Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

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STATIONARY SOURCE SAMPLING REPORT

REFERENCE NO. 8116

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RALEIGH REGIONAL OFFICE

S.T. WOOTEN COMPANY

PRINCETON, NORTH CAROLINA

PARTICULATE EMISSIONS AND PLUME OPACITY TESTING

ROTARY DRYER STACK

NOVEMBER 1, 1990

REPORT CERTIFICATION

DATE November 19, 1990

The project was carried out under my direction and supervision.

Signature _____
Neill M. Harden

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

Signature _____
George W. Walsh

The preparation of this report was carried out under my direction and supervision.

Signature _____
Tony Wong

I hereby certify that this report is authentic and accurate.

Signature _____
Frank J. Phoenix, P.E.

ENTROPY

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INTRODUCTION

1.1 Outline of Test Program. Stationary source sampling was performed for S.T. Wooten Company in Princeton, North Carolina, on November 1, 1990. Testing was conducted at the rotary dryer stack to determine the particulate emissions and plume opacity. Table 1-1 is a test log which shows the test parameters, sampling methods, and run numbers for the test program.

TABLE 1-1
TEST LOG

Test Parameter	Sampling Method	Run Numbers - Repetition 1	2	3
CO_2,O_2	EPA 3	M3-2	----	----
Particulate	EPA 5	M5-1	M5-2	M5-3
Plume Opacity	EPA 9	M9-1	M9-2	M9-3

1.2 Test Participants. Table 1-2 lists the personnel involved in the test program.

TABLE 1-2
TEST PARTICIPANTS

S.T. Wooten Company	Tim Mooney Test Coordinator
	Billy Ray Windburn Plant Contact
Entropy Environmentalists Inc.	Neill M. Harden Project Manager
	Andrew L. Carpenter Engineering Technician
	Tan Le Visible Emissions Observer

SUMMARY OF RESULTS

Tables 2-1 and 2-2 summarize the results of the particulate emissions and plume opacity testing, respectively. Detailed test results are presented in Appendix A; field and analytical data are given in Appendix B.

TABLE 2-1

PARTICULATE TESTS SUMMARY

Rotary Dryer Stack

	M5-1	M5-2	M5-3	Average
Run Date	11/01/90	11/01/90	11/01/90	
Run Start Time	850	1053	1240	
Run Finish Time	1008	1206	1353	
Test Train Parameters:				
Volume Of Dry Gas Sample, SCF *	38.817	41.945	40.638	
Percent Isokinetic	99.4	98.5	103.5	
Flue Gas Parameters:				
CO_2, Percent By Volume, Dry	5.7	5.7	5.7	5.7
O_2, Percent By Volume, Dry	12.8	12.8	12.8	12.8
Temperature, °F	204	216	258	226
Air Flow Rate, Dry SCFM *	23,053	22,817	23,173	23,014
Air Flow Rate, Wet ACFM	39,709	39,476	44,820	41,335
Filterable Particulate:				
Concentration, grains/DSCF *	0.00227	0.00140	0.00330	0.00232
Emission Rate, lb/hr	0.448	0.273	0.656	0.459
Filterable + Condensable Particulate:				
Concentration, grains/DSCF *	0.0324	0.0221	0.0245	0.0263
Emission Rate, lb/hr	6.40	4.32	4.87	5.20

* 68° F (20° C) -- 29.92 Inches of Mercury (Hg).

TABLE 2-2

SIX-MINUTE AVERAGE PLUME OPACITY OBSERVATIONS SUMMARY

Rotary Dryer Stack

Run Number	M9-1	M9-2	M9-3
Highest 6-minute Average Opacity, %	1	1	1
Highest Single Opacity Reading, %	10	10	10

Run M9-1

Set No.	Time Start	Time End	Avg. % Opacity
1	0850	0856	0
2	0856	9004	0
3	0904	0910	0
4	0910	0916	1
5	0916	0922	0
6	0922	0928	0
7	0928	0932	1
8	0932	0938	0
9	0938	0944	0
10	0944	0950	0

Run M9-2

Set No.	Time Start	Time End	Avg. % Opacity
1	1055	1101	0
2	1101	1107	0
3	1107	1113	0
4	1113	1119	1
5	1119	1125	0
6	1125	1131	0
7	1131	1137	0
8	1137	1143	1
9	1143	1149	0
10	1149	1155	0

Run M9-3

Set No.	Time Start	Time End	Avg. % Opacity
1	1245	1251	0
2	1251	1257	0
3	1257	0103	1
4	0103	0109	0
5	0109	0115	0
6	0115	0121	0
7	0121	0127	0
8	0127	0133	0
9	0133	0139	1
10	0139	0145	0

PROCESS DESCRIPTION AND OPERATION

3.1 General. The S.T. Wooten Company operates an Aztec double drum asphalt plant in Princeton, North Carolina. The unit consist of a mixing chamber and rotary dryer, baghouse, ID fan, and stack.

3.2 Source Air Flow. Figure 3-1 is an air flow schematic which shows the passage of flue gases exhausted from the rotary dryer.

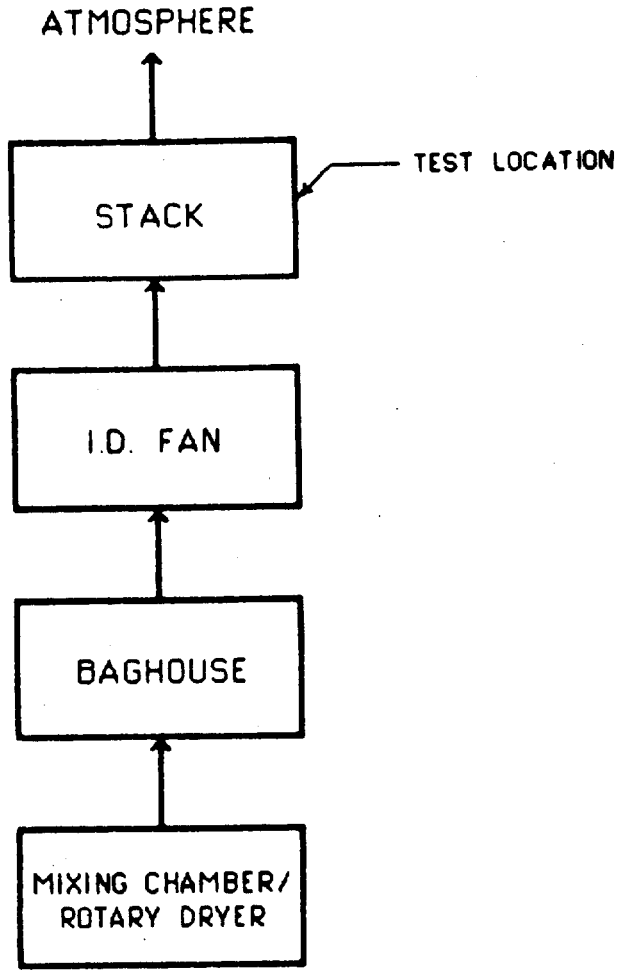

FIGURE 3-1. ROTARY DRYER AIR FLOW SCHEMATIC.

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 Environment, Health, and Natural Resources. This section provides brief descriptions of the sampling and analytical procedures. Detailed descriptions of the procedures 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 30 equal areas with five sampling points on each of six traverse axes, 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 M5-2, a multipoint, integrated flue gas sample was collected and analyzed according to the procedures outlined in EPA Method 3. The analytical results were used to determine the flue gas composition and molecular weight.

4.3.3 Flue Gas Moisture Content. Moisture content was determined according to the procedures outlined in EPA Method 5.

4.4 Emissions Determinations

4.4.1 Particulate. Emissions were withdrawn isokinetically from the source using an EPA Method 5 sampling train. The sampling train consisted of a nozzle, heated glass probe, filter, four chilled impingers, and a metering console. Filterable particulate was collected on Whatman EPM2000 glass fiber filters. Condensable particulate was captured in a chilled impinger system. The first two impingers each contained 100 mL of distilled, deionized (DI) water, the third remained empty, and the fourth contained preweighed silica gel. Each of the 30 points was sampled for two minutes resulting in net run times of 60 minutes.

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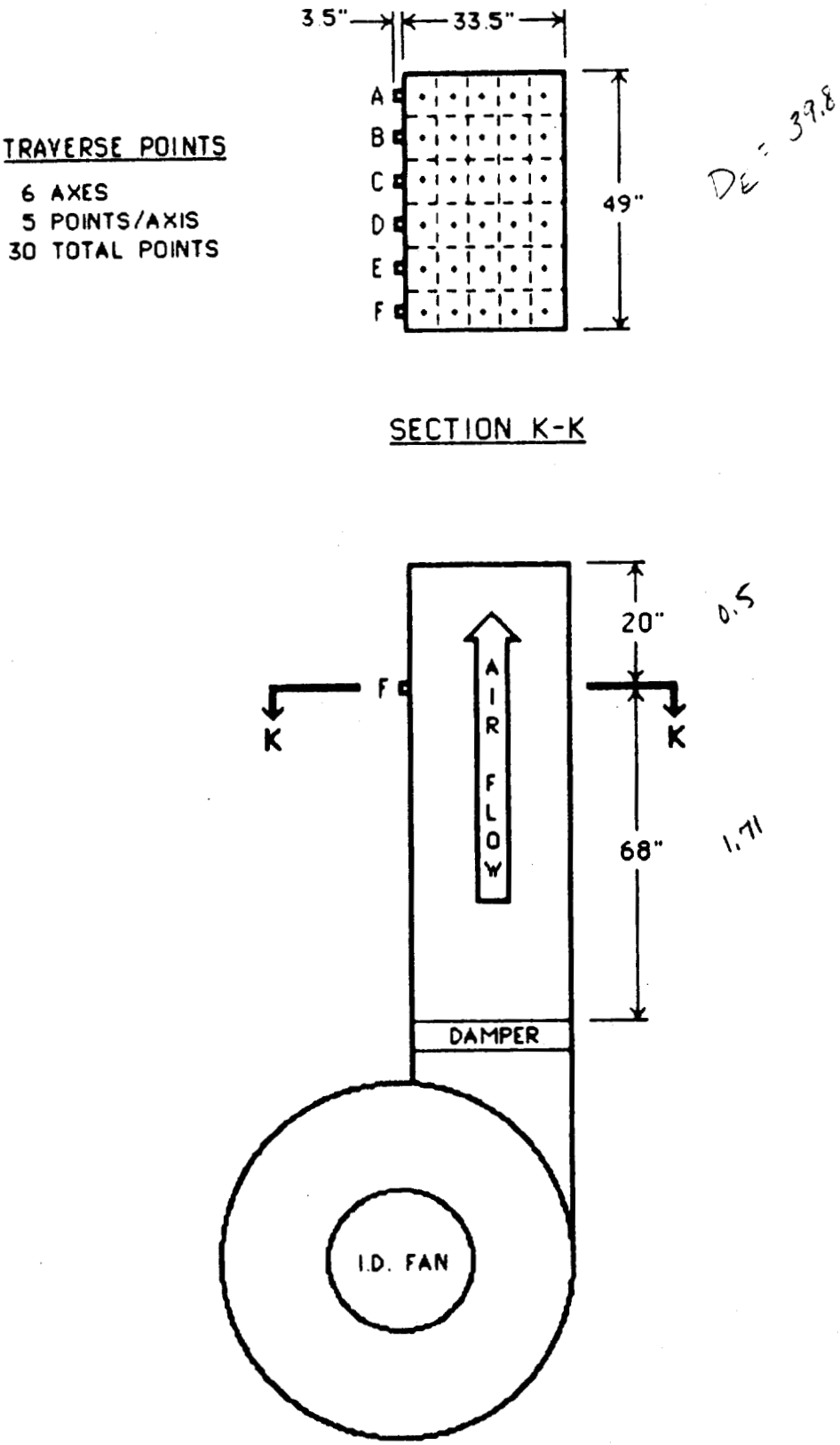


FIGURE 4-1. ROTARY DRYER STACK TEST LOCATION.

Sample Recovery. The filter was removed and placed in a glass jar. The reagents were returned to the original quart jars, weighed, and the weights were recorded on the label. The silica gel was returned to the original container, weighed, and the weight was recorded on the label. All fronthalf components of the sampling train including the nozzle, probe, and fronthalf of the filter holder were rinsed with acetone into a pint jar. The backhalf of the filter holder and the impingers were rinsed with acetone into a pint jar.

Sample Analyses. EPA Method 5 analytical procedures were used to analyze the filter and fronthalf acetone rinse for filterable particulate. The DI water reagent and acetone rinses were analyzed to determine the condensable particulate. The DI water reagent was extracted three times with chloroform and then extracted three times with ether. The acetone rinses and the pooled chloroform and ether phases were evaporated to dryness at room temperature and desiccated. After extraction, the water phase was evaporated to dryness on a steam bath and desiccated. Following desiccation, a gravimetric analysis was performed on each phase to determine the weight of the residue.

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

4.5 Equipment Calibration. Pertinent calibration data are provided in Appendix C.

QUALITY ASSURANCE/QUALITY CONTROL

5.1 General. Entropy Environmentalists Inc. (EEI) is committed to the continued implementation of a Quality Assurance Program to assure the quality of sampling and analytical procedures of environmental measurement data. The Quality Assurance measures taken during this test project equals or exceeds the minimum QA/QC recommendations as set forth by the U.S. Environmental Protection Agency (EPA) for a particular method.

The following sections outline the QA program implemented by EEI to justify the validity of test procedures. As applicable, the QA system for the various test programs addresses the following areas:

- Project Organization
- Preventive Maintenance & Equipment Calibration
- QA Sample Processing
- Analytical Instrument Calibration
- Blanks and Spiked Samples
- Internal/External System Checks
- Data Reduction & Validation
- Continuous Emissions Monitoring
- QA/QC Summary

5.2 Project Organization. The organization of the project team, including QA functions, are shown in Figure 5-1. Note that the QA structure is independent of the organizational groups which generate measurement data during the test program.

5.3 Preventive Maintenance and Equipment Calibration. An effective preventive maintenance program decreases downtime and thus increases data completeness and quality. Pretest and posttest equipment calibrations are conducted in a manner and at a frequency which meets or exceeds U.S. EPA specifications.

Each item transported to the field is inspected to detect equipment problems which may originate during periods of storage. All equipment returning from the field are cleaned, repaired, reconditioned, and recalibrated as necessary. Routine maintenance on equipment (dry gas meters, pumps, magnehelics/manometers, pitot tubes, and nozzles) is carried out periodically for leaks, corrosion, dents, or any other damage. Table 5-1 shows the activities for equipment calibration.

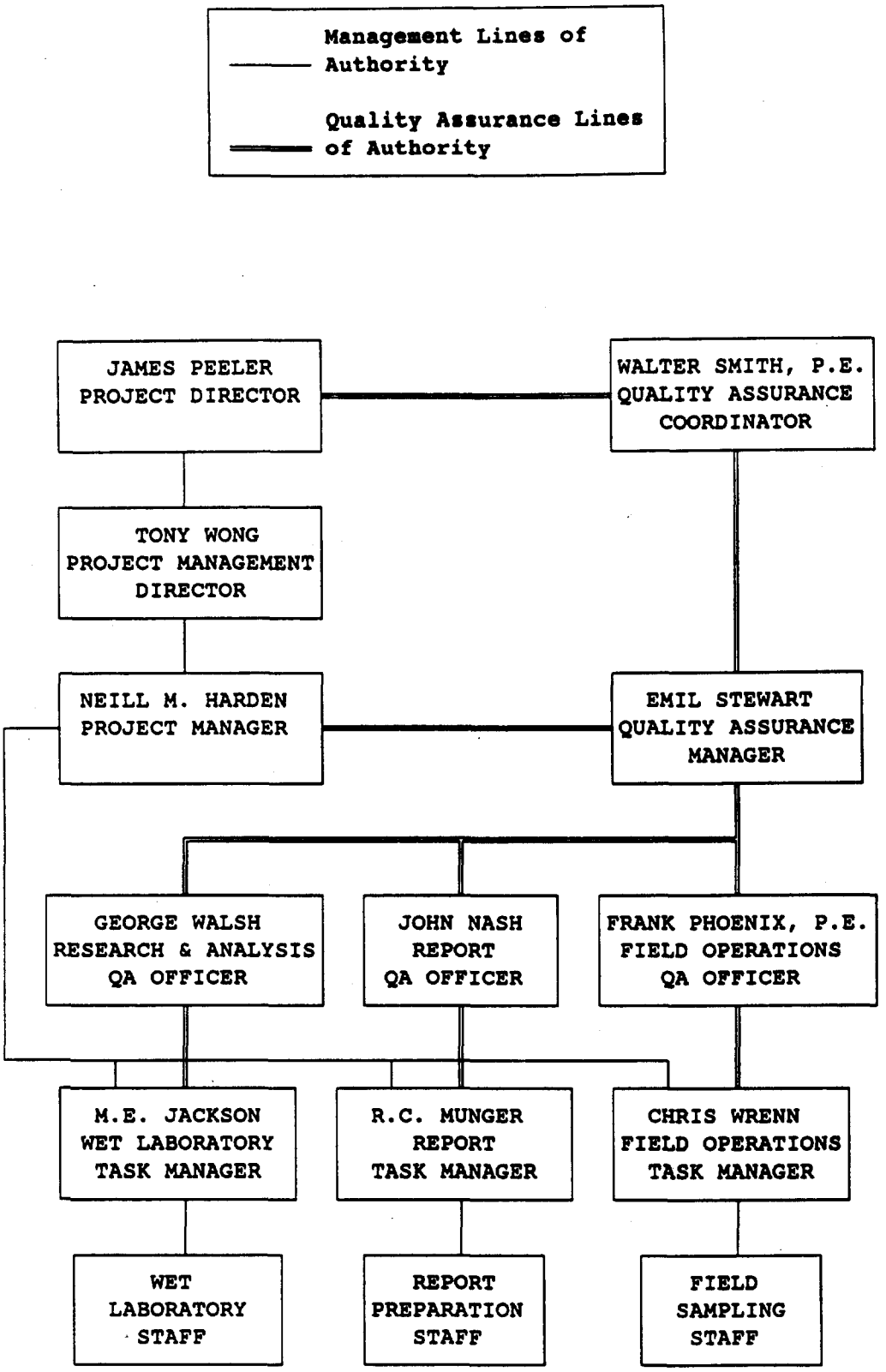


FIGURE 5-1 PROJECT ORGANIZATION

TABLE 5-1

IN-HOUSE EQUIPMENT CALIBRATION

Apparatus	Calibration Method And Frequency	Specifications	Corrective Action
Type S Pitot Tubes	Standards contained in EPA Method 2.	Coefficient of 0.84 ± 0.02	Refurbish or recalibrate.
	Visual inspection prior to shipment to test site and again prior to each day of testing.		
Manometers	Leak checked before and after each field use.		Repair or replace
Magnehelic Gauges	Initially calibrated over full range.	0-10" water column	
	After each field use, checked against inclined manometer at average settings encountered during testing.	Within ± 5%	Repair and Recalibrate.
Thermometers -Impinger -Dry Gas Meter -Filter Box	After purchase and prior to each field use, using ASTM mercury-in-glass thermometer.	Imp = ± 2°F DGM = ± 5.4°F FB = ± 5.4°F	Adjust, determine correction factor, or reject.
Thermocouple/ Potentiometer	After purchase. 3-point (ice bath, boiling water, and hot oil) using ASTM mercury-in-glass thermometer.	± 1.5% of absolute temperature.	Adjust, determine correction factor, or reject.
	Before and after each field use, compared to ASTM mercury-in-glass thermometer at ambient conditions.		
Dry Gas Meter and Orifice	Full calibration (every 6 months) over wide range of orifice settings to obtain calibration factor.	DGM = ± 0.02 from avg.coeff. for each run. Ori. = ± 0.15" H20 over delta H range of 0.4" to 4.0".	Adjust or replace
	10-minute quick calibration before sending to test site and again prior to each day of field use.	± 3% of full. ± 5% of full.	Use if no backup. Do not use.
	Posttest (at average delta H and highest vacuum) to determine if meter gamma has changed.	± 5% of full calibration. Factor (initial or recalibration) that yields the lowest sample volume for the testing is used.	Meter calibration, meter coefficient
Dry Gas Meter Transfer Standard	Annual calibrations conducted in triplicate using EPA wet test meter. Calibrations conducted at 7 flow rates from 0.25 to 1.40 cfm.	± 2% of average factor for each calibration run.	Adjust and recalibrate.
Barometer	Before and after each field use against an aneroid barometer.	± 0.1" mercury.	Adjust to agree.
	Reference barometer adjusted for elevation differences.		
Probe Nozzle	Average of 5 I.D. measurements using a micrometer. Visual inspection before and after each field use.	Difference between high and low measurement < 0.004"	Repair and recalibrate.

5.4 Sample Processing. Entropy employs systems which ensure the integrity of an environmental sample from the time of acquisition, through analysis, and ultimately to proper disposal. These systems are necessary to allow valid conclusions to be drawn from analytical results separated in time and space from the sampling operation. In addition, these systems recognize that samples are occasionally of value even after analytical results have been reported.

Samples are collected, transported, and stored in clean containers which are constructed of materials inert to the analytical matrix. Containers are used which allow air tight seals. When necessary, containers are employed which prevent photochemical reactions. All sample containers are labeled with the following information:

- Unique source identifier
- Sample run identifier
- Analyte identifier
- Sample matrix identifier
- Sample analyst identifier

Additional information relating to the sample is recorded on the data sheet for the sampling run that afforded the subject sample. Accordingly, the sampling data sheet contains all the information listed above, plus the date and time the sample was acquired and supplemental information such as observations pertinent to the quality of the sample. For condensed samples, e.g., samples in liquid media, the sample levels are marked on the outside of the container; this mark is used to indicate sample loss, and as such, may serve as a reference in adjusting results accordingly.

For transport from the field to the laboratory, samples are stored in locked boxes and secured in a fashion which minimizes movement and thus prevents breakage of containers. Boxes used for transporting glass containers are packed with foam.

Samples remain in the custody of the sampler from acquisition until conveyance to the laboratory analyst, if the analyst is different from the sampler. The sampler initiates a sample chain of custody record at the time of sample collection in the field. All custody transfers are documented on the chain of custody form, which remains with the sample at all times.

Analytical data are identified in a manner identical to that of the sampling data. Accordingly, all data generated from the analysis of samples are documented with the following information:

- Source identifier
- Sample run identifier
- Analyte identifier
- Sample matrix identifier
- Analyst identifier
- Analysis date

Portions of samples remaining after analysis are returned to their original sample containers. These samples are stored in designated storage areas until their destruction is authorized.

5.5 Instrument Calibration. Instrument calibration is one of the most important functions in generating precise and accurate quality data. A listing of major in-house instrumentation and the corresponding Quality Assurance program is given in Table 5-2.

All of the contract laboratories involved in the analytical testing for the test program maintained rigorous QA programs for instrument calibration.

5.6 Blanks and Spikes. Field blanks, method blanks, trip blanks, lab-proof blanks and filter blanks are obtained, digested and analyzed when applicable. The blanks reflect the background contamination obtained from the various sources during the sampling and analysis. Thus, data adjustment or correction can be made accordingly.

In most cases, it is not necessary to digest and analyze the method blanks, reagent blanks or the lab-proof blanks unless the field blank shows a high level of contamination. If a high level of contamination is present, it is imperative to individually analyze the above blanks to help determine the cause of contamination.

Spiked samples are used to check on the performance of a routine analysis or the recovery efficiency of a method. During spiking, a known amount of stock solutions of the substance of interest is added to the sample prior to sample extraction, digestion, and analysis.

TABLE 5-2

IN-HOUSE INSTRUMENT CALIBRATION

Apparatus	Calibration Method And Frequency	Corrective Specifications	Action
Analytical & Top Loading Balance	Daily and monthly checks with a series of class S weights. Balance serviced annually by a qualified service representative and checked with a series of NBS weights.	± 1 mg of class S weights.	Adjust or repair.
Gas Chromatograph	3-point calibration curve at the expected range. Duplicate injection of the sample until ± 5% variation is achieved. Calibration repeated at the end of each test series.		
HPLC/Ion Chromatograph	Calibrations conducted at the beginning, after the first injection, and after the second injection.		
Fisher Accument 925 pH/Selective Ion Meter	5- point calibration prior to analyzing the samples for the specific ions.		

5.7 Internal/External System Audit Checks. System and performance audits are routine elements of all Entropy QA/QC programs.

Internal Systems Audit: The following sampling equipment checks were conducted prior to sample collection.

- All sampling equipment was thoroughly checked to ensure clean and operable components.
- Equipment was inspected for possible damage from shipment.
- The oil manometers or Magnehelic gauges were leveled and zeroed.
- The temperature measurement systems were checked for damage and operability by measuring the ambient temperature.

Performance Audits: Performance audits of the laboratory are conducted prior to the processing of any compliance samples for analysis. Audit materials typically include samples available from the EPA prior to new source testing. Also, samples of known concentration are specially prepared in-house or obtained from the EPA for Internal QA checks.

External Sytems Audits: Entropy is subject to a system audit each time a test is conducted for any Air Pollution Control agency. This procedure entails an EPA observer on-site to do qualitative evaluation of performance to demonstrate compliance with the applicable regulations.

5.8 Data Reduction and Validation. The test team leader is responsible for reviewing and validating data as they are acquired. Each team leader has extensive knowledge of sampling methodology and the characteristics of the process being measured and is capable of evaluating the accuracy, representativeness, and completeness of raw data on-site, where action to replace inadequate data can be taken immediately.

Data obtained during calibrations and test runs are recorded on standardized forms which are checked twice for completeness and accuracy by the QA Director or his designated representative. Data reduction and consistency are achieved by using the standardized forms and using Entropy's in-house computer facilities.

5.9 QA/QC Summary. All chemicals used were American Chemical Society (ACS), High Purity Liquid Chromatography (HPLC), or pesticide grade. The distilled, deionized water utilized met or exceeded the American Society for Testing and Materials (ASTM) specifications for Type-I reagent water. Pretest and posttest leak checks were conducted on each sampling train.

APPENDIX A.1

A. TEST RESULTS

1. Particulate

PLANT: S.T. Wooten Company, Princeton, North Carolina

RUN #	DATE	SAMPLING LOCATION	OPERATOR
M5-1	11/01/90	Rotary Dryer Stack	Neill M. Harden
M5-2	11/01/90	Rotary Dryer Stack	Neill M. Harden
M5-3	11/01/90	Rotary Dryer Stack	Neill M. Harden

		M5-1	M5-2	M5-3
	Run Start Time	850	1053	1240
	Run Finish Time	1008	1206	1353
	Net Traversing Points	30	30	30
Theta	Net Run Time, Minutes	60.00	60.00	60.00
Dia	Nozzle Diameter, Inches	0.243	0.255	0.243
Cp	Pitot Tube Coefficient	0.840	0.840	0.840
Y	Dry Gas Meter Calibration Factor	0.9921	0.9921	0.9921
Pbar	Barometric Pressure, Inches Hg	29.70	29.70	29.70
Delta-H	Avg. Pressure Differential of Orifice Meter, Inches H_2O	1.68	1.99	1.94
Vm	Volume Of Metered Gas Sample, Dry ACF	40.012	44.328	43.730
tm	Dry Gas Meter Temperature, Degrees F	78	92	102
Vmstd	Volume Of Metered Gas Sample, Dry SCF*	38.817	41.945	40.638
Vlc	Total Volume of Liquid Collected in Impingers & Silica Gel, ml	296.0	303.0	354.0
Vwstd	Volume of Water Vapor, SCF*	13.933	14.262	16.663
$\%H_2O$	Moisture Content, Percent by Volume	26.4	25.4	29.1
Mfd	Dry Mole Fraction	0.736	0.746	0.709
$\%CO_2$	Carbon Dioxide, Percent By Volume, Dry	5.7	5.7	5.7
$\%O_2$	Oxygen, Percent By Volume, Dry	12.8	12.8	12.8
Md	Gas Molecular Weight, lb/lb-Mole, Dry	29.42	29.42	29.42
Ms	Gas Molecular Weight, lb/lb-Mole, Wet	26.41	26.52	26.10
Pg	Flue Gas Static Pressure, Inches H_2O	-0.25	-0.25	-0.35
Ps	Absolute Flue Gas Pressure, Inches Hg	29.68	29.68	29.67
ts	Flue Gas Temperature, Degrees F	204	216	258
Delta-p	Average Velocity Head, Inches H_2O	0.7712	0.7517	0.8976
vs	Flue Gas Velocity, Feet/Second	58.04	57.70	65.51
A	Stack/Duct Area, Square Inches	1,642	1,642	1,642
Qsd	Volumetric Air Flow Rate, Dry SCFM*	23,053	22,817	23,173
Qaw	Volumetric Air Flow Rate, Wet ACFM	39,709	39,476	44,820
%I	Isokinetic Sampling Rate, Percent	99.4	98.5	103.5

* 68° F (20° C) -- 29.92 Inches of Mercury (Hg)

(Continued next page)

FIELD DATA AND RESULTS TABULATION
(Continued)

PLANT: S.T. Wooten Company, Princeton, North Carolina

		M5-1	M5-2	M5-3
		---	---	---
	Filterable Particulate			
mg	Catch Weight, Milligrams	5.7	3.8	8.7
gr/DSCF	Concentration, grains/DSCF *	0.00227	0.00140	0.00330
lb/hr	Emission Rate, lb/hr	0.448	0.273	0.656
	Filterable + Condensable Particulate			
mg	Catch Weight, Milligrams	81.5	60.1	64.6
gr/DSCF	Concentration, grains/DSCF *	0.0324	0.0221	0.0245
lb/hr	Emission Rate, lb/hr	6.40	4.32	4.87

* 68° F (20° C) -- 29.92 Inches of Mercury (Hg)

APPENDIX A.2

A. TEST RESULTS

2. Plume Opacity

Name of Source: S.T. Wooten Asphalt Plant, Princeton, NC Asphalt Dryer

Observer: Tan Le

File Name: M9-1

Start Time: 0850 Stop Time: 0950 Date of Test: 11-01-1990

- O R I G I N A L D A T A -

Sec>> Min	00	15	30	45	Sec>> Min	00	15	30	45
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	5	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	5	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	10	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	5	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	10	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	5	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	5
23	10	0	0	0	53	0	0	0	5
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	5	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	5	0	0	0
30	0	0	0	0	60	0	0	0	0

NOTE: _____

DATE PRINT: 11-07-1990 TIME PRINT: 12:26:35

ENTROPY

Name of Source: S.T. Wooten Asphalt Plant, Princeton, NC Asphalt Dryer

Observer: Tan Le

File Name: M9-1

Start Time: 0850 Stop Time: 0950 Date of Test: 11-01-1990

-ROLLING AVERAGES-

Sec>> Min	00	15	30	45	Sec>> Min	00	15	30	45
1	-	-	-	-	31	0	0	0	0
2	-	-	-	-	32	0	0	0	0
3	-	-	-	-	33	0	0	0	0
4	-	-	-	-	34	0	0	0	0
5	-	-	-	-	35	0	0	0	0
6	-	-	-	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	1	1	1	1
12	0	0	0	0	42	1	1	1	1
13	0	0	0	0	43	1	1	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	1
23	1	1	1	1	53	1	1	1	1
24	1	1	1	1	54	1	0	0	0
25	1	1	1	1	55	0	0	0	0
26	1	1	1	0	56	0	0	0	0
27	0	1	1	1	57	0	0	0	0
28	1	1	1	1	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0
30	0	0	0	0	60	0	0	0	0

BLOCK SIZE (for Rolling Averages) = 24 READINGS

*The highest BLOCK in this ROLLING AVERAGE is at 53 Min and 45 Sec

>> OPERATION WAS PERFORMED ON THE: original DATA. <<

NOTE: _____

DATE PRINT: 11-07-1990 TIME PRINT: 12:27:10

ENTROPY

Name of Source: S.T. Wooten Asphalt Plant, Princeton, NC Asphalt Dryer

Observer: Tan Le

File Name: M9-1

Start Time: 0850 Stop Time: 0950 Date of Test: 11-01-1990

- B L O C K A V E R A G E S -

Sec>> Min	00	15	30	45	Sec>> Min	00	15	30	45
1	-	-	-	-	31	-	-	-	-
2	-	-	-	-	32	-	-	-	-
3	-	-	-	-	33	-	-	-	-
4	-	-	-	-	34	-	-	-	-
5	-	-	-	-	35	-	-	-	-
6	-	-	-	0	36	-	-	-	0
7	-	-	-	-	37	-	-	-	-
8	-	-	-	-	38	-	-	-	-
9	-	-	-	-	39	-	-	-	-
10	-	-	-	-	40	-	-	-	-
11	-	-	-	-	41	-	-	-	-
12	-	-	-	0	42	-	-	-	1
13	-	-	-	-	43	-	-	-	-
14	-	-	-	-	44	-	-	-	-
15	-	-	-	-	45	-	-	-	-
16	-	-	-	-	46	-	-	-	-
17	-	-	-	-	47	-	-	-	-
18	-	-	-	0	48	-	-	-	0
19	-	-	-	-	49	-	-	-	-
20	-	-	-	-	50	-	-	-	-
21	-	-	-	-	51	-	-	-	-
22	-	-	-	-	52	-	-	-	-
23	-	-	-	-	53	-	-	-	-
24	-	-	-	1	54	-	-	-	0
25	-	-	-	-	55	-	-	-	-
26	-	-	-	-	56	-	-	-	-
27	-	-	-	-	57	-	-	-	-
28	-	-	-	-	58	-	-	-	-
29	-	-	-	-	59	-	-	-	-
30	-	-	-	0	60	-	-	-	0

BLOCK SIZE = 24 READINGS

>> OPERATION WAS PERFORMED ON THE: original DATA. <<

NOTE: _____

DATE PRINT: 11-07-1990 TIME PRINT: 12:27:54

ENTROPY

Name of Source: S.T. Wooten Asphalt Plant Princeton, NC Rotary Dryer

Observer: Tan Le

File Name: M9-2

Start Time: 1055 Stop Time: 1155 Date of Test: 11-01-1990

- O R I G I N A L D A T A -

Sec>> Min	00	15	30	45	Sec>> Min	00	15	30	45
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	5	0	0
8	5	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	5	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	5	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	10	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	10	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	5	0	0
23	0	0	0	0	53	0	0	0	0
24	0	5	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0
30	0	0	10	0	60	0	0	0	0

NOTE: _____

DATE PRINT: 11-07-1990 TIME PRINT: 12:48:37

ENTROPY

Name of Source: S.T. Wooten Asphalt Plant Princeton, NC Rotary Dryer

Observer: Tan Le

File Name: M9-2

Start Time: 1055 Stop Time: 1155 Date of Test: 11-01-1990

- R O L L I N G A V E R A G E S -

Sec>> Min	00	15	30	45	Sec>> Min	00	15	30	45
1	-	-	-	-	31	0	0	0	0
2	-	-	-	-	32	0	0	0	0
3	-	-	-	-	33	0	0	0	0
4	-	-	-	-	34	0	0	0	0
5	-	-	-	-	35	0	0	0	0
6	-	-	-	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	1	1	1
18	0	0	0	0	48	1	1	1	1
19	0	0	0	0	49	1	1	1	1
20	0	0	0	0	50	1	1	1	1
21	0	0	0	0	51	1	0	0	0
22	0	0	0	0	52	0	1	1	1
23	0	0	0	0	53	1	0	0	0
24	0	1	1	1	54	0	0	0	0
25	1	1	1	1	55	0	0	0	0
26	1	1	1	1	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0
30	0	0	0	0	60	0	0	0	0

BLOCK SIZE (for Rolling Averages) = 24 READINGS

*The highest BLOCK in this ROLLING AVERAGE is at 24 Min and 15 Sec

>> OPERATION WAS PERFORMED ON THE: original DATA. <<

NOTE: _____

DATE PRINT: 11-07-1990 TIME PRINT: 12:55:13

ENTROPY

Name of Source: S.T. Wooten Asphalt Plant Princeton, NC Rotary Dryer

Observer: Tan Le

File Name: M9-2

Start Time: 1055 Stop Time: 1155 Date of Test: 11-01-1990

- B L O C K A V E R A G E S -

Sec>> Min	00	15	30	45	Sec>> Min	00	15	30	45
1	-	-	-	-	31	-	-	-	-
2	-	-	-	-	32	-	-	-	-
3	-	-	-	-	33	-	-	-	-
4	-	-	-	-	34	-	-	-	-
5	-	-	-	-	35	-	-	-	-
6	-	-	-	0	36	-	-	-	0
7	-	-	-	-	37	-	-	-	-
8	-	-	-	-	38	-	-	-	-
9	-	-	-	-	39	-	-	-	-
10	-	-	-	-	40	-	-	-	-
11	-	-	-	-	41	-	-	-	-
12	-	-	-	0	42	-	-	-	0
13	-	-	-	-	43	-	-	-	-
14	-	-	-	-	44	-	-	-	-
15	-	-	-	-	45	-	-	-	-
16	-	-	-	-	46	-	-	-	-
17	-	-	-	-	47	-	-	-	-
18	-	-	-	0	48	-	-	-	1
19	-	-	-	-	49	-	-	-	-
20	-	-	-	-	50	-	-	-	-
21	-	-	-	-	51	-	-	-	-
22	-	-	-	-	52	-	-	-	-
23	-	-	-	-	53	-	-	-	-
24	-	-	-	1	54	-	-	-	0
25	-	-	-	-	55	-	-	-	-
26	-	-	-	-	56	-	-	-	-
27	-	-	-	-	57	-	-	-	-
28	-	-	-	-	58	-	-	-	-
29	-	-	-	-	59	-	-	-	-
30	-	-	-	0	60	-	-	-	0

BLOCK SIZE = 24 READINGS

>> OPERATION WAS PERFORMED ON THE: original DATA. <<

NOTE: _____

DATE PRINT: 11-07-1990 TIME PRINT: 12:55:50

ENTROPY

Name of Source: S.T. Wooten Asphalt Plant, Princeton, NC Rotary Dryer

Observer: Tan Le

File Name: M9-3

Start Time: 1245 Stop Time: 0145 Date of Test: 11-01-1990

- O R I G I N A L D A T A -

Sec>> Min	00	15	30	45	Sec>> Min	00	15	30	45
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	5	0	5	0
8	0	0	0	0	38	0	0	0	0
9	5	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	5	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	5	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	10	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	5	0	10	0
23	0	0	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	5	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	5	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	5	0	59	0	0	0	0
30	0	0	0	0	60	0	0	0	0

NOTE: _____

DATE PRINT: 11-07-1990 TIME PRINT: 12:53:45

ENTROPY

Name of Source: S.T. Wooten Asphalt Plant, Princeton, NC Rotary Dryer

Observer: Tan Le

File Name: M9-3

Start Time: 1245 Stop Time: 0145 Date of Test: 11-01-1990

- R O L L I N G A V E R A G E S -

Sec>> Min	00	15	30	45	Sec>> Min	00	15	30	45
1	-	-	-	-	31	0	0	0	0
2	-	-	-	-	32	0	0	0	0
3	-	-	-	-	33	0	0	0	0
4	-	-	-	-	34	0	0	0	0
5	-	-	-	-	35	0	0	0	0
6	-	-	-	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	1	1	1	47	0	0	0	0
18	1	1	1	1	48	0	0	0	0
19	1	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	1	1
23	0	0	0	0	53	1	1	1	1
24	0	0	0	0	54	1	1	1	1
25	0	0	0	0	55	1	1	1	1
26	0	0	0	0	56	1	1	1	1
27	0	0	0	0	57	1	1	1	1
28	0	0	0	0	58	1	1	0	0
29	0	0	0	0	59	0	0	0	0
30	0	0	0	0	60	0	0	0	0

BLOCK SIZE (for Rolling Averages) = 24 READINGS

*The highest BLOCK in this ROLLING AVERAGE is at 57 Min and 15 Sec

>> OPERATION WAS PERFORMED ON THE: original DATA. <<

NOTE: _____

DATE PRINT: 11-07-1990 TIME PRINT: 12:54:25

ENTROPY

Name of Source: S.T. Wooten Asphalt Plant, Princeton, NC Rotary Dryer

Observer: Tan Le

File Name: M9-3

Start Time: 1245 Stop Time: 0145 Date of Test: 11-01-1990

- B L O C K A V E R A G E S -

Sec>> Min	00	15	30	45	Sec>> Min	00	15	30	45
1	-	-	-	-	31	-	-	-	-
2	-	-	-	-	32	-	-	-	-
3	-	-	-	-	33	-	-	-	-
4	-	-	-	-	34	-	-	-	-
5	-	-	-	-	35	-	-	-	-
6	-	-	-	0	36	-	-	-	0
7	-	-	-	-	37	-	-	-	-
8	-	-	-	-	38	-	-	-	-
9	-	-	-	-	39	-	-	-	-
10	-	-	-	-	40	-	-	-	-
11	-	-	-	-	41	-	-	-	-
12	-	-	-	0	42	-	-	-	0
13	-	-	-	-	43	-	-	-	-
14	-	-	-	-	44	-	-	-	-
15	-	-	-	-	45	-	-	-	-
16	-	-	-	-	46	-	-	-	-
17	-	-	-	-	47	-	-	-	-
18	-	-	-	1	48	-	-	-	0
19	-	-	-	-	49	-	-	-	-
20	-	-	-	-	50	-	-	-	-
21	-	-	-	-	51	-	-	-	-
22	-	-	-	-	52	-	-	-	-
23	-	-	-	-	53	-	-	-	-
24	-	-	-	0	54	-	-	-	1
25	-	-	-	-	55	-	-	-	-
26	-	-	-	-	56	-	-	-	-
27	-	-	-	-	57	-	-	-	-
28	-	-	-	-	58	-	-	-	-
29	-	-	-	-	59	-	-	-	-
30	-	-	-	0	60	-	-	-	0

BLOCK SIZE = 24 READINGS

>> OPERATION WAS PERFORMED ON THE: original DATA. <<

NOTE: _____

DATE PRINT: 11-07-1990 TIME PRINT: 12:54:48

ENTROPY

APPENDIX A.3

A. TEST RESULTS

3. Example Calculations

EXAMPLE TEST CALCULATIONS RUN M5-1

Rotary Dryer Stack

VOLUME OF DRY GAS SAMPLED AT STANDARD CONDITIONS

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

$$Vmstd = 17.64 * 0.9921 * 40.012 * \frac{29.70 + (1.680/13.6)}{(460 + 78)} = 38.817 \text{ DSCF}$$

VOLUME OF WATER VAPOR AT STANDARD CONDITIONS

$$Vwstd = 0.04707 * Vlc$$

$$Vwstd = 0.04707 * 296.0 = 13.933 \text{ SCF}$$

PERCENT MOISTURE, BY VOLUME, AS MEASURED IN FLUE GAS

$$\%H_2O = 100 * Vwstd / (Vwstd + Vmstd)$$

$$\%H_2O = \frac{13.933}{13.933 + 38.817} * 100 = 26.4\ \%$$

ABSOLUTE FLUE GAS PRESSURE

$$Ps = Pbar + (Pg / 13.6)$$

$$Ps = 29.70 + (-0.25/13.6) = 29.68 \text{ inches Hg}$$

DRY MOLE FRACTION OF FLUE GAS

$$Mfd = 1 - \%H_2O / 100$$

$$Mfd = 1 - 26.4/100 = 0.736$$

DRY MOLECULAR WEIGHT OF FLUE GAS

$$Md = (\%CO_2/100 * 44) + (\%O_2/100 * 32) + ((100 - \%CO_2 - \%O_2)/100 * 28)$$

$$Md = (5.7/100 * 44) + (12.8/100 * 32) + ((100 - 5.7 - 12.8)/100 * 28)$$

$$Md = 29.42 \text{ lb/lb-Mole}$$

WET MOLECULAR WEIGHT OF FLUE GAS

$$Ms = (Md * Mfd) + (0.18 * \%H_2O)$$

$$Ms = (29.42 * 0.736) + (0.18 * 26.4) = 26.41 \text{ lb/lb-Mole}$$

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

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

$$vs = 85.49 * 0.840 * \text{SQUARE ROOT}\left[\frac{0.7712 * (460 + 204)}{29.68 * 26.41}\right] = 58.04 \text{ ft/sec}$$

DRY VOLUMETRIC FLUE GAS FLOW RATE AT STANDARD CONDITIONS

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

$$Qsd = \frac{60}{144} * 0.736 * 58.04 * 1,642.0 * \frac{528}{460 + 204} * \frac{29.68}{29.92}$$

Qsd = 23,053 DSCFM

WET VOLUMETRIC FLUE GAS FLOW RATE AT ACTUAL CONDITIONS

Qaw = 60 / 144 * vs * A

Qaw = 60 / 144 * 58.04 * 1,642.0 = 39,709 ACFM

PERCENT ISOKINETIC OF SAMPLING RATE

$$\%I = \frac{Pstd}{Tstd} * \frac{100}{60} * \frac{(ts + 460) * Vmstd}{Ps * vs * Mfd * Theta * (\pi * (NozzleDia/2)^2/144)}$$

$$\%I = \frac{29.92}{528} * \frac{100}{60} * \frac{(204 + 460) * 38.817}{29.68 * 58.04 * 0.736 * 60.00 * (\pi * (0.243/2)^2/144)}$$

%I = 99.4 %

CONCENTRATION, GRAINS PER DRY STANDARD CUBIC FOOT, FILTERABLE PARTICULATE

$$gr/DSCF = \frac{7,000}{453.592} * \frac{(mg / 10^3)}{Vmstd}$$

$$gr/DSCF = \frac{7,000}{453.592} * \frac{(5.7/10^3)}{38.817} = 0.00227 \text{ gr/DSCF}$$

EMISSION RATE, POUNDS PER HOUR, FILTERABLE PARTICULATE

$$lb/hr = \frac{60}{453.592} * \frac{(mg / 10^3)}{Vmstd} * Qsd$$

$$lb/hr = \frac{60}{453.592} * \frac{(5.7/10^3)}{38.817} * 23{,}053 = 0.448 \ lb/hr$$

APPENDIX B.1

B. FIELD AND ANALYTICAL DATA

1. Particulate

Sampling and Velocity Traverse Point Determination
EPA Method 1

PLANT NAME S.T. WOOTEN

CITY, STATE PRINCETON, N.C.

SAMPLING LOCATION ROTARY DRYER STACK

NO. OF PORTS AVAILABLE 6

NO. OF PORTS USED 6

PORT INSIDE DIAMETER 3"

DISTANCE FROM FAR WALL TO OUTSIDE OF PORT 37"

NIPPLE LENGTH AND/OR WALL THICKNESS 3 1/2

DEPTH OF STACK OR DUCT 33 1/2

STACK OR DUCT WIDTH (IF RECTANGULAR) 49

EQUIVALENT DIAMETER:

$$D_E = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2\,(33\tfrac{1}{2})\,(49)}{(33\tfrac{1}{2} + 49)} = 39.79$$

DISTANCE FROM PORTS TO FLOW DISTURBANCES	UPSTREAM	DOWNSTREAM
	68"	20"
DIAMETERS	1.7	0.50

STACK/DUCT AREA = 33 1/2 X 49 = 1641.5 IN²

LOCATION OF POINTS IN CIRCULAR STACKS OR DUCTS

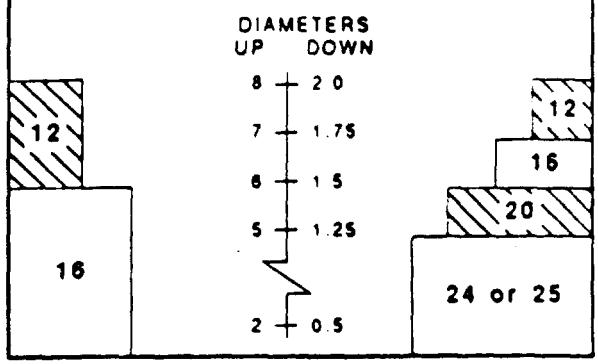
	4	6	8	10	12	14	16	18	20	22	24
1	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3	75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4	93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5		85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6		95.6	80.6	65.8	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	72.6
16							98.4	92.5	87.1	82.0	77.0
17								95.8	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 POINTS IN RECTANGULAR STACKS OR DUCTS

	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											95.8

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	10.0	3 3/8"	7 1/2"
2	30.0	10	13 1/2
3	50.0	16 3/4	20 1/4
4	70.0	23 1/2	27
5	90.0	30 1/8	33 5/8
6			
7			
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24			

F-0016
10-90

SEE REVERSE FOR FIELD USE CHECKLIST

ENTROPY

ORSAT FIELD DATA

Plant Name S.T. WOOTEN

Sampling Location ROTARY DRYER STACK Fuel Type #2 FUEL OIL

Run and/or Sample No. M3-2 Leak Test? ✓ Date 11-1 Operator MH

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
1053	1545	5.7	18.5	—	12.8	—	
TO		5.7	18.5		12.8		
1206		5.7	18.5		12.8		
	Avg.	5.7		Avg.	12.8		81.5

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.			

F-1009

ISOKINETIC TYPE FIELD DATA SHEET

21

COMPANY NAME S.T. WOOTTEN RUN NUMBER M5-1
ADDRESS PRINCETON, N.C. TIME START 0856
SAMPLING LOCATION ROTARY DRYER STACK TIME FINISH 1008
DATE 11-1-90 TEAM LEADER MM TECHNICIANS AC
BAROMETRIC PRESSURE. IN. HG 29.7 STATIC PRESSURE IN. H_2O -0.25
TRAIN LEAK CHECK VACUUM IN. HG 15 11(1) 12(F) ___ ___ ___ ___
TRAIN LEAK RATE, CU.FT/MIN 0.003 0.004 0.004 ___ ___ ___ ___

EQUIPMENT CHECKS

- ✓ PITOTS, PRETEST
- ✓ PITOTS, POSTTEST
- ___ M3 SAMPLING SYS/TED BAG
- ✓ THERMOCOUPLE @ 55 PRE
- ✓ THERMOCOUPLE @ 65 POST

IDENTIFICATION NUMBERS

REAGENT BOX 550 NOZZLE 704 DIAMETER 0.243
METER BOX N5 Y 0.9921 T/C READOUT F38
UMBILICAL 445 T/C PROBE R199
SAMPLE BOX 53 ORSAT PUMP ___
PROBE 4-25 PITOT ___ TEDLAR BAG ___

LEAK CHECK READINGS

0	332.272
1	332.438
2	
3	
4	
5	
6	

FILTER #	TARE
E0754	0.5035

DELTA $H_@$	1.729				
METER TEMP	05				
EST. %H_2O	27				
C FACTOR	0.61				
STACK TEMP	305	220			
REF DELTA P	1.12	1.0			
K-FACTOR	1.64	1.84			

FYRITE

C_p 0.84

LINE	SAMPLE POINT	CLOCK TIME MINUTES	DRY GAS METER READINGS CUBIC FEET	PITOT READING IN. H_2O	ORIFICE SETTING IN. H2O IDEAL	ORIFICE SETTING IN. H2O ACTUAL	GAS METER TEMP. °F	VACUUM IN. HG GAUGE	GAS TEMPERATURES FILTER BOX °F	GAS TEMPERATURES IMPINGER EXIT °F	STACK TEMP. °F	LK CHK #
1	A 1	0	310.356	3.55	5.83	5.83	61	9	265	55	199	
2	2	2	312.95	2.80	4.60	4.60	63	8	265	55	204	
3	3	4	315.20	.75	1.23	1.23	65	4	265	55	200	
4	4	6	316.69	.28	.51	.51	66	2	265	51	190	
5	5	8	317.53	.35	.64	.64	66	2	270	51	186	
6	B 1	10/0	318.426	3.00	5.52	5.52	67	10	270	51	182	
7	2	2	320.86	1.55	2.85	2.85	71	7	270	51	195	
8	3	4	322.82	.46	.85	.85	72	3	270	53	198	
9	4	6	323.98	.36	.66	.66	72	2	270	53	198	
10	5	8	324.89	.36	.66	.66	73	2	270	53	194	
11	C 1	20/0	325.817	2.00	3.68	3.68	74	8	275	56	197	
12	2	2	327.91	1.08	1.99	1.99	76	5	275	56	199	
13	3	4	329.52	.40	.74	.74	77	3	275	56	195	
14	4	6	330.58	.27	.50	.50	78	2	275	56	198	
15	5	8	331.43	.35	.64	.64	78	2	275	56	195	
16	D 1	30/0	332.272	1.87	3.44	3.44	79	7	275	60	193	X
17	2	2	334.43	1.05	1.93	1.93	81	5	275	60	206	
18	3	4	336.06	.26	.48	.48	82	2	275	60	209	
19	4	6	336.91	.34	.63	.63	82	2	275	60	209	
20	5	8	337.78	.30	.55	.55	83	2	275	60	208	
21	E 1	40/0	338.663	1.95	3.59	3.59	83	7	275	57	203	
22	2	2	340.75	.85	1.56	1.56	85	5	275	57	214	
23	3	4	342.28	.21	.39	.39	86	2	275	57	216	
24	4	6	343.06	.44	.81	.81	86	3	275	57	217	
25	5	8	343.95	.50	.92	.92	86	3	275	57	217	

F1010
12/89
p1

minutes ___ Vm ___ $(\sqrt{\Delta p})^2$ ___ ΔH ___ tm ___ ts ___

ISOKINETIC TYPE FIELD DATA SHEET (continued)

COMPANY NAME: S.T. WOOTEN
RUN NUMBER: M5-1
SAMPLING LOCATION: ROTARY DRYER STACK
DATE: 11-1-90

LINE	SAMPLE POINT	CLOCK TIME MINUTES	DRY GAS METER READINGS CUBIC FEET	PITOT READING IN. H_2O	ORIFICE SETTING IN. H2O IDEAL	ORIFICE SETTING IN. H2O ACTUAL	GAS METER TEMP. °F	VACUUM IN. HG GAUGE	GAS TEMPERATURES FILTER BOX °F	GAS TEMPERATURES IMPINGER EXIT °F	STACK TEMP. °F	LK CHK #
26	F 1	50/0	345.072	1.30	2.39	2.39	86	5	275	57	217	
27	2	2	346.69	.33	.61	.61	87	2	275	57	219	
28	3	4	347.68	.29	.53	.53	88	2	275	57	212	
29	4	6	348.52	.26	.48	.48	88	2	275	59	213	
30	5	8	349.33	.65	1.20	1.20	89	3	275	59	219	
31		60/OFF	350.534									
32												
33												
34												
35												
36												
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63												
64												
65												

60	40.012	.7712	1.68	78	204
minutes	Vm	$(\sqrt{\Delta p})^2$	ΔH	tm	ts

F1010
9/89
p2

ENTROPY

ISOKINETIC TYPE FIELD DATA SHEET

23

COMPANY NAME S.T. WOOTEN — RUN NUMBER M5-2
ADDRESS PRINCETON, N.C — TIME START 1053
SAMPLING LOCATION ROTARY DRYER STACK — TIME FINISH 1206
DATE 11-1-90 TEAM LEADER MF — TECHNICIANS AC
BAROMETRIC PRESSURE. IN. HG 29.7 — STATIC PRESSURE IN. H_2O -0.25
TRAIN LEAK CHECK VACUUM IN. HG 15 | 12 (1) | 12 (F)
TRAIN LEAK RATE, CU.FT/MIN 0.002 | 0.002 | 0.002

EQUIPMENT CHECKS

- ✓ PITOTS, PRETEST
- ✓ PITOTS, POSTTEST
- ✓ M3 SAMPLING SYS/TED BAG
- ✓ THERMOCOUPLE @ 82 PRE
- ✓ THERMOCOUPLE @ 85 POST

IDENTIFICATION NUMBERS

REAGENT BOX 550 NOZZLE 706 DIAMETER 0.255
METER BOX 25 Y 0.9921 T/C READOUT F 38
UMBILICAL 4 45 T/C PROBE R 199
SAMPLE BOX 30 ORSAT PUMP 53
PROBE 4-21 PITOT ____ TEDLAR BAG ____

LEAK CHECK READINGS

0	371.829
1	371.907
2	
3	
4	
5	
6	

FILTER #	TARE
E0755	0.4966

DELTA $H_@$	1.729
METER TEMP	100
EST. $\%H_2O$	27
C FACTOR	0.64
STACK TEMP	230
REF DELTA P	0.82
K-FACTOR	2.24

FYRITE: 5.0, 6.0

C_p 0.84

LINE	SAMPLE POINT	CLOCK TIME MINUTES	DRY GAS METER READINGS CUBIC FEET	PITOT READING IN. H_2O	ORIFICE SETTING IN. H_2O IDEAL	ORIFICE SETTING IN. H_2O ACTUAL	GAS METER TEMP. °F	VACUUM IN. HG GAUGE	GAS TEMPERATURES FILTER BOX °F	GAS TEMPERATURES IMPINGER EXIT °F	STACK TEMP. °F	LK CHK #
1	F 1	0	350.780	1.15	2.58	2.58	78	6	275	60	208	
2	2	2	352.78	.53	1.19	1.19	80	3	275	60	220	
3	3	4	353.93	.30	.67	.67	80	2	275	60	220	
4	4	6	354.86	.53	1.19	1.19	82	2	275	60	222	
5	5	8	356.10	.75	1.68	1.68	82	3	275	60	215	
6	E 1	10/0	357.487	1.85	4.15	4.15	84	8	275	60	214	
7	2	2	360.04	.90	2.02	2.02	86	5	275	63	230	
8	3	4	361.53	.23	.52	.52	87	2	275	63	224	
9	4	6	362.42	.48	1.08	1.08	87	2	275	63	214	
10	5	8	363.59	.60	1.35	1.35	88	3	275	63	209	
11	D 1	20/0	364.825	2.00	4.49	4.49	89	10	275	65	211	
12	2	2	367.14	1.05	2.36	2.36	92	6	270	65	218	
13	3	4	368.88	.33	.74	.74	93	2	270	65	222	
14	4	6	369.99	.20	.45	.45	92	2	275	65	220	
15	5	8	370.78	.41	.92	.92	92	2	275	65	210	
16	C 1	30/0	371.829	1.82	4.08	4.08	92	9	275	65	210	X
17	2	2	374.10	.95	2.13	2.13	94	5	275	62	213	
18	3	4	375.82	.42	.94	.94	94	2	275	62	212	
19	4	6	376.94	.28	.63	.63	95	2	275	62	222	
20	5	8	377.83	.36	.81	.81	95	2	275	62	218	
21	B 1	40/0	378.877	2.65	5.95	5.95	97	11	275	65	218	
22	2	2	381.51	1.52	3.41	3.41	98	7	275	65	221	
23	3	4	383.67	.56	1.26	1.26	98	3	275	65	217	
24	4	6	385.00	.25	.56	.56	98	2	275	65	202	
25	5	8	385.88	.32	.72	.72	98	2	275	65	198	

Total 60 minutes — Vm 44.328 — $(\sqrt{\Delta p})^2$ .7517 — ΔH 1.99 — tm 92 — ts 216

F1010
12/89
p1

COMPANY NAME WESTEN RUN NUMBER .95-2
SAMPLING LOCATION STACK DATE 11-1-90

LINE	SAMPLE POINT	CLOCK TIME MINUTES	DRY GAS METER READINGS CUBIC FEET	PITOT READING IN. H_2O	ORIFICE SETTING IN. H2O IDEAL	ORIFICE SETTING IN. H2O ACTUAL	GAS METER TEMP. °F	VACUUM IN. HG GAUGE	GAS TEMPERATURES FILTER BOX °F	GAS TEMPERATURES IMPINGER EXIT °F	STACK TEMP. °F	LK CHK #
26	A 1	50/0	386.847	2.40	5.39	5.39	98	11	270	65	202	
27	2	2	389.39	2.60	5.83	5.83	100	11	270	65	218	
28	3	4	392.05	.58	1.30	1.30	101	3	270	65	215	
29	4	6	393.42	.32	.72	.72	100	2	270	65	218	
30	5	8	394.42	.20	.45	.45	100	2	270	65	222	
31		60/OFF	395.186									
32												
33												
34												
35												
36												
37												
38												
39												
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63												
64												
65												

60	44.328	.7517	1.99	92	216
minutes	Vm	$(\sqrt{\Delta p})^2$	ΔH	tm	ts

F1010
9/89
p2

ENTROPY

ISOKINETIC TYPE FIELD DATA SHEET

25

COMPANY NAME S.T. WOOTEN — RUN NUMBER MS-3
ADDRESS PRINCETON, N.C. — TIME START 1240
SAMPLING LOCATION ROTARY DRYER STACK — TIME FINISH 1353
DATE 11-1-90 TEAM LEADER [illegible] — TECHNICIANS AC
BAROMETRIC PRESSURE. IN. HG 29.7 — STATIC PRESSURE IN. H_2O -0.35
TRAIN LEAK CHECK VACUUM IN. HG 15 — 12(I) — 12(F)
TRAIN LEAK RATE, CU.FT/MIN 0.004 — 0.003 — 0.016

EQUIPMENT CHECKS

- ✓ PITOTS, PRETEST
- ✓ PITOTS, POSTTEST
- M3 SAMPLING SYS/TED BAG
- ✓ THERMOCOUPLE @ 85 PRE
- ✓ THERMOCOUPLE @ 87 POST

IDENTIFICATION NUMBERS

REAGENT BOX 550 NOZZLE 704 DIAMETER 0.243
METER BOX N5 Y 0.9921 T/C READOUT F 38
UMBILICAL 045 T/C PROBE 199
SAMPLE BOX 53 ORSAT PUMP
PROBE 4-25 PITOT TEDLAR BAG

LEAK CHECK READINGS

1	419.346
1	419.423
2	
3	
4	
5	
6	

FILTER #	TARE
E0750	0.5007

DELTA $H_@$	1.729				FYRITE
METER TEMP	103				
EST. %H_2O	27				
C FACTOR	0.64				
STACK TEMP	230	250			
REF DELTA P	0.98	1.00			
K-FACTOR	1.88	1.84			C_p 0.84

LINE	SAMPLE POINT	CLOCK TIME MINUTES	DRY GAS METER READINGS CUBIC FEET	PITOT READING IN. H_2O	ORIFICE SETTING IN. H2O IDEAL	ORIFICE SETTING IN. H2O ACTUAL	GAS METER TEMP. °F	VACUUM IN. HG GAUGE	GAS TEMPERATURES FILTER BOX °F	GAS TEMPERATURES IMPINGER EXIT °F	STACK TEMP. °F	LK CHK #
1	A 1	0	395.393	3.55	6.67	6.67	90	11	250	65	231	
2	2	2	398.16	2.35	4.41	4.41	92	8	250	65	233	
3	3	4	400.09	.87	1.63	1.63	93	5	255	65	235	
4	4	6	402.25	.37	.69	.69	94	3	255	65	235	
5	5	8	403.18	.32	.60	.60	93	2	260	65	236	
6	B 1	10/0	404.038	3.00	5.63	5.63	94	11	260	65	232	
7	2	2	406.61	1.83	3.44	3.44	97	7	260	65	255	
8	3	4	408.76	1.00	1.84	1.84	98	5	270	65	254	
9	4	6	410.27	.47	.88	.88	98	3	270	65	231	
10	5	8	411.44	.62	1.16	1.16	100	3	270	65	219	
11	C 1	20/0	412.597	2.05	3.85	3.85	100	8	270	67	239	
12	2	2	414.69	1.05	1.97	1.97	101	6	270	67	250	
13	3	4	416.31	.47	.86	.86	103	3	270	67	257	
14	4	6	417.35	.37	.68	.68	103	3	270	67	253	
15	5	8	418.32	.46	.85	.85	103	3	270	67	245	
16	D 1	30/0	419.346	2.03	3.74	3.74	102	8	270	68	263	
17	2	2	421.54	1.00	1.84	1.84	104	5	275	68	268	
18	3	4	423.13	.31	.58	.58	105	2	275	68	262	
19	4	6	423.96	.26	.49	.49	105	2	275	65	260	
20	5	8	424.76	.40	.75	.75	105	2	270	65	252	
21	E 1	40/0	425.753	1.90	3.57	3.57	105	7	270	65	256	
22	2	2	427.74	1.00	1.84	1.84	106	5	270	65	267	
23	3	4	429.34	.26	.48	.48	107	3	265	65	275	
24	4	6	430.13	.48	.88	.88	107	3	265	65	275	
25	5	8	431.23	.72	1.32	1.32	107	4	265	65	286	

F1010
12/89
p1

minutes — Vm — $(\sqrt{\Delta p})^2$ — ΔH — tm — ts

ISOKINETIC TYPE FIELD DATA SHEET (continued)

COMPANY NAME: WOOTEN — RUN NUMBER: M5-3
SAMPLING LOCATION: STACK — DATE: 11-1-90

LINE	SAMPLE POINT	CLOCK TIME MINUTES	DRY GAS METER READINGS CUBIC FEET	PITOT READING IN. H_2O	ORIFICE SETTING IN. H2O IDEAL	ORIFICE SETTING IN. H2O ACTUAL	GAS METER TEMP. °F	VACUUM IN. HG GAUGE	GAS TEMPERATURES FILTER BOX °F	GAS TEMPERATURES IMPINGER EXIT °F	STACK TEMP. °F	LK CHK #
26	F1	50/0	432.543	1.75	3.22	3.22	107	7	260	65	288	
27	2	2	434.49	.65	1.20	1.20	108	3	260	65	301	
28	3	4	435.88	.37	.68	.68	109	3	260	65	302	
29	4	6	436.82	.57	1.05	1.05	109	3	260	65	288	
30	5	8	437.92	.75	1.38	1.38	110	4	260	65	283	
31		60/OFF	439.200									
32												
33												
34												
35												
36												
37												
38												
39												
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61												
62												
63												
64												
65												

60	43.73	.8976	1.94	102	258
minutes	Vm	$(\sqrt{\Delta p})^2$	ΔH	ts	ts

F1010
9/89
p2

ENTROPY

PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name: S.T. WOOTEN EEI Ref# 8116

Sampling Location: Rotary Dryer Stack

Date Received: 11/2 Date Analyzed: 11/12 Reagent Box(es): 0550

Run Number			M5-1		M5-2		M5-3
Run Date			11/1		11/1		11/1
Sample ID/Container #	init.	date	F / 631	date	F / 633	date	F / 635
	JC	11/6	4.4327	11/6	4.3037	11/6	4.3725
	JC	11/5	4.4328	11/5	4.3036	11/5	4.3724
Tare Weight., g.			3.9267		3.8051		3.8655
SAMPLE WT., g.			0.5060		0.4985		0.5069

Sample ID/Container #	init.	date	R / 632	date	R / 634	date	R / 636
	JC	11/6	3.9054	11/6	3.8559	11/6	3.7692
	JC	11/5	3.9056	11/5	3.8558	11/5	3.7691
Tare Wt., g.			3.9020		3.8535		3.7664
SAMPLE WT., g.			0.0034		0.0023		0.0027

Sum of Particulate, mg.		509.4		500.8	509.6
Total Filter Tare, mg.		503.5		496.8	500.7
Blank Residue, mg.	(100 ml)	0.2	(100 ml) 0.2	(100 ml)	0.2
TOTAL PARTICULATE CATCH, mg.		5.7		3.8	8.7

Blank Beaker # 2003
Final wt., mg. 99546.3
Tare wt., mg. 99545.9
Residue, mg. 0.4
Volume, ml. 200
Concentration, mg/ml 0.002

---Legend---
✓ = Final Weight
F = Filter R = Rinse

1 = Light 2 = Medium
3 = Heavy or Dark

Sample Description

Run #	Color	Loading
-1	(1) 2 3	(1) 2 3
-2	(1) 2 3	(1) 2 3
-3	(1) 2 3	1 (2) 3

Notes and comments:
Predominate color of samples is: colorless
Date of full balance span 11/5/90

SUMMARY OF IMPINGERS' WATER ANALYSIS

Plant Name: S.T. WOOTEN COMPANY EEI Ref# 8116

Run Number	M5-1	M5-2	M5-3
Run Date	11/1	11/1	11/1

Sample ID/Container #			1 / 680		1 / 683		1 / 686
	init.	date		date		date	
	JC			11/13	3.4345		
	JC			11/12	3.4348		
	JC	11/9	3.4956	11/9	3.4362	11/9	3.4880
	JS	11/8	3.4961	11/8	3.4370	11/8	3.4881
Tare Weight., g.			3.4645		3.4093		3.4691
SAMPLE WT., g.			0.0311		0.0252		0.0189

Sample ID/Container #			2 / 681		2 / 684		2 / 687
	init.	date					
	JC	11/14	3.5551				
	JC	11/13	3.5553	11/12	3.5119		
	JC	11/12	3.5573	11/9	3.5118	11/12	3.4773
	JS	11/8	3.6038	11/8	3.5137	11/9	3.4777
Tare Wt., g.			3.5185		3.4870		3.4479
SAMPLE WT., g.			0.0366		0.0248		0.0294

Sample ID/Container #			4 / 682		4 / 685		4 / 688
	init.	date					
	JC			11/9	3.4785		
	JS	11/8	3.5283	11/8	3.4787	11/8	3.5187
	JS	11/7	3.5288	11/7	3.4793	11/7	3.5191
Tare Wt., g.			3.5197		3.4717		3.5106
SAMPLE WT., g.			0.0086		0.0068		0.0081

1 Organic Fraction Catch, mg.		31.1		25.2		18.9
2 Inorganic Fraction Catch, mg		36.6		24.8		29.4
4 Acetone Soluble Catch, mg.		8.6		6.8		8.1
Acetone Residue, mg.	(225 ml)	0.5	(225 ml)	0.5	(225 ml)	0.5
Water Residue, mg.	(200 ml)	0.0	(200 ml)	0.0	(200 ml)	0.0
TOTAL IMPINGERS' CATCH, mg.		75.8		56.3		55.9
TOTAL TRAIN CATCH, mg.		81.5		60.1		64.6

Procedure Explanation
1 - Extractable with chloroform and ether
2 - Water catch after extraction and heating to 210 F
4 - Acetone rinsings of impingers and connecting glassware

Blank Bag #	1-236
Final wt., mg.	4234.6
Tare wt., mg.	4234.6
Residue, mg.	0.0
Volume, ml.	200
Conc., mg/ml	0.0

MOISTURE SAMPLING LABORATORY RESULTS

Plant Name: S.T. WOOTEN EEI Ref# 8116

Sampling Location: Rotary Dryer Stack

Date Received: 11/2 Date Analyzed: 11/2 Reagent Box(es): 0550

Run Number	M5-1	M5-2	M5-3
Run Date	11/1	11/1	11/1

ANALYSIS OF MOISTURE CATCH

Reagent 1 (H2O)			
Final Weight, g.	860.0	860.5	911.5
Tared Weight, g.	580.5	573.0	580.5
	==========	==========	==========
Water Catch,g.	279.5	287.5	331.0
Reagent 2 ( )			
Final Weight, g.			
Tared Weight, g.			
	==========	==========	==========
Water Catch,g.	0.0	0.0	0.0
eagent 3 ( )			
Final Weight, g.			
Tared Weight, g.			
	==========	==========	==========
Water Catch,g.	0.0	0.0	0.0
CONDENSED WATER, g.	279.5	287.5	331.0
Silica Gel:			
Final Weight, g.	216.5	215.5	223.0
Tared Weight, g.	200.0	200.0	200.0
	==========	==========	==========
ADSORBED WATER, g.	16.5	15.5	23.0
TOTAL WATER COLLECTED, g.	296.0	303.0	354.0

REAGENT BOX CUSTODY SHEET

30

Box No. 0550 Assembly Date 10/26/90 Assembled By JC

Plant Name S.T. WOOTEN EEI Ref. No. 8166

Sampling Loc. ROTARY DRYER STACK Method 5

Individual Tare of Reagent 200 (mL)(~~gm~~) of DI H_2O

Individual Tare of Reagent _____ (mL)(gm) of _____

Individual Tare of Silica Gel 200 gm

Run Number	Run Date	Filter Number	Filter Tare (gm)	Liquid Tare at Mark? *	Init.	Sample Recov. Date	%Sil. Gel Spent	Liquid Level Marked?	Init.
M5-1	11-1	E0754	0.5035	✓	MH	11-1	75	✓	MH
				Sample Appearance					
M5-2	11-1	E0755	0.4908	✓	MH	11-1	75	✓	MH
				Sample Appearance					
M5-3	11-1	E0750	0.5007	✓	MH	11-1	85	✓	MH
				Sample Appearance					

Date box received back in lab 11-2 Received by BVS

All liquid levels at mark (check) YES ✓ NO ___ *

Balance zeroed and spanned (initials) _____

* Estimate loss if not at mark; use "REMARKS" section.

REAGENT BOX INTEGRITY (check if locked or explain in "REMARKS")	
Immediately after assembly in lab ✓	In field, just prior to use ___
Immediately after field sample recovery ___	When received back at lab ✓

REMARKS _____

L-0010 3-90

ENTROPY

APPENDIX B.2

B. FIELD AND ANALYTICAL DATA

2. Plume Opacity

Run 1

VISIBLE EMISSION OBSERVATION FORM

SOURCE NAME	S.T. wooten Asphalt plant
ADDRESS	Route 3 - EAST 70
CITY	Princeton
STATE	NC
ZIP	27569
PHONE	(919) 936-2008
SOURCE ID NUMBER	
PROCESS EQUIPMENT	Rotary Dryer
OPERATING MODE	192 TPH
CONTROL EQUIPMENT	BAGHOUSE
OPERATING MODE	N/A

DESCRIBE EMISSION POINT
START 7'x 3' Rect. Duct STOP ✓

HEIGHT ABOVE GROUND LEVEL	START 25' STOP 25'
HEIGHT RELATIVE TO OBSERVER	START ≃ 25' STOP ≃ 25'
DISTANCE FROM OBSERVER	START ≃ 90' STOP
DIRECTION FROM OBSERVER	START NW STOP ✓

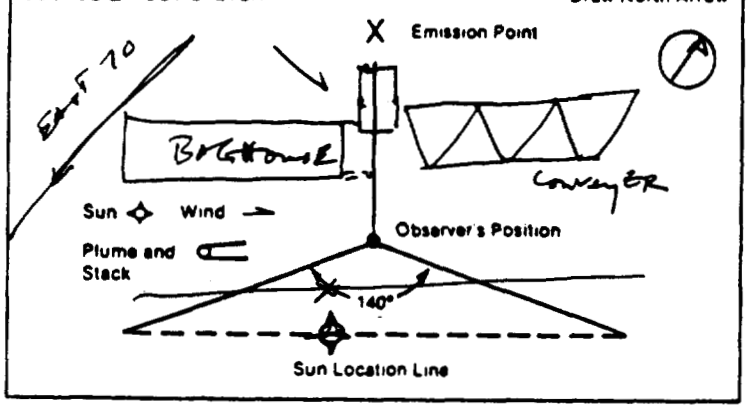
DESCRIBE EMISSIONS Little puffs of plume.
START No visible emissions STOP ✓

EMISSION COLOR	START Clear STOP clear
PLUME TYPE	CONTINUOUS ☑ FUGITIVE ☐ INTERMITTENT ☐
WATER DROPLETS PRESENT	NO ☑ YES ☐
IS WATER DROPLET PLUME	ATTACHED ☐ N/A DETACHED ☐

POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED
START ≃ 2' above stack exit STOP ✓

DESCRIBE BACKGROUND	START Sky STOP Sky
BACKGROUND COLOR	START blue/wh STOP
SKY CONDITIONS	START Clear STOP clear
WIND SPEED	START 0-5 mph STOP
WIND DIRECTION	START NE STOP NE
AMBIENT TEMP	START 60°F STOP 72°F
WET BULB TEMP	62°F
RH, percent	≃57%

SOURCE LAYOUT SKETCH — Draw North Arrow



COMMENTS
Use #2 oil

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TITLE
DATE

OBSERVATION DATE	START TIME	STOP TIME
NOV 1, 1990	8:50 AM	9:50 AM

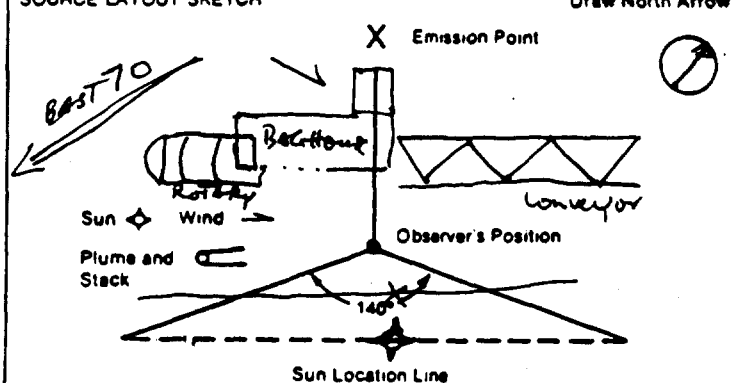
MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30	45
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	5	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	5	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	10	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	5	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	10	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	5	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	5
23	10	0	0	0	53	0	0	0	5
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	5	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	5	0	0	0
30	0	0	0	0	60	0	0	0	0

AVERAGE OPACITY FOR HIGHEST PERIOD	0.3%
NUMBER OF READINGS ABOVE	0.3 % WERE 11
RANGE OF OPACITY READINGS	0.0 MINIMUM — MAXIMUM 10.0
OBSERVER'S NAME (PRINT)	TANLE
Certificate No.	227397
OBSERVER'S SIGNATURE	C. Tan
DATE	NOV. 1. 90
ORGANIZATION	ENTROPY ENVIRONMENTALISTS INC.
CERTIFIED BY	ETA
DATE	Sept 26. 90
VERIFIED BY	
DATE	

VISIBLE EMISSION OBSERVATION FORM

SOURCE NAME	S.T. wooten Asphalt plant
ADDRESS	Route 3 - EAST 70
CITY	Princeton
STATE	NC
ZIP	27569
PHONE	(919) 936-2008
SOURCE ID NUMBER	
PROCESS EQUIPMENT	Rotary Dryer
OPERATING MODE	190 TPH
CONTROL EQUIPMENT	BAGHOUSE
OPERATING MODE	N/A
DESCRIBE EMISSION POINT START	7'x3' Rect. Duct
DESCRIBE EMISSION POINT STOP	✓
HEIGHT ABOVE GROUND LEVEL START	≈25'
HEIGHT ABOVE GROUND LEVEL STOP	25'
HEIGHT RELATIVE TO OBSERVER START	25'
HEIGHT RELATIVE TO OBSERVER STOP	25'
DISTANCE FROM OBSERVER START	≈100'
DISTANCE FROM OBSERVER STOP	≈100'
DIRECTION FROM OBSERVER START	NNW
DIRECTION FROM OBSERVER STOP	
DESCRIBE EMISSIONS START	No visible emissions, little puffs of part
DESCRIBE EMISSIONS STOP	
EMISSION COLOR START	Clear
EMISSION COLOR STOP	Clear
PLUME TYPE	CONTINUOUS ☒ FUGITIVE ☐ INTERMITTENT ☐
WATER DROPLETS PRESENT	NO ☒ YES ☐
IS WATER DROPLET PLUME	ATTACHED ☐ N/A DETACHED ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED START	≈2' above stack exit
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED STOP	
DESCRIBE BACKGROUND START	Sky
DESCRIBE BACKGROUND STOP	✓
BACKGROUND COLOR START	Blue
BACKGROUND COLOR STOP	
SKY CONDITIONS START	Clear
SKY CONDITIONS STOP	Clear
WIND SPEED START	0-5 mph
WIND SPEED STOP	0-5 mph
WIND DIRECTION START	NE
WIND DIRECTION STOP	NE
AMBIENT TEMP START	75°F
AMBIENT TEMP STOP	79°F
WET BULB TEMP	66°F
RH, percent	≈50%

SOURCE LAYOUT SKETCH — Draw North Arrow



COMMENTS: Use #2 oil

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OBSERVATION DATE	START TIME	STOP TIME
Nov 1, 90	10:55 AM	11:55

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30
1	0	0	0	0	31	0	0	0
2	0	0	0	0	32	0	0	0
3	0	0	0	0	33	0	0	0
4	0	0	0	0	34	0	0	0
5	0	0	0	0	35	0	0	0
6	0	0	0	0	36	0	0	0
7	0	0	0	0	37	0	5	0
8	5	0	0	0	38	0	0	0
9	0	0	0	0	39	0	0	0
10	0	0	0	0	40	0	0	0
11	0	0	0	0	41	0	0	0
12	0	0	5	0	42	0	0	0
13	0	0	0	0	43	0	0	0
14	0	0	0	0	44	0	0	0
15	0	0	0	0	45	0	5	0
16	0	0	0	0	46	0	0	0
17	0	0	0	0	47	0	10	0
18	0	0	0	0	48	0	0	0
19	0	0	0	0	49	0	0	0
20	0	0	0	0	50	0	0	0
21	10	0	0	0	51	0	0	0
22	0	0	0	0	52	0	5	0
23	0	0	0	0	53	0	0	0
24	0	5	0	0	54	0	0	0
25	0	0	0	0	55	0	0	0
26	0	0	0	0	56	0	0	0
27	0	0	0	0	57	0	0	0
28	0	0	0	0	58	0	0	0
29	0	0	0	0	59	0	0	0
30	0	0	10	0	60	0	0	0

AVERAGE OPACITY FOR HIGHEST PERIOD	0.25
NUMBER OF READINGS ABOVE 0.25% WERE	9
RANGE OF OPACITY READINGS MINIMUM	0.0
MAXIMUM	10.0
OBSERVER'S NAME (PRINT)	TAN LE
Certificate No.	227397
OBSERVER'S SIGNATURE	Le Tan
DATE	Nov. 1. 9
ORGANIZATION	ENTROPY ENVIRONMENTALISTS
CERTIFIED BY	ETA
DATE	Sept
VERIFIED BY	
DATE	

VISIBLE EMISSION OBSERVATION FORM

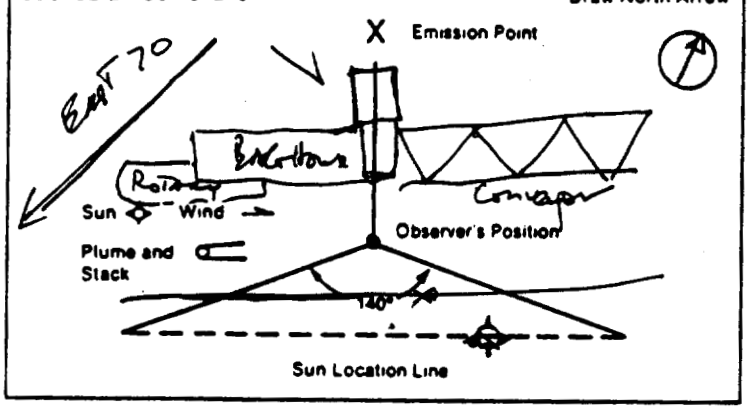
SOURCE NAME	S.T. wooten Asphalt plant
ADDRESS	Route 3 — EAST 70
CITY	Princeton
STATE	NC
ZIP	27569
PHONE	(919) 936-2008
SOURCE ID NUMBER	
PROCESS EQUIPMENT	Rotary Dryer
OPERATING MODE	212 TPH
CONTROL EQUIPMENT	BAGHOUSE
OPERATING MODE	N/A

DESCRIBE EMISSION POINT
START 7'x3' Rect. Duct STOP ✓
HEIGHT ABOVE GROUND LEVEL START ≃25' STOP ≃25'
HEIGHT RELATIVE TO OBSERVER START 25' STOP 25'
DISTANCE FROM OBSERVER START ≃ 100' STOP 100'
DIRECTION FROM OBSERVER START NW STOP

DESCRIBE EMISSIONS
START No Visible Emissions STOP Little puffs of Dust ✓
EMISSION COLOR START Clear STOP
PLUME TYPE CONTINUOUS ☑ FUGITIVE ☐ INTERMITTENT ☐
WATER DROPLETS PRESENT NO ☑ YES ☐
IS WATER DROPLET PLUME ATTACHED ☐ N/A DETACHED ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED
START ≃2' above duct exit STOP ✓

DESCRIBE BACKGROUND
START Sky STOP Sky
BACKGROUND COLOR START blue STOP blue
SKY CONDITIONS START clear STOP clear
WIND SPEED START 0-5mph STOP ✓
WIND DIRECTION START NE STOP ✓
AMBIENT TEMP START 80°F STOP 82°F
WET BULB TEMP 70°F
RH, percent ≃ 55%

SOURCE LAYOUT SKETCH — Draw North Arrow



COMMENTS: Use #2 oil

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TITLE

OBSERVATION DATE	START TIME	STOP TIME
NOV. 1-90	12:45 PM	1:45

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30
1	0	0	0	0	31	0	0	0
2	0	0	0	0	32	0	0	0
3	0	0	0	0	33	0	0	0
4	0	0	0	0	34	0	0	0
5	0	0	0	0	35	0	0	0
6	0	0	0	0	36	0	0	0
7	0	0	0	0	37	5	0	5
8	0	0	0	0	38	0	0	0
9	5	0	0	0	39	0	0	0
10	0	0	0	0	40	0	0	0
11	0	0	0	0	41	0	0	0
12	0	0	0	0	42	0	0	0
13	0	5	0	0	43	0	0	0
14	0	0	0	0	44	0	0	5
15	0	0	0	0	45	0	0	0
16	0	0	0	0	46	0	0	0
17	0	10	0	0	47	0	0	0
18	0	0	0	0	48	0	0	0
19	0	0	0	0	49	0	0	0
20	0	0	0	0	50	0	0	0
21	0	0	0	0	51	0	0	0
22	0	0	0	0	52	5	0	10
23	0	0	0	0	53	0	0	0
24	0	0	0	0	54	0	0	0
25	0	5	0	0	55	0	0	0
26	0	0	0	0	56	0	0	0
27	0	0	0	0	57	0	5	0
28	0	0	0	0	58	0	0	0
29	0	0	5	0	59	0	0	0
30	0	0	0	0	60	0	0	0

AVERAGE OPACITY FOR HIGHEST PERIOD 0.27
NUMBER OF READINGS ABOV 0.27 % WERE 11
RANGE OF OPACITY READINGS MINIMUM 0.0 MAXIMUM 10

OBSERVER'S NAME (PRINT) TAN LE
Certificate NO. 027397
OBSERVER'S SIGNATURE
DATE NOV 1
ORGANIZATION ENTROPY ENVIRONMENTALISTS INC
CERTIFIED BY ETA
DATE Sept
VERIFIED BY
DATE

APPENDIX C

CALIBRATION DATA

SAMPLING EQUIPMENT CHECKLIST

Plant Name/Address S.T. WOOTEN - PRINCETON, N.C. Job No. 8116

Sampling Location ROTARY DRYER STACK Team Leader MM

BAROMETER CHECK

Date	Entropy In-House Reference Barometer	Field Barometer	Check OK?*
10-31-90	29.82	29.8	✓

* ± 0.1" Mercury

THERMOMETERS AND THERMOCOUPLE CHECK

Date 10-31 Reference Thermometer Ambient Temperature, °F 75

Thermometers	Ambient Temperature, °F	Acceptance Range, °F	Check OK?
Impinger Exit	76	± 2.0	✓
Filter Box	75	± 5.4	✓
Dry Gas Meter	74	± 5.4	✓

Adjust thermometer until acceptable. If it cannot be adjusted, use as back-up. If no backup, record ambient temp. indicated by unadjusted thermometer.

Thermocouple	73	± 8.0* (± 2.0)**	✓

* ± 1.5% of Absolute Temperature.

** Acceptance range is ± 2.0°F if used in saturated or water droplet-laden gas stream.

PITOT AND NOZZLE CHECK

Pitot No.	Visual Check	Nozzle No.	Visual Check
M04-25	✓	704	✓
4-21	✓	706	✓
4-25	✓		

Dry Gas Meter Identification: 1054682 Calibration by: WLS

Date: 7-18-90 Barometric Pressure (P_b): 30.04 in. Hg

(Page 1 of 2)

ENTROPY ENVIRONMENTALISTS, INC.

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

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. ($\bar{Y}_{ds}$)
	2.6230	79	2.602	80	0.51	10	0.2579	1.0089	1.0087
	2.6503	79	2.579	80	0.51	10	0.2606	1.0283	1.0283
	2.6503	79	2.563	80	0.51	10	0.2606	1.0347	1.0347
	4.0802	79	3.989	80	0.91	10	0.4011	1.0225	1.0225
	4.0528	79	3.922	80	0.91	10	0.3984	1.0330	1.0330
	4.0164	79	3.915	80	0.91	10	0.3949	1.0255	1.0255
	4.8452	79	4.696	81	1.40	10	0.4763	1.0321	1.0320
	4.8452	79	4.669	81	1.40	10	0.4763	1.0380	1.0380
	4.7996	79	4.645	81	1.40	10	0.4719	1.0336	1.0335
	7.9235	79	7.802	81	2.60	10	0.7790	1.0129	1.0129
	7.8780	79	7.880	81	2.60	10	0.7745	0.9971	0.9971
	7.9508	79	7.922	81	2.60	10	0.7817	1.0010	1.0010
	10.146	79	10.184	82	4.40	10	0.9975	0.9911	0.9911
	10.164	79	10.224	82	4.40	10	0.9993	0.9890	0.9890
	10.127	79	10.213	82	4.40	10	0.9956	0.9865	0.9865
	11.676	79	11.874	83	5.50	10	1.1479	0.9775	0.9774

$$Y_{ds} = \frac{(V_s)\ (t_{ds} + 460)\ (P_b)}{\ldots}$$

$$Q = (17.64)\ \frac{(P_b)\ (V_s)}{\ldots}$$

Dry Gas Meter Identification: 1054682 Calibration by: WLS

(Page 2 of 2)

Date: 7-18-90 Barometric Pressure (P_b): 30.04 in. Hg

ENTROPY ENVIRONMENTALISTS, INC.

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

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. ($\bar{Y}_{ds}$)
	11.612	79	11.807	83	5.50	10	1.1416	0.9776	0.9776
	11.594	79	11.833	83	5.50	10	1.1398	0.9740	0.9739
	12.796	82	13.133	84	6.50	10	1.2510	0.9626	0.9626
	12.805	82	13.122	84	6.50	10	1.2519	0.9641	0.9641
	12.787	82	13.095	84	6.50	10	1.2502	0.9647	0.9647

$Y_{ds} = 1.0026$

$$Y_{ds} = \frac{(V_s)\ (t_{ds} + 460)\ (P_b)}{\text{----------}}$$

$$Q = (17.64)\ \frac{(P_b)\ (V_s)}{\text{----------}}$$

ISOKINETIC METERBOX FULLTEST CALIBRATION

Meterbox No. N5 Calibrated By RDS/MBC

Date 7-26-90 Barometric Pressure (P_b) 29.7 (In. Hg)

Date _____* Barometric Pressure (P_b) _____ (In. Hg)*

Standard Meter No. 1054682 Standard Meter Coefficient 1.0026

STANDARD METER			METERBOX METERING SYSTEM				
Gas Volume (V_{ds}) cf	Temp. (t_{ds}) °F	Time (θ) Min.	Orifice Setting (ΔH) In. H2O	Gas Volume (V_d) cf	Temp. (t_d) °F	Coeff. (Y_d)	$\Delta H@$ In. H_2O
4.112	76	10	0.5	4.176	80	.9934	1.671
4.129	76	↓	0.5	4.188	80	.9946	1.657
8.155	78	↓	2.0	8.254	81	.9912	1.708
8.065	77	↓	2.0	8.241	84	.9891	1.731
12.259	77	↓	4.8	12.374	82	.9908	1.804
12.212	77	↓	4.8	12.386	86	.9936	1.805
					Average	.9921	1.729

1. Coefficient range: 0.97-1.03.
2. Coefficient tolerance: for individual runs, ± 0.02 from average.
3. $\Delta H@$ range: 1.6-2.0.
4. $\Delta H@$ tolerance: ≤ 0.15 In. H_2O over ΔH range of 0.4 In.-4.0 In.

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

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

ON-SITE DRY GAS METER AUDIT

Plant Name S.T. WOOTEN Job Number 8116

Date 10-31-90 Meter Box Identification Number N5

Time 1420 Fulltest Gamma (Y) 0.9921 $\Delta H_@$ 1.729

Auditor MH Barometric Pressure (P_{bar}) 29.8 In. Hg

Zero Magnehelics? (check) ✓

Dry Gas Meter Reading (ft^3)	Meter Temperature (°F)	Upper and Lower Limits for Audit Gamma
Initial 302.000	Initial 76	0.96 * Y = 0.9524
Final 309.549	Final 84	1.04 * Y = 1.0318

Dry Gas Volume Metered (ft^3)	Average Meter Temperature (°F)	Run Time (Base = 10)	
		(Min.)	(Sec.)
Vm = 7.549	Tm = 80	10	00

$$Y_c = \frac{[\text{Min.} + (\text{Sec.} / 60)]}{Vm} * \left[\frac{0.0319\ (Tm + 460)}{P_{bar}}\right]^{0.5}$$

$$Y_c = \frac{[10 + (00 / 60)]}{7.549} * \left[\frac{0.0319\ (80 + 460)}{29.8}\right]^{0.5} = 1.0072$$

Calculated Audit Y

Audit Gamma Within Acceptable Limits? Yes ✓ No ____

F-1040 rev. 3-90

ENTROPY

ISOKINETIC METERBOX POSTTEST CALIBRATION

METERBOX NO. N5

Date 11-8-90 Calibrated By MBC Job Number 8116

Barometric Pressure (P_b) 29.34 (In. Hg) Meterbox Vacuum 11 (In. Hg)

Standard Meter No. 1054682 Standard Meter Coefficient 1.0026

STANDARD METER			METERBOX METERING SYSTEM				
Gas Volume (V_{ds}) cf	Temp. (t_{ds}) °F	Time (θ) Min.	Orifice Setting (ΔH) In. H2O	Gas Volume (V_d) cf	Temp. (t_d) °F	Coeff. (Y_d)	$\Delta H@$ In. H_2O
7.743	71	10	1.9	7.973	94	1.0114	1.709
7.760	71	10	1.9	8.001	96	1.0134	1.697
7.725	71	10	1.9	7.967	98	1.0168	1.706
					Average	1.0139	1.704

Fulltest Y_d .9921 Date 7-26-90 % Dev. 2.2 Allowed Dev.: ± 5%

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

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

R-0031 rev. 1-90

ENTROPY

NOZZLE NUMBER: 704

Date	Initials	Dia. 1	Dia. 2	Dia. 3	Dia. 4	Dia. 5	Average
12-2-82	ST	.239	.243	.242	.242	.243	0.242"
4-6-83	PLO	.246	.244	.244	.243	.245	0.244"
11-18-83	PLO	.244	.246	.244	.246	.245	0.245"
3-8-84	JNC	.244	.245	.245	.247	.244	0.245"
7-6-84	TTm	.247	.247	.248	.247	.246	0.247
10-23-84	ATM	.242	.242	.243	.242	.243	0.242
10.24.85	GC	.246	.246	.248	.249	.247	0.247
2-13-86	T. m°D.	.248	.247	.250	.251	.248	0.249
3/10/87	ST	.254	.254	.255	.256	.255	.255
3/20/87	SH	.250	.252	.252	.252	.249	.251
12/10/87	DB	.251	.250	.251	.250	.250	.250
8-11-88	JC	.249	.253	.250	.249	.251	.250
10/18/88	BKG	.259	.263	.261	.262	.262	.261
12/05/88	BKG	.261	.264	.262	.263	.264	.263
1/13/89	BKG	.266	.269	.267	.268	.269	.268
3/10/89	BKG	.256	.255	.256	.256	.255	.256
6/22/89	LM	.259	.260	.258	.258	.257	.258
8-21-89	JRW	.242	.243	.244	.242	.243	.243

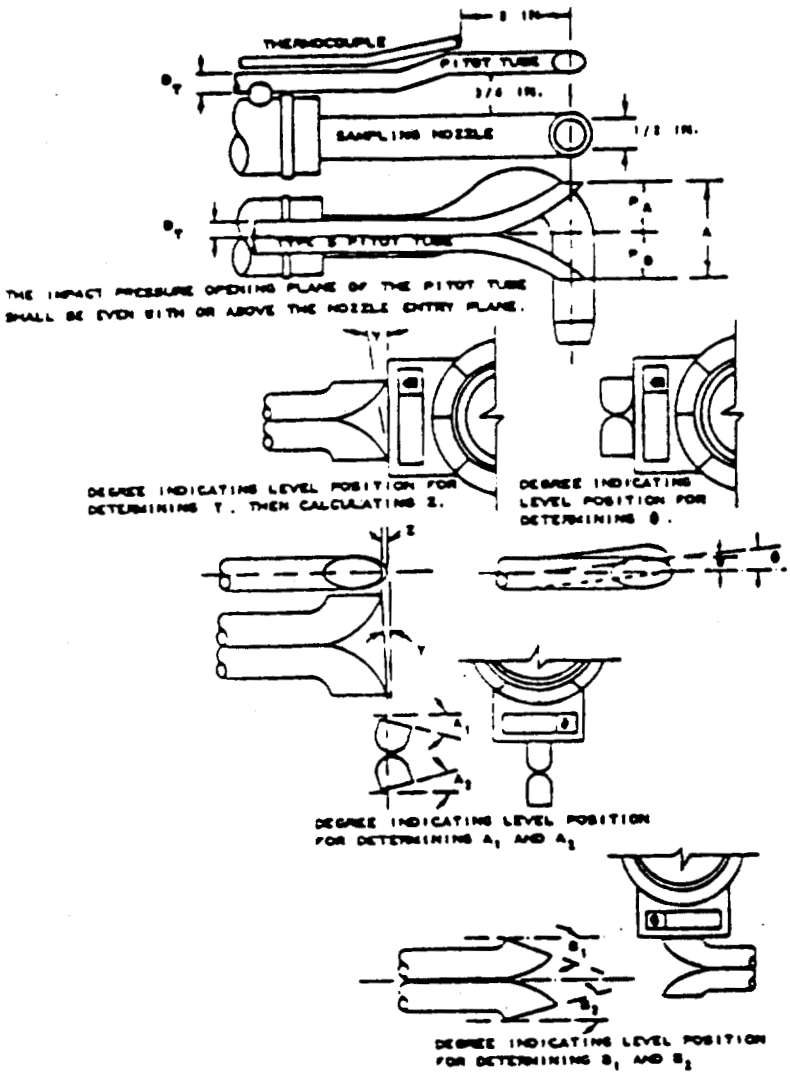
NOTE: All diameters measured in inches.

NOZZLE NUMBER: 706

Date	Initials	Dia. 1	Dia. 2	Dia. 3	Dia. 4	Dia. 5	Average
3/10/87	ST	.248	.248	.249	.249	.249	0.249
3/20/87	SH	.242	.245	.244	.245	.245	.244
8-11-88	AC	Missing	—	—	—	—	—
9-20-88	RDS	.257	.255	.256	.257	.257	.256
10/18/88	BKG	.270	.270	.271	.270	.269	.270
1/13/89	BKG	.274	.276	.277	.274	.275	.275
6/22/89	LM	.270	.272	.272	.271	.270	.271
8-21-89	JRW	.258	.252	.256	.256	.255	.255

NOTE: All diameters measured in inches.

PITOT TUBE INSPECTION DATA SHEET



level?	YES
obstructions?	NONE
damaged?	NONE
$-10^\circ < \alpha_1 < +10^\circ$	1°
$-10^\circ < \alpha_2 < +10^\circ$	1°
$-5^\circ < \beta_1 < +5^\circ$	0
$-5^\circ < \beta_2 < +5^\circ$	0
γ	1°
θ	0
A	.832
$1.05\ D_t < p_a < 1.5\ D_t$	.419
$1.05\ D_t < P_b < 1.5\ D_t$	.413
$3/16" < D_t < 3/8"$	375
$A \tan \gamma < 0.125"$	.014
$A \tan \theta < 0.03125"$	0
$P_a = P_b \pm 0.063"$	.006 YES

Comments: _____

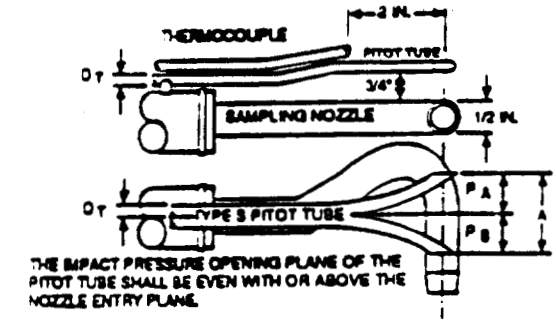
I certify that pitot tube/probe number 4-21 meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube calibration factor of 0.84.

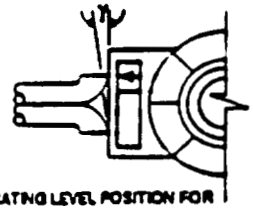
Signature W. Shell

Date 2-13-90

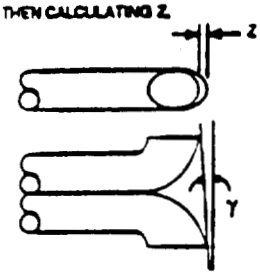
*SEE 40 CFR 60, VOL. 42 NO. 160 METHOD 2. VERIFY THE MINIMUM 2 INCH SETBACK OF THE THERMOCOUPLE AND THE MINIMUM 3/4 INCH SEPARATION BETWEEN THE PITOT TUBE AND THE NOZZLE AS SHOWN AT THE TOP OF THIS PAGE.

PITOT TUBE INSPECTION

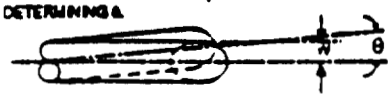


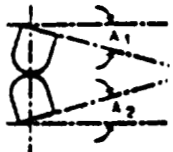


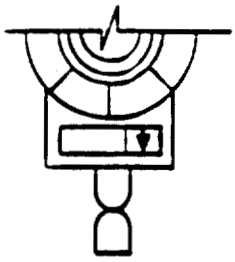
DEGREE INDICATING LEVEL POSITION FOR DETERMINING α, THEN CALCULATING Z.



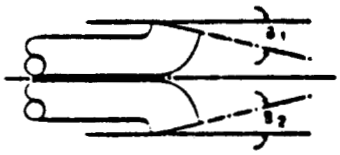
DEGREE INDICATING LEVEL POSITION FOR DETERMINING θ.

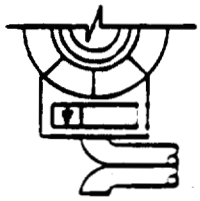






DEGREE INDICATING LEVEL POSITION FOR DETERMINING A_1 AND A_2.





DEGREE INDICATING LEVEL POSITION FOR DETERMINING β_1 AND β_2.

level?	YES
obstructions?	NONE
damaged?	NONE
$-10° < \alpha_1 < +10°$	0
$-10° < \alpha_2 < +10°$	0
$-5° < B1 < +5°$	0
$-5° < B2 < +5°$	0
γ	1°
θ	0
A	.944
$1.05\ D_t < P_a < 1.5\ D_t$	.472
$1.05\ D_t < P_b < 1.5\ D_t$	.472
$3/16" < D_t < 3/8"$	.375
A tan γ < 0.125"	.016
A tan θ < 0.03125"	0
$P_a = P_b \pm 0.063"$	YES 0

See 40 CFR 60, Vol. 42 No. 160 EPA Method 2. Verify the minimum 2-inch setback of the thermocouple and the minimum 3/4-inch separation between the pitot tube and the nozzle as shown at the top of this page.

Comments: _____

I certify that pitot tube/probe number 4-25 meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube calibration factor of 0.84.

Signature Chas C Blanton

Date 5-14-90

R-0028 rev. 3/90

THERMOCOUPLE CALIBRATION

Thermocouple No.: R199

Date: 8/28/90

Calibrated By: CCB

Barometric Pressure, Inches Hg: 29.51

Ambient Temperature, °F: 72.0

Mercury-In-Glass Thermometer I.D. No.: 7121K

Calibration System Used	Potentiometer I.D. Number	Reference Thermometer Temperature T_o °F	Reference Thermometer Temperature T_c °F	Mean Temperature of Hg Column T_m °F	Thermocouple Thermometer Temperature T_t °F	Temperature Diff., % (Allowable: ≤ 1.5 %)
Ice Bath	F-9	32.0	31.96	72.0	30.6	.28
		32.0	31.96	72.0	30.6	.28
		32.0	31.96	72.0	30.6	.28
Boiling Water	F-9	214.0	215.82	110.0	211.8	.59
		214.0	215.82	110.0	211.8	.59
		214.0	215.82	110.0	211.8	.59
Boiling Oil	F-9	388.0	396.88	120.0	386.8	1.18
		388.0	396.88	120.0	386.8	1.18
		388.0	396.88	120.0	386.6	1.20

Corrected Temperature $= T_c = T_o + [(.00009) * (T_o - 20) * (T_o - T_m)]$

$$\text{Temperature Difference} = \frac{[(T_c + 460) - (T_t + 460)]}{(T_c + 460)} * 100$$

APPENDIX D

SAMPLING AND ANALYTICAL PROCEDURES

this report is incomplete. (c)

EVALUATOR FMT EVALUATION DATE 05/10/93

METHOD 5: SECONDARY EMISSIONS TEST REPORT EVALUATION

AGENCY ~~[illegible]~~ NC FACILITY: Potters Industries, Inc TEST DATE: 9/2/87

PROCESS TESTED (SCC):

TEST RESULTS/PROCESS RATES/EMISSION FACTOR RATINGS:

	Run 1	Run 2	Run 3	
filtrable part. emiss	0.4309	0.5633	0.7006	lb/hr

PM EM : $\frac{0.565}{642/2000}$ = 1.76 lb/ton

Appdx D sampling & analytical procedure is missing

PROCESS RATE 3
is process rate during testing representative of normal operations

624 lb/hr – 660 lb/hr avg = 642 lb/hr

FLOW/STREAM ANALYSIS 3
Methods 1-4 or equivalent (including traverse and port illustrations, cyclonic flow determination, MW and moisture calculations) performed to allow calculation of emission rates at standard conditions

Method 1 ✓
2 ✓
3 CO_2 O_2, CO, N_2
4 ✓

FIELD DATA 3
is field data on standard forms, and does raw data correspond with printout

SAMPLING DURATION 3
must have at least 3 runs, each ≥ 1 hour ✓ duration, with sampling ≥ 2 minutes at each traverse point, and total sampling volume ≥ 30 dscf ✓

24 equal area ~ 2.5 min

look at field fcs

SAMPLING TEMPERATURE 3
both probe and filter must be maintained at 248 ± 25°F or other temperature specified in NSPS

impinger T should < 68°F

Probe T: 245 – 269 46 – 66

ISOKINETICS 3
within 100±10% for all runs

105.3 106.5 103.7

BACK-HALF NA
if any, what method was used to catch and recover condensible matter

EQUIPMENT
borosilicate glass probe liner, quartz fiber filter

CALIBRATION were both pre- and post-test calibrations performed for
meter box ✓ 3

pitot tube ✓ 2
no doc (although the procedure shows they did)

temperature sensor 2
no doc

nozzle (3 #) ✓ 3

LEAK CHECKS 3
pretest optional; post-test, conducted at vacuum ≥ highest sampling vacuum, leakage rate < 0.02 cfm or 4% of average sampling rate

15"	8"	8"
0.006	0.003	0.002

BLANKS 2
acetone blank analyzed, < 0.001% residue

$\frac{0.3}{502.8} \times 100\% = 0.06\%$ $\frac{0.4}{469.9} = 0.085\%$

SAMPLE PREP 3 $\frac{0.3}{478.1} = 0.06\%$
filter desiccation and tare weights documented

No doc

AIR POLLUTION CONTROL DEVICE(S)

FACILITY: Potters Industries, Inc TEST DATE: 9/21/87

CONTROL SYSTEM CONFIGURATION: _____

BAGHOUSE

Make/Model No./Specifications: Dustex multiclone

Pressure Drop: _____

Gas-to-Cloth Ratio: _____

Design Efficiency / Exit Concentration: _____

Fiber Type/Weave: _____

INERTIAL SEPARATOR

Make/Model No./Specifications: /

Design Efficiency / Exit Concentration: _____

Pressure Drop: _____

ELECTROSTATIC PRECIPITATOR

Make/Model No./Specifications: _____

Design Efficiency / Exit Concentration: _____

No. of Fields in Operation: _____

Pressure Drop: _____

Voltage: _____

No. of Fields: _____

Amperage: _____

SCRUBBER

Make/Model No./Specifications: _____

Scrubbing Liquid: _____

Design Efficiency / Exit Concentration: _____

Scrubbant Flow Rate: _____

Pressure Drop: _____

Scrubbant pH: _____

ADSORPTION SYSTEM

Make/Model No./Specifications: _____

Adsorbent: _____

Design Efficiency / Exit Concentration: _____

System Analyzer Readings: _____

INCINERATOR

Make/Model No./Specifications: _____

Design Efficiency / Exit Concentration: _____

Chamber Temperature(s): _____

Residence Time: _____

Catalyst/Bed Type: _____

POTTERS INDUSTRIES INC.
an affiliate of The PQ Corporation

September 23, 1987

North Carolina Department of
Natural Resources & Cummunity Development
P.O. Box 27667
Raleigh, N.C. 27611

Att: Mr. David Y. Daniel

Dear Dave,

Please find attached Entropy's "Particulate Emissions Compliance Testing" final report for your records. As indicated on page 2-2, the actual emissions measured, while running coarse material, was 0.43, 0.56 and 0.70 pounds per hour. The feed rate of material being furnaced increased from 624 pounds per hour to 660 pounds per hour which explains why the emissions steadily increased during the three runs.

Thank you for your attention and cooperation. Please contact me if any other information is required.

Very truly yours,

POTTERS INDUSTRIES, INC.

Charles J. Friedrich

Charles J. Friedrich
Test Coordinator

CJF:jm
Attachment

Corporate Headquarters: 377 Route 17, Hasbrouck Heights, New Jersey 07604, U.S.A., Tel. 201 288-4700, Telex: 219054 or 133447

ENTROPY
ENVIRONMENTALISTS INC.

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

STATIONARY SOURCE SAMPLING REPORT

EEI REF. NO. 5639

POTTERS INDUSTRIES INC.

APEX, NORTH CAROLINA

PARTICULATE EMISSIONS COMPLIANCE TESTING

FURNACE NO. 2 MULTICLONE STACK

SEPTEMBER 2, 1987

REPORT CERTIFICATION

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

Date September 15, 1987 Signature _____

Barry F. Rudd

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

Date September 15, 1987 Signature _____

D. James Grove, P.E.

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4.3	Volumetric Air Flow Rates	4-1
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B.	Field and Analytical Data	7
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INTRODUCTION

1.1 Outline of Test Program. Stationary source sampling was performed for Potters Industries, Inc. in Apex, North Carolina, on September 2, 1987. Three EPA Method 5 runs were performed at the furnace No. 2 multiclone stack to determine the particulate emissions for compliance purposes.

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

TABLE 1-1

TEST PARTICIPANTS

Potters Industries, Inc.	Charles Friedrich Test Coordinator
North Carolina Department of Natural Resources and Community Development	David Y. Daniel Test Observer
Entropy Environmentalists, Inc.	Barry F. Rudd Project Supervisor
	Roger D. Satterfield Engineering Technician

SUMMARY OF RESULTS

Table 2-1 presents a run-by-run summary of the particulate emissions from the testing performed September 2, 1987, at the furnace No. 2 multiclone stack. The average emission rate was 0.565 pounds per hour; since the allowable emission rate for the unit is 2.5 pounds per hour, the compliance standards were met.

Detailed test results are given in Appendix A; field and analytical data are presented in Appendix B.

TABLE 2-1

PARTICULATE TESTS SUMMARY OF RESULTS

Furnace No. 2 Multiclone Stack

	1	2	3
Run Date	9/02/87	9/02/87	9/02/87
Test Train Parameters:			
Volume of Dry Gas Sampled, SCF*	48.794	49.304	49.686
Percent Isokinetic	105.3	106.5	103.7
Flue Gas Parameters:			
Temperature, Degrees F	537	540	543
Volumetric Air Flow Rates SCFM*, Dry	3,160	3,157	3,269
ACFM, Wet	6,548	6,564	6,751
Method 5 Results:			
Catch, Milligrams	50.3	66.5	80.5
Concentration, Grains/DSCF*	0.01591	0.02081	0.02500
Emission Rate, Lbs/Hour	0.4309	0.5633	0.7006

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

PROCESS DESCRIPTION AND OPERATION

The process at the Potters Industries Inc. plant in Apex, North Carolina is confidential. Figure 3-1 is an air flow schematic which shows the test location.

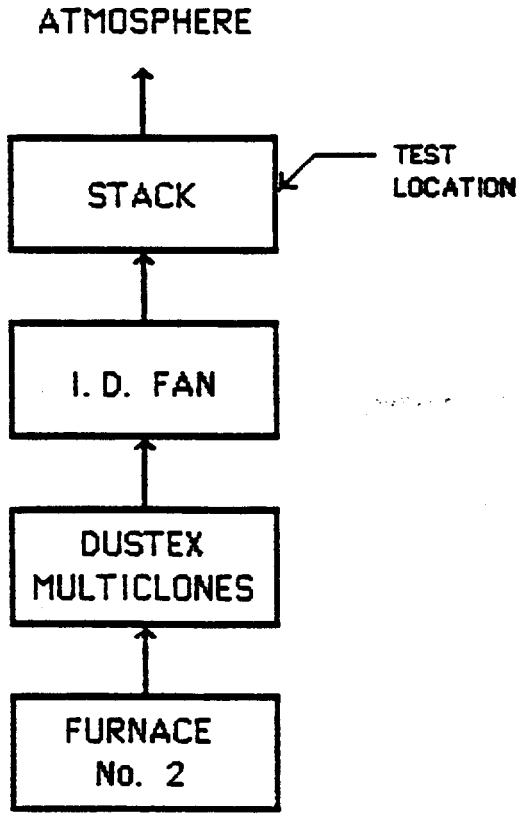


FIGURE 3-1. FURNACE No. 2 AIR FLOW SCHEMATIC SHOWING TEST LOCATION

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 Part 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 24 equal areas with 12 traverse points on each of 2 axes, 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 multiclone stack cross section.

4.3.2 Flue Gas Composition. During run 3, 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 Emissions Determinations. EPA Method 5 sampling and analytical procedures were used to determine the particulate emissions. Each of the 24 equal areas was sampled for 2.5 minutes, resulting in a net run time of 60 minutes.

4.5 Equipment Calibration. Pertinent equipment calibration data are provided in Appendix C.

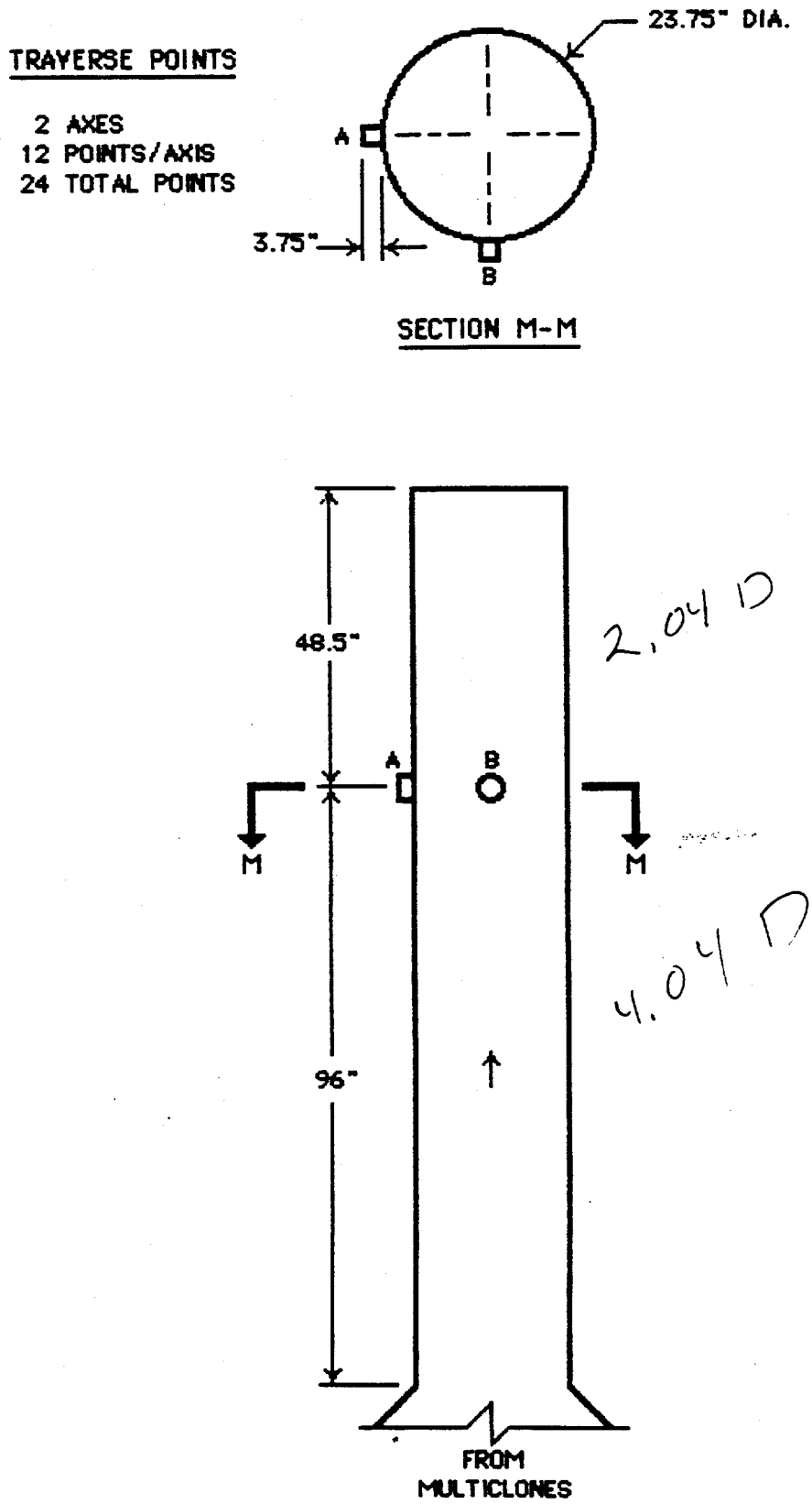


FIGURE 4-1. FURNACE No. 2 MULTICLONE STACK TEST LOCATION

APPENDIX A

TEST RESULTS AND EXAMPLE CALCULATIONS

ISOKINETIC SAMPLING TRAIN FIELD DATA & RESULTS TABULATION

PLANT: Potters Industries, Inc., Apex, North Carolina

RUN #	DATE	SAMPLING LOCATION	OPERATOR
1	9/02/87	Furnace No. 2 Multiclone Stack	Barry F. Rudd
2	9/02/87	Furnace No. 2 Multiclone Stack	Barry F. Rudd
3	9/02/87	Furnace No. 2 Multiclone Stack	Barry F. Rudd

		1	2	3
	Run Start Time	800	927	1054
	Run Finish Time	902	1029	1156
	Net Sampling Points	24	24	24
Theta	Net Run Time, Minutes	60.00	60.00	60.00
Dia	Nozzle Diameter, Inches	0.371	0.371	0.371
Cp	Pitot Tube Coefficient	0.840	0.840	0.840
Y	Dry Gas Meter Calibration Factor	0.997	0.997	0.997
Pbar	Barometric Pressure, Inches Hg	29.80	29.80	29.80
Delta H	Avg. Pressure Differential of Orifice Meter, Inches H2O	2.320	2.320	2.460
Vm	Volume of Metered Gas Sample, Dry ACF	51.655	52.382	52.675
tm	Dry Gas Meter Temperature, Degrees F	98	100	99
Vm(std)	Volume of Metered Gas Sample, Dry SCF*	48.794	49.304	49.686
Vlc	Total Volume of Liquid Collected in Impingers & Silica Gel, mL	95.5	97.0	86.5
Vw(std)	Volume of Water Vapor, SCF*	4.495	4.566	4.072
%H2O	Moisture Content, Percent by Volume	8.4	8.5	7.6
Mfd	Dry Mole Fraction	0.916	0.915	0.924
%CO2	Carbon Dioxide, Percent by Volume, Dry	4.2	4.2	4.2
%O2	Oxygen, Percent by Volume, Dry	13.2	13.2	13.2
%CO+N2	CO + N2, Percent by Volume, Dry	82.6	82.6	82.6
Md	Dry Molecular Weight, Lb/Lb-Mole	29.20	29.20	29.20
Ms	Wet Molecular Weight, Lb/Lb-Mole	28.26	28.25	28.35
Pg	Flue Gas Static Pressure, Inches H2O	-0.14	-0.15	-0.15
Ps	Absolute Flue Gas Press., Inches HG	29.79	29.79	29.79
ts	Flue Gas Temperature, Degrees F	537	540	543
Delta p	Average Velocity Head, Inches H2O	0.2060	0.2064	0.2184
vs	Flue Gas Velocity, Feet/Second	35.47	35.56	36.57
A	Stack/Duct Area, Square Inches	443.0	443.0	443.0
Qsd	Volumetric Air Flow Rate, Dry SCFM*	3,160	3,157	3,269
Qaw	Volumetric Air Flow Rate, Wet ACFM	6,548	6,564	6,751
%I	Isokinetic Sampling Rate, Percent	105.3	106.5	103.7

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

(continued next page)

		1	2	3
	Method 5 Results:			
mg	Catch, Milligrams	50.3	66.5	80.5
gr/DSCF	Concentration, Grains per DSCF*	0.01591	0.02081	0.02500
Lb/Hr	Emission Rate, Lbs/Hour (PMRc)	0.4309	0.5633	0.7006

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

EXAMPLE PARTICULATE TEST CALCULATIONS NO. 1

Furnace No. 2 Multiclone Stack

VOLUME OF DRY GAS SAMPLED AT STANDARD CONDITIONS

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

$$Vm(std) = 17.64 * 0.997 * 51.655 * \frac{(29.80 + 2.320/13.6)}{(460 + 98)} = 48.794 \text{ DSCF}$$

VOLUME OF WATER VAPOR AT STANDARD CONDITIONS

$$Vw(std) = 0.04707 * Vlc$$

$$Vw(std) = 0.04707 * 95.5 = 4.495 \text{ SCF}$$

PERCENT MOISTURE, BY VOLUME, AS MEASURED IN FLUE GAS

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

$$\%H2O = \frac{4.495}{4.495 + 48.794} * 100 = 8.4\ \%$$

DRY MOLE FRACTION OF FLUE GAS

$$Mfd = 1 - \%H2O/100$$

$$Mfd = 1 - 8.4/100 = 0.916$$

DRY MOLECULAR WEIGHT OF FLUE GAS

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

$$Md = 4.2*0.44 + 13.2*0.32 + 82.6*0.28 = 29.20 \text{ LB/LB-MOLE}$$

WET MOLECULAR WEIGHT OF FLUE GAS

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

$$Ms = 29.20 * 0.916 + (0.18 * 8.4) = 28.26 \text{ LB/LB-MOLE}$$

ABSOLUTE FLUE GAS PRESSURE

$$Ps = Pbar + Pg / 13.6$$

$$Ps = 29.80 + (-0.1 / 13.6) = 29.79 \text{ IN. HG.}$$

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

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

$$vs = 85.49 * 0.840 * SQRT\left[\frac{0.2060 * (460 + 537)}{29.79 * 28.26}\right] = 35.5 \text{ FT/SEC}$$

DRY VOLUMETRIC FLUE GAS FLOW RATE @ STANDARD CONDITIONS

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

$$Qsd = \frac{60}{144} * 0.916 * 35.5 * 443.0 * \frac{528}{537 + 460} * \frac{29.79}{29.92}$$

$$Qsd = 3,160 \text{ SCFM}$$

WET VOLUMETRIC STACK GAS FLOW RATE @ FLUE GAS CONDITIONS

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

$$Qaw = 60 / 144 * 35.5 * 443.0 = 6,548 \text{ ACFM}$$

PERCENT ISOKINETIC OF SAMPLING RATE

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

$$\%I = \frac{29.92}{528} * \frac{100}{60} * \frac{(537 + 460) * 48.794}{29.79 * 35.5 * 0.916 * 60.00 * 0.0007507}$$

$$\%I = 105.3 \ \%$$

GRAINS PER DRY STANDARD CUBIC FOOT

$$gr/DSCF = \frac{7000}{453.592} * \frac{mgs}{Vm(std)}$$

$$gr/DSCF = \frac{7000}{453.592} * \frac{50.3}{48.794} = 0.0159 \quad gr/DSCF$$

POUNDS PER HOUR

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

Lb/Hr = 60/7000 * 0.0159 * 3.160 = 0.43 LB/HR

APPENDIX B

FIELD AND ANALYTICAL DATA

Preliminary Field Data

PLANT NAME POTTER INDUSTRIES

LOCATION APEX, N.C.

SAMPLING LOCATION #2 MULTICLONE OUTLET

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 27½"

NIPPLE LENGTH 3¾"

DEPTH OF DUCT 23¾"

WIDTH (RECTANGULAR DUCT) —

EQUIVALENT DIAMETER:

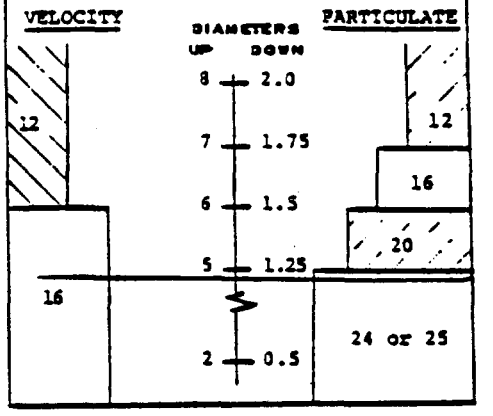
$D_e = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2(\quad)(\quad)}{(\quad + \quad)} = —$

DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE	UPSTREAM	DOWNSTREAM
	8'	4'
DIAMETERS	4	2

STACK AREA= $\pi(11.875)^2$ = 443 IN^2

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	2.1	1"	4¾"
2	6.7	1½"	5¼"
3	11.8	2¾"	6½"
4	17.7	4¼"	8"
5	25.0	5⅞"	9⅝"
6	35.6	8½"	12¼"
7	64.4	15¼"	19"
8	75.0	17¾"	21½"
9	82.3	19½"	23¼"
10	88.2	21"	24¾"
11	93.3	22⅛"	25⅞"
12	97.9	22¾"	26½"
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											95.8

ENTROPY ENVIRONMENTALISTS, INC

ORSAT FIELD DATA

Plant Name PATTERS INDUSTRIES - APEX, NC

Sampling Location #2 MULTICLONE OUTLET STACK Fuel Type NAT. GAS

Run and/or Sample No. 3 Leak Test? ✓ Date 09-02-87 Operator RFR

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
1054	1600	4.1	17.4	—	13.3	—	
/	1610	4.2	17.4		13.2		
1156	1620	4.2	17.4		13.2		
	Avg.	4.2		Avg.	13.2	—	82.6

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: Potters Industries
ADDRESS: Apex, NC
SAMPLING LOCATION: # 2 Multiclone Outlet Stack
DATE: 09-02-87
TEAM LEADER: B. Rudd
TECHNICIANS: R. Satterfield
BAROMETRIC PRESSURE, IN. HG: 29.8
STATIC PRESSURE, IN. H_2O: -0.14
RUN NUMBER: 1
TIME START: 0800
TIME FINISH: 0902

SAMPLING TRAIN LEAK TEST VACUUM, IN. HG: 15 | 8 | 8
SAMPLING TRAIN LEAK RATE, CU. FT./MIN.: 0.006 | 0.003 | 0.002

EQUIPMENT CHECKS

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- N/A ORSAT SAMPLING SYSTEM
- N/A TEDLAR BAG
- ✓ THERMOCOUPLE @ 540 °F

IDENTIFICATION NUMBERS

REAGENT BOX: 0202 NOZZLE: 512 DIAMETER: 0.371
METER BOX: N-6 T/C READOUT: F-3
UMBILICAL: U-09 T/C PROBE: 4-8
SAMPLE BOX: 14 ORSAT PUMP: N/A
PROBE: 4-12 TEDLAR BAG: N/A

FILTER #	TARE
E5940	0.5028

NOMOGRAPH SET-UP NOMOGRAPH # BFK

$\Delta H_@$: 1.75 C FACTOR: 1.03
METER TEMP: 100 STACK TEMP: 540
% MOISTURE: 4 REF. ΔP: 0.165
K = .01115152

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-12	0/0	296.940	0.209	2.33	2.33	94	3	252	66	533	
11	2½	299.05	0.206	2.30	2.30	95	3	259	60	536	
10	5	301.17	0.209	2.33	2.33	96	3	262	58	538	
9	7½	303.24	0.217	2.42	2.42	97	4	264	57	541	
8	10	305.39	0.203	2.26	2.26	98	4	261	56	541	
7	12½	307.53	0.221	2.46	2.46	98	4	268	56	542	
6	15	309.69	0.232	2.59	2.59	97	5	257	58	543	
5	17½	311.94	0.234	2.61	2.61	96	5	255	61	541	
4	20	314.22	0.224	2.50	2.50	92	5	255	63	538	
3	22½	316.45	0.214	2.39	2.39	88	5	254	64	525	
2	25	318.62	0.182	2.03	2.03	88	4	258	65	525	
1	27½	320.70	0.141	1.57	1.57	90	3	263	66	523	L.C.
B-12	30/0	322.518	0.230	2.56	2.56	92	4	261	65	536	322.581
11	2½	324.79	0.255	2.84	2.84	94	5	260	60	541	
10	5	327.16	0.260	2.90	2.90	96	5	258	57	542	Fyrite
9	7½	329.56	0.260	2.90	2.90	98	5	257	58	544	14% CO_2
8	10	331.89	0.253	2.82	2.82	100	5	253	51	545	
7	12½	334.36	0.241	2.69	2.69	103	5	250	48	545	
6	15	336.69	0.213	2.38	2.38	104	5	249	46	542	
5	17½	338.93	0.195	2.17	2.17	104	5	247	47	540	
4	20	341.07	0.183	2.04	2.04	106	4	257	49	536	
3	22½	343.18	0.159	1.77	1.77	108	4	253	51	531	
2	25	345.16	0.128	1.43	1.43	109	3	255	54	528	
1	27½	346.95	0.121	1.35	1.35	111	3	255	58	525	
	60/off	348.658									

V_M	$(\sqrt{\Delta P})^2$	ΔH	T_M	T_s
51.655	~~.206~~ .206	2.32	98	537

F-1010
8/86

ENTROPY

PARTICULATE FIELD DATA

COMPANY NAME: Potters Industries
ADDRESS: Apex, NC
SAMPLING LOCATION: #2 Multiclone Outlet Stack
DATE: 09.02.87
TEAM LEADER: B. Rudd
TECHNICIANS: R. Satterfield
RUN NUMBER: 2
TIME START: 0927
TIME FINISH: 1029
BAROMETRIC PRESSURE, IN. HG: 29.8
STATIC PRESSURE, IN. H_2O: -0.15
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
- N/A ORSAT SAMPLING SYSTEM
- N/A TEDLAR BAG
- ✓ THERMOCOUPLE @ 540 °F

IDENTIFICATION NUMBERS

REAGENT BOX: 0202 NOZZLE: 572 DIAMETER: 0.371
METER BOX: N.6 T/C READOUT: E.3
UMBILICAL: 4.09 T/C PROBE: 4.8
SAMPLE BOX: 13 ORSAT PUMP: N/A
PROBE: 4.12 TEDLAR BAG: N/A

FILTER #	TARE
E-5558	0.4699

NOMOGRAPH SET-UP

NOMOGRAPH #: BFR
$\Delta H_@$: 1.75
C FACTOR: 1.03
METER TEMP: 100
STACK TEMP: 540
% MOISTURE: 4
REF. ΔP: 0.165
K: 0.0115152

SAMPLE POINT	CLOCK TIME, MIN.	DRY GAS METER READING, CU. FT.	PITOT READING (ΔP), IN. H_2O	ORIFICE SETTING (ΔH), IN. H_2O IDEAL	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-12	0/0	348.831	0.192	2.14	2.14	96	2	248	65	535	
11	2½	350.88	0.204	2.27	2.27	96	2	252	60	538	
10	5	353.09	0.207	2.31	2.31	97	2	254	57	541	
9	7½	355.28	0.209	2.33	2.33	98	2	257	55	542	
8	10	357.43	0.219	2.44	2.44	97	2	260	54	545	
7	12½	359.65	0.217	2.42	2.42	95	2	261	54	546	
6	15	361.88	0.242	2.70	2.70	95	2	258	56	547	
5	17½	364.16	0.244	2.72	2.72	94	3	257	59	544	
4	20	366.51	0.228	2.54	2.54	94	3	255	61	544	
3	22½	368.78	0.217	2.42	2.42	94	3	254	62	537	
2	25	371.01	0.191	2.13	2.13	95	2	251	64	531	
1	27½	373.11	0.154	1.72	1.72	95	2	252	64	527	
B-12	30/0	375.049	0.249	2.78	2.78	96	3	255	66	539	
11	2½	377.37	0.239	2.67	2.67	98	3	258	62	543	
10	5	379.69	0.260	2.90	2.90	100	3	259	61	546	
9	7½	382.13	0.255	2.84	2.84	102	3	260	58	548	
8	10	384.54	0.255	2.84	2.84	105	3	257	58	547	
7	12½	386.97	0.237	2.64	2.64	107	3	255	60	546	
6	15	389.31	0.201	2.24	2.24	108	3	255	62	543	
5	17½	391.48	0.183	2.04	2.04	108	3	253	65	540	
4	20	393.59	0.178	1.98	1.98	109	3	250	65	539	
3	22½	395.70	0.164	1.83	1.83	111	2	248	66	538	
2	25	397.68	0.139	1.55	1.55	109	2	247	66	530	
1	27½	399.54	0.114	1.27	1.27	108	2	245	65	524	
	60/OFF	401.213									

V_M	$(\sqrt{\Delta P})^2$	ΔH	T_M	T_S
52.382	.2064	2.32	100	540

F-1010
8/86

ENTROPY

PARTICULATE FIELD DATA

COMPANY NAME: Potters Industries — RUN NUMBER: 3
ADDRESS: Apex, NC — TIME START: 1054
SAMPLING LOCATION: #2 Multiclone Outlet Stack — TIME FINISH: 1156
DATE: 09-02-87 — TEAM LEADER: B. Rudd — TECHNICIANS: R. Satterfield
BAROMETRIC PRESSURE, IN. HG: 29.8 — STATIC PRESSURE, IN. H_2O: -0.15
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG: 15 8
SAMPLING TRAIN LEAK RATE, CU. FT./MIN.: 0.012 0.006

EQUIPMENT CHECKS

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 540 °F

IDENTIFICATION NUMBERS

REAGENT BOX: 0202 — NOZZLE: 512 — DIAMETER: 0.371
METER BOX: N.6 — T/C READOUT: F.3
UMBILICAL: U.09 — T/C PROBE: 4.8
SAMPLE BOX: 14 — ORSAT PUMP: 4
PROBE: 4.12 — TEDLAR BAG: 5

FILTER #	TARE
E 5559	0.4781

NOMOGRAPH SET-UP — NOMOGRAPH #: BER

$\Delta H_@$: 1.75 — C FACTOR: 1.03
METER TEMP: 100 — STACK TEMP: 540
% MOISTURE: 4 — REF. ΔP: 0.165
K = 0.0111515

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-12	0/0	401.400	0.208	2.32	2.32	91	5	254	66	541	
11	2½	403.55	0.221	2.46	2.46	93	5	256	61	543	
10	5	405.72	0.220	2.45	2.45	95	6	258	59	545	
9	7½	407.98	0.224	2.50	2.50	96	6	261	55	547	
8	10	410.19	0.225	2.51	2.51	94	6	262	53	549	
7	12½	412.39	0.233	2.60	2.60	93	6	260	51	549	
6	15	414.61	0.238	2.65	2.65	93	6	259	51	548	
5	17½	416.87	0.244	2.72	2.72	94	6	257	50	546	
4	20	419.16	0.229	2.55	2.55	94	6	255	48	544	
3	22½	421.39	0.216	2.41	2.41	94	5	253	48	540	
2	25	423.56	0.194	2.16	2.16	93	5	255	47	538	
1	27½	425.63	0.157	1.75	1.75	95	5	269	48	524	
B-12	30/0	427.480	0.254	2.83	2.83	96	6	254	59	541	
11	2½	429.81	0.260	2.90	2.90	98	6	251	56	545	
10	5	432.15	0.265	2.96	2.96	100	7	255	52	548	
9	7½	434.53	0.260	2.90	2.90	103	7	257	51	548	
8	10	436.92	0.265	2.96	2.96	105	7	254	54	549	
7	12½	439.34	0.260	2.90	2.90	107	7	253	54	549	
6	15	441.75	0.255	2.84	2.84	109	7	252	53	548	
5	17½	444.16	0.210	2.34	2.34	109	6	250	55	546	
4	20	446.35	0.201	2.24	2.24	107	5	248	56	544	
3	22½	448.48	0.176	1.96	1.96	105	5	245	58	542	
2	25	450.50	0.148	1.65	1.65	103	4	249	61	536	
1	27½	452.40	0.122	1.36	1.36	101	3	253	63	531	
	60/0	454.075									

V_M	$(\sqrt{\Delta P})^2$	ΔH	T_M	T_S
52.675	.2184	2.46	99	543

F-1010
8/86

ENTROPY

PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name POTTERS EEI Ref. # 5639

Sampling Location FURNACE No. 2 MULTICLONE STACK

Date Received 9/2 Date Analyzed 9/9 Reagent Box(es) 0202

Run Number	1	2	3
Run Date	9/2	9/2	9/2

SUMMARY OF PARTICULATE ANALYSES

Sum of Particulate, mg.	553.4	536.8	558.9
Total Filter Tare mg.	502.8	469.9	478.1
Blank Residue, mg.	(150 mL) 0.3	(200 mL) 0.4	(125 mL) 0.3
TOTAL PARTICULATE CATCH, mg.	50.3	66.5	80.5

ANALYSIS OF MOISTURE CATCH

Reagent 1 (H_2O):			
Final Weight, g.	270.0	270.0	255.0
Tared Weight, g.	200.0	200.0	200.0
Water Catch, g.	70.0	70.0	55.0
Reagent 2 ( ):			
Final Weight, g.	—	—	—
Tared Weight, g.	—	—	—
Water Catch, g.	—	—	—
CONDENSED WATER, g.	70.0	70.0	55.0
Silica Gel:			
Final Weight, g.	225.5	227.0	231.5
Tared Weight, g.	200.0	200.0	200.0
ADSORBED WATER, g.	25.5	27.0	31.5
TOTAL WATER COLLECTED, g.	95.5	97.0	86.5

Blank Beaker # 2010
Final wt. mg. 102345.7
Tare wt. mg. 102345.3
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 POTTERS EEI Ref. # 5639

Run Number	1	2	3
Run Date	9/2	9/2	9/2
Sample ID/Container #	FLR 27	FLR 30	FLR 35
Tare Wt., g.	111.1396 ✓111.1391 111.1402 110.5857	✓109.8275 109.8275 109.8294 109.2907	✓99.6457 99.6458 99.6472 99.0868
SAMPLE WT., g.	0.5534	0.5368	0.5589
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 # 0802

Date of Makeup 8/13 Initials MAS 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 Potters Industries

SAMPLING LOCATION #2 Multiclone Outlet

Run Number	Date Used	Initials	Locked?	Date Cleanup	% S. Gel Spent	Initials	Locked
1	09.02.87	BFR	✓	09.02.87	70	BFR	✓
2	09.02.87	BFR	✓	09.02.87	70	BFR	✓
3	09.02.87	BFR	✓	09.02.87	80	BFR	✓

Received in Lab Date 9/2 Initials J.F.J. Locked? ✓

Zero & Span Balance Initials J.F.J.

Sampling Method: EPA Method 5

Remarks:

Filter #	Tare Weight (grams)	Used on Test
E5940	.5028	1
E5958	.4699	2
E5959	.4781	3

ENTROPY ENVIRONMENTALISTS, INC.

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 $\pm$ 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°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.

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. ($\bar{Y}_{ds}$)
0.30	2.924	82.4	2.906	81	0.40	10.00	0.2864	1.0026	
	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	
* 0.40	4.235	80.6	4.330	77	0.85	10.00	.4125	.9700	
	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	
0.50	5.328	78.8	5.206	75	1.10	10.00	.5271	1.0135	
	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	
* 0.80	8.288	81	8.216	79	2.65	10.00	.8067	.9985	
	8.397	82	8.214	80	2.65	10.00	.8058	1.0119	
	8.352	82.4	8.199	80	2.65	10.00	.8108	1.0075	
1.00	10.638	83.3	10.472	81	4.15	10.00	1.040	1.0014	
	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	

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

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

Dry Gas Meter Identification: 6836323 Calibration by: MH

Date: 3-16-82 Barometric Pressure (P_b): 30.12 in. Hg

ENTROPY ENVIRONMENTALISTS, INC.

*Date: 3-17-82 *Barometric Pressure (P_b): 29.85 in. Hg

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	0.9927	
	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	.9836	
	13.752	81.5	13.712	80	7.00	10.00	1.35	.9833	

$Y_{ds} = 1.0042$

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

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

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Meter Box Number: N6

Calibration by: T. McDonald

Standard Meter Number: 6838323 Standard Meter Gamma: 1.0042

Date: 8-13-87 Barometric Pressure (P_b): 29.42 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
4.145	74	10.0	0.50	4.108	78	1.0196	1.64
4.152	74	10.0	0.50	4.147	80	1.0154	1.63
8.077	74	10.0	2.1	8.276	83	0.9914	1.80
8.093	74	10.0	2.1	8.360	86	0.9888	1.78
12.056	75	10.0	4.8	12.467	88	0.9829	1.84
12.059	75	10.0	4.8	12.533	90	0.9816	1.83
					Average	0.9966	1.75

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

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

Meter Box Number: N6

Calibration by: TMS

Meter Box Vacuum: 7 in. Hg

Standard Meter Number: 6838323 Standard Meter Gamma: 1.0042

Date: 9-8-87 Barometric Pressure (P_b): 29.40 in. Hg

POSTTEST CALIBRATION

Standard Meter			Meter Box Metering System				
Gas Volume (V_{ds}) ft^3	Temp. (t_{ds}) °F	Time (s) 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
8.329	76	10	2.36	8.508	90	1.0028	1.90
8.320	76	10	2.36	8.554	93	1.0018	1.89
8.303	76	10	2.36	8.592	95	0.9989	1.90
					Average	1.0012	1.90

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

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

NOZZLE NUMBER: 512

Date	Initials	Dia. 1	Dia. 2	Dia. 3	Dia. 4	Dia. 5	Average
12-2-82	ST	.365	.364	.366	.365	.367	0.365
2-2-83	PLO	.370	.369	.369	.370	.368	0.369
6-7-83	NMH	.367	.363	.366	.367	.366	0.366
3-12-84	MAH	.374	.372	.372	.372	.373	0.373
3-25-85	JDE	.375	.375	.374	.373	.373	0.374
2-19-86	JE	.374	.376	.375	.374	.375	0.375
9-17-86	BTB	.375	.376	.377	.375	.376	.376
1/13/87	JE	.374	.376	.376	.375	.374	0.375
3/11/87	ST	.374	.374	.376	.375	.375	.375
3/20/87	SH	.374	.373	.372	.372	.372	0.373
4/21/87	JE	.370	.371	.373	.370	.373	.371

NOTE: All diameters measured in inches.

APPENDIX D

SAMPLING AND ANALYTICAL PROCEDURES