assoc.
DATE	Nov 86
CONTINUED ON VEO FORM NUMBER	2 - 2

COMPANY NAME Adams Construction Co.			
STREET ADDRESS			
CITY Benson	STATE NC	ZIP	
PHONE (KEY CONTACT)	SOURCE ID NUMBER		
PROCESS EQUIPMENT	OPERATING MODE		
CONTROL EQUIPMENT	OPERATING MODE		
DESCRIBE EMISSION POINT			
HEIGHT ABOVE GROUND LEVEL	HEIGHT RELATIVE TO OBSERVER Start End		
DISTANCE FROM OBSERVER Start End	DIRECTION FROM OBSERVER Start End		
DESCRIBE EMISSIONS Start End			
EMISSION COLOR Start End	IF WATER DROPLET PLUME Attached ☐ Detached ☐		
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED Start End			
DESCRIBE PLUME BACKGROUND Start End			
BACKGROUND COLOR Start End	SKY CONDITIONS Start End		
WIND SPEED Start End	WIND DIRECTION Start End		
AMBIENT TEMP Start End	WET BULB TEMP	RH, percent	



ADDITIONAL INFORMATION

OBSERVATION DATE	START TIME	END TIME
4/22/87		

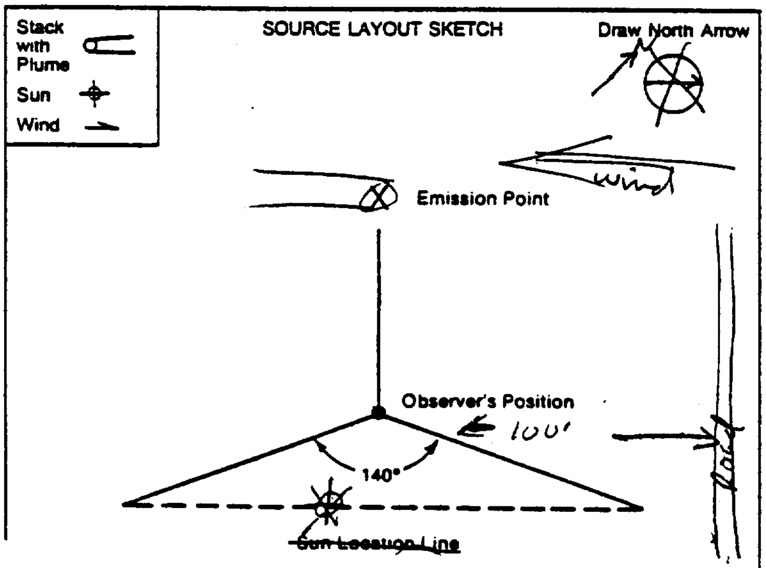
MIN \ SEC	0	15	30	45	COMMENTS
1	0	0	0	0	6 of 10
2	0	0	0	0	
3	0	0	0	0	0.8
4	0	0	5	5	Attached plume
5	5	5	0	0	may be water vapo
6	0	0	0	0	
7	0	0	0	0	7 of 10
8	0	0	0	0	
9	0	0	10	0	0.4
10	0	0	0	0	
11	0	0	0	0	
12	0	0	0	0	8 of 10
13	0	0	0	0	↓
14	0	0	0	0	
15	0	0	0	0	0
16	0	0	0	0	
17	0	0	0	0	
18	0	0	0	0	
19	0	0	0	0	9 of 10
20	0	0	0	0	
21	0	0	0	0	
22	0	0	0	0	0
23	0	0	0	0	
24	0	0	0	0	
25	0	0	0	0	10 of 10
26	0	0	0	0	
27	0	0	0	0	
28	0	0	0	0	0
29	0	0	0	0	
30	0	0	0	0	

OBSERVER'S NAME (PRINT)	
OBSERVER'S SIGNATURE [signature]	DATE 4/22/87
ORGANIZATION	
CERTIFIED BY	DATE
CONTINUED ON VEO FORM NUMBER	END

3-1

COMPANY NAME	Adams Constr. Co.
STREET ADDRESS	
CITY	Benson
STATE	NC
ZIP	
PHONE (KEY CONTACT)	
SOURCE ID NUMBER	
PROCESS EQUIPMENT	Asphalt Plant
OPERATING MODE	
CONTROL EQUIPMENT	Baghouse
OPERATING MODE	
DESCRIBE EMISSION POINT	Rectangular Stack
HEIGHT ABOVE GROUND LEVEL	~30'
HEIGHT RELATIVE TO OBSERVER	Start 30' End
DISTANCE FROM OBSERVER	Start 150' End
DIRECTION FROM OBSERVER	Start NW End
DESCRIBE EMISSIONS	Start Detached Steam Plume End
EMISSION COLOR	Start No Color End
IF WATER DROPLET PLUME	Attached ☐ Detached ☒
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	Start Stack Exit End
DESCRIBE PLUME BACKGROUND	Start Sky & Clouds End
BACKGROUND COLOR	Start White & Blue End
SKY CONDITIONS	Start Var. Cloudy End
WIND SPEED	Start 0-5 mph End
WIND DIRECTION	Start NE End
AMBIENT TEMP	Start 85 End
WET BULB TEMP	
RH, percent	

SOURCE LAYOUT SKETCH



ADDITIONAL INFORMATION

OBSERVATION DATE	4/22/87
START TIME	1350
END TIME	1458

MIN \ SEC	0	15	30	45	COMMENTS
1	0	0	0	0	1 of 10
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	0
5	0	0	0	0	
6	0	0	0	0	
7	0	0	0	0	2 of 10
8	0	0	0	0	
9	0	0	0	0	0.6
10	0	0	0	5	
11	0	5	5	0	
12	0	0	0	0	
13	0	0	0	0	3 of 10
14	0	5	5	0	
15	0	0	0	0	0.4
16	0	0	0	0	
17	0	0	0	10	
18	0	0	0	0	
19	0	0	0	0	4 of 10
20	0	0	0	0	
21	0	0	0	5	
22	0	0	0	0	0.4
23	0	0	0	0	
24	0	0	5	0	
25	0	0	0	0	5 of 10
26	0	0	0	0	
27	0	0	0	0	
28	0	0	0	0	0.6
29	0	0	0	5	
30	0	0	0	10	

OBSERVER'S NAME (PRINT)	Michael L. Kirkman
OBSERVER'S SIGNATURE	Michael L. Kirkman
DATE	4/22/87
ORGANIZATION	Entropy
CERTIFIED BY	Eastern Tech. Assoc.
DATE	Nov 86
CONTINUED ON VEO FORM NUMBER	3-2

COMPANY/NAME		
Adams Construction Co.		
STREET ADDRESS		
CITY: Benson	STATE: NC	ZIP
PHONE (KEY CONTACT)	SOURCE ID NUMBER	

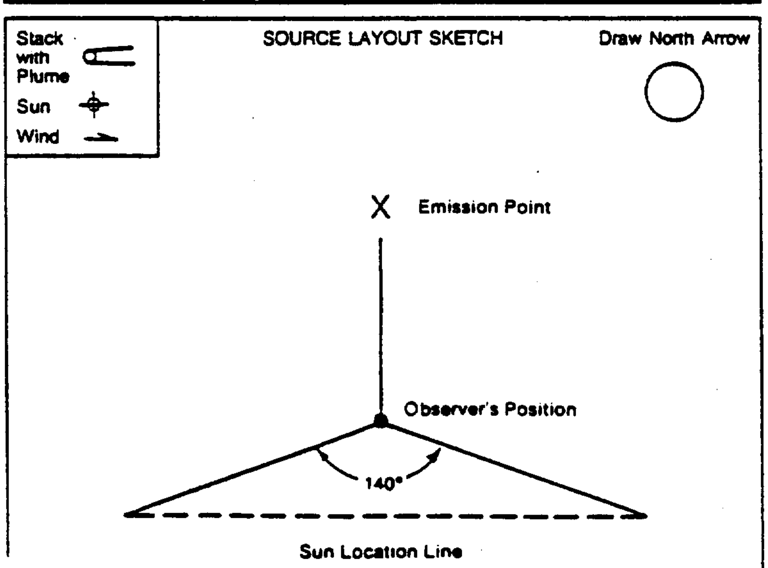
PROCESS EQUIPMENT	OPERATING MODE
CONTROL EQUIPMENT	OPERATING MODE

DESCRIBE EMISSION POINT	
HEIGHT ABOVE GROUND LEVEL	HEIGHT RELATIVE TO OBSERVER Start End
DISTANCE FROM OBSERVER Start End	DIRECTION FROM OBSERVER Start End

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

DESCRIBE PLUME BACKGROUND Start End		
BACKGROUND COLOR Start End	SKY CONDITIONS Start End	
WIND SPEED Start End	WIND DIRECTION Start End	
AMBIENT TEMP Start End	WET BULB TEMP	RH, percent

SOURCE LAYOUT SKETCH



ADDITIONAL INFORMATION

OBSERVATION DATE	START TIME	END TIME
4/22/87		

MIN \ SEC	0	15	30	45	COMMENTS
1	0	0	0	0	6 of 10
2	0	0	0	0	
3	0	0	0	0	0
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	
7	0	0	0	0	7 of 10
8	0	0	0	0	
9	0	0	0	0	
10	5	5	0	0	0.9
11	0	0	10	0	
12	0	0	0	0	
13	0	0	0	0	8 of 10
14	0	0	0	0	
15	0	0	0	0	0
16	0	0	0	0	
17	0	0	0	0	
18	0	0	0	0	
19	0	0	0	0	9 of 10
20	0	0	0	0	
21	0	10	5	0	0.9
22	0	0	0	0	
23	0	5	0	0	
24	0	0	0	0	stopped 14X4
25	0	0	0	0	10 of 10 started
26	0	0	10	0	1452
27	0	0	0	0	0.4
28	0	0	0	0	
29	0	0	0	0	
30	0	0	0	0	

OBSERVER'S NAME (PRINT)	
OBSERVER'S SIGNATURE	DATE 4/22/87
ORGANIZATION	
CERTIFIED BY	DATE
CONTINUED ON VEO FORM NUMBER	END

APPENDIX C

CALIBRATION DATA

QUALITY ASSURANCE PROCEDURES

General. Each item of field test equipment purchased or constructed by Entropy is assigned a unique, permanent identification number. New items for which calibration is required are calibrated before initial field use. Equipment whose calibration status may change with use or with time is inspected in the field before testing begins, and again upon return from each field use. When an item of equipment is found to be out of calibration, it is adjusted and recalibrated or retired from service. All equipment is periodically recalibrated in full, regardless of the outcome of these regular inspections.

Calibrations are conducted in a manner and at a frequency which meet or exceed U. S. EPA specifications. Entropy follows the calibration procedures outlined in EPA Reference Methods, and those recommended within the Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III (EPA-600/4-77-027b, August, 1977). When the Reference Methods are inapplicable, Entropy uses methods such as those prescribed by the American Society for Testing and Materials (ASTM).

Data obtained during calibrations are recorded on standardized forms, which are checked for completeness and accuracy by the Quality Assurance Manager or the Quality Assurance Director. Data reduction and subsequent calculations are performed using Entropy's in-house computer facilities. Calculations are generally performed at least twice as a check for accuracy. Copies of calibration data are included in the test or project reports.

Inspection and Maintenance. An effective preventive maintenance program is necessary to ensure data quality. Each item of equipment returning from the field is inspected before it is returned to storage. During the course of these inspections, items are cleaned, repaired, reconditioned, and recalibrated where necessary.

Each item of equipment transported to the field for this test program was inspected again before being packed. Entropy performs these quality assurance activities prior to departure for the job site to detect equipment problems which may originate during periods of storage. This minimizes lost time on site due to equipment failure.

Occasional equipment failure in the field is unavoidable despite the most rigorous inspection and maintenance procedures. For this reason, Entropy routinely transports sufficient backup equipment to the job site to have complete redundancy of all critical sampling train components.

Calibration. Emissions sampling equipment that requires calibration includes the nozzle, pitot tube, pressure gauges, thermometers, flow meters, dry gas meters, and barometers. The following sections elaborate on the calibration procedures followed by Entropy for these items of equipment. Calibration data for the specific items of equipment used for this test program follow the text.

Nozzles. Each probe nozzle is uniquely and permanently identified at the time of purchase, and calibrated before initial field use. The inside diameter of the nozzle is measured to the nearest 0.001 in. using a micrometer. Five measurements are made using different diameters each time. If the difference between the high and the low numbers does not exceed 0.004 inch, the average of the five measurements is used. If the difference exceeds this amount, or when the nozzle becomes nicked, dented, or corroded, the nozzle is reshaped, sharpened, and recalibrated.

Pitot Tubes. All Type S pitot tubes used by Entropy, whether separate or attached to a sampling probe, are constructed in-house or by Nutech Corporation. Each pitot is calibrated when new in accordance with the geometry standards contained in EPA Reference Method 2. A Type S pitot tube, constructed and positioned according to these standards, will have a coefficient of 0.84 ± 0.02. This coefficient should not change as long as the pitot tube is not damaged.

Each pitot tube is inspected visually before it is transported to the field. If this inspection indicates damage or raises doubt that the pitot remains in accordance with the EPA geometry standards, the pitot tube is not used until it has been refurbished and recalibrated.

Differential Pressure Gauges. Some meter consoles used by Entropy are equipped with 10 in. W.C. inclined-vertical manometers. Fluid manometers do not require calibration other than leak checks. Manometers are leak-checked in the field prior to each test series, and again upon return from the field.

Most of Entropy's meter consoles are equipped with Magnehelic differential pressure gauges. Each set of gauges is calibrated initially over its full range, 0-10 inches W.C. After each field use, the calibration of the gauge set is checked against an inclined manometer at the average delta p encountered during the test. If the agreement is within $\pm$ 5 percent, the calibration is acceptable.

Thermometers

Impinger Thermometer. On site, prior to the start of testing, the thermometer used to monitor the temperature of the gas leaving the last impinger is compared with a mercury-in-glass thermometer which meets ASTM E-1 specifications. The impinger thermometer is adjusted if necessary until it agrees within $2^{o}F$ of the reference thermometer. (If the thermometer is not adjustable, it is labeled with a correction factor).

Dry Gas Meter Thermometer. The thermometer used to measure the temperature of the metered gas sample is checked prior to each field trip against an ASTM mercury-in-glass thermometer. The dry gas meter thermometer is acceptable if the values agree with $5.4^{o}F$. Thermometers not meeting this requirement are adjusted or labeled with a correction factor.

Flue Gas Temperature Sensor. All thermocouples employed by Entropy for the measurement of flue gas temperatures are calibrated upon receipt. Initial calibrations are performed at three points (ice bath, boiling water, and hot oil). An ASTM mercury-in-glass thermometer is used as a reference. The thermocouple is acceptable if the agreement is within 1.5 percent (absolute) at each of the three calibration points.

On site, prior to the start of testing, the reading from the stack gas thermocouple-potentiometer combination is compared with a mercury-in-glass reference thermometer. If the two agree within 1.5 percent (absolute), the thermocouple and potentiometer are considered to be in proper working order for the test series.

After each field use, the thermocouple-potentiometer system is compared with an ASTM mercury-in-glass reference thermometer at a temperature within 10 percent of the average absolute flue gas temperature. If the absolute temperatures agree within 1.5 percent, the temperature data are considered valid.

Dry Gas Meter and Orifice. The dry gas meter and orifice are calibrated simultaneously. There are two calibration procedures. The full calibration is a complete laboratory procedure used to obtain the calibration factor of the dry gas meter before its first use and periodically thereafter. Full calibrations are performed at three different orifice settings (flow rates). A simpler procedure, the posttest calibration, is designed to check whether the calibration factor has changed. Posttest calibrations are performed after each field test series at an intermediate orifice setting (based on the test data) and at the maximum vacuum reached during the test.

Entropy uses as a transfer standard a dry gas meter that is calibrated annually against a spirometer. During the annual calibration, triplicate calibration runs are performed at seven flow rates ranging from 0.25 to 1.40 cfm.

Dry Gas Meter. Each metering system receives a full calibration at the time of purchase, and a posttest calibration after each field use. If the calibration factor, Y, deviates by less than five percent from the initial value, the test data are acceptable. If Y deviates by more than five percent, the meter is recalibrated and the meter coefficient (initial or recalibrated) that yields the lowest sample volume for the test runs is used.

EPA Reference Method 5 calls for another full calibration anytime the posttest calibration check indicates that Y has changed by more than five percent. Standard practice at Entropy is to recalibrate the dry gas meter anytime Y is found to be outside the range $0.98 \leq Y \leq 1.02$.

Orifice. An orifice calibration factor is calculated for each flow setting during a full calibration. If the range of values does not vary by more than 0.15 in. H_2O over the range of 0.4 to 4.0 in. H_2O, the arithmetic average of the values obtained during the calibration is used.

Barometer. Each field barometer is adjusted before each test series to agree within ± 0.1 inches of a reference aneroid barometer. The reference barometer is checked weekly against the station pressure value (corrected for elevation difference) reported by the National Weather Service station at the Raleigh-Durham airport, approximately 2.5 miles from Entropy's location.

SAMPLING EQUIPMENT CALIBRATION CHECKLIST

JOB NAME/NUMBER Adams Const. Co TEAM LEADER (TMS)

SAMPLING LOCATION Baghouse stack

BAROMETER CHECK

DATE	ENTROPY IN-HOUSE REFERENCE BAROMETER	FIELD BAROMETER
4-21-87	29.51	29.51

THERMOMETERS AND THERMOCOUPLE CHECK

DATE 4-22-87 REFERENCE THERMOMETER AMBIENT TEMPERATURE 63 °F

	AMBIENT TEMPERATURE °F	MUST BE WITHIN ACCEPTANCE RANGE °F
THERMOMETERS		
Impinger Exit	61	±2°F
Filter Compartment	60	±5.4°F
Dry Gas Meter	64	±5.4°F
Other	palmer 0-600 60°	
THERMOCOUPLE	66	±8°F

NOTE: Adjust thermometer until acceptable. If thermometer can't be adjusted, use a backup. If no back up, then use the unadjusted thermometer and record actual ambient temperature.

PITOT AND NOZZLE CHECK

	I.D. #	*VISUAL INSPECTION CHECK*
PITOTS	6-3	✓
	6-4	✓
NOZZLES	306	✓

ENTROPY

Dry Gas Meter Identification: 683832 3   Calibration by: Mf

Date: 3-26-86   Barometric Pressure (P_b): 30.12 in. Hg

*Date: 3-27-86   *Barometric Pressure (P_b): 29.85 in. Hg

ENTROPY ENVIRONMENTALISTS, INC.

Approx. Flow Rate (Q) cfm	Spirometer Gas Volume (V_s) ft^3	Spirometer Temp. (t_s) °F	Dry Gas Meter Gas Volume (V_{ds}) ft^3	Dry Gas Meter Temp. (t_{ds}) °F	Pressure (Δp) in. H_2O	Time (θ) min.	Flow Rate (Q) cfm	Meter Meter Coeff. (Y_{ds})	Avg. Meter Coeff. ($\bar{Y}_{ds}$)
	2.924	82.4	2.906	81	0.40	10.00	0.2864	1.0026	
0.30	2.969	82.8	2.869	81	.40	10.00	.2906	1.0304	
	3.652	83.3	3.501	81	.40	12.00	.3571	1.0377	
*	4.235	80.6	4.330	77	0.85	10.00	.4125	.9700	
0.40	4.545	80.6	4.370	78	.85	10.00	.4427	1.0328	
	4.417	80.6	4.345	79	.85	10.00	.4302	1.0114	
	5.328	78.8	5.206	75	1.10	10.00	.5271	1.0135	
0.50	5.383	79.7	5.212	77	1.15	10.00	.5317	1.025	
	5.301	79.7	5.166	78	1.15	10.00	.5219	1.020	
*	8.288	81	8.216	79	2.65	10.00	.8067	.9985	
0.80	8.397	82	8.214	80	2.65	10.00	.8458	1.0119	
	8.352	82.4	8.199	80	2.65	10.00	.8108	1.0075	
	10.638	83.3	10.472	81	4.15	10.00	1.040	1.0014	
1.00	10.656	83.3	10.534	81.5	4.15	10.00	1.042	.9981	
	10.528	83.3	10.450	81.5	4.15	10.00	1.0296	.9941	

$$Y_{ds} = \frac{(V_s)(t_{ds} + 460)(P_b)}{(V_{ds})(t_s + 460)(P_b + (\Delta p / 13.6))}$$

$$Q = (17.64)\frac{(P_b)(V_s)}{(t_s + 460)(\theta)}$$

Dry Gas Meter Identification: 6838323 Calibration by: MH

Date: 3-26-86 Barometric Pressure (P_b): 30.12 in. Hg

*Date: 3-27-86 *Barometric Pressure (P_b): 29.85 in. Hg

ENTROPY ENVIRONMENTALISTS, INC.

Approx. Flow Rate (Q) cfm	Spirometer Gas Volume (V_s) ft^3	Spirometer Temp. (t_s) °F	Dry Gas Meter Gas Volume (V_{ds}) ft^3	Dry Gas Meter Temp. (t_{ds}) °F	Pressure (Δp) in. H_2O	Time (Θ) min.	Flow Rate (Q) cfm	Meter Meter Coeff. (Y_{ds})	Avg. Meter Coeff. ($\bar{Y}_{ds}$)
* 1.20	12.304	82.4	12.168	80	5.50	10.00	1.1945	0.9932	
	12.177	82.4	12.065	80	5.50	10.00	1.1821	.9914	
	12.186	82.4	12.100	80	5.50	10.00	1.1830	.9892	
1.35	13.698	82.4	13.494	79.5	6.85	10.00	1.3418	.9931	
	13.552	82.4	13.505	80	6.85	10.00	1.33	.9826	
	13.752	81.5	13.712	80	7.00	10.00	1.35	.9833	

$\bar{Y}_{ds} = 1.0042$

$$Y_{ds} = \frac{(V_s)(t_{ds} + 460)(P_b)}{(V_{ds})(t_s + 460)(P_b + (p / 13.6))}$$

$$Q = (17.64) \frac{(P_b)(V_s)}{(t_s + 460)(\Theta)}$$

Meter Box Number: N19

Calibration by: B.D. Ritchie

Standard Meter Number: 6835323 Standard Meter Gamma: 1.0042

Date: 3/9/87 Barometric Pressure (P_b): 29.15 in. Hg

*Date: ______ *Barometric Pressure (P_b): ______ in. Hg

PRETEST CALIBRATION

Standard Meter			Meter Box Metering System				
Gas Volume (V_{ds}) ft^3	Temp. (t_{ds}) °F	Time (θ) min.	Orifice Setting (ΔH) in. H_2O	Gas Volume (V_d) ft^3	Temp. (t_d) °F	Coeff. (Y_d)	$\Delta H_@$ in. H_2O
3.943	66	10.0	0.50	3.968	70	1.0042	1.81
3.948	66	10.0	0.50	3.970	70	0.9979	1.82
7.985	66	10.0	2.1	7.957	70	0.9974	1.90
[illegible]	[illegible]	10.0	2.1	7.944	71	0.9965	1.90
11.944	[illegible]	10.0	4.0	[illegible]	72	0.9970	1.97
[illegible]	[illegible]	10.0	4.0	11.942	73	0.9983	[illegible]
					Average	0.997[illegible]	1.90

0.998

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460) * P_b}{V_d * (t_{ds} + 460) * (P_b + H/13.6)}$$

$$\Delta H_@ = \frac{0.0317 * \Delta H}{P_b * (t_d + 460)} * \left[\frac{(t_{ds} + 460) * \theta}{Y_{ds} * V_{ds}}\right]^2$$

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ENTROPY

Meter Box Number: N19

Calibration by: T. McDaniel

Meter Box Vacuum: 3" in. Hg

Standard Meter Number: 6838323 Standard Meter Gamma: 1.0042

Date: 5-5-87 Barometric Pressure (P_b): 29.70 in. Hg

POSTTEST CALIBRATION

Standard Meter			Meter Box Metering System				
Gas Volume (V_{ds}) ft^3	Temp. (t_{ds}) °F	Time (θ) min.	Orifice Setting (ΔH) in. H_2O	Gas Volume (V_d) ft^3	Temp. (t_d) °F	Coeff. (Y_d)	$\Delta H_@$ in. H_2O
5.860	67	10.0	1.2	5.932	73	1.0003	1.93
5.825	67	10.0	1.2	5.955	76	0.9961	1.94
5.787	67	10.0	1.2	5.994	78	0.9868	1.96
					Average	0.9944	1.94

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460) * P_b}{V_d * (t_{ds} + 460) * (P_b + \Delta H/13.6)}$$

$$\Delta H_@ = \frac{0.0317 * \Delta H}{P_b * (t_d + 460)} * \left[\frac{(t_{ds} + 460) * \theta}{Y_{ds} * V_{ds}}\right]^2$$

NOZZLE NUMBER: 306

Date	Initials	Dia. 1	Dia. 2	Dia. 3	Dia. 4	Dia. 5	Average
12-2-82	ST	.245	.243	.245	.244	.247	0.245
04-07-93	HEC	0.249	0.251	0.248	0.247	0.247	0.248
4-26-83	PLO	.252	.253	.251	.251	.253	0.252
5-10-83	JNC	.252	.250	.250	.252	.251	0.251
7-6-84	TTM	.248	.249	.249	.248	.250	0.249
10-23-84	ATM	.246	.244	.244	.245	.247	0.245
2-1-85	SSH	.245	.246	.244	.248	.244	0.245
6-30-86	BB	.245	.244	.247	.245	.247	0.246
10/23/86	G.E.	0.244	0.242	.245	.245	.246	0.244
1/15/87	JE	.247	.246	.248	.246	.245	0.246
3/10/87	ST	.247	.247	.247	.248	.247	0.247
3-20-87	SH	.242	.243	.243	.246	.245	.244

NOTE: All diameters measured in inches.

ENTROPY ENVIRONMENTALISTS, INC.

APPENDIX D

SAMPLING AND ANALYTICAL PROCEDURES

ISOKINETIC SAMPLING TRAIN FIELD DATA & RESULTS TABULATION

PLANT: Adams Construction Company, Benson, North Carolina

RUN #	DATE	SAMPLING LOCATION	OPERATOR
1	4/22/87	Rotary Dryer Baghouse Stack	A. Thomas McDonald
2	4/22/87	Rotary Dryer Baghouse Stack	A. Thomas McDonald
3	4/22/87	Rotary Dryer Baghouse Stack	A. Thomas McDonald

		1	2	3
	Run Start Time	904	1205	1350
	Run Finish Time	1130	1314	1500
	Net Sampling Points	20	20	20
Theta	Net Run Time, Minutes	60.00	60.00	60.00
Dia	Nozzle Diameter, Inches	0.244	0.244	0.244
Cp	Pitot Tube Coefficient	0.840	0.840	0.840
Y	Dry Gas Meter Calibration Factor	0.998	0.998	0.998
Pbar	Barometric Pressure, Inches Hg	29.60	29.60	29.60
Delta H	Avg. Pressure Differential of Orifice Meter, Inches H2O	1.200	1.100	1.170
Vm	Volume of Metered Gas Sample, Dry ACF	35.665	34.196	35.046
tm	Dry Gas Meter Temperature, Degrees F	79	87	88
Vm(std)	Volume of Metered Gas Sample, Dry SCF*	34.583	32.666	33.423
Vlc	Total Volume of Liquid Collected in Impingers & Silica Gel, mL	288.0	189.0	266.5
Vw(std)	Volume of Water Vapor, SCF*	13.556	8.896	12.544
%H2O	Moisture Content, Percent by Volume	28.2	21.4	27.3
Mfd	Dry Mole Fraction	0.718	0.786	0.727
%CO2	Carbon Dioxide, Percent by Volume, Dry	4.5	4.5	4.5
%O2	Oxygen, Percent by Volume, Dry	15.0	15.0	15.0
%CO+N2	CO + N2, Percent by Volume, Dry	80.5	80.5	80.5
Md	Dry Molecular Weight, Lb/Lb-Mole	29.32	29.32	29.32
Ms	Wet Molecular Weight, Lb/Lb-Mole	26.13	26.90	26.23
Pg	Flue Gas Static Pressure, Inches H2O	-0.27	-0.32	-0.19
Ps	Absolute Flue Gas Press., Inches HG	29.58	29.58	29.59
ts	Flue Gas Temperature, Degrees F	275	275	275
Delta p	Average Velocity Head, Inches H2O	0.6464	0.6150	0.6446
vs	Flue Gas Velocity, Feet/Second	56.30	54.13	56.11
A	Stack/Duct Area, Square Inches	2,447	2,447	2,447
Qsd	Volumetric Air Flow Rate, Dry SCFM*	29,275	30,791	29,536
Qaw	Volumetric Air Flow Rate, Wet ACFM	57,401	55,192	57,208
%I	Isokinetic Sampling Rate, Percent	102.9	92.4	98.6

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

		1	2	3
	Method 5 Results:	----	----	----
mg	Catch, Milligrams	55.8	49.2	47.3
gr/DSCF	Concentration, Grains per DSCF*	0.02490	0.02324	0.02184
Lb/Hr	Emission Rate, Lbs/Hour (PMRc)	6.248	6.135	5.529

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

EXAMPLE PARTICULATE TEST CALCULATIONS NO. 1

Rotary Dryer Baghouse Stack

VOLUME OF DRY GAS SAMPLED AT STANDARD CONDITIONS

$$Vm(std) = 17.64 * Y * Vm * \frac{(Pbar + Delta\ H/13.6)}{(460 + tm)}$$

$$Vm(std) = 17.64 * 0.998 * 35.665 * \frac{(29.60 + 1.200/13.6)}{(460 + 79)} = 34.583 \text{ DSCF}$$

VOLUME OF WATER VAPOR AT STANDARD CONDITIONS

Vw(std) = 0.04707 * Vlc

Vw(std) = 0.04707 * 288.0 = 13.556 SCF

PERCENT MOISTURE, BY VOLUME, AS MEASURED IN FLUE GAS

%H2O = 100 * Vw(std) / (Vw(std) + Vm(std))

$$\%H2O = \frac{13.556}{13.556 + 34.583} * 100 = 28.2\ \%$$

DRY MOLE FRACTION OF FLUE GAS

Mfd = 1 - %H2O/100

Mfd = 1 - 28.2/100 = 0.718

DRY MOLECULAR WEIGHT OF FLUE GAS

Md = %CO2 * 0.44 + %O2 * 0.32 + %CO+N2 * 0.28

Md = 4.5*0.44 + 15.0*0.32 + 80.5*0.28 = 29.32 LB/LB-MOLE

WET MOLECULAR WEIGHT OF FLUE GAS

Ms = (Md * Mfd) + (0.18 * %H2O)

Ms = 29.32 * 0.718 + (0.18 * 28.2) = 26.13 LB/LB-MOLE

ABSOLUTE FLUE GAS PRESSURE

$$Ps = Pbar + Pg / 13.6$$

$$Ps = 29.60 + (-0.2 / 13.6) = 29.58 \text{ IN. HG.}$$

AVERAGE FLUE GAS VELOCITY [Note: (Delta p)avg is square of avg sq. root]

$$vs = 85.49 * Cp * SQRT\left[\frac{(\text{Delta p})avg * (460 + ts)}{Ps * Ms}\right]$$

$$vs = 85.49 * 0.840 * SQRT\left[\frac{0.6464 * (460 + 275)}{29.58 * 26.13}\right] = 56.3 \text{ FT/SEC}$$

DRY VOLUMETRIC FLUE GAS FLOW RATE @ STANDARD CONDITIONS

$$Qsd = \frac{60}{144} * Mfd * vs * A * \frac{Tstd}{ts + 460} * \frac{Ps}{Pstd}$$

$$Qsd = \frac{60}{144} * 0.718 * 56.3 * 2{,}447.0 * \frac{528}{275 + 460} * \frac{29.58}{29.92}$$

$$Qsd = 29{,}275 \text{ SCFM}$$

WET VOLUMETRIC STACK GAS FLOW RATE @ FLUE GAS CONDITIONS

$$Qaw = 60 / 144 * vs * A$$

$$Qaw = 60 / 144 * 56.3 * 2{,}447.0 = 57{,}401 \text{ ACFM}$$

PERCENT ISOKINETIC OF SAMPLING RATE

$$\%I = \frac{Pstd}{Tstd} * \frac{100}{60} * \frac{(ts + 460) * Vm(std)}{Ps * vs * Mfd * Theta * \text{Area-nozzle, sq.ft.}}$$

$$\%I = \frac{29.92}{528} * \frac{100}{60} * \frac{(275 + 460) * 34.583}{29.58 * 56.3 * 0.718 * 60.00 * 0.0003247}$$

$$\%I = 102.9 \%$$

GRAINS PER DRY STANDARD CUBIC FOOT

$$gr/DSCF = \frac{7000}{453{,}592} * \frac{mgs}{Vm(std)}$$

$$gr/DSCF = \frac{7000}{453{,}592} * \frac{55.8}{34.583} = 0.0249 \quad gr/DSCF$$

POUNDS PER HOUR

Lb/Hr = 60 / 7000 * gr/DSCF * Qsd

Lb/Hr = 60/7000 * 0.0249 * 29,275 = 6.25 LB/HR