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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State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF ENVIRONMENTAL QUALITY
CN 027, TRENTON, N.J. 08625

JORGE H. BERKOWITZ, Ph.D.
DIRECTOR

(609) 292-5383

June 30, 1988

MEMORANDUM

TO: Don Patterson

FROM: Edward Choromanski

SUBJECT: New Jersey Pulverizing Company
Bagville, New Jersey
APC ID No. 78003
NJ Stack No. 001

Emission tests were conducted at the above referenced facility on the Drier Stack No. 1. The purpose of the tests was to determine the particulate emission rate and collection efficiency of the cyclone/scrubber system.

Doug Bruckman reviewed the final test report. His review indicates that the particulate collection efficiency of the control device did not meet the 99% collection efficiency stated on Permit No. P-77187, for all test runs. Although, Mr. Bruckman stated that the particulate emission rates were within the permit standards, further review indicates that the particulate emission standards exceeded the standards stated on Permit No. P-77187, during all test runs. The following chart represents the corrected outlet emissions.

RUN NO.	ACTUAL EMISSION RATE (LB/HR)	ALLOWABLE EMISSION RATE (LB/HR)
1	7.99	0.31
2	5.59	0.31
3	7.14	0.31

The amount of sand dried during the tests were within permit standards as verified by Central Regional Office personnel.

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DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF ENVIRONMENTAL QUALITY
CN 027, TRENTON, N.J. 08625

JORGE H. BERKOWITZ, Ph.D.
DIRECTOR

(609) 292-5383

June 21, 1988

MEMORANDUM

TO: Ed Choromanski

FROM: Douglas J. Bruckman

SUBJECT: New Jersey Pulverizing Company
Bayville, NJ
ID #78003 NJ Stack #001
Permit No. 77187

Stack tests were conducted at New Jersey Pulverizing in Bayville, NJ on November 19, 1987 by Weston Consultants of West Chester, Pa. The tests were conducted to determine outlet particulate emissions and also to determine compliance with the permit conditions - 99%-removal efficiency of control device.

The test results are as follows:

PARTICULATE

Run No.	Inlet Emission Rate * lbs/hr	Outlet Emission Rate lbs/hr	Allowable Emission Rate lbs/hr	Control Efficiency **	Required Control Efficiency
1	58.99	7.99	9.18	86.46%	99%
2	59.73	5.59	9.18	90.64%	99%
3	65.79	7.14	9.18	89.15%	99%

* The inlet E.R.is the sum of the cyclone catch rate plus the measured mass rate.

** Control Efficiency = $\frac{\text{E.R. scrubber inlet - E.R. outlet}}{\text{E.R. scrubber inlet}}$

Technical Services using the raw data supplied produced substantially the same results. The test results indicate that the particulate emissions were in compliance with the values on Permit No 77187. However the required control efficiency of 99% was not obtained during the test - 90.64% was the highest control efficiency demonstrated. Production data was taken during runs # 1 & 2. Note that production was operated at permitted conditions.

After reviewing the stack test report it was found necessary to require NJ Pulverizing to install an additional control device to achieve a minimum collection efficiency of 99%, as stated in the permit conditions.

Based on the reported emission test results, the following action is recommended.

1. Proper enforcement action i recommended since the source's particulate emission rate exceed Permit No. P-77187 standards during each test run.

2. Proper enforcement action is recommended since the particulate control efficiency was not within the requirements specified by Permit No. P-77187.

c Milt Polakovic
Louis Mikolajczyk
Harold Christiff
Joe DePierro
Doug Bruckman

WESTON
MANAGERS DESIGNERS CONSULTANTS

SOURCE EMISSIONS COMPLIANCE TEST REPORT SAND DRYER SYSTEM New Jersey Pulverizing Company Bayville, New Jersey

W.O.# 2373-01-02

JANUARY 1988

Jeffrey D. Ostrowski FOR RR
Roy Rakiewicz
Project Scientist

James C Serne FOR
Barry L. Jackson
Project Manager
Air Quality Testing Services

Prepared by:
ROY F. WESTON, INC.
Weston Way
West Chester, PA 19380
(215) 692-3030

Edward J. Stanek

NJP001B.RPT

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SUMMARY

New Jersey Pulverizing Company (NJPCO) contracted Roy F. Weston, Inc. (Weston) to conduct a source compliance testing and analysis program on the Sand Dryer Wet Scrubber located at its Bayville, New Jersey Plant.

The Primary objective of the survey was to determine particulate mass rates and concentrations entering and exiting the scrubber in order to establish the collection efficiency of the control device for comparison with applicable New Jersey Department of Environmental Protection (NJDEP) air pollution regulations. A series of three simultaneous wet scrubber inlet and outlet (stack) particulate tests was conducted. Material collected by the cyclone separator located between the dryer exhaust and scrubber was captured, retained and weighed to establish mass rates exiting the sand dryer.

Particulate emission compliance test results are summarized in Table 1. Detailed test data and test results are provided in Tables 2 and 3 in the test results and discussion section of the report.

All testing procedures conformed to the U.S. Environmental Protection Agency (EPA) and NJDEP protocols.

NEW JERSEY PULVERIZING COMPANY
BAYVILLE, NEW JERSEY

TABLE 1

SUMMARY OF TEST RESUTS FOR
SAND DRYER SCRUBBER

LOCATION	RUN	TEST DATE	TEST PERIOD	MEASURED GR/DSCF[1]	LBS/HR[2]	NJDEP[3] ALLOWABLE REMOVAL EFFICIENCY PERCENT	SCRUBBER PARTICULATE REMOVAL EFFICIENCY PERCENT
INLET							
	1	11-19-87	1137-1420	0.102	59.0	____	____
	2	11-19-87	1729-1842	0.071	59.7	____	____
	3	11-19-87	2115-2244	0.076	65.8	____	____
		SERIES AVG.		0.083	61.4		
OUTLET							
	1	11-19-87	1135-1415	0.038	7.99	99.00	86.5 %
	2	11-19-87	1729-1842	0.026	5.59	99.00	90.6 %
	3	11-19-87	2115-2244	0.033	7.14	99.00	89.2 %
		SERIES AVG.		0.032	7.04	--	88.8 %

1 Standard conditions = 70 deg. F. (21.1 deg. C.) and 29.92 inches Hg (760mm Hg) gr/dscf = grains per dry standard cubic foot at standard conditions

2 The inlet lbs/hr mass rate was obtained by adding the cyclone catch rate (lbs/hr) and measured mass rate (lbs/hr) between the cyclone and scrubber to obtain a total dryer exit mass rate (lbs/hr)

3 Scrubber particulate removal efficiency must be $\geq$ 99.0 % to demonstrate compliance with DEP regulations

INTRODUCTION

NJPCO contracted WESTON to conduct a source compliance testing and analysis program on the Sand Dryer Wet Scrubber located at its Bayville, New Jersey Plant.

The primary objective of the program was to determine the particulate emissions compliance status of the source relevant to NJDEP regulations.

Simultaneous particulate tests utilizing NJDEP Air Test Method 1[1] were performed on the scrubber inlet and outlet locations during the day of 19 November 1987 by WESTON Air Quality Testing Services personnel.

The compliance test results are summarized in Table 1 in the Summary section. Detailed test data and test results summaries are presented in Tables 2 and 3 of this report in the Test Results and Discussion Section.

Descriptions of the sand dryer process, test locations, test equipment, test procedures, sample recovery techniques and analytical methods used during the survey are also included herein. Raw test data, laboratory reports, sample calculations, equipment calibration records and a list of WESTON project participants are provided in Appendices A through F respectively.

[1] N.J.A.C. 7:27B-1, Air Test Method 1, "Sampling and Analytical Procedures for Determining Emissions of Particles from Manufacturing Processes and from Combustion of Fuels".

DESCRIPTION OF PROCESS

The source is a rotary sand and gravel dryer that is fired directly by natural gas (primary fuel) or No. 2 fuel oil. The unit is designed to produce 31.25 tons per hour (62,500 lbs/hr) of sand and gravel on a continuous basis. The dried material is then packaged and prepared for shipment.

Particulate emissions from the dryer are controlled by a cyclone and wet scrubber in series.

DESCRIPTION OF TEST LOCATIONS

Sand Dryer Scrubber Inlet

Two 4" ID test ports were placed 90° apart on a horizontal section of circular 32" diameter duct work leading to the scrubber.

Tests ports were located on the 32" ID duct 8 diameters from the nearest upstream disturbance and at least 2 stack diameters from the nearest downstream disturbance. Criteria for traverse point location as dictated by New Jersey Air Test Method 1 required a minimum of 12 traverse points, six per port axis for this duct configuration. Figure 1 illustrates the test port and sampling point locations.

Sand Dryer Scrubber Outlet

Two test ports, 90° apart, were located on the 35 1/2" ID exhaust stack at a site which was 8 diameters from the nearest upstream flow disturbance (scrubber) and greater than 2 diameters from the downstream stack discharge disturbance. Criteria for traverse point location as dictated by New Jersey Air Test Method 1 required a minimum of twelve traverse points, six per port axis, for this stack configuration. Figure 2 illustrates the test port and sampling port locations.

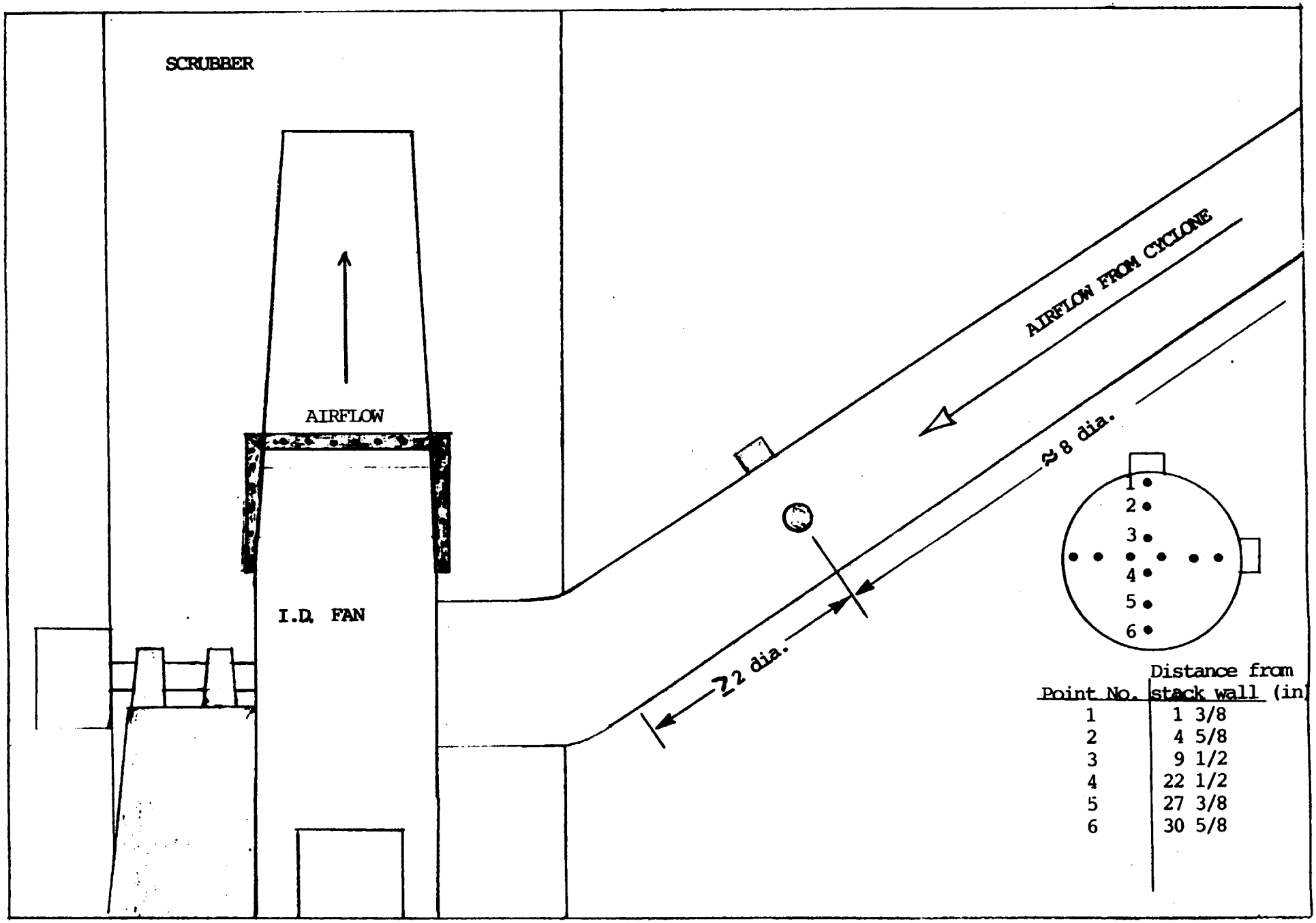
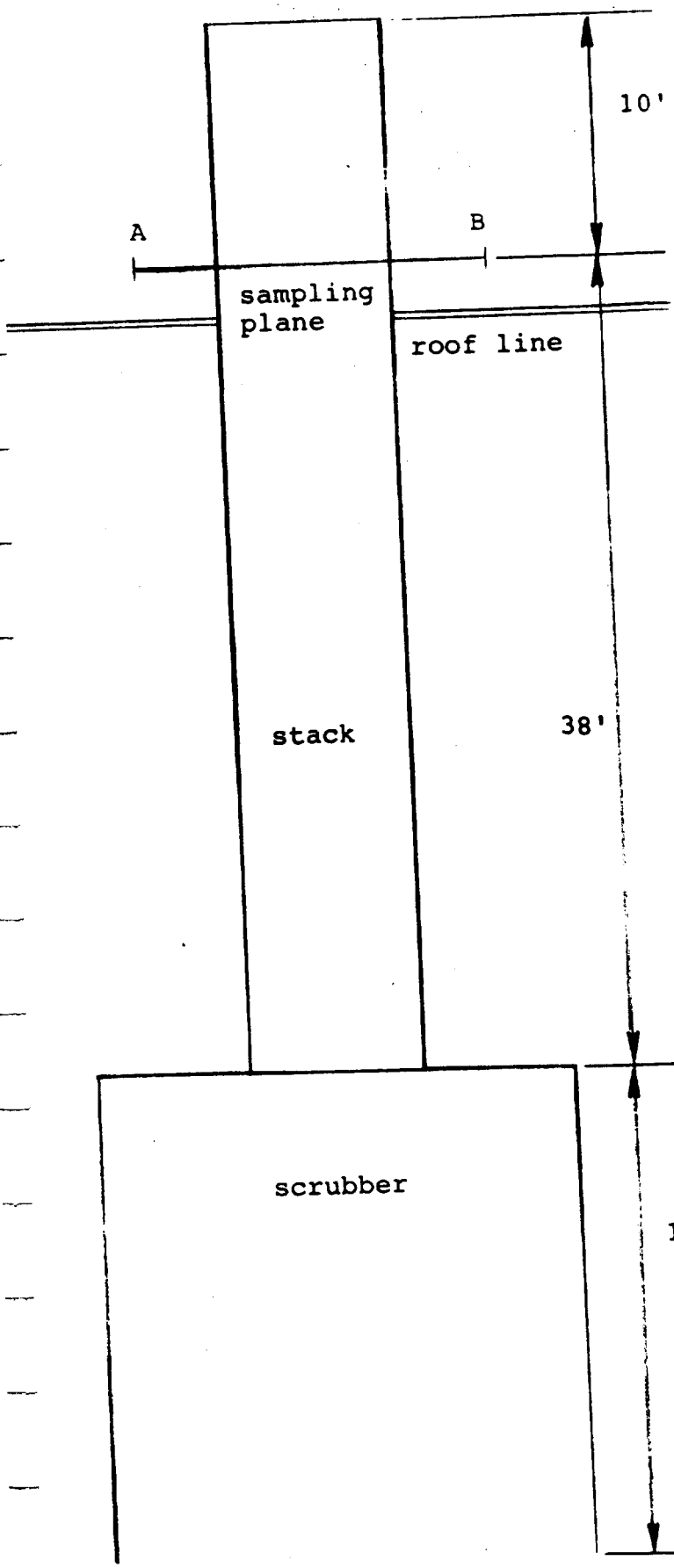
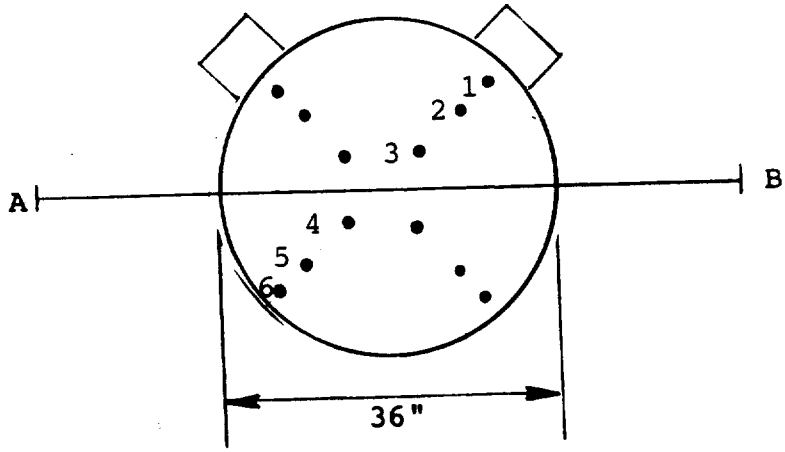


FIGURE 1
TEST PORT AND POINT
LOCATION FOR SCRUBBER
INLET LOCATION





Point No.	Distance from Stack wall (in)
1	1 5/8
2	5 1/8
3	10 1/2
4	25
5	30 3/8
6	33 7/8

FIGURE 2: Test Port and Point Location for Scrubber Outlet location

Note: Stack height dimensions are approximate.

DESCRIPTION OF SAMPLING TRAIN

Particulate

The sampling train utilized to perform the particulate sampling at the outlet location was a New Jersey Air Test Method 1 train (See Figure 3). The inlet train used was an EPA Method 5 train modified to include an in-stack thimble and a section of Teflon tubing between the filter holder and first impinger. (See Figure 4).

At the outlet location a calibrated stainless steel nozzle was attached to a heated ($\leq$ 225°F) 4 ft. borosilicate probe. The probe was connected to a heated ($\leq$ 225°F) borosilicate filter holder containing a 9-cm Reeve Angel 934 AH glass fiber filter (preweighed to a constant 0.1 mg weight). At the inlet location a section of flexible Teflon tubing was inserted between the filter holder and first impinger and an in-stack glass fiber thimble was added between the nozzle and probe to collect the bulk of heavy particulate.

Flue gas velocity was measured by using a calibrated "S" type pitot tube (provided with extensions) fastened alongside the sampling probe. Flue gas temperature was monitored with a calibrated direct readout pyrometer equipped with a chromel alumel thermocouple positioned near the sampling nozzle. Probe exit and filter exit gas temperatures were monitored at the outlet location with a calibrated direct readout pyrometer equipped with chromel-alumel thermocouple positioned in the sample gas stream after the probe but before the filter and after the filter, respectively.

Stack gas stream composition (carbon dioxide, oxygen, and carbon monoxide content) was determined utilizing a bag sampler and an Orsat apparatus to analyze integrated samples of the flue gases for each test. The integrated samples of the flue gases were collected at a constant rate of 0.8 liter per minute at each sample point. Triplicate Orsat analyses were performed on each sample.

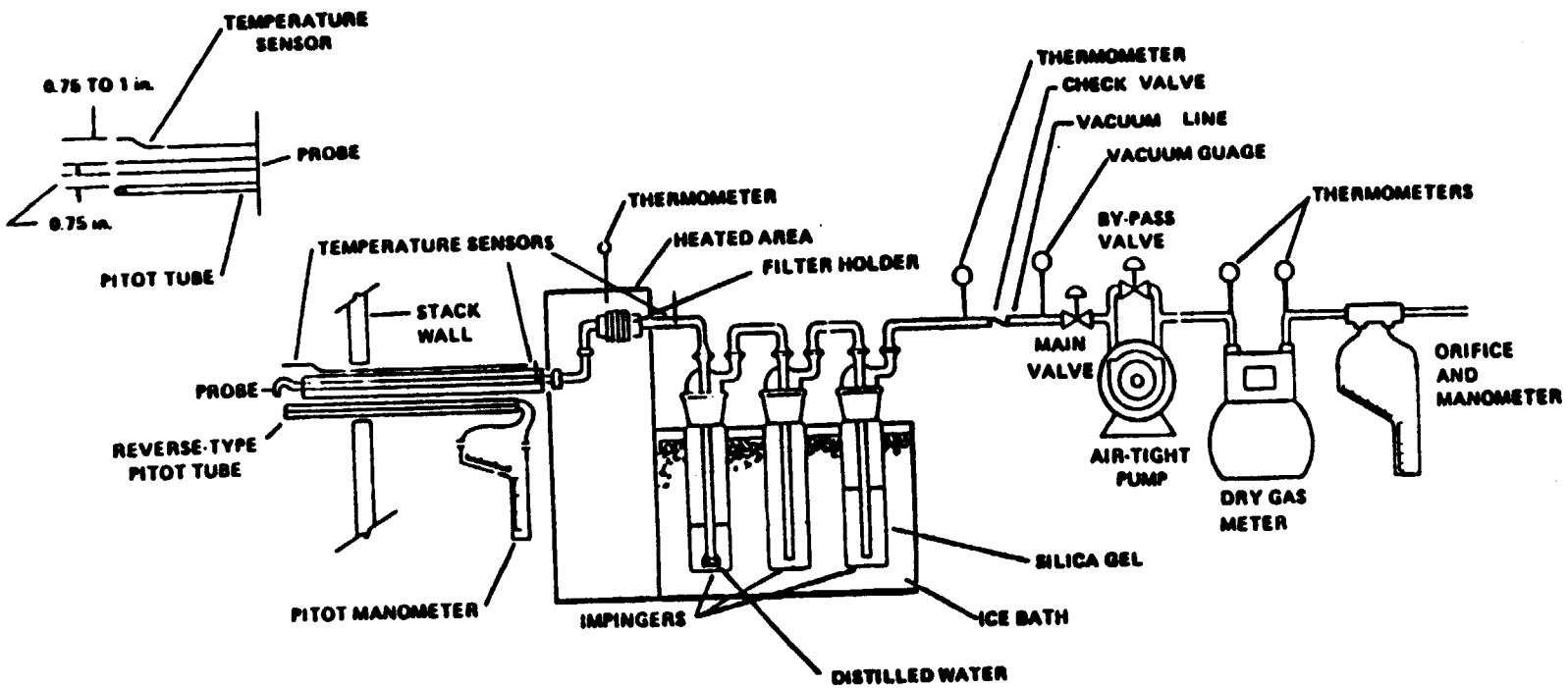


FIGURE 3 PARTICULATE SAMPLING TRAIN

N.J. Air Test Method 1

Outlet Location

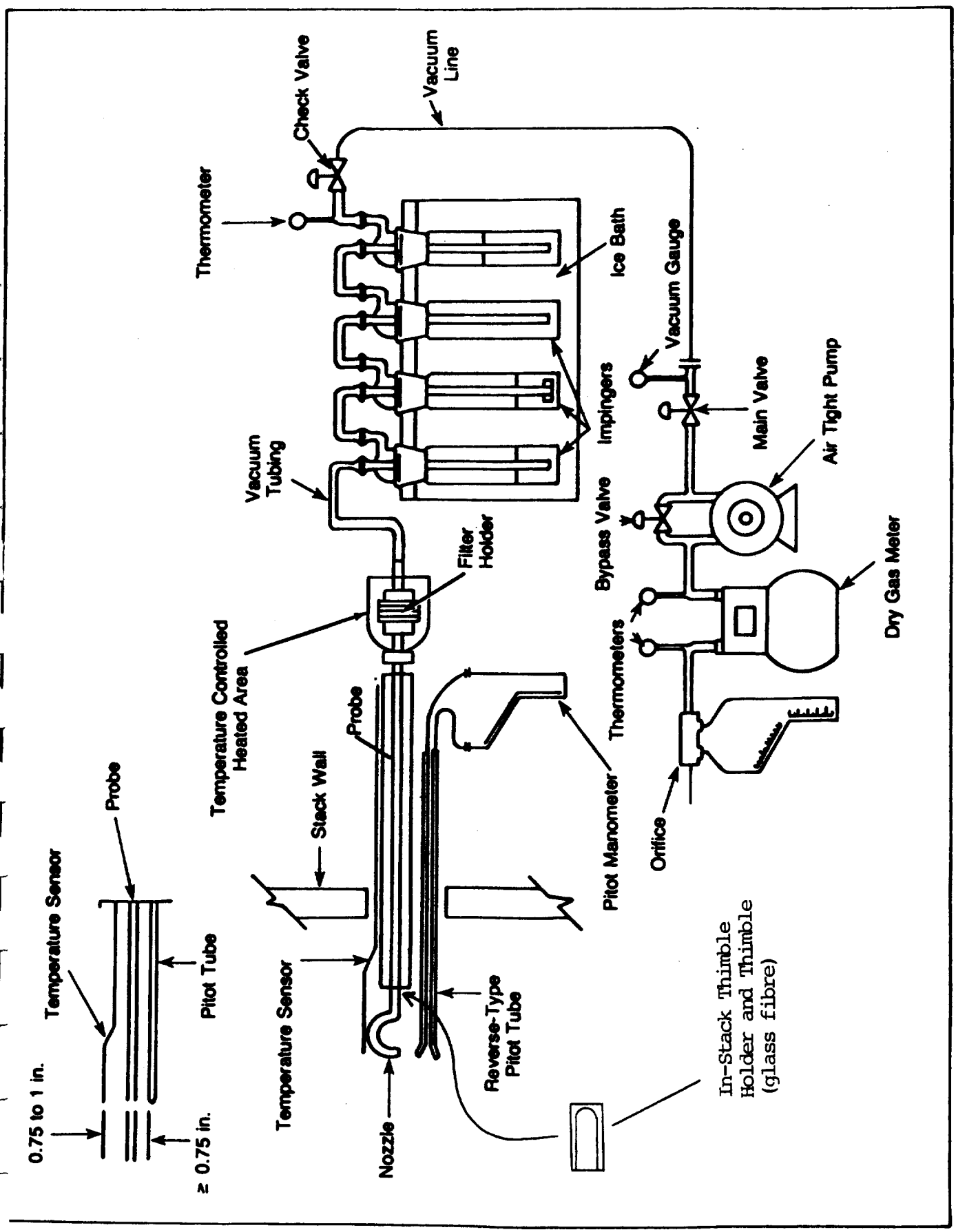


FIGURE 4: PARTICULATE SAMPLING TRAIN
INLET LOCATION ERM #5

TEST PROCEDURES

Preliminary Tests

Preliminary test data were obtained at the scrubber inlet and stack test locations. Stack geometry measurements were recorded, and traverse point distances calculated. A preliminary velocity traverse was performed at each location to determine velocity profiles using a calibrated S-type pitot tube and a Dwyer inclined manometer. Flue gas temperatures were observed with a calibrated direct readout pyrometer equipped with a chromel-alumel thermocouple. Water vapor content was measured utilizing EPA Method 4 procedures at the scrubber inlet. The scrubber outlet percent water vapor was determined by the saturation temperature of the gas stream using a psychometric chart. A check for the presence or absence of cyclonic flow was conducted at both locations prior to formal testing. The cyclonic flow check at both test sites proved to be negative ($\theta < 20^{o}$), verifying the suitability of the test sites for obtaining representative samples.

Calibration of probe nozzles, pitot tubes, metering systems, and temperature gauges was performed according to EPA Method 5[2] and NJDEP procedures. (See Appendix D for calibration records.)

[2]"Standards of Performance for New Stationary Sources, "Code of Federal Regulations", Title 40, Part 60, Appendix A, as amended.

Formal Tests

A series of three simultaneous particulate test runs was conducted on the Sand Dryer scrubber inlet and stack locations.

Test period length for each particulate test run at both locations was 60 minutes. A total of 12 traverse points were sampled for five minutes each at the inlet location. Twelve traverse points were sampled for five minutes each at the stack location also.

During particulate sampling, gas stream velocities were measured by inserting a calibrated "S" type pitot tube into the gas stream adjacent to the sampling nozzle. The velocity pressure differential was observed immediately after positioning the nozzle at each point, and the sampling rate adjusted to maintain isokineticity. Stack gas temperature was monitored at each point with a pyrometer and thermocouple. Temperature readings of the probe exit, filter exit, final impinger and dry test meter gas stream were also recorded. Leak checks were performed on each apparatus according to NJ Air Test Method One instructions, prior to and following each run.

A constant rate integrated sampling technique was employed to collect flue gas samples at each particulate traverse point for the molecular weight determination using an Orsat analyzer. The sampling train was operated for 5 minutes with the Tedlar bag disconnected to purge extraneous gases during each test.

During each test period, particulate captured by the cyclone separator was transferred to tared containers and weighed. The weights were converted to a lbs/hr collection rate, and added to the measured lbs/hr emission rate measured at the scrubber inlet. The resulting dryer exit emission rate was used to calculate the system collection efficiency (see Appendix C - sample calculations).

ANALYTICAL PROCEDURES

Particulate Sample Recovery

At the conclusion of each test run, the sampling train was dismantled, the openings sealed and the components transported to the field laboratory. A complete chain-of-custody record for the samples was maintained from this point forward.

A consistent procedure was employed for sample recovery:

1. The preweighed glass fiber filter was removed from its holder with tweezers and placed in its original container (pertri dish) along with any loose particulates and filter fragments. The inlet pre-weighed glass fiber thimble was removed from the thimble holder with tweezers and placed on its original container (500 ml amber glass jar).

2. The particulate adhering to the internal surfaces of the nozzle, probe, inlet thimble holder and front-half of the filter holder was rinsed with acetone into a borosilicate container while brushing a minimum of three times until no visible particulate remained. Particulate adhering to the brush was rinsed with acetone into the same container. The container was sealed with a Teflon-lined closure (sample type 2).

3. The total volume of liquid in impingers 1 and 2 was measured to the nearest milliliter, the value recorded and the impinger contents were discarded.

4. The silica gel was removed from the last impinger and immediately weighed to the nearest tenth gram. The weight gain was recorded.

5. An acetone blank sample was placed into a borosilicate/Teflon container for gravimetric analysis.

Each container was labeled to clearly identify its contents. The height of the fluid level was marked on the container of each sample to determine if leakage had occurred during transport. All samples were placed in a locked shipping crate, then transported to the WESTON laboratories for analysis.

Particulate Analysis

Gravimetric analysis of the partiuclate samples was performed as follows:

1. The filters (sample type 1) and any loose fragments were heated to 220-230°F for 2 to 3 hours, cooled in a dessicator to room temperature and weighed to a constant weight (± 0.5 mg) to the nearest 0.1 mg.

2. The front-half acetone wash samples (sample type 2) and an acetone blank were transferred to tared 250 ml beakers, and evaporated to dryness at ambient temperature and pressure. The samples were then heated to 220-230°F for 24 hours, and weighed to a constant 0.1 mg weight. Final front-half wash residue weights were determined by correcting for the acetone blank factor.

The weight of the material collected on the glass fiber filter (and thimble of the inlet train) plus the residue weight of the acetone wash sample yields the total front half weight which was used to calculate the particulate emission results.

TEST RESULTS AND DISCUSSION

A summary of compliance test results is presented in Table 1, page 2 of this report. Detailed test data and test results summaries are included in Tables 2 and 3 of this section.

All test data and test results shown herein are believed to be representative of process emissions encountered during the survey periods. Representatives of NJDEP were present during all sampling periods to witness the tests.

Run 1 at the scrubber inlet was stopped at 1201 due to a power loss but was restarted at 1234 and run to completion. Run 1 of the scrubber outlet was also halted due to the loss of power. It was stopped at 1157 and resumed at 1230 for completion.

The sample volume on run 1 of the scrubber inlet was less than 30 dscf as required by NJATM 1. Approval for a sample volume of less than 30 dscf was given by the NJDEP observers on site due to the expected high particulate loading at this test location. Although the loading was not as high as expected, sufficient particulate was collected to calculate a grain loading and mass emission rate for this run. The nozzle size was adjusted upward on runs 2 and 3.

During all test periods, the measured particulate removal efficiency of the collection system was below the state minimum allowable removal efficiency of 99.0 percent. The average removal efficiency for the three test runs was 88.8 %; the range was 86.5% to 90.6%

NEW JERSEY PULVERIZING
BAYVILLE, NEW JERSEY
TABLE 2
SUMMARY OF PARTICULATE RESULTS

TEST DATA:	1	2	3
	SCRUBBER INLET		
Test run number	11-19-87	11-19-87	11-19-87
Test location	1137-1420	1729-1842	2115-2244
Test date			
Test time period			
SAMPLING DATA:			
Sampling duration, min.	60.0	60.0	60.0
Nozzle diameter, in.	0.120	0.175	0.175
Cross sectional nozzle area, sq.ft.	0.000079	0.000167	0.000167
Barometric pressure, in. Hg	30.31	30.31	30.31
Avg. orifice press. diff., in H2O	0.30	1.74	1.65
Avg. dry gas meter temp., deg F	59	55	55
Avg. abs. dry gas meter temp., deg. R	519	515	515
Total liquid collected by train, ml	33.0	72.5	74.5
Std. vol. of H2O vapor coll., cu.ft.	1.6	3.4	3.5
Dry gas meter calibration factor	1.002	1.002	1.002
Sample vol. at meter cond., dcf	18.591	43.235	43.951
Sample vol. at std. cond., dscf (1)	19.270	45.338	46.052
Percent of isokinetic sampling	104.2	97.4	104.2
GAS STREAM COMPOSITION DATA:			
CO2, % by volume, dry basis	0.0	0.0	0.0
O2, % by volume, dry basis	18.4	18.4	18.4
CO, % by volume, dry basis	0.0	0.0	0.0
N2, % by volume, dry basis	81.6	81.6	81.6
Molecular wt. of dry gas, lb/lb mole	28.74	28.74	28.74
H2O vapor in gas stream, prop. by vol.	0.075	0.070	0.071
Mole fraction of dry gas	0.925	0.930	0.929
Molecular wt. of wet gas, lb/lb mole	27.9	28.0	28.0
GAS STREAM VELOCITY AND VOLUMETRIC FLOW DATA:			
Static pressure, in. H2O	-5.40	-6.00	-5.85
Static pressure, in. Hg	-0.397	-0.441	-0.430
Absolute pressure, in. Hg	29.91	29.87	29.88
Avg. temperature, deg. F	105	103	103
Avg. absolute temperature, deg.R	565	563	563
Pitot tube coefficient	0.84	0.84	0.84
Total number of traverse points	12	12	12
Avg. gas stream velocity, ft./sec.	75.4	88.6	84.1
Stack/duct cross sectional area, sq.ft.	5.59	5.59	5.59
Avg. gas stream volumetric flow, wacf/min.	25300	29700	28200
Avg. gas stream volumetric flow, dscf/min.	21900	25900	24600
LABORATORY REPORT:			
Particulate			
Front half acetone rinse, g	0.11190	0.18220	0.21270
Filter, g	0.00000	0.00000	0.00000
Thimble, g	0.01510	0.02760	0.01530
Total catch, g	0.12700	0.20980	0.22800
CYCLONE CATCH:			
Time, hours	2.72	1.22	1.48
Total sand, lbs	108.5	53.5	73.5
Cyclone catch rate, lbs/hr	39.89	43.85	49.66
PARTICULATE EMISSIONS:			
Concentration, gr/dscf	0.1017	0.0714	0.0764
Mass rate, lbs/hr	19.10	15.88	16.13
Scrubber inlet loading, lbs/hr (2)	58.99	59.73	65.79

(1) Standard conditions = 70 deg. F. (21.1 deg. C.) and 29.92 inches Hg (760 mm Hg)
(2) Scrubber inlet loading = cyclone catch rate + measured mass rate (both in lbs/hr)

NEW JERSEY PULVERIZING
BAYVILLE, NEW JERSEY
TABLE 3
SUMMARY OF PARTICULATE RESULTS

TEST DATA:			
Test run number	1	2	3
Test location		SCRUBBER OUTLET	
Test date	11-19-87	11-19-87	11-19-87
Test time period	1135-1415	1729-1842	2115-2244
SAMPLING DATA:			
Sampling duration, min.	60.0	60.0	60.0
Nozzle diameter, in.	0.185	0.185	0.185
Cross sectional nozzle area, sq.ft.	0.000187	0.000187	0.000187
Barometric pressure, in. Hg	30.31	30.31	30.31
Avg. orifice press. diff., in H2O	1.37	1.38	1.44
Avg. dry gas meter temp., deg F	67	56	57
Avg. abs. dry gas meter temp., deg. R	527	516	517
Total liquid collected by train, ml	61.0	61.0	67.3
Std. vol. of H2O vapor coll., cu.ft.	2.9	2.9	3.2
Dry gas meter calibration factor	0.997	0.997	0.997
Sample vol. at meter cond., dcf	37.720	38.418	39.818
Sample vol. at std. cond., dscf (1)	38.447	39.959	41.345
Percent of isokinetic sampling	96.4	97.8	99.7
GAS STREAM COMPOSITION DATA:			
CO2, % by volume, dry basis	0.0	0.0	0.0
O2, % by volume, dry basis	18.5	18.4	18.5
CO, % by volume, dry basis	0.0	0.0	0.0
N2, % by volume, dry basis	81.5	81.6	81.5
Molecular wt. of dry gas, lb/lb mole	28.74	28.74	28.74
H2O vapor in gas stream, prop. by vol.	0.070	0.067	0.072
Mole fraction of dry gas	0.930	0.933	0.928
Molecular wt. of wet gas, lb/lb mole	28.0	28.0	28.0
GAS STREAM VELOCITY AND VOLUMETRIC FLOW DATA:			
Static pressure, in. H2O	-0.48	-0.79	-0.60
Static pressure, in. Hg	-0.036	-0.058	-0.044
Absolute pressure, in. Hg	30.27	30.25	30.27
Avg. temperature, deg. F	100	96	95
Avg. absolute temperature, deg.R	560	556	555
Pitot tube coefficient	0.84	0.84	0.84
Total number of traverse points	12	12	12
Avg. gas stream velocity, ft./sec.	66.6	67.6	68.8
Stack/duct cross sectional area, sq.ft.	6.87	6.87	6.87
Avg. gas stream volumetric flow, wacf/min.	27400	27900	28400
Avg. gas stream volumetric flow, dscf/min.	24500	25100	25400
LABORATORY REPORT:			
Particulate			
Front half acetone rinse, g	0.08040	0.05818	0.07269
Filter, g	0.01450	0.00920	0.01500
Total catch, g	0.09490	0.06738	0.08769
PARTICULATE EMISSIONS:			
Concentration, gr/dscf	0.0381	0.0260	0.0327
Mass rate, lbs/hr	7.99	5.59	7.14
Scrubber inlet loading, lbs/hr	58.99	59.73	65.79
COLLECTION EFFICIENCY:			
Percent efficient	86.46	90.64	89.15

(1) Standard conditions = 70 deg. F. (21.1 deg. C.) and 29.92 inches Hg (760 mm Hg)

$$CE = \frac{E.R.\ inlet - E.R.\ outlet}{E.R.\ inlet}$$

CLIENT: NJ Pulverizing
FACILITY: BAYVILLE NJ
TEST LOCATION: SCRUBBER INLET
TEST RUN NO.: 1 2 3
TEST DATE: 11/19/87

ROY F. WESTON, INC.

EMISSION TEST DATA/REPORT
QA/QC CHECK LIST

	Initial Data Averages	Data Check 1	Data Check 2 (if req'd)	Data Completeness Check
Raw Test Data	RR	MG	MG	✓
	Initial Lab Calculator	**Check 1**	**Check 2 (if req'd)**	**Data Completeness Check**
Laboratory Data	MT	MG	WS	✓
	Initial Calculator	**Check 1**	**Check 2 (if req'd)**	**Reasonableness Check**
Test Result Calculations	RR	MG	WS	✓
	Author	**Check 1**	**Check 2 (if req'd)**	**Completeness Reasonableness Check**
Test Data Tables	RR	MG	MG	✓
	Author	**Check 1**	**Check 2 (if req'd)**	**Table of Contents, Figure, page number Check**
Report Body	WS/RR	RR	RR/BJ 2:00	✓
	Originator	**Check 1**	**Check 2 (if req'd)**	
Appendices Completeness	RR	JDO		

Compilation Check: ✓ Page alignment and completeness

Draft Report ✓
(if required)
Final Report 1/22/88

Date provided to Client: 1/22/88

Final Report Review: PD _____
PM _____
SM/DM _____

etdr10.24

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT New Jersey Pulverizing
DATE 11/18/87
SAMPLING LOCATION SCRUBBER INLET
INSIDE OF FAR WALL TO OUTSIDE OF PORT. (DISTANCE A) 36"
INSIDE OF NEAR WALL TO OUTSIDE OF PORT. (DISTANCE B) 4"
STACK I.D.. (DISTANCE A - DISTANCE B) 32"
NEAREST UPSTREAM DISTURBANCE ≥ 2"
NEAREST DOWNSTREAM DISTURBANCE ≥ 8"
CALCULATOR RAKIEWICZ

SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1 8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF PORT (SUM OF COLUMNS 4 & 5)
1	.044	32	1 3/8	4"	5 3/8
2	.146	32	4 5/8	4	8 5/8
3	.296	32	9 1/2	4	13 1/2
4	.704	32	22 1/2	4	26 1/2
5	.854	32	27 3/8	4	31 3/8
6	.956	32	30 5/8	4	34 5/8

GAS VELOCITY AND VOLUME DATA FORM

Plant N. J. Pulverizing Location INLET
Date 11/18/87 Run no. 1 24-hr. clock time 1500
Operators _____ Stack diameter or dimensions, in 32"
Barometric pressure, in. Hg 30.04 Cross sectional area, ft.^{2} 5.585
Pitot tube identification no. _____ Cp .84

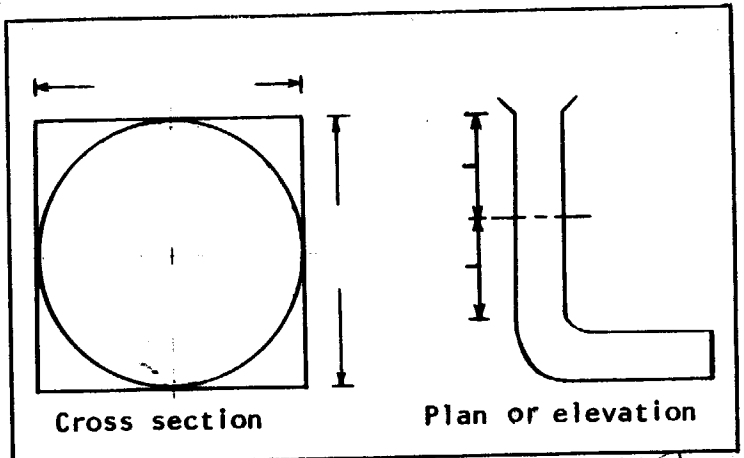
Traverse Point Number	Velocity head (Δp), in. H_2O	Stack Temperature (T_s), ^oF.	Static pressure (P_{static}) in. H_2O	Cyclonic flow determination: Δp at 0° reference	Cyclonic flow determination: Angle (α) which yields a null Δp
1	2.10	121	-5.6		
2	2.20	119		0	
3	2.30	117	-5.7		
4	2.60	115		0	
5	2.60	115			
6	2.0	115			
1	1.7	108			
2	2.2	114		0	
3	2.5	114	-5.7		
4	2.5	115		0	
5	2.1	115			
6	1.8	115			
		8.5% 28.97	M Mwd		
AVG =	2.22				
AVG STAT =	-5.67				
AVG TEMP =	115.25				
		Dn = .175			
				.12 Nozzle	
	FM	K	Nozzle	Tw	K =
	65	.79		60	.175
	60	.78	.77	65	.178
	55	.77		70	.179
	70	.80			
	75	.80			
	Avg. $\sqrt{\Delta p}$	Avg. T_s	Avg. P_{static}		Avg. α [a]

[a] Must be <10 degrees to be acceptable.

PARTICULATE ... DATA FORM

Sheet 1 of 1

Plant NEW JERSEY PULV
City BAYVILLE NJ
Location SCRUBBER INLET
Operator RAKIEWICZ
Run No. 1 Date 11/19/87
Ambient temp., °F
Baro. press. (P_b), in. Hg. 30.31
Sample box no.
Meter box no. Nutech 6
Meter box ΔH@ 1.784
Meter box cal. (Y) 1.002
Probe length, ft. 4
Probe liner material boro
Probe heater setting



Test point schematic

Pitot tube identification no. P-7
Pitot tube cal. factor (C_p) .84
Nozzle identification no. [redacted] NL-9
Avg. nozzle diameter (D_n), in. .175 .120
Pyrometer identification no. NUTECH 6
Thermocouple identification no.
Assumed moisture, % 8.5
Assumed temperature, °F. 115
Static pressure (Pstatic), in. H_2O -54
C factor ___ Reference Δp
Initial leak rate .015 cfm @ 15 in. Hg
Final leak rate .019 cfm @ 3 in. Hg
Filter no. 9377 9347
Comments:
Thimble # T19
K=.175 Pitot tube l.c. good

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, $ft.^3$	Dry gas meter temperature (Tm) Inlet °F.	Dry gas meter temperature (Tm) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0	1137			450.030						
1	5		1.90	.33	451.8	61	61	105	3	56	200
2	10		1.90	.33	453.2	61	61	107	3	51	180
3	15	.182	2.3	.42	455.1	62	62	103	3	49	225
4	20		2.4	.44	457.3	61	63	107	3	48	225
5	25	1201*	2.0	.36	459.5	62	63	101	3	49	215
6	30		1.5	.27	460.335	60	61	97	3	49	225
	0	1347			461.05@						
1	5		1.0	.18	462.00	57	57	109	2	54	225
2	10		1.5	.273	463.7	57	57	109	2	49	225
3	15		1.7	.31	466.0	58	59	105	2.9	53	220
4	20		1.4	.26	467.5	57	57	115	2.5	47	210
5	25	.181	1.2	.22	468.4	57	57	101	2.0	48	210
6	30	1420	1.1	.20	469.344	56	57	97	2.0	48	213
			Restart	at							
	Total θ	1137-1420	Avg. $\sqrt{\Delta P}$ 1.276466	Avg. ΔH 0.29858	Total V_m 18.591	Avg. T_m 59.3		Avg. T_s 104.8	Max. vac. 3	Max. temp. 56	Min. 180 Max. 225

Comments:

* Stopped test due to power loss @ outlet
Restart @ 1234

SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant N.J. Pulverize — Sample date 11/19/87

Sample location Inlet — Run number 1

Sample recovery person RR/DM — Recovery date 11/19

Filter(s) number 9344, 9347, T19

MOISTURE

Impingers		Silica gel		
	118 / 102			
Final volume (wt)	220 ml (g)	Final wt	263.0 g	g
Initial volume (wt)	200 ml (g)	Initial wt	250.0 g	g
Net volume (wt)	20 ml (g)	Net wt	13.0 g	g
Total moisture	33 g			

Color of silica gel 50% Pink 50% Blue

Description of impinger water Clear

RECOVERED SAMPLE

Blank filter container number INL-THB-001A, B — Sealed

Filter container number — Sealed

Description of particulate on filter LIGHT

Acetone rinse container number INL-FHA-001 — Liquid level marked?

Acetone blank container number — Liquid level marked?

Samples stored and locked

Remarks

Date of laboratory custody

Laboratory personnel taking custody

Remarks

SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant NJ Refinery Sample date 11/14/87

Sample location INLET Run number 2

Sample recovery person RAKIEWICZ Recovery date 11/14/87

Filter(s) number 9379, 15

MOISTURE

Impingers			Silica gel		
Final volume (wt)	258.5 ml (g)		Final wt	264 g	g
Initial volume (wt)	200 ml (g)		Initial wt	250 g	g
Net volume (wt)	58.5 ml (g)		Net wt	14 g	g
Total moisture	72 g				

Color of silica gel 90% blue, 10% pink

Description of impinger water

RECOVERED SAMPLE

Blank filter container number INL-VBA002 Sealed

Filter container number INL-THB-002 A, B Sealed ✓

Description of particulate on filter

Acetone rinse container number INL-FHA-002 Liquid level marked? ✓

Acetone blank container number Liquid level marked?

Samples stored and locked

Remarks

Date of laboratory custody

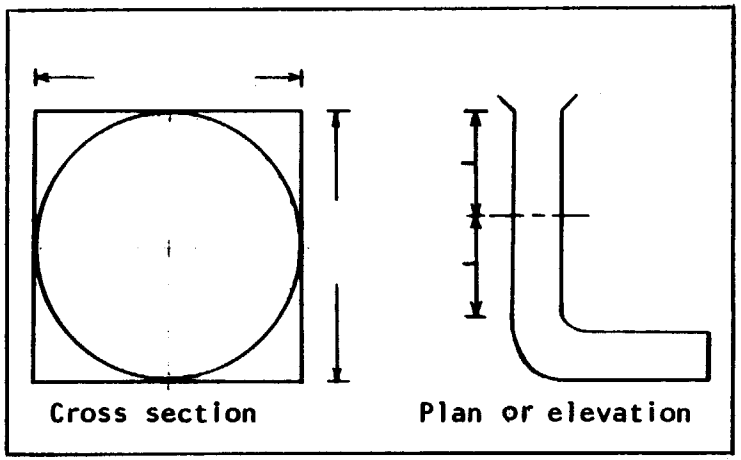
Laboratory personnel taking custody

Remarks

PARTICULATE F _D DATA FORM

Sheet ___ of ___

Plant NS Pulverizers
City Bayville PA
Location INLET
Operator RANIEWICZ
Run No. 3 Date 11/19/87
Ambient temp., °F
Baro. press. (P_b), in. Hg. 30.31
Sample box no.
Meter box no. NUTECH 6
Meter box ΔH@ 1.784
Meter box cal. (Y) 1.002
Probe length, ft. 4
Probe liner material borosilicate
Probe heater setting



Test point schematic

Pitot tube identification no. P-7
Pitot tube cal. factor (C_p) .84
Nozzle identification no. N-12
Avg. nozzle diameter (D_n), in. .175
Pyrometer identification no. NUTECH 6
Thermocouple identification no.
Assumed moisture, % 6
Assumed temperature, °F. 103
Static pressure (P_{static}), in. H_2O -5.85
C factor ___ Reference Δp
Initial leak rate .016 cfm @ 15 in. Hg
Final leak rate .018 cfm @ 7 in. Hg
Filter no. 9360 T-9
Comments: pitot tube I.C. good

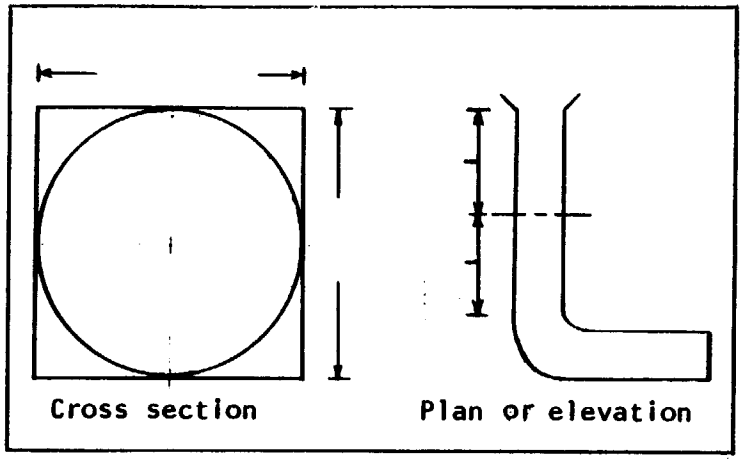
Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, $ft.^3$	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.	
	0	2115			512.929							
1	5		2.1	1.62	517.0	51	52	103	5.5	47	170	
2	10		2.3	1.86	521.4	52	55	112	6.2	47	180	
3	15		2.6	2.12	525.3	53	58	95	7.0	45	220	
4	20		2.6	2.12	527.8	54	59	98	7.0	43	224	
5	25		2.2	1.70	533.2	54	60	94	6.8	45	220	
6	30	2145	1.3	1.05	535.201	55	60	93	4.8	45	200	-3.5
	0	2206			535.510							
1	5	*	1.6	1.31	539.2	54	54	105	5.1	48	200	
2	10		2.2	1.80	542.0	54	56	106	6.5	42	202	
3	15		2.4	1.96	546.4	55	58	106	6.5	45	204	-6.2
4	20	**	2.0	1.64	551.5	54	57	106	6.0	42	200	
5	25		1.7	1.39	554.3	54	58	109	5.0	49	210	
6	30	2244	1.7	1.39	557.189	54	58	111	5.5	46	200	
					21.679 + 22.772							
	Total θ		Avg. $\sqrt{\Delta P}$ 1.427	Avg. ΔH 1.645 (1.67)	Total V_m 43.951	Avg. T_m 55.375		Avg. T_s 103.75	Max. vac. 7.0	Max. temp. 48	Min. no Max. 224	

Comments: Backed @ 2115 mid point I.C. .018 @ 8" * stopped to realign probe
** stopped to check Leak

PARTICULATE F .D DATA FORM

Sheet ___ of 1

Plant N J. Pulverizing
City Bayville NJ
Location INLET
Operator RAKIEWICZ
Run No. 2 Date 11/19/87
Ambient temp., °F
Baro. press. (P_b), in. Hg. 30.31
Sample box no.
Meter box no. NUTECH 6
Meter box ΔH@ 1.784
Meter box cal. (Y) 1.002
Probe length, ft. 4
Probe liner material borosilicate
Probe heater setting 30



Test point schematic

Pitot tube identification no. P-7
Pitot tube cal. factor (C_p) .84
Nozzle identification no. N-12
Avg. nozzle diameter (D_n), in. .175
Pyrometer identification no. #6
Thermocouple identification no.
Assumed moisture, % 8.5
Assumed temperature, °F. 110
Static pressure (P_{static}), in. H_2O -6.0
C factor ___ Reference Δp
Initial leak rate .012 cfm @ 15 in. Hg
Final leak rate .012 cfm @ 7 in. Hg
Filter no. 9379 - TS
Comments:
Pitot tube leak check good
K = .77

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, ft^3	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.	
	0	1729			469.966							
1	5		2.4	1.85	473.5	52	52	100	6.0	45	200	
2	10		2.4	1.85	477.4	52	53	106	6.0	39	200	
3	15		2.8	2.1	481.6	55	57	104	6.8	42	190	-6.9
4	20		2.8	2.1	485.4	53	57	105	7.0	43	199	
5	25		2.6	2.0	489.4	55	58	106	7.0	46	190	
6	30	1759	2.0	1.54	492.473	53	57	102	6.0	46	192	
		1802			492.939							
1	5		1.9	1.46	496.0	53	54	97	5.5	47	210	
2	10		2.0	1.62	500.6	53	57	100	6.0	42	215	-5.6
3	15		2.4	1.85	503.7	54	59	102	7.0	44	215	
4	20		2.4	1.85	507.2	55	59	104	7.0	44	210	
5	25		1.9	1.46	509.6	55	59	101	6.0	46	200	
6	30	1842	1.6	1.23	513.267	54	58	104	5.2	51	208	
	Total θ		Avg. $\sqrt{\Delta P}$ / 1.503411	Avg. ΔH 1.7425	Total V_m 43.235	Avg. T_m 55.1		Avg. T_s 102.6	Max. vac. 7	Max. temp. 51	Min. 190 Max. 215	

Comments: Bucket @ 1729 out @ 1842 Mid point leak ck .015@ (illegible) 8" Hg

SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant N.J. Pulverizer Sample date 11/19

Sample location INLET Run number 3

Sample recovery person RR DM Recovery date 11/19/87

Filter(s) number 9360, T-9

MOISTURE

Impingers			Silica gel		
Final volume (wt)	[illegible] ml (g)		Final wt	2645 g	g
Initial volume (wt)	200 ml (g)		Initial wt	250 g	g
Net volume (wt)	60 ml (g)		Net wt	14.5 g	g
Total moisture	74.5 g				

Color of silica gel 50% BLUE/PINK

Description of impinger water SLIGHTLY FOGGY

RECOVERED SAMPLE

Blank filter container number _____ Sealed _____

Filter container number INL-F-003 Sealed ✓

Description of particulate on filter _____

Acetone rinse container number INL-FHA-003 Liquid level marked? _____

Acetone blank container number _____ Liquid level marked? _____

Samples stored and locked _____

Remarks Thimble - INL-THB-003

Date of laboratory custody _____

Laboratory personnel taking custody _____

Remarks _____

GAS ANALYSIS DATA FORM

Plant NEW JERSEY PELLETIZING Sample location INLET

Date 11/19/87 Run no. 1, 2, 3 Operator BARKER

Sample type: single-point or multipoint; grab or integrated

Analytical method ORSAT Comments LEAK CHECK CO
AMBIENT O2 20.8%

Sample point	24-hour clock time	% CO2	% O2		% CO	
		Reading 1	Reading 2	Net[a]	Reading 3	Net[b]
RUN #1	1230	0.0	18.4	18.4	18.4	0.0
	1235	0.0	18.4	18.4	18.4	0.0
	1240	0.0	18.4	18.4	18.4	0.0
#2	1735	0.0	18.4	18.4	18.4	0.0
	1740	0.0	18.4	18.4	18.4	0.0
	1745	0.0	18.4	18.4	18.4	0.0
RUN #3	1845	0.0	18.4	18.4	18.4	0.0
	1850	0.0	18.4	18.4	18.4	0.0
	1855	0.0	18.4	18.4	18.4	0.0
Averages			----		----	

$\%\ N_2 = 100 - (\%\ CO_2 + \%\ O_2 + \%\ CO) =$

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

[a] Net % O_2 = Reading 2 - Reading 1

[b] Net % CO = Reading 3 - Reading 2

CLIENT: NU PULVERIZING

FACILITY: BAYVILLE NJ

TEST LOCATION: SCRUBBER OUTLET

TEST RUN NO.: 1 & 3

TEST DATE: 11-19-87

SEE PAGE ONE

ROY F. WESTON, INC.

EMISSION TEST DATA/REPORT
QA/QC CHECK LIST

	Initial Data Averages	Data Check 1	Data Check 2 (if req'd)	Data Completeness Check
Raw Test Data	DA	MG	RS	
	Initial Lab Calculator	**Check 1**	**Check 2 (if req'd)**	**Data Completeness Check**
Laboratory Data	MT	RC	BS	
	Initial Calculator	**Check 1**	**Check 2 (if req'd)**	**Reasonableness Check**
Test Result Calculations	KL	MG	BS	
	Author	**Check 1**	**Check 2 (if req'd)**	**Completeness Reasonableness Check**
Test Data Tables	DA	MG	RS	
	Author	**Check 1**	**Check 2 (if req'd)**	**Table of Contents, Figure, page number Check**
Report Body	DA	MG	RK/KJ JDO	
	Originator	**Check 1**	**Check 2 (if req'd)**	
Appendices Completeness				

Compilation Check: Page alignment and completeness

Draft Report _____
(if required)
Final Report _____

Date provided to Client: _____

Final Report Review:

PD _____
PM _____
SM/DM _____

etdr10.24

GAS VELOCITY AND VOLUME DATA FORM

Plant N.J. Pulverizing — Location OUTLET
Date 11/18/87 — Run no. 1 — 24-hr. clock time
Operators — Stack diameter or dimensions, in. 36
Barometric pressure, in. Hg 30.04 — Cross sectional area, ft.^{2} 7.069
Pitot tube identification no. — Cp .84

Traverse Point Number	Velocity head (Δp), in. H_2O	Stack Temperature (T_s), ^oF.	Static pressure (P_{static}) in. H_2O	Cyclonic flow determination: Δp at 0° reference	Cyclonic flow determination: Angle (α) which yields a null Δp
1	1.32	~~90~~	-.42		
2	1.30	~~90~~		-.02	<5°
3	1.30	~~90~~	-.85		
4	1.40	~~90~~		-.04	8°
5	1.35	~~90~~	-.65		
6	1.10	~~90~~		-.02	5°
1	1.40	95		-.02	5°
2	1.40	102	-.84		
3	1.42	102		+.15	<5°
4	1.38	107	-.61		
5	1.10	109		+.14	8°
6	WDD.75	103	-.22		
AVG Δp =	1.30	Avg=103	Avg = -.60		
		Sat @ 103° = 7%			
		TM = 65°			

TM	K
65	1.09
60	1.08
55	1.07
70	1.10
75	1.11

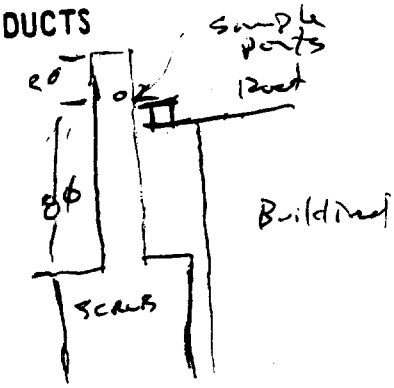
3/16" Nozzle .185 NZ

Avg. $\sqrt{\Delta p}$	Avg. Ts	Avg. P static	Avg. α [a]

[a] Must be <10 degrees to be acceptable.

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT New Jersey Pulverizing
DATE 11/18/87
SAMPLING LOCATION Scrubber Outlet
INSIDE OF FAR WALL TO OUTSIDE OF PORT. (DISTANCE A) 40
INSIDE OF NEAR WALL TO OUTSIDE OF PORT. (DISTANCE B) 4 1/2
STACK I.D.. (DISTANCE A - DISTANCE B) 35 1/2
NEAREST UPSTREAM DISTURBANCE ≥ 2
NEAREST DOWNSTREAM DISTURBANCE ≥ 8
CALCULATOR RAKIEWICZ



SCHEMATIC OF SAMPLING LOCATION

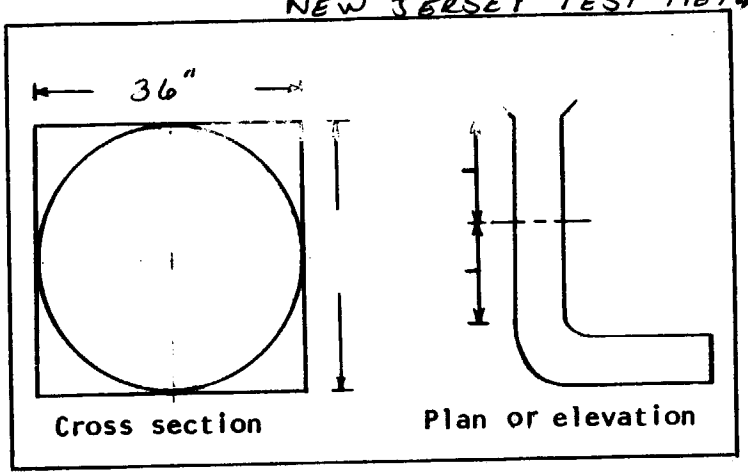
TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1 8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF PORT (SUM OF COLUMNS 4 & 5)
1	.044	35 1/2	1 5/8	4 1/2	6 1/8
2	.146		5 1/8		9 5/8
3	.296		10 1/2		15
4	.704		25		29 1/2
5	.854		30 3/8		34 7/8
6	.956		33 7/8		38 3/8

PARTICULATE [illegible]D DATA FORM

NEW JERSEY TEST METHOD 1

Sheet ___ of ___

Plant N.J. Pulverizing
City Bayville NJ
Location Scrubber Outlet
Operator ALSTON/BARKER
Run No. 1 Date 11/19/87
Ambient temp., °F 70
Baro. press. (P_b), in. Hg. 30.31
Sample box no. N/A
Meter box no. 7
Meter box ΔH@ 1.809
Meter box cal. (Y) .9969
Probe length, ft. 4
Probe liner material borosilicate
Probe heater setting 65 °F



Pitot tube identification no. P-8
Pitot tube cal. factor (C_p) .84
Nozzle identification no. N-5
Avg. nozzle diameter (D_n), in. .185
Pyrometer identification no. #7
Thermocouple identification no. ___
Assumed moisture, % 7
Assumed temperature, °F. 103
Static pressure (P_{static}), in. H_2O -.25, -.67,
K factor .604 Reference Δp N/A -.53
Initial leak rate .013 cfm @ 16 in. Hg
Final leak rate 0.006 cfm @ 11 in. Hg
Filter no. 9376
Comments: pitot tube L.C - good
lung system L.C - good

Test point schematic

K=

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H	Gas meter reading, ft.³	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F (4)	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F. (4)	Probe Ex.t Temp (2)	Filter box temp., °F. (1)	Filter Exit temp °F (3)
	0	1135			394.425								
1	5		1.35	1.4	397.8	64	65	92	9	51	180	160	116
2	10		1.40	1.466	401.0	64	66	95	9	47	167	160	125
3	15		1.40	1.466	393.6	64	66	97	10	49	197	195	140
4	20		1.30	1.365	396.8	65	66	100	10	51	203	185	158
5	25		1.35	1.309	399.9	66	67	97	10	53	197	165	153
6	30	1239	1.10	1.146	402.850	70	73	97	8	52	204	166	144
	0	1345	[illegible]		403.155								
1	5		1.30	1.365	406.5	66	67	103	9	49	167	160	100
2	10		1.30	1.365	409.4	67	69	103	9	46	180	169	116
3	15		1.45	1.518	412.6	67	69	101	9	47	182	160	110
4	20		1.45	1.518	416.3	66	68	104	10	48	187	148	123
5	25		1.40	1.466	419.4	66	68	101	11	50	181	125	113
6	30	1415	0.96	1.005	422.500	66	68	94	9	52	210	164	115
			13.68/12	16.403/12	19.345 18.8			1194/12					
	Total θ	1135-1415	Avg. $\sqrt{\Delta P}$	Avg. ΔH	Total V_m	Avg. T_m		Avg. T_s	Max. vac.	Max. temp.		Min. 125 / Max. 195	100 / 158
	60		1.140586	1.36669	37.72	66.8		99.5	11	53	210		

Comments: 11:57 - lost power
12:30 - resumed test
midpoint L.C - 0.015 cfm @ 15" Hg

SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant NT PULVERIZING Sample date 11/19/87

Sample location SCRUBBER OUTLET Run number ONE

Sample recovery person ALSTON/BARKER Recovery date 11/19/87

Filter(s) number 9376

MOISTURE

Impingers			Silica gel		
Final volume (wt)	246 ml (g)		Final wt	365 g	g
Initial volume (wt)	200 ml (g)		Initial wt	350 g	g
Net volume (wt)	46 ml (g)		Net wt	15 g	g
Total moisture	61 g				

Color of silica gel 1/3 pink, 2/3 blue

Description of impinger water clear

RECOVERED SAMPLE

Blank filter container number BLK-F-001 Sealed

Filter container number OUT-F-001 Sealed yes

Description of particulate on filter brown

Acetone rinse container number OUT-FHA-001 (2 of 2) Liquid level marked?

Acetone blank container number BLK-FHA-001 Liquid level marked?

Samples stored and locked

Remarks

Date of laboratory custody

Laboratory personnel taking custody

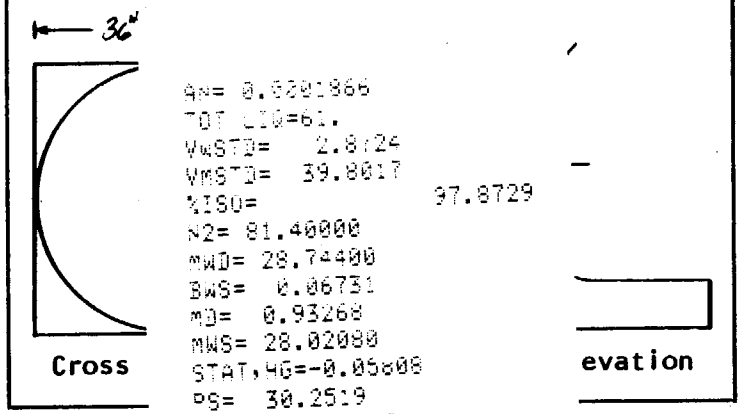
Remarks

PARTICULATE [illegible]D DATA FORM

NEW JERSEY TEST METHOD 1

Sheet ___ of ___

Plant N. S. PULVERIZING
City BAYVILLE, NJ
Location SCRUBBER OUTLET
Operator ALSTON / BARKER
Run No. TWO Date 11/19/97
Ambient temp., °F 57
Baro. press. (P_b), in. Hg. 30.31
Sample box no. N/A
Meter box no. [redacted] 7
Meter box ΔH@ [redacted] 1.808
Meter box cal. (Y) 0.9969
Probe length, ft. 4
Probe liner material BOROSILICATE
Probe heater setting 65 °F



AN= 0.0201866
TOT [illegible]=61.
VWSTD= 2.8124
VMSTD= 39.8017
%ISO= 97.8729
N2= 81.40000
MWD= 28.74400
BWS= 0.06731
MD= 0.93268
MWS= 28.02080
STAT,HG=-0.05e00
PS= 30.2519
VACT= 67.6045
AS= 7.0685
WACFM= 1720.7
DCFT=

Pitot tube identification no. P-8
Pitot tube cal. factor (C_p) 0.84
Nozzle identification no. N-5
Avg. nozzle diameter (D_n), in. 0.185
Pyrometer identification no. A7
Thermocouple identification no. ___
Assumed moisture, % 7
Assumed temperature, °F. 100
Static pressure (P_{static}), in. H_2O -.79
K factor 1.018 Reference Δp N/A
Initial leak rate 0.01 cfm @ 15 in. Hg
Final leak rate .005 cfm @ 12 in. Hg
Filter no. 9348
Comments:
pitot tube LC - O.K
lung system LC - O.K

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice pressure differential (ΔH), in. H_2O	Dry gas meter ft.³	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F (5)	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F. (4)	Impinger exit gas temp., PROBE EXIT TEMP	Filter box temp., °F. (1)	Filter box temp., FILTER EXIT TEMP (3)
	0	1723			423.110								
1	5		1.30	1.323	425.6	54	55	94	8.5	41	208	134	133
2	10		1.30	1.323	428.8	55	55	97	9	38	208	189	133
3	15		1.40	1.435	431.9	55	56	98	10	37	197	109	135
4	20		1.35	1.374	434.9	55	57	97	10	37	190	94	124
5	25	(1:46)	1.30	1.323	438.9	56	57	98	10	38	195	90	118
6	30	1753	1.30	1.323	441.545	55	58	97	10	38	218	225	153
	0	1809			441.745			91		43	203	175	100
1	5		1.45	1.476	445.0	55	57	91	10	43	203	175	100
2	10	(1:52)	1.50	1.527	448.3	56	57	92	12	39	207	160	138
3	15		1.45	1.476	451.7	56	58	97	12	39	210	180	143
4	20	(1:58)	1.50	1.527	455.2	56	58	97	12	41	209	161	146
5	25		1.35	1.374	458.8	56	58	96	11	40	211	174	149
6	30	1840	1.05	1.069	461.728	56	58	97	9	40	210	173	146
	Total θ 60	1723-1840	Avg. $\sqrt{\Delta P}$ 1.162518	Avg. ΔH 1.3783	Total V_m 39.418	Avg. T_m 56.2		Avg. T_s 95.9	Max. vac. 12	Max. temp. 43	218	Min. 90 / Max. 225	100 / 153

Comments: midpoint L.C (initial) - 0.006 cfm @ 15" Hg
(final) - 0.006 cfm @ 15" Hg

SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant NJ PULVERIZING Sample date 11/19/87

Sample location SCRUBBER OUTLET Run number TWO

Sample recovery person ALSTON/BARKER Recovery date 11/19/87

Filter(s) number 9348

MOISTURE

Impingers			Silica gel		
Final volume (wt)	246 ml (g)		Final wt	265 g	g
Initial volume (wt)	200 ml (g)		Initial wt	250 g	g
Net volume (wt)	46 ml (g)		Net wt	15 g	g
Total moisture	61 g				

Color of silica gel 1/3 pink 2/3 blue

Description of impinger water clear

RECOVERED SAMPLE

Blank filter container number BLK-F-001 Sealed

Filter container number OUT-F-002 Sealed yes

Description of particulate on filter brown

Acetone rinse container number OUT-FHA-002 Liquid level marked?

Acetone blank container number BLK-FHA-001 Liquid level marked?

Samples stored and locked

Remarks

Date of laboratory custody

Laboratory personnel taking custody

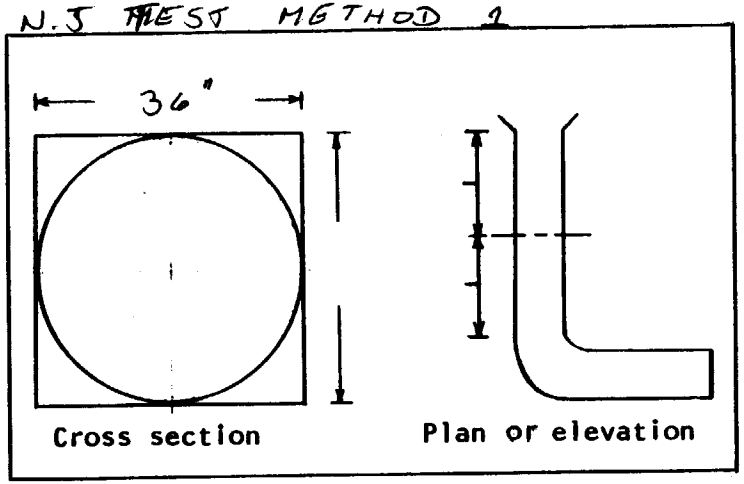
Remarks

PARTICULATE F _D DATA FORM

Sheet ___ of ___

N.J TEST METHOD 2

Plant NJ PULVERIZING
City BAYVILLE, NJ
Location SCRUBBER OUTLET
Operator ALSTON/BARKER
Run No. THREE Date 11/19/87
Ambient temp., °F 56
Baro. press. (P_b), in. Hg. 30.31
Sample box no. N/A
Meter box no. 7
Meter box ΔH@ 1.808
Meter box cal. (Y) 0.9969
Probe length, ft. 4
Probe liner material BOROSILICATE
Probe heater setting 75°F



Test point schematic

Pitot tube identification no. P-8
Pitot tube cal. factor (C_p) 0.84
Nozzle identification no. N-5
Avg. nozzle diameter (D_n), in. 0.198
Pyrometer identification no. #7
Thermocouple identification no. ___
Assumed moisture, % 7
Assumed temperature, °F. [redacted]
Static pressure (Pstatic), in. H_2O -.60
K factor 1.027 Reference Δp N/A
Initial leak rate 0.01 cfm @ 15 in. Hg
Final leak rate 0.012 cfm @ 12 in. Hg
Filter no. 9345
Comments:
pitot tube L.C - good
lung system L.C - good

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, $ft.^3$	Dry gas meter temperature (Tm) Inlet °F.	Dry gas meter temperature (Tm) Outlet °F.	Source temperature (T_s), °F (5)	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F. (4)	Impinger exit gas temp., PROBE EXIT TEMP (2)	Filter box temp., °F. (1)	Filter box temp., FILTER EXIT TEMP (3)
	0	2110			462.339								
1	5		1.60	1.643	465.60	55	56	97	12	39	225	179	95
2	10		1.50	1.541	469.2	55	56	104	12	38	219	172	132
3	15		1.50	1.544	472.7	55	57	91	12	42	221	199	155
4	20		1.40	1.438	475.8	56	57	92	12	41	221	198	164
5	25		1.30	1.335	479.1	56	58	90	11	41	224	205	168
6	30	2140	1.20	1.232	482.344	56	59	92	10	41	224	198	170
	0	2200			482.550								
1	5		1.55	1.592	485.7	56	57	87	10	43	211	132	107
2	10		1.40	1.438	489.0	57	59	95	11	41	198	112	127
3	15		1.45	1.489	492.5	57	59	100	12	41	203	179	129
4	20		1.50	1.541	496.0	57	59	101	12	41	217	195	150
5	25		1.30	1.335	499.1	58	60	103	12	43	205	147	146
6	30	2230	1.15	1.191	502.359	58	60	92	10	43	206	171	140
	Total θ 60	2110 - 2230	Avg. $\sqrt{\Delta P}$ 1.143575	Avg. ΔH 1.44217	Total V_m 39.818	Avg. T_m 57.2		Avg. T_s 95.3	Max. vac. 12	Max. temp. 43	225	Min. 112 Max. 205	95 168

170

Comments: midpoint L.C (initial) - 0.007 cfm @ 15" Hg
(final) - 0.011 cfm @ 15" Hg

SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant NJ PULVERIZING Sample date 11/19/87

Sample location SCRUBBER OUTLET Run number THREE

Sample recovery person ALSTON/BARKER Recovery date 11/19/87

Filter(s) number 9349

MOISTURE

Impingers			Silica gel		
Final volume (wt)	252 ml (g)		Final wt	265.3 g	g
Initial volume (wt)	200 ml (g)		Initial wt	250 g	g
Net volume (wt)	52 ml (g)		Net wt	15.3 g	g
Total moisture	67.3 g				

Color of silica gel 1/3 pink, 2/3 blue

Description of impinger water clear

RECOVERED SAMPLE

Blank filter container number BLK-F-001 Sealed

Filter container number OUT-F-003 Sealed

Description of particulate on filter Brown

Acetone rinse container number OUT-FHA-003 Liquid level marked?

Acetone blank container number BLK-FHA-001 Liquid level marked?

Samples stored and locked

Remarks

Date of laboratory custody

Laboratory personnel taking custody

Remarks

GAS ANALYSIS DATA FORM

Plant NEW JERSEY PULVARIZING Sample location OUTLET

Date 11/19/87 Run no. 1, 2, 3 Operator BARKER

Sample type: single-point or multipoint; grab or integrated

Analytical method DRSAT Comments LEAK CHECK OK
AMBIENT 20.0%

Sample point	24-hour clock time	% CO2 Reading 1	% O2 Reading 2	% O2 Net[a]	% CO Reading 3	% CO Net[b]
	1245	0.0	18.6	18.6	18.6	0.0
	1250	0.0	18.6	18.6	18.6	0.0
	1255	0.0	18.4	18.4	18.4	0.0
	1750	0.0	18.4	18.4	18.4	0.0
	1755	0.0	18.4	18.4	18.4	0.0
	1800	0.0	18.4	18.4	18.4	0.0
	2335	0.0	18.4	18.4	18.4	0.0
	2340	0.0	18.6	18.6	18.6	0.0
	2342	0.6	18.4	18.4	18.4	0.0
Averages			----		----	

$\%\ N_2 = 100 - (\%\ CO_2 + \%\ O_2 + \%\ CO) =$

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

[a] Net % O_2 = Reading 2 - Reading 1

[b] Net % CO = Reading 3 - Reading 2

APPENDIX B
LABORATORY REPORTS

Inter-Office Memorandum

WESTON MANAGERS DESIGNERS/CONSULTANTS

TO: Jeff O'Neill
Josie King

FROM: Mike Taylor DATE: 30 November 1987

PROJECT: **NJ PULVERIZING** W.O. NO.: 2373-01-02-0025

SUBJECT: Analytical Results for Method 5 Source Samples
RFW Batch 8711-833

ACTION:

Attached are the results for the source emission samples submitted to WESTON Analytics on November 20, 1987. The samples were analyzed for particulates according to EPA Method 5.

Custody transfer record and raw data sheets are included for your information. Should you have any questions regarding this report, please do not hesitate to call.

/sma
Attachments

WESTON

CLIENT: NJ PULVERIZING
DATE OF REPORT: 28 November 1987

TABLE OF RESULTS
EPA METHOD 5: PARTICULATE

RFW NUMBER	CLIENT ID	DATE COLLECTED	DATE ANALYZED	*NET WEIGHT IN GRAMS
8711-833-001	OUT-F-001	11-19-87	11-22-87	0.0148
8711-833-009	OUT-FHA-001		THRU	0.0812
			11-30-87	
8711-833-002	OUT-F-002	11-19-87	11-22-87	0.0095
8711-833-010	OUT-FHA-002		THRU	0.0588
			11-30-87	
8711-833-003	OUT-F-003	11-19-87	11-22-87	0.0153
8711-833-011	OUT-FHA-003		THRU	0.0730
			11-30-87	
8711-833-004	INL-F-001A	11-19-87	11-22-87	-0.0014
8711-833-005	INL-F-001B		THRU	-0.0005
8711-833-012	INL-FHA-001		11-30-87	0.1119
8711-833-016	INL-THB-001			SEE RAW DATA
8711-833-006	INL-F-002	11-19-87	11-22-87	-0.0010
8711-833-013	INL-FHA-002		THRU	0.1822
8711-833-017	INL-THB-002		11-30-87	SEE RAW DATA
8711-833-007	INL-F-003	11-19-87	11-22-87	0.0004
8711-833-014	INL-FHA-003		THRU	0.2127
8711-833-018	INL-THB-003		11-30-87	SEE RAW DATA
8711-833-008	BLNK-F-001	11-19-87	11-22-87	0.0003
8711-833-015	BLNK-FHA-001		THRU	0.0002
8711-833-019	BLNK-THB-001		11-30-87	SEE RAW DATA

* Note that acetone rinses have not been corrected for the blank.

WESTON

Custody Transfer Record/Lab Work Request

MIKE

Received By [illegible]
Date 11/20/84
Assigned to

Client N.J. Pulverizing
Client Contact R. SANTO
Phone

RFW Contact RAKIEWICZ
Date Due 12/18/87
Project Number 2373-01-02-0025

8711-833-

SAMPLE IDENTIFICATION | **ANALYSES REQUESTED**

Sample No.	Client ID No.	Description	Matrix	Date Collected	Container/Preservative	EPA method 5 particulate
001	✓	OUT-F-001		11/19/87	Petri dish	✓
2	✓	OUT-F-002				✓
3	✓	OUT-F-003				✓
4	✓	INL-F-001A				✓
5	✓	INL-F-001B				✓
6	✓	INL-F-002				✓
7	✓	INL-F-003				✓
8	✓	BLNK-F-001				✓
9	✓	OUT-FHA-001 (2 jars)			Amber glass	✓
10	✓	OUT-FHA-002				✓
11	✓	OUT-FHA-003				✓
12	✓	INL-FHA-001				✓
13	✓	INL-FHA-002				✓
14	✓	INL-FHA-003				✓
15	✓	BLNK-FHA-001				✓
16	✓	INL-THB-001	*			✓
17	✓	INL-THB-002	*			✓
18	✓	INL-THB-003	*			✓
19		BLNK-THB-001				✓

Tag to case

Matrix:
S- Soil DS- Drum Solids
W- Water DL- Drum Liquids
O- Oil X- Other

Special Instructions: * use caution when handling thimbles particulate is on outside. INL-THB-002 became wet during testing

Items/Reason	Relinquished By	Received By	Date	Time	Items/Reason	Relinquished By	Received By	Date	Time
Analysis	[signature]	[signature]	11/20/87						

RFW 21-21-001/A-3/86

PARTICULATE SAMPLE ANALYSES

Analyst J Rinehart / A. [illegible] Date 11-22 thru 11-26

Plant N.J. Pulverizing Sampling Location _____ Run # 1

Test Date 11-19-87 Test Period _____ Stack # Out-F-001 Process# _____

871-833

	Beaker #	Volume ml	Tare(1) grams	Tare(2) grams		Final(1) grams	Final(2) grams	Δ wt. grams	Blk. Cor. grams	Net wt. grams
009 FHA	N-27	640	106.3712	106.3743	106.37425	106.4556	106.4552	106.4554		0.0812
001 FILTER$_1$ #	9376	–	.4159	0.4160	0.41595	0.4306	0.4308	0.4307		0.0148
FILTER$_2$ #										
FH TOTAL										
BHW										
BHA										
TOTAL										
Comments										

Plant N.J. Pulverizing Sampling Location _____ Run # 2

Test Date 11-19-87 Test Period _____ Stack # Out F-002 Process# _____

	Beaker #	Volume ml	Tare(1) grams	Tare(2) grams		Final(1) grams	Final(2) grams	Δ wt. grams	Blk. Cor. grams	Net wt. grams
010 FHA	B-24	500	103.4257	103.4255	103.4256	103.4842	103.4845	103.4843		0.0588
002 FILTER$_1$ #	9348	–	0.4112	0.4114	0.4113	0.4208	0.4208	0.4208		0.0095
FILTER$_2$ #										
FH TOTAL										
BHW										
BHA										
TOTAL										
Comments										

ROY F. WESTON

Plant N.J. Pulverizing Sampling Location _____ Run # 3

Test Date 11-19-87 Test Period _____ Stack # Out F-003 Process# _____

	Beaker #	Volume ml	Tare(1) grams	Tare(2) grams		Final(1) grams	Final(2) grams	Δ wt. grams	Blk. Cor. grams	Net wt. grams
011 FHA	N-10	250	109.4806	109.4803	109.48045	109.5536	109.5532	109.5534		0.0730
003 FILTER$_1$ #	9349	–	0.4100	0.4102	0.4101	0.4254	0.4254	0.4254		0.0153
FILTER$_2$ #										
FH TOTAL										
BHW										
BHA										
TOTAL										
Comments										
008 FILTER BK	9380		.4171	0.4171	0.4171	0.4172	0.4176	0.4174		0.0003
015 ACETONE BLK	N-20	160	104.8007	104.8005	104.8016	104.8020	104.8016	104.8015		0.0002
WATER BLK										

CODE: FHA=Front half acetone wash BHW=Back half water(impinger contents + water wash) BHA=Back half acetone wash FH TOTAL=Front half catch weight TOTAL=Total train catch weight

PARTICULATE SAMPLE ANALYSES

Analyst J Pinchak / Acker Date 11-22 thru 11-26

Plant N.J. Pulverizing Sampling Location _____ Run # 1A

Test Date 11-19-87 Test Period _____ Stack # INL-F-001A Process# _____

8711-833

	Beaker #	Volume ml	Tare(1) grams	Tare(2) grams		Final(1) grams	Final(2) grams	Δ wt. grams	Blk. Cor. grams	Net wt. grams
012 FHA	N-20	500	105.4753	105.4749	105.4751	105.5872	105.5868	105.5870		0.1119
004 FILTER$_1$ #	9347	-	0.4112	0.4114	0.4113	0.4100	0.4099	0.40995		-0.0014
005 FILTER$_2$ #	9377	-	0.4143	0.4142	0.41425	0.4137	0.4138	0.41375		-0.0005
FH TOTAL						2.2745	2.2745	2.2745		
016 ~~BHW~~ thimble	T-19									
BHA										
TOTAL										
Comments										

Plant N.J. Pulverizing Sampling Location _____ Run # 1B 2

Test Date 11-19-87 Test Period _____ Stack # INL-F-002 Process# _____

	Beaker #	Volume ml	Tare(1) grams	Tare(2) grams		Final(1) grams	Final(2) grams	Δ wt. grams	Blk. Cor. grams	Net wt. grams
013 FHA	N-21	440	107.4728	107.4726	107.4727	107.6551	107.6546	107.65485		0.1822
006 FILTER$_1$ #	9377	-	0.4176	0.4176	0.4176	0.4166	0.4167	0.41665		-0.0010
FILTER$_2$ #										
FH TOTAL						2.4541	2.4537	2.4539		
017 ~~BHW~~ thimble	T-5									
BHA										
TOTAL										
Comments										

ROY F. WESTON

Plant N.J. Pulverizing Sampling Location _____ Run # 3

Test Date 11-19-87 Test Period _____ Stack # INL-F-003 Process# _____

	Beaker #	Volume ml	Tare(1) grams	Tare(2) grams		Final(1) grams	Final(2) grams	Δ wt. grams	Blk. Cor. grams	Net wt. grams
014 FHA	N-8	470	101.5092	101.5092	101.5090	101.7216	101.7219	101.72175		0.212
007 FILTER$_1$ #	9365		0.4074	0.4074	0.4074	0.4079	0.4076	0.40775		0.0004
FILTER$_2$ #										
FH TOTAL						2.1139	2.1138	2.11385		
018 ~~BHW~~ thimble	T9									
BHA										
TOTAL						2.1932	2.1930	2.1931		
Comments										
019 thimble ACETONE BLK	T-5									
WATER BLK										

CODE: FHA=Front half acetone wash BHW=Back half water(impinger contents + water wash) BHA=Back half acetone wash FH TOTAL=Front half catch weight TOTAL=Total train catch weight

APPENDIX C
SAMPLE CALCULATIONS

WESTON

New Jersey Polverizing
11/19/87
1134-1415
Scrubber Outlet

SAMPLE CALCULATIONS

Test Run No: 1

1. Volume of dry gas sampled at standard conditions, (70°F, 29.92 in. Hg), dscf.

$$V_{m(std)} = \frac{17.71 \times Y \times V_m \times \left(P_b + \frac{\Delta H}{13.6}\right)}{T_m + 460}$$

$$V_{m(std)} = \frac{17.71 \times .9969 \times 37.72 \times \left(30.31 + \frac{1.36693}{13.6}\right)}{(66.75 + 460)} = 38.447$$

Where:

$V_{m(std)}$ = Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscf.

V_m = Volume of gas sample measured by the dry gas meter at meter conditions, dcf.

P_b = Barometric pressure, in. Hg.

H = Average pressure drop across the orifice meter, in. H_2O.

T_m = Average dry gas meter temperature, °F.

17.71 = Factor that includes ratio of standard temperature (530°R) to standard pressure (29.92 in. Hg), °R/in. Hg.

Y = Dry gas meter calibration factor.

2. Volume of water vapor in the gas sample corrected to standard conditions, scf.

$$V_{w(std)} = (\quad \times V_{wc}) + (\quad \times W_{wsg})$$

$$V_{w(std)} = (0.04733 \times 76 \quad) + (0.0474 \times 15 \quad) = 2.9$$

Where:

$V_{w(std)}$ = Volume of water vapor in the gas sample corrected to standard conditions, scf.

V_{wc} = Volume of liquid condensed in impingers, mL.

W_{wsg} = Weight of water vapor collected in silica gel, g.

0.04733 = Factor which includes the density of water (0.002201 lb/mL), the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant (21.85 [in. Hg] [ft^3]/[lb/mole][°R]; absolute temperature at standard conditions (530°R), absolute pressure at standard conditions (29.92 in. Hg), ft^3/mL.

0.0474 = Factor which includes the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant (21.85 [in. Hg][ft^3]/[lb-mole][°R]), absolute temperature at standard conditions (530°R), absolute pressure at standard conditions (29.92 in. Hg), and 453.6 g/lb, ft^3/g.

3. Moisture content.

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

$$B_{ws} = \frac{2.9}{2.9 + 39.447} = 0.070$$

Where:

B_{ws} = Proportion of water vapor, by volume, in the gas stream, dimensionless.

4. Mole fraction of dry gas.

$$M_d = 1 - B_{ws}$$

$$M_d = 1 - .07 = .930$$

Where:

M_d = Mole fraction of dry gas, dimensionless.

5. Dry molecular weight of gas stream, lb/lb-mole.

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

$$MW_d = (0.440 \times 0\ ) + (0.320 \times 18.5\ ) + [0.280\ (81.5 + 0.0\ )]$$

$$= 28.74$$

Where:

MW_d = Dry molecular weight, lb/lb-mole.

$\%CO_2$ = Percent carbon dioxide by volume, dry basis.

$\%O_2$ = Percent oxygen by volume, dry basis.

$\%N_2$ = Percent nitrogen by volume, dry basis.

%CO = Percent carbon monoxide by volume, dry basis.

0.440 = Molecular weight of carbon dioxide, divided by 100.

0.320 = Molecular weight of oxygen, divided by 100.

0.280 = Molecular weight of nitrogen or carbon monoxide, divided by 100.

6. Actual molecular weight of gas stream (wet basis), lb/lb-mole.

$MW_s = (MW_d \times M_d) + (18\ [1 - M_d])$

$MW_s = (28.74 \times .73) + (18\ [1 - .73])$

Where: $= 25.0$

MW_s = Molecular weight of wet gas, lb/lb-mole.

18 = Molecular weight of water, lb/lb-mole.

7. Average velocity of gas stream at actual conditions, ft/sec.

$$v_s = 85.49 \times C_p \times (\sqrt{\Delta p})_{avg.} \times \left[\frac{T_s\ (avg)}{P_s \times MW_s}\right]^{\frac{1}{2}}$$

$$v_s = 85.49 \times .84 \times 1.1406 \times \left[\frac{559.5}{30.31 \times .28}\right]^{\frac{1}{2}}$$

Where: $= 66.6$

v_s = Average gas stream velocity, ft/sec.

85.49 = Pitot tube constant, ft/sec $\times \left[\frac{(lb/lb\text{-mole})(in.\ Hg)}{(°R)\ (in.\ H_2O)}\right]^{\frac{1}{2}}$

C_p = Pitot tube coefficient, dimensionless.

Δp = Velocity head of stack gas, in H_2O.

T_s = Absolute gas stream temperature, °R.

P_s = Absolute stack gas pressure, in. Hg.

8. Average gas stream dry volumetric flow rate, dscf/min.

$$Q_{s(std)} = \frac{1062.8 \times v_s \times A_s \times M_d \times P_s}{T_s}$$

$$Q_{s(std)} = \frac{1062.8 \times 66.6 \times 6.87 \times .93 \times 30.31}{(99.5 + 460)}$$

= 24500

Where:

$Q_{s(std)}$ = Volumetric flow rate of dry stack gas, corrected to standard conditions, dscf/min.

A_s = Cross-sectional area of stack, $ft.^2$.

1062.8 = Factor which includes standard temperature (530°R) standard pressure (29.92 in. Hg), and 60 sec/min, $\frac{(°R)\ (sec)}{(in.\ Hg)(min)}$.

9. Isokinetic variation calculated from intermediate values, percent.

$$I = \frac{17.251 \times T_s \times V_{m(std)}}{v_s \times \theta \times P_s \times M_d \times (D_n)^2}$$

$$I = \frac{17.251 \times 559.5 \times 38.447}{66.6 \times 60 \times 30.31 \times .93 \times (.185)^2}$$

= 96.4

Where:

I = Percent of isokinetic sampling.

θ = Total sampling time, minutes.

D_n = Diameter of nozzle, inches.

17.251 = Factor which includes standard temperature (530°R) standard pressure (29.92 in. Hg), the formula for calculating area of circle $\frac{\pi D^2}{4}$, conversion of square feet to square inches (144), conversion of seconds to minutes (60), and conversion to percent (100), $\frac{(\text{in. Hg})\ (\text{in}^2)\ (\text{min})}{(°\text{R})\ (\text{ft}^2)\ (\text{sec})}$.

10. Particulate concentration, gr/dscf.

$$C_1 = 0.015432 \times \frac{M_t}{V_{m(std)}}$$

$$C_1 = 0.015432 \times \frac{14.9}{33.447} = .0381$$

Where:

C_1 = Particulate concentration, gr/dscf.

M_t = Total weight of particulate caught by train, mg.

0.015432 = Conversion factor of gr/mg.

11. Particulate mass emission rate, lb/hr.

$$PMR_t = 0.0085714 \times C_1 \times Q_{s(std)}$$

$$= 0.0085714 \times .0381 \times 24500 = 8.0$$

Where:

PMR_t = Particulate mass emission rate, lb/hr.

0.0085714 = Conversion factor relating minutes to hours (60), and grains to pounds (7,000), (lb) (min)/(gr) (hr).

12. Particulate Removal Efficiency

$$\%E = \frac{PMRi - PMRo}{PMRi} \times 100$$

$$\%E = \frac{58.99 - 7.99}{58.99} \times 100$$

$$= 86.46$$

%E = Percent Efficiency

PMRi = Pollutant Mass Rate at Scrubber inlet, lbs/hr

PMRo = Pollutant Mass Rate at Scrubber Outlet, lbs/hr

Sand Captured by Cyclone

TIME	HOURS	lbs of Sand	lbs/hr
1137-1420	2.72	108.5	39.89
1729-1842	1.22	53.5	43.85
2115-2244	1.48	73.5	49.66

Sand was weighed and recorded by WESTON

APPENDIX D
EQUIPMENT CALIBRATION RECORDS

New Cal, B

METER BOX CALIBRATION DATA AND CALCULATION FORM

Date 11 September 1981 Meter Box Number NuTech #4

Barometric pressure, P_b = 30.16 in. Hg Calibrated by James Wood

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperatures: Wet test meter (t_w), °F	Temperatures: Dry gas meter Inlet (t_{d_i}), °F	Temperatures: Dry gas meter Outlet (t_{d_o}), °F	Temperatures: Dry gas meter Avg[a] (t_d), °F	Time (θ), min	Y_i	ΔHθ, in.
~~.5~~	5	012.966 017.960	71	75 75 76	74 74 75	74.5	12.4	1.007	1.705
0	5	018.702 023.708	71	76 76 76	75 75 75	75.5	8.85	1.005	1.734
1.5	10	024.200 034.212	71	76 76 76	75 75 76	75.7	14.8	1.004	1.818
0	10	034.959 044.987	71	76 77 77	75 76 77	76.3	12.95	1.002	1.853
0	10	045.784 055.845	71	77 78 78	76 77 79	77.5	10.8	.9988	1.929
4.0	10								
							Avg	Y 1.003	ΔHθ 1.808

$\sqrt{\Delta H}$, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)}$		$\Delta H\theta_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\theta}{V_w}\right]$		
0.5	0.0368	534.8-30.16-5 531-30.20-4.994	1.007	.01685 .000001 534.8-30.16	531-12.4 ÷5 ✓	1.705
~~1.0~~	0.0735	535.5-30.16-5 531-30.23-5.005	1.005	.0317 .000002 535.5-30.16	531-8.85 ÷5 ✓	1.734
1	0.110	535.7-30.16-10 531-30.27-10.012	1.004	.04755 .0000029 535.7-30.16	531-14.8 ÷10 ✓	1.818
2.0	0.147	536.3-30.16-10 531-30.31-10.028	1.002	.0634 .0000034 536.3-30.16	531-12.95 ÷10 ✓	1.853
2.5	0.221	537.5-30.16-10 531-30.38-10.061	.9988	.0951 .0000059 537.5-30.16	531-10.8 ÷10 ✓	1.929
3	0.294					

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

Test numbers _____ Date 9 OCT 1984 Meter box number #1 Plant SEMI-CORP

Barometric pressure, P_b = 30.36 in. Hg Dry gas meter number _____ Pretest Y 1.003

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_I}), °F	Temperature: Dry gas meter: Outlet (t_{d_O}), °F	Temperature: Dry gas meter: Average (t_d), °F	Time (θ), min	Vacuum setting, in. Hg.	Y_i	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 460)}$
1.5"	10	328.803 338.595	69.8	73 74 75	74 76 77	74.8	14.98	4.0"	.9966	
1.5"	10	338.595 348.992	69.5	75 75 77	76 76 78	76	14.98	4.0"	.9983	
1.5"	10	348.992 359.118	69.8	76 77 77	78 78 79	77.5	14.95	4.0"	.9983	
									Y = .9977	

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

V_w = Gas volume passing through the wet test meter, ft^3.

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

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

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

t_{d_O} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, $\frac{t_{d_I} + t_{d_O}}{2}$, °F.

ΔH = Pressure differential across orifice, in H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y ± 0.05Y

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 460)}$	$\Delta H@_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)}{V_w} \right.$

Calibration meter box

POSTTEST DRY GAS METER CALIBRATION DATA FORM

Nutech

Test numbers _____ Date 22 OCT 1987 Meter box number # 6 Plant _____

Barometric pressure, P_b = 30.25 in. Hg Dry gas meter number _____ Pretest Y 1.006

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average (t_d), °F	Time (θ), min	Vacuum setting, in. Hg.	Y_i	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w +$
1.0"	10	215.223 225.285	68	71 72 73	72 73 76	72.8	17.8	4.0"	1.001	
1.0"	10	225.285 235.342	68	73 74 74	73 75 77	74.3	17.83	4.0"	1.004	
1.0"	10	235.342 245.455	68	74 74 75	75 77 78	75.5	17.88	4.0"	1.003	
									Y = 1.002	

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

V_w = Gas volume passing through the wet test meter, ft^3.

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

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

t_i = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, $\frac{t_{d_i} + t_{d_o}}{2}$, °F.

ΔH = Pressure differential across orifice, in H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y ± 0.05Y

P_b = Barometric pressure, in. Hg.

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 460$
Δ		

$\Delta H@_i = \frac{0.0317\,\Delta H}{P_b (t_d + 460)} \left| \frac{(t_w +}{V_w} \right.$

STACK TEMPERATURE SENSOR CALIBRAT[illegible] DATA FORM

Date 2/16/87 Thermocouple number NuTech #6

Ambient temperature 73 °F Barometric pressure 30.14 in. Hg

Calibrato: J Mills Reference: mercury-in-glass yes

other

Reference point number	Source[a] (specify)	Reference thermometer temperature, °F	Thermocouple potentiometer temperature, °F	Temperature difference,[b] %
32°F	ice BATH	32°F	32°F	0.0 %
73°F	AMBIENT	73°F	72°F	-0.19 %
379°F	Hot oil	379°F	381°F	+0.24 %

[a] Type of calibration system used.

[b] $\left[\frac{(\text{ref temp, °F} + 459.67) - (\text{test thermom temp, °F} + 459.67)}{\text{ref temp, °F} + 459.67}\right] 100 \leq 1.5\%$.

New Calibration METER BOX CALIBRATION DATA AND CALCULATION FORM

te 14 August 1987 Meter Box Number Note: CC's #6

Barometric pressure, P_b = 30.24 in. Hg Calibrated by Bruce Weed

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperatures: Wet test meter (t_w), °F	Temperatures: Dry gas meter Inlet (t_{d_i}), °F	Temperatures: Dry gas meter Outlet (t_{d_o}), °F	Temperatures: Dry gas meter Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$
.5	5	588.700 593.703	72.5	77 75 78	78 79 80	78.3	12.4	1.009	1.64
.0	5	594.448 599.460	72.5	78 78 79	78 79 80	78.1	8.81	1.007	1.73
1.5	10	599.957 610.036	72.5	78 79 79	79 81 84	80.0	14.98	1.003	1.79
.0	10	610.523 620.649	72.5	80 80 81	81 85 86	82.3	13.23	1.001	1.919
.0	10	621.407 631.594	72.5	80 80 81	81 83 86	82.2	10.88	.9923	1.772
4.0	10								
							Avg	Y 1.002	ΔH@ 1.784

$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)}$	$\Delta H@_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)}{V_w} \right.$
0.0368	588.3 - 30.24 - 5 532.5 - 30.95 - 5.003 = 1.009	.01585 .000001 588.3 - 30.24
0.0735	598.7 - 30.24 - 5 532.5 - 30.31 - 5.013 = 1.007	.0317 .0000019 538.7 - 30.24
0.110	540 - 30.24 - 10 532.5 - 30.35 - 10.069 = 1.003	.04755 .0000029 540 - 30.24
0.147	542.2 - 30.24 - 10 532.5 - 30.39 - 10.126 = 1.001	.0634 .0000039 542.2 - 30.24
0.221	542.2 - 30.24 - 10 532.5 30.46 - 10.187 = .9923	.0951 .0000059 542.2 - 30.24
0.294		

532.5 - 13.4 ÷5 ✓		1.7
532.5 - 8.81 ÷5 ✓		1.7
532.5 - 14.98 ÷10 ✓		1.7
532.5 - 13.23 ÷10 ✓		1.9
532.5 - 10.88 ÷10 ✓		1.7

f there is only one thermometer on the dry gas meter, record the temperature under t_d.

STACK TEMPERATURE SENSOR CALIBRAT[illegible] DATA FORM

Date 2/16/87 Thermocouple number NUTECH #7

Ambient temperature 73 °F Barometric pressure 30.14 in. Hg

Calibrato: J Mc Reference: mercury-in-glass yes

other

Reference point number	Source[a] (specify)	Reference thermometer temperature, °F	Thermocouple potentiometer temperature, °F	Temperature difference,[b] %
32°F	ICE BATH	32°F	32°F	0.0 %
73°F	AMBIENT	73°F	72°F	-0.19 %
379°F	Hot oil	379°F	379°F	0.0 %

[a] Type of calibration system used.

[b] $\left[\frac{(\text{ref temp, °F} + 459.67) - (\text{test thermom temp, °F} + 459.67)}{\text{ref temp, °F} + 459.67}\right] 100 \leq 1.5\%$.

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot Tube P-8

Pitot tube assembly level? ✓ yes _____ no

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

α_1 = 1 ° (<10°), α_2 = 2 ° (<10°), β_1 = 1 ° (<5°),
β_2 = 2 ° (<5°)

γ = 1 °, θ = 1 °, A = .936 cm (in.)

z = A sin γ = .016 cm (in.); <0.32 cm (<1/8 in.),
w = A sin θ = .016 cm (in.); <.08 cm (<1/32 in.)

P_A .468 cm (in.) P_b .468 cm (in.)

D_t = .374 cm (in.)

Comments: INSPECTED 7/10/07 B. STOUD

Calibration required? _____ yes ✓ no

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot Tube P-7

Pitot tube assembly level? ✓ yes _____ no

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

α_1 = 1 ° (<10°), α_2 = 1 ° (<10°), β_1 = 1 ° (<5°),
β_2 = 2 ° (<5°)

γ = 1 °, θ = 1 °, A = 1.034 cm (in.)

z = A sin γ = .018 cm (in.); <0.32 cm (<1/8 in.),
w = A sin θ = .018 cm (in.); <.08 cm (<1/32 in.)

P_A .517 cm (in.) P_b .517 cm (in.)

D_t = .375 cm (in.)

Comments: INSPECTED 7/10/87 B Straub

Calibration required? _____ yes ✓ no

STTI DR AS ER IBR ON A R

Test numbers _____ Date 24 Nov 1987 Meter box number #6 (Notched) Plant N.J. Pulverizing

Barometric pressure, P_b = 30.29 in. Hg Dry gas meter number _____ Pretest Y .9962

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_I}), °F	Temperature: Dry gas meter: Outlet (t_{d_O}), °F	Temperature: Dry gas meter: Average (t_d), °F	Time (θ), min	Vacuum setting, in. Hg.	Y_i	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 4$
1.74	10	570.856 580.950	72.5	77 76 77	78 79 81	78.	14.03	6"	.9948	
1.74	10	580.950 591.080	72.5	79 78 79	77 82 83	79.7	14.08	6"	.9964	
1.70	10	591.080 601.231	72.5	79 80 81	82 81 85	81.8	14.13	6"	.9982	
									Y = .9971	

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

V_w = Gas volume passing through the wet test meter, ft^3.

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

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

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

t_{d_O} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, $\frac{t_{d_I} + t_{d_O}}{2}$, °F.

ΔH = Pressure differential across orifice, in H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y ± 0.05Y

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

Δ	ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 460)}$
			$\Delta H\theta_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 46}{V_w} \right.$

ibrator: [illegible] STT DR AS ER IBR ON A F

No Tech

Test numbers _____ Date 24 NOV 1987 Meter box number # 7 Plant N.J. PULVERIZING

Barometric pressure, P_b = 30.29 In.Hg Dry gas meter number _____ Pretest Y .9969

fice ometer tting, n), . H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_I}), °F	Temperature: Dry gas meter: Outlet (t_{d_O}), °F	Temperature: Dry gas meter: Average (t_d), °F	Time (θ), min	Vacuum setting, In. Hg.	Y_i	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 4}$
		511.180		74	74					
1.5"	10	521.213	73	75 76	76 77	75	14.72	10"	.9968	
		531.213		76	77					
1.5"	10	541.239	73	77 78	78 80	77.5	14.46	10"	.9982	
		541.529		77	79					
1.5"	10	551.631	73	78 79	80 81	79	14.50	10"	.9974	
									Y = .9975	

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

V_w = Gas volume passing through the wet test meter, ft^3.

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

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

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

t_{d_O} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, $\frac{t_{d_I} + t_{d_O}}{2}$, °F.

ΔH = Pressure differential across orifice, In H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y ± 0.05Y

P_b = Barometric pressure, In. Hg.

θ = Time of calibration run, min.

ΔH, In. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 460)}$
Δ		

$\Delta H\theta_i = \frac{0.0317\,\Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 46}{V_w} \right.$

ON-SITE

NOZZLE CALIBRATION DATA FORM

Date 11-16-87 Calibrated by RAKIEWICZ

Nozzle identification number	Nozzle diameter, inches[a]			ΔD,[b]	D_{avg}[c]
	D_1	D_2	D_3		
N-9	.120	.121	.120	.001	.120
N-12	.176	.175	.175	.001	.175
N-5	.184	.185	.185	.001	.185

Where:

[a] $D_{1,2,3}$ = three different nozzle diamters, inches; each diameter must be measured to nearest 0.001 in.

[b] ΔD = maximum difference between any two diameters, inches. ΔD must be $\leq$ 0.004 in.

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

APPENDIX E
WESTON PROJECT PARTICIPANTS

PROJECT PARTICIPANTS

The following WESTON employees participated in this project:

Richard B. Ruch, JR Project Director	econENVIRONomics Division
Barry L. Jackson Project Manager	econENVIRONomics Division
Roy Rakiewicz Asst. Project Scientist	econENVIRONomics Division
Ted Barker Project Technician	econENVIRONomics Division
Denise Alston Asst. Proj. Engineer	econENVIRONomics Division
Dan Miesse Project Technician	econENVIRONomics Division
Micheal Taylor Laboratory Supervisor	WESTON ANALYTICS